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Environmental solutions to antimicrobial resistance in Africa**

Note by the secretariat

I. Introduction

1. Antimicrobials have contributed to reducing infectious diseases in humans, animals and plants for decades. They have significantly contributed to increasing animal and crop production and improving healthcare. However, the misuse of antimicrobials has created a favourable environment for resistant microbes to develop.

2. Antimicrobials are often misperceived to be a technical challenge of limited impact. However, scientific evidence strongly indicates that antimicrobial resistance represents a major vulnerability in all countries, especially in Africa. A direct result of antimicrobial resistance is an increasing trend in serious illnesses and deaths and increases in health-associated costs, including lowered population productivity.

3. As antimicrobial resistance evolves quietly to become a major health, environmental and economic threat to African countries and in the face of more visible threats such as the COVID-19 pandemic and climate change, governments need to pay more attention to addressing this issue.

4. There is currently enough evidence to show why antimicrobial resistance occurs, how it develops and its adverse direct and indirect consequences. Therefore, coherent policy actions are urgently needed to overcome this challenge and avoid further impact on people and the environment.

5. The environment is a reservoir of antimicrobial resistance microbes and pathogens. Ensuring this reservoir does not receive or pass on these microbes is critical in guaranteeing the success of environmental solutions in addressing the antimicrobial resistance threat.

6. This note highlights the immediate need for African governments and especially the ministries of environment to take ambitious, collaborative action with other stakeholders to prevent and minimize the adverse impacts of environmental pollution in exacerbating the unfolding regional and global antimicrobial resistance crisis. Deliberate efforts must also be made to bring together all ‘One Health’ sectors at the national level to build synergies and create co-benefits in the fight against antimicrobial resistance while also contributing to achieving the Sustainable Development Goals.

7. Solutions to antimicrobial resistance have been looked at over time, primarily from a medical lens. But increasingly, achieving success has called for the need to “cut off” the risk of antimicrobial resistance from the sources, and this is where the environmental dimension comes in.

* In accordance with the decision taken at the meeting of the Bureau of the African Ministerial Conference on the Environment held on 26 May 2022, the eighteenth session of the Conference, which was adjourned on 16 September 2021, will resume as an in-person meeting in Dakar from 12 to 16 September 2022.

** The present document is being issued without formal editing.

II. Background

8. The World Health Organisation (WHO) considers that increasing antimicrobial resistance in human and animal pathogens is among the top ten threats compromising global health. Already, it is estimated that globally 1.4 million people die because of antibiotic-resistant infections, with almost 5 million deaths associated with complications from resistant bacterial infections. Most of these deaths are in Africa and South Asia, and this number is likely to rise substantially unless there is sustained action across the globe. Moreover, Sub-Saharan Africa has the highest incidence of antimicrobial resistance deaths globally at 24 per 100,000 population, in contrast to high-income countries where deaths are about 13 per 100,000 population. If the status quo maintains, up to 4.1 million people across Sub-Saharan Africa will die annually from antimicrobial resistance by 2050.

9. Antimicrobial resistance is, therefore, an emerging global threat with the likelihood of permanent humanitarian and economic consequences if not tackled aggressively. Over the decades, several bacteria, fungi, viruses, and parasites have become resistant to the antimicrobials that were used as a treatment to prevent a wide range of deadly infectious diseases they caused in humans, plants, and animals.[1] Subsequently, antimicrobial resistance in the environment leads to animal and plant diseases or soil biodiversity loss, leading to further use of antimicrobials, thereby creating resistance. The cyclic interrelationships, complexities, and multiple causalities and dynamics that depict the environmental dimensions of antimicrobial resistance demand a holistic approach to addressing antimicrobial resistance in the environment.

10. One health is a system as well as a holistic approach which is adequate to understand environmental dimensions of antimicrobial resistance better and inform science-based decisions and actions.[2] Antimicrobial resistance poses a vital One Health challenge advanced by the interdependence of humans, animals, and the environment.[3]

11. The core issue is that many microbes have grown increasingly more “resistant” to available medicines. This means medicines are less able to cure or prevent infections, and people have smaller chances of recovering from a broad range of common to lethal infections. A direct result is an increasing trend in severe illnesses and deaths and increases in health-associated costs, including lowered population productivity. The dilemma is that the medicines used to control or prevent human and animal infections, and in some situations to promote animal growth, simultaneously drive microbes to evolve genetically and develop resistance to treatment. The risks of individuals dying from resistant infections and the associated increase in healthcare costs are considerable.

12. Recent studies have estimated the magnitude of such consequences to be larger than for major global diseases such as HIV and malaria. On the global scale, attention to antimicrobial resistance has been dominated by a focus on the health and agriculture sectors. However, it is essential to note that the consequences of antimicrobial resistance directly affect human and animal health and the ecosystems within which they co-exist, resulting in a socioeconomic loss. Indeed, the environment is key to antimicrobial resistance development, transmission, and spread to humans, animals, and plants.[4]

13. To understand the environmental dimensions of antimicrobial resistance, it will be imperative that we consider water, soil, and waste from different sources as crucial elements that contribute to environmental releases of antimicrobials. Nonetheless, it is insufficient to only study antimicrobial resistance in the environmental compartments based on these critical elements without considering the anthropocentric perspective. The emergence of antimicrobial resistance in the environment is because of many human activities which create pollution in the environmental media.[5]

14. The economic impact is also likely to be significant. By 2050 it is estimated that antimicrobial resistance could be responsible for a loss of 3.8% of the world’s annual gross domestic product; by 2030, the gross domestic product shortfall due to antimicrobial resistance could be US$3.4 trillion per year, while 24 million more people could be pushed into extreme poverty.

15. The urgency to reverse this bleak scenario is critical, and the role of the environmental dimensions cannot be underestimated.

[1] Omulo, S., Thumbi, S. M., Njenga, M. K., & Call, D. R. (2015). A review of 40 years of enteric antimicrobial resistance research in Eastern Africa: what can be done better?. Antimicrobial resistance and infection control, 4(1), 1-13.

[2] wedocs.unep.org/bitstream/handle/20.500.11822/38373/antimicrobial_R.pdf .

[3] www.frontiersin.org/articles/10.3389/fcimb.2021.771510/full.

[4] wedocs.unep.org/bitstream/handle/20.500.11822/38373/antimicrobial_R.pdf .

[5] Ibid.

III. Environmental dimensions of antimicrobial resistance

16. Global attention to antimicrobial resistance has been dominated by a focus on the health and agriculture sectors. However, the environment is also vital to antimicrobial resistance development, transmission and spread to humans, animals, and plants. The environmental impacts of antimicrobial resistance and the causes of the development and spread of resistance in the environment are complex, and essential knowledge gaps require further research. However, there is evidence that both biological and chemical pollutants, which enter the environment, can fundamentally influence the development of antimicrobial resistance, transmission and spread.

17. As evidenced by research, antimicrobial resistance occurrence in the environment is found in the magnitude of environmental reservoirs, such as wastewater, where the pathogens causing diseases might be harboured. The complications of climate change, urbanization, anthropogenic activities, resource depletion and antimicrobial residues in the ecosystem further increase the danger of transferal of antimicrobial resistance.[6,7]

18. Studies have shown that global warming combined with high population densities has led to higher antimicrobial resistance in bacteria. This is because the transfer of resistance genes is accelerated at higher temperatures, and the bacteria can acquire and spread antimicrobial resistance genes more quickly. Therefore, increasing global warming will lead to increased informal settlements, especially in Africa, creating new breeding grounds for resistant pathogens.[8]

19. Global warming further exacerbates change in the ecosystems, which leads to floods, droughts, and other natural disasters. Recently, the intensity and frequency of these climatic hazards have risen in Africa. Consequently, this causes the spread of microbes to new areas where they adapt, for example, in insects that serve as vectors for new diseases.[9]

20. It is also known that the environment acts as a “reservoir” of antimicrobial resistance microbes (bacteria, fungi, viruses) and parasites, from where they spread to animals and cross spread between humans and animals through contaminated food, and poor hygiene, poor sanitation, and proximity. This multiplicity of factors makes the environment a breeding ground and reservoir of antimicrobial resistance microbes.

21. This creates a two-way open system communication with the environment acting as a reservoir, where there is an “input” of chemical and biological pollutants that catalyse antimicrobial resistance microbes and “output” of these microbes to humans and animals to compound health risks. The “input” into this reservoir is a chemical and biological pollutant from various sources, including health facilities, municipal waste and sewerage, runoff of waste and chemicals from animal and crop production, pharmaceuticals manufacture, and other sources of our shared environment. This catalyses the incubation, growth, and spread of resistant microbes into – water, soils, and plants, thus – creating the reservoir. The “output” from this reservoir is through the consumption of contaminated elements – especially food and human/animal interactions. Environmental solutions to control the “input” of these contaminants into the environment is critical – and this is where solutions to the emerging scourge of antimicrobial resistance lie.

22. Specifically, five primary pollutant sources contribute to the development, transmission and spread of antimicrobial resistance in the environment: (a) poor sanitation, sewage, and waste effluent; (b) effluent and waste from pharmaceutical manufacturing; (c) effluent and waste from healthcare facilities; (d) use of antimicrobials and manure in crop production; (e) releases, effluent and waste in intensive terrestrial and aquatic animal production.

23. Other important global drivers which may contribute to the spread of antimicrobial resistance include transnational and intercontinental transport and movements of food, goods and people, the spreading of antimicrobial resistance by wildlife, and rapid urbanization. In addition, with population

[6] Elton, L., Thomason, M. J., Tembo, J., Velavan, T. P., Pallerla, S. R., Arruda, L. B., ... & McHugh, T. D. (2020). Antimicrobial resistance preparedness in sub-Saharan African countries. Antimicrobial Resistance & Infection Control, 9(1), 1-11.

[7] Aidara-Kane, A., Angulo, F. J., Conly, J. M., Minato, Y., Silbergeld, E. K., McEwen, S. A., & Collignon, P. J. (2018). World Health Organization (WHO) guidelines on use of medically important antimicrobials in food-producing animals. Antimicrobial Resistance & Infection Control, 7(1), 1-8.

[8] MacFadden, D. R., McGough, S. F., Fisman, D., Santillana, M., & Brownstein, J. S. (2018). Antibiotic resistance increases with local temperature. Nature Climate Change, 8(6), 510-514.

[9] Ibid.

growth and growing demand for food and healthcare, an increase in antimicrobials' use and pollutant releases into the environment can be expected.

IV. Antimicrobial resistance in Africa

24. It is estimated that 92 million people fall ill across Africa from consuming contaminated foods, resulting in 137,000 deaths yearly. In addition, only 27% of people in sub-Saharan Africa have access to basic sanitation, and 220 million people still practice open defecation. In some urban areas in Africa, up to 47% of households discharge liquid waste into open gutters. Farmers in both urban and city peripheries use this wastewater for vegetable irrigation. In some cases, up to 84% of those farming close to urban areas of Africa use untreated wastewater for irrigation, at least during the dry season. Such informal urban farms supply up to 90% of vegetables in African cities.

25. On pesticide and chemical fertilizer use from agriculture, residues have been detected in 96% of samples drawn from the largest river in Africa – the white Nile. In addition, up to 60% of health facilities in the least developed countries – the majority being in Africa – are not equipped to handle medical waste. Regular disposal of pharmaceutical waste into 'general waste' has allowed streams of different medicines to enter landfill and aquatic environments in the region. This has affected the quality of the surrounding land and water accessed by the residents and wildlife. 19 of the 20 least developed countries most vulnerable to pharmaceutical waste threats are in Africa.

26. The spread of new diseases adds to Africa's challenge on the high burden of communicable diseases, leading to extensive antimicrobial use to suppress the disease-causing pathogens and subsequent resistance.[10]

27. Additionally, Africa is consistently faced with several challenges in implementing effective and sustainable antimicrobial resistance surveillance programmes, especially in the low- and middle-income countries. These challenges include poor infrastructural and institutional capacities, lack of investment and human resources, underutilization of available data, and scarce dissemination to regulatory bodies. The antimicrobial resistance surveillance that is carried out is based only on local hospital data, small cohort studies in neonatal and adult wards, and routine laboratory samples taken from patients with suspected infection and healthcare-associated infections.

28. Significant data gaps exist on antimicrobial resistance in Africa that cannot be relied upon to identify the actual burden of antimicrobial resistance in the community, hospital settings, animals, and the environment. This also includes the microbial acquisition of antimicrobial resistance, transmission patterns, genotypic evolution of antimicrobial resistance mechanisms, clonal spread, and asymptomatic carriage.[11]

V. One Health response to antimicrobial resistance

29. Antimicrobial resistance represents a major global threat across human, animal, plant, food, and environmental sectors. Limiting the emergence and spread of resistant pathogens is critical to preserving the world's ability to treat diseases in humans, animals, and plants, reduce food safety and security risks, protect the environment, and maintain progress towards the Sustainable Development Goals, including those on poverty, hunger, health and well-being, inequality, clean water and sanitation, work and economic growth, sustainable consumption and production, and partnerships.

30. The interlinked and multi-faceted challenges posed by antimicrobial resistance cannot be effectively addressed by one sector alone. Tackling antimicrobial resistance requires a united multisectoral and systems approach to inform science-based decisions and actions. It also requires different actors – government, academic disciplines, civil society, the private sector, and the multilateral system – to work together to advance a One Health approach. The One Health approach aims to sustainably balance and optimize the health of people, animals, ecosystems, and the wider environment. It mobilizes multiple sectors, disciplines, and communities to work together to foster well-being and tackle threats to health and ecosystems. Taking a 'One Health' approach has many benefits, including cost savings incurred by addressing multiple threats simultaneously.

31. As a healthy environment supports all human, animal, and plant life, paying close attention to antimicrobial pollution in the environment is paramount for a One Health response to antimicrobial resistance.

[10] Essack, S. Y., Desta, A. T., Abotsi, R. E., & Agoba, E. E. (2017). Antimicrobial resistance in the WHO African region: current status and roadmap for action. Journal of public health, 39(1), 8-13.

[11] Ibid.

32. Several African countries have developed national action plans to implement the One-Health approach. However, most coordination mechanisms do not adequately represent the environment sector. The Quadripartite Partnership on One-Health, which brings together the World Health Organization, the Food and Agriculture Organization of the United Nations, the World Organization for Animal Health and the United Nations Environment Programme, supports countries in developing and implementing their One-Health action plans and specifically address antimicrobial resistance.

33. Awareness and communication are critical in mainstreaming the environmental dimension in One Health and antimicrobial resistance in Africa. The annual World Anti-Microbial Awareness Week in November provides a launching pad for campaigns and educational activities among the public and critical stakeholders. Collaboration with the private sector is essential, as are civil society organizations in addressing antimicrobial resistance. This is necessary for contributing to the positive efforts of the One Health approach in addressing antimicrobial resistance and supporting the implementations of the countries' National Action Plans on antimicrobial resistance. To progress in implementing National Action Plans on antimicrobial resistance within the countries, it is crucial to advocate for transparency and accountability to ensure that National Action Plans commitments are met in the future.[12]

VI. Possible environmental policy intervention to antimicrobial resistance in Africa

34. Much progress related to policymaking has been made. In 2015, at the High-Level Meeting of the United Nations, world leaders committed to acting against antimicrobial resistance. In 2016, the World Health Assembly of WHO adopted a Global Action Plan for antimicrobial resistance, which was endorsed later by the Member States assemblies of the Food and Agriculture Organization and the World Organization for Animal Health. In addition, countries like Nepal and Thailand have established surveillance systems and multisectoral partnerships, while early champions of efforts to address antimicrobial resistance, like Sweden and the United Kingdom, have implemented local and overseas programmes to address antimicrobial resistance, including support for surveillance, antimicrobial resistance stewardship programmes and funding.

35. Increasingly, African Governments have become motivated to improve environmental conditions in order to protect the health and wellbeing of their populations. It is in view of this recognition that the African Ministers of Health and those in charge of the Environment have held joint meetings in 2008, 2010 and 2018 to explore avenues for a multi-sectoral approach to address health and environment issues. These meetings have resulted in the Libreville Declaration on Health and Environment in Africa, the Luanda Commitment on Health and Environment, and the Strategic Action Plan to scale up health and environment interventions in Africa, 2019-2029, which are yet to be fully implemented.

36. While such actions provide a good foundation, levels of antibiotic resistance remain largely unchanged, and more measures are needed.

37. For Africa to be better prepared to meet this emerging regional and global threat and to mitigate the environmental risks of antimicrobial resistance, the action of African countries should focus on the following areas:

(a) Adopt a One-Health approach[13] towards addressing antimicrobial resistance in African countries. This will include strengthening the participation of the environment sector in national coordination mechanisms as well as in the development and review of One-Health (and antimicrobial resistance-specific) policies, strategies and action plans;

(b) Enhance environmental governance, planning and regulatory frameworks to strengthen intersectoral coherence in combating antimicrobial resistance through enhanced synergy in policy actions between the key sectors involved, including agriculture, animal production, health, and the environment. There is a need to ensure the environmental policy dimension, as driven by ministers of the environment and national lead agencies, is included in all antimicrobial resistance national action plans alongside the other traditional ministries. Beyond this, there is also a need to support actions to reduce and minimize environmental releases of antimicrobial resistance-relevant pollutants, as well as to strengthen research and innovation frameworks, transparency, and accountability systems that

[12] Harant, A. (2022). Assessing transparency and accountability of national action plans on antimicrobial resistance in 15 African countries. Antimicrobial Resistance & Infection Control, 11(1), 1-15.

[13] UNEA 5.2 Ministerial Declaration recognized the risk for future pandemics and other health risks if humanity doesn't overhaul its patterns of interaction with nature by adopting a holistic approach such as One Health

ensure these releases are minimized to the point of elimination. This also calls for establishing or strengthening the One Health approach at national and regional levels, where the direct sectors can come together to find solutions to antimicrobial resistance;

(c) Identify and target priority antimicrobial resistance-relevant pollutants to ensure action is focused on the high-risk sources. Address origins of releases of chemical and biological pollutants that most affect antimicrobial resistance in the environment. Examples include sewerage systems, livestock production, hospitals, and pharmaceutical manufacturing sites. This can be in two ways. The first is through effective waste treatment. Wastewater treatment and management at these known sources of contamination can reduce the number of antimicrobial-resistant microbes and gene concentrations that may leach into the shared environment and cause antimicrobial resistance. The second is reducing the use of anti-microbials. For example, in agriculture, the environmental application of antimicrobials such as fungicides, antibiotics and antivirals in plant-based food production systems needs to be reduced through measures such as integrated pest management;

(d) Improve reporting, surveillance, and monitoring of antimicrobial resistance movements on three dimensions. First is measuring the impact of antimicrobial pollution on biodiversity and integrating environmental monitoring data (e.g., from monitoring of surface water, solid waste, and airborne particulate matter) with existing antimicrobial resistance surveillance and pollutants data to establish the extent of damage to inform solutions planning. Second, the risk profiles to establish how likely antimicrobial resistance-relevant pollution is to occur should be built into surveillance methodologies based on other monitoring systems to zero in on the high-risk antimicrobial resistance areas and address them as a priority. Third is strengthened documentation through the transparent and swift collection and reporting of the production, sale, use and disposal of unused or expired antimicrobials to trace and ensure safe disposal, as well as documenting all key sources of antimicrobial resistance pollution for effective control of discharge into the environment;

(e) Prioritize financing, innovation, and capacity development to address antimicrobial resistance from the environment lens. This means policy actors in ministries of environment need to introduce innovative and sustainable financing to address antimicrobial resistance – and this could be the elimination of subsidies on agricultural inputs such as agrochemicals that can be sources of antimicrobial resistance pollutants. Actions could include disincentivizing their use and incentivizing sustainable, low-risk solutions to drive uptake. It is also important to put in place incentives that target financing facilities for low-risk solutions such as green bonds or public and private partnerships to finance specific environmental actions (e.g., waste management technologies) or sustainable inputs that lower the risk of antimicrobial resistance discharge into the environment so that they are prioritized;

(f) Continuously address awareness and knowledge gaps to inform decision-making on prioritizing interventions to prevent and mitigate antimicrobial resistance development and spread in the environment. While actionable evidence of the importance of the environmental dimensions of antimicrobial resistance has been mounting, some key data and knowledge gaps remain, including interlinkages and negative feedback loops that increase antimicrobial resistance proliferation in the environment. This hinders systematic priority-setting and the selection of cost-effective, context-specific preventive and mitigation action. Actions to collect additional data needed in critical areas to facilitate systematic priority setting and decision making and continuous research on the environmental dimension of antimicrobial resistance should be prioritized across Africa. This should be through building relevant partnerships between government decision-makers and scientific and research institutions to continuously refresh knowledge that informs policy and investment decisions to address antimicrobial resistance.