

What are the Challenges and how can bio-economy based research contribute to the SDGs?

Wayne Powell. Oslo 24th September 2018

Where has the 20th Century left us?

There is less poverty, but more food inequality

- ~1.3bn still live below the poverty line (\$1.25/day)
- 1 in 4 children worldwide are stunted
- In 2008, 35% of the world population was overweight, and 29% was micronutrient deficient



Source: GloPlan, 2014





We are more informed than ever before





MEDLINE-indexed articles published per year

OXFORD MARTIN SCHOOL

OXFORE



There are major natural and physical resource pressures

In key ways, the early 21st Century is already determined



The global community will have to contend with a number of significant challenges

Consumption will increase with prosperity

Demographic momentum:

An extra billion people by 2025

Urbanisation:

global urban:rural ratio ~55% by 2025



Alemao Shanty Town, Brazil Brazil is forecast to have 90% urbanisation by 2020 33% of the world's urban population live in slums The world's cities emit almost 80% of global CO2



Climate change:

GHG in the atmosphere now will drive changes up to 2030



Rising urban population, 2050 projections



Nourishing the world's cities

Global food security will become primarily an urban challenge in the future. However, the current international food security agenda is mostly rural-oriented and still focuses more on food availability than on food access and nutrition.

Food deserts
 Urban food security indicators
 Informal economy
 Rural-urban linkages





Figure 6 - Correlation of food price index to social unrest, 2004 to 2012



Red dashed lines correspond to the beginning dates of "food riots" and protests in North Africa and the Middle East between 2004 and 2011. The overall death toll is indicated in parentheses next to each country.

Source: Lagi, Bertand, Bar-Yam 2011.

The Syrian refugee crisis has roots within climate change





Migration is a legitimate form of adaptation to climate change

Defining & tackling global challenges/ Wicked challenges: different ways of working at Pace & step changes



~9.8 Billion People / 1 Planet

The Sustainable Development Goals are a global expression of sustainability



SDGs are integrated set of global priorities that are interdependent.

> 6 CLEAN WATER AND SANITATION

> > RESPONSIBLE CONSUMPTION

SUSTAINABLE DEVELOPMENT GOALS





Convergence of global diets & a need for diet diversity



A study of the world's countries finds that over the last 50 years, diets have become ever more similar.



Source: Khoury et al. 2014. Proc. Natl. Acad. Sci. USA.

Over the last 50 years, the global diet has shifted dramatically, including greater amounts of major oil crops and lesser quantities of regionally important staples.

Average change in the calories from crops in national diets worldwide, 1961-2009

Percent change in calorie contribution to diet



Source: Khoury et al. 2014. Proc. Natl. Acad. Sci. USA.

Global impact food consumption obesity



Exhibit E1

Obesity is one of the top three global social burdens generated by human beings

Estimated annual global direct economic impact and investment to mitigate selected global burdens, 2012¹ GDP, \$ trillion



Time for major structural and technical innovation in how food is produced.



- Population growth is slowing down
- Current food production has low energy and environmental efficiency

A Circular Food Systems approach



Healthy diets from sustainable food systems





'If we get it right on Food, we get it right on People and the Planet'.

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Livelihood approaches are complex and diverse



Testing interventions for their food security impact





Contribution to food availability / security



Size of land holding

Four principles to make evidence synthesis

SRUC

more useful for policy Nature 558, 344 (2018)

FOUR PRINCIPLES

These features help researchers, policymakers and others to commission, do, share, appraise and use evidence syntheses.

INCLUSIVE

- Involves policymakers and is relevant and useful to them.
- Considers many types and sources of evidence.
- Uses a range of skills and people.

RIGOROUS

- Uses the most comprehensive feasible body of evidence.
- Recognizes and minimizes bias.
- Is independently reviewed as part of a quality-assurance process.

TRANSPARENT

- Clearly describes the research question, methods, sources of evidence and quality-assurance process.
- Communicates complexities and areas of contention.
- Acknowledges assumptions, limitations and uncertainties, including any evidence gaps.
- Declares personal, political and organizational interests and manages any conflicts.

ACCESSIBLE

- Is written in plain language.
- Is available in a suitable time frame.
- Is freely available online.

onature

The state of the world in 1950



- No knowledge of DNA
- No widespread use of antibiotics
- Few co-ordinated vaccination programs
- Serious threats from smallpox, polio, whooping cough, diptheria, and syphilis
- Little international co-ordination for scientific research
- Only the most primitive of computers
- Cost of oil (inflation-adjusted): \$26/barrel
- No space travel, no satellites
- No contraceptive pill

Evidence based optimist!





Farming: the lowest intensity of IT in any economic sector





Private sector engagement

EXHIBIT 4 | Agriculture Patents Registered Worldwide from 2010 Through 2014



Sources: Thomson Innovation; BCG analysis.

Note: Analysis based on approximately 16,000 Derwent World Patents Index patent families registered from 2010 through 2014.

The biosphere – nature's solutions



Boosting the Circular Bio-economy





International Livestock Science





BILL& MELINDA GATES foundation







Science-based opportunities for small scale farmers in sub Saharan Africa







SRUC

II RI

IVESTOCK RESEARCH



Diversity of environments has created diversity of genetics.



genomes and adaptations of Africa's livestock, such as the NAMETK cattle (above) could help breed new genotypes tailored to changing local environments.

2.5 5 10 Decimal Degrees

A rich biodiversity

Kenya Boran – Efficient utilizers of low quality forages



Ndama – Trypanotolerant





Ankole Cattle – Meat reputed to be low in cholesterol

Diverse indigenous cattle



Kuri – Bulbous horns

Nguni –best hide for leather jackets and shoes





Linking pastoral based systems to rumen microbiology & host genomics





Microbial genes associated with FCE



- 49 microbial genes significantly associated with feed conversion ratio explaining 81% of the variation in model effects & 88% of the variation in FCE.
- Microbial genes are related to known metabolic pathways, e.g. degradation of amino acids and proteins, protein and vitamin synthesis

Roehe et al. (2016) PLOS Genetics

Genomic Selection: an unifying theme



The biosphere – nature's solutions



A Circular Bioeconomy



Sustainable management for multiple ecosystem services



SDGs and Circular Bioeconomy



The Circular Bio-economy & Universities



Creating a 21st Century University that drives both a local and global Circular Bioeconomy







These divisions currently feel irreconcilable

Positioning for the future?





Expectations of funders & Society have changed







- No longer funders but INVESTORS!
- Emergence of new DISRUPTIVE TECHNOLOGIES
- Research delivering economic and social benefits



Sustainable employment loop



UKRI & Industrial Strategy





"We will invest an additional £4.7 billion by 2020- 21 in R&D funding."

"We must become a more innovative economy and do more to <u>commercialise</u> our world leading science base."

Building our Industrial Strategy

> Green Paper January 2017

"<u>Innovation</u> is not just about a few people in labs making breakthroughs, but about adopting new and <u>more productive ways of working</u>."

> "Building a new system of technical <u>education</u> boosting STEM skills, digital skills and numeracy."

Green Brexit & 'High-yield' farming costs the environment less!





We are dealing with Complexity!

'High-yield' farming costs the environment less than previously thought – and could help spare habitats



Nature Sustainability volume 1, pages477–485 (2018



Private sector engagement

EXHIBIT 4 | Agriculture Patents Registered Worldwide from 2010 Through 2014



CGIAR is a global research partnership for a food secure future

Sources: Thomson Innovation; BCG analysis. Note: Analysis based on approximately 16,000 Derwent World Patents Index patent families registered from 2010 through 2014.



Consortium



Final thoughts

Extraordinary time of change

- Agriculture is food
 think whole
 value chain
- Data is now commodity, questions & interpretation create the value

Future investment



Strategy for future investment CORE

Areas with a strong UK research community, closely engaged with developing world challenges, often actively engaged with UK and international partners and making a significant global contribution. Examples include infectious diseases, crops for developing world, development studies.

Areas with a strong research community, but not strongly orientated to developing world contexts, examples include clean energy or industrial biotechnology where the opportunity for developing world is considerable but nascent.

Also renewal and growth in capability through targeted new blood and early career investment. Careful consideration of the opportunities and implications of supporting new capability overseas.

TRANSFORMATIONAL

All challenge topics benefit from a multidisciplinary approach. However, it is particularly suited to multidimensional "wicked" challenges seeking new insights or needing radical approaches. Examples include the consequences for developing world of climate change, demographic shifts, economic development, rapid urbanisation and conflict.

Global population growth is the fastest in regions where threats of food insecurity are greatest





Nearly 80% of the world's young people reside in low- and middle-income countries.

Africa's youth population is expected to double by 2050, with 1 billion people under the age of 18.

Heightens the need for SDGs but makes them more difficult to achieve.



~9.8 Billion People / 1 Planet