

# Public health and climate change: a One Health approach



## Overview

- A One Health approach recognises that the health of humans, animals, and the environment are closely interlinked. It aims to design and implement policy that engages multiple sectors and disciplines to improve human, animal and environmental health outcomes.
- The approach has been recommended to understand the complex impacts of climate change on public health, including diseases passed between animals and humans, antimicrobial resistance and the safety and security of food and water.
- The UK Government's Biological Security Strategy (2023) emphasises the use of a One Health approach, specifically for tackling antimicrobial resistance and infectious diseases.
- Implementation of a One Health approach requires interdisciplinary and cross-sector collaboration, community engagement, monitoring and data management, and education.
- There is emerging evidence of the economic benefits of implementing One Health, though multi-sectoral cost-effectiveness can be hard to evaluate.
- Challenges of implementing One Health include power imbalances between lower, middle- and high-income countries, conflicts of interest between sectors, underrepresentation of the environmental sector and limited evaluation mechanisms.

## Background

One Health recognises that human, animal and environmental health are closely interlinked.<sup>1</sup> It aims to design and implement policy that engages multiple sectors and disciplines to achieve better health outcomes. For example, the trade in live wild animals can damage the environment whilst also increasing the risk of emergence of new infectious diseases. Therefore, it recognises that policies on wildlife trade can also deliver benefits to human, animal and environmental health. The One Health concept is not new, but public health emergencies, such as Zika virus and Covid-19, have renewed policymakers' interest. These emergencies highlight the interconnectedness and changing relationships between humans, animals and the environment ([PN 617](#), [PB 42](#)).<sup>2-4</sup>

The collaborative and interdisciplinary approach of One Health has been recommended to tackle key impacts of climate change on public health ([see below](#)).<sup>5-14</sup> This POSTnote will focus on using a One Health approach to tackle key impacts of climate change on public health. It will take a global perspective on implementing the approach, with areas of focus on UK policy.

### Box 1: Defining One Health

The One Health High Level Expert Panel (OHHLEP) are a panel of cross-disciplinary experts, set up in 2021. In 2022, OHHLEP agreed on a One Health definition.<sup>1</sup> One Health is formally defined as:

“an integrated, unifying approach that aims to sustainably balance and optimize the health of people, animals and ecosystems. It recognizes the health of humans, domestic and wild animals, plants, and the wider environment (including ecosystems) are closely linked and inter-dependent.”<sup>1</sup>

The definition extends to how the approach mobilises sectors.\* Academic and NGO stakeholders have welcomed the definition. Some emphasise that it is important to ensure that all partners in an intervention interpret the definition in the same way.

Similar concepts to One Health include 'Planetary Health', 'One Medicine' and 'Ecohealth'.<sup>15</sup> These are also interdisciplinary approaches, but they emphasise different sectors and scales.<sup>16-19</sup>

## International and UK policy

The World Health Organisation (WHO) is an international advocate for One Health and emphasises the approach in the 'Pandemic Preparedness' international treaty draft ([CBP-9550](#)).<sup>20</sup> The Quadripartite is a global collaboration between the Food and Agriculture Organization (FAO), United Nations Environment Programme (UNEP),

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\*\* The approach mobilizes multiple sectors, disciplines and communities at varying levels of society to work together to foster well-being and tackle threats to health and ecosystems, while addressing the collective need for clean water, energy and air, safe and nutritious food, taking action on climate change, and contributing to sustainable development.

WHO and the World Organisation for Animal Health (WOAH). The OHHLEP act as an advisory body to the Quadripartite. The Quadripartite released the One Health Joint Plan of Action (2022-2026) that provides a framework for One Health implementation (Box 2).<sup>21</sup> One Health features in several global commitments, such as the UN Sustainable Development Goals and UN Paris Agreement on climate change.<sup>22,23</sup>

In June 2023, the UK Government published 'The UK Biological Security Strategy' accompanied by an implementation plan which emphasises a One Health approach, specifically for tackling antimicrobial resistance (AMR) and infectious disease.<sup>24</sup> The UK is part of the One Health European Joint Programme,<sup>†</sup> which encourages international and interdisciplinary collaboration.<sup>25</sup>

The House of Commons Science, Innovation and Technology Select Committee is currently conducting an inquiry on 'Emerging diseases and learnings from Covid-19' which examines pandemic preparedness and highlights One Health.<sup>24,26</sup>

## **Box 2: The One Health Joint Plan of Action (2022-2026)<sup>21</sup>**

The Joint Plan of Action was released by the Quadripartite and provides actions for One Health implementation:

1. improve health systems
2. lower the risks of zoonotic epidemics and pandemics
3. control neglected zoonotic, tropical and vector-borne diseases
4. improve the assessment and management of food safety
5. curb the emergence of AMR
6. integrate the environment.

These actions aim to be pursued using the following principles:

- use a holistic, whole-systems approach
- encourage communication and partnership between the public-private sectors
- strengthen the governance, institutional and legal frameworks
- utilise indigenous and local community knowledge.

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<sup>†</sup> The One Health European Joint programme is a partnership between 44 research centres across 22 countries. Their goals focus on zoonotic threats, AMR and foodborne zoonoses.

# What impacts of climate change can One Health address?

Climate change can increase health security risks for societies, which has resulted in the need for pandemic preparation<sup>‡</sup> and national plans for resilience (PN 680).<sup>§</sup> This POSTnote will focus on several public health threats that are impacted by climate change.

## Antimicrobial resistance

AMR occurs when pathogens (e.g. bacteria) develop resistance to antimicrobial drugs such as antibiotics, making antimicrobial treatment less effective (PN 595). Antimicrobials are used in humans, livestock, and agriculture. AMR is becoming more widespread due to multiple factors.\*\*

Climate change can alter environmental conditions, which may stimulate bacterial growth and horizontal gene transfer (the exchange of genetic material that can cause AMR).<sup>36,37</sup> These can increase the rate of resistance development. Climate change may increase the occurrence of some pathogens that could be difficult to treat as more pathogens develop resistance.<sup>38,39</sup> AMR pathogens and genetic elements can pass between humans, animals and the environment.

The UK Government has a five-year action plan for tackling AMR (2019-2024), which emphasises a One Health approach.<sup>40</sup> The UK Department for Health and Social Care funded a Fleming fund to support a One Health approach to AMR in lower and middle-income countries (LMIC).<sup>41</sup> Countries are increasingly implementing an integrated response to AMR, for example, Denmark, the US and the Netherlands.<sup>42</sup>

The Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS) is considered a successful example of a One Health approach to AMR. CIPARS monitors, analyses and disseminates data on antimicrobial usage and resistance.<sup>43-45</sup> There remains some uncertainty around the most effective strategies of integrated surveillance of AMR.<sup>46</sup>

## Zoonotic disease

Climate change is altering the distribution, transmission and severity of zoonotic pathogens and their vectors (organisms or objects that transmit pathogens between

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<sup>‡</sup> Pandemic preparedness involves putting measures in place to prevent the spread and impact of future pandemics. Measures include early warning systems, early identification of the pathogen and vaccine development.<sup>27</sup>

<sup>§</sup> Resilience to climate change is our ability to prepare for, respond and recover from hazardous events in a timely manner.<sup>28</sup> The UK Government resilience framework and the Government Office for Science Resilience Foresight project aim to improve resilience (PB 40).<sup>29,30</sup>

\*\* Additional drivers of the increased frequency of AMR include the high use of antimicrobials in humans, animals and agriculture and inappropriate use of antimicrobials.<sup>31,32</sup> The use of antimicrobials in humans and livestock has declined in Europe over the last decade.<sup>33-35</sup>

animals and humans, and animals to animals). This can be because of changes to pathogen lifecycles and habitat suitability for pathogens and vectors ([PN 660](#)).<sup>47–50</sup>

Surveillance, prevention, and preparedness for outbreaks of zoonoses provide examples of how One Health can have a significant benefit (Box 3). Globally, incorporating wildlife and the environment into zoonoses control programmes remains a challenge because of limited resources and funding.<sup>43</sup>

### **Box 3: An international case study on a One Health approach to rabies control**

Multiple stakeholders argue that rabies control is a successful example of a One Health approach to zoonotic disease. Rabies distribution can be sensitive to climate conditions.<sup>51–53</sup>

Rabies is a virus that can cause seizures and paralysis. The virus is passed to humans mainly from rabies-infected dog bites.<sup>54</sup> Globally, rabies causes approximately 59,000 human deaths each year, in 150, predominantly LMICs.<sup>55</sup>

Vaccines can be used to:

- immunise people in advance of potential exposure<sup>††</sup>
- treat people following exposure, which does not prevent transmission
- limit transmission in animal populations. Vaccination of 70% of at-risk dogs in a population can eliminate rabies, but investment can be limited.<sup>55,56</sup>

Rabies control benefits human and animal health though it may present challenges because it relies on expenditure from specific sectors such as the veterinary sector, vaccine manufacturers and border surveillance. A One Health approach that shares the costs and benefits between multiple sectors and disciplines can help to alleviate this challenge.<sup>57</sup>

In South America, coordinated intersectoral mass dog vaccination campaigns and integrated medical and veterinary surveillance have been effective. Rabies-related human deaths are almost non-existent in the region.<sup>58,59</sup>

## **Safety and security of food and water**

Climate change is increasing the occurrence of extreme weather events, such as floods and droughts.<sup>60</sup> These can ruin crops, destroy livestock, and increase livestock and crop disease incidence ([PN 600](#)).<sup>61–64</sup> Climate change can affect water sanitation and hygiene ([PB 40](#)). For example, high precipitation can increase the contamination of water sources by human and animal faeces.<sup>10</sup>

The suitability of local climates for crops and livestock is shifting, changing the distribution of crops and farming practices.<sup>65,66</sup> Higher temperatures and precipitation

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<sup>††</sup> Immunising vaccines in humans can prevent rabies transmission but availability of vaccines is scarce in many endemic countries.

increase the occurrence of some foodborne pathogens (such as salmonellosis).<sup>67,68</sup> There is a wealth of evidence on the occurrence and impact of foodborne disease on illness and mortality, such as norovirus.<sup>69,70</sup>

There are some established integrated surveillance systems of foodborne pathogens. For example, an EU co-ordinated multisector approach to salmonellosis control reduced the number of annual cases in the EU from 200,000 in 2004 to 90,000 in 2014.<sup>71</sup>

There is limited evidence on the financial and health benefits of using a One Health approach to tackle food safety.<sup>43</sup> In some cases, this can be because the multisector and integrative nature of a One Health approach can make it difficult to identify the specific actions responsible for improvements to food safety outcomes.<sup>43</sup>

## Key components of One Health

### Interdisciplinary and cross-sector collaboration

Diverse expertise is required to tackle public health challenges using a One Health approach. A global analysis of One Health interventions found 110 of 184 (60%) interventions include the human, animal, and environmental health sectors (see section on [Including the environmental sector](#)).<sup>72</sup> It is important to note that not all disciplines are required for every intervention. Academic and NGO stakeholders agree that other disciplinary expertise (from social sciences, law and wildlife biology) is essential to implementing One Health.<sup>73</sup> For example, anthropologists are important for understanding community perspectives.<sup>74</sup>

There can be many barriers to interdisciplinary working, with differences in cultures, working styles and vocabulary.<sup>75,76</sup> A lack of guidance on how to address these differences can make it difficult to effectively collaborate.<sup>77</sup>

Internationally, the bureaucracy of collaboration and resource sharing between government departments can be challenging.<sup>78</sup> A governmental inter-department One Health committee can help to co-ordinate and manage One Health policy, as shown in Bangladesh.<sup>79</sup> Some evidence suggests that partnerships with the private sector are important for resource access and infrastructure development.<sup>72</sup>

### Community engagement

Community engagement involves working collaboratively and equitably with the public on matters that affect their health and wellbeing.<sup>80</sup> Internationally, some interventions include the government and academia but may not prioritise the local or relevant communities.<sup>72</sup>

Stakeholders agree that actively listening to the needs of local communities is often important for gaining trust, identifying intervention aims and increasing impact.<sup>72,81–85</sup> For example, the One Health for Humans, Environment, Animals and Livelihoods (HEAL) project in Ethiopia, Somalia and Kenya involved interacting with local

agricultural communities to collaboratively decide the project agenda, which resulted in outcomes meeting local needs.<sup>86,87</sup>

Community engagement enables tailoring an intervention to the country or region of implementation. This helps to improve efficiency and use of resources.<sup>72,88</sup> The UK Department for Environment, Food and Rural Affairs (Defra) Science Advisory Council review on public engagement found it was important for the public to understand their purpose in an intervention.<sup>89</sup>

Engaging with local communities can yield insightful knowledge. For example, the One Health FIELD songs project<sup>++</sup> recorded the knowledge of displaced Syrian agricultural communities to aid sustainable development in the Middle East.<sup>90</sup>

## Education and awareness

Evidence suggests that an understanding of One Health and interdisciplinary ways of working need to be taught in current and future professional and policymaking communities.<sup>91,92</sup>

Currently, One Health education can be limited to medical and veterinary training, which can encourage discipline-specific thinking.<sup>91</sup> There is evidence of a lack of awareness of One Health. For example, a survey of 357 medical students in Europe found 80% were unaware of One Health and its importance for AMR, though this varies between countries.<sup>93</sup> There are some wider initiatives, such as PhD programmes and school workshops, though some academics call for One Health inclusion in the school curriculum.<sup>2,94–96</sup>

Professional and technical training can be necessary for One Health implementation. For example, experts in genomic sequencing are needed for effective surveillance ([see below](#)). Increased public awareness can encourage a One Health approach.<sup>97</sup> One Health Day and European Antibiotic Awareness Day can help to engage multiple sectors.<sup>98,99</sup>

## Monitoring and data management

A One Health approach to surveillance involves the collection, analysis, dissemination and use of data from humans, animals and the environment.<sup>100</sup> Data can be brought together from a variety of sources using different methods.<sup>101</sup> Examples of surveillance data include:

- disease vector distribution<sup>102</sup>
- the epidemiology of an infectious disease<sup>103</sup>
- DNA sequencing of pathogens.<sup>104</sup>

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<sup>++</sup> The One Health FIELD Network (Food Security Intelligence and Evidence-based Interventions for Local Sustainable Development in Fragile and Conflict-affected States) is an interdisciplinary project that aims to increase food system resilience. The project gathers local knowledge, from non-traditional sources of data, to improve food security in specific regions of conflict. The FIELD songs project records knowledge from Syrian agricultural communities in the form of traditional songs.

Effective surveillance requires the sharing of data between sectors, disciplines and countries. This may present a challenge because of data inaccessibility and compliance with international data protection regulations (such as GDPR and The Nagoya Protocol<sup>§§</sup>).<sup>75,106</sup> The WHO set up a hub for pandemic and epidemic intelligence to strengthen data sharing between disciplines and countries.<sup>108</sup>

In the UK, the cross-departmental Pathogen Surveillance in Agriculture, Food and Environment Programme (PATH-SAFE), co-ordinated by the Food Standards Agency, is piloting an integrated surveillance system for AMR and foodborne pathogens.<sup>109</sup>

## Economic implications of One Health

Many economic benefits of One Health are calculated based on which sectors are involved in the intervention and these often relate to human health outcomes.<sup>110</sup> Modelling approaches can be used to predict economic outcomes, with uncertainty surrounding these predictions.<sup>110</sup>

Evidence of the economic benefits of an intervention may only be realised when the impacts on all sectors are measured (Box 4). For example, by considering the effects on human health, livestock production and the environment.<sup>111,112</sup>

Cost-effectiveness may become apparent in the long-term, such as in Switzerland where the cross-sector surveillance of the foodborne bacteria, *Campylobacter*, became cost-effective after 5 years.<sup>113,114</sup> Rabies interventions suggest that the economic benefits are maximised when interventions are locally specific which requires regional research and knowledge.<sup>115</sup>

There is emerging international evidence for the economic benefits of using a One Health approach:

- the World Bank estimates the cost of reducing the drivers of emerging disease using a One Health approach (prevention) to be US\$10.3 -US\$11.5 billion compared to US\$30.1 billion per year for monitoring and detecting disease spill-over (preparedness)<sup>116</sup>
- between 2009-2015 integrated surveillance of West Nile virus in Italy in animals and humans saved €1 million<sup>117</sup>
- in 2001 in Denmark, cross-sector surveillance and control of the food-borne disease, salmonellosis, saved US\$25.5 million.<sup>118</sup>

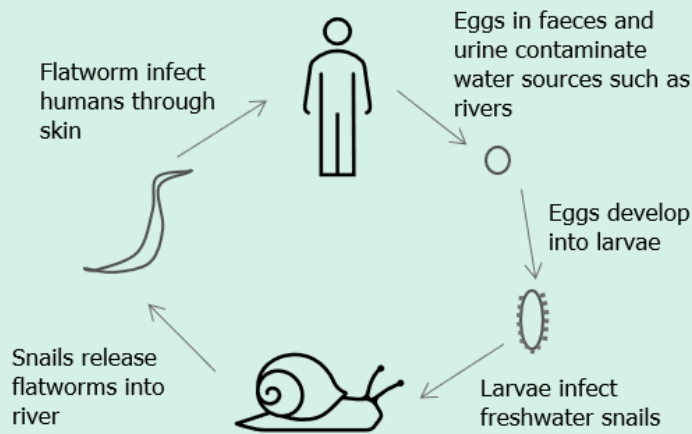
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<sup>§§</sup> The Nagoya Protocol is an international agreement that provides a framework for the implementation of one goal of the Convention of Biological Diversity. Signatories agree to fair and equitable sharing of the benefits derived from genetic information.<sup>105,106</sup> The agreement originally aimed to enable the conservation of biodiversity but it can be a significant barrier to sharing genetic data, such as viral sequences required for vaccine development.<sup>107</sup>



### **Box 4: Evidence of the co-benefits of One Health: control of schistosomiasis in Mali<sup>119</sup>**

Schistosomiasis causes 200,000 deaths per year, predominantly in sub-Saharan Africa.<sup>120,121</sup> The geographic distribution of schistosomiasis is changing due to climate change.<sup>122</sup> It is caused by a parasitic flatworm. The diagram below shows the infection cycle between the worm and people:



Schistosomiasis can be treated with the drug praziquantel.<sup>123</sup> Praziquantel costs \$0.32 USD annually per person.<sup>124</sup> The large number of infections makes this costly. Re-infection after treatment is common in endemic areas.<sup>125</sup>

A One Health approach to schistosomiasis is being trialed. When river prawns are reintroduced to rivers, they eat the snails. This can reduce the number of infections by 18% over 18 months.<sup>119</sup> Globally, improving the design of dams to allow the passage of prawns could sustain river prawns, leading to fewer snails and infections.<sup>122,126</sup>

In addition, this approach aims to provide these co-benefits:<sup>127</sup>

- harvesting prawns by local communities can improve nutrition and provide a source of financial income
- gender equality promotion by giving females in the community the opportunity to farm and sell prawns.

## **Challenges and opportunities**

### **Equity of access to One Health**

Evidence suggests that there is an imbalance of access to resources, including funding and research, between higher income countries (HIC) and LMIC. For

example, a study showed that 35 of 58 (61%) global One Health interventions are headquartered in Europe or North America, which may lead to further inequality.<sup>72</sup> The imbalance is also reflected by the distribution of scientific publications on One Health.<sup>16,128</sup>

A shortage of resources in LMIC can pose a challenge to equitable collaboration as interventions rely on resources donated from other countries.<sup>72,129</sup> The imbalance can lead to HICs setting the agenda for an intervention based on HICs priorities.<sup>130</sup> HIC may prioritise emerging threats rather than endemic threats.<sup>84</sup> For example, researchers have focussed on Highly Pathogenic Avian Influenza in sub-Saharan Africa but this is not a priority in sub-Saharan African because it does not cause high mortality or economic loss.<sup>131</sup> In some cases LMIC organisations can be replaced or marginalised by organisations from HICs.<sup>132</sup>

These challenges can be overcome by creating interventions that are region- or country-led, for example, the Global Alliance for Rabies Control (GARC) set up regional rabies-centric networks such as the Pan-African Rabies Control Network.<sup>133</sup> These networks combine existing mechanisms and consist of a diverse representation of the country.<sup>134</sup> The GARC takes an organisational, rather than leadership role, and organises meetings with governments to improve strategies.<sup>72</sup>

## Conflicts of interest

One Health emphasises that animal and environmental health should be protected regardless of their impacts or benefits to human health.<sup>135</sup> Internationally, some initiatives have prioritised human health when it conflicts with animal and environmental health.<sup>135,136</sup> For example, during the Covid-19 pandemic, 17 million farmed mink were killed in Denmark to protect human health because it was feared mink could become a reservoir of the virus.<sup>137</sup>

A One Health approach can be challenging as the objectives of different sectors can be conflicting. For example, the One Health Poultry Hub aims to sustainably improve poultry farming in areas of Asia, which requires meeting the needs of local consumers and poultry farmers, whilst improving sustainability and reducing zoonotic disease risks.<sup>138</sup>

## Including the environmental sector

Evidence suggests there can be difficulties in including the environmental sector due to a lack of assessment and evaluation tools to use during evaluation of interventions.<sup>139</sup> Globally, One Health interventions commonly include veterinary and medical experts, but can underrepresent the environmental sector and wildlife experts.<sup>72,128,140–142</sup> Stakeholders agree that the health of the environment needs to be considered as it is important and can be changeable.<sup>140</sup> Though the importance of the environment is often recognised, for example in AMR surveillance, there can be a lack of co-ordination of environmental goals and actions within interventions.<sup>143</sup>

These challenges can be overcome by increasing the inclusion of the environmental sector. Additionally, overcoming this challenge may require a change in mindset to one that values the health of the environment as it does human and domestic animal health.<sup>141</sup> In 2021, UNEP officially joined the Tripartite to form the Quadripartite to actively involve the environmental sector in One Health initiatives.<sup>144</sup>

## Putting theory into practice

There is a wealth of literature on the theory of One Health but stakeholders agree that there is a lack of guidance on how to implement One Health in different settings.<sup>103,145,146</sup> Stakeholders highlight that interdisciplinary and cross-sector collaboration can be difficult and guidance is often needed to initiate communication and negotiations. The aims of an initiative may be broad and require trade-offs between sectors, which presents a challenge for implementation.<sup>82</sup>

The Quadripartite will publish an implementation guide to complement the One Health Joint Plan of Action and provide guidance for putting One Health into practice.<sup>147</sup> To resolve some of the challenges in One Health implementation, international organisations have hosted workshops that bring together a range of experts and stakeholders. Feedback from attendees has shown these can be effective (Box 4).<sup>139,148</sup>

### Box 4: Putting One Health into practice with National Bridging Workshops (NBW)

WHO, FAO and WOAHA run workshops on implementing a One Health approach to zoonotic disease.<sup>139,148</sup> Workshops bring together 50-130 stakeholders from the human and animal health sectors and from local, regional, and national levels. There can be fewer representatives from the environmental sector (see [Including the environmental sector](#)). These workshops aim to:

- encourage communication and trust between sectors and hierarchies in society
- identify strengths and weaknesses in current multisectoral collaboration
- create a joint NBW Roadmap containing actions to improve cross-sectoral collaboration.

WHO, FAO and WOAHA provide guidance and tools.<sup>149</sup> In 16 countries, a One Health expert ('NBW catalyst') was hired to oversee implementation and coordinate meetings and events. Progress is evaluated every 1-2 years and the roadmap is updated.

Feedback from 28 countries that have participated in NBW show that 98.4% of participants saw a positive improvement in multisector collaboration.<sup>139,148</sup>

## Evaluation of outcomes

There may be limited objective measurements to monitor and evaluate the outcome of One Health interventions. This may prevent political interest and stakeholder implementation of One Health.<sup>110,146,150</sup> Measuring and monitoring the outcomes of One Health initiatives can be challenging because outcomes cannot be measured using a single metric.<sup>151</sup> Commonly used metrics include measuring quality of life and disease incidence.<sup>110,111,152</sup> These measures relate to public health and do not measure the outcomes in other areas, such as the environment or animal health.<sup>151</sup> Economic evaluation is a common measure of intervention outcomes, though this

may oversimplify the impacts of an intervention, for example environmental benefits can be difficult to quantify.<sup>110,114,153,154</sup>

The challenge of monitoring and evaluating outcomes can be overcome by using a combination of measures that are altered to suit different interventions. This could include measuring disease outcomes, cost analysis, socioeconomic indicators and environmental impact assessments.<sup>110</sup> The evaluation objectives and actions, agreed with communities, can be decided at the start of the intervention. For example, the HALI project on emerging zoonosis in Tanzania set a list of evaluation and monitoring objectives and activities needed to achieve these.<sup>155</sup>

The European Cooperation in Science and Technology (COST) funded the Network for the Evaluation of One Health (NEOH) (2014-2018)<sup>\*\*\*</sup> to create an interdisciplinary and quantitative evaluation framework for One Health.<sup>156,157</sup> This has successfully been put into practice to evaluate some initiatives, for example, West Nile virus surveillance in Italy.<sup>158</sup>

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\*\*\* The Network for the Evaluation of One Health has now been converted into the Network for Ecohealth and One Health.

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