

Ecosystem restoration – a public health intervention

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36 We are seemingly locked into a downward spiral of ecological degradation, biodiversity
37 loss, and a climate emergency. Ecological restoration aims to improve the ecological
38 trajectory of degraded ecosystems. Ecosystem declines threaten human health¹. Dramatic
39 changes in human behavior and government policy are essential, but will only occur
40 through a profound paradigm shift explicitly linking human and ecological health. We
41 outline the case for ecological restoration as a ‘public health intervention’, and provide an
42 action plan that enables the required paradigm shift.

43

44 *Environmental health and public health are linked*

45 Health systems, world-wide, are struggling to cope with the burgeoning global burden of
46 disease. There is a growing awareness of the environmental determinants or co-
47 determinants of many diseases², including allergies, immune dysfunction, infectious
48 diseases and emerging zoonoses, and mental health disorders¹.

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50 Recent examples of the synergistic consequences of climate change and ecological
51 degradation are raiding the global public consciousness. The cumulative impacts of
52 prolonged drought, catastrophic bushfires and devastating extreme weather events have
53 shaken Australians – and perhaps the world – over the last year. Health consequences of
54 both drought and bushfire are well understood^{3,4}. This year, the global spread of SARS-
55 CoV-2 virus, and the resulting COVID-19 pandemic, is a poignant example of how the
56 degradation of ecosystems can contribute to the emergence of novel diseases.

57

58 These events cost livelihoods, are deleterious to human health, and strain health systems.
59 Rising public health costs of the global burden of disease must incentivize society to push
60 towards a *restorative culture*, and away from a culture of ecological degradation.

61 Therefore, an important realization likely to help drive the required paradigm shift is

62 recognition that ecological degradation is driving many public health problems, and we
63 cannot solve these public health problems without tackling ecological degradation.

64

65 *Ecosystem restoration – a public health intervention*

66 The United Nations (UN) Decade on Ecosystem Restoration

67 (<https://www.decadeonrestoration.org/>) and the Land Degradation Neutrality programme of
68 the UN Convention on Combatting Desertification

69 (<https://www.unccd.int/actions/achieving-land-degradation-neutrality>) encourage signatory

70 nations to recognize the central importance of ecological restoration. There is growing

71 understanding of the causal links between human health and ecological health, including

72 the role of soil health and biodiversity both above and below ground⁵. However, while the

73 links between environmental quality and human health are becoming better understood,

74 the potential of ecosystem restoration as a public health intervention remains inadequately

75 explored.

76

77 Ecological restoration improves ecological health through the reversal of ecosystem

78 degradation, the repair of damaged ecosystems, and the reconnection of society with

79 nature. While there have been attempts to understand and conceptualize the nexus

80 between ecological restoration and human health, a unifying framework and resolution of

81 the mechanisms is yet to be defined.

82

83 Two principal knowledge gaps currently limit our ability to fully realize the benefits of

84 linking ecological restoration with public health:

85 1. Quantification of individual health benefit, resulting from directly participating in

86 restoration activities (e.g., the achievement of restoring an area can reduce the anxiety

87 and depression common amongst the environmentally aware); and,

88 2. Population health benefits resulting from the outcomes of ecological restoration (e.g.,
89 restored ecosystems providing cleaner downstream water, reducing a number of
90 disease risks).

91

92 *Realizing the health benefits from ecological restoration*

93 Although evidence is building to link ecological restoration with human health, the specific
94 processes and mechanisms by which these health benefits might be conferred remain
95 unclear. To unravel the links and firmly establish empirical bases for the restoration-human
96 health nexus, we propose a five-point action plan:

97 1. *Collaborations and conversations.* Transdisciplinary associations of scientists, health
98 professionals, practitioners and policymakers are required. Establishing united
99 collaborations will elucidate and realize the potential of ecological and human health
100 links. Jointly achieving health and restoration goals will yield economic benefit through
101 cost sharing.

102 2. *Education and learning.* Restoration ecologists and health professionals must engage
103 in transdisciplinary learning and capitalize on already well-established links. This will
104 improve the shared understanding, enabling enhanced partnerships that are more
105 effective.

106 3. *Defining the causal links.* The transdisciplinary associations established in step 1
107 should undertake or provide opportunities for research to determine the causal links
108 between ecosystem restoration and health outcomes. This research would clarify the
109 importance of the ecosystem-human health nexus, and provide the empirical evidence
110 required to know what restoration actions would most effectively improve health
111 outcomes. A starting place for this research could leverage existing links between the
112 health sector and environmental activities such as 'green prescriptions'⁶.

- 113 4. *Monitoring restoration and health outcomes.* After the causal links have been defined,
114 methodologies that enable effective, cost-efficient monitoring and evaluation of the
115 public health benefits from ecosystem restoration are required. These approaches
116 could become standardized restoration monitoring and evaluation methodologies.
- 117 5. *Community ownership and stewardship.* Community ownership through involvement
118 with, and actual demonstration of, the cross-benefits of linking restoration with health is
119 required. It is only with this ownership that policymakers and funders are likely to
120 support aspirational initiatives, helping to drive the required paradigm shift. There is
121 also a need to adequately recognize and value the importance and role of traditional
122 ecological knowledge as part of community ownership and engagement.

123

124 Examples already exist of transdisciplinary collaborations that aim to bring together
125 ecological restoration and human health sectors. Two such examples are the EcoHealth
126 Network (EHN, www.ecohealthglobal.org) and the Healthy Urban Microbiome Initiative
127 (HUMI, www.humi.site), which are interlinked global action initiatives working together at
128 the interfaces of ecological restoration and human health. The EHN was established in
129 2019 and is developing an international network across a diversity of stakeholders (e.g.,
130 restoration practitioners and scientists, landscape designers, farmers, medical
131 professionals) that are involved in restorative activities. HUMI was established in 2016,
132 and is a UN-backed initiative that seeks to restore the immune-restorative power of
133 biodiverse green spaces in cities to maximize human health gains.

134

135 The world faces extraordinary environmental and health challenges. Half the world's seven
136 billion people currently live in cities, and this number is predicted to increase to 70% by
137 2030⁷. Urbanization is driving ecosystem degradation and biodiversity loss that is, in turn,
138 causing increasing levels of chronic disease, resulting in dramatic health budget increases.

139 The global demographic shift and increasing health crisis is defined by humanity's loss of
140 connection with the natural world. It is all the more tragic for having mostly ignored
141 Indigenous voices on our connection with nature. We now mostly live in biologically-
142 impoverished cities, and our demand for environmental resources has led to this global
143 environmental crisis. Ecological restoration is a clearly identifiable pathway to tackle our
144 nexus challenge, and it is becoming clear that the human and ecological health crises are
145 intimately interwoven. Improved understanding of the links between ecological restoration
146 and human health will catalyze the required investment into this most fundamental of
147 public health interventions, which will likely result in environmental and health gains that
148 pay generational dividends.

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