



**(TMG)**  
ThinkTankforSustainability  
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# TRUE COST ACCOUNTING AND DIETARY PATTERNS:

AN OPPORTUNITY FOR COHERENT  
FOOD SYSTEM POLICY



# KEY MESSAGES

1. For the first time, this report presents how True Cost Accounting (TCA<sup>1</sup>) can be used as a tool to assess and develop dietary policy in an innovative and systematic way. It can be used at various levels of governance of the food system to work towards human health, environmental sustainability and socially just food consumption.
2. TCA seeks to contribute to an increase in healthy and at the same time environmentally sound diets, ensuring that no part of the food system exceeds the nine planetary boundaries nor fails to meet the United Nations (UN) Human Rights goals (and thus helping to achieve the SDGs).
3. TCA can be used to analyse production and supply chain practices within different dietary patterns becoming the basis for food system-related policy action. The starting point of TCA is the analysis of existing, predominant dietary patterns and the associated hidden positive and negative aspects along entire food value chains.
4. TCA unveils externalities – the impacts of the food system that are not inherent to the listed price of the food at the point of purchase – and provides an approach to analysing the real costs of those externalized impacts.
5. The Economics of Ecosystems and Biodiversity for Agriculture and Food programme (TEEBAgriFood) systems approach provides a framework for TCA to capture the hidden positive and negative externalities along entire agri-food value chains. TEEBAgriFood takes into account natural, human, produced and social capital.
6. The idea of putting sustainable consumption at the centre of a TCA will guide the analysis and open new opportunities for policies transforming the whole food system.
7. TCA can be applied to the wide range of processing and distribution pathways and to all types of production systems and all points-of-consumption. For policymakers and practitioners alike two essential tools for TCA implementation are outlined in this report: the design of a framework and required data for a TCA analysis of diets.
8. The availability and systematic collection of data for the assessment of diets is in its infancy and needs further development. Because of very limited data availability on externalities, public-sector funded research and analysis are required to understand the full picture of food consumption and production effects.
9. The complexity of the challenge and the multitude of entry points to change food systems require coordinated public and private sector policies. TCA provides a framework for inclusive participation mechanisms and multi-stakeholder platforms, including food policy councils at various geo-political levels.
10. A TCA analysis starting with dietary patterns, assessing and valuing the entire agri-food system, and identifying real but economically invisible externalities, has the potential to provide unique support to a breakthrough in food system policies. Based on the framework further steps towards implementation must be developed.

*This report was prepared by TMG-Think Tank for Sustainability and WWF Germany and was authored by Michael W. Hamm, Olivia Riemer and Tanja Plötz. It is an adapted summary of the full report which contains greater detail and referencing. The entire report can be found online at [www.wwf-scp.org](http://www.wwf-scp.org). This summary report was made possible with the support of the German Federal Ministry for Environment, Nature Conservation and Nuclear Safety.*

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<sup>1</sup>TCA has been described by the Global Alliance for the Future of Food as: "A critical tool to help us, as a global community, better understand the impacts of food systems, address the most harmful practices, and find new, positive pathways forward. By evaluating the impacts—both positive and negative—inherent in different food systems and making these impacts transparent, decision-makers on farms and in governments, institutions and businesses can make better informed decisions that consider the economic, environmental and social impacts of their choices." [GA\\_TCA\\_Booklet\\_2019\\_Digital.pdf \(ccrp.org\)](#)

# EXECUTIVE SUMMARY

This report has a clear value proposition: the goal of True Cost Accounting (TCA) is to support the development of policies that aim to ensure that the global population can access and consume a sustainable, socially inclusive diet on a daily basis and that food and nutrition security for all becomes a reality – while not exceeding the nine planetary boundaries nor failing to meet the UN Human Rights goals. TCA is a tool for analysing diets, supply chains, production strategies, business strategies, governance and public policy.



On average, to date global dietary patterns demonstrate relatively low consumption of fruits, vegetables, plant-based proteins and whole grains with high consumption of added sugars, salt and meat. It is clear from existing science that dietary patterns, looked at as a global average, need to change. But a global average tells little about pattern changes needed in individual countries. In some countries, there is a need for significant increases across a range of foods, including animal products, and the need to eliminate various micronutrient and macronutrient deficiencies. In others, the opposite is needed – a general decrease in caloric consumption and that of specific food categories, especially animal products

These very general dietary statements, however, will have little information on the environmental sustainability or social justice/welfare aspects associated with specific dietary patterns. The environmental and social “costs” associated with food consumption and production are neither calculated nor captured, and they are thus not mirrored in food prices either. A “true cost of food” analysis can be a powerful tool for decision-making by addressing the most harmful practices of today, and illustrating new, positive pathways forward.

Both, the need for transforming food systems and the opportunities in this are huge.

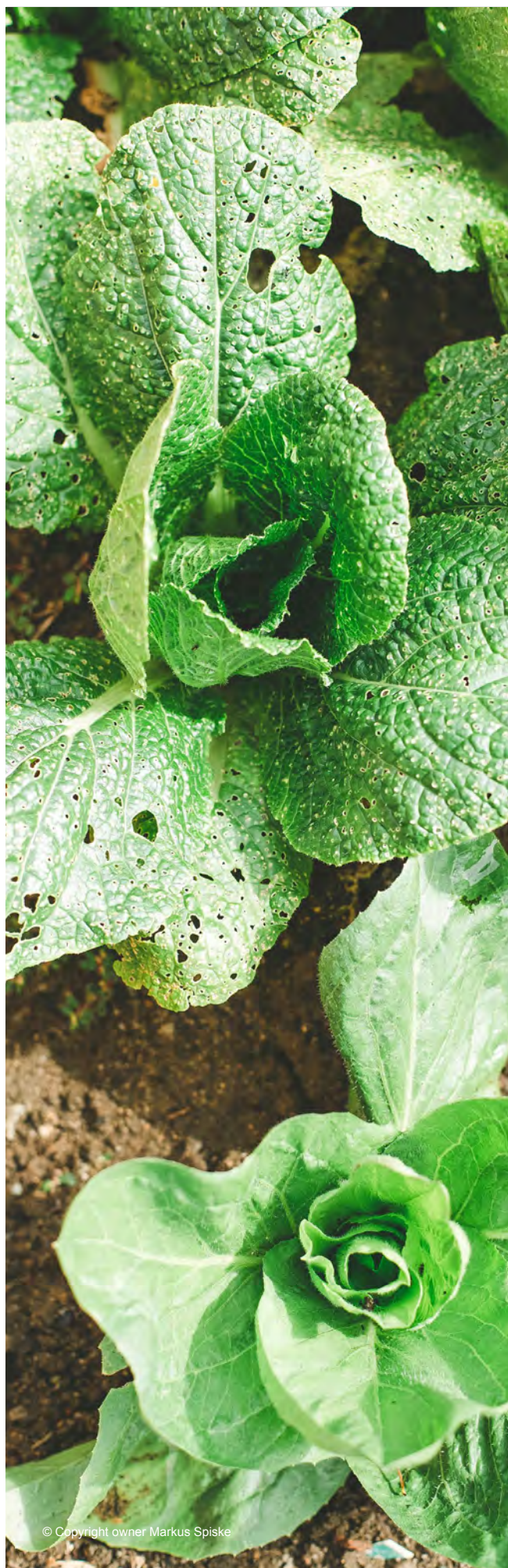


Sustainable consumption and production have been on the agenda of national and international meetings for quite some time now, but progress has been limited so far. Agricultural policies and food security/ food and nutrition policies are often made in isolation. This is no longer feasible. To achieve the objectives of sustainable development, environmental and climate goals, a dramatic policy reform is needed – one in which policy focuses on a deliberate end goal and moves backwards along a range of policy threads. This report presents for the first time how TCA can be used as an innovative and systematic tool to assess and develop dietary policy.

TCA can be used to develop environmentally sustainable and socially just food system policies. It brings to light all positive and negative externalities – impacts of the food system that are not part to the listed price of food at the point of purchase – and provides an approach for analysing the costs of those externalized impacts.

Utilizing the four capitals (natural, human, produced and social capital), TCA can be used to backtrack impacts along the supply chain to understand the external costs; the circularity or non-circularity of resources; and possible strategies for planetary health. TCA can also be used to identify externalized costs of human welfare, rights and security. It allows identification of what needs changing in order to deliver nutritious, socially just and environmentally sustainable food systems.

The complexity of the challenge and the multitude of entry points to change food systems requires coordinated public and private sector policies. Creating an enabling environment for a rapid and fundamental movement towards the goal of healthy and sustainable dietary patterns can be guided by applying a TCA. And TCA can provide a framework for inclusive participation mechanisms and multi-stakeholder platforms, including food policy councils at various geo-political levels. It can trigger a new momentum for overcoming the limitations of traditional policies.



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# TCA WITH DIETS AS THE STARTING POINT

While there is a strong theoretical framework for conducting a TCA analysis, it has not been done with dietary patterns as the starting point. Here, a systems perspective on human diets is examined, including trends in food consumption and dietary patterns as well as examples of sustainable and healthy diets.

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## THE STARTING POINT

# TCA AND DIETARY PATTERNS

These serious facts command us to start our analysis with dietary patterns as the starting point:

- High footprint dietary patterns, if globalized, would pose a serious issue as the land requirements to produce those dietary patterns are unavailable on Earth;
- A large part of the world population consumes excess calories leading to overweight and obesity – with an estimated 2.1 billion people being obese;
- The minimum costs of a healthy diet are approximately double the global poverty level income – with estimates of 3 billion people unable to afford this;
- Within a country there is often wide a variation of dietary patterns – with some being much more environmentally sustainable than others, in part depending on production practices;

- A large percentage of the population is either underfed and/or undernourished – in 2020, up to 811 million people faced hunger<sup>2</sup>;
- In general, people need to consume more fruits and vegetables, whole grains and plant-based protein while consuming fewer total calories, added sugar and added salt.

There is a wide array of externalities both negative (e.g. water contamination, greenhouse gas (GHG) release, low worker wages) and positive (e.g. carbon sequestration in some production systems) connected to dietary patterns that are not embedded in the pricing of our food. Externalities can be higher or lower depending on the production and supply chain practices for different components of the dietary pattern. A TCA framework examines these negative and positive externalities through the lens of four capitals: natural, human, produced and social capital (Figure 1).

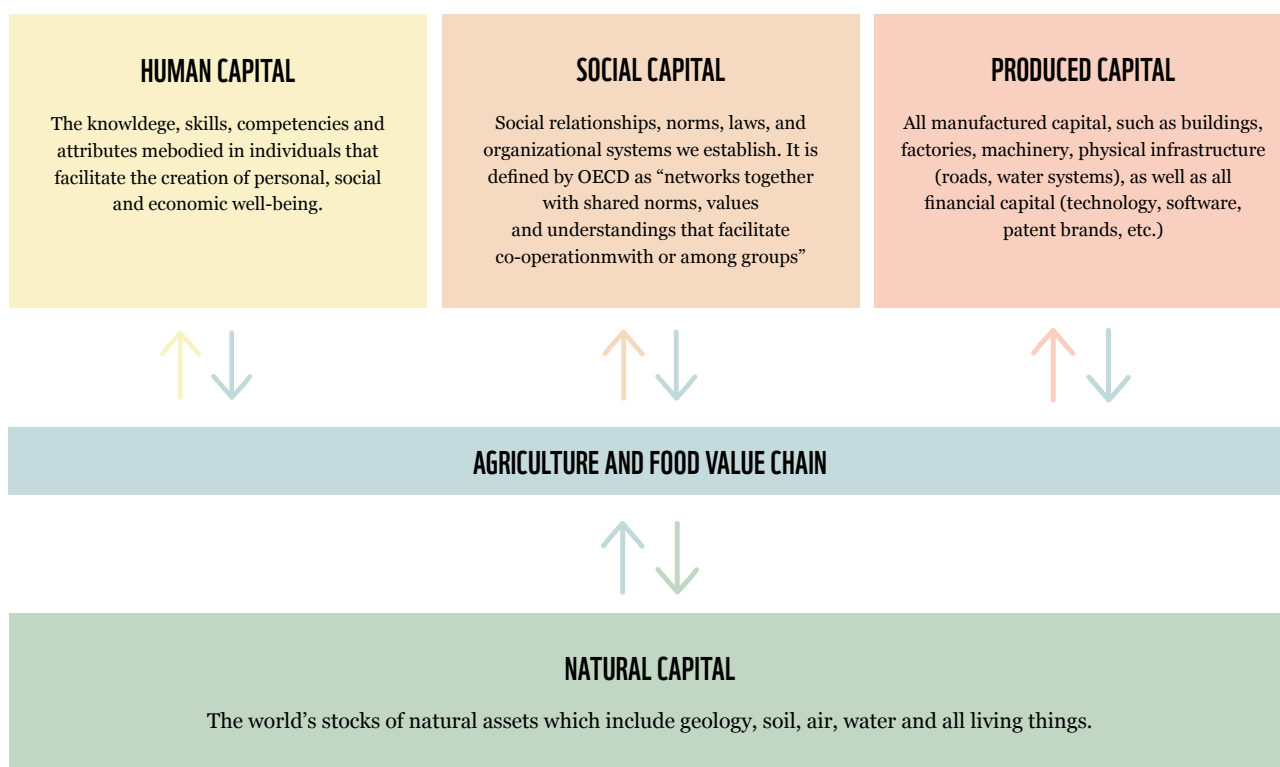


Figure 1: Natural, social, human and produced capital. TMG – Think Tank for Sustainability (2021).

<sup>2</sup>The State of Food Security and Nutrition in the World 2021 | FAO | Food and Agriculture Organization of the United Nations.





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In a food system context, natural capital is the base for food production; human capital holds the knowledge and skills to use resources wisely and at the same time generate produced capital; social capital provides the structures and guidelines for the different components to work together in a global food system, with the potential for enhanced human health and environmental sustainability. All of these should be considered while examining dietary patterns and staying within a safe operating space.<sup>3</sup>

There are a number of proposals for improving the environmental, social and economic sustainability of dietary patterns. Overall, they share one common thread concerning environmental sustainability and dietary pattern change: a need to reduce average global meat consumption – especially ruminant meats but not exclusively. This does not mean that every country needs to see a reduction nor does it mean that meat cannot be produced in an environmentally improved manner compared to much of current meat production. From a human health point of view there are other common threads among reports: a need to increase average fruit and vegetable consumption and a need to keep caloric consumption at a level to ensure healthy body weight. What is typically not addressed in these reports are human

health-related issues such as consuming more whole grains, reducing sugar and salt intake and keeping fat intake to a healthy level.

Furthermore, there are nuances to these recommendations when it comes to sustainability. For example, vegetarian and vegan dietary patterns generally demonstrate greater sustainability than a high meat diet. If water use, however, is the key consideration then under some circumstances a high-almond vegetarian diet could actually be more detrimental than high meat intake (as almonds are produced primarily using irrigated water and animal feed can be produced using rainfall). When addressing dietary patterns there are thus two aspects to consider: (i) on average dietary patterns that meet World Health Organization (WHO) standards and are relatively low in animal products (while still meeting all micronutrient needs) tend to be more environmentally sustainable when considering current dominant production strategies and production locations; (ii) within a particular dietary pattern there can be great variations in terms of environmental sustainability for various reasons. Utilising TCA can discern these variations. The ability to compare dietary patterns for negative and positive externalities is part of the power and currently unrealized potential of TCA.

<sup>3</sup> Chapter 1 and Annex II of the full report provide further details on the four capitals and associated positive and negative impacts of diets across food supply chains based on the TEEB-AgriFood Evaluation Framework. The Evaluation Framework – The Economics of Ecosystems and Biodiversity (teebweb.org) <http://teebweb.org/our-work/agrifood/understanding-teebagrifood/evaluation-framework/>

**In the context of coherent policy development around food system sustainability and social justice, it is important to understand the current status of national dietary guidelines. While national dietary guidelines are in place for over 100 countries, only a few contemplate environmental sustainability (or social welfare/justice) as part of their considerations. One of the values of TCA in analysing diets is that it allows to link human health to environmental and social health dimensions. TCA is a key tool to address the imperative that national dietary guidelines must incorporate environmental and social sustainability dimensions.**





# **TCA AS A TOOL FOR ANALYZING DIETS AND INFORMING DECISION- MAKERS**

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# ANALYZING DIETS AND INFORMING DECISION-MAKERS

Food and agricultural policy has a wide array of impacts as it shapes the range of research conducted at institutes and universities, the type of support provided to producers and industries, the direction of financial investments, and the incentives or encouragement (e.g. through prices provided to consumers) for certain dietary patterns.



Our suggestion to focus on consumption is a result of serious issues at the consumption side such as overconsumption, waste, aggressive marketing in food environments, and mainly, the fact that some consumers are ill-equipped or have little access to better diets. Public policy in food and agriculture should use consumption as a starting point – what should/ could people be eating, on average, to meet several simultaneous goals:

- staying within Earth’s planetary boundaries;
- ensuring food and nutrition security for all residents;
- reducing diseases and deaths that are the result of unhealthy dietary patterns as well as other human health issues caused by the food system;
- ensuring dignity, opportunities and liveable wages for all workers in the supply chain;
- meeting the UN Human Rights domains for all residents (staying above Raworth’s “social floor”);
- ensuring gender equity across the supply chain and for consumers;



- ensuring reasonable profit/ income for supply chain companies and primary producers (farmers);
- ensuring dignity for the animals in our food system.

The TCA tool can be used for understanding the externalities in the food system and then using the outputs from this tool to define coherent and forward-thinking policy. Dietary patterns, including inherent environmental sustainability and social equity aspects, should be the entry point for targeting coordinated policy actions related to food systems. Natural capital (using the planetary boundaries) and human/social capital (using the UN Human Rights dimensions) provide a set of social, human and environmental boundary targets.

**TCA can serve as a tool to analyse the options for a food system transition: What are the dominant patterns? What are alternative possibilities? What opportunities can be imagined given ongoing developments in science, technology and human development? What would maximize food system resilience in an unknown future? What changes in dietary patterns, in production and supply chain practices would be needed?**

This is the value of a comprehensive method of accounting, both in a qualitative and a quantitative sense – namely a TCA. The analysis informs about the desired change. It shows where change is needed (e.g.: Does policy need to

intervene regarding living wages and/or implement stronger environmental regulations?). Depending on the monetization method, different information is provided by TCA results. If a damage cost approach is used, it shows the costs/ damage by current dominant food system paradigms and alternatives (e.g., the costs of the damage one tonne of carbon is causing). If a marginal abatement cost/ prevention cost approach is used it shows the costs of preventing damage (e.g., the cost of reducing CO<sub>2</sub> emission to zero by using 100% renewable energies).

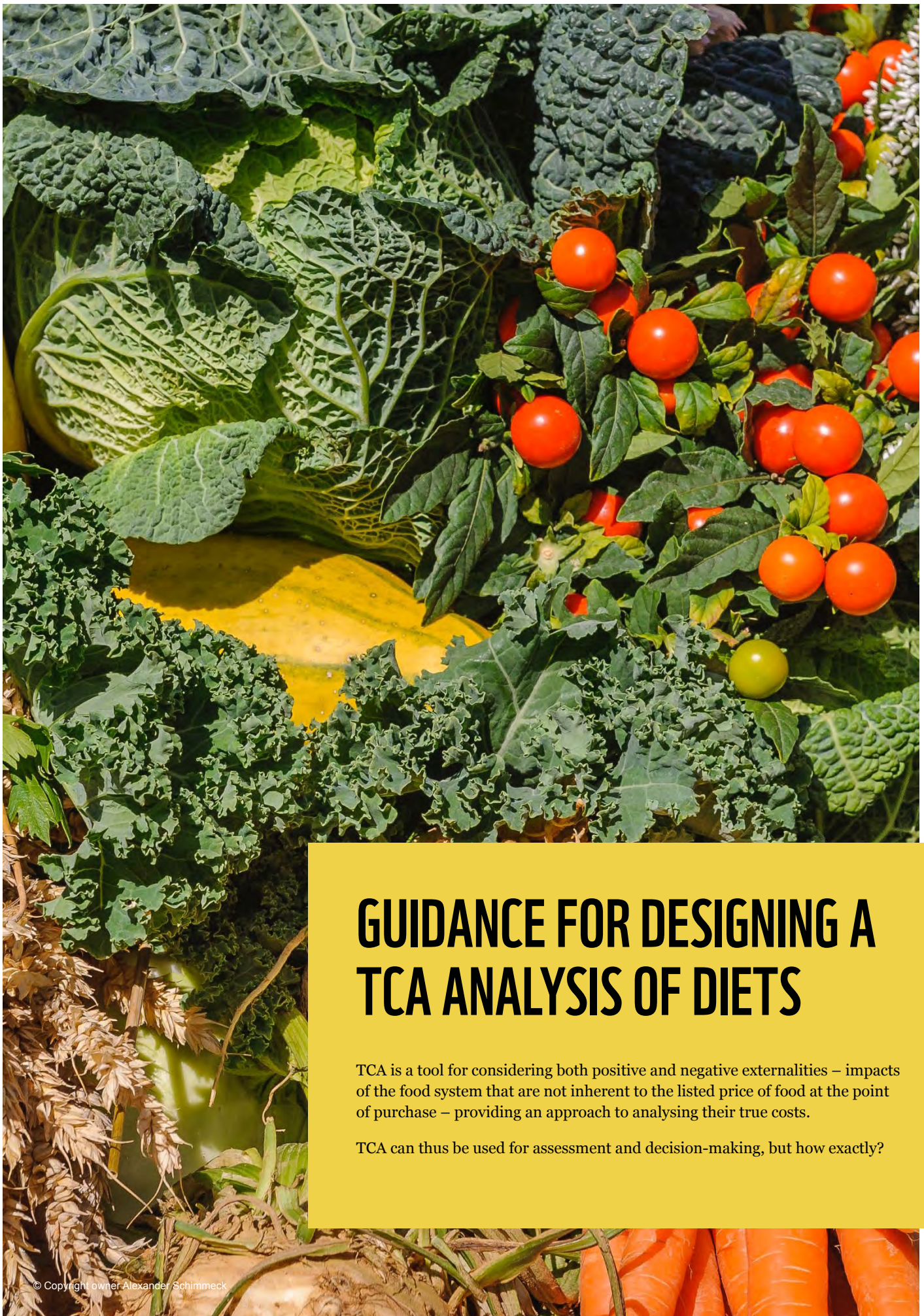
The use of TCA and TCA-like tools has so far mainly taken place in the private sector to analyse the impacts of individual products or product categories either at the firm and/or the supply chain level. TCA is used by companies to understand their environmental and human sustainability performance and identify strategies for substantial improvement. A TCA considering diets and dietary patterns is of a different nature, since no single firm (outside of retailing and some food distribution firms) encompasses the whole range of nutrition.

Hence it is the task of the public sector to undertake or fund a dietary pattern approach to understand the impacts of overall food consumption.

Within a dietary pattern there are diverse distribution channels in play given that a food's source can be global, continental, regional, national or local. A range of processing and distribution pathways, points-of-consumption (eating out vs. eating at home), production systems (e.g. conventional vs. organic) as well as variable amounts of waste need to be considered. Also, countries have varying degrees of traditional and 'modern' food systems. This is where TCA becomes extremely useful and relevant for public policy. Without a TCA approach as a standard operating procedure in public policy, regulation and law development, there will continue to be an extremely mixed record globally be an extremely mixed record globally – with some companies, some farmers and some localities performing better than others. In addition, the scattered policy situation among agricultural policy, food policy and dietary policy will remain.

**The structure of food systems varies across the globe and understanding the dynamics across and within nations is crucial. Researchers have divided ‘food systems’ into three broad types: traditional (generally low external inputs, small scale production, short supply chains); ‘modern’ (generally high external inputs, larger scale production, longer supply chains); and mixed (elements of both traditional and ‘modern’ food systems). Approximately 1 billion people eat the crops of traditional systems, about 4 billion people eat within mixed food systems, and about 2 billion within ‘modern’ food systems. It is crucial to understand the basic typology and extent of a nation’s food system mix as part of a TCA analysis.**





# GUIDANCE FOR DESIGNING A TCA ANALYSIS OF DIETS

TCA is a tool for considering both positive and negative externalities – impacts of the food system that are not inherent to the listed price of food at the point of purchase – providing an approach to analysing their true costs.

TCA can thus be used for assessment and decision-making, but how exactly?

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# THE STRUCTURES AND IMPACTS OF DIETARY PATTERNS<sup>4</sup>

Initially, dietary and food system targets need to be set. In the following scenario, a national government wants to develop a strategy for increasing annual fruit and vegetable consumption by 50% in its population, with 90% of fruits and vegetables produced in-country, ensuring equitable treatment of workers throughout the supply chain and environmental sustainability being a hallmark of the system.

This implies several threads of policy:

1. policies that provide for national food and nutrition security while generating conditions for people to consume more healthy food;
2. policies that provide incentives for farmers and others along the supply chain to produce adequate amounts over the year while doing so sustainably;
3. policies providing for equitable worker rights along the supply chain;
4. policies to ensure different scales of production have market access and reasonable returns; and
5. policies to fill research gaps and collect data on continuous improvement over time.

This includes both food produced and consumed domestically and imported food. It further means understanding all the trade-offs regarding domestic versus international sourcing.

## STEP 1: FRAME

In the first stage, the basic question to ask is: “Why is the TCA analysis being done?” In the context of dietary and food policies typical reasons are: (i) to expand the understanding of what a population currently consumes and the impacts around the four capitals as well as to identify pathways for improving dietary patterns, i.e. eliminating or greatly reducing externalities; and (ii) to develop policy that will align the food system (including production, all actions

within the supply chain, and the management of waste at all stages) and dietary patterns with markedly improved metrics in the region (e.g. national, sub-national, global), regarding environmental sustainability, human rights development and preservation, human health and social cohesion, especially with regard to democracy, power and participation. This means taking account of the stocks, flows, outcomes and impacts of various dietary patterns within the population.

The ultimate indicator of these food system impacts is represented in the food consumed, thus the starting point of the analysis is the food a population eats and wastes annually. Within a population there are a range of dietary patterns, and moral, ethical, cultural or practical considerations behind purchasing decisions. While the first step in conducting a TCA analysis is finding out what the dietary patterns in a population are (not just as averages), an important parallel step in the process is deciding the geographic boundaries for food production analysis.

## STEP 2: DESCRIBE AND SCOPE

During the second phase, the systems underlying the different components of diets are described, including agri-food value chains, processing activities, capital stocks and flows, outcomes, impacts and trends. Using vegetable consumption as an example the description starts with how much is consumed; where and how the vegetables are produced; where the vegetables are sourced from (grocery stores, local farm markets, restaurants, etc.); how they reach the market; what is used as intermediate storage; logistics and means of transport, etc.

<sup>4</sup>For a discussion of existing literature, frameworks and tools for conducting a TCA analysis on dietary patterns please refer to the full report, chapter 2.3.



STEP 3: COLLECT DATA AND MEASURE

In the third stage, data is collected on the dietary patterns under consideration and their impacts, using a number of metrics for natural, human, social and produced capital (see Table 1 below).

STEP 4: PREDICT AND ANALYSE

The fourth phase monitors secondary data and accounts for future scenarios. Regional production data will provide a sense of what is produced currently – but it will only provide a limited context for what is feasible in future given the

challenges of climate change, water stress, population growth and urbanization.

Useful questions to address include:

- 1. What do projections indicate for the region with regard to these four challenges?
- 2. How much and what kind of technologies will need to be developed to keep up business-as-usual from the perspective of production, processing and distribution?
- 3. What additional complications will this imply?

<div><p><b>NATURAL CAPITAL</b></p><ul style="list-style-type: none"><li>• Net GHG release</li><li>• Blue water footprint relative to regional water sufficiency</li><li>• Chemical use impact (ecotoxicity)</li><li>• Land use and deforestation rate</li><li>• Biogeochemical cycles (N and P)</li><li>• Biodiversity impacts</li><li>• Soil erosion</li><li>• Soil build up (and soil carbon)</li><li>• Energy sources</li><li>• Animal welfare</li></ul></div>	<div><p><b>SOCIAL CAPITAL</b></p><ul style="list-style-type: none"><li>• Size and distribution of farms and companies in the supply hain</li><li>• Power balance and capacity to organise (i.e. unionization, cooperatives)</li><li>• Ownership concentration, property rights, land grabbing</li><li>• Access to technology</li><li>• Data ownership at all levels of the food system</li><li>• Human migration laws and food system labour</li></ul></div>
<div><p><b>HUMAN CAPITAL</b></p><ul style="list-style-type: none"><li>• Human health impacts – direct and indirect</li><li>• Human rights and working conditions</li><li>• Living wages in the supply chain</li><li>• Gender equity and opportunities</li><li>• Child and elder labour</li><li>• Food and nutrition security</li></ul></div>	<div><p><b>PRODUCED CAPITAL</b></p><ul style="list-style-type: none"><li>• Mechanization, artificial intelligence, equipment based on renewable energies</li><li>• Size and distribution of processing companies</li><li>• Post-harvest infrastructure</li><li>• Barriers to market entry; concentration of know-how and resources</li></ul></div>

Table 1: A selection of metrics to mec sure impacts across the four capitals

In most cases only part of the food consumed is produced within the same region, so another question arises from this: ‘What are the climatic/water resource scenarios of our food’s sourcing area, and for the different parts of the food value chain?’ One example for predictions and analyses is distribution transportation, which is generally considered a relatively unimportant part of agriculture and the food system with respect to GHGs. However, this is largely due to averaging across the whole food system and all of production. If looked at in the context of specific dietary components (e.g. fruits and vegetables), it will become a lot more important. With regard to the supply chain we should ask ourselves: “Where do we stand right now and where can we move to over the next decade in terms of GHG release in each part of the food system?”

## STEP 5: MONETIZE/ VALUE

As a fifth step, positive and negative environmental and social impacts should be valued, so as to better understand the magnitude of impacts and to be able to compare different dietary patterns. The product of a TCA assessment of diets will likely be a combination of quantitative and qualitative results. Some factors of current dietary patterns can be monetized (e.g.: “How much does the current dietary pattern cost regarding damage to the environment, poverty, health, etc.?”). As we know a fair bit about alternatives to the dominant food system paradigm, some statements about sustainable and healthy dietary patterns can be made, such as “What does a transition to a sustainable and healthy diet cost and what are implementation costs?” Having said that, not all valuation will be quantitative. Monetization is not always feasible or suitable, which is why qualitative assessment and valuation is also important. The Happiness Index is an example of a non-monetized assessment with important implications for policy.

## STEP 6: DEVELOP POLICY ACTIONS

Finally, once steps 1-5 have been completed for the various value chains in the dietary pattern – fruits, vegetables, dairy products or substitutes, proteins, grains, etc. – they can be combined to understand the overall impact and provide the basis for comprehensive and targeted policy development.<sup>5</sup>



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<sup>5</sup> Existing resources on TCA can and should be used when applying each of the 6 steps. While none of the existing resources are designed to support a TCA analysis of dietary patterns from a policy perspective, different sources can be utilized for individual steps, such as the TEEB-AgriFood framework for a general understanding of TCA. A good overview of existing TCA frameworks, tools, databases and case studies is provided in [the online inventory jointly created by TMG-Think Tank for Sustainability and Soil and More Impacts](#).



An aerial photograph of a lush green landscape. A river flows through the center, surrounded by dense forest. To the right, there are several rectangular agricultural fields. The overall scene is vibrant and green, with sunlight filtering through the trees.

# **THE ROLE OF POLICY IN DRIVING CHANGE AND TRIGGERING SHIFTS IN CONSUMER BEHAVIOUR**

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# DRIVING CHANGE IN CONSUMER BEHAVIOUR<sup>6</sup>

To simultaneously address staying below the ceiling of planetary boundaries and above the floor of the UN Human Rights domains (and thus achieve the SDGs) radical policy change is needed.

The multitude of political instruments that can be used to effect this change fall within four broad categories:

- legal and regulatory;
- economic and financial;
- social and cultural; and
- rights-based.

In the case made in this report, these policy instruments are brought to bear from the vantage of healthy and sustainable dietary patterns and can be affected or developed at different policy levels. For example, ensuring healthy lunches for school children involves laws and regulations at the national, sub-national and local levels – and a variety of actions at each of these levels. The goal requires additional financial support as making sure that only healthy food is put on childrens' plates is typically more costly than the high calorie, low nutrient meals that are often offered today. It requires social and cultural interventions – meals should be harmonised with local culture – and it typically means some level of education of the children, their parents and the general community. It also means ensuring that all children have a right to the meal without stigmas. A good example is the World Food Program's 'Home Grown School Feeding' in 46 countries working with local farmers to provide meals for the school children in their area.<sup>7</sup>

Another point of interest is monitoring where current political priorities are set, by looking at where funding goes (research funding is a good indicator of political priorities). In the approach advocated in this report, there needs to be significant research at the level of consumers and consumption as well as up the food value chain and within agricultural production itself. With most research funding currently spent in other areas it is clear that a major shift in publicly funded research needs to occur.



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<sup>6</sup>For examples of demand-side policy interventions that make a difference and could be scalable to impact a wider range of people please refer to the full report, chapter 3.2.

<sup>7</sup> World Food Program's 'Home grown school feeding'





# FOOD SYSTEM ARENAS FOR POLICY CHANGE UTILIZING TRUE COST ACCOUNTING

TCA can be applied at various policy levels.

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# FOOD SYSTEM ARENAS FOR POLICY CHANGE

For the purpose of this exercise, dietary patterns and the use of TCA at the national level will be considered. Table 2 summarises food system arenas in which policy change will need to occur over the long run to contribute to sustainable transformation, and provides examples of how this can be informed by using TCA.<sup>8</sup>

AREAS IN WHICH SHIFTS THROUGH POLICY CHANGE WILL NEED TO OCCUR	EXAMPLES OF TCA SUPPORT
Highlighting domestic production	Analysing the externalities of not recycling natural resources
<p>Agriculture and farming incentives to stay within planetary boundaries and above the social floor – requiring a good understanding of what this means at the farm level with regard to:</p> <ul style="list-style-type: none"> <li>• eliminating chemical pollutants;</li> <li>• eliminating soil and soil carbon loss with net carbon sequestration as feasible (i.e. enhancing soil quality);</li> <li>• maintaining nutrient balance in soil and avoiding nutrient losses to air or water;</li> <li>• enhancing biodiversity in the agricultural landscape;</li> <li>• using blue water resources cautiously (surface and aquifer waters);</li> <li>• minimizing the use of mined and manufactured nutrients, with those used not escaping the agricultural landscape (either to aquifers, as surface runoff or volatilization);</li> <li>• developing non-fossil fuel mechanization;</li> <li>• living wages for farm workers and average net incomes for farmers;</li> <li>• safe working conditions for farm workers.</li> </ul>	Identifying and quantifying negative (e.g. pollutants, losses in natural resources) and positive externalities (e.g. enhancing soil quality and soil carbon).
<p>Production and supply chain incentives to stay within planetary boundaries and above the social floor:</p> <ul style="list-style-type: none"> <li>• eliminating chemical pollutants (including endocrine disrupting chemicals or EDCs<sup>9</sup> in packaging), net zero or better carbon, water use, transition to renewable energies;</li> </ul>	Identifying negative externalities (e.g., of issues such as income below living wages) and positive externalities (e.g., being above the living wage level across the supply chain).

<sup>8</sup> Some of these areas are hinted at below and discussed in more detail in the full report, chapter 3.4.

<sup>9</sup> EDCs in food supply are “an exogenous substance or mixture that alters function(s) of the endocrine system and consequently causes adverse health effects in an intact organism, or its progeny, or (sub)populations”. [Link](#)



<ul style="list-style-type: none"> <li>• living wages and safe working conditions across supply chains;</li> <li>• gender equity in treatment and opportunities across supply chains</li> <li>• developing know-how that is broadly shared;</li> <li>• governance power distribution and the ability of people at all stages of operation to participate including unionization rights;</li> <li>• circularity of nutrient and organic waste flows;</li> <li>• zero waste in the system.</li> </ul>	
<p>Ensuring that consumers are facing:</p> <ul style="list-style-type: none"> <li>• greatly reduced health risks resulting from food related diseases or chemical pollutants;</li> <li>• a food environment that ensures that the healthy and sustainable consumption option is also the most affordable one and easiest to access;</li> <li>• access to and availability of healthy and environmentally friendly food options, at all times and to all parts of society, ensuring zero food insecurity;</li> <li>• a food supply that respects cultural habits.</li> </ul>	<p>Highlighting the externalities of current food and health care systems. If extrapolated, TCA can even help identify better ways to spend health care resources as a result of avoiding costs related to a malfunctioning food system.</p>
<p>Government-funded research, innovation and development to gather details about food system externalities and to gain greater insights into those practices that stay within the social and planetary boundaries (e.g., what is needed for a net zero-carbon food system?). It follows that the economy must be recognized as an outgrowth of the four capitals and therefore kept within social and planetary limits.</p>	<p>Indicating where additional research is needed by highlighting areas lacking data</p>

Table 2: Required policy change and examples for possible TCA interventions

## DOMESTIC PRODUCTION

Ideally the global food system should become quantitatively more regional/ local in nature while still having a national/ global context and connectivity. The geographic context argues that global, national, regional, and local governance should work together proactively to organize cooperatively on this issue – minimizing or eliminating environmental degradation so as to stay within planetary boundaries while ensuring that all people are above the social floor.

## AGRICULTURE AND FARMING

In the report, we have taken organic production and processing as an example of a direction to move in developing sustainable food system. This does not imply that organic production is the ultimate or gold standard for all areas of concern. It has been shown, though, that this production practise has the potential to feed the world – under certain preconditions: a need to reduce land devoted to animal husbandry and a reduction in food waste, both needed for sustainably feeding the world anyhow. The one challenge that remains is nitrogen usage, which can partly be improved

through resource circularity – another argument for greater ocalization/ regionalization.

## PRODUCTION AND SUPPLY CHAINS

EDCs are widely used in food and agriculture within pesticides, taste and appearance enhancers, flavour preservatives and for food packaging. Among other impacts, there is strong linkage with male testicular cancer, female breast cancer, and hints to long term effects. Estimates reckon that the economic costs (health, lost productivity, etc.) of these side effects amount to about USD 217 billion in the EU (1.28% of GDP) and USD 340 billion in the US (2.33% of GDP)<sup>10</sup>. By starting from a vantage point of healthy diets and moving up the value chain, these chemicals would be banned from all packaging materials, as taste and flavour enhancers and pesticides.

It becomes clear from reports that have been published that there are a range of strategies and tools in place for policy-makers. TCA can help in quantify impacts, giving more weight to the arguments in favour of changes, and providing analyses where they are lacking – given the necessary research funding is made available.

<sup>10</sup> Exposure to endocrine-disrupting chemicals in the USA: a population-based disease burden and cost analysis

<sup>11</sup> The quote on the next page is taken from the *Farm to Fork Strategy*

As an example for a possible political setting to apply a TCA analysis starting from a diets perspective, we could look at the European Commission's 'Farm to Fork Strategy'. With dietary patterns as the entry point, it might be renamed 'Fork to Farm Strategy'. A report states that "even though the EU's transition to sustainable food systems has started in many areas, food systems remain one of the key drivers of climate change and environmental degradation. There is an urgent need to reduce dependency on pesticides and antimicrobials, reduce excess fertilisation, increase organic farming, improve animal welfare and reverse biodiversity loss<sup>11</sup>". The report outlines a wide range of supporting policy as well as the range of policies needed and promised within the EU. There are others reports for other geopolitical settings, with similar messages.



## CONCLUSION

# REDESIGNING FOOD POLICY

The diets that people consume daily are the product of a large number of complex food system factors, and they have far-reaching implications. Dietary choices determine how natural resources are managed and used, how livestock is reared and crops are grown, how many and which types of inputs are used, how much processing is done, how fair producers are paid and treated, how healthy and nutritious daily meals are, how far food has to travel, and how much waste is generated along the way. What is eaten is driven and influenced by a variety of factors, including a wide range of supply and demand side policy measures and interventions (i.e. administrative, market-based, information-based and behavioural policies).



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These policies have in large parts been developed using partial, incomplete or omitting information, often neglecting significant impacts on the environment, livelihoods and human health. A more holistic, integrated and systems-based approach is needed for (re)designing food policy that supports sustainable and healthy diets while

taking into account the true cost of food.

As argued in this report, TCA seeks to respond to this call by assessing the economic, ecological and social costs and benefits of food systems in order to provide more accurate and reliable data to policymakers.

It is also a call for more robust policies in terms of research, development and business/ consumer/ farmer support, so that the planetary boundaries are upheld and everyone stays above the social floor. While TCA is still developing, the report provides suggestions for how it can be used as a policy tool to incentivize sustainable and healthy food consumption and a broader transformation of food systems.

Overarching global strategies for food system transformation are essential to meet the Paris Climate Accord agreements and the UN SDGs. Moving from a 20th to a 21st century global food system that meets environmental and social justice goals depends on a willingness to change behaviours. National policy actions need to be coordinated across current policy silos for agriculture, food, health and environment allowing for an integrated policy approach. TCA provides a tool for assessing best-case scenarios across multiple domains.

Assessments based on TCA results are needed to create the best fitting food system leading to sustainable dietary patterns. Solutions for sustainable food systems need to be developed in the context of a global goal. This goal should ensure that every human being is able to access and consume a healthy, sustainable diet every day and in line with cultural traditions. This report proposes that political strategies should be developed starting from dietary patterns and moving backwards along supply chains to identify the most suited policy interventions. It is for the purpose of well-informed policy interventions that application of a TCA approach is recommended, to acquire knowledge on trade-offs across the potential paths of development. Strategic decision-making in a participatory governance approach will be the way forward, making sure that the food system stays within the bounds of environmental sustainability and human rights.

Since TCA is still in its infancy, this synthesis and in particular the related report outlines a stepwise approach and offers practical guidance on the design of TCA at policy level. This should help to enable the uptake of TCA as a policy guidance tool. Supporting activities, i.e. funding of further research in the field as well as provision of additional data, will be necessary for a thorough TCA analysis of diets. Caveats aside, TCA is both a necessary and useful tool for developing integrated food system policy that is serious about ensuring healthy, sustainable diets for the global population today and into the future.



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