

Supplemental information

Scientists' call to action: Microbes, planetary health, and the Sustainable Development Goals

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Table S1: Summary of how using microbial technology to directly advance Sustainable Development Goals (SDGs) will also indirectly help to reach other SDGs. Only SDGs considered able to be directly influenced by microbes are included as rows (i.e., SDGs 4 (quality education), 5 (gender equality), 11 (sustainable cities and communities), and 16 (peace, justice and strong institutions) are only named in the indirect effects column). This table was used to create Figure 5.

SDG	Indirect effects on other SDGs	Explanation of indirect effects
1 – No poverty	2, 3, 4, 5, 6, 10, 11, 12, 16	Using microbes to reduce poverty goes hand-in-hand with increasing food production/distribution (2), improving health (3), and ensuring access to clean water (6). Reduced poverty will also lead to better distribution of wealth and resources (10), better access to education (4), and better self-sufficiency for women and access to healthcare (5). Additionally, no poverty means communities are healthier (11), all countries can improve their technological capacity for sustainable consumption and production (12), and violence is reduced (16).
2 – Zero hunger	1, 3, 4, 5, 10, 11, 12, 16	Using microbes to reach targets relating to zero hunger will consequently reduce poverty (1) and improve health and wellbeing (3). Hunger elimination will also improve people’s ability to benefit from education (4), and have long-term positive effects on community wellbeing and peace (11, 16). Improved agricultural incomes will also open up development opportunities for women (5) and reduce income and resource inequality (10). Microbial biotechnology used to reduce hunger will also contribute to key SDG 12 targets of reducing food waste chemical impacts.
3 – Good health and wellbeing	1, 2, 4, 5, 8, 10, 11, 16	Microbial technology used to improve human health will consequently reduce poverty (1) and improve nutritional benefits obtained from food (2). Improved health will also reduce the negative impact of sickness on people’s contributions to the local and national economy (8). Additionally, improved healthcare will reduce inequality (5, 10), improve community wellbeing and peace (11, 16), and make it easier for people to pursue education (4).
6 – Clean water and sanitation	1, 2, 3, 5, 10, 14	Clean water availability is integral for eliminating poverty (1) and ensuring good health and wellbeing (3). Additionally, microbial methods to improve water recycling and reduce contaminants or harmful algal blooms will increase water availability for food production (2) and improve habitat for aquatic organisms (14). Lack of clean water also exacerbates inequalities (including gender inequality). Improving water quality and sanitation will help to reduce inequalities (5, 10), and promote community peace and wellbeing (16, 11).
7 – Affordable and clean energy	2, 9, 10, 11, 13	Clean energy will improve the sustainability of industries (9) and cities (11), and reduce emissions contributing to climate change (13). Reduced reliance on artificial fertilizers will improve sustainable agricultural practices (2). Additionally, improving the availability and affordability of energy in developing countries will contribute to reducing inequalities (10).

8 – Decent work and economic growth	1, 2, 9, 10, 11, 12, 13, 14, 15, 16	Using microbes to build a more sustainable economy will involve improving agricultural practices and waste management (2) and a shift towards more sustainable manufacturing processes (9, 11, 12) that will reduce climate impacts (13). Transforming the global economy will also provide employment to implement new technologies, particularly in resource-poor settings (1, 10), promoting peace and community wellbeing (16, 11). Additionally, valuing microbes in markets will help to support life on Earth (14, 15).
9 – Industry, innovation and infrastructure	3, 7, 8, 10, 11, 12, 13	Using microbes to reinvent the chemical industry will result in improved clean energy (7), a more sustainable economy (8, 11, 12), and reduced climate impacts (13). Microbial innovation of medical products will also improve human health (3), and new socio-economic opportunities in many regions will reduce inequalities (10).
10 – Reduced inequalities	1, 2, 3, 4, 5, 6, 7, 11, 16	The role of microbial technology in reducing inequalities goes hand-in-hand with reducing poverty (1) and hunger (2), and improving access to healthcare (3), clean water (6), and affordable energy (7). Reducing these inequalities will also lead to greater gender equality (5), improve living conditions (11), promote peace (16), improve access to quality education (4).
12 – Responsible consumption and production	2, 6, 7, 11, 13, 14, 15	Reducing food waste will lead to more food availability and reduced hunger (2). Improving the sustainable management and use of natural resources, as well as using microbes to improve chemical and waste management, will keep waterways cleaner (6) and benefit life in water (14) and on land (15). Improving resource use will also lead to cleaner energy (7), more sustainable cities (11), and better climate action (13).
13 – Climate action	1, 2, 3, 4, 6, 10, 11, 14, 15, 16	Microbial technology used to mitigate emissions through improving agricultural practices, improving waste management, and restoring degraded land (e.g., peatlands) to increase carbon storage will benefit life on land (15) and life below water (14). Climate change mitigation will also alleviate the disproportionate negative effects experienced by many countries, thereby reducing inequalities (10). Climate change-induced human migration can lead to a breakdown of communities, poverty, hunger, and poor access to healthcare, clean water, and education. Microbial-based climate mitigation will therefore positively contribute to numerous other SDGs (1, 2, 3, 4, 6, 11, 16).
14 – Life below water	1, 2, 3, 6, 13, 15	Improving the health of aquatic communities will ensure aquatic habitats provide a sustainable food source (1, 2), improve the availability of clean water (6), and reduce disease outbreaks (3). Microbes can also help to buffer against climate change impacts (e.g., ocean acidification; 13) and support other trophic levels including those on land (15).
15 – Life on land	1, 2, 3, 13, 14	Healthy terrestrial ecosystems provide sustainable food (1, 2) and reduce the spread of disease (3). Using microbes to improve restoration and conservation will also improve the health of aquatic communities (14), and contribute to climate change mitigation (13).
17 – Partnerships for the goals	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16	Considering microbes in international and organizational partnerships will help advance all goals
