Towards Food Sustainability: Reshaping the Coexistence of Different Food Systems in South America and Africa – Project Description

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Publisher:
Centre for Development and Environment (CDE), University of Bern
Hallerstrasse 10, CH-3012 Bern, Switzerland
www.cde.unibe.ch

Funding:
The project "Towards food sustainability: Reshaping the coexistence of different food systems in South America and Africa" is part of the Swiss Programme for Research on Global Issues for Development (r4d programme). As such, it is funded by the Swiss Agency for Development and Cooperation and the Swiss National Science Foundation [Grant number 400540_152033], with additional support from the Centre for Development and Environment (CDE), University of Bern, Switzerland.

Research consortium:
Agroecología Universidad Cochabamba (AGRUCO), Cochabamba, Bolivia; Centre for Training and Integrated Research in Arid and Semiarid Lands Development (CETRAD), Nanyuki, Kenya; Geneva Academy of International Humanitarian Law and Human Rights, Geneva, Switzerland; as well as Centre for Development and Environment (CDE), Institute of Geography, and Institute of Social Anthropology, all at the University of Bern, Switzerland.

Citation:
Rist S, Golay C, Bürgi Bonanomi E, Delgado Burgoa FM, Kiteme BP, Haller T, Ifejika Speranza C. 2016. *Towards Food Sustainability: Reshaping the Coexistence of Different Food Systems in South America and Africa – Project Description.* Towards Food Sustainability Working Paper No. 1. Bern, Switzerland: Centre for Development and Environment (CDE), University of Bern.

DOI: http://dx.doi.org/10.7892/boris.92603

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Language editing: Marlène Thibault, CDE

Layout: Simone Kummer, CDE

Cover photo: Fruit market near Thika, Kenya (by Horacio Augstburger)

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1 Research hypotheses and objectives of the project

1.1 Problem statement

The convergence of the effects of the global financial crisis of 2007/08, climate change, and the growing demand for food and biofuels led to a sharp **increase in global food prices**, which have since remained historically high. According to the UN Special Rapporteur on the right to food, Olivier De Schutter, this demonstrates that "the food systems we have inherited from the twentieth century have failed" [1]. In 2012, about 842 million people were still suffering from hunger, and about 2.5 billion individuals lacked the essential micronutrients that are needed for a healthy and active life [2]. Increasing food system productivity seems the most immediate response. However, there is growing consensus among scientists, experts, policymakers, and civil society groups that increasing agricultural productivity will not suffice to resolve the food crisis [3, 4]. In a 2010 Science article, Godfray et al. [5] point out that reducing hunger and malnutrition and feeding 9 billion people by 2050 requires a reorientation of global food policies. They need to be aligned with social and natural sciences concerned with food systems, and must go beyond just maximizing global food productivity: rather, the aim must be to **optimize the complex interactions between food production, environmental impacts, and social justice outcomes.**

Science and policy give converging answers on how to respond to this challenge. The scientific communities dealing with a wider approach to food security[1] conclude that better understanding the complex interactions between different food systems and their social, economic, political, and ecological effects – and later acting upon this understanding – requires viewing food security as part of the broader concept of **food sustainability** [6-11]. There is agreement in current debates that the definition of food sustainability must concern the type of technical and economic development of diverse, sometimes conflicting or complementary food systems, and the implication this has for intra- and intergenerational equity (reduction of poverty and inequality), environmental sustainability, and resilience [12-15]. Hence, food sustainability is not only about asking whether people have enough food in terms of availability, access, and adequate utilization, which represents the "official" definition of food security; it is also about asking under which conditions food is produced and further circulated until reaching consumption. Considering the conditions under which food is produced, processed, distributed, and consumed means applying the f**ood systems approach** [13].

In his final report, the UN chief policy advisor on the right to food points in the same direction, stating that efforts to improve food security need to be put it the wider context of the **right to food**. He defines the right to food as "the right of every individual, alone or in community with others, to have physical and economic access at all times to sufficient, adequate and culturally acceptable food that is **produced and consumed sustainably**, preserving access to food for future generations" [1]. Although this broad definition of the right to food is not shared by all key actors dealing with food security issues, a growing number of international organizations and governments – e.g. FAO, IFAD, WB, many national and international farming and advocacy organizations, IFOAM, OXFAM, FIAN etc. [16-20] – agree on the importance of further advancing national policies on the right to food as an adequate context for reforming food policies.

[1] The definitions of the concepts mentioned in this introduction, e.g. food security, food systems, food sustainability, right to food, etc. are given and briefly discussed in the "State of research in the field" (section 2).

The research proposed here is therefore **aimed at analysing the outcomes and trade-offs of different coexisting food systems** in terms of their individual and aggregate contributions to food security, the right to food and other related human rights, reduction of poverty and inequality, environmental integrity, and social-ecological resilience. This **concept of food sustainability based on five principles** (see also section 2.2) forms the normative background that will guide the identification of innovations and policy options for making food systems more sustainable, in terms of both their internal structures and their coexistence and interactions.

1.2 General objective and research questions

Our **basic hypothesis** is that assessing different food systems against the principles of food sustainability will make it possible (1) to improve the conditions under which actors in smallholder and other family- or community-based food systems earn, adapt, and innovate their livelihoods – especially by reducing risks, food insecurity, and power asymmetries and securing access to land, common-pool resources, agro-technical inputs, credits, and markets; (2) to reduce the negative socio-economic, political, and ecological externalities of agro-industrial, but also partially unsustainable smallholder or family and community-based food systems; and (3) to thereby enhance collaboration and complementarity and (4) reduce competition and conflict between different food systems by establishing platforms that allow more sustainable food systems to emerge and expand, based on an inclusive and democratic process.

1.2.1 Main research objective and research approach

The main objective of the proposed research is to provide evidence-based scientific knowledge for the formulation and promotion of innovation strategies and policy options that improve individual and aggregate levels of food systems' sustainability. The emphasis is on finding ways to enhance collaboration within and between coexisting food systems.

The project adopts a **transdisciplinary research approach**, as this is one of the most effective ways of dealing with the complexities and uncertainties that have to be considered when investigating factors that shape the sustainability of food systems [21-23]. A transdisciplinary approach means organizing a process of knowledge co-production between researchers and food system stakeholders; this will include production of target or *normative knowledge* (expressed here in the five principles of food sustainability), *systems knowledge* (i.e. understanding of food systems in terms of the proposed research questions), and *transformation knowledge* (i.e. identification of innovations and policy options for improving food systems' sustainability). Production of transformation knowledge is closely related to the project's **strategy of communication and implementation** of research results. It is organized around the development of a "Food Sustainability Assessment Framework (FoodSAF)" that can be used by non-scientific actors to find innovations and policy options for making food systems more sustainable. A first version of the FoodSAF will be refined based on application and testing (through "Transformative Pilot Actions" (TPA), carried out by part of the project staff) in a number of different countries (details in chapters 2 and 7).

Empirical research on the impacts of interactions between different food systems will be carried out in based on two primary case studies in Bolivia and Kenya (selection of countries and regions see 3.3) and in four secondary case studies in South America and Africa. To achieve the project's main objective, the research will focus on the research questions indicated below. Each **research question** will be addressed by a different **work package (WP)**. While WP1 will deal with the study regions'

broader contexts, WPs 2-4 will study concrete social, economic, and environmental aspects, producing knowledge required for assessing the sustainability of the food systems under investigation. WP5 serves as the main platform for integrating results from the other WPs and translating them into the outputs and activities that are at the core of the project's communication and implementation strategy.

1.2.2 Specific research questions

WP1 will address research questions focusing on context mapping, trends, and space for democratic participation. Context mapping will serve to identify key **external factors** that have influenced the investigated food systems over the last 10-15 years, as well as related trends and their likely future development. Emphasis will be placed on the following **research questions:**

1. *Which **existing laws and treaties** regulate the investigated food systems and the interactions between them, providing the contextual factors that determine their food sustainability?*
2. *Which **economic, social, and environmental drivers** are impacting on the selected food systems and the interactions between them?*
3. *How do these external factors impact on the **policy space** of the country or region concerned?*
4. *Which innovative **policy and legal options** contribute to an enabling environment for food sustainability in the selected countries and regions?*

WP2 will address research questions focusing on institutions, actors, and perceptions:

5. *How do **formal and informal institutions** including public, private, and customary law transform and shape food-system-specific institutions and related patterns of interaction and power hierarchies among key actors within and between food systems?*
6. *How are cognitive factors (social, cultural, and symbolic values) expressed in actor-specific food system activities (production, processing, packaging/distributing/retailing, and consumption of food), and how do they relate to risk and insecurity?*
7. *What are the outcomes of existing institutional configurations within and between food systems for **human rights** and especially the right to food?*

WP3 will address research questions focusing on activities, value chains, livelihoods, and food security:

8. *How do specific food system activities – both market-based and subsistence-oriented ones – shape the key outcomes of individual food systems in terms of food security, the reduction of poverty and of inequality, and the right to food and other human rights?*
9. *What are key trade-offs between individual food systems coexisting in the same geographical areas?*

WP4 will address research questions focusing on environmental integrity and social-ecological resilience:

10. *What is the state of food systems' environmental integrity?*
11. *How do food systems' environmental integrity and their socio-economic outcomes influence social-ecological resilience, and how do different actors perceive this resilience?*

WP5 will address research questions focusing on integration, policy options, and dissemination:

12. *What food systems are most promising from a comparative perspective, and what are their individual and aggregate contributions to food sustainability in a context of coexistence?*
13. How can innovations and novel policy options that increase collaboration within and between different food systems help to raise levels of food sustainability?

1.2.3 Integration of results

The results from WPs 1-4 will be systematized and integrated jointly by all WPs in a process organized and moderated by WP5. This process will follow an iterative procedure to interrelate the results from WPs 1-4 and their ramifications on a cross-scale background, covering effects from local to global levels. Collaboration between WPs will take place throughout the research process (see section 3.2 and chapter 5).

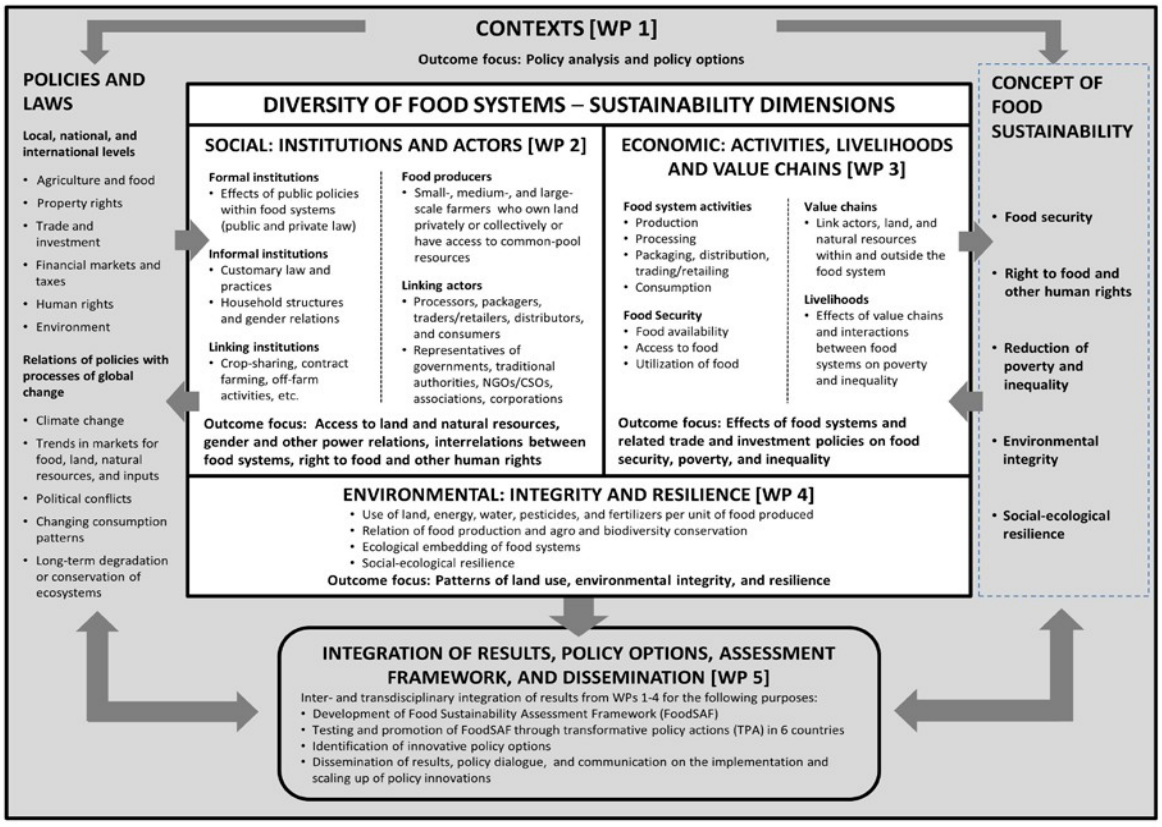


Figure 1.1 Main components and work packages (WPs) of the proposed research project.

2 State of research in the field

This project aims to assess food systems based on the normative concept of food sustainability. Section 2.1 summarizes the state of the art regarding basic concepts and issues that need to be considered when empirically evaluating the sustainability of food systems. A summary of the main findings of previous research on the specific matters covered by this project is followed by an outline of knowledge gaps, as well as an overview of research in the relevant fields done by the co-applicants for this research project. In section 2.2 we show how these fields of research feed into the definition of a concept of food sustainability based on five principles, and how this concept can contribute to further scientific and societal debates on the issue.

2.1 Foundations of food sustainability

2.1.1 Food security and food systems

“Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life” [24]. This widely accepted **definition of food security** covers the dimensions of *availability* of food supplies, *access* to food in terms of sufficient income, subsistence, and/or food aid, the nutritionally adequate *utilization* of food, and *stability* to assure the three former aspects also in situations of adverse weather conditions, political instability, or economic constraints (unemployment, rising food prices, etc.) [25].

There is growing consensus that food security must be understood as an *outcome of multiple factors* that are operating at local to global scales, are of short-term to long-term nature, and involve cross-sectoral trade-offs [26-28]. Food securitycan therefore be understood as an outcome of ***food systems***. The concept of food systems builds on *four food-related activities: production; processing; packaging, distribution, and retailing; and consumption* [26, 29]. Thus, a food systems perspective looks not only at how food is produced; it also takes account of how different food production systems are linked to specific ways of processing, packaging, retailing, and consuming food. Based on structural, political (or institutional), and cognitive variables, Colonna et al. [13] developed a typology for characterizing **diverse food systems** as “domestic”, “local”, “regional”, “agri-industrial”, or “differentiated quality” food systems. Among the many food systems, we find those of about 500 million smallholder farms who provide food and livelihoods for about 2.5 billion people [4]; they are based in highly diversified, partly subsistence-oriented and partly market-oriented food production. With family-related labour as their main input, they use relatively low levels of external inputs, have a low level of mechanization, and process part of their produce for consumption by the family. The share of produce that goes from local to global markets is packaged, retailed, and consumed according to the requirements of the other food systems with which smallholder food systems interact [30, 31]. A second category, which frequently overlaps with the first, are the so-called “alternative” family or community-based food systems; they often involve organic or agroecological farming practices, or geographically confined production for local to regional markets, including producer–consumer associations etc. [9, 16, 32, 33]. Food systems of this type value local knowledge and preferences, emphasize “natural” food processing methods, and avoid excessive waste and transport over long distances between production and consumption (so-called “food kilometres”) [34, 35]. Together, smallholder and alternative food systems provide about 55% of the food consumed worldwide [13]. A third category consists of agro-industrial food systems. They are generally based in large monocultures, use high levels of external inputs (fertilizers, pesticides, seeds), and are highly mechanized and capital-intensive.

Food is often produced far away from the places of consumption, making it necessary to link producers and consumers through global value chains; as a consequence, the food is highly processed, heavily packaged, and distributed through highly specialized retail networks that also imply specific forms of consumption [36, 37]. Agro-industrial food systems contribute 45% of global food consumption [13]. It is clear that under current circumstances, global food security cannot be maintained and improved without the combined food supply from all these coexisting food systems. However, given the great diversity of food systems' structures and organizational rationales, we understand the **coexistence of food systems as referring to their interrelations and interactions, including positive trade-offs as well as tensions, contradictions, and conflicts.**

In this respect, **interactions between smallholder and agro-industrial food systems** are particularly critical. Due to pronounced power asymmetries between the two types of food system, actors of agro-industrial systems can easily access modern technologies, capital, infrastructure, markets, and consequently also land, water, and other natural resources, as well as labour. By contrast, smallholders face severe limitations in accessing these fundamental assets and competing under equal conditions [38-41]. Additionally, they are exposed to well-investigated threats from the rapid and often unregulated expansion of agro-industrial food systems in developing and emerging countries. These threats range from land concentration and dispossession to unfair exercise of buyer power and increased marginalization of women, ethnic minorities, or landless people [42-50], and often result in conflicting claims on land and water [51, 52].

Regardless of structural contradictions and differing interests, the actors of the different food systems are increasingly interacting, e.g. through *contract farming, outgrower schemes* [53, 54], private forms of rural extension, credit provision, transport facilities, storage infrastructure, and related technology transfers between agribusinesses and smallholders [55, 56]. Finding ways to reshape the current forms of interaction between food systems in a context of more equity without compromising the maintenance and improvement of food security for all is therefore a top priority for research and policy.

The concept of food systems goes **beyond the concept of agricultural supply chains.** A food systems approach also involves studying the flow of goods and services through value chains, but the aim is to understand how they relate to socio-economic and political conditions, and what outcomes this has for social and environmental welfare [13, 57].

This project addresses a major **research gap** by not only looking at the performance of individual food systems, but also identifying conditions and factors that make the coexistence of food systems more sustainable [13, 58-62]. This will be done by focusing on conflicts as well as potentials for overcoming them based on **collaboration and complementarity** between diverse food systems [3, 11, 61, 63-67]. Addressing food security from a food systems perspective is one of the main concerns of WP3.

Own research in the field has focused on assessing the socio-environmental sustainability of different food systems [68-70]; food policies [71, 72]; value chains in organic agriculture [73-75]; institutional change [76, 77]; how smallholder food systems and transformations of common-pool resources relate to resilience [78-82]; and the roles of local knowledge [83-88] in the sustainability of food production.

2.1.2 The right to food

According to the United Nations Committee on Economic, Social and Cultural Rights, the right to food "is realized when every man, woman and child, alone or in community with others, has physical and economic access at all times to adequate food or means for its procurement. (…) the core content of the right to adequate food implies: The availability of food in a quantity and quality sufficient to satisfy the dietary needs of individuals, free from adverse substances, and acceptable within a given culture; The accessibility of such food in ways that are sustainable and that do not interfere with the enjoyment of other human rights" [89]. In his final report presented in 2014, the United Nations Special Rapporteur on the right to food, Olivier De Schutter, proposed a new definition of the right to food which integrates more explicitly the aspect of sustainability in production and consumption: "the right of every individual, alone or in community with others, to have physical and economic access at all times to sufficient, adequate and culturally acceptable food that is produced and consumed sustainably, preserving access to food for future generations" [1].

According to De Schutter, **a policy shift from a focus on food security to a focus on the right to food – explicitly including the aspect of sustainability – is necessary for dealing with increasingly interdependent food systems** [1]. This means understanding food security not primarily as the result of what rural people produce or consume on their farms, but as the outcome of complex and dynamic livelihoods that are intimately linked to the type of relationships rural people have among themselves and with other actors of the food systems. With regard to interactions between different types of food producers, this perspective calls for a better understanding of institutional changes and political conditions under which large agribusinesses, medium-sized farms, and smallholders can complement each other to produce multiple outcomes in a way that is conducive to realizing the right to food at local to global levels. More specifically, food policies have to be reconceptualized, taking into account international human rights treaties and soft law instruments, trade and investment treaties and policies, cooperatives, marketing boards, public procurement, and competition law (see also section 2.1.5) [90].

The **right to food** is increasingly prominent in international policy debates – as evidenced by the United Nations Committee on World Food Security and the United Nations Comprehensive Framework for Action [19]. It has also been incorporated into a growing number of national constitutions, including those of Kenya and Bolivia [19, 49, 90- 94]. At the international level, states and international organizations have come to recognize that the right to food is an important basis for achieving food security [19].

The right to food brings in state obligations – to respect, protect, and fulfil this right at the national level and extraterritorially [1, 72, 89] – and the obligations of business entities to respect it and provide remedies in case of violations [95]. The right to food also implies that policy implementation should adhere to further human-rights principles, in particular the principles of participation, accountability, non-discrimination (including gender equality), transparency, human dignity, empowerment, and the rule of law [19, 96, 97]. Not legally binding, but nevertheless important initiatives are based on voluntary adherence to private standards set by agribusiness-related corporations or international organizations [98]. The 2004 *Voluntary Guidelines to support the progressive realization of the right to adequate food in the context of national food security,* and the 2012 *Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests* are prime examples [18, 99]. These offer widely acknowledged, politically legitimate recommendations for aligning food security policies and land governance with human rights – particularly with the right to food – and with internationally recognized environmental and economic standards [100]. The "Principles for responsible

agricultural investments and food systems" that are currently being negotiated in the UN Committee on World Food Security are also important [101].

For De Schutter, to protect the right to food in the context of large-scale land acquisition, there is a need to respect at least 11 principles[2] [56]. Despite their soft-law character, the Special Rapporteur stressed that these principles "are not optional; [but] follow from existing international human rights norms" [56]. The relationship between food sustainability and the concept of "food sovereignty" proposed by scientists and activists supporting national and global small-scale farmer movements requires investigation as well [7, 90, 102-104]. Integrating these 11 principles in the concept of food systems' food sustainability, as well as in the framework for assessing it, hence constitutes a **research gap** which our project will address. Policies promoting the right to food and other human rights are made at national levels. Linking national legislation processes and policy implementation with the study of concrete food systems will make it possible to address yet **another research gap:** How are national policies addressing and impacting on the diversity of food systems that generally exists at subnational levels, as well as the related innovation processes within and between food systems and the underlying cognitive aspects (values, meanings, interests)?

Own research has focused on the definition of the right to food and its use to respond to food crises [105]; its relation to large-scale land acquisition [106]; the legal and political recognition of the right to food, including in Bolivia and Kenya [19, 72, 93, 94]; the links between the right to food, food sovereignty, and gender equality [107]; the interpretation of the right to property to protect individuals' and communities' right to land [50]; and economic, social, and cultural rights and their contribution to the dialogue on human-rights and development [108, 109] [110, 111]. These aspects will be addressed by WP2 in close collaboration with WP1 and WP3.

2.1.3 Reduction of poverty and inequality, and value chains

Food systems have a significant impact on poverty and inequality, which are distinct issues. While non-agricultural activities are more likely to reduce the poverty of better-off poor (living on 1-2 US$ per day), agriculture is significantly more effective among the poorest of the poor (less than 1 US$ per day), especially where inequality is low [112].

Poverty reduction therefore requires not only economic growth and higher productivity, but also lower inequality of access to, and the distribution of, basic agricultural means of production [113, 114]. As a result, smallholder development remains a key food security option, but policies must take account of specific contexts in terms of existing land distribution and agricultural potential [115, 116]. Market failures in input and output markets remain a challenge to smallholders, and the fact that large agribusinesses have become the main purchasers of smallholder produce will not fully resolve the issue. Effective market coordination requires new institutions based on interaction among state and private-

[2] They concern: The obligation to conduct negotiations leading to LSLAs in a fully transparent manner and with the participation of local communities; the requirement of free, prior and informed consent of the local communities concerned; the general prohibition of forced evictions; the obligation to recognize and protect land tenure rights of local communities; the importance of sharing of revenues generated by LSLAs with the local population; the necessity of choosing labour-intensive farming systems in countries facing high levels of rural poverty and few employment opportunities in other sectors; the need to protect the environment; the necessity of including clear and detailed obligations for investors in the agreements, with sanctions for non-compliance; the need to include a clause providing that a certain minimum percentage of the crops produced will be sold in local markets in food-importing countries, to contribute to local food security; the necessity to undertake prior impact assessments, including on food security, environment and employment; the obligation to protect indigenous peoples' rights; and those of respecting the applicable ILO instruments.

sector actors as well as NGOs and smallholders themselves [117, 118]. This should allow smallholders to retain their minimax risk strategies (combining multiple-crop food systems with animal husbandry or access to common-pool resources under customary law) which have been fundamental to subsistence-based food systems [78, 81, 119-121].

Economic links within and between different food systems can be understood by means of **value chains.** A single food system incorporates the value chains of many individual products, each chain involving multiple enterprises and comprising the same stages or activities as a food system: agricultural production, processing, packaging, and (sale for) consumption. Value chains are increasingly "global" and play an important role in international trade, as emphasized recently by OECD, WTO, UNCTAD, and the World Bank [122-125]. These studies' **macro-oriented and top-down approach** that links national input-output tables must be complemented by a **micro-oriented approach** that looks at processes *within* **global value chains (GVCs)** and focuses on three dimensions to assess economic outcomes within and between food systems.

The *first dimension* is the quantitative economic and geographical structure of value chains. Many studies [126-135] "map" the different stages of food GVCs to support policies for growth and exports. This provides an essential empirical foundation for the analysis of both value chains and food systems, identifying foreign trade and investment linkages, market structures and competition, and key components of the "business environment", such as transport, energy, and water infrastructure.

The *second dimension* is **GVC governance**, or the distribution of power and income through the chain [136, 137]. The literature distinguishes between buyer-led and producer-led (food) value chains, where the chain's dominant firm is a retailer (supermarket) or a commodity processor, respectively. Governance also involves **product and process regulation**, particularly important in food GVCs, with complex and potentially contradictory impacts on **smallholder producers and their food systems** [138, 139]. Supermarkets impose safety standards on smallholder suppliers in the GVCs they lead, and while agribusiness food processors take direct responsibility for safety, they demand quality inputs from suppliers. Such standards are potentially a pathway for **upgrading** productivity and quality in smallholder production, but may instead also constitute a barrier to entry in the GVC, forcing small-scale producers from the market. A positive outcome can only be achieved through coherent national and international policy interventions in production as well as in infrastructure and logistics, "trade facilitation", and trade promotion [123, 140]. Pressure from consumers in industrialized countries for "corporate social responsibility" demands that large multinationals meet public standards on social and environmental impact by reporting their "sustainability impact" based on guidelines developed by multilateral organizations or international NGOs [141, 142], or by financing independent studies of their impact in a particular poor country (that often usefully combine quantitative and qualitative methodologies) [143-145].

The *third dimension* to be considered in such a GVC approach is the **impact on poverty reduction and inequality**. A small group of studies – often with a **gender** focus – has examined the effects of GVCs on poor people directly involved in production: small-scale farmers, farm labourers, and workers in agro-industrial processing. Both benefits and costs can be identified: for example, in the Kenyan vegetable industry, both smallholder farmers supplying domestic supermarkets [146] and workers (mostly female) in export processing [147] obtain significantly more income from participation in value chains, which for the latter group contributes to poverty reduction via asset accumulation and increased flexibility [148]. By contrast, horticulture GVCs in South Africa often exacerbate women workers' vulnerability [149, 150]. Public investment in rural infrastructure and services remains essential,

despite transformed markets as illustrated by Kenya's maize production [151]. Food GVCs also affect poverty via consumption, with factors such as **nutrition** and dietary pattern shifts being just as significant as product prices [118, 135, 152, 153]. Scale advantages in GVCs may lower food costs for the urban poor, an effect that is either reinforced or offset by market concentration, depending on context.

A major **research gap**, which is at the heart of research in WP3, is the need for integrating GVCs' "vertical" (chain) dimension with their "horizontal" one – their effects on the wider society in which they are embedded. GVC analysis limits attention to market processes and actors *within* the value chain, and usually ignores groups outside the chain, irrespective of whether they have never participated or have become marginalized by structural shifts in the chain (especially at the international level) [117, 154]. By integrating the GVC framework with the food systems framework, our project will deploy the *strengths* of GVC analysis – identification of structure and causal interactions among variables – while extending it to take account of the broader system. In this way, we will combine economic and political-economy dimensions in analysing food systems' coexistence and interaction, and explore their relation to the five principles of food sustainability. These aspects are at the core of WP3.

Our **own research** on this topic has examined corporate strategies and impacts of foreign investors in host countries [155, 156]. We have also examined social movements for alternative agriculture and fair trade, and those of organic farmers and consumers. These movements have politicized food systems and challenged hierarchies among systems [75, 157].

2.1.4 Environmental integrity and resilience

There are numerous ways of assessing the environmental integrity of agricultural production systems [158-162]. However, the bulk of scientific work concerns specific dimensions or aspects of environmental integrity. More comprehensive approaches and methods, required for assessing the environmental integrity of food systems as they are defined here, are still rare. An exception that comes near to this requirement is the "Sustainability Assessment of Food and Agriculture Systems (SAFA)" of FAO [141]. The SAFA methodology proposes a comprehensive set of indicators for assessing the effect of an enterprise engaged in food or agricultural value chains. The indicators measure six aspects of environmental integrity concerning the atmosphere (greenhouse gases, air quality), water (withdrawal and quality), land (soil quality and degradation), biodiversity (diversity of ecosystems, species, and genes), materials and energy (use and waste management), and animal welfare (health and freedom from stress). However, these indicators are mainly designed for enterprises to assess the sustainability of specific value chains in the food and agriculture systems they are involved in. Thus, the indicators are not automatically suited for assessing the food sustainability of entire food systems and their interactions. Moreover, they do not yet systematically incorporate the right to food. The presence of the group in charge of further developing SAFA within FAO in the scientific advisory board of our project will guarantee optimal exchange and collaboration enabling both sides to benefit from each other's ongoing work.

Thus, the proposed project will contribute to filling the **research gap** concerning the **adaptation of methods for measuring the environmental integrity of value chains for measuring that of food *systems***. Possible options include the method for measuring the environmental integrity of agricultural production systems developed by Gerbens-Leenes et al. [163]. This method yields three performance outcomes – the total land, energy, and water requirements per unit (e.g. kilogram) of food produced. We will adding the use of fertilizers and pesticides [164]. Regarding the relationships between specific food systems and biodiversity on-farm functional biodiversity is often inadequately acknowledged or understood, and conventional intensification tends to disrupt biodiversity's beneficial

functions [60]. For this reason, we will explore the use of a method for evaluating the ecological sustainability of agricultural landscapes called the SINUS approach [165]. Mapping the ecological embeddedness of certain key features of food supply chains will be explored as an additional option [34, 166]. The assessment of information on the quality of natural resources and the balance between degradation and conservation will also be studied by including the perceptions of key actors related to different food systems. In this sense, we will address local “traditional” knowledge, which was shown to be of great importance in the use of ecosystems and natural resources for creating livelihoods [121, 167, 168]. However, unravelling this knowledge and facilitating its interaction with natural scientists’ knowledge is not an easy task. The applicants have considerable experience in researching local traditional knowledge and facilitating its interaction with knowledge from the natural sciences [79-82, 84, 86, 119, 169, 170].

Research on the social and ecological performance of food and agricultural systems has shown that **building resilience** is fundamental in reducing negative impacts of global change, such as climate change, volatility of food, input, or product prices, rapid societal or political changes, emerging conflicts, and natural disasters [9, 171, 172]. Resilience refers to the existence of mechanisms for coping with or adapting to environmental, socio-economic, or political pressure [173-176] and is most often operationalized as resilience of social-ecological systems [52, 177-180]. Resilience of social-ecological systems has been subdivided into the three components buffer capacity, self- organization, and adaptive capacity [181]. Buffer capacity refers to the quality of and access to resources, and to diversity (e.g. biodiversity or diversity of livelihood activities). Self-organization refers to social capital and connectedness, and learning capacity to feedback mechanisms within the systems aiming reflexive governance [176, 182]. W4 will be take charge of these aspects.

Own research by the members of this project has focused on the development of concepts and methods for assessing the resilience of social-ecological farming systems and rural livelihood systems with a view to achieving more sustainable food production [69, 74, 183].

2.1.5 Policy contexts, trade, investment, and food systems

Different legal regimes and policies impact differently on different food systems. Laws, treaties, and policies introduce farm and price support schemes, shape standards for the production, processing, distribution, and consumption of food, define intellectual und real-estate property rights, promote spatial planning, control public procurement, foster competition, regulate trade in agricultural products and related means of production, and promote domestic and foreign investment in agriculture. They also state the obligations of states and businesses with regard to human rights and labour standards, and introduce obligations to take into account environmental standards. Not least, financial and tax regimes also impact on local food systems and their interaction.

Local, national, and international legal regimes have equally relevant impacts, and they interact [184]. The same is also true of the regimes of investors’, producers’, and consumers’ host and home countries, since they all allocate responsibility and define accountability [95]. However, regulations tend to be fragmented; this is particularly true of international regulations, but applies to national laws and policies too. There is a lack of both horizontal and vertical coherence and mutual supportiveness [185]. Certain interests (such as intellectual property rights or foreign investors’ rights) tend to be strongly protected, whereas other interests and needs (such as local land rights or obligations of investors) tend to lack effective legal protection or targets [186]. Numerous other regulatory lacunae exist, particularly in the field of financial and tax regulation [187]. Furthermore, policies and laws are often not geared towards the principle of sustainable development [188], but follow other predefined

rationales. This is particularly true for trade and investment policies [189]. All these deficits contribute to food systems often not interacting in a sustainable way.

In the literature, thorough coherence analyses of laws and policies from a perspective of sustainable development and multi-layered governance are rare, not least due to a lack of interdisciplinary interaction between jurisprudence, social sciences, and sustainability research. Hence, in order to achieve coherent and sustainable national regulations and international treaties, the sustainable development literature suggests introducing informed, evidence-based decision- making procedures. A key component of such procedures are *ex ante* (and *ex post*) sustainability impact assessments (SIA) of legal regimes [190]. Human rights advocates promote the introduction of human rights into such SIAs to increase their effectiveness [191]. While promising attempts have been made, e.g. to measure *ex ante* the impact of future trade agreements on sustainable development and human rights [192, 193], such SIAs generally assess regulations that have already been drafted and tabled, merely providing recommendations on how to mitigate the effects by introducing complementary measures [194]. A **research gap** to be addressed by the proposed project concerns the fact that most optimal regulatory options – which would be most conducive to sustainable development, i.e. to food sustainability in the present context – are rarely thoroughly sought [195]. This deficiency stems from the fact that the drafting of regulation and policies is not informed by analysis of local systems and "bottom-up" approaches towards their sustainability. The applicants' own research in this context has focused on related issues, such as the protection of property in international law [186], sustainable development in international law-making [189], as well as in financial and tax regulation [187]. These aspects will mainly be covered by WP1.

2.2 Food sustainability

The above state of research in the field clearly calls for a concept of food sustainability that reflects the environmental, economic, and social dimensions of sustainability [14]. More concretely, authors mainly dealing with the **conceptual building blocks of food sustainability** suggest that that food sustainability means bringing together the concepts of intra- and intergenerational equity, environmental integrity, and resilience [6, 14, 15, 62, 196, 197]. Beyond this, there is a growing body of work proposing that democracy and reflexive governance approaches also have fundamental roles to play in making food systems more sustainable [6, 197-199]. The present project makes use of the state of the art presented in section 2.1 to concretize the general core concepts of food sustainability in the following ways:

First, as laid out in section 2.1.1, food sustainability must be addressed in the wider context of *food systems*. The concept of food systems enables a better understanding of how food security is linked with different processes of global change, e.g. with climate change [28, 200], global trends in trade and investment policies [201, 202], and increasing competition over land and natural resources based on the needs to produce food and bioenergy while conserving biodiversity [51], as well as on changing consumption patterns [203].

Second, as shown in section 2.1.2, the principle of equity with regard to food sustainability can build on the fact that this concept is increasingly being linked to **human rights and more specifically to the right to food** [1, 71, 72, 106]. This makes it possible to connect the issue of food sustainability to the fundamental conceptual dimension of social justice – a link not previously made explicit. This adds to the operationalization of food sustainability by enabling its assessment based on how well a given

food system conforms with human rights, specific forms of land and intellectual property rights [204-206], including rights of consultation and participation, or principles of gender equity [207].

Third, the scientific literature presented in section 2.1.3 supports the statement that the outcomes of food systems can be adequately evaluated in economic terms by determining to what extent they contribute to the **reduction of poverty and inequality**; in this context, it is important to consider the effects of currently existing forms of interaction between food systems and explore ways of innovating food systems both individually and in terms of their interactions. We agree with numerous researchers who state that there is scope for the further development of smallholder or alternative food systems, which have received less attention than others [16, 171, 208]. This includes exploring country-specific ways of enhancing the agricultural sector's performance and its contribution to poverty reduction and growing incomes for rural people by improving overall conditions in terms of land rights, access to common-pool resources, rural people's organizational capacities for intervening in political arenas, and market mechanisms [76, 209, 210].

Fourth, as shown in section 2.1.4, there is growing consensus that the concept of **environmental integrity** provides an adequate entry point for assessing the biophysical sustainability of food systems. Such assessment can draw on previous studies evaluating food systems' greenhouse gas emissions [203, 211], use of land, water, energy, fertilizers, and pesticides [163], and biodiversity conservation [60, 212-214]. Further, the state of the art suggests that resilience is best operationalized as the social-ecological resilience of food systems [173, 175, 176, 178, 215-217].

Fifth, as laid out in section 2.1.5, it is increasingly important that research on food sustainability not only examines individual food systems as such, but also analyses their interactions with contextual factors and processes, e.g. processes of global change, or policies at national to global scales.

In line with the scientific literature cited, this research project starts by establishing a **definition of sustainability that is based on five principles:** (1) food security; (2) the right to food and other related human rights; (3) the reduction of poverty and inequality; (4) environmental integrity; and (5) social-ecological resilience (see also Figure 1). We further consider that these basic variables for assessing food sustainability must conform to the more general principles on how to achieve sustainable development, such as democratic participation in food system governance, economic viability, and intergenerational equity in the short to long run.

In view of the state of research in the field as summarized above, the proposed project will help to fill the following **research gaps**: (1) **making the concept of food sustainability operational** and applicable for a comprehensive assessment not only of individual agricultural value chains or even food systems, but – most importantly – of how the various forms of interactions between different, coexisting food systems relate to food sustainability; (2) in-depth research on how **institutional configurations** within and between food systems relate to cognitive aspects, e.g. how social and cultural values are expressed regarding the four basic food system activities (production, processing, packaging/distributing/retailing, and consumption of food); (3) **developing food policies that integrate the right to food** and other human rights with economic and environmental dimensions of sustainability; (4) empiric research on the **relationship between the reduction of poverty and inequality and food security**, taking account of trade-offs between different food systems; (5) developing novel institutional strategies for **enhancing transparency, fostering democratic decision-making, and reducing power asymmetries** within and between food systems; (6) providing empirical evidence of

potentials and limitations in making individual and coexisting food systems more adaptive and resilient; this will be based on learning [27] and polycentric food governance [14, 28, 62, 218], in response to the need for creating policy spaces for more place-based forms of reflexive governance [219] that allow social movements promoting alternative food systems [220] to participate in shaping food policies [221] based on their own conceptions.

Own research of the project team has dealt with the conceptualization of the right to food and innovative policy measures [19, 72, 105], assessment of trade and investment policies with regard to human rights and the sustainability of food and agricultural systems [50, 106], long-term transformation of development and land policies [222-224] and the implications this has for the prospects of more sustainable learning-based [225-227] governance of land and natural resources [68, 223, 228], cognitive aspects of agriculture and food production [83, 84, 229-231], and factors of resilience-building in food systems [74, 182, 183].

3 Methodology

This project brings together an extraordinarily broad team of human and physical geographers, social anthropologists, jurists, (political) economists, agronomists, agroecologists, and nutritionists committed to an inter- and transdisciplinary research approach. Inter- and transdisciplinarity is increasingly recognized as an adequate response to the challenge of researching complex and dynamic phenomena, such as food systems exposed to growing degrees of environmental and socio-economic uncertainty [22, 23, 232].

This research project is designed to support the **transdisciplinary** co-production of knowledge that is understood as an iterative process in which scientists and non-scientific stakeholders work together to identify, analyse and solve challenges of sustainable development. It comprises three stages, focussed on production of the following knowledge forms [21]:

1) **Target knowledge.** This involves identifying problems and solutions, while explicitly recognizing and agreeing upon the *normative foundations* underpinning them. It requires close interaction between scientists and other stakeholders. This has already been done on behalf of the planned project: in four multi-stakeholder workshops, Northern and Southern partners identified food sustainability as an emerging, highly relevant transdisciplinary issue and placed it at the normative core of the planned project. These workshops took place in Switzerland – with Olivier De Schutter[3], the Swiss NGO Swissaid, Frances Moore Lappe, Jean Feyder, Hans Hurni, and three Swiss parliamentarians[4] among the participants – as well as in Bolivia [233] and in Kenya [234].

2) **Systems knowledge.** In the planned project, this involves achieving a better understanding of how food systems work, what sorts of conditions produce what types of outcomes, and how well these outcomes match the principles of food sustainability (as defined earlier in regards to target knowledge). Systems knowledge will comprise: (1) *interdisciplinary coordination* of how to implement the research questions defined in this project; (2) *disciplinary deepening* on the specific contextual, social, economic, and environmental features and conditions surrounding food systems and their interaction; (3) *interdisciplinary integration and synthesis* of the disciplinary research on these specific aspects in an effort to identify individual and aggregate outcomes and how they relate to the principles of food sustainability. This will include development of the FoodSAF for use by non-scientific actors.

3) **Transformation knowledge.** This will involve focussed discussion of the main disciplinary/ interdisciplinary research results in an effort to elaborate and promote transition strategies that improve the sustainability and coexistence of individual food systems. These efforts will be greatly enhanced by the “Transformative Pilot Actions (TPA) occurring in the final two years, in which selected non-scientific stakeholders from Brazil, Peru, Ghana and Zambia will be supported by the project to apply the FoodSAF in other food systems and to implement own activities that boost societal/scientific debates and initiatives on food sustainability.

[3] http://www.uniaktuell.unibe.ch/content/geistgesellschaft/2013/uno_sonderbeauftragter/index_ger.html

[4] http://www.uniaktuell.unibe.ch/content/rechtwirtschaft/2013/ernaehrungssicherheit/index_ger.html

In addition to adopting an inter- and transdisciplinary approach, the project will address its research questions based on case studies. Following Gerring [235], we will apply a **multiple case study design**, in which a reduced number of cases are studied in-depth to understand their main features and dynamics and – at least partly – shed light on a larger number of similar cases. For this purpose, we have combined a "typical" and "diverse" case selection procedure [235], leading to a research design based on two in-depth case studies of typical food systems in Bolivia and Kenya, whose results at a later stage will be compared with less in-depth results from the application of the FoodSAF in one additional region in both Bolivia and Kenya, and in at least two regions each in Brazil, Peru, Ghana, and Zambia (see 3.3 for case study selection). Cases and contexts are deliberately not separated, as the interplay between them is an important aspect to be investigated (see research questions and WPs). Comparisons are made by analysing similarities and differences between individual food systems, their interactions, their contexts, and the corresponding outcomes that determine the food sustainability of different coexisting food systems. This enables a first level of generalization that is oriented not towards a universe of other cases, but towards theoretical propositions [236], e.g. related to factors making the coexistence of food systems more (or less) sustainable. Data resulting from application of the FoodSAF tool to assess the food sustainability of food systems in additional regions of Bolivia and Kenya, as well as in Brazil, Peru, Ghana, and Zambia, will provide more – although less detailed – information on other specific cases of interaction between food systems. On this basis, a more comprehensive cross-country comparative analysis of case- and context-specific similarities and differences will be made in such a way that more general patterns can emerge as "isolated regularities" of case and context interactions [237].

3.1 Mixed-methods approach

Food sustainability in the planned in-depth case studies can best be assessed by means of a mixed-methods approach. Johnson et al. [238] define this approach as an intellectual and practical synthesis that combines qualitative and quantitative research with the aim of providing informative, complete, balanced, and useful results; additionally, the approach is cognizant, appreciative, and inclusive of local and wider sociopolitical realities, resources, and needs. Qualitative and quantitative research methods complement each other and compensate each other's weaknesses [239]. Mixed-methods is also a centrepiece of the transdisciplinary and case study research approaches to which this project is committed [240, 241]. The use of mixed-methods makes it possible to add validity to the interdisciplinary in-depth case studies through triangulation [242], i.e. the combination of different methodologies in the study of the same phenomenon based on four operations: (a) data triangulation (i.e. use of a variety of data sources), (b) investigator triangulation (i.e. use of several different disciplinary perspectives), (c) theory triangulation (i.e. use of multiple theories to interpret results), and (d) methodological triangulation (i.e. use of multiple methods to study a research problem).

3.2 Research plan and methods

We use the mixed-methods approach as a strategy for generating information in five domains of research corresponding to the main topics and scales covered by each WP (contexts; institutions and actors; value chains, food security, poverty, and inequality; environmental integrity and resilience; and integration, synthesis, policy options, application, and dissemination).

WP1 focuses on context mapping, trends, and space for democratic participation. This will involve the collection and analysis of qualitative and quantitative data on the *national and international contexts* in which the selected food systems are situated.

Table 3.1 Research questions, key variables, main methods, and scales addressed in WP1.

WP1: Context mapping, trends, and space for democratic participation	
Main scale of research: national to international Methodological collaboration with WPs 2, 3, 4, 5. Inputs to and feedback from WPs 2, 3, 4, 5.	
1. Which existing laws and treaties regulate the investigated food systems and the interactions between them, providing the contextual factors that determine their food sustainability?	
Key variables	National and international laws and policies concerning farm support schemes; standards of food production and consumption; trade in agricultural products; investment in agriculture; the right to food; labour standards; environmental standards; spatial planning; tax schemes; financial market; regulation; cross-country and cross-continental comparisons:
Methods	Review of laws, treaties, and literature – including case law, statistics, and maps – pertaining to both home and host states of investors, producers, and consumers, from a legal coherence and multi-layered governance perspective and taking into account the extraterritorial nature of human rights.
2. Which economic, social, and environmental drivers are impacting on the selected food systems and the interactions between them?	
Key variables	Key global drivers and related data about trade and investment flows; market trends; national budgets, including external debts; changing consumption and lifestyle patterns; development of gender relations; climate change factors; land degradation; biodiversity degradation.
Methods	Review of literature, statistics, maps, and case law, as well as legal coherence analysis.
3. How do these external factors impact on the policy space of the country or region concerned?	
Key variables	External factors that enable or hinder political processes in which actor-specific understandings of food sustainability areexpressed and negotiated in a democratic way; key actors at the national level; national key actors' perspectives on the principles of food sustainability.
Methods	Review of laws, treaties, and literature; direct observation, semi-structured expert interviews, and focus groups.
4. Which innovative policy and legal options contribute to an enabling environment for food sustainability in the selected countries and regions?	
Key variables	Existing policy spaces; policy coherence; incentive structures; relation between national and international laws.
Methods	Workshops with researchers of WPs 2-5, stakeholder forum representatives, and advisory board members; review of case law and legal coherence analysis.

WP2 focuses on understanding institutional configurations and dynamics within and between food systems. Research will concentrate on those parts of food systems that are relevant at the local scale; this will also help to clarify how local institutional configurations of food systems relate to the right to food and other human rights.

Table 3.2 Research questions, key variables, main methods, and scales addressed in WP2.

WP2: Institutions, actors, and perceptions	
Main scale of research: local (in line with dimensions of food systems under study) *Methodological collaboration with WPs 1, 3, 4. Inputs to and feedback from WPs 1, 3, 4, 5.*	
5. How do formal and informal institutions including public, private, and customary law transform and shape food-system-specific institutions and related patterns of interaction and power hierarchies among key actors within and between food systems?	
Key variables	Land property rights, access to land and associated natural resources (incl. common-pool resources with common-property institutions); key actors within food systems; internal and external actors linking different food systems; gender, ethnic, class, and other power relations among key actors in different food systems; dynamics of socio-economic differentiation among food system actors; types of intersections between different food systems (contract farming, agricultural wage labour, crop-sharing arrangements); potentials for conflict, bargaining power, and collaboration; degrees of social participation in decision-making within different food systems.
Methods	Review of literature, statistics, and maps; participatory observation, open and semi-structured interviews, biographies and narrative interviews, oral history of institution-building, participatory mapping, transect walks, and focus groups.
6. How are cognitive factors (social, cultural, and symbolic values) expressed in actor-specific food system activities (production, processing, packaging/distributing/retailing, and consumption of food), and how do they relate to risk and insecurity?	
Key variables	Use of local, scientific, and other knowledge; joint value creation regarding main features of food systems; perceptions and ideological legitimization of individual food systems and their coexistence; perceptions of risks, food insecurity, poverty, sustainability, development, potentials for conflict, and complementarities.
Methods	Participatory observation, open and semi-structured interviews, biographies and narrative interviews, oral history of institution-building, focus groups, and techniques based on intersectionality [243, 244].
7. What are the outcomes of existing institutional configurations within and between food systems for human rights and especially the right to food?	
Key variables	Ways in which individuals and communities exercise their right to food e.g. through subsistence production or wage labour); ways in which public authorities implement their obligations to respect, protect, and fulfil the right to food and other interdependent human rights, such as labour rights and property rights; ways in which businesses implement their obligations to respect human rights and remedy violations.
Methods	Open and semi-structured interviews, focus groups, expert interviews, surveys.
5. How do formal and informal institutions including public, private, and customary law transform and shape food-system-specific institutions and related patterns of interaction and power hierarchies among key actors within and between food systems?	
Key variables	Land property rights, access to land and associated natural resources (incl. common-pool resources with common-property institutions); key actors within food systems; internal and external actors linking different food systems; gender, ethnic, class, and other power relations among key actors in different food systems; dynamics of socio-economic differentiation among food system actors; types of intersections between different food systems (contract farming, agricultural wage labour, crop-sharing arrangements); potentials for conflict, bargaining power, and collaboration; degrees of social participation in decision-making within different food systems.
Methods	Review of literature, statistics, and maps; participatory observation, open and semi-structured interviews, biographies and narrative interviews, oral history of institution-building, participatory mapping, transect walks, and focus groups.

WP3 focuses on food system activities, value chains, livelihoods, and food security. This will involve collecting data on food system activities at the local scale, as well as finding out how value chains link local with subnational, national, and global scales, and what implications this has for food security at the intra- and inter-household levels and for the reduction of poverty and inequality. WP3 will coordinate its activities closely with WP2 and WP1, as it will contribute data on key outcomes of institutional configurations, e.g. regarding the generation and distribution of incomes and benefits, food security, and the right to food and other human rights.

Table 3.3 Research questions, key variables, main methods, and scales addressed in WP3.

WP3: Activities, value chains, livelihoods, and food security	
Main scale of research: local (and its links with subnational, national, and global scales) *Methodological collaboration with WPs 1, 2, 4. Inputs to and feedback from WPs 1, 2, 4, 5.*	
8. How do specific food system activities – both market-based and subsistence-oriented ones – shape the key outcomes of individual food systems in terms of food security, the reduction of poverty and of inequality, and the right to food and other human rights?	
Key variables	Price determination as an outcome of supply and demand interaction: value chains shaping the supply side of market-based food systems of corporations, small enterprises, agriculture, and agro-processing industries; level and composition of output and international trade, cost structure and value-added distribution of food products; demand-side of market-based food systems, analysing household incomes, livelihood assets, consumption, and related levels of food security (particularly of low-income households); specific roles of subsistence production, contract farming, outgrower schemes, contract farming, wage labour (in agro-processing, transport and distribution, and retail sectors); and consumption patterns (of urban households deriving incomes outside food systems).
Methods	Review of literature, official economic/trade statistics and maps; participatory observation and mapping, focus groups, and open and semi-structured interviews, including of businesses at all stages of value chains; household and panel surveys for evaluating food security [245], livelihood systems; value and commodity chain mapping [246]; FAO guidelines and methods for assessing food system outcomes and impacts on the right to food [247].
9. What are key trade-offs between individual food systems coexisting in the same geographical areas?	
Key variables	Interactions between food security, food prices, and poverty and inequality, particularly with regard to employment and unemployment, gender, and nutrition (using data from above).
Methods	Same methods as for studying research question 8; review of local statistics; interviews and a household survey including questions on household economic data, as well as price and value trends.

WP4 focuses on environmental integrity and social-ecological resilience. Based on close collaboration with WPs 2 and 3, WP4 will analyse land use and land cover change over the last 10 to 20 years and investigate how this is linked with ecological buffer capacity, socio-economic self-organization, and learning capacity, which are the main factors determining the social-ecological resilience of the food systems under investigation.

Table 3.4 Research questions, key variables, main methods, and scales addressed in WP4.

WP4: Environmental integrity and social-ecological resilience	
Main scale of research: local (in line with dimensions of food systems under study) *Methodological collaboration with WPs 2, 3. Inputs to and feedback from WPs 1, 2, 3, 5.*	
10. What is the state of food systems' environmental integrity?	
Key variables	Main patterns of land use; intensity of the use of land, water, energy, fertilizers, and pesticides per unit of food produced; basic features of food systems' impact on biodiversity conservation and degradation; ecological embeddedness of food systems.
Methods	Review of literature, statistics and maps; participatory observation, open and semi-structured interviews, participatory mapping, and focus groups. Land use and land cover change will be analysed by means of GIS and remote sensing, as well as review of satellite images, statistics, and maps, combined with selected transversal methods. Environmental integrity will be assessed based on a selection of indicators proposed by FAO's SAFA tool [141]; evaluating ecological embeddedness [34, 166] of food systems; their relevance for biodiversity conservation is made as proposed by Peterseil's landscape-based approach [165]
11. How do food systems' environmental integrity and their socio-economic outcomes influence social-ecological resilience, and how do different actors perceive this resilience?	
Key variables	Food systems' ecological buffer capacity, social-ecological self-organization, and capacity for learning and adapting to changing conditions; actor-specific perceptions of risks, vulnerability, and current and future impacts of global change.
Methods	Review of literature, statistics, and maps; resilience will be assessed based on indicators developed by Cabell and Oelofse [216] and Ifejika Speranza et al. [183] by using household surveys , field visits with national natural scientists, including transect walks and interaction with local communities; participatory observation, open and semi-structured interviews, participatory mapping, and focus groups.

WP5 focuses on integration, policy options, and dissemination. This WP constitutes the inter- and transdisciplinary platform through which key scientists working in all other WPs will collaborate and interact with non-academic stakeholders in the food systems under investigation.

Table 3.5 Research questions, key variables, main methods, and scales addressed in WP5.

WP5: Integration, policy options, and dissemination	
Main scale of research: local (and its links with subnational, national, and global scales) *Inputs from WPs 1, 2, 3, 4 and feedback to WP 1.*	
12. What food systems are most promising from a comparative perspective, and what are their individual and aggregate contributions to food sustainability in a context of coexistence?	
Key variables	Potentials and limitations of socio-economic, social, and technical innovations that help to make food systems more sustainable at both individual and aggregate levels.
Methods	Interdisciplinary workshops moderated by external peers/facilitators; expert groups; and stakeholder platforms for the discussion, contextualization, and validation of scientific insights.
13. How can existing levels of food sustainability be increased through innovations and policy options that increase collaboration within and between different food systems?	
Key variables	Potentials and limitations in innovating food systems individually and with regard to their interactions;; potentials and limitations of policy options promote the innovation of food systems with a view to enhancing their food sustainability; policy coherence of proposed options with wider policy environments.
Methods	Same methods as for research question 12.

WP5 faces a special challenge related to the process of integrating results from the different work packages. This integration will be achieved by *interrelating results from the local to global scales* addressed by the individual WPs and feeding the resulting insights into processes of application and dissemination of research products. More specifically, the integration of research results will happen along the following five steps:

1. **Identify and compare individual contributions of the food systems under investigation** to the five principles of food sustainability by means of an interdisciplinary assessment of the outcomes of WPs 1-4.
2. **Identify aggregate contributions of the food systems under investigation** to the five principles of food sustainability, taking account of trade-offs between food systems and related local, regional, national, and global scales.
3. In an inter- and transdisciplinary process, **identify promising socio-economic, social, and technical innovations** for making individual food systems more sustainable, and devise ways of scaling up the more sustainable among them.
4. In an inter- and transdisciplinary process, **identify promising policy options for improving food sustainability** by optimizing complementarities and collaboration between different food systems.
5. **Make cross-country comparisons** both within and across continents between the various South American and African countries involved in this research project.

The disciplinary research will occur in the context **of interdisciplinary collaboration between the research teams.** Though ongoing, the collaboration will be particularly intense in the following (partly overlapping) stages of activity:

1) **Inauguration of empirical research and analysis of contexts and trends** (year 1): Interdisciplinary collaboration between the research teams began with the development of the pre-proposal, and intensified during *workshops held in Switzerland, Kenya, and Bolivia* in order to elaborate the full proposal. Emphasizing conceptual and methodological reflections grounded in concrete experiences, this type of interaction will continue throughout the project, especially via platforms such as the regional stakeholder forums and the advisory board.

Interdisciplinary collaboration will also be very intensive during the *inauguration phase* of empirical research and investigation of contexts and trends. Before beginning the disciplinary work, interdisciplinary collaboration will be required to define the types of food systems for investigation and the scope of empirical work to be implemented; it will also be required to establish the regional stakeholder forums and agree upon the terms of reference governing participation in later disciplinary, interdisciplinary, and transdisciplinary phases of knowledge production. This will also be necessary to ensure maximum coherence between the research on specific food systems (WPs 2–4) and the research on the surrounding contexts (WP1). Thus, members of WP1 must consider interdisciplinary collaboration with WPs 2–5. This will help ensure systematic analysis of the relationship between specific aspects of food systems and the broader contexts shaping them. Especially important in the first half year, this collaboration will involve *joint definition of calls, recruitment, and discussion of the specific research questions of the Southern and Northern PhDs.* Though less intense in the subsequent phase, interdisciplinary collaboration with WP1 will continue via *joint fieldwork* related to a WTI-based PhD project on contextual factors.

2) **Disciplinary deepening** (years 2–4): The disciplinary research taking place in WPs 2–4 will focus on specific institutional, economic, and ecological features of food systems. Nevertheless, interdisciplinary collaboration between the teams will remain important, since their disciplinary research will be systematically tied to the topics specified for WPs 2–4. Further, the teams working in different WPs will often use similar methods – e.g. interviews, focus groups, surveys – easily facilitating integration of each other's questions in materials used for data collection.

3) **Horizontal and vertical integration** (years 4–5): Interdisciplinary collaboration during this period is at the core of WP5. The members of WP5 will be recruited from the other WPs, ensuring adequate representation of disciplinary perspectives and results in an overall, integrated picture of food sustainability. This concerns the integration of research results provided by teams studying specific features of individual food systems. Such *horizontal integration* of social, economic, and environmental data on specific food systems will enable identification of the outcomes they produce and how they measure up to the five principles of food sustainability. It relies on collaboration between senior researchers, postdocs, and PhDs, moderated by CDE (main applicant and postdoc).

This will lay the foundation for joint evaluation of coexisting food systems' aggregate outcomes, as measured against principles of food sustainability. Such *vertical integration* will enable researchers to outline promising conditions, measures, and innovations leading to more coherent policy options capable of steering food systems towards improved sustainability and coexistence. To this end, cross-country interdisciplinary teams will carry out comparative analyses of the case studies. This phase of interdisciplinary collaboration between senior researchers, postdocs, and PhDs will be moderated by CDE, WTI, CETRAD, and AGRUCO-PROBIOMA (co-applicants) who have significant experience translating research results into coherent policy options. WP1 will enable formulation of innovations and policy options that emphasize coherence and effectiveness.

4) **Application, communication, and dissemination** (years 5–6): This will be a phase of intense interdisciplinary collaboration between the teams of WPs 1–4 focussing on the elaboration of the FoodSAF as well as planning and execution of TPAs to promote this instrument and other initiatives designed to optimize policy incidence, societal debates, and networking on behalf of food sustainability theory and practice (see also chapter 7).

The integration of qualitative and quantitative data will be secured through joint development of an interdisciplinary framework. It first version will be developed in the beginning of research process through interdisciplinary team work. This so-called "food sustainability meta framework" of the project will show in each project stage how the assessment of food systems' sustainability at individual and aggregate levels is made operational by means of specific sets of qualitative and quantitative indicators [248].

This fundamental step of interdisciplinary integration and synthesis is aimed at creatively addressing the four barriers of interdisciplinary practice identified by Lele and Norgaard [249]: values underlying all types of inquiry (choice of questions, theoretical positions, variables, and style of research); different disciplinary theories or explanatory models; use of different epistemologies and methods of defining data validity; expectations of the wider societies that interact with academia in interdisciplinary processes. The research team will address these challenges in a self-reflective process that makes explicit the value judgments that are embedded in the different researchers' choice of variables and models. This will create enabling conditions for mutual learning aimed at developing new models and alternative

taxonomies based in inter- and transdisciplinary plurality. The learning process will be enhanced through interaction with external peers, who will be in charge of moderating it to ensure that the team addresses blind spots and contradictions that without an external view would be difficult to reveal [250].

Given its role as a platform for interdisciplinary collaboration among researchers also involved in other WPs, WP5 is at the same time unit in charge of organizing **application, communication, and dissemination of research results and products.** This will mainly be achieved by developing a "Food Sustainability Assessment Framework" (FoodSAF) that will then be further applied in other regions of Bolivia and Kenya, as well as in at least two regions in Brazil, Peru, Ghana, and Zambia. Application of the FoodSAF will be supported through transformative pilot actions (TPA) (see section 5.1). The FoodSAF will consist of a written handbook that shows 1) how to delimit and distinguish different food systems in an area of interest based on empirical evidence; 2) how food sustainability can be empirically assessed with regard to each of the five principles by means of specific qualitative and quantitative indicators, including a simple description of how to use the methods proposed for collecting and interpreting data on each indicator; 3) how assessments of individual food systems can be aggregated to appraise overall food sustainability; 4) how to foster a reflexive collective process for identifying most promising innovations and enabling policy options that improve food sustainability by enhancing collaboration within and between food systems. After initial testing, the FoodSAF will be made available as software, enabling its use and dissemination for a wider public.

3.3 Rationale for country selection

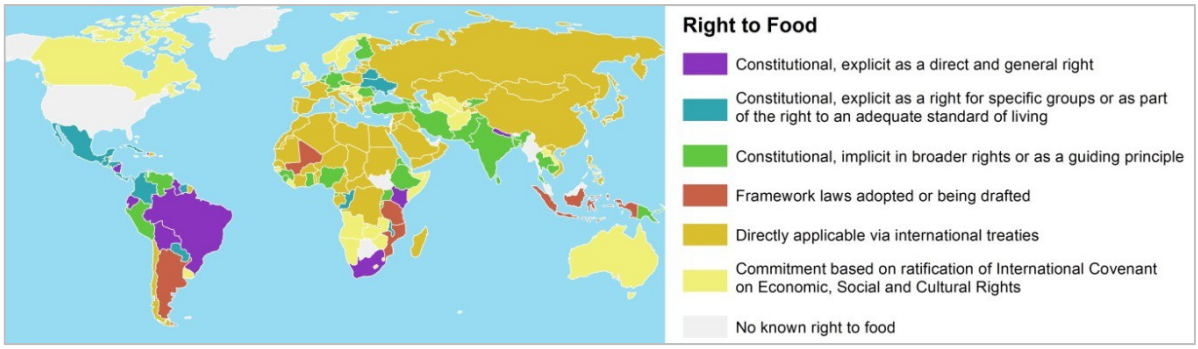
The rationale for selection of Bolivia and Kenya as case study countries was based on the following, theoretically defined *five primary* criteria (corresponding indicators used are given in brackets; see also figure 2) 1) hunger and food insecurity are severe (global hunger index); 2) implementation of the right to food is well advanced (degree of recognition of the right to food at the national level; see figure 2). Additionally, seven secondary criteria were used in order to make sure that the primary and secondary case studies allow for relevant and interesting cross-country and cross-continental comparisons (for details on these criteria see figure 2).

Case study areas and food systems studied in Bolivia and Kenya

In Bolivia, the participants of the preparatory workshop held in February 2014 [233] selected the region of Santa Cruz as a case study area for this project. In the region's mosaic-like landscape, indigenous smallholders' food systems coexist with other food systems involving medium- and large-scale producers and actors more directly involved in processing, distributing, and consuming food. The main crop is soy. About 97% of the region's 12,000 soy producers are small- and medium-scale farmers who also produce corn, vegetables, sugar cane, and rice. The remaining 3% are large-scale producers. The latter cultivate 55% of the region's total area under soy, and they benefit greatly from diesel subsidies and the rapid expansion of food- and flex-crop-related industrial and transport infrastructure [251, 252].

Similarities:

- Kenya and Bolivia are among the more advanced countries in their regions with regard to national **legislation** on the right to food (see figure below).
- The global hunger index [2] ranks **hunger, food insecurity, and poverty** among rural populations in Kenya and Bolivia as "serious".
- In Kenya and Bolivia, export-oriented agro-industrial **food systems coexist and compete** with other food systems (mainly those of smallholders) for land, natural resources, capital, markets, and consumers.



Recognition of the right to food at the national level (elaborated by authors of this proposal)

Differences and cross-country comparisons:

A more detailed look at Bolivia and Kenya shows that while they both generally meet the five primary selection criteria, there are other relevant aspects in which they differ:

- Hunger and food insecurity, the share of the total population living in rural areas, agriculture's contribution to the GDP, employment in agriculture, the land area sold or leased to foreign investors, and land degradation are considerably higher in Kenya than in Bolivia; but interestingly, Kenya has lower rates of rural poverty and income inequality. Finding the reasons for this will add value to cross-country comparisons.

The additional, more qualitative assessments of food sustainability to be achieved by applying the FoodSAF tool in Brazil, Peru, Ghana, and Zambia will enable additional cross-country comparisons. Interesting preliminary observations include the following:

- Brazil and Peru (see table below) have lower indicator values than Bolivia for hunger, food insecurity, rural poverty, rural share of population, employment in agriculture, agricultural exports, and income inequality, whereas large-scale land acquisition and environmental degradation are more widespread. The question arises whether improvements in food security below a certain critical threshold lead to negative trade-offs such as an increase in large-scale land holdings (or acquisitions) and environmental problems.
- All of Zambia's indicator values are worse than Kenya's. In Ghana, hunger and food insecurity are below critical levels, and rural poverty, rural share of population, employment in agriculture, and income inequality are also lower than in Kenya; by contrast, the values for agricultural exports, large-scale land acquisition, and land degradation are higher. Like in South America, this enables analysis of whether improvements with regard to food security and poverty come at the cost of growing dependence on large-scale land investors and of land degradation.
- Finally, comparison across continents will enable analysis of how varying structural features – e.g. related to land tenure regimes, forms of dealing with land leases for corporate agriculture, or social and societal organization (governance) –influence the outcomes of different food systems, and how they affect national or regional food sustainability.

Indicator	Bolivia	Brazil	Peru	Kenya	Ghana	Zambia
Global Hunger Index, 2013	11.2	< 5	5.5	18.0	8.2	24.1
Population living in rural areas (%), 2010	33.2	15.4	22.8	76.0	48.1	60.8
Rural population below national poverty line (%), 2011	66.4	46.7	56.5	49.1	39.2	60.5
Contribution of agriculture to GDP (%), average 2009-11	11.7	5.5	7.8	23.1	27.3	20.7
Share of employment in agriculture (%), average 2005-10	36.1	17.0	0.8	61.1	57.2	72.2
GINI coefficient, average 2005-11	56.3	54.7	48.1	47.7	42.8	57.5
Total surface of land deals (in 100,000 ha), 2014	0.34	13.90	2.97	2.78	8.44	3.24
Contribution of agriculture to GDP (%), average 2009-11	11.7	5.5	7.8	23.1	27.3	20.7

Source: FAO Statistical Yearbook 2013, Global Hunger Index 2013, MDG Indicators 2013, www.landmatrix.org, Bai et al. 2008.

Figure 3.1 Overview of similarities and differences between Bolivia and Kenya and additional countries of comparison (Brazil, Peru, Ghana, and Zambia).

In recent years, the Bolivian government has begun to introduce targeted measures to support small-scale soy producers, including provision of access to public storage facilities, preferential price and fair trade arrangements, promotion of loans, extension services, promotion of cooperatives, marketing boards or public procurement, increases in minimum wages, facilitation of land worker unions' activities, eased access to justice for labour (and other) issues, and – where necessary – support in securing land and promotion of the rights of labourers on large-scale farms. These measures are consistent with key proposals made by experts dealing with the improvement of structural conditions for coexistence between large- and small-scale farmers [16, 56, 63, 67, 209]. The case studies will therefore evaluate the individual and aggregate food sustainability of smallholders', medium family farmers', and agro-industrial food systems; in addition, we will analyse the food system of the national enterprise "La Colonia de Pirai", which buys non- transgenic soy for its own meat and milk production. The project's main research partners in Bolivia, AGRUCO and PROBIOMA, have long been working in the area, promoting food systems' agroecological development [69, 253, 254].

In Kenya, the participants of the preparatory workshop organized in March 2014 identified the Mount Kenya region as a study area for this project. More specifically, research will be carried out in the counties of Meru and Laikipia. In this region, large commercial farms employ several thousand farm workers, who at the same time are also smallholders; in addition, there are other food producers in the region, including large ranches as well as medium- and small-scale farms. These coexisting food systems produce, and partly process, commercialize, and consume food in a mosaic-like landscape; these landscapes spans a wide range of agroecological zones from humid to subhumid to semi-arid and arid, and they are connected to local, national, and global markets. They produce cash crops (tea, coffee, wheat, cotton, bananas, mangoes, and flowers); food crops (maize, beans, pulses, potatoes, tomatoes, and onions); and livestock products (dairy products and meat from cattle, goats, and camels). The region's different food systems compete for land, capital, and water, with access to water being particularly hotly contested [255, 256]. Based on its different agroecological zones and its great cultural diversity (e.g. Meru, Kikuyus, Embu, Boran, and others), the Mount Kenya region is highly suitable for comparison with other regions in Kenya and in neighbouring countries. Research on related topics has been ongoing for many years in the area. The past work of CETRAD and CDE as well as other organizations in the region can serve as a basis for the proposed study to build on.

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This working paper describes the background, objectives, research questions, and overall organization of the r4d project “Towards Food Sustainability: Reshaping the Coexistence of Different Food Systems in South America and Africa”. It outlines the five normative principles of food sustainablity – food security, the right to food, reduction of poverty and inequality, environmental integrity, and social-ecological resilience – that underpin the concept of food sustainability used in the project, and how these principles can be addressed by an interdicisplnary group of researchers. Further, the working paper describes how research on the sustainability of food systems can benefit policymaking and practice by involving different actors from the very outset and throughout all project stages.

The present Working Paper Series is an outcome of the project “Towards Food Sustainability: Reshaping the Coexistence of Different Food Systems in South America and Africa”. The project is part of the Swiss Programme for Research on Global Issues for Development (r4d Programme) funded by the Swiss Agency for Development and Cooperation and the Swiss National Science Foundation and is carried out by the following institutions: Agroecología Universidad Cochabamba (AGRUCO), Cochabamba, Bolivia; Centre for Training and Integrated Research in Arid and Semiarid Lands Development (CETRAD), Nanyuki, Kenya; Geneva Academy of International Humanitarian Law and Human Rights, Geneva, Switzerland; as well as Centre for Development and Environment (CDE), Institute of Geography, and Institute of Social Anthropology, all at the University of Bern, Switzerland.

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