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Abstract

With the shift from petroleum-based to biomass-based economies, global biomass demand and trade is growing. This trend could become a threat to food security. Though rising concerns about sustainability aspects have led to the development of voluntary certification standards to ensure that biomass is sustainably produced, food security aspects are hardly addressed as practical criteria and indicators lack. The research objective of this working paper is to identify how the Human Right to adequate Food (RtaF), which is applicable in over 100 countries, can be ensured in local biomass production and in certification systems in food insecure regions. We aim to first develop a suitable conceptual framework to integrate the RtaF in biomass production, processing and trade and derive guidance for the choice of the criteria. Second, we identify appropriate criteria to ensure that the RtaF is not violated by certified biomass operators based on a comprehensive literature review, stakeholder workshops and expert interviews with certification bodies, standard initiatives, NGOs, ministries, scientists and enterprises. The conceptual framework is based on the UN "Voluntary Guidelines to Support the Progressive Realization of the RtaF in the Context of National Food Security" and the four dimensions of food security. Based on this framework, we developed the rights-based food security principle. To ensure that the RtaF is not adversely affected by certified biomass production and trade, we propose 45 criteria, classified in 17 themes which are derived from the voluntary guidelines. The suggested criteria are applicable to all biomass types and uses and serve as a best-practice set to complement existing sustainability standards for biomass.

Keywords: certification, biomass, bioenergy, food security, right to adequate food, sustainability standards

Contents

List of Abbreviations

BEFS	Bioenergy and Food Security
C-B	Cost-Benefit ratio
CFS	Committee on World Food Security
CFS-RAI	CFS Principles for Responsible Investment in Agriculture and Food Systems
ESIA	Environmental and social impact assessments
FAO	Food and Agriculture Organizations
FONAP	Forum for Sustainable Palm Oil
FPIC	Free, Prior and Informed Consent
FSC	Forest Stewardship Council
IFAD	International Fund for Agricultural Development
ILO	International Labour Organization
INRO	Initiative on Sustainable Supply of Raw Materials for the Industrial Use of Biomass
IRR	Internal Rate of Return
ISCC	International Sustainability&Carbon Certification Standard
LSLA	large-scale land acquisitions
NGO	Non-governmental Organization
NPV	Net present value
OECD	Organisation for Economic Co-operation and Development
PRAI	Principles for Responsible Agricultural Investment that Respects Rights, Livelihoods and Resources
RtaF	Human Right to adequate Food
RSPO	Roundtable for Responsible Palm Oil
RSB	Roundtable of Sustainable Biomaterials
RTRS	Round Table on Responsible Soy
VGGT	Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development

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Summary

Worldwide, governments start to shift from fossil fuel-based to biomass-based economies. Consequently, global biomass demand, trade and production is increasing also for non-food uses. Sustainability concerns regarding non-food biomass production are growing and led, for example, to the development of environmental regulations for bioenergy in the EU. Private certification standards for biomass such as REDcert, ISCC, RSB or Bonsucro are a response to these sustainability concerns though their performance levels regarding environmental and social criteria vary. Food security aspects are hardly addressed in these standards and practical indicators, verifiers and hence measurability lack. This becomes especially alarming when the non-food biomass demand continues to increase, involving the potential trade-offs with food security at local, national or global level.

The objective of this research is to identify how the Human Right to adequate Food (RtaF), which is applicable in over 100 countries, can be ensured through certification systems when producing and processing biomass in food insecure regions. We first develop a suitable conceptual framework to integrate food security and the RtaF in biomass production, processing and trade and to derive guidance for the choice of the indicators. Second, we identify appropriate criteria to ensure that the Right to Food is not violated by certified biomass operators.

In addition to a comprehensive literature review and a screening of the ten major biomass standards and certification systems, we conducted over ten expert interviews and two multi-stakeholder workshops with certification bodies, standard initiatives, NGOs, ministries, scientists and UN organizations. The conceptual framework is based on the four dimensions of food security (access, availability, utilization, stability) and the “Voluntary Guidelines to support the progressive realization of the RtaF in the context of national food security” of the FAO.

The framework led to the selection of 14 out of the 19 voluntary guidelines which fall within the responsibility of a company. For each selected guideline at least one criterion is established resulting in a total of 45 criteria which form the rights-based food security principle. Where possible, existing criteria are used to ensure a smooth integration in commonly used sustainability standards.

The criteria are applicable to all biomass types and uses, for different biomass sustainability standards, farm sizes and business types. They represent a best-practice set to ensure that the RtaF is not violated at local level when producing and trading biomass and hence protect the food security of the people involved at local level. The multi-stakeholder process ensured that the criteria are feasible, practicable and measurable though a field testing phase and further verification guidelines for the criteria are still required. In future, the rights-based food security principle can and should be included as a whole set in existing biomass sustainability standards and certification schemes as well as in the European Renewable Energy Directive to foster local food security in food insecure regions.

1 Introduction

International demand and trade for food and non-food biomass[1] is growing since governments have started to shift from fossil fuel-based to bio-based economies. Biomass produced for food and feed requires the same resources as biomass for non-food uses, e.g. energetic or material uses (OECD and FAO, 2014). Hence, the increasing demand for biomass leads to a rising competition between the different uses in a context of limited availability of arable land, water and energy. This trend may have adverse impacts on food security through the direct competition between biomass production for export or non-food purposes and available land and water resources for local food production, leading to lower food supplies and consequently rising food prices at local and international level (Heinimö and Junginger 2009; Bringezu 2011; Kampmann, Brouwer, and Scheppers 2008; Virchow et al. 2014).

In the past years, the increasing use of bioenergy in the industrialized countries has led to more biomass imports and large-scale land investments (Popp et al. 2014). These new markets for biomass attract national and international investors. Although international organizations such as World Bank and UNCTAD (World Bank and UNCTAD, 2014) promote responsible foreign direct investment in agriculture in the expectation of positive effects on the development of the agricultural sector, most of these investments fail to include environmental and social aspects in a responsible way (Brüntrup et al., 2014). Thus, biomass imports and large-scale land investments are often associated with negative effects on the environment and the local population, especially in food insecure regions, of the exporting countries (Diop et al. 2013; Cotula, Dyer, and Vermeulen 2008; Popp et al. 2014).

1.1 Voluntary sustainability standards for biomass

In response to these negative effects and hence in order to satisfy environmental and social sustainability requirements for biomass, various global sustainability standards and certification schemes have emerged as new private governance mechanisms (Charnovitz et al., 2008; Geibler, 2012; Klooster, 2010; Mohr and Bausch, 2013; Scarlat and Dallemand, 2011). It is often assumed that adverse environmental and social impacts of (large-scale) biomass production, export and trade can be mitigated through private engagement and cooperative mechanisms involving civil society actors, business and state authorities (Hemmati 2002; Pattberg 2006; Geibler 2012). In the last two decades, voluntary sustainability standards proliferated (van Dam, 2009) yet with great differences in their aims, scope and concepts of sustainability and feedstock types (e.g. addressing biomass in general or only a specific commodity such as palm oil). The main standards were mostly developed in multi-stakeholder processes referring to one specific feedstock such as the Forest Stewardship Council (FSC) for wood, the Round Table on Responsible Soy (RTRS) and the Roundtable for Responsible Palm Oil (RSPO). Others refer to multiple feedstocks such as the Roundtable of Sustainable Biomaterials (RSB) or the International Sustainability & Carbon Certification Standard (ISCC). These initiatives gained support with the introduction of the Renewable Energy Directive of the European Union (EU RED), which includes a set of mandatory sustainability criteria for bioenergy (EC, 2009). Voluntary certification systems which fulfil these criteria can then be used to prove compliance.

1.2 International guidelines for the food and agricultural sector

In 2004 the United Nations (UN) released the "Voluntary Guidelines to Support the Progressive Realization of the Right to Adequate Food in the Context of National Food Security" (hereafter Right to Food guidelines), which provide policy recommendations for the implementation of the Human

[1] With the term biomass, we specifically refer to biological material derived from plants and animals in the agricultural or forestry sector that is used as food for human consumption or for non-food purposes such as animal feed, energy feedstock, fibre and industrial raw materials.

Right to adequate Food[2] (FAO, 2005). The last decade was then used to develop, parallel to the development of voluntary sustainability standards, several guidelines targeting and framing sustainable agricultural supply chains at international level. The idea was to guide business investments and to prevent negative environmental and social effects of investments in the agricultural and other business sectors. In 2012 the UN addressed public and private actors with the "Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security" (VGGT), which were developed during a three year consultation process including national governments, civil society organizations, the private sector and farmers' associations (FAO, 2012a). The VGGT build upon the Right to Food guidelines and complement these with technical instructions specifically on land rights. A broader focus on Human Rights in business practices led to the development of the UN Guiding Principles on Business and Human Rights, also known as the Ruggi Principles, which were endorsed by the UN Human Rights Council in 2011 (United Nations 2011). The FAO initiative for "Bioenergy and Food Security" (BEFS) developed guiding principles related to bioenergy and food security (FAO 2014a). The BEFS approach is to support countries in designing and implementing sustainable bioenergy policies and strategies to ensure that a bioenergy extension fosters food and energy security as well as agricultural and rural development.

In 2014, an initiative lead by the World Bank, the Food and Agricultural Organization (FAO), the International Fund for Agricultural Development (IFAD) and the United Nations Conference on Trade and Development (UNCTAD) established "The Principles for Responsible Agricultural Investment that Respects Rights, Livelihoods and Resources" (PRAI) (World Bank and UNCTAD, 2014). While these guidelines mainly focus on large-scale land acquisitions (LSLA) and the need to enhance investments in the agricultural sector, another process started at the Committee on World Food Security (CFS) which endorsed the "CFS Principles for Responsible Investment in Agriculture and Food Systems" (CFS-RAI), also in 2014 (CFS, 2014). These principles were developed during an inclusive consultation process, engaging a wide range of different stakeholders with a brought focus on investors and land holders including multinational companies. Both principle sets have a voluntary character and thus are usually not enforced in national or international laws. Instead they provide a general and voluntary guidance for investors and governments with recommendations for sustainability practices and technical advice.

Both, the private sustainability standards as well as the international guidelines intent to guide and voluntarily regulate sustainability aspects of biomass production. In contrast to international guidelines, private sustainability standards are often combined with certification systems. Certification monitors the implementation of a standard by an individual or a company through a third party verification process against a set of criteria and indicators. This requires exactly defined and measurable criteria and indicators which are controlled during on-site audits (Albersmeier et al., 2009). The primacy of food security within the production of biomass is widely discussed at international level (e.g. the BEFS approach) and emphasized by the civil society (Schneider, 2014). Yet, only few proposals have been made on assessing food security aspects in private certification standards for biomass (Scarlat and Dallemand, 2011). Among the various sustainability certification schemes, only the RSB defined a comprehensive guideline to assess the principles that ensure and enhance food security (RSB, 2012). However, this complex assessment method seems not applicable in the context of private certification due to the need for intensive data collection (including household surveys) and analysis[3]. Furthermore, a study assessing the sustainability performance of different biomass certification schemes revealed a lack of methods to assess and avoid negative impacts on local food security through certification standards (WWF, 2013).

The objective of this research is to identify how the Human Right to adequate Food (RtaF), which is applicable in over 100 countries, can be ensured in local biomass production through certification systems in food insecure regions. Two research questions are therefore addressed:

[2] Hereafter abbreviated as 'Right to Food'.

[3] Own assessment and private communication by a certification body, 04 June 2014.

1. What is a suitable conceptual framework to integrate the Right to adequate Food in biomass production, processing and trade and which can guide the choice of criteria and indicators?
2. Which criteria are appropriate to ensure that the Right to adequate Food is protected by certified biomass operators?

The next chapter describes the methodology that was applied in this study and in the third chapter we explain the conceptual framework, which leads to the choice of criteria. In chapter four we present the developed rights-based food security principle with the responding criteria set. Chapter five discusses and explains the reasoning for the choice of criteria and chapter six ends with the conclusions and recommendations.

2 Methodology

We decided on an iterative process for the development of the rights-based food security principle with its relevant criteria based on intensive stakeholder interaction. We started with a comprehensive review including literature on the Human Right to adequate Food, food security and its measurement (see also Table A1), standards and certification systems, and a screening of the major biomass standards and certification systems. As we found no adequate concept to guide the choice of food security criteria, we developed our own conceptual framework based on the definition of food security of the 1996 World Food Summit and the Human Right to adequate Food (hereafter Right to Food). The concepts and definitions used for the framework as well as the framework itself is described in detail in chapter three.

In a second step, sustainability standards for biomass were assessed for already existing indicators concerning the Right to adequate Food. The screening process included the following ten standards: FSC, RTRS, RSPO, RSB, ISCC, Bonsucro, UTZ Certified, REDCert, the Initiative on Sustainable Supply of Raw Materials for the Industrial Use of Biomass (INRO)[4] sustainability criteria and the Global Bioenergy Partnership Sustainability Indicators (Bonsucro, 2011; FSC, 2012; GBEP, 2011; INRO, 2013; ISCC, 2011; REDcert, 2014; RSB, 2013; RSPO, 2013; RTRS, 2013; UTZ Certified, 2014a). Based on the conceptual framework, the criteria were clustered according to 14 selected main Right to Food guidelines. This overview of social and environmental aspects that were already addressed in sustainability standards formed a good basis for the selection of criteria. Important aspects to ensure the Right to Food which were not already covered by existing criteria and indicators were thus also identified. Based on the conceptual framework additional criteria were developed where necessary, which resulted in the first draft of criteria for the rights-based food security principle.

A small scientific workshop was held on the measurement of food security. Then, the stakeholder consultation process was initiated to include the feedback on the first draft of the criteria set. Interviews and consultations took place with a total of ten experts from the ISCC Standard, the standard 'Cotton made in Africa', experts from the FAO, the World Food Program (WFP) and the German Agency for International Cooperation (GIZ)/ Forum for Sustainable Palm Oil (FONAP) (see Annex, Table A2). Two multi-stakeholder workshops with a total of 27 participants from certification bodies, standard initiatives, NGOs, ministries, researchers and enterprises were held to discuss the work in progress regarding the developed rights-based food security principle for sustainability standards (Annex Table A3). The aim was to discuss the conceptual framework and the criteria and to assess their contribution to secure the Right to Food in biomass production. The research took place from November 2014 until August 2015.

[4] INRO (Initiative Nachhaltige Rohstoffbereitstellung für die stoffliche Biomassenutzung) is a German multi-stakeholder initiative with the aim is to reach an agreement with the industrial Companies on voluntary certification of renewable resources before primary processing.

3 Conceptual framework

In the following, a brief definition of the concepts of food security and the Right to adequate Food is presented on which we have based the framework. Then, we describe the conceptual framework.

3.1 Definitions of food security and the right to adequate food

Many food security concepts exist. Definitions and thinking around food security has changed over the last decades from a rather production/supply oriented definition to a broad one including aspects of access and nutrition as well (Maxwell, 1996; Pinstrup-Andersen, 2009). We follow the food security definition of the 1996 World Food Summit[5]. According to the FAO (2006; 2008) and the United Nations (2015), there are four dimensions of food security, .i.e. availability, access, utilization and stability, with several determining factors:

- Food availability refers to the availability of sufficient quantities of food of appropriate quality. It is determined by domestic production, import capacity, food stocks and food aid.
- Food access refers to "access by individuals to adequate resources (entitlements) for acquiring appropriate foods for a nutritious diet. Entitlements are defined as the set of all commodity bundles over which a person can establish command given the legal, political, economic and social arrangements of the community in which they live (including traditional rights such as access to common resources)" (FAO, 2006, p. 1). Physical and economic food access is determined by the purchasing power, income of the population/household, transport and market infrastructure.
- Food utilization refers to an adequate diet, also in regard to quality and diversity, food safety, clean water, sanitation and health care to reach a state of nutritional well-being where all physiological needs are met. It emphasizes the importance of non-food inputs in food security.
- Food stability: "To be food secure, a population, household or individual must have access to adequate food at all times. They should not risk losing access to food as a consequence of sudden shocks (e.g. an economic or climatic crisis) or cyclical events (e.g. seasonal food insecurity)" (FAO, 2006, p. 1). The concept of stability is thus also relevant to the other three dimensions of food security and is determined by weather variability, price fluctuations, political factors and economic factors.

The FAO BEFS initiative for bioenergy and food security developed guiding principles related to bioenergy and food security to support countries in designing and implementing sustainable bioenergy policies and strategies that ensure that a bioenergy sector extension fosters food and energy security as well as agricultural and rural development[6]. We adapt their guiding principles for food security[7] to our purposes of integrating food security into certified biomass production and trade. Hence, we extend the above mentioned four dimensions of food security in the following way:

- Food availability: sustainable biomass production and trade should, if possible, increase - or at least not reduce - the global and local availability of sufficient quantities of food of appropriate quality.
- Food access: sustainable biomass production and trade should, if possible, increase - or at least not reduce - access by individuals, especially among the poor and vulnerable groups, to adequate resources for acquiring appropriate foods for a nutritious diet.

[5] "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." FAO (1996). Declaration on World Food Security. World Food Summit, FAO, Rome.

[6] http://www.fao.org/energy/befs/en/

[7] http://www.fao.org/energy/befs/definitions/en/

- Food utilization: sustainable biomass production and trade should, if possible, improve - or at least not worsen - especially among the poor and vulnerable groups, the utilization of food, through proper cooking, adequate diet, clean water, sanitation and health care to reach a state of nutritional well-being where all physiological needs are met.
- Food stability: sustainable biomass production and trade should, if possible, increase - or at least not reduce - access by individuals, especially among the poor and vulnerable groups, to adequate food at all times, by strengthening - or at least not weakening - their resilience to both sudden shocks and cyclical events.

Our understanding of the Human Right to adequate Food is based on Article 25 of the Universal Declaration of Human Rights in 1948[8], its further detailed explanation in the "International Covenant on Economic, Social and Cultural Rights (ICESCR) of 1966", Article 11[9], and the General Comment 12 on the 'The right to adequate food (Art.11)' of the UN Committee on Economic, Social and Cultural Rights in 1999 which is the most detailed of all (UN-CESCR, 1999). Since these documents still contain few recommendations for implementation, the "Voluntary Guidelines to Support the Progressive Realization of the Right to Adequate Food in the Context of National Food Security" (FAO, 2005) were developed. These Right to Food Guidelines further explain and provide more concrete recommendations on how the RtaF can be implemented to guarantee food security in all the four dimensions (FAO, 2005); they address mostly states with listing duties of a government to ensure and protect the RtaF. In total, there are 19 voluntary guidelines, which address important elements of food security such as good governance, market systems, legal frameworks, economic development policies and access to resources and assets. Guideline number 8 (Access to Resources and Assets) is further detailed in 6 sub-guidelines (labour, land, water, genetic resources, sustainability, services). Each guideline is considered of equal importance to ensure food security, i.e. if one guideline is completely ignored it is likely that food security is not achieved in the way the Right to Food would require it.

The Right to Food guidelines also refer to companies and international obligations, making other states and the private sector likewise responsible to support the implementation of the RtaF respectively not counteract its implementation. The need for a company to respect human rights and thus the RtaF are additionally part of many international agreements such as the ILO conventions, the VGGT or the CFS Principles and also stipulated in the UN Guiding Principles on Business and Human Rights (United Nations, 2011).

3.2 The five pillars of the conceptual framework

We structure our conceptual framework and with that the choice of criteria for the rights-based food security principle around the Human Right to adequate Food, the Right to Food guidelines and the four dimensions of food security with their respective determinants (Table 1). We decided for these concepts and, hence against the food sovereignty concept, as they are internationally accepted and

[8] "Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, housing and medical care and necessary social services, and the right to security in the event of unemployment, sickness, disability, widowhood, old age or other lack of livelihood in circumstances beyond his control." (Universal Declaration of Human Rights, 1948, Article 25(1)).

[9] "The States Parties to the present Covenant, recognizing the fundamental right of everyone to be free from hunger, shall take, individually and through international co-operation, the measures, including specific programmes, which are needed: (a) To improve methods of production, conservation and distribution of food by making full use of technical and scientific knowledge, by disseminating knowledge of the principles of nutrition and by developing or reforming agrarian systems in such a way as to achieve the most efficient development and utilization of natural resources; (b) Taking into account the problems of both food-importing and food-exporting countries, to ensure an equitable distribution of world food supplies in relation to need." (*International Covenant on Economic, Social and Cultural Rights (ICESCR), 1966", Article 11 (2)).*

highly relevant for national and international agricultural, trade and development policies (Beuchelt and Virchow, 2012).

We complement the four dimensions with a fifth one covering cross-cutting aspects which are important elements of the Right to Food but are not that apparent in the four food security dimensions. The cross-cutting dimension covers aspects such as education, participation in processes, accountability, non-discrimination, transparency, human dignity, empowerment, and rule of law (PANTHER framework of the FAO[10]), women rights and gender equity. Gender aspects and food security are highly linked; biomass investments may build opportunities for women but can also increase existing inequalities (Beuchelt and Badstue, 2013). The fifth dimension is added for two reasons: First, although the concept of food and nutrition security has changed over time, the food availability (supply) dimension still receives most attention while other issues, like equity concerns are neglected (Beuchelt and Badstue, 2013).

Out of the original 19 voluntary Right to Food guidelines, we selected 14 guidelines and 5 sub-guidelines, which we consider as necessary to be addressed at the local level to ensure that the RtaF is not violated when an investment in biomass production or processing for trade is taking place. As the five dimensions of food security are easier to conceptualize and more frequently known by non-experts than the Right to Food guidelines, we base the framework on our five dimensions of food security and their respective determinants relevant at local level (Table 1). The food security determinants are then matched with the Right to Food guidelines (listed in Table 1 next to the determinant in parenthesis). Sometimes, two or more Right to Food guidelines relate to a specific determinant of food security. To attribute a Right to Food guideline directly to one food security dimension is not always a clear-cut decision as the guidelines are often broadly and encompassing formulated. We classify a Right to Food guideline in more than one dimension when we think it is highly relevant for several dimensions. In literature, including grey literature, such an attempt has not yet been done. For a better oversight, we summarize only the Right to Food guidelines relevant at local level in the second part of Table 1.

The selection of the criteria has been done from the viewpoint of biomass production for trade and export. While the trade direction is generally not of importance, we especially addressed the situation of biomass exports from food or income insecure countries to industrialized countries. In choosing the criteria for the rights-based food security principle we always considered potential effects caused by a biomass investment/trade in food insecure regions.

In our framework, we distinguish those guidelines of the voluntary Right to Food guidelines, which we consider to be also applicable and relevant for private enterprise from those guidelines that directly imply state obligations and can only be fulfilled by a state.

Again, there is no guiding literature for this, as, due to their historical development, the Right to Food guidelines are predominately directed at states and less at the private sector. The following Right to Food guidelines are considered to be only implementable at state level (*Table 1*):

- GUIDELINE 5 Institutions
- GUIDELINE 7 Legal framework
- GUIDELINE 8D Genetic resources for food and agriculture
- GUIDELINE 12 National financial resources
- GUIDELINE 13 Support for vulnerable groups
- GUIDELINE 18 National human rights institutions

GUIDELINE 15 'International food aid' is not used at all because we found no direct relation to investments/trade in the biomass sector. It is clear that the state's government is finally responsible to ensure the implementation and protection of the right to food. The private sector has to ensure that they fulfil those voluntary Right to Food guidelines which they can contribute to, i.e. those we

[10] http://www.fao.org/righttofood/about-right-to-food/human-right-principles-panther/en/

have identified in Table 1. However, if not all guidelines are fulfilled, it is difficult to achieve food security and the implementation of the right to food – even in the private sector at enterprise/operator level. Therefore, we see the need to apply a "national level assessment tool" for the state where the biomass is to be certified. This tool, which yet needs to be developed, should provide an overview on how the state performs concerning these six Right to Food guidelines. This tool should be based on existing tools such as the "Screen state action against hunger!" guide by FIAN and Welthungerhilfe (Suarez-Franco, Ratjen, and Schneider 2007). The extent to which the legal and institutional framework addresses the Right to Food and food security, e.g., through protection of land and resource rights or good governance, will determine the effectiveness of a certification scheme in this state (Bäckstrand, 2006; Bracco, 2015; Mutersbaugh, 2005).

In cases where these guidelines are ignored or even violated, it is difficult to anticipate whether the criteria of the rights-based food security principle applied by an operator can be correctly verified because trustful information to check the compliance may not be (easily) obtained. Costs for verification will increase as more time is needed for the field assessment and more stakeholders might need to be consulted in a more pro-active manner (see also chapter 5.1). The assessment tool at state level supports companies and certification bodies before investing in certification and will indicate states where the risk of incompliance is higher and thus a more intensive auditing and verification process must be conducted. More research over longer time frames is needed to analyze whether certification schemes and especially the rights-based food security principle can actually work, be correctly verified and bring the desired benefits in states with weak governance or failed states. In other words: Can private companies in states with weak governance or failed states invest in biomass production, processing and trade without violating the Right to Food by following the guidelines?

Table 1:Relevant factors for the realization of food security and the Right to adequate Food when producing and trading biomass

Food stability	Food availability	Food access	Food utilization	Cross-cutting elements
Food security determinants relevant at local level				
Weather variability (RtaF-G. 16)	Production *(domestic production, import, food aid) (RtaF-G. 8B, 8C)*	Transport and markets (infrastructure, functioning markets, access to markets) (RtaF-G. 2,4, 8F)	Preparation (RtaF-G. 10,11)	Women rights & gender equity (RtaF-G. 8, 8B, and others)
Price fluctuations (RtaF-G. 4)	Storage/Food Stocks	Income (employment, fair wage, safety net) (RtaF-G. 8A, 14)	Knowledge, Culture, Gender (RtaF-G. 11, 10)	Education (RtaF-G. 11)
Political factors (RtaF-G. 1)	Processing	Intra-household distribution of food (RtaF-G. 10)	Health / hygiene & Sanitation, child care (RtaF-G. 10,8C)	PANTHER principles: participation, accountability, non-discrimination, transparency, human dignity, empowerment, rule of law (RtaF-G. 1,6, 19)
Economic factors (RtaF-G. 3,4)		Poverty & purchasing power (RtaF-G. 2, 8, 8A)	Access to clean water & Energy (RtaF-G. 8C)	
			Food quality, adequacy/diversity (RtaF-G. 10); Food safety (RtaF-G. 9)	
Right to Food guidelines relevant at local level				
GUIDELINE 1 Democracy, good governance, human rights and the rule of law	GUIDELINE 8B Land	GUIDELINE 2 Economic development policies	GUIDELINE 8C Water	GUIDELINE 8 Access to resources and assets
GUIDELINE 3 Strategies (Development Strategies)	GUIDELINE 8C Water	GUIDELINE 8A Labour	GUIDELINE 9 Food safety and consumer protection	GUIDELINE 6 Stakeholders
GUIDELINE 4 Market systems		GUIDELINE 8F Services	GUIDELINE 10 Nutrition	GUIDELINE 11 Education and awareness raising
GUIDELINE 16 Natural and human-made disasters		GUIDELINE 14 Safety nets	GUIDELINE 11 Education and awareness raising	GUIDELINE 17 Monitoring, indicators and benchmarks
GUIDELINE 8E Sustainability (Ecological Sustainability)		*GUIDELINE 4 Market systems*		GUIDELINE 19 International dimension
GUIDELINE 2 Economic development policies		*GUIDELINE 8 Access to resources and assets*		*GUIDELINE 1 Democracy, good governance, human rights, rule of law*
		GUIDELINE 10 Nutrition		
Right to Food guidelines relevant at national level (to be determined before a certification is issued)				
				GUIDELINE 5 Institutions GUIDELINE 7 Legal framework
				GUIDELINE 8D Genetic resources for food and agriculture
				GUIDELINE 12 National financial resources
				GUIDELINE 13 Support for vulnerable groups
				GUIDELINE 18 National human rights institutions

Notes: RtAF-G. = Right to adequate food voluntary guideline. *Italics:* RtaF guideline categorized in more than one dimension.

4 The rights-based food security principle

Based on the above described conceptual framework, we derived the "rights-based food security principle" which comprises 45 relevant criteria regarding food security and the Human Right to adequate Food (Table 2). The short title for each criteria group originates from the Right to Food guidelines (FAO, 2005). According the four dimensions of food and nutrition security, the criteria are clustered under stability, access, availability and utilization, with some criteria referring also to two dimensions.

Key consideration for the selection of the criteria were five questions: (i) what falls under the responsibility of the local operator[11], (ii) what is desirable from a food security/RtaF perspective, (iii) what is possible and realistic for an operator (including small investors/farmers) to implement, (iv) what is verifiable/measurable at adequate costs in the field and (v) whether a sound causality between the investment and changes in local food security can be established.

As described in chapter 2, not all criteria needed to be developed from the scratch as we identified already existing criteria through the screening process of certification systems. From the screened standards, diverse suggestions for the wording of criteria could be derived.

Newly defined criteria of this rights-based principle are (Table 2):

- Criterion 2.1 regarding the compliance with national food security strategies
- Criterion 3.1 regarding the local value creation
- Criterion 3.2 regarding the access to local markets
- Criterion 4.1 and 4.2 addressing the operators' responsibilities in case of adverse impacts through natural disasters
- Criterion 6.1 regarding a prove of the long term economic sustainability of the operation
- Criterion 13.1 regarding efforts to improve workers' access to food
- Criterion 15.1 emphasizing women rights
- Criterion 17.2 emphasizing the operators' specific responsibility for communities inside his/her property

The other criteria are already implemented in one way or the other in many sustainability standards though phrasing or comprehensiveness may differ greatly and not every standard covers the same aspects. As several criteria included in Table 2 are already part of sustainability standards for biomass, a broad range of experiences with their applicability, practicability and justification exists.

Some existing certification schemes divide their criteria into "minor musts" and "major musts" such as in the ISCC system, or "minimum requirements" and "process requirements" such as in the Fairtrade system. This categorization reduces the burden for the producer and allows participation in the certification system (Lewandowski and Faaij, 2006). As farmers might already derive benefits from the system, these new resources can then be used to reach fulfilment of the full criteria list (ibid.). We therefore also distinguish between criteria with immediate application and criteria where an implementation period, between one to three years, is defined. Ideally, the whole set of criteria should be ensured from the beginning of the operation and/or certification process. Depending on the size and kind of operator the implementation period might need to be further prolonged given the specific conditions of marginalized farmers. Especially for family farmers[12] we suggest a scheme

[11] With operator, we mean a biomass producer or processor holding a biomass sustainability certification. An operator can be e.g. a large estate or plantation, company, public enterprise, cooperative, individual farmer or a family farmer.

[12] Family farming is defined as: "a means of organizing agricultural, forestry, fisheries, pastoral and aquaculture production which is managed and operated by a family and predominantly reliant on family labour, both women's and men's. The family and the farm are linked, coevolve and combine economic, environmental, reproductive, social and cultural functions" (Garner and O Campos 2014).

of “continuous improvement” to enable their participation and not overburden them at the beginning with too many requirements (Table 2). Additionally, non-applicable criteria are defined for family farmers such as criterion 2.1 “Strategies”. The column “explanation” gives first indications about the corresponding criterion, what is to be assessed as well as further explanations and recommendations for actions. A reference to international guidelines, mainly the VGGT and the CFS-RAI, is included. The third column “reviewed by” lists first documents and procedures for the auditing process. These need to be expanded and further detailed in a comprehensive auditor handbook with verification guidelines, which also includes the technical knowledge of international guidelines.

In countries where the undernourishment level is below 5% based on national or FAO data, the relevance of the application of the rights-based food security principle may be questionable. In these countries, the certification of biomass may not include the audit of the food security principle. However, as many middle-income countries often still have regional hotspots with higher levels of food insecurity (e.g. Brazil, Mexico), local and regional data needs to be cross-checked. In regions with a prevalence of undernourishment of more than 5 % the rights-based food security principle has to be fully checked. If a biomass operator is to be certified in a region with > 5% food insecurity, all criteria of the principle have to be checked. It always has to be checked in countries where the Global Hunger Index[13] is defined as moderate, serious, alarming or extremely alarming.

[13] The Global Hunger Index (GHI) is designed to comprehensively measure and track hunger globally and by country and region and is calculated each year by the International Food Policy Research Institute (IFPRI), see also: https://www.ifpri.org/topic/global-hunger-index.

Table 2: Criteria of the rights-based food security principle

Criteria of the rights-based food security principle			Explanation	Verified by	Covered by INRO	Progressive implementation
Stability	**1 Democracy, good governance, human rights and the rule of law (RtaF-G. 1)**					
	1.1	The operator must demonstrate compliance with all applicable national, regional and local laws and regulations.	For family farmers special adaption periods can be implemented according the national regulatory context.	Documents of due diligence process, self-declaration on laws, operating license, company registration	X	
	1.2	The operator holds a written policy committing to the "Guiding Principles on Business and Human Rights" in all operations and transactions. The implementation of the policy must be documented and communicated to all levels of the workforce and operations.	Not applicable for family farmers. This must be available in all languages of the employed workers and signed. Implementation must be part of the job description of management personnel.	Documents, workers interviews without management (spontaneous in the fields), document of trainings		
	2 Strategies (RtaF-G. 3)					
	2.1	The operator endorses existing national strategies with regard to food security and does not contradict them by any of its business activities.	Strategies: national food security strategies, poverty reduction strategies (PRSP), national development programmes, Local land use plans and climate mitigation and adaptation strategies. Not applicable for family farmers	Written reference to the strategies, maps, documents		
	3 Market systems (RtaF-G. 4)					
	3.1	The operator adopts an implementation plan to support local value creation.	Local value creation could be supported through e.g. employment of local workers, the rising inclusion of local supplier into the supply chain, local investments in processing, school/training centres, services for suppliers such as training, input, transport, storage facilities and health centres. Local food production sold in shops run by operators.	Workers records, interviews with workers, community, check of the employment role for the whole workforce (local and foreign workers)		

	3 Market systems (RtaF-G. 4)					
	3.2	The operator must not reduce the access to markets for local communities through its operations.	There must be access to local markets for communities e.g. transport ways.	Check of guarding practice of the entrances to the company land (operations of the guards, is the road permanently blocked, is it narrowed for any larger transport than motorbike, etc.), are roads open for communities (motorbikes and business vehicles), Interview with shop owners on company practices, records of community consultations, interview with workers on their supply base, interview with union		
	4 Natural and human-made disasters (RtaF-G. 16)					
	4.1	The operator recognizes all national and /or international natural disaster risk assessments, strategies and maps in the business plan/strategy.	If no assessment is available, the operator has to conduct the assessment and address the findings in its business plan within three years. Natural disasters include drought and floods. Process indicator to be implemented within 3 years.	Business plan, maps, strategy		3 Years
	4.2	The operator informs suppliers and communities in the concerned region about natural risks and provides support in case of strong adverse natural and human made disasters.	Support must be adapted according the risk exposed e.g. insurance scheme, irrigation system, food support etc.	Information about measures taken by the operator		
	5 Sustainability (RtaF-G. 8E)					
	5.1	The operator has to apply Good Agricultural Practices (concerning soil management, chemical application and use, water management, fertilizer application).		Management plan, worker interviews	X	
Access	**6 Economic development policies (RtaF-G. 2)**					
	6.1	Provision of a business plan showing evidence to long term economic viability of the operation.		Business plan, definition of indicators: NPV, IRR, C-B etc. , check if responsible personnel is on-site		
	6.2	The operator has to provide fair, legal and transparent arrangements with suppliers. Agreed payments shall be made in a timely manner.	The arrangements can be verified also through contracts, bills or any signed agreement. Are the suppliers independent or a part of the group of the company or its mother organization? Are verbal contracts accepted?	Contracts, workers interviews, sample of suppliers, check delivery notes and invoices		

7 Labour (RtaF-G. 8A)					
7.1	Compliance with the ILO Core Conventions and the Declaration on Fundamental Principles and Rights at Work.	ILO Convention 87 on Freedom of Association and the Protection of the Right to Organise; ILO Convention 98 on the Right to Organise and Collective Bargaining; ILO Convention 29 on Forced Labour; ILO Convention 105 on the Abolition of Forced Labour; ILO Convention 138 on Minimum Age; ILO Convention 111 on Discrimination (Employment and Occupation); ILO Convention 100 on Equal Remuneration; ILO Convention 182 on Worst Forms of Child Labour; Labour laws and union agreements are available in a language workers understand.	Stakeholder interviews, documented implementation, policies, grievance documents	X	
7.2	The operator pays wages for all workers according at least to the calculated national adequate Living Wages.	According to RAI Principles Principle 2, Paragraph 22; iii. Regional estimates of Living Wages are published by Fairtrade International. If no Living wages are estimated, the operator pays wages for all workers that are (at least) according government regulated minimum wages in the specific sector for the applicable work as required by law, including all mandated wages, allowances and benefits. If there are no national or specific sector wages agreed, the producer agrees freely a wage with the workers (annual). The agreements have to be in line with all applicable laws and international conventions and local collective agreements.	Relevant documents, payment sheets, interviews with workers, workers involved in negotiations and unions representatives		
7.3	If payment for piecework is applied, the pay rate, based on an eight hour workday, allows workers to earn at least the adequate Living Wage.	According to RAI Principles Principle 2, Paragraph 22; iii, Wage must be determined in a clause of the contract.	Payment records, stakeholder interviews (workers council/ representatives)		
7.4	Men and women earn equal pay for equal work.		Interviews with workers (men and women), payment documents		

	7 Labour (RtaF-G. 8A)				
	7.5	Workers are not subjected and their awareness is trained in any form on discrimination in hiring, remuneration, benefits, access to training, promotion, termination, retirement or any other aspect of employment, based on race, colour, gender, religion, political opinion, national extraction, social origin, sexual orientation, family responsibilities, marital status, union membership, age or any other condition that could give rise to discrimination.	Workers refers to permanent and casual workers.	Interviews with workers, meeting and training minutes, grievance documents, Check of work contracts and hiring practices, is there a difference between permanent and part time staff?	X
	7.6	Workers confirm that no deductions from wages as a result of disciplinary measures are made.		Interviews	
	7.7	The operator provides all employees with fair, legal, written contracts, signed by both the employee and the employer.	The contracts detail all payments and conditions of employment (e.g. working hours, deductions (clearly state what for: loan, rice, cooking oil, housing, water supply, transport, etc.), overtime, sickness, holiday entitlement, maternity leave, reasons for dismissal, period of notice) in the national, local and foreign languages and explained carefully by a manager, supervisor or trust person. Copies of working contracts can be shown for every employee indicated in the records. If though cultural habits no contract is available any other proof must be available.	Contracts, interview workers and workers rep.	X
	7.8	The operator endorses a health and safety policy where the main health and safety risks are assessed. An implementation plan addressing measures for mitigation of these risks is in place. The policy and plan applies to all workers, including contractors, workers and suppliers. The implementation is regularly monitored and improved.		Records of trainings, meetings, accidents, plans, policy, monitoring system, workers interviews, record at local clinic	
	7.9	All workers involved in the operation shall be adequately trained in safe working, using adequate and appropriate protective equipment.		Training documents, interviews	X

	7 Labour (RtaF-G. 8A)					
	7.10	An adequate share of workers/staff must be trained in first aid and sufficient first aid kits must be available	According the ILO Workplace Safety and Health (First Aid) Regulation No. S137 of 1 March 2006. As not defined we recommend 1 person for companies < 20, and 5% for companies > 20 employees. Process indicator to be implemented within 1 year.	Training documents, interviews, check of rescue chain on-site		1 year
	7.11	Occupational injuries shall be recorded using Lost Time Accident (LTA) metrics.		Documents		
	8 Services (RtaF-G. 8F)					
	8.1	The operator provides agricultural services and capacity building for suppliers and communities inside the property (plantation). A plan has to be available.	Services and capacity building in e.g. integrated pest management, good agricultural practices, fertilizer management, quality management, health and safety, disaster risk management, social awareness etc. The dialogue with the community should be documented and lead to actions. Process indicator to be implemented within 1 year.	Documents (budget, photos, contracts, bills and name records), interviews, production figures, interviews with suppliers, community		1 Year
	9 Safety nets (RtaF-G. 14)					
	9.1	Workers are provided with medical care in case of accidents or work related diseases. Additionally, workers are covered with a public accident and medical insurance, if existent. Sick leaves are paid according the law.		Documents, interviews, checking the clinics and patients' records to gain info if only company workers are treated or also others (community, family members), check of illness and payment records	X	
	9.2	All permanent workers are provided with an occupational pension fund according the national law.		Documents, interviews		
Availability	**10 Land (RtaF-G. 8B)**					
	10.1	The operator respects all human rights and legitimate tenure rights and conducts an appropriate assessment to prevent any adverse impacts on them (see VGGT 3.2).	The operator demonstrates that the legitimate land tenure rights have been comprehensively assessed, established and documented. Legal boundaries of the operator shall be clearly demarcated and visibly maintained. See VGGT Chapter 3.2; Note: it is not sufficient to regard only national rights; If no cadastral land register exists, maps of an appropriate scale showing the extent of legitimate tenure rights shall be developed through participatory mapping involving affected parties (see VGGT Chapter 17 Records of tenure rights).	Legal documents, cadastral land registers stakeholder (community) interviews	X	

	10 Land (RtaF-G. 8B)					
	10.2	All decisions regarding land rights and land use rights, such as buying, selling or valuing related to the operator were based on the Free, Prior, and Informed Consent of all stakeholders involved.	Note: it is not sufficient to assess only governmental assigned land rights.	Documents, negotiated agreements stakeholder interviews		
	10.3	There has been no forced or involuntary physical or economic displacement, resettlement or relinquishment of land rights for the purpose of the production.	If communities are resettled, it must be according their FPIC and VGGT Chapter 16. Expropriation and compensation	Documents, stakeholder interviews		
	10.4	Land used by operator may not be under dispute, contested and/or under conflict.	In case of any conflict a conflict resolution processes must be implemented and accepted by all parties involved according the Free, Prior and Informed Consent (FPIC) and VGGT Chapter 25. Conflicts in respect to tenure of land, fisheries and forests incl. the technical guidelines for FPIC in VGGT.	Documents of meetings, stakeholder interviews		
Utilization	**11 Water (RtaF-G. 8C)**					
	11.1	The operator implements a water management plan and a monitoring system. If communities rely on the same water source the plan must be agreed with free, prior, informed consent by stakeholders and may not be under dispute.	Management plan, developed and/or examined by qualified hydrologists, must follow legislation and existing water rights, both formal and customary. Good agricultural practices have to be applied in the plan to reduce water usage and to maintain and improve water quality.	Stakeholder interviews, water management plan, irrigation plan, water meters at production sit, origin of water (rain water collection, surface water, well),comparison of water rights and the amount used, monitoring of ground water levels		
	11.2	Water used by the operator does not negatively affect availability, quality and access to the water supply to communities which rely on the same water resources. There has to be a continuous monitoring of the availability, quality and access to the water resources.	Negative affect are i.e. reduce and/or alter in quality or quantity. This applies to water resources within and /or used by the local community. If access to water resources for the community and their livelihood activities was reduced, an agreement under the FPIC must be negotiated.	Documented identification of communities, water supply and quality, water stream maps, at least three check points for water quality control		
	12 Food safety and consumer protection (RtaF-G. 9)					
	12.1	The operator must not use pesticides and chemicals that are categorised as World Health Organisation Class 1A, 1B, or 2 and/or that are listed by the Stockholm or Rotterdam Conventions. Any use of pesticides and other chemicals must be documented.	Comparison of regional positive list. Process indicator to be implemented within 2 years for the WHO 2 categorized chemicals.	Chemicals management plan, storage, Inspection of mixing areas in facility and/or in field, Verification on-site which chemicals are used (interview, observing the purpose in order to determine if the indicated pesticide is used.)	X	2 years only for WHO 2

	12 Food safety and consumer protection (RtaF-G. 9)				
	12.2	The operator uses integrated pest management (IPM) and supports scheme suppliers with training in IPM.		Field observation, training documents and interviews with suppliers, management and sprayers (subcontractors) on how and where the chemical is used, are calibration methods used?	
	12.3	Workers have always access to safe drinking water.		Direct observation, interviews with workers	X
	13 Nutrition (RtaF-G. 10)				
	13.1	The operator shall make demonstrable efforts improve workers' access to adequate, safe, sufficient and affordable food.	Access to food can be supported by income or a canteen. If the operator provides food it shall be diversified, locally produced and nutritious. Gratis or subsidized delivery of nutritious food.	Direct observation, interview with workers and kitchen personnel, documented actions, check if food provided by the company is bought locally (rice, cooking oil, housing inventories, etc.)	
	13.2	Breastfeeding women have two additional 30- minute breaks per day to nurture the child.		Written policy, interviews	
Cross-cutting	**14 Stakeholders (RtaF-G. 6)**				
	14.1	The operator has to establish an internal grievance mechanism for workers and an external grievance mechanism for stakeholder. The mechanism has been made known and is accessible to the communities. All grievances were documented and monitored. A responsible person for grievances is named and known to the workers and communities around the farm.	According to RAI Principle 9 Chapter 29. The monitoring documents have to address how it was dealt with the submitted grievances. Methods (e.g. information sharing, group meetings, interviews, questionnaires, workshops, written materials, languages including local dialects, etc.) have to be suitable to achieve the intended engagement and consultation processes. Stakeholder can be community members, NGOs etc.	Documents, stakeholder and management representative interviews, meeting records, interview with security guards (are mostly local), documents on community dialogs, Community development programmes, Celebrations with the communities	
	14.2	The affected persons and the community at large do support the project before the operator starts the process.			
	15 Women rights and gender equity (RtaF-G. 8)				
	15.1	Women should not be discriminated and their rights have to be respected.	Regarding other conditions of employment like maternity leave, social security provisions, non-monetary benefits, etc. must be fulfilled according to the national regulation. In stakeholder processes, including the FPIC, women must be appropriately included and their voices equally heard and respected.		

15 Women rights and gender equity (RtaF-G. 8)					
15.2	No work with pesticides must be undertaken by pregnant or breast-feeding women.				
16 Education and awareness raising (RtaF-G. 11)					
16.1	The operator implemented a formal training programme that covers all agricultural activities of the company (e.g. use and application of chemicals and fertilizers). This includes regular assessments of training needs and documentation of the programme.	The training program provides and adequate program according the workers tasks. Process indicator to be implemented within 1 year.	Records of training, worker interviews	X	1 Year
16.2	All children living on the operation have access to quality primary school education which does not exceed local school fees.	Access to school can be provided through transport or an onside installation.	Interviews family, schools observation, - visiting schools on company land and check facilities and school records, Visit kindergartens and crutches	X	
17 Monitoring, indicators and benchmarks (RtaF-G. 17)					
17.1	The operator has to conduct an ex-ante impact assessment on food security and the Right to Adequate Food of concerned communities on the operator´s property, within its operating scale (e.g. outgrower schemes) and nearby surrounding communities. The availability, access, quality and stability of food must not be negatively affected by the planned operator investments and activities. This applies only for new investments.	The assessment shall provide suggestions to avoid negative impacts. Any anticipated negative impacts on food security and the Right to Adequate Food must be addressed before the investments takes place. If negative impacts cannot be avoided, the investment cannot become certified as compliant with the Rights-based food security principle.			
17.2	The operator is responsible to ensure food security for inhabitants (communities) within the operator`s property and administrative boundaries, even when the inhabitants are not employees of the operator. The food security situation must be monitored by a food security screening.	Food security is understood according the four dimensions: stability, availability, assess and utilization. Measures can be: access to land, fields and gardens for agriculture, access to safe drinking water, and subsidies for staple and nutritious foods. In those communities and for those inhabitants which are affected by food insecurity - detected by the food security screening -, the operator has to establish a social plan agreed with directly impacted stakeholders which includes special measures to benefit women, youth, indigenous people and vulnerable people to eliminate their food insecurity.			

17 Monitoring, indicators and benchmarks (RtaF-G. 17)				
17.3	In communities resettled according the FPIC the operator has to monitor the food security situation through a food security screening and e.g. a continuous dialogue and ensure their food security.	This applies to resettlements after January 2012 (VGGT). Food security is understood according the four dimensions: stability, availability, assess and utilization. If the food security screening indicates food insecurity, a comprehensive Food Security Impact Assessment must be carried out on behalf of the operator. The impact assessment shall evaluate the scope of accountability and determine corrective measures. The indicated measure should be monitored and will be assessed during upcoming audits. In those communities and for those inhabitants which are affected by food insecurity, the operator has to establish a social plan agreed with directly impacted stakeholders which includes special measures to benefit women, youth, indigenous people and vulnerable people to eliminate their food insecurity	
17.4	Operations above 1000 ha have to conduct a food security screening also in the surrounding communities of the operator`s property and administrative boundaries. In these communities the availability, access, quality and stability of food must not be reduced by the producers' activities. The operator is responsible to ensure that the investment does not create or exacerbate local or national food security.	If the food security screening indicates a negative impact on the food security situation and detects food insecurity, a comprehensive Food Security Impact Assessment must be carried out by an independent organization, paid by the operator. The impact assessment shall evaluate the scope of accountability and determine corrective measures and needs to be submitted to the certification system. In those communities and for those inhabitants which are affected by food insecurity due to the operator`s activities, the operator has to establish a social plan agreed with directly impacted stakeholders which includes special measures to benefit women, youth, indigenous people and vulnerable people to eliminate their food insecurity. The corrective measures have to be monitored and are assessed during upcoming audits.	After two years of certification a Q&D assessment, Food Security Assessment (if negative results before), visit and interviews in local markets and stores

5 Discussion of the rights-based food security principle

How to best address food security in biomass production and private voluntary certification schemes was a point for intensive discussions and changes during the research process. The initial approach to directly measure impacts of certified biomass production on the food security of local communities generated a discussion about the relationship between the operator's activities and the impacts on a community. The food security impacts of an operator are often not separable from other impacts on the locality such as unfavorable weather events like droughts or floods, food price hikes at global and local level or other biomass operators and enterprises using also land and water resources.

We reviewed available food security literature for methods on food and nutrition security measurement and their strengths and weaknesses to identify a suitable assessment tool to measure impacts on the food and nutrition security situation at the local level (Ballard, Cafiero, and Schmidhuber, 2014; Barrett, 2010; Hoddinott and Yohannes, 2002; Maxwell et al., 1999; Maxwell, 1996; Pinstrup-Andersen, 2009; Swindale and Bilinsky, 2006). Table A1 in the Annex shows the compilation of the different approaches based on household food consumption surveys, coping strategies or perception based approaches such as the FAO Food Insecurity Experience Scale. Additionally, we revised the method of the standard RSB to assess impacts on food security of local communities through biomass production (RSB, 2012). An approach to assess impacts on local food security is the direct measurement and sampling of data through household interviews (Pangaribowo et al., 2013) as also suggested by the RSB. This is highly time and cost intensive and requires excellent analytical and econometric skills to analyze the household data and assess the impact.

During a workshop at the Center for Development Research (ZEF), Germany, we discussed with food security researchers how a valid assessment of the food and nutrition situation in the production region and possible impacts of biomass production on food security could be made with limited resources, i.e. low costs, little time and no specific expert knowledge. This was complemented by consultations with staff of the Right to Food section and the Voices of the Hungry Project at the FAO as well as the World Food Program (WFP). The challenge is to establish the causality between food security outcomes and the activities of the certified operator. To establish causality in these environments, large data sets including panel data are necessary combined with rigorous quantitative (econometric) impact assessment methodology - an activity done by scientists in lengthy studies and far beyond the scope of an audit and of any auditor's capacities.

We decided to withdraw from the approach to directly measure impacts on local food security due to reasons regarding costs, practicability, problems with causality and the freedom of an individual to forego food or reduce food quality or diversity for any personal reasons e.g. in order to purchase luxury goods or due to religious rules. We decided to instead use an approach which seeks to ensure the capabilities to secure food and nutrition at the individual level. This was also welcomed in the stakeholder workshops. To protect local communities against adverse impacts on their Right to Food that might occur through an operator, we define criteria which lie directly in the area of responsibility of an operator. Through this approach, the operator can be directly held accountable for noncompliance.

5.1 Reflections on the responsibility of operators regarding food security

Sustainability certification helps biomass purchasing companies to address sustainability concerns and regulations by requiring compliance with a sustainability standard from the various suppliers in their value chain (Gereffi et al., 2005). The OECD Guidelines on Multinational Enterprises demand that business enterprises based in OECD countries should use their "business relationships" to "seek ways to prevent or mitigate adverse human rights impacts that are directly linked to their business operations, products or services by a business relationship, even if they do not contribute to those impacts" (OECD 2011). Changing practices and the acceptance of social responsibility along the value

chain is mainly demand driven and can theoretically be passed on along the supply chain up to, in the case of biomass, the primary producer (Gereffi et al., 2005). However, many business enterprises operate as part of large networks of agents, suppliers, subcontractors and clients and therefore it may be difficult for the company to systematically monitor the activities of all its business partners. Companies at the consumer end of the supply chain may claim the compliance with human rights without having the means to guarantee this along their complete supply chain.

Although companies are faced with complex value chains, they should be able to conduct a due diligence[14] of impacts on human rights through their business activities and must be hold responsible for impacts on food security within their scope of action (Bettzieche et al., 2015)[15]. "In national legal systems, and under international law, the responsibility of business enterprises to conduct due diligence does not end at the legal boundary of the individual company" (De Schutter et al. 2012). Principle 13 of the UN principles on Business and Human Rights therefore addresses on the one hand the accountability for the operator's own activities and on the other hand those impacts that arise from activities "directly linked to their operations, products or services by their business relationships, even if they have not contributed to those impacts" (United Nations, 2011). Following this principle companies sourcing biomass from suppliers who might cause adverse impacts on local food security could be held accountable as they are part of the chain of responsibility.

a. Operator model, business size and responsibility for food security

Local communities may experience positive or negative impacts of the investment of an operator in biomass production depending on the business size and production model of the operator. This must also be reflected in the requirements of the certification system. We distinguish between (i) family farmers[16], (ii) operators with at least one permanent employee, which therefore do not fall under the definition of a family farmer and (iii) companies with a certain size[17] or production model where a high impact on local communities can be assumed. Due to the high differences between countries and the national context, this third group will require further definition after a first pilot test of the presented criteria. Specific indications and explanations need to be provided in the verification guidance for auditors.

The area of responsibility of the private sector, state and the individual concerning food security differ widely (see Figure 1). The responsibility of an operator to ensure the RtaF in the locality where it acts must be directly verifiable by a third-party audit during the certification process. The food security situation of a household or an individual is not part of the operator's responsibility, as the individual has the freedom to decide whether and what to eat and how the obtained wage should be spent. For example, the operator pays a living wage but the individual decides to eat simple food and instead buy other products such as a TV or prefers an unhealthy diet. A food security measurement may then detect food and nutrition insecurity, yet the operator cannot influence this decision as it is not related to its activities and he/she has no right to impose certain food consumption patterns on individuals. However, the operator has to provide all means to enable an individual and her/his household to be food secure and to fulfil the RtaF. The operator is responsible to provide conditions for her or his employees, including casual workers and resettled communities which lead to the fulfillment of their RtaF. We include resettled communities in this responsibility as they often are food insecure after a resettlement triggered by the operator's activities. Hence, the operator must follow laws, pay living wages or fair[18] prices for the crops purchased for example in outgrower

[14] Investigation/appraisal of a business.

[15] A comprehensive assessment for the implementation of the UN Principles for Business and Human rights was published by the German Institute for Human Rights (Bettzieche et al., 2015). This document describes the responsibility of companies also within complex value chains, the need to conduct due diligence, sanction mechanisms and the role of the state to support the UN principles.

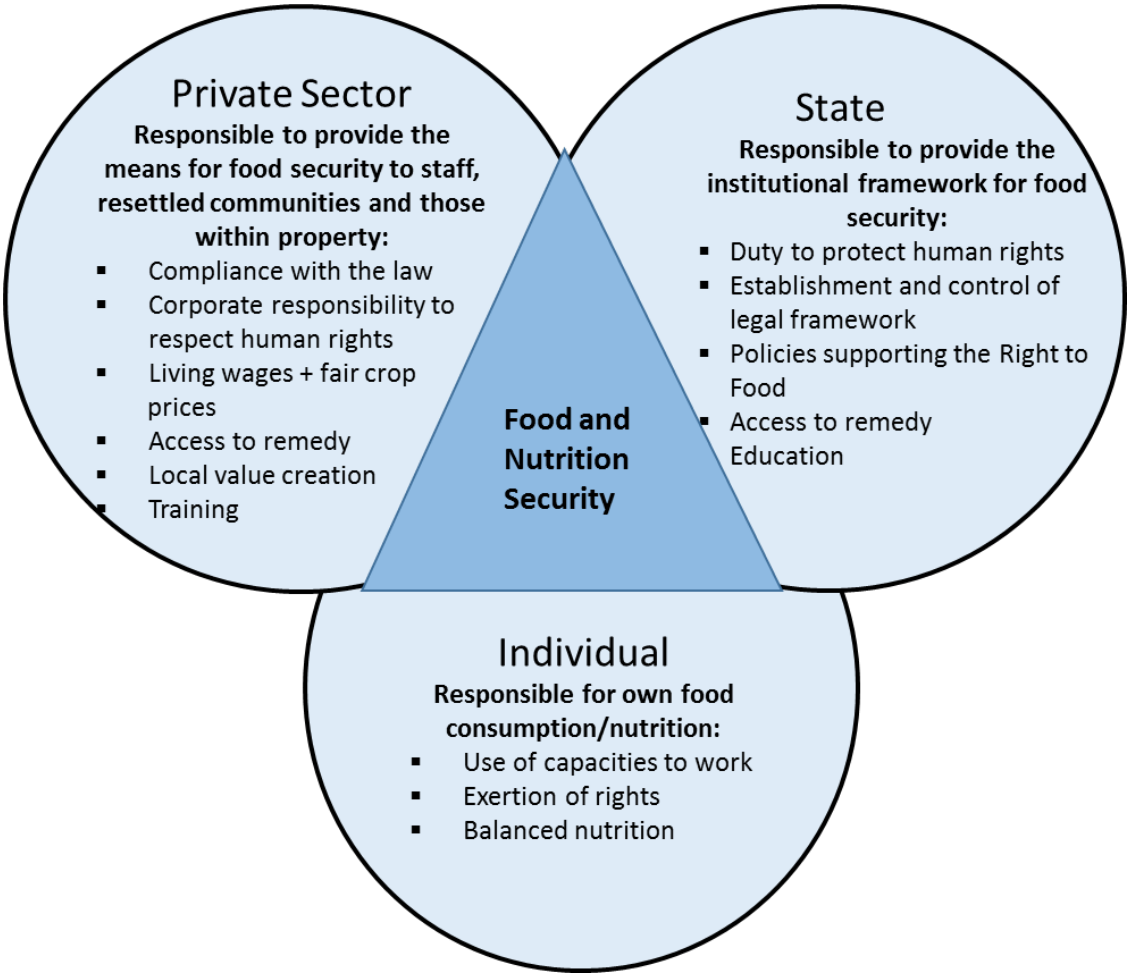
[16] Family farmers are usually certified in groups e.g. as an association or cooperative.

[17] The definition of the size depends on national context.

[18] Acknowledging that it is very difficult to define what a fair price is.

schemes, provide access to remedy and support local value creation. The individual is responsible to use her or his capacities to work and/or produce food (especially relevant for resettled communities) and to be well nourished. The state must provide the needed institutional and legal framework, which includes policies that support the implementation of the right to food, education or access to remedy.

Figure 1: Areas of responsibility of the private sector, the state and the individual



5.2 Explanations to the selected Right to adequate Food criteria

This section describes the selected criteria in more detail and provides reasoning as well as further explanations where considered necessary. However, it does not repeat everything listed in the criteria of Table 2.

5.2.1 Democracy, good governance and the rule of law

The framework of any certification system builds upon the national laws and regulations. All national laws and regulations must be respected. The human rights, as signed by nearly all states worldwide, thus need to be respected as well. Many of the here proposed criteria are regulated under the social laws such as wages and worker' rights. Regulated and ensured land rights are important as often here conflicts evolve with biomass operations.

5.2.2 Strategies

The operator has to revise and adapt its business activities to the national strategies concerning food security such as National Food Security Strategies, Poverty Reduction Strategy Papers, or National Climate Change Adaptation Plans. The findings from the criterion on "strategies" must therefore be addressed in the business plan of the operation and must consider its potential contribution to national policies on integrated development objectives. This criteria does not need to be applied by family farmers, as it is considered too demanding given their low potential to contribute to or conflict the national strategies.

5.2.3 Market systems

For this criterion, we originally thought to measure impacts on food prices on the local market, as large-scale (non-food) biomass production for export can lead to rising food prices on local markets. However, we refrained from this approach for two reasons: (i) the rise in market prices for local food cannot per se be interpreted as a negative effect on local food security due to possible positive effects for food producers and a general rise in living standards that may overcompensate price increases; (ii) a rise in local market prices furthermore cannot be easily attributed to be the consequence of an operator's activities, as other factors such as seasonality, unfavorable weather or exchange rate fluctuations also influence market prices.
During the first stakeholder workshop, the participants agreed that the proposed food security principle should create the conditions that allow local communities to cope with changing market constraints which is also indicated in the Right to Food guideline. We therefore focus on local value creation to provide access to food, and see the responsibility of an operator in supporting local value creation through e.g. providing employment to locals, inclusion of local suppliers, investments in local processing to provide jobs.

While the creation and support of a local market system and infrastructure is the responsibility of the state, access to market infrastructure must not be reduced by certified biomass operators, i.e. in terms of the use of available infrastructure or the unrestricted gate passage of large-scale properties to be able to easily reach markets.

5.2.4 Natural and human-made disasters

The assessment of possible natural disasters was identified as a means to stabilize food security in risk-prone areas within the certification process. Through the recognition of a natural disaster risk plan, the operator may prevent and foresee possible risks for her/his production. This can stabilize the economic sustainability of the production process. Operators cooperating with local suppliers must include these groups in the natural risk assessment, inform them about the risks, provide emergency plans, and offer support in case of adverse impacts through natural disasters based on the local conditions, e.g., through water storage systems in cisterns, food support, provision of drinking water or seed supply. This support in case of disasters is not a criterion which can be verified by ticking off a specific requirement due to context specificity. The operator must prove that measures are taken to reduce risks and improve or stabilize the conditions.

5.2.5 Sustainability

Following the Right to Food guidelines, this guideline refers exclusively to ecological sustainability. Therefore, this criterion demands compliance with the Good Agricultural Practices. Food security strongly depends on the preservation and sustainable management of soil resources, which includes water management as addressed in criterion 10, and sustainable farming techniques. We acknowledge that ecological sustainability refers to much more, with many aspects being essential for food security. However, as this proposed set of criteria is designed to be added to and integrated in already existing sustainability standards (e.g. those mentioned in chapter 2), no criteria covering all

aspects of ecological sustainability were defined. This would be definitely needed if the principle is used as a stand-alone certification.

5.2.6 Economic development policies

An agricultural investment in food-insecure regions should respond to the overall development objectives of the country where the investment takes place in terms of social, economic and environmental development. If an environmental and social impact assessment has been conducted (as required by some standards), the results and recommendations of these assessments must be reflected in the business plan. To assess the financial viability, the auditor can be provided by the operator with, for example, the cost-benefit ratio, and the net present value of the investment respectively the discounted cash flow calculations, including an economic risk or sensitivity analysis. The acquired land should correspond to the capital invested. A recent World Bank and UNCTAD study of 179 agricultural investment projects in 32 countries found that 50% were regarded as partial or complete financial failures due to fundamental flaws such as inappropriate sites, poor crop choices or over-optimistic planning assumptions (World Bank and UNCTAD, 2014). A due diligence assessment of the business plan and activities might also reduce adverse effects on local suppliers and support their long-term market opportunities. An abrupt withdrawal from an investor might have negative effects on the local food security situation especially when land use has been converted to perennial (non-food) crops. During the audit, information about the operator's and investor's background and expertise in agricultural investments in food-insecure regions is essential to obtain an impression of the capacity to manage such investment and the attached risk for the local communities in case of business failure.

5.2.7 Labour

Most biomass certification standards already require the payment of (sector-specific) minimum wages. That workers and suppliers need to receive a living wage is already recognized in the International Labour Organization Constitution (1919), United Nations Universal Declaration of Human Rights (1948), the Council of Europe's European Social Charter (1961) and the UN International Covenant on Economic and Social Cultural Rights (1966). Hence, a living wage is considered a fundamental human right and the basis to ensure the Right to Food. We follow the definition of a living wage of the ISEAL Alliance which is: "Remuneration received for a standard work week by a worker in a particular place sufficient to afford a decent standard of living of the worker and her or his family. Elements of a decent standard of living include food, water, housing, education, healthcare, transport, clothing and other essential needs including provision for unexpected events" (ISEAL Alliance, 2013).

The payment of a living wage is also recognized by international guidelines for a sustainable agricultural sector, for example, the CFS-RAI require "Creating new jobs and fostering decent work through improved working conditions, occupational safety and health, adequate living wages, and/or training for career advancement" (Principle 2, Chapter 22 ii) (CFS, 2014).

Under the umbrella of the ISEAL alliance, six certification schemes, among others Fairtrade International and the FSC, agreed to the above definition of a living wage and will use the proposed methodology for estimating living wages. Currently, these organizations seek to determine living wages for different countries with first reports from the wine, tea and flower sectors in different African countries and the banana sector in the Dominican Republic (Anker and Anker, 2014, 2013). Those values could serve as a benchmark for this criterion. Several certification schemes have already reacted to the findings for living wages. In 2014, UTZ Certified approved the new "Code of Conduct for Individual Farms", which introduced a new criterion on living wage (UTZ Certified, 2014b). The revised "Fairtrade Standard for Hired Labour" requires employers to negotiate with workers' representatives on wages, and claims annual increases in real wages towards the living wage (Fairtrade International, 2014).

5.2.8 Services

In general, agricultural services and support are part of national rural policy, but also private companies should support agricultural services for local workers and suppliers, especially in outgrower schemes, to enhance food security. There is a direct benefit for operators from this, e.g. the local supply becomes higher and more stable. For communities living inside the operator's property (plantation) we see a direct responsibility of the operator to support those communities with services and capacity building in agriculture such as trainings in good agricultural practices or integrated pest management. There should be a direct dialogue with the communities where trainings and activities are jointly planned. This planning and the training sessions should be documented, e.g. by photographs, handouts.

5.2.9 Safety nets

In regard to safety nets we include medical care in case of accidents or work related diseases and illnesses. This is necessary as work related accidents often lead to absence or drop-outs from work which means a loss of income and thus leaving the person without the means to purchase food. If a public accident insurance, medical insurance and/or an occupational pension fund is demanded by law and existent in the country, the company has to enroll their staff in these. In local communities safety nets are supported through social relations and must be considered and maintained if a community agreed to the resettlement process[19]. In this case, the supportive character of social networks must not be adversely affected as they provide a minimum support including basic food security to people (Beuchelt 2008; Fischer et al. 2010).

5.2.10 Land

Land is an important factor to secure access to and the availability of food through own production. The criteria required under this topic were derived and built upon the VGGT, which also defines guidelines for the private sector to ensure land rights and therefore the Right to Food (FAO, 2012a). The recognition and assessment of all existing land rights and water rights, which often come together with land rights such as formal and customary (traditional) land rights and land use rights, are essential to ensure the Right to Food. Investments often target lands governed by customary rights that are not adequately recognized and protected under national laws, or sites where governments lack the capacity to enforce the law (Hunsberger et al., 2014). The key principle for any land acquisition and resettlement process and a key component of effective stakeholder engagement and consultation is the Free, Prior and Informed Consent (FPIC). In conjunction with the VGGT the FAO released a technical guide which supports the identification of stakeholders, land rights holders and the implementation process of FPIC (FAO 2014b). This document represents the reference for any land acquisitions certified under the Rights-based food security principle. Experience in applying FPIC in the extractive sector already exists (Mahanty and McDermott, 2013; Owen and Kemp, 2014) but a broader inside knowledge on its applicability during a biomass certification process is still lacking. The implementation of FPIC in a certification process must therefore be monitored and strengthened. Current evidence from research is that local people's capacity to bargain or give free consent to investments is limited by their lack of access to institutions and economic alternatives in the region, limited education and power differentials including a limited understanding of the consequences (Cotula and Vermeulen, 2010). A clear guidance on what is needed for the verification process such as documentation, participation lists, photos documenting the meetings and interviews must be part of the implementation practice.

Biomass production on land which is under dispute must not be certified to avoid "land grabbing". The criterion on land must include all types of land use and tenure rights and provide adequate means of verification. Operators seeking for sustainability certification, which ensures the RtaF, are

[19] According the Free, Prior and informed Consent.

required to assess and address all existing land and user rights. Conflicts about the land rights and resettlement processes must be resolved according VGGT Chapter 16 “Expropriation and compensation” and Chapter 25 “Conflicts in respect to tenure of land, fisheries and forests”.

To reduce the impact on local communities and a possible rise of land conflicts through the investment, the land purchased for the investment should correspond to the capital invested. This is important against the background of failed investments in the agricultural sector with large assignments of land rights (World Bank and UNCTAD, 2014).

5.2.11 Water

The overuse and pollution of water can have strong adverse impacts on local food security, foremost in water scarce regions as water is needed for food production, food preparation and direct consumption. The use and access to water by local communities must not be reduced by a certified operator. The operator must therefore provide evidence that the use of water is also not under conflict with the local community, even though the use rights were awarded to him through the regional authority. As water rights often are coupled with land rights, the existence of legitimate land tenure rights is essential also in this context. The certified operator is also accountable to not contaminate downstream water.

5.2.12 Food safety and consumer protection

This criterion in strongly connected to the above criterion on water. Local food security must not be reduced through the contamination of local drinking water or through inadequate spraying of pesticides affecting local farmer fields, people and houses through drift or spraying by airplanes. The use and application of pesticides must be monitored. If a canteen or shop selling food is managed by the operator, the products must be free of contamination and safe to be consumed.

5.2.13 Nutrition

The individual nutrition is the responsibility of the individual itself (Figure 1). However, the operator must make demonstrable efforts to improve workers’ access to adequate, safe, sufficient and affordable food. That means that access to food could be supported either through wages, through a canteen providing nutritious food, or through affordable, diversified and nutritious food in a shop on the property. To enhance the local value creation, the operator should provide locally produced, diversified and nutritious food.

5.2.14 Stakeholders

The provision of a grievance procedure, internal for employees and external for communities within or surrounding the operator’s property, is part of the operators’ due diligence. According to the CFS-Rai principle 9 the operator has to incorporate “inclusive and transparent governance structures, processes, and grievance mechanisms” (CFS, 2014). The grievance mechanisms must be directly coupled to a conflict resolution process. The monitoring and documentation of the procedure of any submitted grievance must be demonstrated during the auditing.

5.2.15 Women rights and gender equity

The criterion on women rights and gender equity was added since women interests and gender equity is often neglected in policies, certifications and verification practices given many reasons including power structures, vested interests and gender roles as well as norms and attitudes. Though in several criteria this aspect is touched upon, there is the need to highlight it in a specific criterion given the persistent discrimination of women in labor markets and societies.

While awareness is more common in regard to equity issues in employment, such as equal pay for equal labour or special precautions and care for employed pregnant and breast-feeding women, less awareness and consciousness exists in regard to the role of women in households and society in food insecure regions. This becomes especially important regarding land use and land use rights, the FPIC processes and for food security.

In most food insecure regions, roles and responsibilities are gendered, i.e. men are responsible primarily for productive (agricultural) work and household representation while women are responsible for both productive and reproductive work, including household food security and nutrition. Furthermore, women and men have different spaces over which they have authority. Women often have less formal land titles and only land use rights which can present a big problem when biomass investments take place (Doss, Meinzen-Dick, and Bomuhangi 2014). This can go so far that e.g. in some communities, certain fields, trees or tree products are clearly allocated to women (Kiptot 2015; Doss 2002). Land deals have been found to ignore women's land rights and negotiations were male-dominated or only among men and access to employment, an often presumed major compensation for loss of land, was skewed against women (Wisborg 2014). Therefore, women must be equally addressed and appropriately included in stakeholder processes, to make sure their voices are heard, respected and that equity is further fostered as requested by the Right to Food.

5.2.16 Education and awareness raising

Education and training is a fundamental tool to support a persons' capability to ensure her/his RtaF. Companies are responsible to enhance their workers' skills and train their workers in work related areas e.g. safety at work, crop production, mechanics or first aid. Furthermore, trainings in areas enhancing supplementary skills, can increase also the benefit of the operator.

Access to school is fundamental and must be supported where necessary. According to the operator and the conditions, this can mean: provision of school transport, school on the property (plantation) or cooperation with public schools in the region.

5.2.17 Monitoring, indicators and benchmarks

We are concerned that food security of local communities will be negatively affected by large-scale biomass operations given reported negative impacts (De Schutter 2011; Bracco 2015; Harvey and Pilgrim 2011; Anseeuw and et al. 2012; Deininger and Byerlee 2011; Cotula and Vermeulen 2010). Although we assume that a full compliance with the rights-based food security principle would not lead to negative impacts through the operation, an additional monitoring of food security impacts must be implemented to gain certainty about this assumption. A certification does not create automatically added value for the certified operator which is often a problem for poor family farmers. Food security effects on family farmers being organized in group certifications can be difficult to detect and certified family farmers may be even poorer than non-certified farmers (Beuchelt and Zeller 2012; Beuchelt, Kiemen, and Zeller 2010; Beuchelt 2012).

Under the UN Principles on Business and Human Rights, the clear responsibility of the private sector is to conduct a human rights due diligence divided into three steps: (i) identify actual or potential impacts on local food security; (ii) prevent and mitigate negative impacts identified; and (iii) account for impacts and respond to them (United Nations, 2011).

For that reason, the criteria require (i) a Right to Food ex-ante impact assessment, and (ii) an (ex-post) monitoring procedure. The ex-ante impact assessment is an indispensable tool to address food and nutrition security, especially possible negative impacts of an operation, before investments take place. However, the tool still needs to be developed. Meanwhile, a possible tool for a first assessment of new investments could be the "Bioenergy and Food Security (BEFS) Operator Level Tool" (FAO, 2015) which consists of a check in three parts: 1) change in the supply of food to the

domestic market; 2) resource availability and efficiency of use; and 3) physical displacement, change in access to resources, compensation and income generation (FAO, 2012b).[20] However, this tool addresses mainly food availability and neglects the other dimensions of food security respectively other elements of the Right to Food.

In a second step, we propose an (ex-post) monitoring of possible impacts on (i) communities inside the operator's property, (ii) resettled communities due to the operator's activities, and (iii) on communities surrounding the operator's property. A grievance mechanism must be established for all three groups. We see a clear responsibility of the operator for the first two groups, as both groups are very likely to be directly affected by the activities. Hence, the operator needs to avoid and address negative impacts on the food security situation. Even for the third group, we demand that the availability, access, quality and stability of food for local communities may not be reduced through the certified operator. However, in this case, the causality is much more difficult to establish. Via a yet to be established screening tool (e.g. based on focus groups), it needs to be assessed for all three groups whether the food security and Right to Food situation in any of the five dimensions of our conceptual framework is deteriorating. If that is the case, the operator must take appropriate action to improve the food security situation and fulfill the right to adequate food for the first two groups. For the third group, possible causes must be looked at. If easy identifiable causes such as droughts or floods, global food price hikes or exchange rate fluctuations can be quickly ruled out, an in-depth assessment needs to be conducted to detect the causality between the deterioration of local food security and the operator's activities. This assessment should be executed by an independent body e.g. university or research institute. Corrective measures have to be defined and jointly agreed upon with the affected communities and need then to be monitored.

5.3 Reflections on the implementation and potential limitations of the rights-based food security principle as part of a sustainability standard

The emergence and proliferation of voluntary standards and certification schemes is based on the assumption that the implementation of these systems would lead to the desired positive impacts. "Over time it became clear, however, that `compliance' and `impact' are not synonymous" (SCSKASC 2012, p. 50). Research results indicate gaps between certified practices and desired impacts, yet difficulties to appropriately assess impacts also exist (Beuchelt and Zeller 2011; Hardt et al. 2015; SCSKASC 2012). Thus, there is a risk that despite adhering to the rights-based food security principle, the desired impact of local food security of those involved or affected by the biomass operator may not materialize. The required field testing phase of the developed principle will provide first insights. Since impacts often take time to materialize, rigorous impact assessments are recommended after a few years when the rights-based food security principle has been implemented. Ideally, the impact assessments should be following a quantitative-qualitative approach and be based on a sound baseline with a carefully chosen counterfactual.

While standards can monitor good agricultural practices, they may be more limited in controlling complex issues such as food security, transparency and informed consent, or land rights. Here, clear-cut quantitative indicators may not be easily defined and rather qualitative approaches are needed, requiring more time and skills of the audit team. Especially in countries with weak governance, it needs to be critically scrutinized what can be really verified in the field due to missing documentation, financial reasons, fraud or capacity constraints. Research institutes and CSOs can

[20] The tool builds upon key international references such as the Global Bioenergy Partnership Sustainability Indicators for Bioenergy, the FAO Voluntary Guidelines on the Responsible Governance of Tenure, and the International Finance Corporation Performance Standard 5 on Land Acquisition and Involuntary Resettlement. It is essential to test its applicability for certification schemes as no published experience in this regard is available. Private communication with a certification body (April 2015) however indicated that it is not a feasible tool for a certification system.

play an important role as evaluators regarding the performance and implementation of the standards.

The effectiveness and efficiency of certification is subject to existing institutions, national and local laws, and their enforcement. Research and experiences have shown that certification works well in countries with good governance, legal foundation and adequate institutions (SCSKASC 2012). This also applies to the potential of certification to protect local food security. In a state with weak governance, weak enforcement of land tenure and other rights and a weak juridical system, certification may not be an effective mechanism, and may be unable to replace missing state regulations. Own observation showed that certification tends to be able to compensate up to a certain degree governmental weaknesses, especially weak enforcement mechanisms, but is less or not effective with failing governments, where basic needs and rights of the population are not fulfilled or even violated. This is an area which has not yet been much explored by research.

The existence of a rights-based food security principle can prevent violations of the Human Right to Food by operators on a local level but it may not replace the implementation of sound development strategies. Likewise, the rights-based food security principle, cannot lead to the improvement of production systems in food insecure regions if it was only integrated in a few certification systems and if there was little or no demand from consumers at the end of the supply chain. Governmental regulations requesting the use of the rights-based food security principle may internalize social costs and create a market for certified products. If one takes the viewpoint that the respect of the right to food is an obligation, which over hundred states have endorsed and nearly all states worldwide signed with the Universal Declaration of Human Rights, there is the question how much can be achieved with the integration of the rights-based food security principle in voluntary certification standards. An independent “rights-based food security” standard, or in the long run a “human rights” standard for enterprises and products, would yield probably more results. With such a distinction non-certified enterprises and products could be easily distinguished and consumers could easier chose products that have not been involved human right violations.

When the support of a few large enterprises in Europe and Germany could be gained to make the principle obligatory in their supply chains, changes in supply chains are more likely to happen (as the coffee case shows). This makes it more attractive for many certification systems to fully integrate the rights-based food security principle in their system than the moral argument. Governmental regulations are also not uncommon as, for example, the European Renewable Energy Directive (EU-RED) demands compliance with environmental sustainability standards for bioenergy which lead to the proliferation of many environmental standards and certification systems. The rights-based food security principle could be equally added to the EU-RED as part of the required sustainability criteria. However, given the emerging bioeconomies and thus growing uses of biomass for fiber, chemicals and other bio-based materials, the principle should be obligatory for all biomass types and uses. This would avoid a market distortion among the different biomass uses. Still, markets are distorted by requiring environmental standards for liquid bioenergy in the EU-RED while other energy sources, especially petroleum and coal, and fossil based raw materials, do not underlie regulatory restrictions. Other sectors therefore might derive a competitive advantage and hence, markets are distorted (Carus et al. 2014).

6 Conclusions and recommendations

Rising concerns about negative impacts on local food security through growing biomass production in food insecure regions and international trade prompted us to address the question how the Human Right to adequate Food can be ensured in biomass production and certification systems. For this, a conceptual framework was developed to integrate the RtaF in biomass production and trade and to guide the choice of criteria for a rights-based food security principle. The framework is based on the four dimensions of food and nutrition security, the Human Right to adequate Food and the "Voluntary Guidelines to support the progressive realization of the Right to Food in the context of national food security". Two challenges we addressed were to identify (i) who is responsible that a person consumes sufficient quantity and quality of food and (ii) how to measure local food security in a cheap, quick and reliable way & attribute causality correctly.

According to the conceptual framework, a rights-based food security principle with 45 criteria categorized under 17 themes derived from the Right to Food guidelines was developed. The suggested criteria are applicable to all biomass types and uses, and to different biomass standards, farm sizes and business types. For the first time, practicable and measurable criteria exist.

The criteria ensuring the Right to Food are designed as a best-practice set which can be added as a whole to the existing criteria and indicators of any biomass sustainability standard. A screening of the sustainability standards and related criteria showed that there is some overlap with our criteria, which increases its adoptability. Many sustainability standards already have sound experiences with implementing some of the criteria while for the newly proposed criteria experiences regarding the verifiability are lacking. Although being discussed with auditors, practitioners and standard setters, we see the need for a field testing phase of the whole criteria set under the rights-based food security principle. The experiences derived from this test phase need to be integrated in a comprehensive auditor handbook supporting the verification and handling of the principle.

After a field testing, we recommend the inclusion of the rights-based food security principle and its criteria in all biomass sustainability standards. Given the limited demand and willingness to pay for sustainably produced goods of consumers yet political statements regarding "food first" when using biomass in the bioeconomy, we see the need to make the rights-based food security principle part of governmental regulations. Meanwhile, governments could already support the principle by using their substantial purchasing power to buy goods that have been certified according to the principle. A change in procurement policies will increase the demand and be a step towards the desired impacts.

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Annex

Table A1: Selection of approaches and indicators to measure food and nutrition security

Approaches / Indicator	**Description**	**Source**
Diet Diversity Scores (DDS), Calorie Deficit Score (CDS), Nutrient Deficit Score (NDS),	- Food consumed over a given reference period - Food and nutrition security at household level - Household surveys - Used in RSB	Pangaribowo et al., 2013
Medical and biomarker indicators (MBI)	- Measure micronutrient deficiencies with precision - Need high accuracy to be reliable - Very costly data collection	Pangaribowo et al., 2013
Various indicators such as: Frequency of vegetable consumption, of meat and fish consumption, of dairy products consumption; number of meals eaten a day; dietary diversity of 8 major food groups; food expenditure budget share of total household expenditure; duration of household food stocks; main water source for drinking	- All measured at household level	Pangaribowo et al., 2013
Coping strategies	- Ranking in focus groups - Quick appraisal which is combinable with other methods - Captures also vulnerability	Maxwell, 1996, Maxwell et al., August 1999
Food Insecurity Experience Scale (FIES)	- Used by FAO - Experience-based metric of severity of food insecurity that relies on people's direct responses to eight questions regarding their access to adequate food	Ballard et al., 2013
Household Hunger Scale	- New indicator to assess household hunger in food insecure areas - Allows for estimating the percent of households affected by three different severities of household hunger: 1) Little to no household hunger; 2) Moderate household hunger; and 3) Severe household hunger	Coates et al., 2007
Food Consumption Score (FCS)	- Used by the World Food Programme - Composite score based on dietary diversity, food frequency, and relative nutritional importance of different food groups	WFP, 2008

Emergency Food Security Assessment (EFSA)	- Used by the World Food Programme - Analyses the impact of a crisis on the food security of households and communities	WFP, 2009

Table A2: List of interviewed experts

Interviewed expert	**Interview Date**
Anne Kepple and Terri Ballard, FAO	5 May, 2015
Andrea Rossi, GBEP/FAO	5 May, 2015
Aysha Twose and Tobias Flaemig, WFP	6 May, 2015
Juán García y Cebolla, FAO	7 May, 2015
Daniel May, GIZ/FONAP	17 June, 2015
Dr. Jan Henke, ISCC	20 February, 9 July 2015
Oliver Glatow, Auditor, ISCC	9 July, 2015
Babette Wehrmann, Consultant on land	18 July, 2015

Table A3: Stakeholder workshops and participants

Stakeholder Workshop	**Participants**	**Date**
1. Measuring Food and Nutrition Security	ZEF researchers	16 March, 2015
2. Food Security Indicators for Biomass Certifications I	Representatives from the Ministry of Food and Agriculture, the Agency for Renewable Resources, WWF, Bread for the World, Welthungerhilfe e.V., GIZ, ISCC, von Thünen Institute and ZEF researchers	19 May, 2015
3. Food Security Indicators for Biomass Certifications II	Representatives from the Ministry of Food and Agriculture, the Agency for Renewable Resources, WWF, Bread for the World, Welthungerhilfe e.V., GIZ, NOVA Institute, IINAS, ISCC, SGS, REDCert, Bahlsen GmbH & Co. KG, Fuchs Europe Schmierstoffe GmbH, ERRMA, Aid by Trade Foundation and ZEF researchers	14 July, 2015

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Editors: Christian Borgemeister, Joachim von Braun, Manfred Denich, Solvay Gerke, Eva Youkhana and Till Stellmacher

25. Obeng, G. Y.; Evers, H.-D.; Akuffo, F. O., Braimah, I. and A. Brew-Hammond (2007). Solar PV Rural Electrification and Energy-Poverty Assessment in Ghana: A Principal Component Analysis.
26. Eguavoen, Irit; E. Youkhana (2008). Small Towns Face Big Challenge. The Management of Piped Systems after the Water Sector Reform in Ghana.
27. Evers, Hans-Dieter (2008). Knowledge Hubs and Knowledge Clusters: Designing a Knowledge Architecture for Development
28. Ampomah, Ben Y.; Adjei, B. and E. Youkhana (2008). The Transboundary Water Resources Management Regime of the Volta Basin.
29. Saravanan.V.S.; McDonald, Geoffrey T. and Peter P. Mollinga (2008). Critical Review of Integrated Water Resources Management: Moving Beyond Polarised Discourse.
30. Laube, Wolfram; Awo, Martha and Benjamin Schraven (2008). Erratic Rains and Erratic Markets: Environmental change, economic globalisation and the expansion of shallow groundwater irrigation in West Africa.
31. Mollinga, Peter P. (2008). For a Political Sociology of Water Resources Management.
32. Hauck, Jennifer; Youkhana, Eva (2008). Histories of water and fisheries management in Northern Ghana.
33. Mollinga, Peter P. (2008). The Rational Organisation of Dissent. Boundary concepts, boundary objects and boundary settings in the interdisciplinary study of natural resources management.
34. Evers, Hans-Dieter; Gerke, Solvay (2009). Strategic Group Analysis.
35. Evers, Hans-Dieter; Benedikter, Simon (2009). Strategic Group Formation in the Mekong Delta - The Development of a Modern Hydraulic Society.
36. Obeng, George Yaw; Evers, Hans-Dieter (2009). Solar PV Rural Electrification and Energy-Poverty: A Review and Conceptual Framework With Reference to Ghana.
37. Scholtes, Fabian (2009). Analysing and explaining power in a capability perspective.
38. Eguavoen, Irit (2009). The Acquisition of Water Storage Facilities in the Abay River Basin, Ethiopia.
39. Hornidge, Anna-Katharina; Mehmood Ul Hassan; Mollinga, Peter P. (2009). 'Follow the Innovation' – A joint experimentation and learning approach to transdisciplinary innovation research.
40. Scholtes, Fabian (2009). How does moral knowledge matter in development practice, and how can it be researched?
41. Laube, Wolfram (2009). Creative Bureaucracy: Balancing power in irrigation administration in northern Ghana.
42. Laube, Wolfram (2009). Changing the Course of History? Implementing water reforms in Ghana and South Africa.
43. Scholtes, Fabian (2009). Status quo and prospects of smallholders in the Brazilian sugarcane and ethanol sector: Lessons for development and poverty reduction.
44. Evers, Hans-Dieter; Genschick, Sven; Schraven, Benjamin (2009). Constructing Epistemic Landscapes: Methods of GIS-Based Mapping.
45. Saravanan V.S. (2009). Integration of Policies in Framing Water Management Problem: Analysing Policy Processes using a Bayesian Network.
46. Saravanan V.S. (2009). Dancing to the Tune of Democracy: Agents Negotiating Power to Decentralise Water Management.
47. Huu, Pham Cong; Rhlers, Eckart; Saravanan, V. Subramanian (2009). Dyke System Planing: Theory and Practice in Can Tho City, Vietnam.
48. Evers, Hans-Dieter; Bauer, Tatjana (2009). Emerging Epistemic Landscapes: Knowledge Clusters in Ho Chi Minh City and the Mekong Delta.
49. Reis, Nadine; Mollinga, Peter P. (2009). Microcredit for Rural Water Supply and Sanitation in the Mekong Delta. Policy implementation between the needs for clean water and 'beautiful latrines'.

50. Gerke, Solvay; Ehlert, Judith (2009). Local Knowledge as Strategic Resource: Fishery in the Seasonal Floodplains of the Mekong Delta, Vietnam

51. Schraven, Benjamin; Eguavoen, Irit; Manske, Günther (2009). Doctoral degrees for capacity development: Results from a survey among African BiGS-DR alumni.

52. Nguyen, Loan (2010). Legal Framework of the Water Sector in Vietnam.

53. Nguyen, Loan (2010). Problems of Law Enforcement in Vietnam. The Case of Wastewater Management in Can Tho City.

54. Oberkircher, Lisa et al. (2010). Rethinking Water Management in Khorezm, Uzbekistan. Concepts and Recommendations.

55. Waibel, Gabi (2010). State Management in Transition: Understanding Water Resources Management in Vietnam.

56. Saravanan V.S.; Mollinga, Peter P. (2010). Water Pollution and Human Health. Transdisciplinary Research on Risk Governance in a Complex Society.

57. Vormoor, Klaus (2010). Water Engineering, Agricultural Development and Socio-Economic Trends in the Mekong Delta, Vietnam.

58. Hornidge, Anna-Katharina; Kurfürst, Sandra (2010). Envisioning the Future, Conceptualising Public Space. Hanoi and Singapore Negotiating Spaces for Negotiation.

59. Mollinga, Peter P. (2010). Transdisciplinary Method for Water Pollution and Human Health Research.

60. Youkhana, Eva (2010). Gender and the development of handicraft production in rural Yucatán/Mexico.

61. Naz, Farhat; Saravanan V. Subramanian (2010). Water Management across Space and Time in India.

62. Evers, Hans-Dieter; Nordin, Ramli, Nienkemoer, Pamela (2010). Knowledge Cluster Formation in Peninsular Malaysia: The Emergence of an Epistemic Landscape.

63. Mehmood Ul Hassan; Hornidge, Anna-Katharina (2010). 'Follow the Innovation' – The second year of a joint experimentation and learning approach to transdisciplinary research in Uzbekistan.

64. Mollinga, Peter P. (2010). Boundary concepts for interdisciplinary analysis of irrigation water management in South Asia.

65. Noelle-Karimi, Christine (2006). Village Institutions in the Perception of National and International Actors in Afghanistan. (**Amu Darya Project Working Paper No. 1**)

66. Kuzmits, Bernd (2006). Cross-bordering Water Management in Central Asia. (**Amu Darya Project Working Paper No. 2**)

67. Schetter, Conrad; Glassner, Rainer; Karokhail, Masood (2006). Understanding Local Violence. Security Arrangements in Kandahar, Kunduz and Paktia. (**Amu Darya Project Working Paper No. 3**)

68. Shah, Usman (2007). Livelihoods in the Asqalan and Sufi-Qarayateem Canal Irrigation Systems in the Kunduz River Basin. (**Amu Darya Project Working Paper No. 4**)

69. ter Steege, Bernie (2007). Infrastructure and Water Distribution in the Asqalan and Sufi-Qarayateem Canal Irrigation Systems in the Kunduz River Basin. (**Amu Darya Project Working Paper No. 5**)

70. Mielke, Katja (2007). On The Concept of 'Village' in Northeastern Afghanistan. Explorations from Kunduz Province. (**Amu Darya Project Working Paper No. 6**)

71. Mielke, Katja; Glassner, Rainer; Schetter, Conrad; Yarash, Nasratullah (2007). Local Governance in Warsaj and Farkhar Districts. (**Amu Darya Project Working Paper No. 7**)

72. Meininghaus, Esther (2007). Legal Pluralism in Afghanistan. (**Amu Darya Project Working Paper No. 8**)

73. Yarash, Nasratullah; Smith, Paul; Mielke, Katja (2010). The fuel economy of mountain villages in Ishkamish and Burka (Northeast Afghanistan). Rural subsistence and urban marketing patterns. (**Amu Darya Project Working Paper No. 9**)

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75. Shtaltovna, Anastasiya; Hornidge, Anna-Katharina; Mollinga, Peter P. (2011). The Reinvention of Agricultural Service Organisations in Uzbekistan – a Machine-Tractor Park in the Khorezm Region.

76. Stellmacher, Till; Grote, Ulrike (2011). Forest Coffee Certification in Ethiopia: Economic Boon or Ecological Bane?

77. Gatzweiler, Franz W.; Baumüller, Heike; Ladenburger, Christine; von Braun, Joachim (2011). Marginality. Addressing the roots causes of extreme poverty.

78. Mielke, Katja; Schetter, Conrad; Wilde, Andreas (2011). Dimensions of Social Order: Empirical Fact, Analytical Framework and Boundary Concept.

79. Yarash, Nasratullah; Mielke, Katja (2011). The Social Order of the Bazaar: Socio-economic embedding of Retail and Trade in Kunduz and Imam Sahib

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81. Ziai, Aram (2011). Some reflections on the concept of 'development'.

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83. Eguavoen, Irit; Tesfai, Weyni (2011). Rebuilding livelihoods after dam-induced relocation in Koga, Blue Nile basin, Ethiopia.

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88. Graw, Valerie; Ladenburger, Christine (2012). Mapping Marginality Hotspots. Geographical Targeting for Poverty Reduction.

89. Gerke, Solvay; Evers, Hans-Dieter (2012). Looking East, looking West: Penang as a Knowledge Hub.

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92. Hiemenz, Ulrich (2012). The Politics of the Fight Against Food Price Volatility – Where do we stand and where are we heading?

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100. Callo-Concha, Daniel; Gaiser, Thomas and Ewert, Frank (2012). Farming and cropping systems in the West African Sudanian Savanna. WASCAL research area: Northern Ghana, Southwest Burkina Faso and Northern Benin.

101. Sow, Papa (2012). Uncertainties and conflicting environmental adaptation strategies in the region of the Pink Lake, Senegal.

102. Tan, Siwei (2012). Reconsidering the Vietnamese development vision of "industrialisation and modernisation by 2020".

103. Ziai, Aram (2012). Postcolonial perspectives on 'development'.

104. Kelboro, Girma; Stellmacher, Till (2012). Contesting the National Park theorem? Governance and land use in Nech Sar National Park, Ethiopia.

105. Kotsila, Panagiota (2012). "Health is gold": Institutional structures and the realities of health access in the Mekong Delta, Vietnam.

106. Mandler, Andreas (2013). Knowledge and Governance Arrangements in Agricultural Production: Negotiating Access to Arable Land in Zarafshan Valley, Tajikistan.

107. Tsegai, Daniel; McBain, Florence; Tischbein, Bernhard (2013). Water, sanitation and hygiene: the missing link with agriculture.

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109. von Braun, Joachim; Gerber, Nicolas; Mirzabaev, Alisher; Nkonya Ephraim (2013). The Economics of Land Degradation.

110. Stellmacher, Till (2013). Local forest governance in Ethiopia: Between legal pluralism and livelihood realities.

111. Evers, Hans-Dieter; Purwaningrum, Farah (2013). Japanese Automobile Conglomerates in Indonesia: Knowledge Transfer within an Industrial Cluster in the Jakarta Metropolitan Area.

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113. Ayaribilla Akudugu, Jonas; Laube, Wolfram (2013). Implementing Local Economic Development in Ghana: Multiple Actors and Rationalities.

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