# JNCC Report 743
# Understanding the Global Environmental Footprint and Impacts of Welsh Consumption

## Annex 1
## An introduction to consumption-based metrics

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**Note:** Whilst this report uses Welsh specific examples to put things into context for those who contracted the work, much of the information would be of wider relevance to any country or Devolved Administration wishing to understand the different options that are available for estimating the impacts of a country's consumption.

# An introduction to consumption-based metrics

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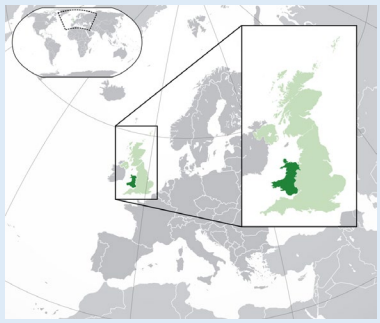
**A number of different options are available to help understand the pressures and impacts from a country's consumption. This guide explains several of them, including the situations in which you would select each, key differences and alignment between them, and the policy interventions that each would be sensitive to. It also provides a forward look towards improvements that may be possible in the future.**

## What are consumption-based pressures and impacts and why are they important?

Environmental pressures and impacts are often measured where they take place. For example, governments may report on deforestation or carbon emissions within their borders. However, their ultimate drivers are often located far away. For example, forest or other habitats may be cleared to produce palm oil or soy that is traded to the other side of the world. If a country imports more, it may decrease local environmental pressures and impacts, but may 'offshore' these (or new) impacts overseas. This will ultimately fail to address the issues at a global scale. Consumption-based metrics aim to provide the evidence to be able to consider pressures and impacts from the perspective of those ultimately driving them, complementing traditional domestic based measurements.

**~22000 ha of land in Wales is used to grow wheat** Domestic estimates include pressures and impacts that are taking place within Wales. They do not include impacts taking place outside of Wales, even if Wales is associated with these impacts. They do include impacts taking place in Wales even if related to commodities that are then exported.



**~75000-100000 ha of land worldwide grows wheat that is consumed in Wales** Consumption estimates include pressures and impacts that are taking place anywhere in world, if they can be linked to consumption within Wales. Pressures and impacts from goods produced in Wales are included if they are also consumed in Wales, but excluded if they are produced in Wales and then exported elsewhere.

Consumption covers anything that is bought and not re-sold, including anything that is eaten, used, worn or wasted. Understanding consumption is not only important to address the biodiversity loss and other environmental pressures and impacts linked to the production of goods all around the world, but also to understand the associated pressures and impacts on ecosystem services which are essential to ensure resource security and supply chain resilience.

## What consumption-based metrics are available?

The Convention on Biological Diversity's Monitoring Framework for the Kunming-Montreal Global Biodiversity Framework has included the following as component indicators of relevance to understanding the sustainability of consumption:

- **Food Waste Index:** An estimate of total food waste at retail and consumer level (households/food service).
- **Material Footprint:** An estimate of the total tonnes of material extracted or produced to support consumption. This includes material discarded at previous stages in the supply chain (e.g. the tonnes of ore extracted to create metal is included, not just the tonnes of metal in the final product).
- **Ecological Footprint:** An estimate of how much regeneration (bioproductive land and water area) would be required to produce natural resources that are consumed and to absorb waste that is produced. A basic version is freely available on the website, but additional bespoke analyses are also possible.
- **GEIC (Global Environmental Impacts of Consumption) indicator:** Estimates of the biodiversity loss, deforestation and water impacts associated with consumption. Breaks down each impact by commodity type and location.

Although not included in the Framework (which only focuses on biodiversity), another high-profile consumption-based metric is the **Carbon Footprint:** An estimate of carbon emissions from a consumption perspective. This document focuses in detail on these five key metrics, but also explores several others more briefly on page 9.

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**What are the key differences between each metric?**
Each metric is trying to answer a different question. Each of these questions is important for sustainability in different ways. This leads to different kinds of broad policy applications each are most suited to, and different key strengths and weaknesses. This page also provides information on where to find out more about each metric discussed.

| | Food Waste Index | Material Footprint | Ecological Footprint | GEIC indicator | Carbon Footprint |
|---|---|---|---|---|---|
| What question is it trying to answer? | How much food waste is produced by retailers and consumers? | How much mass is extracted or produced to support consumption? | How much of the regenerative capacity of the biosphere is occupied by human demand? | How much biodiversity loss, water impacts, defore station, etc, take place as a result of consumption? | How much carbon is emitted as a result of consumption? |
| Why is this question important for environmental sustainability? | Waste is an unnecessary aspect of consumption. Cuts in waste could lead to cuts in the overall amount consumed, and so reductions in associated impacts | Total mass can be used as a crude proxy for total pressures and impacts on the environment due to consumption | Planetary resources are finite. If we are consuming more than can be regenerated, this is not sustainable. Results are compared to an ecological threshold, providing context rather than just an absolute value | Biodiversity loss, water impacts and deforestation are key aspects of environmental sustainability | Understanding the carbon emissions that we are associated with is key for climate change mitigation |
| What kind of policy applications is this best suited for? *Note that all metrics have multiple uses (see next page) – this row provides a high level assessment of the most relevant application* | Waste policy | High level resource use policy | Providing the 'big picture' – e.g. evidence of the need for action, creating a high level policy framework | Identifying 'hotspots' of impact, to target policy actions to commodities or geographies | Carbon policy |
| Units | Tonnes | Tonnes | Global hectares (globally comparable hectares with world average productivity) | Varies by impact type, e.g. hectares for deforestation | Tonnes of carbon dioxide equivalent |
| Where can I find out more? | https://www.unep.org/resources/report/unep-food-waste-index-report-2021 | https://www.ons.gov.uk/economy/environmentalaccounts/articles/materialfootprintintheuk/2018 | https://www.footprintnetwork.org/our-work/ecological-footprint/ | https://commodityfootprints.earth/ | https://www.gov.uk/government/statistics/uks-carbon-footprint/carbon-footprint-for-the-uk-and-england-to-2019 |

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**When should I use each metric?**
Each consumption-based metric available may be best suited to answer a particular question. All are useful, but provide complementary perspectives and insights.

**Key:**
- ✓✓✓ Best suited to this situation
- ✓✓ Could also be used in this situation
- ✓ Could answer part of the question, or would require additional analysis

| I am interested in… | Food Waste Index | Material Footprint | Ecological Footprint | GEIC indicator | Carbon Footprint |
|---|---|---|---|---|---|
| …a single number overview of consumption pressures and impacts as a whole | Only focuses on one aspect of consumption. Indices for each sector will not be combined. | ✓✓ Tonnes of consumption is often used as a crude proxy for overall pressure | ✓✓ Provides one normalised unit across all pressures related to regeneration | ✓ Includes a total for each impact type, but does not combine them | Only focuses on one type of consumption impact |
| …a detailed breakdown to inform action (e.g., targeting commodities/sectors or working with trade partners) | ✓ Three approaches are provided. The most complex breaks down data to inform action | ✓ Results could be broken down further with additional analysis | ✓ Results could be broken down further with additional analysis | ✓✓✓ All results can be broken down by commodity and producer country to inform action | ✓ Results could be broken down further with additional analysis |
| …deforestation, biodiversity loss and water impacts | Does not provide information on specific impact types | Does not provide information on specific impact types | Does not provide information on these impact types specifically, but sub-components provide insight on pressure in various domains | ✓✓✓ Does provide information on these impact types | Does not provide information on these impact types |
| …carbon emissions | Does not provide information on carbon emissions | Does not provide information on carbon emissions | ✓ Estimates the land area that would be required to offset carbon emissions | ✓ Estimates carbon emissions from tropical and subtropical deforestation | ✓✓✓ Key aim is to provide information on carbon emissions |
| …a specific commodity | Information on specific commodities is not available | Information on specific commodities is not available | Information on specific commodities is not available | ✓✓✓ Specific commodities can be selected on the dashboard | Information on specific commodities is not available |
| …coverage of the whole economy | Only covers food products | ✓✓✓ Covers the whole economy | ✓✓✓ Covers the whole economy | ✓ Covers agri-crop commodities, cattle and timber. Ongoing work aims to expand this | ✓✓✓ Covers the whole economy |
| …communicating the scale of the problem simply for a non-specialist audience | ✓ Simple concept, but hard to understand the implications | ✓ Simple concept, but hard to understand the implications | ✓✓✓ Easy to visualise the units, especially if presented as planets required to support consumption | ✓✓ Presented on a visually engaging and interactive dashboard | ✓ Simple concept, but hard to meaningfully understand the implications |
| …waste | ✓✓✓ Key aim is to provide information on waste | Not possible to break results down by how much is due to waste | ✓ With bespoke analysis, can break results down by how much is due to waste | Not possible to break results down by how much is due to waste | Not possible to break results down by how much is due to waste |

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**What is each metric sensitive to?**

These metrics aim to show consumption related pressures and impacts holistically. They will therefore respond to multiple interventions. However, they may respond to some more strongly than to others, and it is difficult to extract the effects of a specific intervention.

**Key:**

Will primarily respond to this

Will respond, combined with other factors

Will respond, with key limitations

| Intervention | Food Waste Index | Material Footprint | Ecological Footprint | GEIC indicator | Carbon Footprint |
|---|---|---|---|---|---|
| **Reducing consumption overall**<br>• More consumption leads to more consumption related pressures and impacts, however efficient the production and supply is<br>• The imbalance in levels of consumption around the world means this intervention will only be appropriate in certain areas<br>• Circular economy strategies (e.g. encouraging recycling, reuse and service-based products) can help reduce consumption overall without affecting economic growth | Reducing waste could lead to reduced total consumption, but FWI does not directly measure total consumption | ✓✓✓<br>Results are entirely based on changes in the amount of consumption | ✓✓<br>Changes in the amount of consumption is a key driving factor behind changes in bioproductive land/water area used | ✓✓<br>Changes in the amount of consumption is a key driving factor behind changes in estimated impacts | ✓✓<br>Changes in the amount of consumption is a key driving factor behind changes in estimated carbon emissions |
| **Reducing waste**<br>• Allows for consumption needs to be met through a lower volume of production (and associated pressures and impacts), as a higher proportion of the total amount produced is used directly rather than going to landfill<br>• Could be undertaken through e.g. increasing recycling, improving regulation on single use products and packaging, educating the public on how to store and use up food, circular economy strategies | ✓✓✓<br>Reductions in waste is what the FWI is designed to measure | ✓<br>Reducing waste could lead to reduced total consumption | ✓✓<br>Changes in the area required to absorb waste is a key driving factor behind changes in results | ✓<br>Reducing waste could lead to reduced total consumption | ✓<br>Reducing waste could lead to reduced total consumption |
| **More sustainable production**<br>• Producers improving their production methods can increase efficiency; the same amount can be consumed for a lower impact<br>• Could be encouraged through funding research and implementation in areas where environmental pressures and impacts are high<br>• Consideration must be given to ensuring that more sustainable production does not lead to lower yields that displace pressures and impacts elsewhere | Waste at the production end of the supply chain is not accounted for (this is covered by FAO's Food Loss Index) | Does not account for sustainability of production *per se*, but would be sensitive to changes in the mass of material used by producers | ✓<br>Production footprints are available and can be analysed by land type | ✓✓<br>Explicitly sensitive to differences in sustainability of production per country and commodity, but tracing exact supply is not possible | ✓<br>Sensitive to differences in the carbon emissions for each broad sector in 14 global regions, but tracing exact supply not possible |
| **Changes in sourcing patterns**<br>• Consuming more from producers that meet sustainability standards can lead to an increase in the sustainability of the supply chains of that consumer.<br>• This can encourage sustainable production by creating greater demand for sustainable products.<br>• However, consideration must be given to the fact that if there is still a buyer willing to accept the less sustainable products elsewhere (e.g. due to price or convenience), changing sourcing patterns risks simply displacing impacts into other markets and therefore not creating any difference overall.<br>• Could be encouraged through e.g. trade deals, sustainable public procurement rules, awareness raising campaigns/ecolabelling | ✓<br>Results would be sensitive to changes in the selection of products with differing levels of sustainability in the context of packaging, risk of going off (e.g. buying fresh produce in bulk / too early), etc | Would be sensitive to this where changes in sourcing pattern across the 14 regions covered led to changes in the amount of material used, but only accounts for mass, so not linked to sustainability standards *per se* | ✓<br>Sensitive in so much as changes in sourcing would result in a quantitative change in consumption. E.g. consuming seaweed or anchovy has much lower footprint per kg than salmon or tuna | ✓✓<br>Changes in sourcing patterns between countries or commodities is a key driver of changes in results. Granular information is available, but tracing exact supply is not possible | ✓<br>Would be sensitive to this where changes in sourcing pattern across the 14 regions covered led to changes in the carbon released whilst producing a comparable volume of product |

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**How are consumption-based metrics calculated?**
To understand the impacts of consumption, it is necessary to first understand how much we are consuming and where the commodities being consumed originated. It is then possible to combine this information with environmental data sources to estimate the impact that is associated with this consumption.

## 1. How much are we consuming and where is it coming from?

- No data source is available that allows us to trace this perfectly; all results at economy-wide scale are modelled estimates.
- It is important to account for embedded consumption. For example, the feed given to a farm animal must be included in final estimates even though this is not visible to the consumer.

**Data options:**

**Physical production and trade data**

- Most countries keep records of their tonnes of production, imports and exports. Can be accessed through sources like FAOSTAT and UN Comtrade Detailed Commodity Breakdown
- Useful for raw commodities, but analysis becomes more difficult when commodities are used as ingredients within products or are embedded (e.g. used as animal feed)
- The last exporting country (not the country of origin) is recorded
- Subnational sources are available for a limited set of countries/commodities, e.g. through Trase

**Financial flow data**

- Models based on financial flow data are known as Multi-Regional Input-Output (MRIO) models
- Can be accessed through sources like Exiobase and GTAP. Exiobase has higher commodity breakdown but lower country breakdown than GTAP
- Models account for embedded commodities and estimate country of origin
- More detailed Input-Output (IO) data can be collated for a particular country or region. For example, UKMRIO uses IO data from ONS, and analyses to downscale these metrics for Welsh Government use IO data from Cardiff University.

In some cases, it is possible to combine data sources. For example, 'hybridising' physical data with financial flow data gives results with a detailed commodity breakdown that also accounts for embedded commodities. Using both FAOSTAT and Exiobase, detail on UK consumption can be kept while also estimating where commodities originated. This is not possible in cases where the sectoral breakdowns do not allow for value add (e.g. combining the high commodity resolution of FAO with the single number that the UKMRIO gives for the agriculture sector).

**What each metric currently uses:**

| Food Waste Index | Material Footprint | Ecological Footprint | GEIC Indicator | Carbon Footprint |
|---|---|---|---|---|
| Does not account for total consumption, so has no need for trade data | The UK version uses UK IO data, combined with Exiobase | The basic version uses physical data. The paid-for version uses GTAP | Uses Exiobase, combined with FAO physical production and trade data | The UK version uses UK IO data, combined with Exiobase |

There is no one agreed method to estimate consumption and model trade flows. Although each metric *currently* uses a particular approach, this is **NOT** fundamentally what that metric *is*. The fundamental differences in each metric are based on how they translate this consumption into an estimate of impact. In theory, each metric could use any combination of data sources above. In practice, there is usually a good reason for the selection of one over the others in each particular case (see page 6). It is, however, important to be aware of the differences in data sources currently used by each metric to understand that they are not exactly aligned and comparable.

## 2. How do we translate consumption to pressures/impacts?

Once data on how much is being consumed and where it is coming from are available, this can be combined with other data sources to give estimates of impact, rather than simply of total consumption.

| Food Waste Index | Material Footprint | Ecological Footprint | GEIC Indicator | Carbon Footprint |
|---|---|---|---|---|
| No consumption data are used. Waste data are collated by national governments | No additional analysis. Assumes that more consumption means more pressure/impact | Results combined with estimates of the area needed to produce what is consumed and absorb associated waste | Results combined with data on the deforestation, biodiversity loss, water use, etc from specific commodities in specific locations | Results combined with data on the carbon emissions associated with different sectors |

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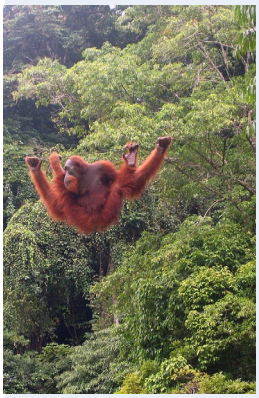
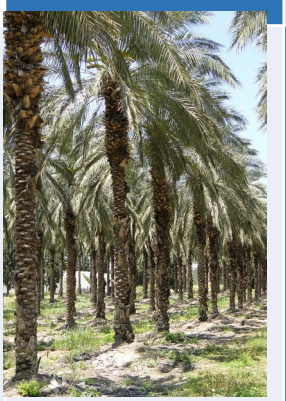
**How do the metrics align and differ?**
Each metric follows different methods. This is necessary to ensure that each meets its individual aims most effectively. However, this also means that they are not directly comparable with each other. Each box in the table below explains the alignment and differences between the metric in the column above and the row to the left.

| | Material Footprint (MF) | Ecological Footprint (EF) | GEIC indicator | Carbon Footprint (CF) |
|---|---|---|---|---|
| **Food Waste Index (FWI)**  | FWI measures waste, MF measures tonnes of material extracted or produced to support consumption. FWI provides a way to report data that countries collect through a variety of methods. MF uses trade models. | FWI measures waste, EF estimates how much land would be required to produce natural resources that are consumed and to absorb waste that is produced. | FWI measures waste, GEIC estimates biodiversity, water and deforestation. FWI provides a way to report data that countries collect through a variety of methods. GEIC calculates data for each country itself. | FWI measures waste, CF measures carbon emissions. FWI provides a way to report data that countries collect through a variety of methods. CF uses trade models. |
|  | **Material Footprint (MF)**  | EF measures land area needed for regeneration, while MF focuses on tonnes of material embedded in consumption. Different underlying trade models are used. | Underlying financial data are the same, but these are combined with different extra data. Spatial breakdown is key for impacts like biodiversity, so GEIC adds production data. MF varies less spatially, so instead adds consumption data. | Based on the same underlying methods, with the CF using additional carbon emission data. |
| | | **Ecological Footprint (EF)**  | EF measures land area needed for regeneration, while GEIC focuses on specific impacts. Spatial breakdown is key for GEIC impacts, whilst EF normalises outputs to global hectares, so different approaches are taken to determine trade. | The carbon aspect of the EF estimates the land that would be required to absorb carbon released, whereas the CF reports on tonnes of emissions. Different underlying trade models are used[1]. |
| | |  | **GEIC indicator**  | CF covers all carbon emissions except land use change. GEIC estimates emissions from deforestation. Not accurate to aggregate due to different underlying trade models (see MF-GEIC comparison – CF has same trade model as MF)[2]. |

**Why can't they all use the same methods?**
Whilst alignment would be useful for comparability, there are good reasons behind the methodological choices that each metric has made. If you are aiming to measure one type of impact, you will want to use the methods that are most appropriate for that, not a method that has been adapted to align with another metric, which may reduce accuracy and relevance. As most of the differences between metrics arise from the fact that they are measuring different things, the lack of alignment is unlikely to be an issue, as direct comparisons are unlikely to be made. Notable exceptions are the CF and the carbon components of the EF[1] and GEIC[2]. It is also important to note that there is also variability *within* each of these methods (e.g., FWI has three levels of method and it is possible for each of the others to use different underlying trade models[3]). Notably, the UK MF and the Welsh MF use different underlying MRIO datasets due to data availability at time of publication.

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**What are the results from each consumption-based metric for Wales?**
In 2022-23, several of these metrics were calculated for Wales. The headline results are summarised below. The Food Waste Index was not calculated, so results for that are not included here. More results and methodological details can be found in the full reports. The Ecological Footprint and Carbon Footprint act as National Indicators.

## Ecological Footprint

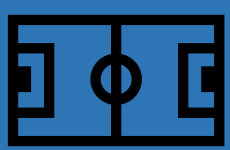
If the entire world population lived like the citizens of Wales, humanity would require **2.08 Earths.**

## Material Footprint

In 2018, Wales used about **33,000 thousand tonnes** of material in its supply chains to support its consumption.

## GEIC Indicator

In 2018, Welsh consumption led to deforestation of an area equivalent to between **94 and 124 football pitches.**



## Carbon Footprint

In 2020, **25 million tonnes of $CO_2$ equivalent** were released into the atmosphere to support Welsh consumption.

**What are the challenges and limitations of producing these estimates at a Welsh scale?**
As a devolved nation, Wales faces additional data challenges when calculating consumption metrics when compared to the UK or other countries internationally. Trade data between countries within the UK are not typically recorded. This makes distinguishing Welsh impacts from impacts associated with other UK countries difficult. Some of the calculations above have instead relied on data sources that compare expenditure between Wales and other UK regions. Others have made use of new data being produced by Cardiff University. In both cases, there is more uncertainty than in UK scale calculations.

**Sources:**
Carbon Footprint: Wales Consumption Emissions Footprint (gov.wales)
All other statistics: JNCC Report 743: Understanding the Global Environmental Footprint and Impacts of Welsh Consumption

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**What evidence gaps remain?**

Development of consumption-based metrics has come a long way in recent years. However, a number of evidence gaps remain that development work going forwards will need to address to provide as accurate and holistic an evidence base as possible.

## Trade data and traceability

All current consumption-based metrics rely on modelling to estimate trade (or ignore trade altogether). Increasing the transparency and volume of data recorded, as goods are produced and traded, especially in data poor regions, would help improve accuracy and traceability. Increasing data resolution would also be useful to understand subnational impacts. This is particularly important for impacts that vary spatially, such as biodiversity loss – if the same commodity is grown in one part of a country compared to another, it might have very different biodiversity impacts, especially in countries with multiple biomes.

## Environmental data gaps

Data on land use change beyond deforestation, or a number of other more specific environmental impact types such as nitrogen and phosphorus pollution are not currently available through the metrics presented.

## Commodity coverage

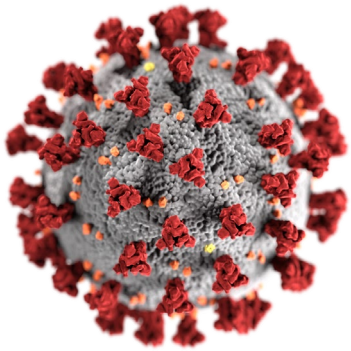
There is currently a trade-off between metrics that cover the whole economy and metrics that are able to give detailed results on the impacts of specific commodities. Understanding specific commodities can help target interventions to where they will make the most difference. Specific information on agricultural crop commodities, cattle and timber are well covered by the GEIC indicator, but more specific information about other sectors would be useful. E.g. metal and mineral commodities are likely to be a rising issue with increases in electric vehicles and the high-tech economy.


## Social impacts

Environmental impacts are not the only issues that can be embedded in supply chains. Understanding our social footprint – for example links to poor working conditions, unfair pay, disregarded land rights, etc – will also be of interest to many and important to address. This is key to avoid unintended consequences of decisions based on environmental information. Environmental conditions in production locations are heavily intertwined with local economic and social development contexts, as well as internationally determined standards. There is currently a significant lack of available data in this regard.

## Understanding the data in context

All consumption-based metrics described in this document have a data lag of several years, with the most recent ending its time series in 2018. This is due to lags in the underlying datasets. It is therefore important to note the unusual context of the years between now and then, with supply chains disrupted and consumption patterns likely to have been significantly affected by EU Exit, Covid and the war in Ukraine. As more data become available, it will be interesting to see whether trends in results are different in more recent years, although it will not likely be possible to disentangle the effects of each.



## Setting targets or monitoring against a specific policy

As demonstrated on page 4, all metrics in this document will respond to multiple and relatively high-level interventions. It is therefore not possible to use them to monitor the effectiveness of, or to set targets against, any one specific policy. Other metrics with more specific sensitivity to a given policy would need to be developed to fill this niche.

# An introduction to consumption-based metrics

**What other ways are there of considering consumption?**
Whilst the metrics explored in this document were selected due to their wide applicability at the level of a national or devolved government, a range of other ways to consider the sustainability of consumption are also available. A brief overview of a selection of these is outlined below.

## Life Cycle Analysis (LCA)

LCA considers all of the inputs (e.g. land area, water use, fertiliser use) and outputs (e.g. N, P or C emissions) across the life cycle of a product. They are most useful for comparing the pressures and impacts of products from specific production systems, about which you have high detail on the processes involved. Some initiatives have scaled up this type of thinking (e.g. through the use of weighted averages) to give global (e.g. Poore and Nemecek, 2019) or national (e.g. LC-Impact) perspectives.

## Company reporting

Companies often report on their sustainability at a high level in annual ESG (Environmental, Social, and Governance) reports. Supply chains are often complex and it can be difficult for companies to trace and report on impacts in detail. However, they are often able to do so at a more granular level than is possible if solely relying on publicly available trade data. The Due Diligence legislation currently being introduced will obligate companies above a certain size to investigate their supply chains for illegal deforestation.

## Certification and ecolabelling

Certification and ecolabelling can be used to prove that a product has met a certain standard, as specified by the certification body. Environmental examples include FSC for timber products and RSPO for palm oil. They can help consumers have confidence in the sustainability of the goods they are buying.

## Material flow accounting

Material flow accounting is an alternative way to understand how goods flow through supply chains. Rather than using financial data like MRIOs do, it bases calculations on physical records. Results can be similarly combined with environmental information to understand sustainability implications. Material flow accounting can cover the whole economy, or focus on a set of specific commodities. An example of a project that does the latter is WWF's Risky Business report, which focuses on the impacts associated with UK consumption of beef & leather, cocoa, palm oil, pulp & paper, rubber, soy and timber.

## Blockchain

Blockchain is a data structure that can verify where commodities have been sourced. It is often cited as a technology that could be useful to help verify sustainable credentials, but is not yet widely implemented.

## Scenario modelling

Whilst the metrics explored in this document estimate past pressures and impacts, many policy applications would require scenario modelling in order to understand what may happen in future given a particular policy or a particular situation (e.g. climate change, population growth). Examples include Co$ting Nature and GLOBIO.

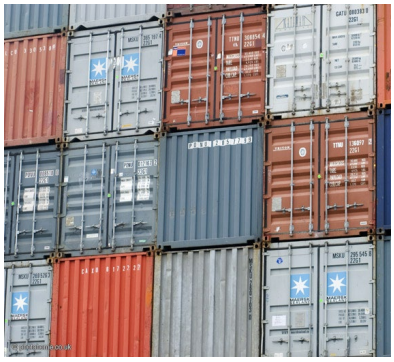
The Convention on Biological Diversity's Monitoring Framework for the Kunming-Montreal Global Biodiversity Framework has included the following as **complementary indicators** of relevance to understanding the sustainability of consumption:

- Extent to which (i) global citizenship education and (ii) education for sustainable development, including gender equality and human rights, are mainstreamed at all levels in: (a) national education policies, (b) curricula, (c) teacher education and (d) student assessments
- Recycling rate
- Life cycle Impact assessment (LCIA) e.g. LIME; Lifecycle Impact Assessment Method based on Endpoint Modelling
- Levels of poverty in developing communities

# An introduction to consumption-based metrics

## Conclusions

Consumption-based metrics are key to understanding the pressures and impacts that we put on both the environment and on the security of our supply chains. A number of different metrics are available, each of which is designed to answer a different question and can provide complementary insights that make them best suited to different use cases. Whilst the approaches used to model or account for trade differ for each metric, each metric could in theory use any of the available trade models – the part that makes them fundamentally different from each other is how environmental information is integrated and accounted for. The different methods used for each are necessary to ensure that each can meet their own use case as effectively as possible, even if this means they are then not directly aligned and comparable to each other across metrics. Results from analyses of Welsh consumption show that if the entire world population lived like the citizens of Wales, humanity would require 2.08 Earths. A number of evidence gaps remain, highlighting a need for continued development work on sustainable consumption metrics in future.



### Footnotes

1. The UK Carbon Footprint estimates the amount of carbon (in tonnes) being emitted to support UK consumption. Carbon is also an important component of the Ecological Footprint, since it is one competing demand for biologically productive space. Carbon emissions from burning fossil fuel accumulate in the atmosphere if there is not enough biocapacity dedicated to absorb these emissions. Therefore, when carbon is reported within the context of the total Ecological Footprint, the tonnes of carbon dioxide emissions are expressed as the amount of productive land area required to sequester those carbon dioxide emissions. This tells us how much biocapacity is necessary to neutralize the emissions from burning fossil fuels. Measuring the carbon footprint in land area does not imply that carbon sequestration is the sole solution to the carbon dilemma. It just shows how much biocapacity is needed to take care of our untreated carbon waste and avoid a carbon build-up in the atmosphere. Measuring it in this way enables us to address the climate change challenge in a holistic way that does not simply shift the burden from one natural system to another. In fact, the climate problem emerges because the planet does not have enough biocapacity to neutralize all the carbon dioxide from fossil fuel and provide for all other demands.
2. The UK Carbon Footprint estimates the amount of carbon (in tonnes) being emitted to support UK consumption. This includes all direct emissions, but it does not include emissions associated with land use change, which are notoriously difficult to estimate consistently and reliably. For example, if forest is burnt to create land for agriculture, the emissions from the agricultural equipment and the fertiliser production will be included, but the change in carbon stock between the forest system and the new agricultural system will not be accounted for. The GEIC indicator includes a metric that reports on the carbon emissions associated with tropical deforestation, based on estimates from Pendrill et al, 2022. This captures one element of land use change emissions. However, it does not account for all land use change emissions, only those from tropical forests. It is also based on different underlying trade methods to the UK Carbon Footprint, as land use change emissions are spatially explicit and so (similar to biodiversity) require a higher resolution understanding of where impacts were taking place than the UK Carbon Footprint does. It is therefore NOT correct to add the two together to estimate overall carbon emissions.
3. For example, the GEIC indicator has now been calculated using two different sets of data. The plan is to publish both of these in future updates to the indicator, as this will allow more countries to be able to use the data, whilst allowing those countries that are included in the more detailed dataset to continue to benefit from the more detailed data.

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