Giving legs to handprint thinking: foundations for evaluating the good we do

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Abstract

In environmental management and sustainability there is an increasing interest in measurement and accounting of beneficial impact - as an incentive to action, as a communication tool, and to move towards a positive, constructive approach focused on opportunities rather than problems. One approach uses the metaphor of a "handprint", complementing the notion of environmental footprints, which have been widely adopted for impact measurement and accounting. We analyse this idea by establishing core principles of handprint thinking: handprint encourages actions with positive impacts, connects to analyses of footprint reductions, but adds value to them, and addresses the issue of what action should be taken. We also identify five key decisions that need to be made in performing a (potentially quantitative) handprint assessment, related to scoping of the improvement to be made, how it is achieved, and how credit is assigned, taking into account constraints on action. A case study of the potential water footprint reduction of an average Finn demonstrates how handprint thinking can be a natural extension of footprint reduction analyses. We find that there is a diversity of possible handprint assessments that have the potential to encourage doing good. Their common foundation is "handprint thinking".

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Key Points:

- "Handprints" encourage positive impact and are inherently value-laden
- Handprint thinking provides the foundation for a variety of possible handprint assessments, centred around five key questions
- Case study discusses the potential handprint of an average Finnish consumer aiming to reduce her food water footprint

Abstract

In environmental management and sustainability there is an increasing interest in measurement and accounting of beneficial impact – as an incentive to action, as a communication tool, and to move towards a positive, constructive approach focused on opportunities rather than problems. One approach uses the metaphor of a "handprint", complementing the notion of environmental footprints, which have been widely adopted for impact measurement and accounting. We analyse this idea by establishing core principles of handprint thinking: handprint encourages actions with positive impacts, connects to analyses of footprint reductions, but adds value to them, and addresses the issue of what action should be taken. We also identify five key decisions that need to be made in performing a (potentially quantitative) handprint assessment, related to scoping of the improvement to be made, how it is achieved, and how credit is assigned, taking into account constraints on action. A case study of the potential water footprint reduction of an average Finn demonstrates how handprint thinking can be a natural extension of footprint reduction analyses. We find that there is a diversity of possible handprint assessments that have the potential to encourage doing good. Their common foundation is "handprint thinking".

Plain language summary

The "handprint" has been suggested as a way of looking at the good we do, to complement the negative impacts captured by environmental "footprints". There are many ways we could try to assess a handprint, which capture different perspectives on the world, and the potential role of the handprint assessment in moving towards sustainability. This paper cuts down the definition of a handprint to three core principles, and then discusses five questions that need to be considered in designing or evaluating a handprint assessment. A case study looks at how an average Finnish consumer can reduce the water footprint of the food they eat.

1 Introduction

While the concept of an environmental footprint is already widely known and applied (Čuček et al., 2012; Hoekstra & Wiedmann, 2014; Ridoutt, Fantke, et al., 2015; Wackernagel et al., 1999), the complementary concept of a "handprint", which aims to promote action to reduce environmental footprints, is still emerging (Grönman et al., 2019; Hayward, 2010, 2012; Kühnen, Hahn, et al., 2019; Norris, 2011; Vatanen et al., 2018). The handprint emphasises an entity's positive impacts, in contrast to the negative impacts connoted by the footprint concept (Biemer et al., 2013; Goleman, 2012).

The idea of evaluating positive impacts is crucial to achieving sustainability. It is not enough to know that a negative impact is occurring - we also need to know what actions would improve the situation. While there are multiple ways of tackling this issue, this paper aims to show that the handprint provides a new angle and potential new insights.

While we discuss the handprint as a general concept, most of the application examples we refer to are drawn from water resources management. This field is the research focus of most of this paper's authors and an issue that is increasingly prominent on governmental, corporate, and individual agendas but which has not yet been examined from a handprint perspective. Focussing on this context, we note that despite remaining gaps and uncertainties, water use and water footprints are increasingly well quantified (Hoekstra & Wiedmann, 2014). Water use,

however, has such diverse impacts that the need for "integrated" water resources management across sectors - not only within the water sector - is well established. In this complex setting, it is difficult to rigorously define what constitutes a positive impact, and what actions should be encouraged. At the same time, there is a sense of urgency in the face of growing population, water needs and demand, and the realisation that humanity is not able to increase its total use of water resources sustainably for much longer, if at all (Foley et al., 2011; Gerten et al., 2013; Rockström et al., 2009; W. Steffen et al., 2015; Wada & Bierkens, 2014). The handprint concept contributes to the suite of solutions to use less freshwater or use it more sustainably (e.g. Foley et al., 2011; Molden, 2007), as it tackles head-on the issue of giving credit for positive impact. Its positive framing shifts the focus to opportunities rather than blame, and emphasises what is possible rather than what is going wrong. These characteristics make the handprint concept sufficiently attractive to warrant consideration.

As they stand, the current, diverse applications of the handprint concept do not yet provide sufficient guidance for evaluating positive impacts. There are definitions and research on the topic (Biemer, 2009; CEE, 2008; Norris, 2011; Rohwedder, 2014), including attempts to calculate handprints (Grönman et al., 2019; Kühnen, Hahn, et al., 2019; Norris, 2015). However, definitions are not always compatible with each other; and there is still confusion, e.g. about the added value of a "handprint" over a "footprint reduction". Assessing a handprint is non-trivial, e.g. quantifying the positive impact attributable to a particular action. A handprint also carries ethical implications related to whether and what action should be taken, by whom, and why. These issues need to be addressed both to ensure handprint assessments are scientifically and socially justifiable, and to reduce barriers to adoption of the concept.

We argue that to achieve sound handprint analyses, they need to be based on sound underlying principles regarding their purpose – and that the above mentioned confusion arises, at least partly, because of the need for discussion of those principles. In this paper, therefore, we aim to frame the principles for handprint *thinking*, to provide a more solid and consistent base for handprint assessments – analogously to the examination of life cycle thinking after life cycle assessments emerged in the 1990s. We identify the defining characteristics of handprint thinking, as well as the key questions to be addressed and decisions to be made in a handprint assessment. These questions and decisions highlight the variety of "handprints", each of which may be legitimate when used for different purposes.

The paper first provides a brief review of existing work on footprint reductions, handprints, and related concepts (Section 2). This forms the basis for our principles and definition of handprint thinking (Section 3.1) and identification of the key questions and decisions (Section 3.2). A simple case study (Section 4) illustrates one possible handprint configuration, highlighting some of the more subtle features of handprint thinking. In the case study we focus on the water handprint of food consumption of a Finnish consumer, though the underlying insights have broader applicability. Section 5 summarizes key conclusions and draws out implications for further research and practice.

2 Review: From footprint reductions to handprint concept

2.1 Footprint reductions

The footprint concept is well accepted in various fields (Hoekstra & Wiedmann, 2014; Ridoutt, Fantke, et al., 2015; Wackernagel et al., 1999) and widely adopted by companies,

organisations and individual citizens to measure their pressure on environment through energy, water, material or other environmental footprints. There is a variety of definitions of footprints and procedures for their calculation (Čuček et al., 2012; Hoekstra et al., 2011; ISO, 2014, 2018). For example, a water 'footprint' can either measure the amount of water used, or the impacts derived from it, as detailed in section 3.2.1 below. A specific characteristic of the footprint concept is that it can be estimated for different entities, such as a product, consumer or producer (Hoekstra & Wiedmann, 2014).

While the footprint concept and footprint assessments have been extremely useful in estimating the impact of human actions on various environmental measures, neither the concept nor indicator identifies whether a footprint is reasonable or if it can be reduced (Amarasinghe & Smakhtin, 2014). This is left to interpretation, sustainability assessment and response formulation (Hoekstra et al., 2011; ISO, 2014) and attempts to define maximum sustainable water footprints, benchmarks and caps (Hoekstra & Wiedmann, 2014). There are indeed numerous studies that estimate how a certain action or measure would reduce the given footprint or footprints (e.g. Chaudhary et al., 2018; Jägermeyr et al., 2015; Jalava et al., 2016; Shaikh et al., 2017), and those have helped and inspired societies, companies, as well as individual citizens, to find ways to reduce their footprint.

Thus, in practice, the idea of a metaphorical footprint is already used to guide actions, particularly focusing on footprint reduction: all else being equal, a higher resource use results in greater impact on the environment. To assess whether a footprint is large in relative terms, it can be compared with footprints of similar or alternative products/organisations/people. An example is the Resource Efficiency Potential Assessment (REPA) (Rohn et al., 2014), focussing on lifestyle material footprint. However, alternative definitions can lead to different conclusions about impact, and therefore about actions to be taken. Finally, reducing one footprint may cause an increase in others (Mekonnen et al., 2016; Pfister et al., 2011), raising questions about measurement and definition of the systems to be assessed.

2.2 Handprint concept – existing definitions and applications

Handprint thinking emerged in the early 2000s, apparently as a response to the concept of the footprint as well as an extension of the concept of the hand as a symbol for action (Hayward, 2010). According to Hayward (2010) and Biemer *et al.* (2013), the term *handprint* was first used more or less independently by a variety of people and groups (Biemer, 2009; CEE, 2008; Lownds, 2009; Norris, 2011; Rohwedder, 2014; A. Steffen, 2006).

As the handprint is intended to be complementary to the footprint, they share similar properties. They both measure impacts (or changes in impacts) for which an actor is responsible by a chain of cause and effect (Norris, 2011). Responsibility is shared and can therefore result in double counting that assessments must take into account (Hoekstra & Wiedmann, 2014). Impacts are measured relative to a stated resource, such that trade-offs may occur between different types of footprints. Actions and their impacts change over time, such that footprints and handprints are considered to be dynamic indicators rather than immutable or static. A key motivation for calculating these indicators is to assess how they can be improved in the future.

The handprint, however, differs from a footprint in key methodological ways, namely that the impacts it includes are subjective, social and basically unlimited. In measuring the 'good that has been done', handprints are built on normative statements on desired direction of change.

They require assessment of a counterfactual baseline, i.e. what would have happened, or would happen, without the action in question (Norris, 2011). While footprints usually focus on physical inputs to an activity, handprints also consider other causal influences, most importantly social links (Hayward, 2010; Norris, 2011). This means that influencing someone to perform an action can in principle be valued as much as actually performing the action oneself, as the action would not have been performed otherwise. In practice, this raises important questions about whose actions are included in a handprint and hence "*who should act under what conditions, and why?*" (Hayward, 2010). In other words, the handprint is directly related to the question of agency in environmental resource management and governance, i.e. the capacity and position of an actor to change the course of events or outcome of processes, with authority (Biermann et al., 2010; Pattberg & Stripple, 2008).

The inclusion of social causal influences means that handprints are not limited to reducing the footprint of an actor's activities. They also include actions that provide new benefits, or help reduce others' footprints, some commentators even seeing the latter as their primary definition (Grönman et al., 2019; Vatanen et al., 2018). Handprints may prompt actions that sustain themselves and may possibly continue to have impacts in the future. As Biemer et *al.* (2013) put it, "*there is no limit to the good you can do*." In principle this could even include companies putting pressure on competitors by demonstrating their sustainability (e.g. Guziana & Dobers, 2013). These methodological differences of the handprint compared to the footprint present significant challenges for its application, but also come with corresponding benefits, in further encouraging debate about what *should* be done, emphasizing agency of an actor, the effects of connections between actors and working 'hand-in-hand' (Hayward, 2010), and promoting thinking about positive flow-on effects in the long term.

The handprint concept has previously been implemented in a variety of ways. The Centre for Environmental Education (CEE) in India developed a quiz and suggested further actions that can be taken influencing the environment, society and the economy (CEE, 2008). The Carbon Handprint website provided the means for anyone to "*record their achievements or promises for the environment*" (Lownds, 2009). The Ecological Handprints website has similarly collected stories about actions (Rohwedder, 2014). Norris (2011) outlines principles for calculation of a handprint based on "linked event modelling", which describes how events are causally related. These ideas are partially implemented in the *handprinter.org* website, which allows calculation of a carbon footprint, pledging of handprint actions and includes indirect handprints by referring friends.

Most recently, at least two projects have focussed on developing handprint assessments for use by businesses. The Collaborating Centre for Sustainable Consumption and Production (CSCP), a spin-off of the Wuppertal Institute, is developing a handprint as a "complementary measurement of positive sustainability impacts of products" (Kühnen, Hahn, et al., 2019; Kühnen, Silva, et al., 2019), using sustainability indicators and life-cycle assessment (LCA) concepts. The VTT Technical Research Centre of Finland is coordinating development of carbon and water handprints to be used in marketing and branding. The carbon handprint is defined as the reduction of the carbon footprint of another actor, calculated according to principles of ISO 14067 Carbon Footprint (Grönman et al., 2019; Vatanen et al., 2018), while work on the water handprint is still ongoing.

2.3 Other related concepts

The handprint is not the only recent concept aiming to capture actions contributing to positive change. Examples of broader approaches include e.g. net positivity and environmental stewardship. Net positivity originates from corporate social responsibility development and emphasises designing corporate and public sector strategies, processes and products in a way that benefits more than they constrain the environment and society (NETPositive Futures & Stockholm Environment Institute, 2019). Stewardship approaches range from prioritising ecosystem health and intrinsic value (Davis et al., 2010; Lange & Shepheard, 2014; Miller & Le Breton-Miller, 2006) to developing environmentally, socially and economically sustainable resource use and governance in public interest with a focus on private sector actions (Alliance for Water Stewardship, 2019; Schulte et al., 2014).

Different applications of compensating for impacts are exemplary of more quantitative takes. Offsetting of carbon emissions by increasing carbon sinks, for example, has become a mainstream, though contested approach in mitigating climate change (Cavanagh & Benjaminsen, 2014; Gössling et al., 2009). There have also been discussions of water offsetting, but the context- and time-specific nature of water resources and water uses limits the applicability of the concept (Sojamo, 2015). Like carbon neutrality, organisational claims and targets of water neutrality have also become popular during the past decade. Water footprints of products or processes are generally impossible to bring down to zero, however, even though their negative impacts can be minimised (Hoekstra, 2008). Lately, replenishment (Rozza et al., 2013) has become a popular concept describing corporate attempts to compensate for their water use.

At a global level, the UN Sustainable Development Goals (United Nations, 2015) set an overall normative framework steering desired action whereas the planetary boundaries define the environmental limits within which humanity can safely operate (Dearing et al., 2014; Gerten et al., 2013; Rockström et al., 2009; W. Steffen et al., 2015). Defining the best practices, indicators and the contributions needed from different actors to reach the targets and stay within a safe and just operating space is a field of ongoing research and development where both the comprehensive and quantitative approaches described above meet (see e.g. the "doughnut" approach (Raworth, 2012, 2017), science based targets for climate action (CDP et al., 2019) and science and context based targets for water (CDP et al., 2017). Handprint thinking as we see it should be situated in that intersection, combining actor specific targets and systemic understanding of issue setting with comparable metrics when possible.

3 What is handprint thinking?

3.1 Key principles and definition

Based on the preceding discussion, we propose three defining principles of handprint thinking, summarised in Figure 1 and described below.

First, the primary focus of handprint thinking is to *encourage actions with positive impacts (HP1)*. There are many ways that encouragement can be provided. A handprint might be an indicator used for tracking and incentivising progress, or a qualitative description that helps to understand what action can be taken. There are also many existing techniques that can be used to encourage positive action, such as impact evaluation tools or decision support tools. These techniques can be used to support handprint assessments, but handprint thinking is distinguished by its specific focus on encouragement.

The second principle is that handprint thinking *connects to analyses of footprint reductions, but adds value to them (HP2)* (or other similar analyses of negative impacts). In most cases, we expect the connection will involve use of impact indicators, and possibly notions of indirect impacts. The connection may, however, also be at a more abstract level, for example, using the two metaphors of footprint and handprint side by side. A handprint may add value compared to a footprint analysis either because it specifically considers *doing good*, or because it gives greater attention to the action itself rather than its outcome, e.g. focuses on the process of *doing less harm*. We identify four key examples:

- A handprint may include positive impact indicators, which are by definition outside the scope of footprint analyses, e.g. helping stakeholders meet their needs (Kühnen, Silva, et al., 2019)
- A handprint may quantify the improvement to negative impacts caused by other agents, e.g. reducing the carbon footprint of another actor (Grönman et al., 2019)
- A handprint may specifically describe the actual pathways by which an improvement occurs. This necessarily extends beyond supply or value chains typically considered in footprint calculations, to the broader value network consisting of a variety of actors (Bair, 2009; Gereffi et al., 2005; Gibbon et al., 2008) influencing chain dynamics, product and resource use and impacts
- A handprint may perform attribution of improvements in indicators, that is, assigning responsibility or credit. This is out of scope of footprint calculations, but not unfamiliar, given they often consider allocation of impacts across multiple uses of a product.

The third defining principle is that handprint thinking *addresses the issue of what action should be taken (HP3)*. Encouraging particular actions has an unavoidable normative aspect, such that, unlike footprints, handprints cannot be used in a purely descriptive way. Design of a handprint assessment will typically need to consider its ethical implications (Hayward, 2010), which is why it is important to consider the alternative decisions that could be made, leading down different paths in an analysis, with different consequences as well as results (Lahtinen et al., 2017).

As an important side-note, a handprint assessment should consider all of these aspects in its design, but might operationalise only some, depending on the application context. The decisions made will still affect the suitability of the assessment for a given purpose – the analyst is not completely free to pick and choose, but our definition of handprint thinking means that handprint assessment may take many forms (also see Norris, 2015), depending on the configuration of decisions made.

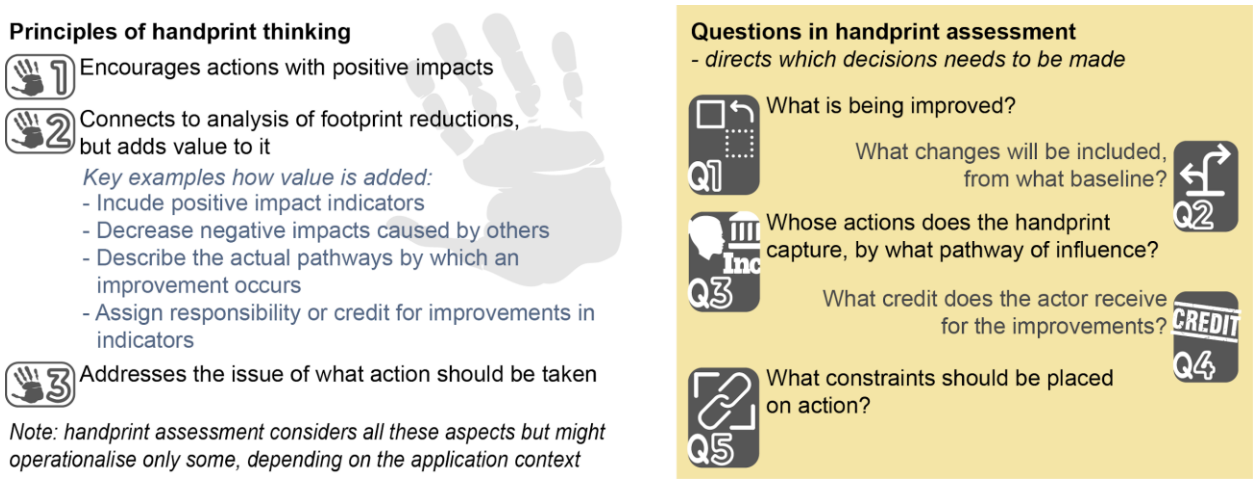


Figure 1 Defining principles of handprint thinking (HP1-3, Section 3.1), and decisions in handprint assessment, expressed as questions (discussed in Section 3.2).

3.2 Questions to be addressed in handprint assessment

This section highlights and discusses questions to be addressed and resulting decisions to be made in the assessment of a handprint (Figure 1). The questions are raised by the handprint principles. Given that there are a wide range of ways in which a handprint could be implemented, this analysis lays the groundwork for development of specific methods.

3.2.1 Question 1: What is being improved?

A handprint assessment needs to determine the scope of impact for which improvements will be investigated. This potentially includes both mitigating negative impacts and making a positive impact (Norris, 2015).

Footprints are an important class of *negative (impact) indicator* given their close relationship to handprints. Fang et al. (2016) describe a classification of footprint indicators according to "theme" and "object", while Ridoutt et al. (2015; 2015) combine both theme and object into the "area of concern" the public is interested in. We illustrate some of the issues involved using water footprints as an example. In terms of "theme", the water footprint can be considered an environmental resource footprint, as opposed to a socio-economic or emission footprint, while the concern of the public is to preserve water resources. The water footprint can be either an inventory or impact measure (Fang et al., 2016), depending on whether it only measures water consumption/use (e.g. the Hoekstra et al. (2011) method without the step of sustainability assessment), or whether it specifically captures scarcity, quality or ecological impacts on water resources, ecosystems or humans (e.g. ISO 14046 Standard).

In terms of footprint "object", the water footprint can either be calculated from a consumption or production perspective, and for any scale, ranging from product to global footprints. Therefore, the scale of the footprint to be reduced raises issues about distributional justice and trade-offs between different water uses. What is optimal at one scale and for one actor or object may not be optimal for another. There is a particular need to account for the spatial and temporal characteristics of water footprints (Guzmán et al., 2017) and accordingly,

handprints, compared to e.g. carbon footprints, which can be straightforwardly added up to global scale.

In the context of water, *positive impact indicators* may, for example, be tied to making progress on Sustainable Development Goals, providing water supply, or maintaining ecosystem health and services.

A comprehensive analysis of all indicators is generally not possible, so it is important to critically select the indicators that are relevant to the specific purpose of the handprint assessment. Analogously, in LCA, comparing impacts of products is considered a specialised task, with its own recommendations (ISO, 2006). In some cases, impacts on multiple indicators could indeed be addressed. In others, one might focus on a spatial and temporal scale where a resource is considered unsustainably exploited, or where the scarce resource is inequitably distributed. Where externalities of optimising a single indicator are known, they might be able to be addressed by constraining what changes to the indicator are permitted. Constraints are further discussed in Question 5.

3.2.2 Question 2: What changes will be included, from what baseline?

The second important decision for handprint analysis to tackle is the issue of what changes to include (Norris, 2015). What changes are counted determines what is rewarded by the handprint, such that this decision is value-laden and may be controversial.

A change in an indicator is by definition relative to a baseline scenario. The baseline scenario can be used quantitatively – calculating the difference in impact indicators, or it can be used qualitatively to single out improvements that should be measured and rewarded. Table 1 gives examples of baselines that yield handprints with various emphases. The handprints may reward different actions. Improvements over time include new innovations as well as personal improvements. Compliance with minimum standards and adoption of best practice might involve stopping violation of regulations or ceasing unsustainable practices. Noteworthy inaction includes refraining from preventing adoption of new technology. Whether these actions should be rewarded by a handprint is likely to be controversial – and is influenced by the choice of baseline.

Beyond the baseline, the scope of impact improvements considered can also change the focus of the handprint. For example, handprint assessment of past actions describes an "actual" handprint. When calculating for a future or hypothetical scenario, one could consider a handprint "potential", which can help in thinking about future improvements.

A particular point of concern when talking about reductions is the potential that they be offset by flow-on increases elsewhere, e.g. to other groups, other places, or other times. Impact improvements from one perspective may yield worsening impacts from another perspective, and, for example, a net zero improvement when combined. Analogously, reducing one group's footprint may fail to reduce or may even increase the footprint of a different group; and improvements in efficiency can enable increased consumption in a "rebound effect". These are major concerns of the argument for demand-side as well as supply-side measures to improve resource use (e.g. Butler & Memon, 2005; Hoekstra & Mekonnen, 2012).

Approaches for including flow-on effects include calculating net improvements, being careful of which improvements are included, and revisiting the selected scope of impacts to ensure the flow-on effects are appropriately accounted for. Calculating net improvements

356 decreases the resulting handprint, providing a penalty because of the flow-on effects. Whether or
357 not this is appropriate depends on whether or not the actor in question is considered responsible
358 for ensuring negative flow-on effects do not occur (also see Section 3.2.4).

359 **Table 1.** Examples of baselines from which changes in indicators could be calculated, identified
360 by the authors, prompted by ideas from a variety of disciplines. Baselines are differentiated
361 according to the resulting focus of the handprint, potential criticisms, and the actions rewarded.

			What actions are rewarded?			
Focus of handprint	Baseline	Potential criticisms	Improvement over time?	Compliance with agreed minimum standards	Adopting best practice?	Inaction?
Measure and encourage improvement over time (Norris, 2011)	Status quo, or past footprint	Past actions not rewarded May reward unacceptable outcomes	Yes	Yes, if not previously compliant	Yes, if not previously adopted	Yes, if previously opposing action
Benchmarking, encourage over-achievement	Agreed norms - Best practice - average performance - Minimum acceptable practices	Requires agreement on minimum standards	Yes, if improvement goes beyond agreed norm	No (unless average performance is non-compliant)	Depends on the norm: - No - Yes, unless best practice is average - Yes	Yes, unless inaction is explicitly condemned
Measure positive impact of actor	Scenario without actor's support - Business as usual - Actor opposing outcome	May not sufficiently encourage desired outcomes Requires credible understanding of actor's role in the system	No, until impact is net positive	Yes, if impact is net positive	Yes, if impact is net positive	Depends on scenario - No - Yes
Encourage altruism	Scenario under self-interest, e.g. Profit-maximising	Even selfish action should be rewarded	No, unless improvement was altruistic	Yes, if compliance is costly	Yes, if best practice is costly	Yes, if opposing action is profitable
Measure and encourage effort	Outcome with minimum effort	Easy actions should be encouraged	Yes, if avoiding change is easier	No, unless minimum standards are difficult	Yes, unless best practice is easy	No

362

363 3.2.3 Question 3: Whose actions does the handprint capture, by what pathway of
364 influence?

365 As noted when introducing the second principle (HP2, see Fig 1), one of the ways in
366 which the handprint concept can add value compared to a footprint reduction is by explicitly

considering agency of an actor and pathways by which an actor's actions lead to reductions in a given footprint or to other positive changes. These may cover material, information and interaction flows.

The actor in focus should be selected based on the purpose and audience of the handprint. As for footprint-based calculations, handprints could be calculated for a broad range of actors such as individuals, companies, non-governmental organisations, countries or even humanity as a whole.

The scope of a handprint is not restricted to the footprint of the actor selected, however, but their influence may extend much further. For example, an individual may potentially have a (small) indirect impact on the global footprint through the action of their country and democratically-elected representative or by being a role model for her peers. A company may provide solutions helping to reduce footprints of others or tackle e.g. a pollution problem whose original responsibility bearers are difficult to identify.

The handprint reflects differences in the agency of actors, i.e. their capacity, position and authority to act within their broader environment (Biermann et al., 2010). Compared to footprints, the handprint can also add value by encouraging individual agency and potentially increasing sense of empowerment. The handprint can also be appealing to companies wanting to showcase their advances in sustainability.

From the actor, there are a range of pathways of influence, for example resulting in water footprint reductions or other changes improving sustainability of water use and services. Bandura (2000) distinguishes between three different forms of agency: personal, proxy and collective.

An actor can act **directly** through a personal action, in which case the pathway is (seemingly) obvious.

An actor can act via a **proxy**, meaning that another entity acts on their behalf. In this case, we can work backwards from a direct change and track down the chain of influence.

An actor can also act **collectively** with others. In determining pathways, this means that influence is exerted by multiple actors in an interdependent way, each of which might in turn be influenced separately.

This distinction is however not always clear-cut, as an actor's action may be influenced by other factors. For example, the actor's scope for action may be constrained by other actors, or possible changes may be limited by infrastructure constraints or lack of availability of alternative consumption choices. Identification of pathways therefore needs to follow-up such factors, seeking to identify other actions by which the actor can further influence them. Furthermore, between actors influence usually goes both ways, making it cyclical.

Useful approaches for identifying actors and their interaction may include stakeholder analysis (see e.g. Reed et al., 2009), institutional mapping and analysis (e.g. Aligica, 2006) and value chain and network analysis, with the network extending to actors beyond producers, processors, retailers and consumers in the value chain, to technology providers, social groups, NGOs/civil society organisations, political parties, media, regulatory agencies and research institutes influencing its dynamics (e.g. Kahler, 2009; Kaplinsky & Morris, 2002). Essentially, concentration and consolidation of power in value chains and networks highlights the actors whose actions need to be changed if different outcomes are to emerge (Sturgeon, 2009).

It is not always clear what action should be taken and by whom, however. As discussed by Hayward (2010), dialogue and inaction may sometimes be more appropriate than action – and action should ideally be informed by consent of those affected. In complex global value chains and networks, well intended action may lead to adverse unintended consequences. Therefore normative constraints, as listed in the third principle (HP3) and discussed in more detail in section 3.2.5 below, should always inform the choice of handprint action to be taken.

3.2.4 Question 4: What credit does the actor receive for the improvement?

A handprint actor would not typically be considered responsible for the full improvement in impact connected with their action. In the case of *direct action*, the action may vary in effectiveness over time, there may be an element of chance involved, or the action may have been influenced by other actors. In the case of *proxy actions*, they might share credit, such that the footprint reduction could be attributed between actors. Where *action is collective*, it may be difficult to untangle the precise role of any single actor.

When not formally assigned, allocating responsibility is a difficult problem and can change the meaning of a handprint assessment. From a quantitative perspective, the problem is to identify the portion of the footprint reduction attributed to the actor, addressing interactions between actions which may cause synergies, trade-offs and risk double-counting. From a qualitative perspective, the issue is to determine who should be rewarded, and hence influence which actions an actor is encouraged to take. How these problems are dealt with therefore reflects different perspectives on influence and power relations.

In Table 2 we propose six alternative approaches, prompted by work in a broad range of disciplines. In a footprint context, every actor is responsible for their own activity and the associated value chain. Focus is on objective measurement of the role of an actor. However, optimism may be preferable over realism when faced with obstacles, and a handprint might be used for other purposes, e.g. to specifically encourage collective action or personal reflection, to provide targeted incentives, to establish benchmarking standards, or to encourage innovation.

3.2.5 Question 5: What constraints should be placed on action?

The fifth question to be addressed deals with limitations that should be placed on action – for example, what should *not* be done in the pursuit of efficiency. The constraints should capture what outcomes or processes are considered unacceptable for different handprint actions and for different actors involved across the value network. Constraints can be either quantitative or qualitative. The first are primarily associated with outcomes and achieving a particular function while the latter are primarily associated with issues of equity, justice and sustainability.

A key aspect of quantitative constraints involves verifying that after applying handprint actions, essential objectives are still achieved. In LCA, the new scenario would have to provide the same *function* as the baseline in order to provide a fair comparison. A "*functional unit*" (ISO, 2006; Weidema et al., 2004) quantitatively defines the outcomes that need to be achieved, ensuring that the new product or service provides at least the same benefits as the original. The focus on function allows a broad range of freedom regarding how that function should be achieved. The constraints can therefore be potentially very broad, e.g. providing a certain level of nutrition, or an absence of under-nourishment. At the global level, actions could be constrained within planetary boundaries and a safe and just operating space for humanity (Dearing et al., 2014; Raworth, 2017). At a local level, constraints might more specifically relate to water for

environmental flows, basic needs and livelihoods. In any specific handprint application, the primary focus of a functional unit is likely to be on the delivery of a particular product or service through a clear value chain, as is usually the case in LCA (ISO 14040/14044).

Table 2. Examples of criteria for allocating responsibility and reward, differentiated according to intended focus of handprint, identified by the authors, prompted by ideas from a variety of disciplines

Focus of handprint	Criteria for allocating responsibility and reward	Potential criticisms
Measure role of actor	Causal attribution – identify causal links, what would happen without actor, Linked Event Modelling (Norris, 2011)	Causal links in social context are highly uncertain, and potentially ambiguous, e.g. who is responsible for outcome of a vote? May lead to a sense of disempowerment Individualistic perspective
Encourage solidarity, cooperation (collective action, Hayward, 2010)	Group identity attribution - Actor receives credit for action of groups they belong to	Objectively assessing belonging may be controversial Potential for manipulation or overestimation of handprint Collectivist perspective
Social learning about roles of actors (reflection)	Perceived agency attribution – actors assign credit based on role they think they had	Only useful in limited contexts
Encourage action, sense of self-effectiveness (targeted incentives)	Agency promotion attribution – assign credit to encourage specific actions, e.g. consistent with a well-functioning, equitable democracy	For management purposes, it is the effect that should count, not the effort made (Hoekstra, 2008)
Benchmarking (establish standards)	Any consistent allocation rule, as used in LCA, e.g. based on physical quantities involved, or economic value added - who pays most should get most credit	Potentially perceived as arbitrary or biased if justification is not accepted
Encourage innovation	Problem solver attribution – credit to actors contributing an innovation that reduces others' impacts (Grönman et al., 2019)	Plays down difficulty of adoption of new solutions Does not encourage taking ownership of problems one causes

Focussing only on quantitative constraints easily limits considerations to outcomes and resource use efficiency, however, when considerations of the process of achieving outcomes as well as distributive aspects of the outcomes are of equal importance for achieving sustainable and just impact. Besides quantitative water use aspects within a value chain, water handprint action should take into account broader aspects of sustainability and good governance in the associated network that should be enhanced or, at minimum, not be violated. Sustainability covers meeting environmental, social and economic needs, including preserving livelihoods. For water handprint action to be legitimate, i.e. justified and exercised with authority (Bodansky, 1999), it must fit with the dominant discourses of the society and institutional traditions, but be sensitive to issues of power, equity and justice within them (Fuchs et al., 2015; Karlsson-Vinkhuyzen & Vihma, 2009; Sojamo, 2015).

The choice of constraints interacts with all the other implementation considerations raised in the preceding sub-sections. They determine whether it is acceptable to focus on reducing a

selected footprint and whether the given action can be considered as an improvement (Question 1 & 2). If focussing on the footprint might cause externalities, constraints can be used to mitigate them. The changes achieved (Question 1), baseline (Question 2) and actions taken (Question 3) should be permitted and feasible according to the constraints selected. The attribution of credit to the actor (Question 4) should be consistent with the values espoused by the constraints. The need for all elements to be consistent with baselines prompts a need for an iterative approach to the development of a handprint. Fixing inconsistencies with one element may cause ripple effects that require changes to the answers selected to any other question.

4 Case study

The way handprint thinking is operationalised may be quite obvious, or subtle. Our main case study, below, emphasises some of the more subtle aspects. To put it in context, we contrast it with a previous publication that illustrates some of the more obvious and intuitive benefits of handprints. Grönman et al. (2019) calculate the handprint of a renewable diesel producer, measured in terms of the reduction in the carbon footprint of their customers. The focus is therefore on reducing the harm done by others, and hence achieving a net positive outcome. The handprint is presented as a single indicator of positive impact for use in communication with specific customers or customer segments. Given the aim is to provide a simple and effective marketing tool, the other aspects of handprint thinking are only touched upon: the producer is given 100% of the credit for the customer's footprint reduction as a result of the customer purchasing their product instead of an alternative of equivalent function. While the calculation includes multiple carbon footprint reduction mechanisms, the handprint does not consider other more complex pathways or constraints on action. The approach of Grönman et al. (2019) is summarised in the second column of Table 3.

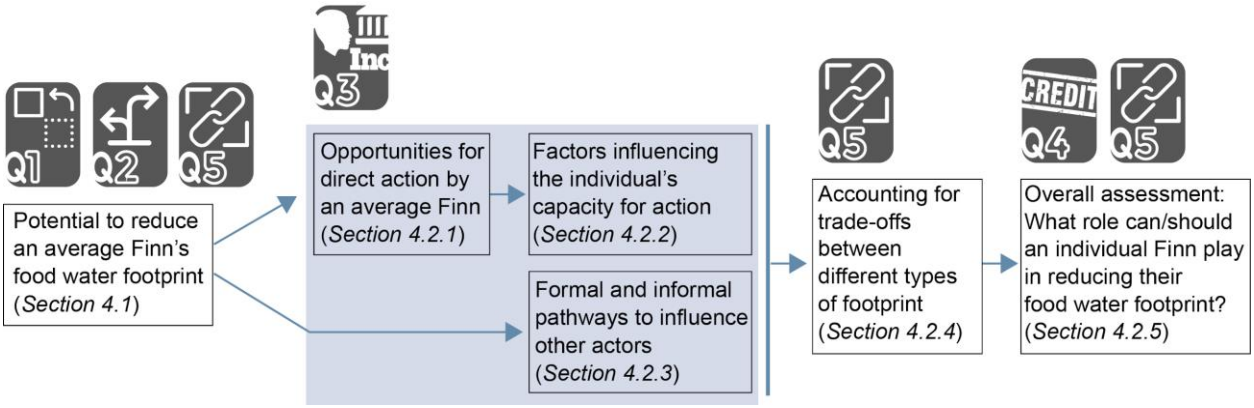
In contrast, our case study focuses on handprint thinking as it relates to reducing a final consumer's own footprint, and combines a quantitative analysis and qualitative discussion. We therefore demonstrate how a footprint reduction analysis can be extended into a handprint analysis, adding value by connecting to qualitative understanding of how action actually occurs, and assigning responsibility and credit. Specifically, we provide a discussion of the pathways an individual could take to achieve footprint reductions.

The case study is divided into two parts, respectively answering the questions:

- *Quantitative footprint reduction analysis*: What is the potential to reduce the global food water footprint of an average individual in Finland?
- *Qualitative analysis*: What role can and should an individual Finn play in reducing that footprint?

Figure 2 summarises the structure of the qualitative analysis. We first identify the direct actions that influence the footprint, and then put them in context by considering the constraints on individual action and the formal and informal pathways to achieve indirect action. In order to address issues relating to boundary of the analysis, we then explicitly discuss the trade-offs involved when the individual Finn is trying to decide what action to take.

In order to avoid interrupting the flow of the case study section, the questions and decisions in the design of the handprint analysis are only implicitly discussed in the text, but are explicitly summarised in Table 3.



513

514 **Figure 2.** Summary of case study structure, discussing the pathways an individual could take to
515 achieve footprint reductions

516

517 **Table 3.** Summary of decisions used to assess handprint in illustrative examples

Principle / Question	Decision in Grönman et al. (2019)	Decision in our case study
HP1: Encourages actions with positive impacts	Supports marketing for organizations "providing products that reduce the footprints of customers"	Encourages reflection on what an individual can do, combining quantitative analysis of footprint reductions with qualitative analysis of the role of an individual. Specifically: • What is the potential to reduce the global food water footprint of an average individual in Finland? • What role can and should an individual Finn play in reducing that footprint?
HP2: Connects to analysis of footprint reduction, but adds value to it	Calculates reduction in footprint of other actors rather than their own	Describe the pathways by which reduction in an individual's footprint could occur, and the role an individual can play, including potential trade-offs with other impacts
HP3: Address the issue of what action should be taken	Assumes that reducing (carbon) footprint is inherently beneficial	Limit footprint reductions based on ethical considerations (Section 4.1), and discuss constraints on individual's actions (Section 4.2.2)
Question 1: What is being improved?	Transportation carbon footprint, calculated using LCA methods, for the annual kilometres driven by a logistics operator in Finland	Individual's food water footprint, for an average person in Finland
Question 2: What changes will be included …	Switching transportation energy source - to a specific renewable diesel product	Changes throughout food value chain: i) Reduction of total consumption, i.e. shift to recommended diet ii) Change in distribution of consumption to less water-intensive products, i.e. a maximum of 25% of protein from meat products, and a maximum of 8.3% of protein from meat iii) Reduction in the footprint per unit of the product itself, i.e. improvement of water productivity iv) Halving of waste and loss occurring in the production, distribution and consumption of the product
… from what baseline?	Status quo: average diesel fuel sold and used in Finland in 2016, including 12% bio-based diesel	Status quo: current diet in Finland We verify that it already meets dietary energy demand, and that no additional footprint is needed to meet health requirements.
Question 3: Whose actions does the handprint capture, by what	Energy producer: the renewable diesel producer's impact by selling	An individual acting directly, and indirectly, through formalised and informal pathways, focussing specifically on conditions in

Principle / Question	Decision in Grönman et al. (2019)	Decision in our case study
pathway of influence?	the renewable diesel product	Finland
Question 4: What credit does the actor receive for the improvements?	100%, and the consumer explicitly does not receive a handprint for reducing their own footprint. (Other actors involved are not considered, e.g. the producers of used cooking oil, the fuel distribution system, regulatory authorities.)	Discussed qualitatively, drawing on analysis of pathways of influence (Section 4.2.5), as a contribution to advancing handprint understanding
Question 5: What constraints should be placed on action?	The new fuel provides the same function and purpose (annual kilometres driven), and accounts for the whole life cycle "from well-to-wheel". (Other impacts of switching products are not considered.)	When calculating total footprint reduction, we impose the requirement of absence of undernourishment (overeating is tolerated), involving meeting dietary energy demand, and meeting minimum FAO and WHO nutritional guidelines (Jalava *et al.*, 2014) Other constraints are discussed qualitatively

4.1 Potential to reduce an average Finn's food water footprint

We focus on reducing the average annual food water footprint of an average individual in Finland. The water footprint of food production is selected as a prominent sustainability issue. There is significant pressure on water resources globally (Kummu et al., 2016; Liu et al., 2017; Mekonnen & Hoekstra, 2016; Wada & Bierkens, 2014), and food production is identified to have the largest share of our consumptive water use, varying between 75% and 95% of the entire global water consumption by humans (Kummu et al., 2016; Wada et al., 2011) . The necessary data is readily available at country scale, including average consumption of foodstuffs collected by FAO (2013a), water footprint data for the corresponding products (Hoekstra & Mekonnen, 2012; Mekonnen & Hoekstra, 2011), and existing analyses of water reduction strategies (e.g. Jägermeyr et al., 2017; Jalava et al., 2016; Mueller et al., 2012; Wada et al., 2014).

Our choice of case study provides an easily relatable and replicable example. Rather than selecting an average global individual, focussing on a specific country allows the case study to start examining the effects of global links, including the values and norms involved, issues related to distribution of resources and food worldwide, value chain management and governance, and concerns about proper process in international diplomatic and trade relations. Indirect impacts on water resources due to imported food are of particular interest in Finland, which is otherwise water rich and its water resources arguably underused (Lehikoinen et al., 2019). Means of influencing those impacts are therefore also important to consider. We are only considering one narrow indicator, so it will be important to qualitatively evaluate potential side-effects of actions.

We focus on four changes in the food supply chain that affect the water footprint, with both a moderate and a high-intensity scenario, as listed in Table 4. Our baseline is the water footprint of the current diet in Finland, with the aim of quantifying potential future improvement. The calculation is based on Kummu et al. (2017).

We ensure that both the baseline and the scenario with changes fulfil the same function, namely absence of undernourishment. The diet must meet minimum dietary energy requirements as well as macronutrient limits defined by FAO and World Health Organisation (WHO) nutritional guidelines, as used in Jalava *et al.* (2014). Overeating is allowed, as it occurs in the

548 baseline. The average Finnish diet has a marginally too high energy intake (2578 kcal/cap/day;
549 compared to the limit of 2550 kcal/cap/day), and a too high fat intake (40% relative to a limit of
550 30% of energy intake), notably due to high consumption of dairy products. We checked that the
551 water footprint of the baseline is higher than with the recommended diet, ensuring that the
552 handprint will reward reduction of overeating, and will not penalise eating healthily.

553 The actions selected cover large parts of the food value chain and network, facilitating
554 discussion of the role of an individual Finn. However, there are a number of changes that have
555 been deliberately avoided. We do not consider actions that would clearly shift the burden of
556 resource use onto others, e.g. reserving the most resource efficient land (and products) in the
557 world for the average Finn at the expense of others. We only consider changes that preserve
558 diversity and freedom of choice, hence ruling out a completely meat-free diet for the entire
559 population, for example. We avoid radical changes to the functioning of society, e.g. to reduce
560 food losses to zero or completely close yield gaps. Other constraints that affect *how* the changes
561 are achieved are discussed in Section 4.2.

562 The total footprint reduction (Table 4) is 51% in a moderate scenario and 69% in a high
563 scenario. Our choice of an individual's footprint as an indicator does not allow for any offsets to
564 be included in this calculation, and we ignore potential rebound effects by which the reductions
565 would at least partially disappear over time. This is important to account for in future studies of
566 handprint assessments. An average Finn cannot single-handedly reach this outcome. Handprint
567 thinking is needed to help understand how this footprint reduction can be achieved, and what role
568 the average Finn can play.

569 **Table 4.** Reduction in an average Finn's food water footprint (expressed as percentage changes).
570 N.B. footprint reductions are not additive. Results are adapted from Kummu et al. (2017).

Action	Moderate scenario	High scenario	References
Baseline - Original diet (OD)	0%	0%	(FAO, 2013a)
Recommended diet, avoiding overeating (RD)	-19%	-19%	(Jalava et al., 2014, 2016)
Diet change – reduction in overeating and animal protein (i.e. includes RD)	-33% (reduction of animal protein intake to 25% of total intake)	-37% (reduction of animal protein intake to 12.5%)	(Jalava et al., 2014, 2016)
Food waste and loss reduction	-5% (25% loss reduction)	-10% (50% loss reduction)	(Kummu et al., 2012), (Jalava et al., 2016)
Yield gap closure Nutrient supply and management Integrated farm water management: Enhanced irrigation efficiency & rainwater management	-24%	-44%	*Moderate*: a) & b): (Mueller et al., 2012) *High*: a) (Fader et al., 2013) b) (Jägermeyr et al., 2016)
Change in footprint from baseline	-51%	-69%	

4.2 What role can/should an individual Finn play in reducing their food water footprint?

After identifying the potential to reduce the global food water footprint of an average individual in Finland, we now focus on what an average Finn can do to reach the reduction, and what they should do to contribute to positive change. According to Statistics Finland (2019), an average Finn is female, 42 years old, is in a relationship and has at least one child, lives in a small detached house in an urban area, has at least a lower-degree level tertiary degree, earns 3500 €/month, votes in elections, eats more meat and animal products than the national recommendations, often has lunch at a workplace cafeteria, and is responsible for food purchases and cooking. For the purpose of the case study, we consider her role in the value chain to be primarily a consumer. Farmers, corporate executives, researchers and policy makers would have a different agency.

In order to add value to the footprint, consistent with Principle 2 (Figure 1), we next discuss the different opportunities for action and pathways of influence she can take.

4.2.1 Opportunities for direct action by an average Finn

The individual's opportunities for reducing her food water footprint are generally determined by her role as a consumer in the value chain. For instance, the individual's actions can rarely contribute to reduction in the footprint of the product itself (improvement of water productivity), except by choosing an equivalent but more efficiently produced product. However, this action might shift the environmental burden of the original product onto other consumers and is therefore not considered in our footprint reduction calculations. As the average individual in Finland is responsible for the household food purchases and cooking, her direct pathways of influence include a shift to the recommended, healthy diet (i.e. in the Finnish context, limiting overall dietary energy and fat intake; see Section 4.1), shift to a less water-intensive diet (i.e. limiting the consumption of animal-based foods) and reducing food waste at home and when eating out. Concrete ways to reduce food waste include, for instance, buying only what is necessary, planning meals in more detail, shopping more frequently, storing food properly and considering expiration dates as suggestions rather than strict rules (FAO, 2013b). To some extent, the individual can also influence food waste reduction at the retailer, e.g. by selecting less desirable products that are likely to end up as waste, such as soon-to-be expired products. Our focus here is on action affecting the footprint of consumption - we assume that if consumption decreases, production will decrease too, and along with it, water use and stress.

4.2.2 Factors influencing the individual's capacity for action

Even with actions that seem very personal, such as diet change, the individual's capacity for action can be limited by a number of factors. Allergies and other health issues may exclude certain foods. Consumer choices are constrained by distributors' selection of products, which are further regulated by national and international policies and trade. Finland is part of the EU, which has common agricultural policy and markets and aims to ensure free competition in consumer goods market for the benefit of the consumer. Even when assuming an unlimited selection of products, the individual may be limited by availability of and access to reliable knowledge on diet recommendations and water footprints of different foods. Awareness of water footprints is growing, but Finland still lacks a reliable labelling system for them.

Economic incentives and decision-making biases, such as moral licensing (Tiefenbeck et al., 2013), are among the subtler constraints. For instance, buying groceries is often cheaper in

bulk and lunch restaurants tend to offer all-you-can eat buffets, creating economic incentives to buy larger quantities of food and potentially leading to higher consumption or more food waste. Similarly, pricing of food rarely reflects the water or other environmental footprints of products. In some cases prices simply reflect production costs, but often the perverse incentives (from the viewpoint of water footprint reduction) can also be due to agricultural subsidies. In Finland, meat and dairy production are heavily subsidised by EU and national agricultural support (Niemi et al., 2014). Cognitive biases play a role in e.g. self-service eating settings, where larger plate sizes have been shown to increase food waste (Kallbekken & Sælen, 2013).

4.2.3 Formal and informal pathways to influence other actors

Other actors in the value chain and broader network that are easily accessible by an individual in Finland include governmental and municipal actors, Finnish companies including farms, non-governmental-organisations and other Finnish individuals. Actors abroad may also be accessible but in many cases indirectly. An individual may influence them in formal and informal ways.

When it comes to formal pathways of influence, an individual may influence legislation by voting at parliamentary, EU or municipal levels. Finnish government and the EU support domestic agricultural primary production by different means, such as agricultural subsidies, taxation and advisory services (Niemi et al., 2014). In addition, the Government and State Treasury provides information and instructions for the municipalities about setting the criteria for sustainability in public procurement competitive bidding process. Finland has a public health and educational system, where daily meals are provided from kindergarten to upper secondary school, from public offices to hospitals. If the public procurements are directed towards local and plant-based raw-materials, the individual's water footprint is reduced and remains in Finland.

Informal pathways of influence include civil society and consumer activism demanding and supporting (e.g. by financial means) more sustainable water use and stewardship practices along food value chains, from farms to processors, retailers and restaurants. Information dissemination in general is another option for advancing more sustainable water footprints and diets and may take place publicly or privately.

- **Public discussion:** An average Finn may take a stand on the water footprint issues in public, i.e. in social media or organize or attend public demonstrations to influence actors in charge. She may also share information provided by reliable actors, e.g. public and private research institutes that provide information about proper nutrition values and the possibilities to eat more sustainably.
- **Private discussion:** The individual normally has an influence on her family and friends. By her own behaviour, an average Finn may support the similar behaviour of those close to her, and in that way support the general opinion in public.

By supporting the positive attitude towards water handprint thinking and reducing water footprint, an individual informally supports the actors actually responsible for direct actions towards reducing the water footprint of her own diet.

654 #### 4.2.4 Accounting for trade-offs between different types of footprints

655 The calculation of potential water footprint reduction carefully ruled out certain extreme
656 trade-offs, e.g. eating healthily increasing the water footprint, and reserving resource efficient
657 land at the expense of others (Section 4.1). Specific footprints, however, inevitably address a
658 specific area of concern (such as protecting water resources in the water footprint) and do not
659 cover the full set of environmental concerns (Ridoutt, Pfister, et al., 2015). The individual
660 therefore still faces trade-offs in their pursuit of a higher handprint.

661 When improving water productivity (24% reduction in water footprint for moderate
662 scenario, Table 4), the risk of burden shifting is high: global assessment shows that in general,
663 water and land footprints are at a tradeoff (Pfister et al., 2011). Two principles can help
664 understand this: (1) if we irrigate, we can increase yields and thus land use efficiency (reducing
665 land footprint) and vice-versa. (2) On the extreme side, one can irrigate the drylands with little
666 land use impacts or cut-down rainforests and cultivate crops without irrigation but high
667 ecosystem damage. Similarly, trade-offs with carbon and water footprint occur (Berger et al.,
668 2015), e.g. regarding whether to encourage energy-intensive greenhouse production of tomatoes
669 in Northern Europe vs. irrigation in water-scarce Spain (Page et al., 2012).

670 An individual could make her own mind up about how to maximise the impact of her
671 efforts. Unless she is well informed (including about the needs and desires of other stakeholders),
672 it may, however, be better to provide support to other institutions to make the decision on her
673 behalf. Weighing competing consequences is, after all, one of the purposes of a democratic
674 government and active civil society.

675 #### 4.2.5 Overall assessment

676 In summary, there are a broad range of actions that an average Finn can take in reducing
677 her food water footprint. Given the importance of diet change in particular (33% reduction in
678 footprint in the moderate scenario, Table 4), an individual can take charge of a large portion of
679 the potential reduction (Section 4.2.1). Individuals that do so should be given full credit for this
680 improvement, to reward and encourage this behaviour. At the same time, the individual cannot
681 be held individually responsible for achieving the change, given the constraints on her (Section
682 4.2.2). The potential handprint described here provides an aspirational rather than critical or
683 judgemental benchmark.

684 There is also a substantial portion of the food water footprint reduction that the individual
685 Finn cannot achieve directly (including 24% reduction through yield gap closure in the moderate
686 scenario, but also food waste reductions along the supply chain). However, as our handprint is
687 measured in actual change in water footprint, it is not enough for the individual to promote
688 interest in the topic, but her actions need to translate into tangible outcomes for them to be
689 counted. The footprint will only change if production practices actually change too. This is an
690 all-or-nothing situation - if change is successful, the individual Finn should be given credit
691 commensurate with her effort, but effort alone is not sufficient. This provides a powerful
692 incentive to work collectively (Section 4.2.3). This part of the Finn's handprint is not about
693 individual action, but effective collaboration with other actors at different stages and levels of
694 food value chains and governance.

695 Importantly, not all actions are permitted. Placing illegitimate pressure on producers is
696 not a permissible solution (e.g. destruction of property). Trade-offs mean that some actions will

come at the cost of increased footprints (or reduced handprints) in other areas (Section 4.2.4), and in Section 4.1 we noted that not all direct actions the average Finn can take to reduce her footprint are credited either. Measuring and achieving a handprint is not just about doing more, but about doing more of the right things, from both an ethical and system-wide perspective.

We conclude that it is within the capacity of the individual Finn to achieve the entire 51% or 69% footprint reduction of the moderate and high scenario (although a substantial portion of the reduction will require collective action and influencing other actors) and she should be encouraged (and credited) in seeking to achieve this potential handprint. The path to achieving it is nuanced and accountability is asymmetric: success is attributable to (every) individual, but the burden of "failure" (at any particular moment) is shared by society. In short, as long as the individual stays within permissible actions and has weighed the trade-offs involved, according to this handprint there is no downside for the average Finn to try to achieve change.

5 Discussion and Conclusions

Handprints are emerging as a promising tool in the search for promoting improvements in sustainability. Drawing attention to the positive may be a more powerful way of achieving impacts than focusing on the negative alone. Instead of paralyzing, a positive approach provides encouragement by making improvement opportunities visible and reachable in the face of global grand challenges, such as climate change, water crisis and biodiversity loss. This is a critical consideration as achieving true impacts has become more and more urgent with regard to many environmental problems. Recognizing this potential of handprints – but also the lack of clarity surrounding them – we set out to examine and clarify the foundations upon which handprints rest, with the objective to advance the development and application of handprints.

Accordingly, we provide a structured and systematic examination of the broad phenomenon of handprints, going beyond its visible manifestations to the underlying dimensions and choices. We put forward and discuss a number of important distinctions that serve to clarify handprints: we separate handprint thinking from the actual handprint assessment, outline principles for handprint thinking, and identify questions that need to be addressed in handprint assessments. Throughout, we illustrate our analysis with examples from freshwater use as related to food production, a centrally important context for environmental protection and an issue that is increasingly prominent on governmental, corporate, and individual agendas but which has not yet been examined from a handprint perspective.

Key findings. We find that lack of clarity about handprints results partly from *confusion* and partly from *contestation* regarding the concept (a distinction raised by Miles, 2012). The fundamental idea of handprint thinking is confused with details of individual handprint assessments. Handprint thinking is intended to be the uncontroversial, joint foundation upon which everything else rests. The three principles of handprint thinking that we lay out (see Figure 1) emphasize points that are shared by all handprints, notably that (i) handprints are intrinsically normative – they address the issue of what should be done, not just what has been done; (ii) handprints deal with and encourage positive impacts against some baseline, rather than focusing on negatives; (iii) as a result, they go beyond current footprint accounting practice, whether it is by measuring different things (positive impacts, impacts of others), or digging deeper into how action will actually be taken in practice, by who, when, and where. The perspective provided by handprint thinking is important and useful even if one never proceeds to a formal handprint assessment.

Part of the lack of clarity surrounding handprints, however, can be attributed to contestation. There are different choices that can be made within handprint assessments, and while these choices cause variability in the resulting outcomes, they can nevertheless all be justified in appropriate circumstances. Thus the carrying out and use of actual handprint assessments is contested as there can be a range of different handprints depending on the way the handprint is conceived. As we have outlined, there are different views, for example, as to (i) whether reducing your own footprint is counted in the handprint; (ii) what is the baseline for handprint assessments; (iii) whether the handprint is assessed for an individual, an organization, or a product/service, which in turn influences the relative importance of direct vs indirect pathways of influence; (iv) how credit is allocated between actors; (v) whether all improvements in indicators are permitted, or some are left out of bounds. These choices lead to a variety of different configurations for handprint assessments.

Theoretical contribution. We contribute to the debate on handprints as well as to the broader debate on capturing and communicating environmental impacts and improvements in three ways. First, as discussed above, we separate handprint thinking and the actual handprint assessment, which helps to clarify where areas of confusion and contestation lie. Second, it becomes apparent that handprint thinking is sufficiently general that it underpins a broad range of approaches to examining positive impacts, which helps to both situate handprints within existing work and highlight opportunities for future experimentation. Third, we identify different configurations in handprint assessments and discuss their pros, cons, and implications. All this helps improve theoretical understanding of handprints but has been lacking in previous literature.

In addition, we contribute specifically to water handprints, providing the first account of how a water handprint relates to existing water footprints in a case study of a food consumption of a Finnish consumer, as well as a range of examples for how water handprint assessments might be designed in the future. We highlight that the five questions we propose (see Figure 1) are likely to be highly contested in the water sector – perhaps more so than for reduction in greenhouse gas emissions. Water use impacts are inherently local and require an integrated perspective that embraces trade-offs and constraints linked to other sectors. This does not prevent the use of handprints, but does mean that handprint assessments for water are likely to be context and purpose-specific.

Practical implications. Our analysis is also relevant for future practice about handprints. Through solidifying the foundations of handprints it can reduce barriers to adoption of handprint thinking and handprint assessments. Our general message to practitioners is a recommendation to be clear about what kind of handprint configuration one is utilizing, and to communicate this also to others. Our specific elaborations about options with handprint assessments provide guidance for users who can, using the framework of our paper, make more informed choices that are best suited for their purposes.

Limitations and suggestions for future work. We have outlined the choices and options with handprints, but we have not attempted to pinpoint one 'correct' choice among the possibilities. While with contested concepts there may not be strictly 'correct' answers as such, some methodological harmonization might nevertheless be desirable to facilitate comparisons and communications in the domain of handprints, as advocated by Grönman et al. (2019), for instance. This is an area for future research to explore. Furthermore, we have not exhausted the list of alternative approaches to performing a handprint assessment, including alternative methods, tools, and data sources, as well as means by which social science understanding of

pathways and agency might be incorporated into an assessment. There is thus a lot of potential for future research to address these issues.

Conclusion. By bringing to light the positive actions of individuals, corporations and other organisations alike, handprints can play an important part in promoting and encouraging contributions to sustainability. During these early stages of development, different interpretations of the handprint concept abound, causing confusion and slowing down its effective application. In this paper we have presented an analysis of the considerations and options within handprints. With the help of this analysis, both scholars and practitioners can now proceed more productively with this promising concept.

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