Institution: University of Essex

Unit of Assessment: 5 – Biological Sciences

Title of case study: Shaping a UN food systems evaluation framework and influencing global policies to boost biological productivity in agricultural systems and improve outcomes for biodiversity and climate

Period when the underpinning research was undertaken: 2000-2015

Details of staff conducting the underpinning research from the submitting unit:

Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Jules Pretty	Professor	1996-present

Period when the claimed impact occurred: 2014-2020

Is this case study continued from a case study submitted in 2014? N

1. Summary of the impact

Essex research has shown that agroecological approaches in Sustainable Intensification (SI) increase the productivity of farmed organisms (crops, livestock) while supporting ecosystem service delivery. This work has benefited **policy makers, farmers, ecosystems** and **businesses** in the United Nations (UN) 194 member states across 130 countries worldwide by:

- **Shaping the development of The UN Environment Programme (UNEP) TEEBAgriFood's ground-breaking globally applicable food systems evaluation framework**, being used by farmers and decision makers in Government and businesses across 10 countries in Africa, Asia and Latin America to evaluate the full costs and benefits of agriculture and food systems.
- **Influencing the recommendations of the UN Food and Agriculture Organization (FAO) and IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services) on agricultural development policy**.

2. Underpinning research

Agricultural systems worldwide have become a major source of harm to biodiversity and ecosystems and are a leading contributor to climate change, biodiversity loss, nutrient loading and localised air pollution. Although per capita global food production has increased by 1.5 fold over 50 years, there remain some 800 million people malnourished. The concept of SI was proposed by Pretty (in 1997) to suggest there were new forms of agricultural intensification that could both boost crop/livestock organism productivity and reduce/eliminate harm to non-farmed organisms, species and natural agro-ecosystems. SI harnesses agroecological interactions (e.g. predation, parasitism, allelopathy, herbivory, nitrogen fixation, pollination, trophic dependencies) to develop components that deliver beneficial services for agriculture and ecosystems. Essex-led research since 2000 has brought together a wide-range of international collaborators who have established the credibility of SI evidence for co-production of biological resources (food, fibre, timber) and improved natural capital (structural diversity and services). This includes global assessments and syntheses that showed 29% of the world's 508M farms are now under forms of SI covering >500 projects in 80 countries **[R1, R2, R3],** demonstrating crop and livestock productivity increases of 79%-113%. These cluster in several categories of agroecological

amendment: integrated pest management, conservation agriculture, crop and pasture, agroforestry and irrigation. A key strength of Pretty's research has been the identification and calculation of negative impacts of agriculture on natural ecosystems and human health. These externalities that are often hidden from formal measures of individual or national farm success are generally not incorporated into agricultural practices, incentives and policies. Research at Essex in 2000 produced the first national assessment of the real impacts of a whole national agricultural and food system, later extended in 2005-2015 **[R4, R5, R6]**. The first detailed analysis of the ecological impacts worldwide of synthetic pesticides was published by Pretty **[R3]** as part of the study of the benefits of implementing integrated pest management in 85 projects in 24 countries of Asia and Africa. World agriculture uses 3.5 billion kg of pesticide active ingredients (a.i.) annually, at an annual environmental cost of USD 10-60 billion worldwide, yet this research showed that the harnessing of agroecological processes on farms and across landscapes had increased crop productivity by 41% whilst reducing pesticide use by 69%. The underpinning research for this case has given Essex a unique understanding of the factors leading to success across many agroecosystems and zones, in particular the enabling policies and practices that have enhanced biodiversity and delivery of ecosystem services through the establishment and spread of agroecological practices for SI. These priorities were identified by a study of the Top 100 Questions in global agriculture involving 55 authors from 25 countries.

3. References to the research [can be supplied by HEI on request]

R1 Pretty J, Noble A D, Bossio D, Dixon J, Hine R E, Penning de Vries F W T and Morison J I L. 2006. Resource-conserving agriculture increases yields in developing countries. Environmental Science & Technology 3(1), 24-43 https://doi.org/10.1021/es051670d
R2 Pretty J, Toulmin C and Williams S. 2011. Sustainable intensification in Africa agriculture. Internat Journ Agric Sust, 9(1), 5-24 https://doi.org/10.3763/ijas.2010.0583
R3 Pretty J and Bharucha Z P. 2015. Integrated pest management for sustainable intensification of agriculture in Asia and Africa. Insects 6(1), 152-182 https://doi.org/10.3390/insects6010152
R4 Pretty J. 2008. Agricultural sustainability: concepts, principles and evidence. Phil Trans Royal Soc Lond B 363 (1491), 447-466 https://doi.org/10.1098/rstb.2007.2163
R5 Godfray C, Beddington J R, Crute I R, Haddad L, Lawrence D, Muir J F, Pretty J, Robinson S, Thomas S M and Toulmin C. 2010. Food security: the challenge of feeding 9 billion people. Science 327, 812-818 https://doi.org/10.1126/science.1185383
R6 Pretty J and Bharucha Z P. 2014. Sustainable intensification in agricultural systems. Annals of Botany 205, 1-26 https://doi.org/10.1093/aob/mcu205

4. Details of the impact

To feed a world in which population and consumption continues to grow, substantial increases in farm organism productivity (crop, livestock) are needed, and these must be achieved without causing further harm to biodiversity, climate and ecosystem processes and functions. Landmark global agreements, including the UN Sustainable Development Goals (SDGs; adopted in 2015) and the Paris Climate Change Agreement (COP21; 2015) have emphasised the need for innovation in food systems in order to meet this challenge. SI offers a practical pathway towards achieving the goal of increasing food production whilst minimising or eliminating negative environmental impact. Since 2000, Pretty's extensive research in this area has made him a leading authority on agroecological approaches through SI, leading to his engagement with UN organisations where he has guided the development of key programmes**.** Through these programmes, Pretty's research on SI has **shaped a ground-breaking food systems evaluation**

framework and informed recommendations on agricultural development policy for the UN's 194 member states across 130 countries benefiting policy makers, farmers and businesses worldwide and supporting the UN-SDGs.

Shaping the development of a ground-breaking globally applicable food systems evaluation framework TEEB (The Economics of Ecosystems and Biodiversity) Agriculture and Food (TEEBAgriFood) is a UNEP global initiative, which aims to protect biodiversity and contribute to a more sustainable agriculture and food sector. Pretty played a central role in the establishment of TEEBAgriFood, as an invited expert advisor on the Project Steering Committee (2015-2017), one of only 8 academic members and the only expert on SI, and was a key contributor to the 'Scientific and Economic Foundations' report (2018) **[S1 p2]**. TEEB confirm '*Pretty was appointed as a high-level member of the TEEBAgriFood Project Steering Committee in 2015 and, as such, regularly contributed to key decisions regarding the substance, scope and strategy around TEEBAgriFood for 18 meetings over two years*' making '*invaluable contributions toward the launch of the 'TEEB for Agriculture & Food' initiative, and in particular the development of the 'Scientific and Economic Foundations' report*' **[S2]**. The 'Scientific and Economic Foundations' report introduces a **new ground-breaking globally applicable food systems evaluation framework**, **which for the first time, presents wider benefits and impacts associated with the different dimensions (environmental, health, social, cultural) of the eco-agri-food chain in a single report [S1]**. Pretty's foundational research describing the external economic impacts of agricultural systems and the externalities of pesticide use and management **[R3, R5, R6, R7]** was heavily drawn upon in 4 out of the 10 chapters **directly shaping the development of this new framework which enables users, on farms, and in governments and businesses to evaluate the impacts and benefits of agriculture and food systems and make better-informed decisions [S1]**. TEEB testify that Pretty ensured '*sustainable intensification as a concept and a system was integrated into the rhetoric of the report in light of its emphasis on a wider set of environmental, social and health outcomes and its constant adaptability to changing conditions and challenges*' and that '*the impacts and externalities of pest management [..]was adequately and accurately captured, described and referenced*.' **[S2]**. This novel evaluation framework was applied on the ground in pilot studies in Africa, Brazil and India from 2018-2020 demonstrating its viability and since 2019 has been implemented through framework testing projects across 10 countries: Kenya, Tanzania, India, China, Malaysia, Indonesia, Thailand, Columbia, Brazil and Mexico **[S3]**. In May 2020, Pretty was appointed to lead a new implementation project applying the framework to evaluate Zero-Budget and Community-Managed Natural Farming (ZB & CMNF) practices in India **[S4].** TEEB confirm that '*The TEEBAgriFood report is a foundational piece of work that has been recognized for its visionary thinking and is being implemented on the ground in a number of pilot studies at the national, local and business level. These projects are geared toward identifying and catalysing policy reforms that more comprehensively account for the positive and negative externalities and impacts associated with land use decisions in agricultural landscapes*' **[S2]**. The TEEBAgriFood framework provides a tool for the holistic implementation of the UN SDGs and was recognized with the prestigious Future Policy Vision Award 2018, awarded by the World Future Council for its comprehensive approach providing opportunities to contribute to the majority of the UN-SDGs and offering an effective system of 'true cost accounting' **[S5]**.

Influencing recommendations for agricultural development policy for the UN's 194 Member States

UN FAO leads international efforts to defeat hunger working in partnership with governments at global, regional and national levels. Pretty '*has been a long term collaborator and institutional partner in support of various initiatives and programs of the UN FAO [...] with outstanding*

contributions and results' Former UN FAO Director of Land and Water Division **[S6]**. Pretty contributed to '*FAO major milestone initiatives and programmes such as: Conservation Agriculture, Sustainable Land Management, Global Soil Partnership', 'supported and contributed to the development of a global partnership initiative on GIAHS (Globally Important Agricultural Heritage Systems)*' which '*was implemented in eight countries and then became a FAO priority programme in 2014'* and *'was a member of Scientific Committee of several other FAO programmes'* including *'the Save and Grow Programme*' **[S6]**. Since 2014, Pretty's research on SI has been drawn upon in 6 FAO publications **[S7a-f]** informing agricultural policy recommendations for the UN's 194 member countries. Notably, Pretty was a key contributor and coordinating editor to the *Save and Grow* programme **[S6, S7f]** the FAO's flagship programme for sustainable crop production intensification which supports policy makers and farmers to realise greater biological productivity while conserving natural resources. His research on SI practices **[R1, R3, R7]** was drawn upon in 3 out of the 4 chapters of *Save and Grow in practice: maize, rice, wheat* (2016) **informing 3 of the 10 policy recommendations for scaling up sustainable crop production of maize, rice and wheat, to reduce pressure on the environment, and build resilience to climate change [S7f]**. The *Save and Grow in practice: maize, rice, wheat* principles for scaling up sustainable crop production are being implemented in maize-based crop systems in Southern Africa and rice-based crop systems in South Asia enabling smallholder farmers to increase productivity and improve their livelihoods, through more sustainable and climate-smart production systems **[S8]**. Former UN FAO Director of Land and Water Division testifies that *Save and Grow* has **'***had major impact on national policies in countries worldwide in the period after 2014***' [S6]**. Considered by the UN FAO as key to achieving the UN SDGs of eliminating poverty and hunger **[S9]**, *Save and Grow*, and Pretty's research which contributed to it, has influenced the FAO's shift in strategic focus (2017) in line with the UN SDGs from being solely on food production, to wider considerations of whole landscapes, habitats and systems **[S10]**.

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services(IPBES) is an intergovernmental organisation (of 134 member Governments), which operates under the auspices of the UN and provides independent scientific assessments on biodiversity and ecosystems. The IPBES 2018 Assessment Report on Land Degradation and Restoration provides a critical analysis of the state of knowledge regarding the importance, drivers, status, and trends of terrestrial ecosystems, recognising that combatting land degradation is an urgent priority in order to protect the biodiversity and ecosystem services that are vital to all life on Earth **[S11]**. Pretty's research **[R1, R2, R4, R6]** describing SI practices which mitigate negative environmental impacts is widely drawn upon in the report which provides policymakers with the information needed to develop appropriate response options, technologies, policies, financial incentives and behaviour changes to avoid land degradation and restore degraded lands, both of which are essential for meeting the UN-SDGs **[S11]**.

5. Sources to corroborate the impact

S1 The Economics of Ecosystems and Biodiversity (TEEB) (2018). TEEB for Agriculture & Food: Scientific and Economic Foundations report (p2, 21, 26, 37, 91, 141, 252, 253, 270, 271)
S2 Testimony from UNEP TEEB Associate Programme Officer
S3 Pilot projects testing and implementing the TEEBAgriFood Evaluation Framework
S4 Invite to Framework Project Advisory Committee TEEBAgriFood Application of Zero Budget Natural Farming in Andhra Pradesh
S5 TEEBAgriFood Evaluation Framework wins 2018 Future Policy Award
https://www.unep.org/news-and-stories/story/un-environment-wins-prestigious-award-new-work-

food-agriculture-and

S6 Testimonial, President WAHF (Former Director of Land and Water Division of UN FAO)

S7 UN FAO reports drawing on Pretty's research since 2014:

a. Mainstreaming ecosystem services and biodiversity into agricultural production and Management in East Africa (2016) p.5
b. Economic analysis of food supply and demand in Sub-Saharan Africa up to 2022 – special focus on fish and fishery products (2016) p.78
c. Policy analysis paper: mainstreaming of biodiversity and ecosystem services with a focus on pollination (2015) p.3
d. Climate Smart Agriculture; Adopting a Territorial Approach to Food Security and Nutrition Policy (2016) p.31
e. Agroecology for food security and nutrition (2014) (p.20, 39, 300, 323)
f. Save and Grow in practice: maize, rice, wheat (2016) (p.iv, 3, 8, 15, 18, 20, 24, 34, 93, 96)

S8 UN FAO webpages compilation: Implementing the Save and Grow Approach

S9 UN FAO's Save and Grow and UN SDGs

S10 2017 UN FAO Reviewed Strategic Framework (p.25, 27)

S11 IPBES 2018 Assessment report on Land Restoration and Degradation (p358-359, 362-364, 371-372, 447, 627)