CIDA Hackathon: Theme 5

Harnessing Digital Agriculture for One Health

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Links	The Issue Details Considerations Constraints Resources

The Issue

Humans, animals, and our earth are inextricably connected. More can be learned of humans, animals, and our shared planet with its resources and ecosystems by studying these topics in their entirety instead of single and separate entities. The COVID-19 pandemic provides numerous examples which illustrate the interconnectedness -and fragility- of our shared ecosystems. We must seek solutions that resolve food security challenges that work in simpatico with natural human and animal activities on our planet.

Challenge 1: How might our experiences of the COVID-19 pandemic be used to prepare us for a more sustainable food supply?

Challenge 2: How might we devise better systems to control pathogens which negatively affect humans, animals, and the environment they share?

Details

The concept of *One Health* recognizes human health is closely connected to the health of animals and our shared environment. Some considerations that make the idea of One Health relevant in today's environment include

- The earth is experiencing climate change, altering how we use the land. Agricultural practice changes and deforestation can yield new opportunities for diseases to pass between animals.
- International travel and trade heighten the migration of humans, animals, and animal products, which can result in the disruptions of natural barriers to disease, allowing them to pass from species to species.
- The global population continues to rise, particularly in low-to-middle-income countries, resulting in the displacement of wild animals and plants. Closer contact with animals and their environment allows diseases to pass between animals and people.

Such changes lead to the spread of new or existing zoonotic diseases, such as rabies, salmonellosis, Lyme disease, ebola, and West Nile Virus infection (diseases that spread between animals and humans).

Major *One Health* issues include zoonotic diseases, antimicrobial resistance, food safety and food security, environmental contamination, and climate change. Some specific examples include

- Antimicrobial resistant germs can spread rapidly in the food supply, soil, water, and communities, making it challenging to treat certain infections in animals and humans.
- The increase in global temperatures is resulting in an increase in vector-borne diseases spread through, for example, mosquitos and ticks.
- Diseases that arise from increased contact with non-native pathogens can affect livestock, food supply, and economies.
- Pathogen contamination of the natural water supply used for drinking and recreation can spread diseases in animals and humans.

Moreover, many of these One Health issues and agriculture are linked:

- Chronic diseases such as obesity and cardiovascular disease in humans are influenced largely by food security and access, along with, the use and overuse of pesticides in agriculture.
- Poor occupational health and safety standards in food production and food markets of plants and livestock can introduce opportunities for food and other pathogens to infect people and animals.
- Non-communicable diseases are linked with mycotoxins and poor access to potable water, affecting human health, food security, and the exportation of food products.

Considerations

Fundamental questions include

- How might we prevent zoonotic disease outbreaks in livestock and people?
- How might we improve both food safety and security for humans, and the health and welfare of food-producing animals?
- How might we reduce the use of antimicrobials and antimicrobial-resistant infections and improve human and livestock health?
- How might we protect global health and food security?
- How might we protect biodiversity and conserve the resources humans, animals, and plants need to flourish on our planet?

To tackle these and other questions, we must promote collaboration across many sectors, including agriculture, the life sciences, human and veterinary medicine, engineering, and the data sciences. A One Health approach attempts to achieve the best health outcomes for people, animals, and plants in a shared environment.

In regions of conflict, zoonotic disease containment, food security, biodiversity preservation, and conservation also become a consideration. Access to humanitarian relief and human rights can diminish in regions of conflict, in addition to environmental destruction and habitat disruption. Data-driven and engineering solutions that address food shortages, infectious disease modeling, and biodiversity preservation and conservation in conflict zones -which can be deployed at scale- would help contain, mitigate, or control the negative impacts conflicts have on humans, animals, and their shared environment.

Constraints

- Solutions must touch at least 2 of the 3 key elements of human, animal, or environmental health and address at least 1 of the following issues
    - How might we prevent zoonotic disease outbreaks in animals and people?
    - How might we improve both food safety and security for humans, and the health and welfare of food-producing animals?
    - How might we reduce antimicrobial-resistant infections and improve human and animal health?
    - How might we protect global health security?
    - How might we protect biodiversity and conserve the resources humans, animals, and plants need to flourish on our planet?
- Solutions must have a digital or engineering component
- The findability, accessibility, interoperability, and reusability (FAIR) data principles are developed for data management

Recommended Resources

Research

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    - How might we prevent zoonotic disease outbreaks in animals and people?
    - How might we improve both food safety and security for humans, and the health and welfare of food-producing animals?
    - How might we reduce antimicrobial-resistant infections and improve human and animal health?
    - How might we protect global health security?
    - How might we protect biodiversity and conservation?

Journal Articles

Zoonotic diseases, outbreaks, conflict

1. Keusch GT, Amuasi JH, Anderson DE, et al. Pandemic origins and a One Health approach to preparedness and prevention: Solutions based on SARS-CoV-2 and other RNA viruses. *Proceedings of the National Academy of Sciences*. 2022;119(42):e2202871119. doi:10.1073/pnas.2202871119.
2. AL-Eitan LN, Tarkhan AH, Alghamdi MA, et al. Bat-Borne Coronaviruses in Jordan and Saudi Arabia: A Threat to Public Health? *Viruses*. 2020;12(12):1413. doi:10.3390/v12121413
3. Van Hout MC, Wells JSG. The right to health, public health and COVID-19: a discourse on the importance of the enforcement of humanitarian and human rights law in conflict settings for the future management of zoonotic pandemic diseases. *Public Health*. 2021;192:3-7. doi:10.1016/j.puhe.2021.01.001
4. Zoonotic Diseases | One Health | CDC. Published July 1, 2021. Accessed February 2, 2023. https://www.cdc.gov/onehealth/basics/zoonotic-diseases.html

White Papers

- Taking a multisectoral, one health approach: a tripartite guide to addressing zoonotic diseases in countries https://apps.who.int/iris/rest/bitstreams/1236638/retrieve
- Agriculture and Digital Technology: a white paper by Inria and INRAE to establish the foundations for responsible digital agriculture | Inria. Accessed February 2, 2023. https://www.inria.fr/en/agriculture-digital-technology-white-paper-inria-inrae-press-release
- Publication preview page | FAO | Food and Agriculture Organization of the United Nations. FAODocuments. Accessed February 2, 2023.

https://www.fao.org/documents/card/en?details=caec22a2-b63d-4c27-861d-dd75788ec1d1/

Videos

- *One Health Explained*.; 2017. Accessed February 2, 2023. **https://www.youtube.com/watch?v=oYfTLL9AxfA**
- *One Health in Managing Zoonotic Diseases*.; 2021. Accessed February 2, 2023. https://www.youtube.com/watch?v=leyWVke5z2o
- *Navigating the Tripartite Zoonoses Guide (TZG): A Training for Advocates and Implementers*.; 2020. Accessed February 2, 2023. https://www.youtube.com/watch?v=0WAjFDiBhMA

Others

- Lipton G. Biodiversity's role in One Health approach has been minimal – until now. Landscape News. Published October 28, 2020. Accessed February 2, 2023. https://news.globallandscapesforum.org/48043/biodiversitys-role-in-one-health-approach-has-been-minimal-until-now/

CASE STUDIES / RESEARCH EXAMPLES:

Case Studies

Current Research Topics Worldwide

- Ghai, R.R., Wallace, R.M., Kile, J.C. *et al.* A generalizable one health framework for the control of zoonotic diseases. *Sci Rep* 12, 8588 (2022). https://doi.org/10.1038/s41598-022-12619-1
- One Health – A Comprehensive Approach To Preventing Disease, Saving Lives | Blogs | CDC. Published November 2, 2020. Accessed February 2, 2023. https://blogs.cdc.gov/global/2020/11/02/one-health-a-comprehensive-approach-to-preventing-disease-saving-lives/
- Thinking about the future of food safety | FAO | Food and Agriculture Organization of the United Nations. FAODocuments. doi:10.4060/cb8667en