Creating the Aquaponics Economy

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This presentation is based on research from the following sources:

TEEB Agri-Food – a U.N. Project

The Sustainable Food Trust

If aquaponics is so darn great, why is commercial viability so difficult?

Economics is the branch of knowledge concerned with the production, consumption, and transfer of wealth / value.

Two key concepts:

Externalities

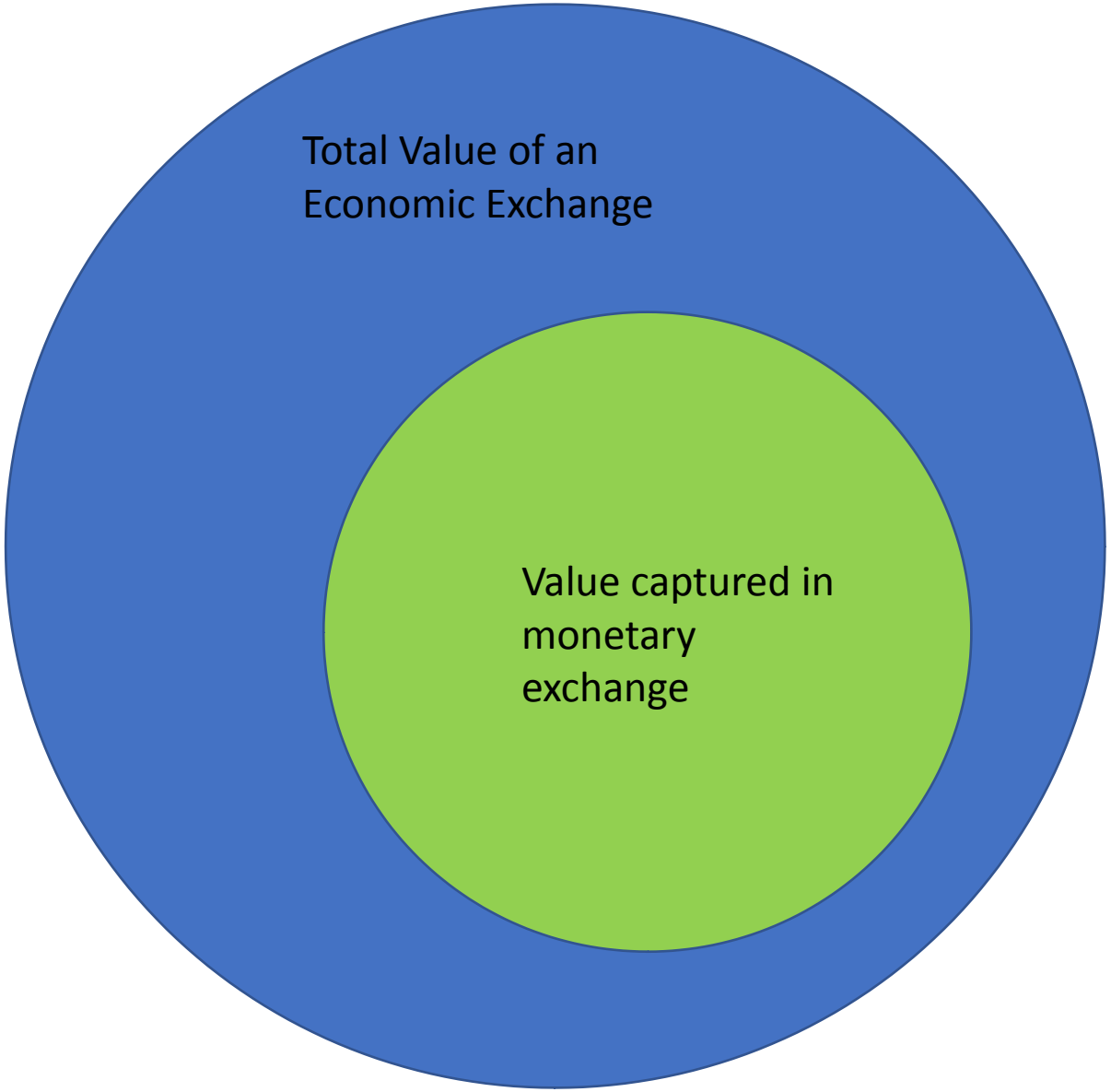
Capital Stocks (particularly NATURAL Capital stocks)

(an economy that quantifies and places value on all aspects of food production, distribution, and transfer)

Economic transactions can have a wide range of value / wealth changes, but NOT ALL of these are captured in our economic system

Value exchange is NOT the same as Monetary exchange!!!

TEEB:
Economists and economic actors place monetary value only on the pieces that can be readily identified and monetized.

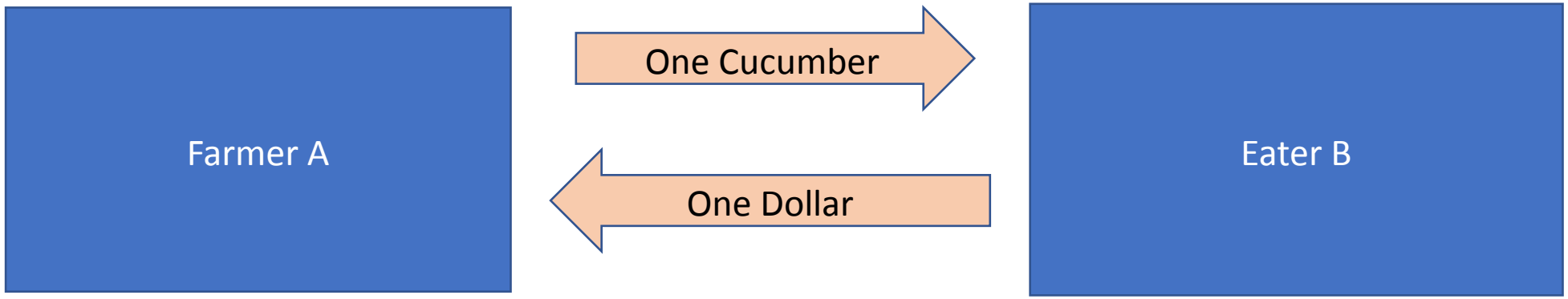


Major Problem
MANY value flows of an economic transaction are not captured by our economic system.

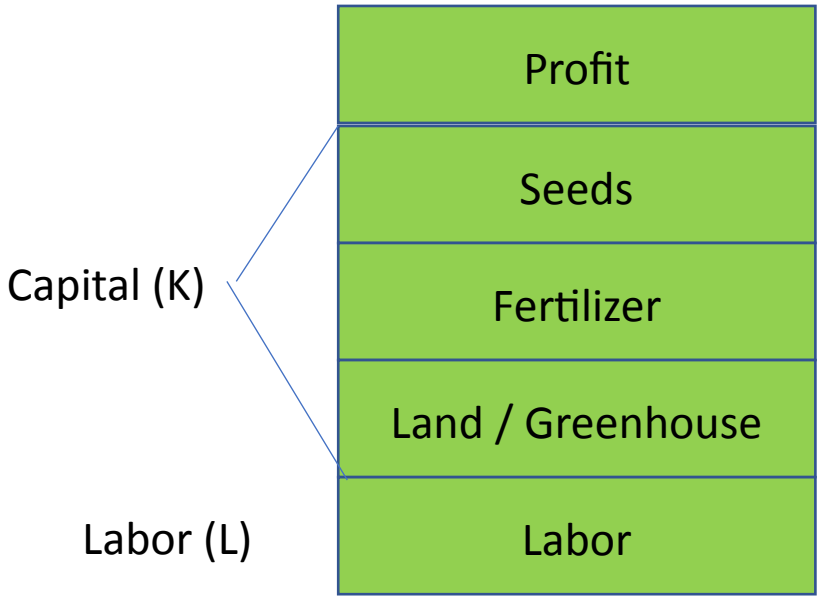
Concept #1 - Externalities: Costs or benefits generated from an economic transaction that are not accounted for and affect a 3rd party. Sometimes called “hidden costs”. Some folks refer to this as the “true cost” of food.

From the TEEB Report:

In agriculture “These externalities include the huge but hidden costs and benefits of agriculture and food systems, which need to be unravelled, understood, and evaluated if the world is ever to be able to work out how to feed and nourish billions of people…”

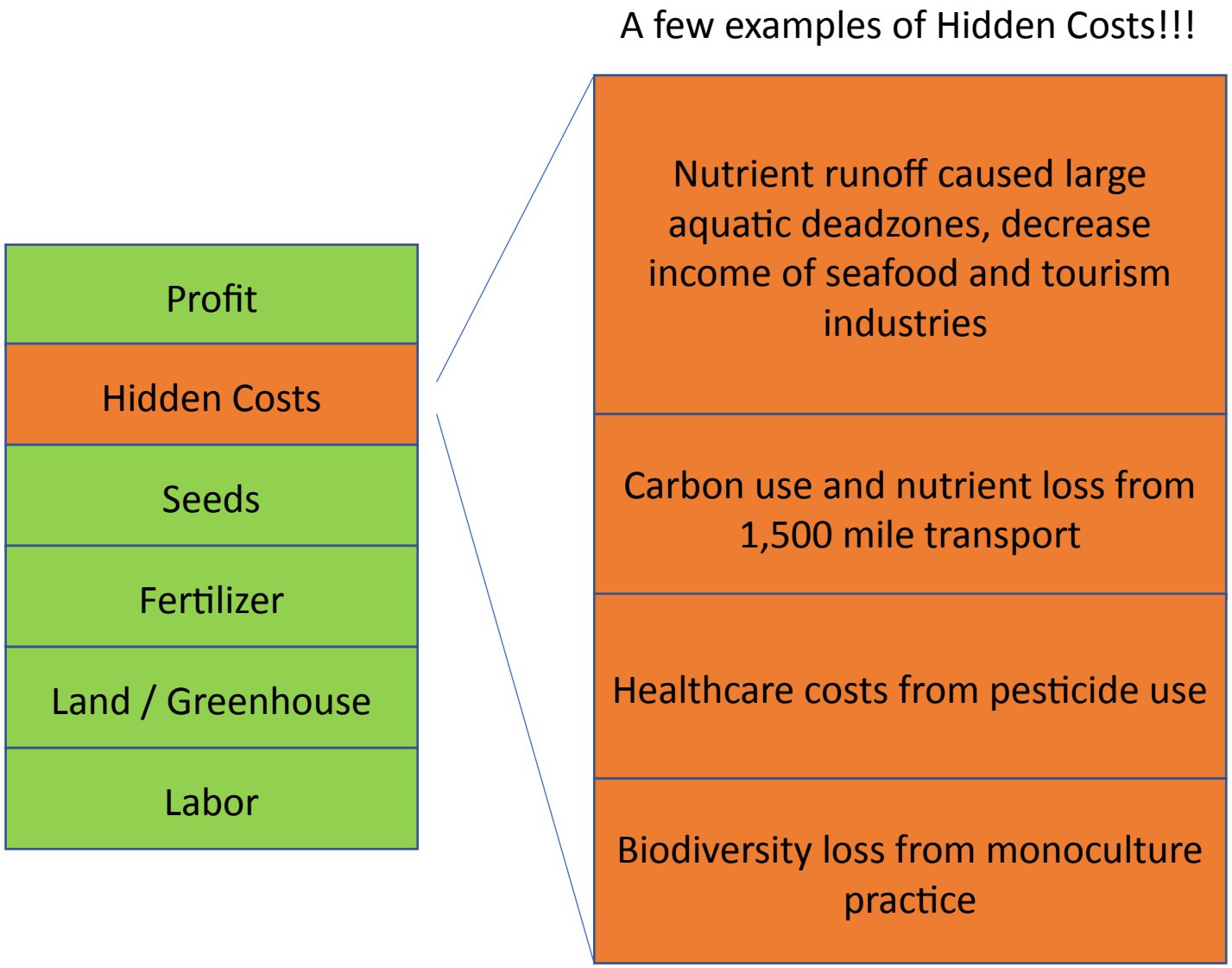


Pricing Cucumber in our current economy



= $1

True Cost of this seemingly harmless little cucumber



=$2??

Externalities embody the concept that we must quantify and value costs and benefits along the entire food production and consumption chain (graphic from TEEB Agri-Food)

Is organic food too expensive or is conventional food to cheap? That’s the question Volkert ask us. Aren’t we paying a price for cheap food produce. For the damage, it does to our planet but also to our own health? Wouldn’t it be wonderful if we could monetize the impact of producing organic food on people and planet, now and for future generations?

TEDxROTTERDAM

Volkert Engelsmans studied economics and business and worked for Cargill USA, a key player in the industrial global food market, travelled the world extensively and saw the impact of food production on society and the environment. Founded Eosta, providing organic fruit to supermarkets and developing a food transparency scheme called Nature & More - convinced that there can be no sustainability without transparency. Eosta is now Europe’s leading distributor of organic and fair trade food and a

So who is paying these hidden costs?
At some point these hidden costs aren't so hidden anymore -- Peekaboo!

Union of Concerned Scientists:
"Industrial agriculture is currently the dominant food production system in the United States. It's characterized by large-scale monoculture, heavy use of chemical fertilizers and pesticides"

"Our industrialized food and agriculture system comes with steep costs, many of which are picked up by taxpayers, rural communities, farmers themselves, other business sectors, and future generations. When we include these "externalities" in our reckoning, we can see that this system is not a cost-effective, healthful, or sustainable way to produce the food we need."

Concept #2 – Capital Stocks

Box 4.1 What are the "four capitals"?

Produced capital[11] refers to all man-made assets, such as buildings, factories, machinery, physical infrastructure (roads, water systems) as well as all financial assets. Human knowledge – sometimes called "intellectual capital" - is usually found embedded within produced capital (technology, software, patents, brands, etc.).

Natural capital refers to "the limited stocks of physical and biological resources found on earth, and of the limited capacity of ecosystems to provide ecosystem services." (TEEB 2010, p.33) For measurement purposes, following the SEEA, it incorporates the "naturally occurring living and non-living components of the Earth, that in combination constitute the biophysical environment" (UN *et al.* 2014, p.134). It thus includes all mineral and energy resources, timber, fish and other biological resources, land and soil resources and all ecosystem types (forests, wetlands, agricultural areas, coastal and marine).

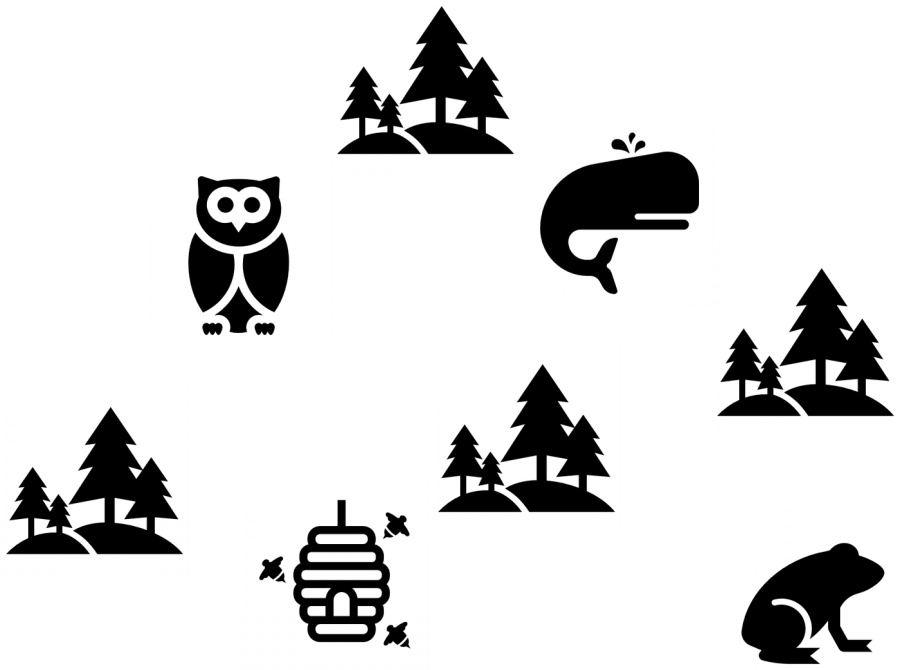
Human capital: represents "the knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being" (Healy and Côte 2001, p.18). Human capital will increase through growth in the number of people, improvements in their health, and improvements in their skills, experience and education. Income-based measurements of human capital usually need to be supplemented with quality indicators such as 'decent' working conditions (ILO 2008)[12].

Social capital encompasses "networks, including institutions, together with shared norms, values and understandings that facilitate cooperation within or among groups" (OECD 2007, p.103)[13]. Social capital may be reflected in both formal and informal arrangements and can be considered as the "glue" that binds individuals in communities. More broadly, it can be seen as the form of capital that "enables" the production and allocation of other forms of capital (UNU-IHDP and UNEP 2014).

Natural Capital Stocks

In economic terms, we would consider the value of a capital stock as the present value (PV) of all future revenue streams generated by the stock

Forest provides **ECOSYSTEM SERVICES**



These are ecosystem services that people and governments will pay for, that existing forests do for FREE!!!!!

- Pollination
- pest control
- freshwater provisioning
- nutrient cycling
- micro-climate regulation
- flood protection
- drought control

In order to understand what society gains or loses from policy choices, or what society (instead of just the business bottom line) gains or loses as a result of business decisions related to eco-agri-food systems, we need to be able to **estimate changes in stocks arising from such actions, and we also need to be able to value these changes. Thus it becomes important to be able to measure and value capital stocks.** To do so, we need to know or be able to estimate the flows of value that are expected to be generated from capital stocks.

In general, capital stocks can be valued as the net present value of their future returns. In other words, the flows from capital stocks have to be estimated, together with costs for maintaining these stocks to be able to deliver those flows. Appropriate discount rates then need to be chosen to convert expected future returns to their present values. Such valuation is generally not very challenging for private goods or services flowing from produced capital, because flows are generally known and market-priced (e.g. rentals minus maintenance costs for farm equipment, factory premises, etc.); interest rates can serve as a reasonable proxy for private discount rates; and most produced capital stocks are tradeable private goods and thus have market prices.

Three pieces of land…. How to visualize NATURAL CAPITAL

Dense Forest has a tremendous amount of Natural Capital through ECOSYSTEM SERVICES:

Someone buys Parcel #1, Dense Forest, razes the forest and builds a shopping mall.

Cityville now has to pay for all these services.

Someone buys Parcel #2 (arid desert) builds a ½ acre aquaponic farm and INCREASES the value Human, Social, and Produced Capital to the citizens of Cityville:

- Access to Jobs / wages
- Food Security
- Access to highly nutritious food

Private Land Parcel #1 Dense Forest	City-ville	Private Land Parcel #2 Arid Desert

SUMMARY
Both the Dense Forest and the Arid Desert were purchased and altered by private citizens.

The Dense Forest was cut down, made into a shopping mall, which dramatically DECREASED the stock of natural capital

The Arid Desert now hosts an aquaponic system which dramatically ADD to social / human capital stocks.

Where in our economic system are these dramatic changes in value accounted for???

GREAT EXAMPLE: Organic Soil Farming

Organic soil farming REBUILDS soil, preserves biodiversity, has better water retention, sequesters carbon --- INCREASES Natural Capital Stock

Here's the problem:

How do we quantify, value, and monetize something like clean air, clean water, or biodiversity?

OH NUTS! Agronomists believe we need to DOUBLE world food production by 2050. But with increasing water scarcity, land scarcity, and a changing climate, this goal looks very difficult.

"These externalities include the huge but hidden costs and benefits of agriculture and food systems, which need to be unravelled, understood, and evaluated if the world is ever to be able to work out how to feed and nourish billions of people…"

Efforts currently underway…..

Some of the commonly used evaluation methodologies that help us understand how eco-agri-food systems function in light

1. Cost Benefit Analyses (CBA) - to understand economic trade-offs between choices
2. Life Cycle Assessments (LCA)– to understand impacts and dependencies along business and other value chains
3. Multi-Criteria Analyses (MCA) – to look beyond cost-benefit or cost effectiveness results and allow the assessment of projects or choices against a variety of criteria, using different quantitative and qualitative indicators.

Gundimeda et al. (2018) explain and provide examples of all the above methodologies, as well as guidance on the appropriateness and use of various specialized tools for land use planning, estimating water requirements and watershed impacts of agriculture, and estimating and valuing ecosystem services" page 55

TEEB for Agriculture & Food

What is "TEEBAgriFood"?

TEEB for Agriculture & Food ('TEEBAgriFood') is a study that will provide guidance and illustrations for comprehensive evaluations (i.e. including of the most significant externalities) of 'eco-agri-food systems'*, whilst demonstrating that the economic environment in which farmers operate is distorted by significant externalities, both negative and positive, and a lack of awareness of our dependency on nature.

TEEBAgriFood is hosted by UN Environment, funded primarily by the Global Alliance for the Future of Food and other institutional and government donors.

TEEBAgriFood will bring together scientists, economists, policymakers, business leaders, and farmers organizations in order to agree how to frame, undertake and use holistic evaluations of agricultural systems, practices, products, policy scenarios against a comprehensive range of impacts and dependencies across food value chains. It makes and illustrates the case for "systems thinking" instead of "silo thinking" when evaluating eco-agri-food systems.

Valuation is very difficult:
Non-linear relationships
Feedback loops
Rebound effects
Delayed responses
Cumulative effects
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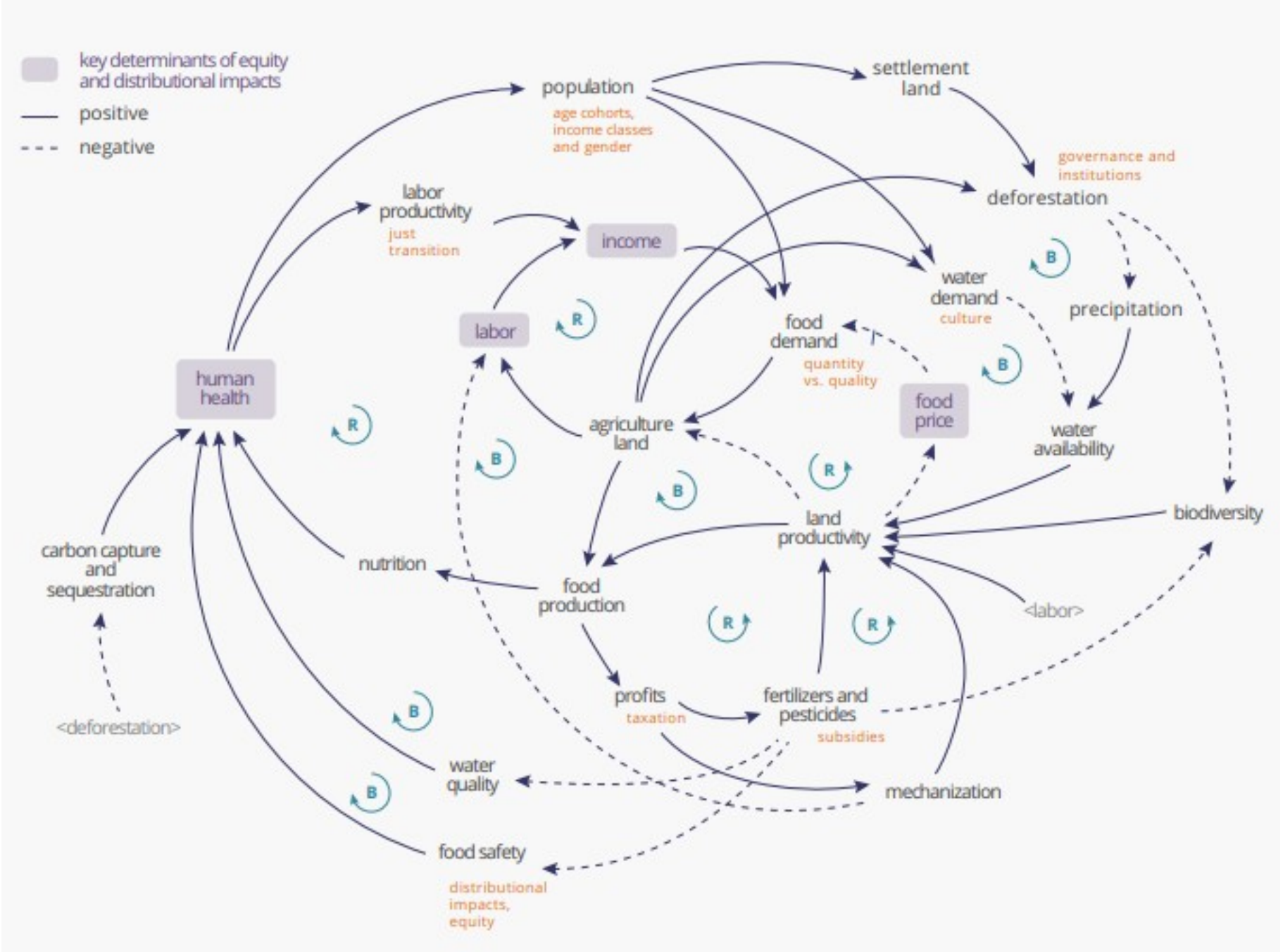
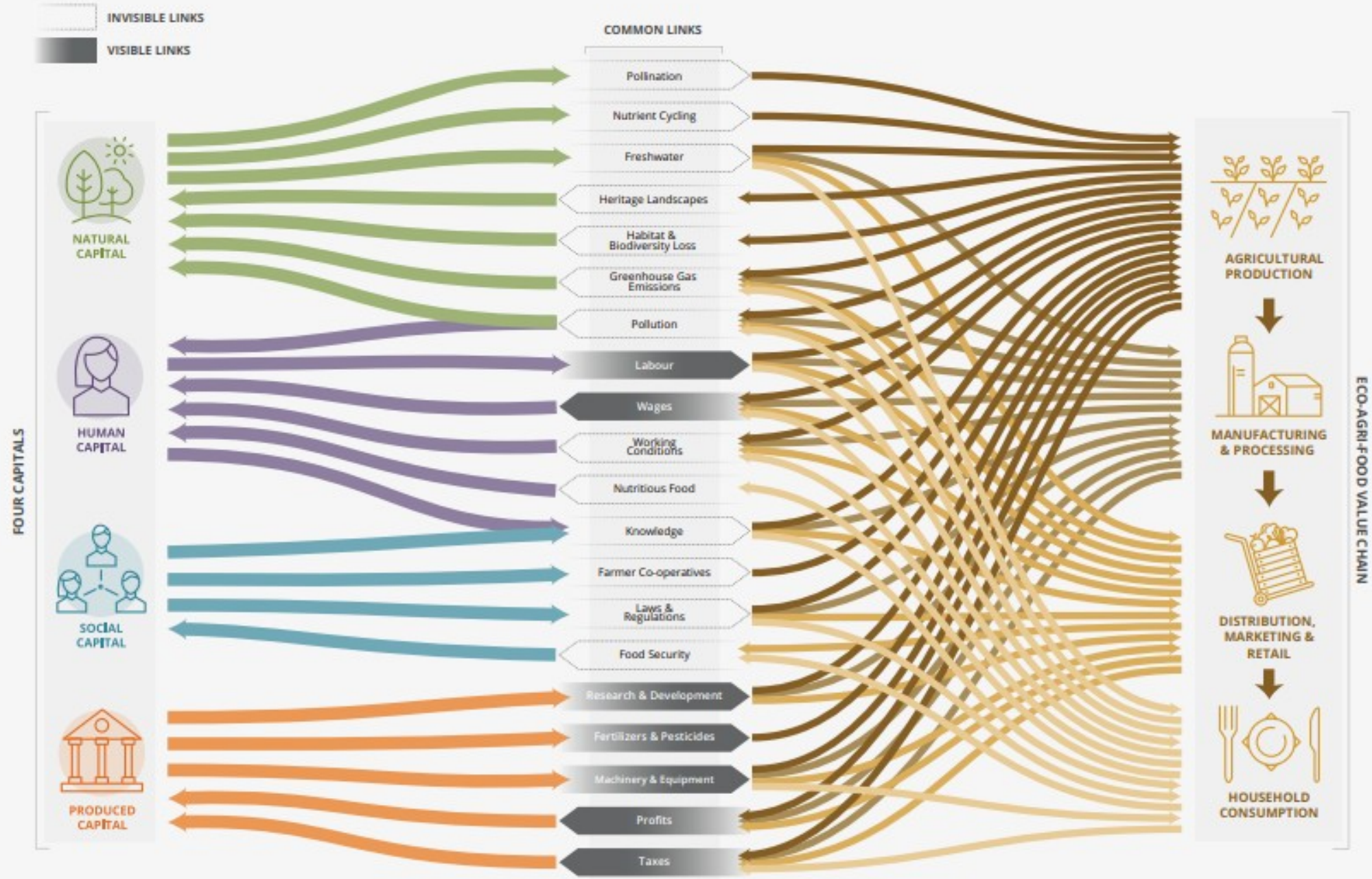


Figure 4.1 Links between four capitals and eco-agri-food value chain (Source: Obst and Sharma 2018)



How can one use the TEEBAgriFood Evaluation Framework to assess an eco-agri-food system?

Why use the TEEBAgriFood Evaluation Framework?

Most current assessments of agricultural and food systems are partial and ignore a number of important relationships that eco-agri-food systems have with our economy, society, environment, and health. Examples of partial assessments include farm level assessments of productivity on the basis of yield per hectare only or assessments of environmental efficiency that cover the agricultural production chain but focus only on water or energy use. Such assessments, while clear in scope, leave out broader issues of sustainability and equity that are fundamental considerations in assessing food systems.

Thankfully, discussion is growing around new approaches to assessing eco-agri-food systems including the use of sustainability indicator sets, the measurement and valuation of ecosystem services as inputs to food systems, and the assessment of the connections between food and population health. The perspective of the TEEBAgriFood Evaluation Framework is that these types of approaches need to be integrated in order to better inform policy decisions. Assessments that are context specific and which consider a comprehensive set of interactions, as described in the Framework, will ensure that decision making about food systems captures all material interactions between environment, economy, society, and health and covers interactions from the farm to household consumption.

Several other works and initiatives have helped move this agenda forward, including the Global Reporting Initiative (GRI 2018), the World Business Council for Sustainable Development's Guide to Corporate Ecosystem Valuation (WBCSD 2011), and the Natural Capital Coalition's (2016) "Natural Capital Protocol" (NCP) which includes a sector guide for food and beverage businesses (Trucost 2016) (page 45)

Efforts underway to make natures value's visible:

Public Policies

Efficient pricing of scarce resources (such as water), or additional charges to cover external impacts or ecosystem services (such as **cost-based fuel prices to cover health damage incurred by air pollution**) are essential"

Limits on aquaculture effluent

Triple Bottom Line – People Planet Profit

B-Corporations

MARKETS

The CEOs of nearly 200 companies just said shareholder value is no longer their main objective

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Maggie Fitzgerald

Consumer purchasing power

People pay more for Organic and Local

Organics specialist Nature & More has teamed up with a number of customers to make real cost of conventional fruit and vegetables visible to European consumers. The pioneering project has now been launched by retailers and health food stores in Sweden (Fruktbudet), Germany (Alnatura, Denn's), Netherlands (Ekoplaza), Finland (SOK) and will be later this season in Denmark (Arstiden, DANSK) and other countries.

Nature & More argues that much of the fruits and vegetables currently available in the UK and EU are sold far too cheaply and conceal negative environmental and social impacts. Consulting firms write hefty social impact reports for companies, but the actual hidden costs at product level are not shared with consumers.

That was, until now: Nature & More’s project, in cooperation with organic retail partners, aims to

https://naturalcapitalcoalition.org/natural-capital-protocol/

The Natural Capital Protocol is a **decision making framework** that enables organizations to identify, measure and value their direct and indirect impacts and dependencies on natural capital.
All organizations, to varying degrees, are dependent on the health of the natural world, and often these organizations likewise impact on nature's ability to underpin their success. Understanding the complex and dynamic relationships that organizations have with the health of natural assets and the ecosystem services they provide enables organizations to make more informed decisions with benefits for their businesses as well as communities, society, the broader economy and the natural world.
Decision makers often do not have the luxury of being able to take actions based purely on their beliefs, opinions or gut feelings. Decisions in organizational contexts must be made on the basis of information. A natural capital approach broadens the quantity and quality of information available to decision makers.
Without an understanding of their impacts and dependencies on natural capital, many decision makers will be at least partly 'flying blind', and can consequently make decisions that are inefficient, ineffective or counterproductive.
Until now, natural capital has for the most part been excluded from decisions and when included, it has been inconsistent, open to interpretation, limited to moral arguments, or based on an incomplete understanding of organizational relationships to natural capital.
The Protocol responds to this gap by offering an internationally standardized framework for the identification, measurement, and valuation of impacts and dependencies on natural capital in order to inform organizational decisions.

To illustrate applications of the Framework, notwithstanding that it is a new **Framework, Sandhu et al. (2018**) have conducted testing as to how it might shed light across ten existing, very diverse, case studies. These case studies had investigated different dimensions of agricultural management systems, including: business analysis, dietary comparison, policy evaluation and national accounts for the agriculture and food sector. From amongst these ten examples, let us look at two applications of the Framework, one each in evaluating agricultural management systems and in policy scenario analysis.

Organic farming sequesters carbon!

The first example compares conventional agriculture and organic agriculture in New Zealand. It considers the values of twelve ecosystem services from a sample of 29 fields (15 conventional and 14 organic), including “provisioning ecosystem services” (food, raw materials, etc.) as well as economically invisible “regulating and supporting services” (pollination, biological pest control, nutrient cycling, etc.). Composting and natural regeneration practices typically found in organic farming lead to higher below-ground (due to high organic matter and carbon) and above-ground (due to continuous ground cover) biomass and biodiversity thus these valuable but non-marketed ecosystem services are much higher in an organic agriculture context. Conversely, conventional agriculture suppresses these ecosystem services resulting in negative impacts on natural capital such as soil health, farm biodiversity, water quality and air quality. Thus, the economic value of ecosystem services from the organic system far exceeds that from conventional systems. As a result, in this study, the total economic value of ecosystem services in organic fields ranged from US $1,610 to US $19,420 ha− 1yr− 1 whereas that of conventional fields was lower, ranging from US $1,270 to US $14,570 ha− 1 yr− 1 (Sandhu et al. 2008). All ecosystem services including food production values were higher in organic fields compared to the conventional ones. This was due to higher market prices for organic produce, with comparable yields from both systems. The TEEBAgriFood Framework allowed comparison of trade-offs between these two alternative production systems.

Hidden costs

Such effects can now be calculated in terms of costs. In 2014, the UN’s Food and Agriculture Organisation developed a method to calculate the hidden costs of food production. Results from the investigation were included in a table from which the costs of water use, water pollution and greenhouse gas emissions, among other factors, could be calculated.

Using this method, Nature & More has calculated that the hidden climate change-linked costs of an acre of a non-organic pears in Argentina amounted to £987 per year. The hidden costs related to water pollution and soil erosion were estimated at £236 and £365 per acre respectively. Taxpayers ultimately have to pay the costs that governments incur for water purification and irrigation water subsidies or those costs get pushed into the future when subsequent generations will have to pay for them – with interest.

Nature & More has also calculated the true costs for pears produced by its organic grower Hugo Sanchez in Argentina’s Rio Negro Valley. In total, Nature & More’s organic pears delivered a social advantage of at least £718 per acre of orchard, with costs for biodiversity, health and social effects not even included in this figure. Per kilo, Nature & More’s organic pears delivered an advantage of at least 4.4p per kilo despite a 17% lower production per acre.

Engelsman added: "The numbers prove our point: organic food is not to expensive, conventional food is too cheap!"

https://sustainablefoodtrust.org/key-issues/true-cost-accounting/sustainability-metrics/

There is growing evidence that agriculture and food is one of the most significant contributors to the transgression of ‘planetary boundaries’, especially in the area of greenhouse gas emissions, biodiversity, soil, water, and nitrogen use. As Professor Johan Rockström pointed out at the World Economic Forum, “A transition to sustainable agriculture and forestry is a fundamental prerequisite to succeed,” yet this transition is prevented by several significant barriers to change.
One of these barriers is the lack of a unified means of measuring food system sustainability. At present, there is a diverse range of overlapping assessment tools and labelling schemes for monitoring and communicating on-farm sustainability. This makes it impossible for consumers, farmers, food businesses and policymakers to gain an accurate understanding of the comparative sustainability of products resulting from different methods of production.

https://sustainablefoodtrust.org/articles/the-true-cost-of-american-food-identified-in-new-report/

Mechanisms that could exist to allow future food pricing to be more honest include the introduction of polluter pays taxes on chemical fertilisers and pesticides and the redirection of farm subsidies in such a way that producers whose systems of production sequester atmospheric carbon dioxide and improve public health are rewarded for these benefits."

Professor Jonathan Foley from the California Academy of Sciences says, "It is undeniable that the global food system is facing a major crisis, with problems impacting food justice, food security, nutrition, the environment and economics. There are some fundamentally broken things in every aspect of the food system."

Wendy Schmidt, President of the Schmidt Family Foundation, argues that we must, "Re-shape the road map and better design a food system which takes into account all the externalities that are currently not included in the cost of food."

In the transcript of a video address given by the Prince of Wales, he says, "It is essential that the true costs of all our activities are properly understood and reflected in the way we run our economies… I make no apology for saying that ways must be found to make sustainable food systems at least as profitable as unsustainable systems… We need new ways of accounting for the true costs and benefits