One Health 15 (2022) 100428

Contents lists available at ScienceDirect

One Health

journal homepage: www.elsevier.com/locate/onehlt

One Health gains momentum in Africa but room exists for improvement

Folorunso O. Fasina [a,b,*,1], Bernard Bett [c,1], Michel Dione [c], Florence Mutua [c], Kristina Roesel [c], Lian Thomas [c], Emmah Kwoba [d], Chrisistom Ayebazibwe [e], Nebart Mtika [f], Daniel T. Gebeyehu [g], Niwael Mtui-Malamsha [h], Maganga Sambo [i,j], Emmanuel S. Swai [k], Charles Bebay [a]

[a] Emergency Centre for Transboundary Animal Diseases (ECTAD), Food and Agriculture Organization of the United Nations (FAO), Nairobi, Kenya
[b] Department of Veterinary Tropical Diseases, University of Pretoria, Onderstepoort 0110, South Africa
[c] International Livestock Research Institute, Nairobi, Kenya
[d] International Training and Education Centre for Health (I-TECH-Kenya)-University of Washington, Kenya
[e] Emergency Centre for Transboundary Animal Diseases (ECTAD), Food and Agriculture Organization of the United Nations (FAO), Kampala, Uganda
[f] Youth Leadership Development on Conservation, Nature Kit, Kasungu, Malawi
[g] Department of Veterinary Medicine, School of Veterinary Medicine, Wollo University, Dessie 1145, Ethiopia
[h] Emergency Centre for Transboundary Animal Diseases (ECTAD), Food and Agriculture Organization of the United Nations (FAO), Dar es Salaam, Tanzania
[i] Department of Environmental Health and Ecological Sciences, Ifakara Health Institute, Tanzania
[j] Institute of Biodiversity, Animal Health & Comparative Medicine, University of Glasgow, United Kingdom
[k] Directorate of Veterinary Services, Ministry of Livestock and Fisheries, Dodoma, Tanzania

ARTICLE INFO

Keywords:
National One Health Platform
Functionality
Transdisciplinary
Integrated approaches to health
One Health evaluation
One Health index
One Health ratio

ABSTRACT

Objectives: The degree of One-Healthiness of a system relates to the effectiveness of an institution to operate within the six main dimensions which identify to what extent it complies with One Health concept. This paper evaluates institutional compliance with One Health concept in 14 institutions from eight African countries.

Methods: We utilised the adapted Network for the Evaluation of One Health (NEOH) tool. The institutions included six national One Health platforms and eight other institutions utilizing One Health approaches. Semi-quantitative evaluation of One Health platforms' competencies in six aspects/dimensions concerning One Health operations and infrastructure: *Systems Thinking, Planning, Transdisciplinary working, Sharing, Learning and Systemic Organization*, was conducted.

Results: The evaluation revealed that although all aspects of One Health scored above average, systemic organization and working in One Health were the strongest areas where tremendous gains had been made across the evaluated countries. The aspects of planning, sharing, learning, and thinking should be optimized to achieve gains emanating from One Health approaches in Africa. Cultural and social balance, and integrated health approach were the strongest areas under working and thinking respectively. Thinking was particularly challenged in areas of dimensions coverage and balance, while planning was challenged in the areas of capacity for detection, identification, monitoring of infectious diseases; biosafety and quality management; skills through taught and distance-learning programmes; information and communication technologies to support learning and skills through research apprenticeships.

Conclusion: We conclude that although One Health has gained momentum in Africa, there still exists room for improvement. The revealed strengths, weaknesses, opportunities, and gaps in One Health implementation provide an opportunity for prioritization and refocusing of efforts and resources to strengthen the identified weak areas.

* Corresponding author at: Emergency Centre for Transboundary Animal Diseases (ECTAD), Food and Agriculture Organization of the United Nations (FAO), Nairobi, Kenya.
E-mail address: folorunso.fasina@fao.org (F.O. Fasina).
[1] Contributed equally to the work.

https://doi.org/10.1016/j.onehlt.2022.100428
Received 11 July 2022; Received in revised form 9 August 2022; Accepted 9 August 2022
Available online 18 August 2022

1. Introduction

In May 2021, the Tripartite (FAO, OIE and WHO) and its new Partner, UNEP, launched the One Health High-Level Expert Panel (OHHLEP). Previously, in November 2020 at the Paris Peace Forum, the Ministerial Meeting of the Alliance for Multilateralism had called on the Tripartite (FAO, OIE and WHO) and UNEP to create a panel of international experts to guide One Health development. An agreement for the creation of such a body was reached at the 27th Tripartite Executive Annual Meeting in February 2021, following which the One Health High Level Expert Panel (OHHLEP) was convened for the first time on May 17th 2021 [1]. The 26 experts that formed the OHHLEP were drawn from various disciplines: a) emerging infectious diseases and zoonoses; b) viral diversity, surveillance and risk assessment for emerging pandemic threats; c) infectious disease epidemiology, prevention and control; d) biodiversity, wildlife and ecosystems health; e) health systems policy and practice and pandemic preparedness; f) food systems and their interlinkages with health; g) social, economic and behavioural sciences relating to One Health; h) disciplines in informatics, modelling, prediction and foresight relevant to assessing impacts of environmental and other changes on emerging diseases and health; and i) climate and environment [1].

The OHHLEP, after reviewing other definitions in use within the fields of One Health, Ecohealth and Planetary health, has now provided a new definition of One Health as follows: '*One Health is 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 interdependent. 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*' [1]. This definition has broadly widened the previous working definitions as outlined in various documents [2–4]. It now means that programmes utilizing a One Health approach nationally, regionally and globally, must work and align to this new definition while implementing their activities. It should be understood that One Health implementation is not a mere sectoral merger but an opportunity for strengthening of core capacity in every sector in order to effectively contribute to prevention, detection, response and recovery efforts to various health threats, and produce the desired outcome – sustainable, strong, beneficial and productive mechanism of coordination and collaboration, producing synergistic actions for public good [2].

Key One Health outcomes include the creation of sustainable all-inclusive platforms for trans-disciplinary engagement, leading to observable positive change. Based on this proposition, selected high-level experts from the public, human, veterinary, wildlife and environmental health, food safety, agriculture, agro-economics, geography and development aid, research, government, and the international organizations have identified drivers of One Health [5]. For a One Health approach to be effective and produce expected outcomes, there must be a relationship between specific operational paradigm (thinking, planning and working) and the drivers (social, economic and environmental) with supporting infrastructure (sharing, learning and systemic organization) [5].

The expected outcomes should border on sustainability, health and welfare, effectiveness and efficiency, and interspecies equity and stewardship. In this context, and to evaluate One Health, one of the useful tools that was developed is the Network for Evaluation of One Health (NEOH) tool [6,7]. The tool was an outcome of multiple collaborations berthed by the Cooperation on Science and Technology Action Network for Evaluation of One Health (NEOH, http://neoh.onehealthglobal.net/). Other tools included the following; Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) One Health priority tool, the One Health Zoonotic Disease Prioritization (OHZDP) tool, antimicrobial use (AMUSE), World Health Organization CHOosing Interventions that are Cost-Effective (WHO-CHOICE), Evaluating knOwLedge Integration Capacity (EVOLvINC) and Avenir One Health Tool (OHT) [8–18]. In addition, platforms are being created for coalescing toolkits and resources for various aspects of One Health [15,19, http://bit.ly/ohafrica].

A critical analysis and careful evaluation of the One Health initiative implemented to date reveals a clear alignment with a number of the UN Sustainable Development Goals (the SDGs – at least the 1 (End poverty in all its forms everywhere), 2 (End hunger, achieve food security and improved nutrition and promote sustainable agriculture), 3 (Ensure healthy lives and promote well-being for all at all ages), 6 (Ensure availability and sustainable management of water and sanitation for all), 7 (Ensure access to affordable, reliable, sustainable and modern energy for all), 10 (Reduce inequality within and among countries), and 11 (Make cities and human settlements inclusive, safe, resilient and sustainable). It also include: 13 (Take urgent action to combat climate change and its impacts), 14 (Conserve and sustainably use the oceans, seas and marine resources for sustainable development), 15 (Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss), 16 (Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels) and 17 (Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development)) [2,20]. Since the SDGs apply to all countries, attaining the aligned One Health SGDs can be evaluated at country level using the implementation frameworks at national and subnational levels [20,21]. For the effective implementation of One Health, countries have been encouraged to develop policy frameworks for One Health, including but not limited to the National One Health Strategic Action Plans (NOHSPs) and the National One Health Platforms (NOHPs)/ Multisectoral Coordinating Mechanisms (MCMs) [2,19].

Many sub-Saharan African countries have set up specific national and sometimes subnational One Health platforms (NOHPs) to coordinate surveillance and control of zoonotic diseases, food safety and security, AMR, poverty, and other health and socio-economic challenges that require One Health interventions [19]. The various national level areas of operations in One Health include coordination, organization, collaboration, communication, capacity building and information sharing, and these are driven by the NOHPs [22]. Furthermore, a functional, fully integrated and institutionalized NOHP, is expected to deliver on its mandate, show leadership and coordinate all One Health stakeholders in any country [23]. To evaluate the effectiveness of NOHPs and partners in sub-Saharan Africa, we utilised the NEOH tool to explore the One Health-ness (OH-ness) of selected platforms with consideration to a framework that measure the three pillars of sustainability, viz. society (social equity), environment (environmental protection) and economy (economic viability) [6,7].

2. Materials and methods

2.1. Development of questionnaire

Using the adapted NEOH Excel work tool, a matching semi-structured two-part questionnaire was developed to evaluate One Health platform's competencies [6,7] (Supplementary 1). *Part A* of the questionnaire considered six domains of One Health; Systemic thinking, Planning, Transdisciplinary working, Sharing, Learning and Systemic organization [6,7]. The sub-domains for evaluation for each domain are listed in Table 2. The questionnaire was reviewed by the institutional review panel of One Health Research, Education, Outreach and Awareness Centre (OHRECA). The final questionnaire was pretested among five selected individuals utilised One Health approach.

Table 1
Evaluated countries and national One Health stakeholders, Africa, February – September 2021.

	Tanzania	Kenya	Uganda	Ethiopia	Mali	Burkina Faso	Senegal	Malawi
NOHP	✓ 1	✓ 1	✓ 1	✗	✓ 1	✓ 1	✗	✓ 1
Stakeholder	✓ 1	✓ 1	✓ 1	✓ 1	✗	✓ 1	✓ 1	✓ 1

*NOHP = National One Health Platform. Note that two national stakeholders from Malawi was included in the analysis. Green boxes indicate evaluation conducted and red boxes indicate evaluation not conducted. A Stakeholder is any other organization utilizing One Health approach within the country and included in this interview.

2.2. Recruitment and training of field Interviewers

We recruited representatives from eight countries into the evaluation including Burkina Faso, Ethiopia, Kenya, Malawi, Mali, Senegal, Tanzania and Uganda (Table 1). A total of six NOHPs and eight other national partners implementing activities through a One Health approach were identified and invited for the study. To facilitate the study, interviewers were recruited ($n = 8$) and trained online on the use of the tool through role plays and re-evaluation of outcomes. The expertise of the interviewers was re-assessed to ensure clarity and ability to lead discussion before the evaluated institutions were approached. In each of the evaluated institutions, the leadership of the institution was first approached to introduce the study and its objectives, and to get signed consent. Each institution also decided the approach through which the evaluation should be conducted (in depth interviews of individual experts, focus group discussions with selected experts, or key informant interviews). The questionnaire was shared with the interviewed personnel representing the institutions to familiarise themselves with the tool before the interview date was set. An interview took approximately 3–4 h to complete. All results were deposited in a central repository for data management.

2.3. Validation of results and stakeholder consultations

Following the completion of the interview process, separate dates were set for the validation and stakeholders' consultations. During this process, a preliminary background and presentation of results was made to the participants. Staff of the evaluated institution and broader One Health stakeholders, whom the institution interacted with, were later randomised and divided into three of four groups. Each group worked through the results again to confer agreement or dissension (with reasons). Average scores of all groups was determined and compared with the original score, and a final mean score was utilised to represent each institution, in each area of assessment. Based on these validated results, an African-wide result were also generated. Finally, average scores for all the NOHPs and Stakeholders were compared using the *t*-test statistics [24].

2.4. Ethical clearance and informed consent

No ethical issue arose in the process of implementing this research. However, all participating institutions and individuals who contributed to the outcomes consented or sought institutional clearance and permission to participate in the study. Each participant willingly contributed to responding to the questions in the tool and availed themselves for follow up validation meetings. This work did not involve any invasive or privacy intrusion methods on the participants. The International Livestock Research Institute (ILRI) provided clearance for the administration of the questionnaire under the activity code: BMZ002301.

3. Results

Overall, we evaluated eight countries from East Africa ($n = 3$), West Africa ($n = 4$) and Southern Africa ($n = 1$). These include six national One Health platforms and eight other institutions utilizing One Health approaches. The other two NOHPs and a Stakeholder declined to respond within the timeframe of the research (Table 1). Although all aspects of One Health evaluated scored above average, the aspects of systemic organization (institutionalization of One Health) and working in One Health were the strongest with a score of 0.78 each (Table 2). The aspects of planning (0.57), sharing (0.57), learning (0.63) and systemic thinking (0.68) still have room for improvement if we are to see the full

Table 2
African-wide mean and median scores for specific areas evaluated for One Health-ness.

Aggregate scores for Africa (Areas of evaluation)	Score	Type
SYSTEMS THINKING	**0.68**	Mean
Dimensions coverage + balance	0.45	Mean
Initiative-to-environment match	0.72	Mean
Integrated health approach	0.83	Mean
System features and targets	0.55	Mean
Sustainability and socio-ecological considerations	0.61	Mean
Perspectives and Theory of Change-factors	0.68	Mean
PLANNING	**0.57**	Mean
Common aims	0.70	Mean
Stakeholder and actor engagement	0.71	Mean
Self-assessment and plan revisions	0.67	Mean
Enhance capacity for detection, identification, monitoring of infectious diseases	0.51	Mean
Enhance biosafety and quality management	0.30	Mean
Enhance skills through taught and distance-learning programmes	0.53	Mean
Enhance information and communication technologies to support learning	0.38	Mean
Enhance skills through research apprenticeships	0.35	Mean
TRANSDISCIPLINARY WORKING	**0.78**	Mean
Broadness of initiative	0.62	Mean
Collaboration	0.73	Mean
Transdisciplinary balance	0.67	Mean
Cultural and social balance	0.88	Mean
Flexibility and adaptation	0.66	Mean
SHARING	**0.57**	Mean
General information/awareness sharing	0.62	Mean
Data and information sharing	0.53	Mean
Methods and results sharing	0.65	Mean
Institutional memory/resilience	0.55	Mean
LEARNING	**0.63**	Mean
Focus on adaptive and generative individual learning	0.55	Mean
Focus on adaptive and generative team learning	0.64	Mean
Focus on adaptive and generative organisational learning	0.54	Mean
Direct learning environment supportive of adaptive and generative learning	0.63	Mean
General learning environment supportive of adaptive and generative learning	0.61	Mean
SYSTEMIC ORGANIZATION	**0.78**	Mean
Team structures	0.77	Mean
Social and leadership structures + skills	0.70	Mean
Competence	0.77	Mean
Focus and innovation	0.75	Mean
Median of all scores	**0.75**	Median
OHI	**0.47**	Median
OHR	**1.08**	Median

Note that all scores (apart from OHI and OHR) can reach a maximum of 1.00.

Table 3
Country-level scores for the six composite areas of evaluation of One Health-ness for National Organization and Platforms implementing Activities using a One Health Approach.

Areas of evaluation		Tanzania		Kenya		Uganda		Ethiopia		Mali		Burkina Faso		Senegal		Malawi		
		NOHP	Stakeholder	NOHP	Stakeholder	NOHP	Stakeholder	NOHP	Stakeholder	NOHP	Stakeholder	NOHP	Stakeholder	NOHP	Stakeholder	NOHP	Stakeholder	Stakeholder
Thinking		**0.80**	**0.80**	**0.50**	**0.56**	**0.80**	**0.60**	**NA**	**0.80**	**0.60**	**NA**	**0.50**	**0.80**	**NA**	**0.80**	**0.60**	**0.80**	**0.85**
	Dimensions coverage + balance	0.80	0.75	0.50	0.56	0.56	0.11	NA	0.13	0.60	NA	0.20	0.40	NA	0.10	0.60	0.56	0.00
	Initiative-to-environment match	1.00	0.80	0.60	0.60	0.80	0.80	NA	0.80	0.60	NA	0.00	1.00	NA	0.60	0.60	0.80	1.00
	Integrated health approach	0.80	0.80	0.70	0.80	1.00	0.80	NA	1.00	0.60	NA	1.00	0.60	NA	1.00	0.60	0.80	1.00
	System features and targets	0.63	0.65	0.40	0.28	0.35	0.70	NA	0.83	0.40	NA	0.60	0.60	NA	0.40	0.40	0.80	0.65
	Sustainability and socio-ecological considerations	0.90	0.70	0.50	0.30	0.90	0.50	NA	0.70	0.30	NA	0.00	0.60	NA	0.80	0.80	0.80	0.90
	Perspectives and TOC-factors	1.00	0.80	0.40	0.80	0.90	0.05	NA	0.50	0.70	NA	0.50	0.80	NA	0.70	0.60	0.80	0.90
Planning		**0.60**	**0.50**	**0.45**	**0.20**	**0.45**	**0.70**	**NA**	**0.60**	**0.50**	**NA**	**0.40**	**0.80**	**NA**	**0.80**	**0.30**	**0.70**	**0.90**
	Common aims	0.90	0.60	0.60	0.30	0.80	0.60	NA	1.00	0.60	NA	0.60	0.70	NA	1.00	0.60	0.70	1.00
	Stakeholder and actor engagement	0.87	0.67	0.60	0.40	0.67	0.57	NA	0.60	0.50	NA	0.80	0.80	NA	0.60	0.50	0.80	0.87
	Self-assessment and plan revisions	0.90	0.70	0.60	0.40	0.60	0.55	NA	0.60	0.50	NA	0.00	0.90	NA	0.70	0.50	0.80	0.90
	Enhance capacity for detection, identification, monitoring of infectious dise	0.40	0.40	0.40	0.20	0.40	0.00	NA	0.60	1.00	NA	0.40	0.80	NA	0.80	0.40	0.60	1.00
	Enhance biosafety and quality management	0.40	0.40	0.30	0.00	0.20	0.40	NA	0.60	1.00	NA	0.20	0.00	NA	0.20	0.20	0.60	NA
	Enhance skills through taught and distance-learning programmes	0.40	0.40	0.20	1.00	0.20	0.80	NA	0.40	0.60	NA	0.20	1.00	NA	0.60	0.20	0.80	NA
	Enhance information and communication technologies to support learning	0.40	0.40	0.10	0.20	0.20	0.80	NA	0.30	0.40	NA	0.20	1.00	NA	0.40	0.20	0.20	NA
	Enhance skills through research apprenticeships	0.40	0.40	0.10	0.20	0.20	1.00	NA	0.60	0.00	NA	0.00	0.00	NA	0.60	0.20	0.80	NA
Working		**1.00**	**0.80**	**0.55**	**0.30**	**0.80**	**0.60**	**NA**	**0.85**	**0.80**	**NA**	**1.00**	**0.80**	**NA**	**0.80**	**0.60**	**0.80**	**0.80**
	Broadness of initiative	0.87	0.77	0.40	0.27	0.50	0.23	NA	0.73	0.80	NA	0.80	0.70	NA	1.00	0.20	0.73	0.30
	Collaboration	0.60	0.80	0.60	0.40	0.80	0.50	NA	0.90	0.90	NA	0.70	0.80	NA	0.70	0.80	0.90	0.80
	Transdisciplinary balance	1.00	0.80	0.40	0.25	0.35	0.65	NA	0.85	1.00	NA	0.80	0.90	NA	0.90	0.30	0.70	0.25
	Cultural and social balance	1.00	0.80	1.00	0.68	1.00	0.90	NA	0.80	0.90	NA	1.00	0.90	NA	0.60	1.00	0.92	1.00
	Flexibility and adaptation	0.70	0.85	0.60	0.30	0.68	0.60	NA	0.75	0.60	NA	0.90	0.60	NA	0.60	0.60	0.80	0.75
Sharing		**0.80**	**0.80**	**0.40**	**0.65**	**0.15**	**0.50**	**NA**	**0.60**	**0.60**	**NA**	**0.60**	**0.60**	**NA**	**0.42**	**0.26**	**0.85**	**0.80**
	General information/awareness sharing	0.60	0.80	0.50	0.70	0.43	0.70	NA	0.63	0.60	NA	0.80	0.60	NA	0.40	0.60	0.70	0.53
	Data and information sharing	0.83	0.73	0.20	0.30	0.03	0.20	NA	0.53	0.60	NA	0.30	0.70	NA	0.40	0.20	0.97	0.93
	Methods and results sharing	0.75	0.60	0.50	0.75	0.50	0.70	NA	0.75	0.60	NA	0.60	0.60	NA	0.50	0.60	0.80	0.70
	Institutional memory/resilience	0.75	0.80	0.40	0.60	0.10	0.50	NA	0.25	0.60	NA	0.40	0.70	NA	0.40	0.20	0.95	0.95
Learning		**0.60**	**0.51**	**0.52**	**0.45**	**0.67**	**0.71**	**NA**	**1.00**	**0.63**	**NA**	**0.42**	**0.42**	**NA**	**0.74**	**0.56**	**0.77**	**0.74**
	Focus on adaptive and generative individual learning	0.65	0.53	0.50	0.33	0.78	0.73	NA	0.43	0.70	NA	0.33	0.40	NA	0.70	0.60	0.73	0.40
	Focus on adaptive and generative team learning	0.48	0.50	0.60	0.50	0.30	0.70	NA	0.78	0.70	NA	1.00	0.40	NA	0.80	0.60	0.63	0.85
	Focus on adaptive and generative organisational learning	0.60	0.50	0.30	0.40	0.33	0.55	NA	0.73	0.50	NA	0.33	0.20	NA	0.80	0.60	0.98	0.78
	Direct learning environment supportive of adaptive and generative learning	0.58	0.50	0.70	0.50	1.00	0.83	NA	0.48	0.50	NA	0.30	0.60	NA	0.75	0.60	0.75	0.83
	General learning environment supportive of adaptive and generative learning	0.68	0.50	0.50	0.50	0.93	0.75	NA	0.40	0.80	NA	0.20	0.50	NA	0.75	0.50	0.75	0.83
Systemic Organization		**0.80**	**0.70**	**0.70**	**0.60**	**0.60**	**0.80**	**NA**	**0.90**	**0.60**	**NA**	**0.80**	**0.80**	**NA**	**0.80**	**0.60**	**0.80**	**0.80**
	Team structures	0.80	0.77	0.90	0.67	0.44	0.82	NA	0.87	0.60	NA	0.70	0.80	NA	0.87	0.80	0.91	0.89
	Social and leadership structures + skills	0.86	0.50	0.64	0.54	0.60	0.70	NA	0.78	0.60	NA	0.80	0.84	NA	0.74	0.60	0.76	0.80
	Competence	0.90	0.75	0.50	0.70	0.80	0.65	NA	0.85	0.80	NA	0.70	0.90	NA	0.70	0.60	0.85	0.90
	Focus and innovation	0.80	0.67	0.50	0.40	0.87	1.00	NA	1.00	0.70	NA	0.50	0.80	NA	0.90	0.50	0.83	0.93
Median		0.80	0.75	0.51	0.51	0.64	0.65	NA	0.83	0.60	NA	0.55	0.80	NA	0.80	0.58	0.80	0.80
OHI		0.59	0.47	0.27	0.20	0.33	0.42	NA	0.52	0.38	NA	0.40	0.50	NA	0.43	0.23	0.62	0.66
OHR		1.15	1.08	0.94	0.43	2.43	0.96	NA	1.19	1.07	NA	1.04	1.56	NA	1.14	1.32	0.92	1.15

TOC = Theory of Change; NOHP = National One Health Platform; Stakeholder = any other organization utilizing One Health approach within the country; OHI = One Health Index. OHR = One Health Ratio. Each aspect of the evaluation for thinking, planning, working, sharing, learning and systemic organization can reach a maximum of 1.00, which is the ideal. The closer to 1.00 a score is, the more robust the organization or a national platform for that particular aspect of evaluation. NA = Not available. The two platforms and the stakeholder were scheduled, but the evaluations were not conducted due to absence of the team to be evaluated.

Table 4
Comparison of aspects of evaluation between the NOHPs and the Stakeholders.

	Thinking (Mean ± SD)	Planning (Mean ± SD)	Working (Mean ± SD)	Sharing (Mean ± SD)	Learning (Mean ± SD)	Systemic Organization (Mean ± SD)	OHI (Mean ± SD)	OHR (Mean ± SD)
NOHPs	0.63 ± 0.14	0.68 ± 0.13	0.59 ± 0.27	0.59 ± 0.12	0.59 ± 0.16	0.71 ± 0.16	0.37 ± 0.13	1.32 ± 0.56
Stakeholders	0.75 ± 0.11	0.74 ± 0.25	0.59 ± 0.28	0.63 ± 0.12	0.53 ± 0.17	0.83 ± 0.08	0.48 ± 0.14	1.05 ± 0.32
P-value	0.10	0.60	1.00	0.55	0.52	0.09	0.16	0.27

benefits of One Health approaches in Africa.

The weakest area within the aspects of systemic thinking was that of dimensions coverage + balance (Score = 0.45), and in planning: Enhance biosafety and quality management (Score = 0.30); Enhance information and communication technologies to support learning (Score = 0.38) and Enhance skills through research apprenticeships (Score = 0.35) (Table 2). The strongest specific areas of strengths are the cultural and social balance (0.88) and integrated health approach (0.83) under the aspects of working and thinking respectively (Table 2). The overall One Health Index and One Health Ratio for Africa was 0.47 and 1.08 respectively.

For country specific One Health-ness, the aspect of planning are still challenged. Twelve out of the 14 assessed institutions have various challenges in these areas of planning, particularly in the areas of enhance capacity for detection, identification, monitoring of infectious diseases; enhance biosafety and quality management; enhance skills through taught and distance-learning programmes; enhance information and communication technologies to support learning and enhance skills through research apprenticeships (Table 3). Several areas of working and systemic organization are well above average (Table 3). There was no significant difference between scores for aspects of the pooled National One Health Platforms and the other National Stakeholders in One Health evaluated (Table 4). The various institution-specific One Health Indices (OHIs) are displayed in Fig. 1.

4. Discussion

We have evaluated 14 institutions in Africa including six national One Health platforms and eight other relevant One Health stakeholders spread across West, East and Southern Africa. This semi-quantitative field research has revealed that integration of the One Health approaches in Africa has gained mileages and are institutionalized in the evaluated countries. We identified the formalization of multi-sectoral coordination mechanisms, nation-wide adoption of guidelines on multi-sectoral coordination, and integration of and systemizing One Health approaches in daily work life in prevention, detection, and response activities. One Health is a lengthy yet complex process that requires continued investment and sustained commitment. Bhatia [2] has similarly confirmed that for sustained global initiatives on One Health, the following things are needed: political will, sustained financing, increased visibility, and coordinated efforts, to support training, information clearing house, needs assessment, proof of concept, capacity building and the One Health global network. Despite the challenges in One Health, multi-sectoral coordination, spearheaded by the NOHPs, offers the promise of effectiveness and efficiency gains. The key outputs, impacts and long term outcomes of multi-sectoral coordination mechanisms in-country must be showcased as evidences in terms of human, economic, and financial benefits, in order to convince decision-makers, especially those who control budgets in ministries of finance and ministry-level budget offices, to increase investment in multi-sectoral coordination [22].

Although overall the key domains of One Health evaluated are relatively similar across countries and institutions (Table 4), some specific areas of differences exist. For instance, academic institution based One Health stakeholders seem to have strength in the areas under learning while the government-owned implementers/coordinating mechanisms (the NOHPs) have strength in systemic organization supporting One Health, it behoves these agencies to facilitate integration mechanisms that promotes cooperation and collaborations among themselves. Such suggestions for more integration and collaboration among various team members, disciplines and sectors have been advocated including allowing room for system thinking, and identification of clearly mapped out theory of change, which should ensure that despite differing goals and independent scientific domains, common aims in One Health can be pursued [6,7,18,22,25]. In our context, theory of change is "an outcomes-based approach which applies critical thinking to the design, implementation, and evaluation of One Health initiatives and programs intended to support change in their context" [26]. Country-level One Health platforms should also continue to strengthen data management systems and build matrices for better coordination of all One Health stakeholders in-country, as well as provide linkage and management of large amounts of heterogeneous data across disciplines and sectors. For emphasis, the evaluation of the integrated systems should be comprehensive and consider relevance, efficiency, effectiveness, impact, and sustainability [22].

The One Health-ness (OH-ness) assessment conducted in this work utilised the modified questionnaire, adapted from the work of Rüegg and colleagues [6,27], with semi-quantitative scoring as a working tool (Supplementary 1). The One Health Index (OHI) compared the operational aspects (thinking, planning and working) to the infrastructure (learning, sharing and systemic organization); it specifically measures the degree of integration by the proportion of the surface of the operational hexagon with the infrastructure hexagon. In contrast, the One Health Ratio (OHR) assessed the relation of the first three operative aspects to the later three infrastructural aspects [27,28]. Based on the outcome of this research, significant strengths but equally some areas of weaknesses have been identified, generally in Africa, but particularly in the different countries assessed in this study. The OHI, an essential indicator in this study, range between 0.20 and 0.66 (median = 0.47) (a value close to 1.00 indicates the highest level of OH-ness) and the overall OHR of 1.08 is an indication of some imbalances between OH operations and supporting infrastructures. This observation is further confirmed by the institutional-level assessment and scores within the aspects of the assessments. Whereas the One Health Working and Systemic Organization dimensions appeared strong, the other four areas still need significant level of improvement (Table 2). It should be understood that sometimes, when focusing on an aspect of One Health index, e.g. systemic, organization or working, the One Health platform and the people working in it may unintentionally or inadvertently ignore other areas e.g. planning and learning. Country NOHPs are encouraged to periodically utilise the tool to assess and reassess itself and constantly implement change or necessary modifications as necessary based on the outcomes of such evaluations. However, caution must be taken to understand that the purpose of this evaluative tool is not to do cross-institutional or cross-country comparison, but to engender improvement in the quality delivery of One Health approach in country and ensure effective One Health-ness of the platforms [6,7,27]. The results of OHI and OHR of these evaluations are not static reports, but rather dynamic and evolving scores, which may change significantly with future evaluations.

Previous evaluations have indicated the challenges associated with planning, thinking, sharing and learning, but also the working and systemic organization [7,18,22,25]. Such challenges include those related to sharing of data, information and communication, competition instead of complementarity, lack of adequate preparedness, lack of

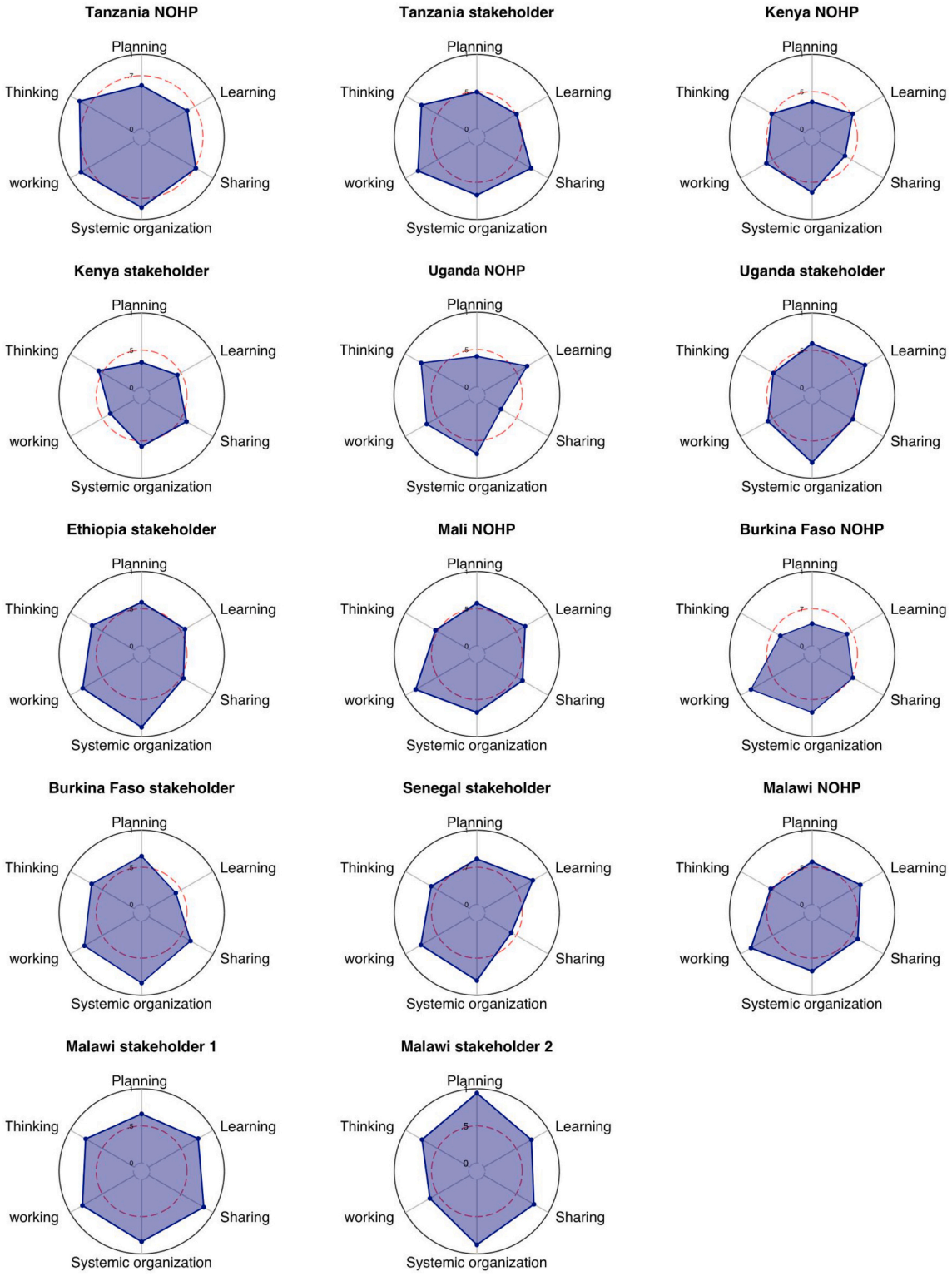

Fig. 1. One Health Indices of the fourteen evaluated One Health platforms and stakeholder institutions in Africa.
The One Health Index (OHI) measures the degree of integration by the proportion of the surface of the operational hexagon with the infrastructure hexagon of an organization. Specifically, it compares the operational aspects (thinking, planning and working) to the infrastructure (learning, sharing and systemic organization) to evaluate the degree of balance [26,27].

focused capacity development in One Health institutions, duplicity of roles, understaffing, over-dependence on external funding, lack of legal and monitoring/evaluation frameworks to support One Health, cross-border limitations preventing epizonal approach to addressing issues, lack of systemizing the One Health implementation, lack of subnational One Health platforms to transform policies into actions, insecurities and political instabilities, lack of co-creation, co-planning and co-implementation of projects and inadequate advocacy among others. These challenges directly arise from or relate directly to the four weak aspects of One Health-ness (planning, thinking, sharing and learning)

mentioned above.

Furthermore, many studies have advocated that the inclusion of theory of change, monitoring, evaluation and learning frameworks, and tools for standardized evaluation of One Health policies into the overall national One Health engagement will sustain the future of One Health approach in Africa and elsewhere [18,22,25]. Future engagements should continue to respond to the need of the society and be outcomes-driven. Formerly, calls have been made for national roadmaps for One Health implementation and institutionalization, and proofs of concepts and success stories in One Health should be show-cased and scaled-up while dependence on external funding should be scaled-down [22].

There is a need to develop the initiative-specific theory of change which follows the whole of One Health approach (from inputs, through research and competencies, key and unintended outputs up to immediate outcomes and the long term outcomes). African One Health platforms must develop matching monitoring, evaluation and learning frameworks that is multi-layered (with consideration to socio-ecological model, multi-stakeholders and multiple perspectives) [30]. The idea of co-creation, co-designing of projects, co-planning as well as co-financing and co-implementation must be engendered within the NOHP and its stakeholders [22,25,29].

4.1. Limitation of the study

This evaluation is a semi-quantitative and the responses are based primarily on the respondents' opinions and self-assessment, it is likely subjected to some personal/professional biases. We made effort to balance such biases by subjecting the primary evaluations to a re-evaluation/validation processes by involving the stakeholders from multiple institutions. As each country's assessors are unique and different from assessors in another country, country level comparison may lead to false or inadvertent error in intercountry comparisons. The only benchmark used for each assessment is the in-country participants, and their opinions and final scores are based on their perceptions of the current status or gains made in One Health. Finally, in terms of responses to the evaluation in countries, the assessment went smoothly, yet was challenged with some degree of disagreements in some countries where personnel from the NOHP and stakeholders disagreed on certain aspects of the assessment and the assigned scores, particularly in the areas of sharing thinking, working and systemic organization. Aragrande et al., [25] have similarly observed such disagreement in the selected projects evaluated at a University in Italy. The post evaluation validation meetings resolved many of these issues identified.

5. Conclusion

In conclusion, the utility of the NEOH evaluation tool and potential improvement of OH-initiatives was evident, and its use have brought out the strengths, weaknesses, opportunities and gaps in One Health implementation in each country and institution assessed. Although, NEOH tool engendered facilitated cross-sectoral perspectives and communication, customization to different environments and settings is suggested. Though, the outputs arose from a semi-quantitative evaluation and may have some degree of subjectivity of the assessors, its outcomes may provide recommendations for improving One Health initiatives and system thinking in country, as well as in improving the NEOH tool, based on experience of its use, in the current study.

Authors' contributions

FOF and **BB** conceptualized the project idea; **FOF, EK, CA, NM, NMM, DTG, MDFM** and **KR** performed field data collection; **All authors** participated in the validation exercises; **BB, FM, MD, KR** and **LT** administered and supervised the project at country levels. **FOF** and **BB** conducted data analysis and visualization. **BB, CB** and **FOF** contributed resources. All authors contributed to writing, reviewing and revising the final version of the manuscript.

Declaration of Competing Interest

The authors declare no conflicts of interest.

Acknowledgements

This report is part of the work integration between One Health Research, Education, Outreach and Awareness Centre (OHRECA) and the Food and Agriculture Organization (FAO). It involved some desk reviews of literature to prepare the survey, and field survey conducted across eight sub-Saharan African countries. We acknowledged the contributions of various National One Health Platforms, the One Health stakeholders in countries and all persons who attended the validation meetings and provided comprehensive information for the research. We are grateful to governments of the eight countries who permitted the in-country evaluations, the International Livestock Research Institute (ILRI), Kenya & Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung (The Federal Ministry of Economic Cooperation and Development), Germany, which funded the work, as well as the Management of the OHRECA. Ilboudo Guy, Ahmadou Sow Ahmadou assisted in carrying out the surveys in West Africa. Sadly, Oscar Mwaibabile, who was part of the field team in Tanzania passed on before this work was presented for publication.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.onehlt.2022.100428.

References

[1] FAO/OIE/UNEP/WHO, One Health High-Level Expert Panel Annual Report 2021, Available at: https://www.who.int/publications/m/item/one-health-high-level-expert-panel-annual-report-2021, 2021. Accessed 16 April 2022.
[2] R. Bhatia, National Framework for One Health, FAO, New Delhi, 2021, https://doi.org/10.4060/cb4072en.
[3] AVMA, One Health — a New Professional Imperative, Available at: https://www.avma.org/news/reports/one-health-summary, 2022. Accessed 23 April 2022.
[4] CDC, One Health, Available at: https://www.cdc.gov/onehealth/index.html, 2022. Accessed 23 April 2022.
[5] S.R. Rüegg, B.J. McMahon, B. Häsler, et al., A blueprint to evaluate one health, Front. Public Health 5 (2017) 20, https://doi.org/10.3389/fpubh.2017.00020.
[6] S.R. Rüegg, L.R. Nielsen, S.C. Buttigieg, et al., A systems approach to evaluate One Health initiatives, Front. Vet. Sci. 5 (2018) 23, https://doi.org/10.3389/fvets.2018.00023.
[7] M.C.E. Hanin, K. Queenan, S. Savic, E. Karimuribo, S.R. Rüegg, B. Häsler, A One Health evaluation of the Southern African Centre for Infectious Disease Surveillance, Front. Vet. Sci. 5 (2018) 33, https://doi.org/10.3389/fvets.2018.00033.
[8] B. Alemu, U. Magnussen, K. Amenu, et al., AMUSE: Tool to measure antimicrobial use: Knowledge, attitude and practice of livestock keepers in Ethiopia. Poster prepared for the Virtual Livestock CRP Planning Meeting, 8–17 June, ILRI, Nairobi, Kenya, 2020.
[9] G.T. Eregata, A. Hailu, K. Stenberg, K.A. Johansson, O.F. Norheim, M.Y. Bertram, Generalised cost-effectiveness analysis of 159 health interventions for the Ethiopian essential health service package, Cost Eff. Resour. Alloc. 19 (2021) 2, https://doi.org/10.1186/s12962-020-00255-3.
[10] World Health Organization, The World Health Organization Choosing Interventions That Are Cost-Effective (WHO-CHOICE), Available at: https://www.who.int/tools/onehealth. Accessed 13 March 2021.
[11] Avenir Health, Avenir One Health Tool, Available at: https://avenirhealth.org/software-onehealth.php. Accessed 20 April 2021.
[12] V. Ng, J.M. Sargeant, A quantitative approach to the prioritization of zoonotic diseases in North America: a health professionals' perspective, PLoS One 8 (8) (2013), e72172, https://doi.org/10.1371/journal.pone.0072172.
[13] CDC, Zoonotic Disease Prioritization, Available at: https://www.cdc.gov/onehealth/what-we-do/zoonotic-disease-prioritization/index.html. Accessed 20 April 2021.
[14] M.Y. Bertram, T.T.T. Edejer, Introduction to the Special Issue on "The World Health Organization choosing interventions that are cost-effective (WHO-CHOICE) update", Int. J. Health Policy Manag. 10 (11) (2021) 670–672, https://doi.org/10.34172/IJHPM.2021.105.
[15] United States Agency for International Development, USAID Preparedness and Response Project. Multisectoral coordination that works: building effective

mechanisms to prevent, detect, and respond to public health threats, Available at: https://assetify-dai.com/resourcelibrary/pandr-multisectoral-coordination.pdf, 2018. Accessed 18 July 2021.
[16] MEASURE Evaluation, Health Information Systems Interoperability Maturity Toolkit: Users' Guide, 2019, pp. 1–55.
[17] J. George, B. Häsler, I. Mremi, C. Sindato, L. Mboera, M. Rweyemamu, J. Mlangwa, A systematic review on integration mechanisms in human and animal health surveillance systems with a view to addressing global health security threats, One Health Outlook 2 (2020) 11, https://doi.org/10.1186/s42522-020-00017-4.
[18] M. Hitziger, J. Berezowski, S. Dürr, et al., System thinking and citizen participation is still missing in One Health initiatives – lessons from fifteen evaluations, Front. Public Health 9 (2021) 653398, https://doi.org/10.3389/fpubh.2021.653398.
[19] One Health Commission, One Health Strategic Action Plans, Available at: https://www.onehealthcommission.org/en/resources_services/one_health_strategic_action_plans/, 2022. Accessed 16 April 2022.
[20] World Health Organization, Monitoring the Health-related Sustainable Development Goals (SDGs). Background paper for the regional technical consultation, 9–10 February 2017, SEARO, New Delhi, India, 2017. Available at: https://www.who.int/docs/default-source/searo/hsd/hwf/01-monitoring-the-health-related-sdgs-background-paper.pdf?sfvrsn=3417607a_4. Accessed 15 March 2022.
[21] United Nations, The Sustainable Development Goals, Available at: https://www.un.org/sustainabledevelopment/development-agenda-retired/, 2022. Accessed 16 April 2022.
[22] F.O. Fasina, O.G. Fasanmi, Y.J. Makonnen, C. Bebay, B. Bett, K. Roesel, The one health landscape in sub-Saharan African countries, One Health 13 (2021), 100325, https://doi.org/10.1016/j.onehlt.2021.100325.
[23] A.Y. Kitua, S. Scribner, M. Rasmuson, Building a functional national One Health platform: the case of Tanzania, One Health Outlook 1 (2019) 3, https://doi.org/10.1186/s42522-019-0003-0.
[24] MedCalc Software Ltd., Comparison of means calculator (Version 20.106). Available at: https://www.medcalc.org/calc/comparison_of_means.php. Accessed April 20, 2022.
[25] M. Aragrande, M. Canali, M. Roccaro, et al., One Health Evaluation: a case study at the University of Bologna, Front. Public Health 9 (2021), 661490, https://doi.org/10.3389/fpubh.2021.661490.
[26] L. Paina, et al., Using theories of change to inform implementation of health systems research and innovation: experiences of Future Health Systems consortium partners in Bangladesh, India and Uganda, Health Res Policy Sys. 15 (2017) 109, https://doi.org/10.1186/s12961-017-0272-y.
[27] S.R. Rüegg, S.C. Buttigieg, F. Goutard, et al., Integrated Approaches to Health: Concepts and Experiences in Framing, Integration and Evaluation of One Health and EcoHealth, Frontiers Media, Lausanne, 2019, https://doi.org/10.3389/978-2-88963-086-8.
[28] S.C. Buttigieg, S. Savic, D. Cauchi, E. Lautier, M. Canali, M. Aragrande, Brucellosis control in Malta and Serbia: a One Health evaluation, Front. Vet. Sci. 5 (2019) 147, https://doi.org/10.3389/fvets.2018.00147.
[29] S. Nawaz, GOHI Monthly Webinar: Monitoring and Evaluation of One Health Initiatives, Ohio State University, 2022. Available at: https://www.youtube.com/watch?v=QcMQpIlH6pA. Accessed 19 April 2022.
[30] X.X. Zhang, et al., Towards a global One Health index: a potential assessment tool for One Health performance, Infect. Dis. Poverty 11 (2022) 57, https://doi.org/10.1186/s40249-022-00979-9.