Work package 3 Summary – Background, Methodologies, analysis and further information

Background

Any investigation of the links between trade and environmental impact needs to be approached from both an environmental and an economic perspective. Understanding the way both systems work and interact can help us to gain an overview of how the environmental impacts of consumption in a globalised economy can be tackled effectively. By examining product supply chains, we can improve our understanding of what the environmental impacts are likely to be, where they occur, who is benefiting and who is bearing the costs, as well as who is driving the demand for these products. By understanding these parameters, we are better positioned to identify possible pressure points and influence change that can enable us to avoid or ameliorate degradation of the environment.

Essentially how society organises to allocate scarce resources to supply its basic needs and demands – food, clothing shelter, energy, etc. – is the economy. As society's interface with the natural environment, including natural capital, the economy has over time become more complex with specialization of production and trade. Areas of specialization (see diagram), termed sectors, such as farming or fishing, manufacturing and services, such as transport, finance and insurance, have different types and levels of environmental impact. As products move along the supply chain from source to consumer, they may involve inputs from a variety of sectors. Understanding the environmental impact of the product consumed requires a knowledge of the processes and inputs involved in this journey.



As economies have become more complex and competition for resources intensified, society has sought to avoid conflict and facilitate distribution by introducing rules and regulations, formal and informal, to set parameters for supply and for the interaction between different elements in the exchange. These rules, which can take the form of government regulation, self-regulation or even third-party regulation, can be introduced at various points along the supply chain with differing effect and varying cost. Policy and its associated regulations can vary significantly in scope; it can be very specific, such as focused on a particular product or sub-sector, or it can be applied across a range of transactions applicable to many sectors. Understanding the various aspects of supply chains will be critical to identifying potential

pressure points and to designing effective intervention aimed at reducing the environmental impacts of consumption.

Many initiatives exist which attempt to assess, quantify and report on the relationship between consumption and environmental impact. Some disaggregate trade flows by identifying or modelling commodity pathways between countries to link importing countries to producing countries. Others have advanced this to identify environmental impacts at the point of production and, are able to attribute this to demand from trading and consuming countries. Some initiatives more directly address impacts at the point of production, taking a bottom up approach and attempting to translate this up the supply chain. Technologies and methods that seek to address this complex problem have been established and overall, this area is maturing. However demonstrably linking consumption to environmental impacts and possible mitigation methods remains challenging.

Work Package Summary

This work package has focussed on the available initiatives and describing their appropriate uses, to do this we have developed 3 main deliverables:

- 1. <u>An introductory guide</u> to understanding consumption and environmental impacts which includes:
 - a. Analysis and explanation of the environmental challenges which arise from consumption of globally traded commodities
 - b. Introduction to the main tools and techniques which are available to address some of these challenges
 - c. Explanation of five 'Pathways to sustainability' that demonstrate use cases of initiatives in understanding links between production, trade and mitigation of impacts
 - d. An extensive reference section which includes a glossary for commonly used terms in the field and a 'tools and techniques' section which defines and explains the different types of approach used by the many initiatives.
- 2. This guide was based on knowledge acquired from a spreadsheet (<u>Trade and environment initiatives.xlsx</u>) which reviews over 250 initiatives which try to link consumption to environmental impact. Links from the guide to a spreadsheet can be used to find additional detail on specific tools or techniques which are currently available. The spreadsheet reviewed the types environmental impacts initiatives address, assessed current level of implementation, identified limitations and knowledge gaps.
- 3. A further <u>two literature reviews</u> were completed with view to informing biodiversity indicator development specifically, these looked at:
 - a. <u>Pressure-Biodiversity models</u> to gain understanding of the range of pressure-biodiversity models available and draw conclusions on the most appropriate direction to take if indicator development were to prioritise the use of biodiversity as a metric.
 - <u>Environmental extensions of Multi Regional Input Output (MRIO) models</u> to evaluate how economic data is translated to pressures within MRIO environmental extensions.

The methods and analysis below describe the process by which these reviews were amassed. Some basic analysis is also included in this document identifying high level trends in the data.

Methodologies and Analysis

Trade and environmental impact initiatives

(Trade and environment initiatives.xlsx)

Methods: The initiatives list was compiled from the GCRF Trade, Development & the Environment Hub scoping exercise (pale blue rows in spreadsheet), the scoping exercise spreadsheet was filtered under 'Sustainability focus on the environment, social side or both' for 'environment' and 'both' and these entries were extracted. Further additions were gathered from in-house expertise on trade and environmental impact initiatives (white rows in spreadsheet). The review was time limited to 20 days during which 252 initiatives were reviewed. The spreadsheet was designed to assess appropriate uses of initiatives and to understand how they link trade and consumption to environmental impact. It was identified early on that there are many possible ways by which initiatives can be sorted and understood with regard to their appropriate uses and implementation (see figure 1).



Possible initiative sorting process

Figure 1- Possible initiative sorting process proposed to assess appropriate use and implementation

With this sorting process as a foundation, the review of initiatives focussed on key elements in figure one which determined appropriate use. Alongside determining what the initiative aims to achieve, how it measures impacts and what the drivers of use are, the spreadsheet also assessed:

- the type of initiative
- Its relevance to trade and environmental impact
- How widely **implemented** the initiative is?
- Through which pathway does it try to drive change (impact pathway)
- Who are the users of the initiative?
- In which **sector** is the initiative applied
- What is the scope
- Does the initiative directly measure impact?
- Which impact family does it address?

Definitions for how we categorised each of these factors are provided in the definitions tab of the spreadsheet and in table 1 below.

Type Definition Spreadsheet category Measures Includes metrics, m-composite-indicators, tools Models A simulation or visualisation of real time occurrences using available data **Data Providers** Collections of data Platforms A platform that include data access/visualisation and decision-support which makes a difference with portals Portals Web interface that provides access to data and tools that define routines or methods Roundtables/Certification Certification schemes and roundtables awarding recognition for abiding by standards they set Initiatives which build consensus around a set of Commitment agreements commitments for countries or companies Think tanks/knowledge agencies Centres of excellence/knowledge/research in the field Relevance Spreadsheet category Definition not at all relevant to in linking trade and environmental None impact Low addresses an impact Medium addresses an impact and links to supply chain or an industry addresses impact and relates to trade High **Extent of Implementation** Spreadsheet category Definition Conceptual appears not yet to have been implemented evidence of pilots or case studies but not yet widespread Testing several case studies and evidence of future implementation Low implementation plan High implementation widely applied and reported on, lots of use cases Impact Pathway Spreadsheet category Definition Land use/management change is influencing on-the-ground land management change Policv is influencing policy decisions Financing/investing is influencing financing/investing decisions **Raw Material Sourcing** is influencing raw material sourcing decisions **Customer Purchasing** is influencing customer purchasing decisions **Users of initiatives** Producers/ Land managers Could be used by Producers/ Land managers Government/ Legislators Could be used by Government/ Legislators Could be used by Investors Investors Purchasing companies Could be used by Purchasing companies Nature conservation Could be used by Nature conservation practitioners practitioners End consumers Could be used by End consumers

 Table 1: Definitions of spreadsheet categories

Sector				
Agriculture	Could be applied in agricultural sector			
Extractives	Could be applied in extractives sector			
Construction	Could be applied in construction sector			
Finance	Could be applied in finance sector			
Food	Could be applied in food sector			
Public	Could be applied in public sector			
Impact family				
Land use	Measures or has impact on land use			
Water	Measures or has impact on water quantity or quality			
Climate change	Measures or has impact on climate change			
Deforestation	Measures or has impact on deforestation (specifically)			
Biodiversity	Measures or has impact on biodiversity			
Air Pollution	Measures or has impact on air pollution and quality			
Soil Erosion	Measures or has impact on Soil erosion and quality			
Social	Measures or has impact on social factors			
Scope				
Spreadsheet category	Definition			
Local	Applied in one small area			
Regional	has been applied across a region			
Sub-National	has been applied across several regions			
National	is applied across a whole country			
International	is applied across several countries			
Global	the whole world is accounted for			
Impact Measure				
Spreadsheet category	Definition			
Pressure	Measures the size of a pressure (forcing mechanism) on the environment			
Risk	Measures the risk/chance of impact as a result of an action			
Direct impact	Measure the actual environmental impact on the area			
Does not directly measure				
Impact	Does no directly measure an impact			

The spreadsheet allowed for drop down selection of only one category for:

- Type
- Relevance
- Extent of Implementation
- Impact pathway
- Scope
- Impact measure

Selection of all categories which applied was available for:

- Users of initiatives
- Sector
- Impact family

Free text boxes were used for the remaining sections of the spreadsheet:

- Initiative name
- Lead organisation
- What is the initiative?
- Proclaimed aim/ Question initiative aims to answer
- Driver of use/ why does the initiative exist?
- Commodity coverage
- What do they use to measure impact?
- How are they communicating outputs?
- Link

Analysis of findings and discussion:

The spreadsheet was designed as a reference spreadsheet for compiling details of initiatives which link consumption to impact. Using the 'impact pathways' filtering mechanism provided the basis for the 'pathways to sustainability' considerations and available tools and concepts sections in <u>the LET Guide</u>.

Small scale comparisons can be made between individual initiatives, if the intention is to decide which is most appropriate for a defined task. In addition, the spreadsheet underpins and supports conclusions in <u>the LET Guide</u>. Examples of the kind of analysis undertaken for the guide are presented in the boxes below.

This review did not try to understand which initiative was 'best', further research to understand which initiatives are the most accurate or implementable could be helpful for specific indicator development, however, to do this the user would need to define what aspects are considered to be the most useful for the chosen purpose. Research also did not explicitly consider how initiatives may be looking to mitigate negative environmental impacts of trade, it only considered tools and techniques which are used to measure the environmental impacts. An additional look at the mitigation methods available for tackling negative impact caused by consumption and trade would be a valuable next step in furthering the reduction of negative environmental impacts.

Box 1 – Number of initiatives which considered social impacts

Of the 252 initiatives reviewed just 73 initiatives (less than 30%) also included a social measure of impact alongside environmental impact showing that the integrated measurement of social and environmental impacts is less common than measurement of purely environmental impacts.

Box 2 – Number of impact categories addressed by initiatives

The 252 initiatives reviewed were assigned one or more impact family if they appeared to address the impact family in question. The impact families were:

- Land Use
- Water
- Climate change
- Deforestation (specifically either alongside or instead of land use)
- Biodiversity
- Air pollution
- Soil Erosion
- Social

The graph below demonstrates the number of initiatives addressing impact families. Zero means that it did not address any of the impact families listed. The maximum is 8; i.e. the initiative addressed all of the impact families listed above. It is possible that some addressed environmental impacts that were not covered by the families listed above. The majority of initiatives, however, addressed none or one impact family. In order to improve sustainability monitoring and integrate this with supply chains, tools and techniques should take into account a range of environmental impacts, however this is not currently the case for the majority of initiatives.



Box 3 – Direct vs indirect measures of impact

Just 33 of the 252 initiatives reviewed incorporated a direct measure of environmental impact. The vast majority did not directly measure impact while a few others used pressure or risk proxies for impact. To accurately measure and integrate environmental impacts with trade, direct environmental impacts need to be measured and reported.



Box 4 – Number of sectors addressed by initiatives

The 252 initiatives reviewed were assigned one or more sectors if they could be applied in that sector. The sectors were:

- Agriculture
- Extractives
- Construction
- Finance
- Food
- Public

The graph below demonstrates the number of initiatives which applied to sectors. Zero means that it did not apply to any of the sectors listed above. The maximum is 6; i.e. the initiative could be applied to all the sectors listed above. The majority of initiatives addressed one or all six sectors which illustrates the disparity between initiatives that are cross-sectoral by nature and those which are sector specific.



Pressure-biodiversity models

(Models and Extensions.xlsx)

Methods: A review of thirty models and associated data sources with potential to be used to calculate biodiversity impacts from pressures through trade data were investigated. This was time limited to 5 days. For each model the following information was captured:

- A summary description
- Details of the raw data used and its update frequency
- Scale of use and scalability
- Baselines
- Environmental pressures included
- Taxonomic coverage
- Threat level of species included
- Sensitivity to management changes
- Assumptions and uncertainty
- Level of effort required for calculation
- Adoption examples
- Timescale of data
- Repeatability of the process

Each model or data source was then assessed against the following criteria, in the following order, and was excluded if any one of the criteria was not met:

- Model or data must be open source and accessible
- Model or data must be scalable for implementation at a global scale
- Model or data must be complete to a stage that at least a first draft / prototype is currently ready for use
- Model or data must be sensitive to management change

Analysis of findings and discussion: Excluded models are listed alongside the reason for their exclusion in Table 2, with possible models and data sources to consider taking forward outlined in Table 3. Figure 1 shows a schematic of two potential options pathways involving these models and data sources.

Exclusion criteria	Models / data sources		
Not open access	GLOBIO, World Food LCA Database		
Not globally scalable under current data constraints	InVEST, Biodiversity Integrity Index, Bioscore, Natural Capital Index, The Biotope method, Conditions for Maintained Biodiversity (CMB) Index, Intact Forests (Global Forest Watch), Functional Diversity Index (Souza et al 2013), Species Pool Effect Potential (Köllner 2000); Spatial overlays (Seto et al. 2012)		
Not sensitive to management changes	Species Threat Abatement and Recovery (STAR), Habitat Suitability models (e.g. Duran et al 2019), Species–Area Models and Vulnerability Indicators (Chaudhary et al 2015), Distribution of phylogenetic diversity (Davies & Buckley 2011; Thuiller et al. 2011), Biogeographic Infrastructure for Large-scaled Biodiversity Indicators (BILBI)		
Not yet ready for use	Geofootprint		

Table 2: Excluded pressure-biodiversity models, with reasons for exclusion

Models / data	Summary description	Principle advantages	Principle disadvantages
	Summary description	Principle advantages	Principle disadvantages
sources to be			
considered in			
PREDICTS (Projecting Responses of Ecological Diversity In Changing Terrestrial Systems)	The project is a database of information taken from published studies that record abundance, occurrence or richness of at least two taxa at two or more sampling locations. Each site was assigned to one of eight land-use classes based on the description of the habitat given in the source paper. A number of biodiversity metrics can be calculated from this.	One of the only data sources available that links biodiversity to land use class and land use intensity – therefore has potential for use in calculating sensitivity to management change (even if only at three levels of intensity). Further detail on the crops involved is included in the additional data for many, so more detailed analyses would also be possible.	Current geographic coverage of the data means that much extrapolation is involved. This is likely to improve in future, but if using immediately, it would be associated with large assumptions.
HESTIA	An expanding global database of Life Cycle Analysis (LCA) studies	One of the only data sources available that links production of goods for trade with the pressures that are causing declines in biodiversity at a global scale in a way that aims to differentiate between production systems.	Does not currently include the effects of these pressures on biodiversity, although this is planned for future inclusion (through combining with PREDICTS data).
LC-Impact	A spatially differentiated global life cycle impact assessment methodology	Good range of pressures considered (not just land use)	Land use module is known to be weak. Sensitivity to management changes possible with improvements but currently weak.
IUCN red list data	A list of taxa with information about their range, population size, habitat and ecology, use and/or trade, threats, and conservation actions that will help inform necessary conservation decisions.	Internationally accepted database.	Updated infrequently. Some taxa have better data than others.
Biodiversity Intactness Index	An indicator of the overall state of biodiversity in a given area, synthesizing land use, ecosystem extent, species richness and population abundance data.	Allows for sensitivity to management change, with well defined categories including 'protected,' 'moderate use,' 'degraded,' 'cultivated,' 'plantation' and 'urban.'	Lack of accurate data for calculation on a global scale – used with PREDICTS, but no other data options currently available.

 Table 3: Pressure-biodiversity models to be considered in future analyses



Figure 1: A schematic for possible future development options of an indicator of the overseas biodiversity impacts of UK consumption

MRIO Environmental Extensions

(Models and Extensions.xlsx)

Methods: A time limited (2 days) review of the documentation associated with MRIO environmental extensions was conducted, recording the raw data sources, calculations and assumptions relied on. Exiobase was prioritised, as the MRIO used within last year's pilot study, with the methods and data sources behind all published extensions recorded (Land Use, Water Use, Air Emissions & GHG Emissions, Nitrogen & Phosphorous Emissions and Materials Flows). EORA, as the most likely alternative, was reviewed second. Due to the time limited nature of the review, only EORA's three most relevant extensions (land use, climate change and biodiversity) were investigated to provide a comparison with Exiobase. The documentation for biodiversity was not openly accessible and was therefore not fully assessed.

Analysis of findings and discussion: The methods were found to be fairly 'black box,' with documentation that was often unclear and difficult to interpret. Most extensions rely on multiple data sources, with a complicated hierarchical system determining where data should be taken from if a data point is unavailable from the preferred data source. Most of the raw data sources used are themselves considered reasonably reliable, mainly coming from questionnaires and surveys sent to national statistics offices. Assumptions of note included:

- In both Exiobase and EORA, land use extensions only considers agriculture and forestry related land use
- In both Exiobase and EORA, carbon extensions do not account for the carbon stocking aspect of land use change (although EORA's method did used to include this)

- In Exiobase, fertiliser use is attributed to crops based on assumptions around specific nutrients requirements compared to land use and productivity per land use in each country
- In Exiobase, emissions from transport and agricultural machinery are not included. In EORA, they state that "Emissions from international Aviation and Shipping are not included."

From the extensions compared between Exiobase and EORA, it appears that they use largely similar methodology and raw data sources. For the carbon extensions, EORA calculate alternative data sets that align with various external methods, to increase compatibility, whereas Exiobase rely solely on their custom method. For the land use extension, Exiobase relies solely on FAO as a data source, whilst EORA uses this in combination with remotely sensed data.