Thematic Review

STANDARDS AND BIODIVERSITY

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State of Sustainability Initiatives

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The State of Sustainability Initiatives was established through a partnership of the international Institute for Environment and Development, AidEnvironment, Entwined and the Finance Alliance for Sustainable Trade. The objective of the SSI is to provide objective reporting and analysis on the market performance and characteristics of voluntary sustainability standards.

About the Report

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Standards and Biodiversity: Thematic Review

June 2017

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Table of Contents

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The report reflects the opinions of the authors alone and does not reflect official positions of the Convention on Biological Diversity, its Secretariat, SECO or any of the other contributors to the report.

Acronyms

BCI	Better Cotton Initiative
BIICP	Biodiversity Impact Indicators for Commodity Production
BOD	biological oxygen demand
CBD	Convention on Biological Diversity
CBD COP	Convention on Biological Diversity Conference of the Parties
DON	Degree of Obligation Number
EU	European Union
FAO	Food and Agricultural Organization of the United Nations
GDP	Gross Domestic Product
GHG	greenhouse gas
GMO	genetically modified organism
HCV	high conservation value
IISD	International Institute for Sustainable Development
ITC	International Trade Centre
NGO	non-governmental organization
OECD	Organisation for Economic Co-operation and Development
RSPO	Roundtable on Sustainable Palm Oil
RTRS	Roundtable on Responsible Soy
SAGP	Sustainable Agricultural Practices (Coca-Cola)
SAI	Sustainable Agriculture Initiative
SDG	Sustainable Development Goal
SRP	Sustainable Rice Platform
SSI	State of Sustainability Initiatives
TEEB	The Economics of Ecosystems and Biodiversity
UN	United Nations
VSS	Voluntary sustainability standards
WWF	World Wildlife Fund

Units and Measures

GJ	gigajoule
ha	hectare
m^3	cubic metres
TJ	terajoule
mt	metric tonne

Foreword

The importance of biodiversity and healthy ecosystems for agricultural production is increasingly being recognized, including in the 2030 Agenda for Sustainable Development. At the same time, while more sustainable practices are increasingly being adopted in agricultural production, agriculture remains the single largest cause of biodiversity loss.

A number of voluntary standards for reducing adverse impacts on ecosystems and biodiversity have been developed for a number of key agricultural commodities. However, such standards were not necessarily developed from a common basis and are lacking for many other commodities. With this in mind, the Secretariat of the Convention on Biological Diversity undertook to identify, with inputs from a range of experts, a core set of biodiversity indicators that might be applied by parties and their agricultural sectors to gauge and compare the respective contributions of these factors in reducing negative impacts on biodiversity. The resulting Biodiversity Impact Indicators for Commodity Production (BIICP) provide a tool for testing and use by these actors. It was also envisioned that they could be further taken up by existing initiatives and standards that address the interface of biodiversity and agricultural commodities. This is all the more urgent, as the growing demand for agricultural commodities will increase the pressures on biodiversity, unless these pressures are appropriately addressed.

Voluntary sustainability standards are an important element of the necessary policy mix to redirect funding towards sustainable production practices and reducing biodiversity loss. This report makes an important contribution by providing a better understanding of the role and potential of different voluntary sustainability standards, and what policy-makers can do to promote their wider application and their more robust integration into overall policy frameworks.

My appreciation and thanks go to the International Institute for Sustainable Development for this timely report. I hope that its analysis and recommendations will be taken into account in the further design of standards and associated public policies.

Cristiana Paşca Palmer, Ph.D
Executive Secretary
Convention on Biological Diversity

Preface

Agricultural production currently accounts for an estimated 40 per cent of global land surface, arguably making it the single most important segment of the economy from a sustainable development perspective. In addition to playing a major role in poverty reduction (SDG 1), zero hunger (SDG 2) and climate action (SDG 13), it is also one of the single most important factors determining global ecosystem health and biodiversity (SDG 14 and SDG 15). What happens in agriculture matters.

Any plausible approach to a wide-scale transformation of agriculture toward sustainable practices must include a vision that directly links economic growth (SDG 8) to sustainable consumption and production (SDG 12).

In this context, the recent growth of voluntary sustainability standards represents a major opportunity. Voluntary sustainability standards set common rules of practice across all actors within the global economy and allow producers and companies to compete on non-price factors, including social, economic and environmental sustainability. They have the potential to create systemic and enduring economic incentives for the adoption of sustainable practices.

The opportunities presented by voluntary standards are particularly acute within the context of biodiversity conservation. With much of the early growth of voluntary sustainability standards having occurred within the agricultural sector, itself the single greatest driver of biodiversity loss, and the vast majority of voluntary standards including significant environmental criteria, they would appear to be well positioned to play a major role in biodiversity conservation.

However, sustainability standards, being voluntary in nature, have developed through an idiosyncratic mix of political, economic and sustainability concerns, giving rise to a high degree of variability among standards systems themselves. And while the diversity of voluntary standards has enabled much-needed innovation in the definition, monitoring and enforcement of sustainable agricultural production, it has also given rise to its own set of questions. How do different initiatives compare in their treatment of biodiversity conservation? What are the actual impacts of such initiatives on biodiversity, and where are these impacts occurring?

Although this report makes no pretense to answering such questions definitively, it does provide an important starting point for making such determinations. By linking the latest criteria and market data for major agricultural standards, with the recently developed Biodiversity Impact Indicators for Commodity Production (BIICP), the report offers a uniquely generic and multi-pronged framework for understanding the potential contribution of voluntary standards to biodiversity conservation.

Ultimately, one of the most important findings of the report may be in its acting as a reminder of how close we are to the beginning of this trajectory. Although markets for certified products have been growing rapidly over the past decade, they still only represent a small portion of overall agricultural production, with many regions of production entirely absent. We all still face a steep learning curve in understanding how these initiatives can be leveraged to their intended outcomes in the most effective way. We hope that this report can play a helpful role in this learning process.

Scott Vaughan
President and Chief Executive Officer, IISD

Executive Summary

Between 2015 and 2016, the Secretariat of the Convention on Biological Diversity convened a multistakeholder group of experts to identify a core set of biodiversity indicators that might be measured by member countries as a basis for understanding the state of biodiversity risk posed by agricultural production within their respective jurisdictions. The resulting Biodiversity Impact Indicators for Commodity Production (BIICP) offer a starting point for understanding the contribution of agricultural practices to biodiversity protection. Voluntary sustainability standards (VSSs) are increasingly being adopted in a variety of sectors as a basis for promoting sustainable agriculture at production. This review attempts to understand the degree to which major VSSs operating in the agriculture sector are aligned with the specific biodiversity-related objectives targeted by the BIICP. The following is a summary of the findings based on our analysis.

The growth of standard-compliant production continues to outpace growth for conventional products in the eight sectors where standards are most active. Standard-compliant production is on track to reach 10 per cent or more of global production across each of these sectors by 2020.

Commodity production compliant with one or more of the 15 voluntary standards covered in this review across the banana, cotton, coffee, cocoa, tea, sugar, palm oil and soybean sectors combined grew, on average, 35 per cent per annum between 2008 and 2014—reaching an estimated trade value of USD 52.5 billion in 2015. The average growth of conventional production over the same period was 3 per cent. By 2014, four of the eight markets reviewed had achieved compliance rates of 10 per cent or more of global production. Based on current market trends and existing "unimplemented" corporate commitments to sustainable sourcing, we expect that standard-compliant production for each of the eight markets will have reached 10 per cent or more of total global production by 2020.

Notwithstanding the significant market growth of voluntary standards across select agricultural sectors, standards remain a marginal force across global agricultural production as a whole.

The total area covered by standards in the eight sectors where standards are most active reached 14.5 million hectares in 2014 (banana, cotton, coffee, cocoa, tea, sugar, palm oil and soybean sectors), accounting for less than 1 per cent of global agricultural area. Similarly, we estimate that 100 per cent certification of these eight agricultural commodities would amount to a mere 12 per cent of global agricultural land area. If voluntary standards are to play a major role in reducing the impacts of agriculture on biodiversity loss, they will have to, at a minimum, establish a significant presence among other crops—most notably, staple crops such as wheat, maize and rice.

The requirements specified by voluntary standards prioritize protection against habitat loss, historically the single most important driver of agriculturally caused biodiversity loss.

The voluntary standards reviewed display a clear emphasis on requirements directed toward habitat conservation. Of the standards reviewed, 87 per cent prohibit production on land recently converted from some or all types of forestland while seven of the top 10 requirements targeted habitat conservation. Given that habitat loss, principally due to land conversion, represents the single most important driver of biodiversity loss arising from agriculture, the focus of voluntary standards on habitat protection is encouraging from a biodiversity perspective.

Voluntary sustainability standards are less well prepared to deal with impending drivers of biodiversity loss such as climate change.

While forest conversion has traditionally been one of the most important drivers of biodiversity loss, climate change is expected to replace land conversion as the most important driver as opportunities for expansion decrease and climate change impacts become more severe. Climate change-related requirements had the lowest level of coverage among the standards reviewed, with none of the standards including strict (critical) requirements on the measurement or reduction of greenhouse gasses (GHGs). Meanwhile requirements explicitly focusing on biodiversity protection are relatively rare among the initiatives surveyed, with only 40 per cent of initiatives specifying critical requirements for risk assessment of biodiversity impacts and 13 per cent requiring that agricultural practices produce no net loss of biodiversity. More explicit attention to biodiversity loss and GHG measurements could facilitate better management of biodiversity loss in the future.

Requirements under existing standards prescribe practices rather than performance outcomes, leaving a vacuum of data and evidence with respect to actual impacts.

The vast majority of requirements reviewed specify ***practices*** rather than performance ***outcomes***. Moreover, requirements tend to focus on practices that ***protect*** ecosystems rather than practices related to the monitoring, measurement or restoration of such systems. Thus, although standards typically maintain a sophisticated auditing infrastructure that may be capable of collecting outcome data, the actual requirements associated with the standards are not prone to producing such data. These observations underscore an outstanding opportunity for standards to play a more proactive role in data collection linked to biodiversity performance targets.

The geographic distribution of compliance with voluntary standards dictates their area of influence on biodiversity protection, but poor location-based data limits specific understanding of potential impact.

In markets where standards only represent a fraction of overall production, their ability to prevent the most egregious threats to biodiversity depends on their relative presence in those regions where such threats exist. A spatial mapping of those commodities where standards are most active against key BIICP reveals a mixed degree of overlap of standards and key biodiversity impact pathways. At current compliance levels, every sector reviewed is potentially subject to significant leakage through conventional production in areas of biodiversity risk. The absence of comprehensive GIS location data for certified production represents a significant challenge in understanding the distributional effect of standards adoption on areas of strategic importance to biodiversity conservation.

Commodity-Specific Observations

Banana certification may be limited by the small portion of production that is traded internationally.

Bananas, as an agroforestry product, have the potential to support relatively high levels of biodiversity. However, banana production is typically grown in a monocrop environment and is one of the most intensive sources of pesticide application in agriculture (second only to cotton by volume). Unlike most of the other commodities reviewed, growth of banana certification has been modest over the past five years, with the per annum growth ranging from 4 to 13 per cent among active initiatives (2008–2014). Moreover, although only 12 per cent of global production is certified, we estimate that this constitutes more than 65 per cent of globally traded bananas, suggesting that a glass ceiling on growth may be imminent in the absence of increasing demand from Southern countries.

Cocoa certification appears to be well positioned to promote improved soil fertility where it matters most through strong presence in countries facing soil fertility challenges.

Cocoa production is one of a handful of crops that enjoys shade cover in its regular production and thus can play an important role in protecting forest-related biodiversity. Global cocoa production, however, has faced stagnant and often decreasing per-hectare yields across several of the major African producing countries, due in part to reduced soil fertility. Cocoa standards, which have relatively strict requirements on intercropping, can offer a pathway for improved soil management. As of 2014, 30 per cent of global production was standard compliant, with the vast majority of compliant production located across African countries with lower soil qualities. Distributionally speaking, cocoa standards appear to be targeting some of the most strategic regions from a soil management perspective. Significant opportunities exist for cocoa standards to play a more proactive role with respect to the protection of high-fertility soils in Indonesia.

Coffee certification appears to be well positioned to limit the eutrophication-related impacts of coffee production.

Coffee, like cocoa, can be grown as an agroforestry product under shade conditions and therefore has the potential to protect forest-based biodiversity through environmentally sound production practices. Since the 1990s, coffee production has been transitioning from shade-grown to full sun coffee, generating increased pressure on key biodiversity hotspots. In addition to the obvious problem of reduced forest cover and related ecosystem integrity, the transition to full-sun production has resulted in increased fertilizer use and, correspondingly, nitrogen runoff to water bodies. A mapping of the distribution of voluntary standards reveals that standards are highly active in areas where the threat of eutrophication from coffee production is most prominent. Voluntary standards also exhibit a strong presence in many countries that still rely on traditional shade practices. The promise of higher prices and better market access associated with standard compliance may also limit coffee-related eutrophication by reducing market pressure on farmers in these regions to transition to full sun production.

Cotton certification appears to be under-represented in countries where cotton-related water use is most problematic.

Cotton requires significant amounts of water for commercial production and has historically been a driver of water scarcity in several major producing regions. Water use efficiency is thus an essential component of sustainable cotton production. Water use requirements across cotton standards emphasize water recycling and efficient irrigation practices, with the Better Cotton Initiative (BCI), the dominant cotton standard, reporting critical requirements across all water use indicators measured. By 2014, 1.9 million mt or 7 per cent of global cotton lint production was standard compliant, up from 163 thousand tonnes or one per cent in 2008. BCI alone aims to have 30 per cent of the world's cotton production verified under the program by 2020. Although both African and Asian countries have been experiencing growth in standard compliant production, Brazil clearly dominates the market, accounting for 41 per cent of all standard compliant cotton in 2014. Expansion of standard compliant cotton across Pakistan and India offer significant opportunities and should be considered to be of strategic importance from a cotton water management perspective.

Palm oil certification is geographically focused where forest conversion is most problematic but may nevertheless have limited impact due to the scale of demand for conventional palm oil by Asian countries.

Oil palm expansion has been linked to massive deforestation threatening biodiversity in the major producing regions. Over 80 per cent of palm oil exports come from the tropical forests of Indonesia and Malaysia, 60 per cent of which are estimated to have directly displaced forests since the year 2000.

The Roundtable on Sustainable Palm Oil, which has prohibitions against palm oil production on recently converted ***primary*** forests but, importantly, not all forests, is the dominant certification system operating in the sector—accounting for 99.5 of all standard-compliant production in 2014. By 2014, 55.4 million mt or 20 per cent of the world's palm oil was standard compliant, up from around 2 per cent in 2008. Virtually all of certified palm oil is sourced from Malaysia, Indonesia and Papua New Guinea—key targets for addressing natural habitat loss arising from palm oil production. The most important challenges facing certification effectiveness in the palm oil sector may be limited demand for certified palm oil across India and China, which together account for 40 per cent of global demand. Unless buyers in these countries require compliance with standards, significant markets for uncertified palm oil can be expected to continue to drive deforestation and/or low standards in producing regions, potentially limiting the effectiveness of certification.

Soy certification is most active in key areas of biodiversity vulnerability but has low adoption rates due to low demand for certified soy from China, the world's most important importer.

Rapid expansion of soy production over the past two decades has driven significant deforestation, particularly in South America. Meanwhile, more than 80 per cent of global soy production is genetically modified, giving rise to increased use of herbicides. Both trends, combined with soy's pronounced overlap with high-biodiversity areas more generally, pose significant biodiversity threats. Although the highest percentage of certified soy comes from the Latin American region where soy expansion poses a particular biodiversity threat, overall certification levels have remained at below 3 per cent despite the active presence of a global mainstream initiative for more than a decade and more than two thirds of soy production being traded on international markets. One of the main hurdles to significant expansion of certified soy production has been the dominance of Chinese demand, which accounts for two thirds of global soy imports but has not, as of yet, generated significant demand for sustainable soy.

Sugarcane certification is highly concentrated in Brazil, which has lower per-volume fertilizer use than other major producing countries.

Sugarcane is associated with high levels of fertilizer and water inputs and thus poses a significant threat to water quality. Sugarcane standards have strong requirements limiting pesticide use and requiring pesticide monitoring. Between 3 and 4 percent of global sugarcane production is certified with Bonsucro, accounting for the vast majority of certified production (52 million tonnes). The overwhelming majority of standard-compliant sugarcane (79 per cent of global) comes from Brazil, which generally has lower per-volume fertilizer inputs than other major producing countries such as India, China, Pakistan and Mexico. These countries represent strategic opportunities for the expansion of certified sugarcane aimed at protecting water quality.

Tea production compliant with standards accounts for 18 per cent of global tea production (by volume) but only 13 per cent of global area under tea production.

Habitat conversion, caused by the plantations themselves when they replace tropical forests and timber for use in the tea-drying process, represents one of the most systemic threats to biodiversity arising from tea production. By 2014, standard-compliant tea accounted for 18 per cent of global production, up from 6 per cent in 2008. Meanwhile, Rainforest Alliance-certified production, the dominant certifier in the sector, grew at a rate of 25 per cent per annum from 2012 to 2014. Notwithstanding these impressive results, certified tea area only represents 13 per cent of global area under tea production. The adoption of standards in tea, as with standards adoption in many other commodities, tends to occur in farms that already employ more sophisticated practices and are associated with higher yields. Strategic intervention by policy-makers may be necessary to enable certification in lower-yielding regions.

Policy Options

Based on our review, it is clear that the major agricultural standards contain significant requirements related to biodiversity conservation. It is also clear, however, that the ***implementation*** of standards, being driven by market forces, is, at best, only partially aligned with biodiversity protection. Policy-makers have a role to play in leveraging the momentum and infrastructure behind voluntary standards to promote a more intentional, strategic and, ultimately, effective implementation of voluntary standards for biodiversity conservation. Key policy options include:

Policy Option 1 – Support Biodiversity-Driven Implementation: Policy-makers can collaborate with voluntary standards during the rollout strategies in their respective countries to facilitate and provide incentives for adoption in areas where they will have maximum impact. Setting national targets and/or requirements for levels of standard-compliant production could support the achievement of Sustainable Development Goal (SDG) 2, SDG 12 and SDG 15 simultaneously.

Policy Option 2 – Offer Leadership in the Development of Integrated Data Systems: Policy-makers can finance the development of national, regional and international data collection and sharing systems that enable voluntary standards (and other stakeholders) to share data with the general public and policy-makers along harmonized parameters so that their role as data collectors can be leveraged to support effective biodiversity management at the national and regional levels.

Policy Option 3 – Support Voluntary Sustainability Standards in the Development of Effective Requirements: Policy-makers can provide financing to standards and research partners to determine the relationship between agricultural production and biodiversity conservation within specific crops so that these can be effectively integrated into the standards development and implementation processes.

Policy Option 4 – Support Impact Research and Analysis: Policy-makers can provide financing to researchers to determine the biodiversity impacts of voluntary standards operating in key sectors as a basis for continual improvement and for determining the strategic application of policy support to such initiatives. Impact data and analysis at the field and landscape levels, as well as data on market distribution and trends, should be prioritized, allowing for farmers and other stakeholders to make real-time course corrections toward sustainability and biodiversity protection.

Policy Option 5 – Implement a Policy Framework for Credibility Assurance: To ensure market fairness and the overall effectiveness of the voluntary sustainability standards sector in meeting stated (biodiversity) objectives, policy-makers can set credibility, accuracy and evidence-based ground rules to ensure that market claims are supported by responsible practice and evidence-based outcomes.

1 Introduction

Biodiversity[1] encompasses all living matter and underpins our existence, as it functions in concert to establish suitable conditions for life on Earth.[2] Although the vast richness of all living species, including species important to the future of agriculture (adaptation to climate change, genetic resources for nutrition improvement, etc.), has yet to be discovered, the rate of biodiversity loss attributed to human activities has reached alarming levels, narrowing the adaptation, development and well-being prospects of present and future generations (Secretariat of the Convention on Biological Diversity, 2014). According to some estimates, the rate of species extinction has increased by between 100 and 1,000 fold since the industrial revolution and is projected to increase by a factor of 10 in the coming century (Rockstrom, 2009).[3] The Millennium Ecosystem Assessment (2005) detailed how human activities are driving irreversible biodiversity losses,[4] while research on the planetary boundaries indicates that biodiversity losses have surpassed a sustainable threshold (Reid et al., 2005; Rockstrom, 2009).

These trends are likely to continue under a "business-as-usual" scenario with increases in global population and consumption patterns. The various species making up the Earth's biodiversity will increasingly be in competition for suitable habitat and resources needed for survival. A 33 per cent population increase by 2050, along with urbanization, could potentially translate into a 100 per cent increase in energy demand, 70 per cent in agricultural production demand and 50 per cent in water demand (Beck & Villarroel Walker, 2013; Dubreuil et al., 2013; Stigson, 2013; Kok et al., 2014), all of which will make halting biodiversity losses even more challenging.[5] These projections highlight the importance and urgency for adopting more sustainable forms of agriculture and have in part motivated the adoption by the global

1 Biological diversity or biodiversity is the result of life's evolution on planet Earth over billions of years and is defined as follows: "The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems" (Convention on Biological Diversity, n.d.). It can be further characterized as species, genetic and ecosystem diversity. Species diversity encompasses all distinct life forms in existence broadly categorized as animals, plants and microorganisms. Of the total number of species on Earth, only a fraction has been discovered, representing an important untapped potential for ecosystem and human well-being. Based on examining the pattern of taxonomic classification of species, it was estimated that there is a total of 8.7 million species with 86 per cent of terrestrial and 91 per cent marine species yet to be described (Mora, et al., 2011). Genetic diversity is fundamental for species to adapt to changing environments brought on by natural and human disturbances. Advances in genetic sciences have opened new horizons to better understand its crucial importance. Ecosystem diversity represents the various distinct assemblages and interactions of living organisms that result in a myriad of ecosystem services essential to well-being (Reid et al., 2005).

2 For instance, vegetation captures and converts sunlight into usable forms of energy, transforms carbon dioxide into oxygen and cycles water through evapotranspiration. Plant life is possible due to insects, animals and microorganisms enabling pollination, fertilization and nitrogen fixing, among others.

3 The species extinction rate has far surpassed the speciation rate, with half of species extinctions occurring on land in the last 20 years due primarily to land use change, species introductions and climate change (Rockstrom, 2009).

4 According to the Millennium Ecosystem Assessment (2005), agriculture is responsible for a significant loss of the world's biomes (66 per cent of two biomes and 50 per cent of four biomes); certain taxonomic group population sizes, ranges or both are currently in decline; species are becoming more homogeneous as a result of intentional and inadvertent species introductions; the number of species are declining with 10–30 per cent of mammal, birds and amphibians currently on the brink of extinction; and genetic diversity dropped notably among cultivated species.

5 Increased meat consumption has been identified as the single most important driver of biodiversity loss by 2050 (see Leadley et al., 2014).

community of Sustainable Development Goal (SDG) 2: End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.[6]

Historically, agriculture has been the single most important source of terrestrial biodiversity loss (PBL Netherlands Environmental Assessment Agency, 2014). Overall, approximately 52 per cent of all land used globally for agriculture is moderately or severely degraded (The Economics of Ecosystems and Biodiversity [TEEB], 2015). Along with forests, large tracts of savannahs and grasslands have also been lost to agriculture. Land converted to agriculture is driven primarily by increasing population densities in smallholder farming areas and by global demand for agricultural commodities, such as soy and palm oil, in large-scale farming regions (PBL Netherlands Environmental Assessment Agency, 2014). Today, approximately 38 per cent of land and 70 per cent of freshwater withdrawals are appropriated for agricultural production (Food and Agriculture Organization [FAO], 2016a; World Bank Group, 2016). Commonly used agricultural inputs such as synthetic fertilizers and pesticides are polluting ecosystems and threatening biodiversity. The runoff from agricultural fields has led to the eutrophication of freshwater bodies and anoxic zones in coastal environments in Europe, eastern and southern United States and Southeast Asia, an estimated surface area of 245,000 km^2 (TEEB, 2015). Chemical pesticides have been linked to important drops in bee populations and have led to the bioaccumulation of persistent chemicals in food chains. As a result, approximately 70 per cent of projected losses in terrestrial biodiversity is attributed to agriculture (Secretariat of the Convention on Biological Diversity, 2014; TEEB, 2015).

Notwithstanding the general trajectory of agriculture over the past several centuries toward decreased biodiversity, agricultural activity can support and promote biodiversity if undertaken in a sustainable manner. For instance, perennial crops can provide habitats and foraging for numerous insects, including pollinators and pest controllers fundamental to agricultural production (TEEB, 2015). Agroforestry supporting crop production such as shade-grown coffee, on the other hand, allows for cultivating cash crops while preserving habitats with high levels of biodiversity. Similarly, the use of nitrogen-fixing crops and integrated pest management can reduce the need for biodiversity-damaging synthetic inputs while simultaneously enhancing biodiversity through their interactions with local ecosystems (TEEB, 2015). Holistic approaches to agriculture, such as combining rice paddy cultivation with aquaculture or using livestock rearing to fertilize pastures and croplands via green manure, offer additional examples of the potential synergies to be realized between agricultural practices and slowing and reversing biodiversity loss.

The overall role of sustainable agriculture as a foundation for biodiversity protection holds particular promise in light of the ubiquitous nature of agriculture globally as well as the substantial economic and productive resources dedicated to agricultural production. The recent growth of agricultural investment as an asset class offers new and growing opportunities to link economic growth and biodiversity protection through agricultural production (Valoral Advisors, 2015).

And although global awareness of the critical role of agriculture as a determinant of global biodiversity has grown significantly over the past two decades, the threat posed by the majority of agriculture systems continues to grow. For instance, over the past 40 years, 20 per cent of the Amazonian rainforest, one of the most biodiverse regions of the world, has been lost to logging, cultivating soy and raising cattle, while half of Southeast Asia's original forest coverage has been lost to accommodate agriculture primarily in the

6 SDG 2 articulates the need for adopting sustainable agricultural production practices as follows: "by 2030 ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters, and that progressively improve land and soil quality" (United Nations Department of Economic and Social Affairs, 2014).

form of oil palm plantations (Achard, 2009; Wallace, n.d.). Trends such as these point toward the deep need for continued efforts on a global scale to transition agricultural practices toward supporting biodiversity.

The Convention for Biological Diversity (CBD), established during the Rio Earth Summit in 1992, provides the principal global framework for enabling a coordinated effort to prevent biodiversity loss.[7] Since its establishment, the CBD has advanced efforts by the global community to achieve biodiversity conservation, restoration and sustainable management, as well as the fair and equitable sharing of the benefits arising out of the utilization of genetic resources. There are currently 196 contracting parties to the CBD (195 countries and the European Union, as a regional organization), working to establish agreements and strategies to sustain biodiversity for present and future generations. Notable among these agreements is the ***Strategic Plan for Biodiversity 2011–2020*** and its twenty **Aichi Biodiversity Targets**, adopted in 2010, which set out five strategic goals and specific targets for the protection and enhancement of biodiversity to be achieved by 2020, including a specific target for agriculture and for genetic resources diversity.[8] Most recently, the Decision of the Parties arising from the CBD's 13th Conference of the Parties calls specifically for the mainstreaming of biodiversity through, among other things, agricultural production (Convention on Biological Diversity, 2016).

Within its specific concern to address biodiversity losses related to agriculture, the CBD Secretariat, under a specific mandate from the 12th meeting of the Conference of the Parties, in the Republic of Korea in October 2014, initiated consultations to identify key indicators to help governments monitor, manage and eventually reverse the impacts of agricultural commodity production on biodiversity. This process resulted in the elaboration of the Biodiversity Impact Indicators for Commodity Production (BIICP), which provide the inspiration for this report (see below).

In addition to the important work undertaken by the CBD, many other initiatives are ongoing to slow and prevent biodiversity losses. UNESCO World Heritage Sites are often established with the objective of protecting rare and endemic species. The International Union for Conservation of Nature's species red list tracks and qualifies the viability of various species by designating them as threatened, vulnerable or species of concern so they can be protected. Through the Commission on Genetic Resources for Food and Agriculture and the International Treaty on Plant Genetic Resources for Food and Agriculture, the Global Action on Pollination Services for Sustainable Agriculture and Research in Soil Biodiversity, the FAO is working toward protecting genetic diversity in our food systems and the equitable sharing of associated benefits as well as pollination services and soil fertility required to maintain food production (FAO, 2016c). A number of private sector schemes have also emerged, such as biodiversity banking, offsets and voluntary sustainability standards (VSSs), each aiming to harness the power of markets to enable development while protecting biodiversity.[9] As these initiatives grow in importance, so does their potential to play a positive role in forwarding broad public objectives toward biodiversity protection.

The rise of VSSs is closely related to a growing

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7 "The Convention establishes three main goals: the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits from the use of genetic resources" (Secretariat of the Convention on Biological Diversity & United Nations Environment Programme, 2000, p.2).

8 "Aichi Biodiversity Target 7: by 2020 areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity and Aichi Biodiversity Target 13: by 2020, the genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species, is maintained and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity" (Convention for Biological Diversity Secretariat, n.d.).

9 For instance, the Business and Biodiversity Offsets Programme is a collaboration between companies, financial institutions, government agencies and civil society organizations to pursue their goals while conserving biodiversity by establishing a biodiversity impact mitigation hierarchy aiming to achieve no net loss or a net gain in biodiversity (Business and Biodiversity Offsets Programme, n.d.).

2 Voluntary Sustainability Standards as Potential Contributors to Biodiversity Protection

awareness of the impacts that consumption and production patterns have on sustainable development. Since the 1992 Rio Earth Summit, where sustainable consumption and production were edified under Principle 8 of the Rio Declaration, consumers have increasingly demanded proof of sustainable production practices, particularly in products coming from regions where laws and enforcement mechanisms are considered weak. While the first initiatives, such as Organic, Fairtrade and Rainforest Alliance, initially targeted niche markets catering to "green consumers," there has been a growing emphasis on broad "market transformation" through VSSs explicitly tailored to mainstream markets.[10] The trend toward integration within mainstream markets reveals the specific potential of voluntary standards to support global objectives and approaches to biodiversity protection (see Box 1).[11]

The growth of voluntary standards represents an important opportunity for all stakeholders to play a proactive role in encouraging and managing the transition toward more sustainable agriculture, by enabling informed consumer choice and direct participation in rule setting for international trade. Improved participatory governance of international markets, itself a cornerstone principle of sustainable development, can be enabled by voluntary standard systems and may represent one of the most compelling arguments for their proliferation.

By allowing consumers and companies to choose sustainable products, VSSs can empower the market to include the costs of biodiversity protection within the pricing mechanism.[12] The market value of certified products across the ten major commodities where standards are active (bananas, cotton, coffee, cocoa, tea, sugar, palm oil, soybeans, seafood and forestry) reached an estimated USD 293.2 billion in 2015. The transition toward sustainable production thus represents a vehicle for directing "investment" by consumers and companies in the promotion of sustainable practices. And while economic incentives created by voluntary standards are often regarded as their most important feature in enabling improved sustainability outcomes, VSSs can also offer direct support to related sustainable development policies in a number of ways. The monitoring, enforcement and traceability systems applied by standards can augment the monitoring and enforcement capacities of local governments in ensuring legal and sustainable sourcing.[13] Multistakeholder governance models have become the norm for "credible" sustainability standards operating in agriculture and can thereby facilitate public efforts toward the promotion of participatory governance.[14] Finally, data collected by voluntary standards boards can also help policy-makers determine the sustainability status of a given sector.[15]

10 A number of single-sector VSSs have emerged, focused on catering to mainstream markets such as the Better Cotton Initiative, the Roundtable on Sustainable Palm Oil, and Roundtable on Responsible Soy and Bonsucro (Komives & Jackson, 2014; Potts et al., 2014; PBL Netherlands Environmental Assessment Agency, 2014).

11 With mainstreaming biodiversity protection as one of the major decisions coming out of CBD COP 13, the current trajectory of voluntary standards would appear to be in close alignment with the current priorities among policy-makers.

12 With the introduction of products identified as "sustainable," producers can compete on sustainability and/or earn a premium for the adoption of sustainable practices. To the extent that prices more accurately reflect the costs of sustainable production with the presence of voluntary standards, there is no guarantee that the final price, in an imperfect market, will offer "full cost internalization." It should be noted, as well, that not all initiatives are associated with premiums, and not all market benefits come in the form of premiums per se.

13 Increasingly, VSSs are being used as a basis for demonstrating due diligence in the sourcing of legally harvested forest products under the EU Forest Law Enforcement, Governance and Trade regime and the U.S. Lacey Act (Castka et al., 2016). Voluntary standards could be used as a basis for measuring achievement toward national targets for sustainable agriculture production.

14 Potts et al. (2014).

15 For instance, the Roundtable on Sustainable Palm Oil and World Resources Institute have teamed up to develop Oil Palm Production Maps to track and prevent potential deforestation. The mapping tool lowers the risk that companies are purchasing palm oil associated with deforestation (Baer, 2014).

BOX 1: Voluntary standards as vehicles for implementing the three pillars of the CBD

The CBD specifies three distinct objectives: 1) the conservation of biological diversity; 2) the sustainable use of its components; and 3) the fair and equitable sharing of the benefits arising out of the utilization of genetic resources. Although this report focuses primarily on the first objective, it is worth noting at the outset the potential role of voluntary standards in promoting the second and third objectives, as well as those detailed more specifically in the Cartagena and Nagoya Protocols.

Voluntary Standards and Biodiversity Protection

The vast majority of requirements specified by agricultural sustainability standards focus on protecting ecosystems and natural habitats (see Section 4.2 Habitat Loss below), which are effectively the central repositories of global biodiversity. Although requirements specifically requiring the protection of biodiversity are relatively rare within standards (see Section 4.16 Biodiversity-Specific Criteria below), practices targeting habitat protection have direct relevance to biodiversity protection. Moreover, the growing tendency of voluntary standards to include an increasingly holistic and comprehensive set of requirements related to production helps ensure that the mutually reinforcing linkages between soils, waterways, flora, fauna and entire ecosystems are similarly maintained and promoted through the breadth of practices stipulated by voluntary standards. As the report documents, the requirements currently contained in major agricultural standards show a strong degree of overlap, and thus alignment, with the objective of biodiversity protection. One of the principal questions addressed in this report is the degree to which such initiatives are "strategically placed" within the market to play a significant role in biodiversity protection where it matters most (see Section 5 below).

Voluntary Standards and Sustainable Use

Agricultural sustainability standards place an emphasis on promoting sustainable agricultural practices. Embedded within these practices are practices that employ a sustainable reliance upon, and use of, existing genetic biodiversity. Some of the most obvious examples include practices such as crop rotation, set asides and integrated pest management. Waste reduction and energy-efficiency requirements can also promote more sustainable use of local biodiversity. Ultimately, reducing the burden of unsustainable agricultural practices on biodiversity is directly related to, and dependent upon, more effective and efficient use of natural ecosystems in agricultural production. As such, the practices promoted by voluntary standards can be expected to support sustainable use at a general level. At the more specific level of the sustainable use of biotechnology and biosafety, the segregation, traceability and auditing systems adopted by voluntary standards can be leveraged to ensure the strategic and controlled use of such technologies while reducing the potential for cross-contamination. As a matter of fact, among the voluntary standards reviewed in this report, six[16] prohibit outright the use of genetically modified organisms (GMOs) in production. Prohibition requirements on GMOs, by their very nature, imply careful management of such products in a manner that supports the Cartagena Protocol. Moreover, several of those standards that do allow for the use of GMOs also include requirements related to their sustainable use.[17]

16 The six standards are Proterra, Global Coffee Program (previously 4C Association), Cotton Made in Africa, International Federation of Organic Agriculture Movements, Rainforest Alliance and Fairtrade International (see Potts et al., 2014).

17 For example, GlobalGAP, the Roundtable for Responsible Soy and the Better Cotton Initiative each specify risk management requirements for the handling of GMOs.

1 INTRODUCTION
2 VOLUNTARY SUSTAINABILITY STANDARDS
3 BACKGROUND
4 CRITERIA COVERAGE ANALYSIS
5 MARKETS
6 CONCLUSION
7 POLICY OPTIONS
8 APPENDICES

BOX 1: Voluntary standards as vehicles for implementing the three pillars of the CBD (continued)

Voluntary Standards and Access and Benefit Sharing

Some voluntary standards, such as the Union for Ethical Biotrade (UEBT) include specific requirements pertaining to the "Fair and equitable sharing of benefits derived from the use of biodiversity" with specific references to the CBD and the Nagoya Protocol. Such explicit attention to access and benefit sharing related to biodiversity, however, is not widespread across such initiatives at present. Fairtrade, without making specific mention of access and benefit sharing related to genetic resources, does make an explicit attempt to ensure equitable trading relationships through its economic criteria (including price minimums). But even voluntary sustainability standards without any strict economic requirements, as market-based instruments, offer the promise of "economic benefits" (in the form of price premiums, improved market access, longer-term relationships, etc.) in return for demonstrable compliance with specified practices. Where those practices include the protection of, and production arising from, genetic biodiversity, the role of voluntary standards in generating market benefits for such practices represents a concrete vehicle for enabling access and benefit sharing.

Voluntary standards also face specific limitations in addressing biodiversity loss. One of the most obvious is linked to their reliance on developed country consumption for their current market status. In a recent survey of 16 standards, all had their headquarters in a developed country, with the majority of board members on most initiatives being based in Northern economies.[18] These trends reflect the reality that virtually all standard-compliant products, with the exception of Organic products, are sold in developed economies. For VSSs to effectively address biodiversity at the global scale, they will need to find a way to gain traction in developing country consumer markets on a broader scale and contribute concretely to sustainability gains.

For the most part, voluntary sustainability standards are driven by, and for, private actors and, as a result, are often developed at arm's length from public policy-makers.[19] As a result, there can be a disconnect between policy objectives and the proponents of standards initiatives themselves.

Notwithstanding these limitations, voluntary standards establish an increasingly sophisticated infrastructure for identifying, enforcing and measuring levels of compliance with best practices that can assist policy-makers in their efforts to implement and regulate biodiversity conservation.

This report seeks to provide a basis for more strategic use of VSS initiatives in the promotion of biodiversity conservation by offering a broad overview of the current market and performance trends across 14 VSS initiatives operating in 11 agricultural commodity markets. Our analysis is divided in three parts:

1. An analysis of the substantive relationship between target VSS initiatives and biodiversity objectives using the Biodiversity Impact Indicators for Commodity Production (BIICP) as a reference framework.

2. An analysis of the market trends for VSS-compliant products across the target commodity sectors.

3. A spatial analysis capturing the relative distribution of VSS-compliant production over key biodiversity hotspots using the BIICP as a reference framework.

Overall, our analysis seeks to provide insight into how and where major voluntary standards in the agriculture sector have the greatest potential to contribute to biodiversity conservation and where the most important bottlenecks to the optimal use of such initiatives reside. By directly linking our analysis to the BIICP process led by the CBD Secretariat, we hope that the analysis can serve the broadest audience possible.

BOX 2: Scope of review

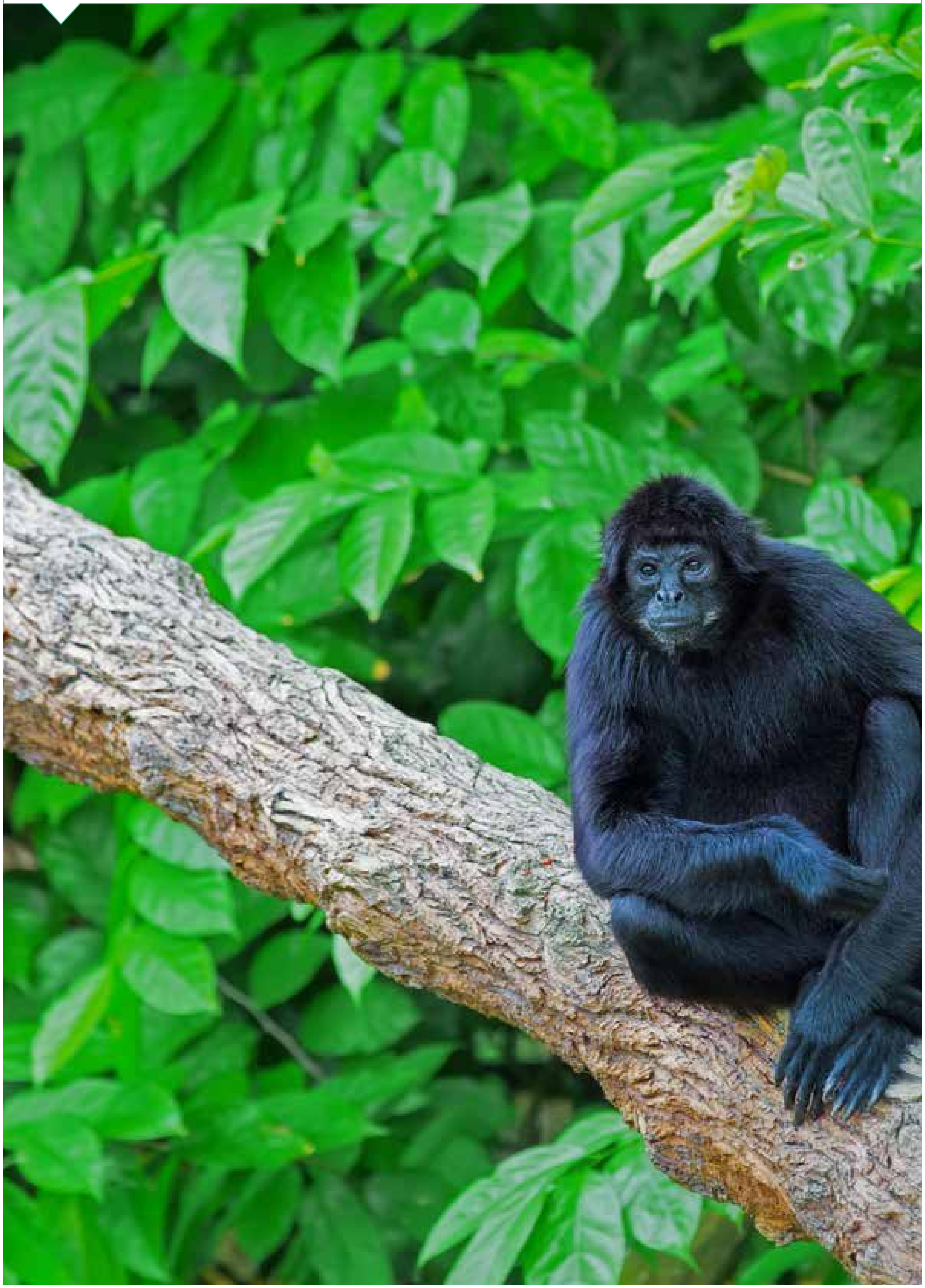
The State of Sustainability Initiatives Standards and Biodiversity Thematic Review covers 14 major international standards initiatives operating in the banana, cocoa, coffee, cotton, palm oil, soy, sugar, tea and cereals (rice, maize and wheat) sectors:

Fairtrade International
Rainforest Alliance
Ethical Tea Partnership
Global Coffee Platform (formerly 4C)
UTZ Certified
IFOAM (organic)
Proterra
Roundtable on Responsible Soy
Roundtable on Sustainable Palm Oil
Bonsucro
Better Cotton Initiative
Cotton Made in Africa
GlobalGAP
Roundtable for Sustainable Biomaterials

Note that Fairtrade international manages separate standards for hired labour and smallholders. This report covers both Fairtrade ***standards giving a total of 15 standards across 14 initiatives.***

18 See Potts et al. (2014) for detailed information on the governance structures of selected international standards.
19 Note, however, that it is common for voluntary standards to reference international law and national law as a basis for describing specific requirements. There is also a growing number of examples where governments offer subsidies for certification and/or preference for certified products in public procurement policies.

3 Biodiversity Impact Indicators for Commodity Production



In 2014, the CBD Secretariat launched a multistakeholder consultation oriented toward identifying a generic and cross-cutting set of indicators to help governments and standard-setting bodies monitor and manage the impacts of agricultural production on biodiversity loss (see Table 1). The current set of thematic areas (impact categories) provides a reference point for policy-makers seeking to manage agriculture-driven biodiversity loss. The suggested indicators below illustrate how the impact categories can be measured and form a reference point for understanding how voluntary standards might contribute to the efforts of policy-makers in reducing biodiversity loss.

Table 1: The Biodiversity Impact Indicators for Commodity Production (BIICP). The BIICP reflect high-level priority indicators for assessing the potential impact or contribution of agricultural production to biodiversity conservation

Theme	Indicators	Objective
Habitat Conservation	HC1: Percent of farm area in land classes of different habitat quality	To prevent adverse impacts on biodiversity by promoting diversity of land classes, particularly those with high conservation value
	HC2: Conversion of natural habitat cover in terms of land-use change over time	To prevent adverse impacts on biodiversity by reducing or preventing land conversion for agricultural development
	HC3: Area-based conservation management by land area	To prevent adverse impacts on biodiversity through intentional managemant of land area under production
Water Use	WU1: Water use per unit area or unit product	To prevent adverse impacts on biodiversity caused by the overuse of water through production and processing
Water Quality	WQ1: Pesticide and organic fertilizer use per unit area or unit product	To prevent adverse impacts on biodiversity from the overuse of synthetic inputs
	WQ2: Biological oxygen demand at sampling sites	To prevent adverse impacts on biodiversity caused by runoff from agriculture production
Soil Fertility	SF1: Soil organic matter per unit volume	To prevent adverse impacts on soil biodiversity by promoting high soil carbon content
Climate Change	CC1: Fossil fuel use per unit area or product	To prevent adverse impacts on biodiversity due to climate change
	CC2: Carbon footprint of product or land area	To prevent the adverse impacts on biodiversity due to climate change

The nine indicators, organized in five broad categories, allow for monitoring the major impact pathways by which agricultural production affects biodiversity, including natural habitat loss, access to sufficient water of adequate quality, soil fertility and climate change. Adopting these indicators to monitor the biodiversity impacts associated with agricultural commodity production at the global scale can facilitate more coordinated efforts to prevent and potentially reverse biodiversity losses. Below is a brief description of the rationale behind each BIICP indicator.

BIICP 1 – Percentage of farm area in land classes of different habitat quality

Establishing and monitoring areas of different habitat quality within agricultural landscapes allows for ascertaining its overall biodiversity conservation value. With proper planning, agricultural landscapes can support biodiversity, by providing habitat for species that can also enhance agricultural production. For instance, shelterbelts[20] prevent wind erosion and can also provide habitats for pollinators as well as birds, smaller animals and insects that prey on agricultural pests.

Numerous approaches can be used to establish habitat qualities within agricultural landscapes, including overlapping areas with high conservation values (HCVs), tree density and species diversity. More specifically, the percentage of farm area in defined conservation classes—such as areas designated as protected, having HCV or having a specific habitat quality and destined for ecological restoration—allows for establishing and monitoring areas of different habitat quality in agricultural landscapes and the corresponding capacity of the land to support biodiversity.

BIICP 2 – Conversion/loss of natural habitat cover

Tracking the conversion of natural habitats can be helpful to understanding the drivers of biodiversity loss. In addition to understanding how land is being converted for agriculture, understanding what natural environments have already been lost can also be insightful. Allowing agricultural lands to go back to their natural states and associated biodiversity could reveal the lost biodiversity opportunities that they represent.

Monitoring the loss of natural habitats can lead to more sustainable land use strategies, which allow for expanding agricultural production while supporting biodiversity. These strategies can include intensifying agricultural production through ecological intensification on existing farm land, expanding farming operations to areas supporting low levels of biodiversity, and conserving natural corridors and key micro-habitats that support agricultural production and biodiversity.

BIICP 3 – Area-based conservation management

The major expanses of agricultural lands across the world could be used to better support biodiversity. To optimize the potential for agricultural lands to support biodiversity, more sustainable agricultural practices need to be adopted. While specific practices can have localized impacts, in many cases, landscape, regional and global impacts can only be accrued where specific attention is given to the area-based management practices. This can take the form of specific actions targeting the development or preservation of biodiverse "areas" or, in the case of voluntary standards, through the certification of large numbers of hectares. Ultimately, the area implicated in conservation practices will have important ramifications for overall biodiversity outcomes.

20 Shelterbelts are typically comprised of trees and shrubs planted around agricultural fields to protect crops and prevent soil wind erosion (Merriam-Webster, 2017).

BIICP 4 – Water use per unit product

Sufficient water of suitable quality is fundamental to agricultural production and maintaining biodiversity. Without adequate precipitation or irrigation, agricultural production is often unviable. The agricultural sector represents approximately 70 per cent of all global freshwater consumption, with 20 per cent of agricultural land under irrigation producing 40 per cent of all agricultural goods (PBL Netherlands Environmental Assessment Agency, 2014).

Water appropriated for agriculture is no longer available to support the natural flora and fauna of an area, representing a lost opportunity to support biodiversity.[21] Consequently, measuring agricultural water consumption is imperative to managing and using it more efficiently, which can be done by tracking water used per unit of agricultural land and/or production. Doing so may allow for adopting more suitable water conservation measures that can sustain water resources for other users and natural environments. The sustainable consumption of fresh water for agricultural production is imperative to supporting biodiversity in many parts of the world.

BIICP 5 – Pesticide and inorganic fertilizer use per unit area or unit product

Poor-quality water, such as acid rain, saline groundwater and chemical-laden surface water, is often unsuitable for agriculture and can impair biodiversity. Agricultural activities can lead to polluting ground and surface waters, where inputs such as fertilizers and pesticides can be toxic in higher concentrations. Degraded water quality will significantly affect biodiversity via several pathways, such as impairing aquatic habitats and bioaccumulating toxins through the food chains.

Measuring the application of pesticides and inorganic fertilizers per unit of product allows for assessing their potential impacts on the quality of ground and surface waters as well as biodiversity. Fertilizer use per unit of product gives an indication of where there may be higher potential for nutrient-enriched runoff to pollute water bodies. High concentrations of nutrients can lead to the eutrophication and formation of hypoxic zones in freshwater and saltwater ecosystems respectively.[22]

BIICP 6 – Biological oxygen demand at sampling sites

Biological oxygen demand (BOD) is commonly used in many parts of the world to establish the water quality of water bodies.[23] Measuring BOD at sampling sites downstream of agricultural landscapes can provide a means to assess the potential contribution of agricultural production to degrading water quality. It also allows for understanding whether or not changing agricultural practices could lead to improvements in water quality. Degraded water quality will have direct impacts on aquatic species that rely on healthy aquatic habitats to survive and will have indirect impacts on terrestrial species that rely on affected water bodies as their water source. Measuring the BOD provides an indication of the potential effects of agricultural production on biodiversity.

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21 The extraction of water for agriculture affects biodiversity by changing water availability and flow regimes by lowering the water table, salinization due to irrigation and decreasing surface water availability (PBL Netherlands Environmental Assessment Agency, 2014).

22 For instance, the corn belt of the United States has been linked to large hypoxic zones found in the Gulf of Mexico (Nassauer, Santelman, & Scavia, 2007).

23 BOD is a measure of water pollution that assesses the dissolved oxygen required to aerobically degrade organic matter in water. High levels of BOD indicate that the dissolved oxygen in water bodies may be too low to support healthy aquatic ecosystems and their biodiversity.

BIICP 7 – Soil organic matter

Agricultural soils are physically lost due to wind and water erosion, which can have negative impacts on food security, as the formation of fertile soils can be a slow process. Agricultural soils are altered due to agricultural practices such as the depletion of nutrients and organic carbon, application of pesticides, salinization of irrigated lands and water-holding capacity due to soil compaction. The presence of organic matter is an indicator of the presence of nutrient-giving life forms, but also provides an environment for greater soil biodiversity (Havlicek & Mitchell, 2014).

Monitoring the organic carbon content of topsoils within agricultural lands can indicate when and where measures to maintain and enhance soil fertility are needed most. Agricultural production practices that can assist with maintaining soil fertility include cultivating cover, perennial and nitrogen-fixing crops, establishing shelterbelts to prevent topsoil erosion, mulching, crop rotation, minimizing tillage, using organic manure and protecting soil micro fauna by avoiding the use of synthetic pesticides.

BIICP 8 – Fossil fuel use per unit area or unit product

Climate change is affecting biodiversity by disrupting the habitat suitability of species in various parts of the world. Agricultural operations are also being affected, as more unpredictable and erratic climatic patterns in the form of changing temperatures and precipitation events are affecting production. Agriculture contributes to climate change by releasing greenhouse gasses (GHGs) through various pathways, including fossil fuel consumption and land use change. Tracking fossil fuel consumption both through direct farm operations and key farm inputs offers an important, albeit only partial, insight into the overall carbon footprint of agriculture.

BIICP 9 – Carbon footprint of product and land use

Practices that can lower the carbon footprint of agricultural products include no-till practices to prevent soil carbon emissions, using renewable energies, preventing the clearing of natural habitats such as forests and wetlands and avoiding the use of fire to clear agricultural fields. Given that any GHG emissions contribute to the carbon footprint of a product or land use, carbon footprint analysis offers a comprehensive measure of agricultural production's contribution to climate change. This is particularly important given the role of land use change as a driver of climate change and the wide range of inputs and processes from agriculture that can contribute to climate change.

4 Criteria Coverage Analysis

VSSs offer several pathways to support biodiversity. While many of these pathways are dependent on the specific enforcement and governance mechanisms associated with a given initiative, the most explicit mechanisms arise in the form of production requirements. The content of requirements, as well as the stringency of the timeline for demonstrating compliance with such requirements, offer a meaningful starting point for determining the potential any given standard has for addressing biodiversity concerns.

The BIICP offer a starting point for analyzing the potential contributions of VSSs to conserving and sustainably using biodiversity (see Table 2). Using the proposed BIICP in this particular analysis also allows us to test them in terms of their suitability for such practical assessments. To determine the degree to which VSSs may contribute to the promotion of positive outcomes related to each of the nine BIICP indicators, we mapped a total of 48 related criteria found in voluntary standards ***and*** covered within the International Trade Center's Standards Map database, as related to the respective nine BIICP indicators. A full list of the indicators used for each BIICP indicator can be found in Appendix A: Methodology.

Voluntary standards employ a wide variety of methodologies for granting "recognition of compliance," but most systems distinguish between critical requirements—requirements that must be met ***prior*** to any recognition of compliance under the system—and other requirements that can be met ***after*** recognition of compliance under the system.[24]

Our coverage analysis seeks to provide an indication of the breadth of voluntary standards (number of issues addressed by requirements) as well as the intensity (degree of obligation associated with requirements) with which that breadth is applied through the compliance timeline. Given the distinction between critical and delayed requirements, an assessment of the distribution of critical requirements (those required as a prerequisite to recognition) along specific biodiversity themes provides an indication of where initiatives have prioritized action. When applying this window of analysis, we refer to "critical" requirements.

Yet another way of assessing the overall intensity of a given requirement is to apply a numerical score to each requirement based on the timing by which compliance with the requirement must be demonstrated. Applying this metric gives a maximum score for critical requirements (5) and minimum score for recommendations (1), with varying delay periods earning points in between (See Box 3). By applying this methodology, we are able to extract average scores across initiatives and indicators offering an indication of intensity. When applying this window of analysis, we refer to "average intensity" scores.

In our review of the results below, we switch between these two forms of analysis in an effort to gain a high-level understanding of the way standards are addressing major biodiversity issues. ***Regardless of the window of analysis, it is critical to note that no criteria-based analysis can be considered a proxy for actual impact or outcome research. Criteria-based analysis serves rather as an indication of the aspirations of different initiatives and the benchmarks against which they hold themselves accountable.***

24 Requirements that can be met after recognition are often time limited. The length of delay permitted before a demonstration of compliance offers a proxy for the prioritization of a given requirement among other requirements.

BOX 3: Criteria coverage analysis methodology

The BIICP were used to assess the potential for VSSs to slow and prevent biodiversity losses by mapping their criteria to the BIICP by undertaking steps 1 to 6 described below.

1. **Data Collection:** Information on VSS criteria was collected from the International Trade Centre (ITC) Standards Map database.
2. **Indicator Mapping:** As part of the ITC Standards Map database structure, VSS criteria categories have been developed. These ITC criteria categories were mapped onto the BIICP by reviewing them in detail and selecting 48 ITC criteria categories matched up with the nine BIICP in Table 1.
3. **Mapping Review:** The VSS criteria falling into the 48 ITC criteria categories (see Appendix B: BIICP Sub-indicators for Criteria Coverage Analysis) were cross-checked with the most recent and publicly available VSS Principles and Criteria documents and with the VSSs themselves.
4. **Degree of Obligation:** The VSS criteria are assigned a degree of obligation number (DON) based on the categories below. To this end, different terms such as "minor must," "major," "immediate," etc. used by VSSs in the ITC Standards Map were translated based on a process utilized by ITC.
   a. 1 = recommendation – implementation suggested in guidance but not required
   b. 2 = longer-term requirement (3-5 years)
   c. 3 = medium-term requirement (2-3 years)
   d. 4 = short-term requirement (within first year)
   e. 5 = critical requirement – must be compliant upon recognition of standard compliance
5. **Aggregated Numbers:** The DONs were then aggregated by examining similar VSS criteria and allotting the highest number among them to give the final number for a given criteria category. For instance, criteria *700369 Protection of rare and threatened species and their habitats* and *700370 Maintaining or protecting rare, threatened or endangered ecosystems* are aggregated into BIICP1-7 Protection of Species, Habitat & Ecosystem by taking the highest DON between the two.

The SSI aims to provide an overview of how different VSSs are addressing biodiversity by examining the criteria that form the agricultural practices that they are promoting. The analysis is not intended to delineate "good" versus "bad" performance. While we recognize that there will be a natural tendency to regard more complete coverage as "better," this may not necessarily be the case. To the extent that more stringent criteria also represent a higher bar for producers to cross, increased competitiveness may decrease the accessibility of sustainable markets to those most in need, thereby restricting the ability of such initiatives to promote poverty-reduction objectives among the most marginalized producers.

BOX 4: Criteria coverage: One piece of a standard's pathway to impact

The initiatives covered by our analysis are, first and foremost, standard-setting bodies. In order to be included in our review, the initiative must promulgate a set of measurable and enforceable standards with global relevance. A scheme owner will, however, typically involve a variety of other components such as conformity assessment, multistakeholder governance, dispute resolution, marketing and even technical assistance related to the implementation of the identified standards.

Increasingly, standards systems are not simply rules to be followed so much as communities of practice incorporating shared decision-making and enforcement activities. Put in more legalistic terms, voluntary standards play a role analogous to public governments by establishing their own internal "rule of law" by performing executive, legislative and judicial functions. The governance roles of voluntary standards may, in many cases, be more important than the criteria themselves in promoting long-term sustainability. By enabling new means of entry into supply chain decision making, voluntary standards are well poised to augment supply chain inclusiveness. The ability of a standard to actually promote participatory governance, however, largely turns on the degree to which it is able to manifest its governance functions in a complete, transparent and equitable manner.

Recognizing this, the SSI Reviews typically include analyses of systems governance regimes applying the full Coverage, Assurance, Responsiveness, Engagement (CARE) analysis (see below). In order to maintain focus on the issue of biodiversity per se, we only consider the coverage portion of the CARE analysis in this review. The potential role of any given initiative to contribute to sustainable development more generally should be considered in light of its entire governance system.[i]

Core Components of the SSI CARE Analysis

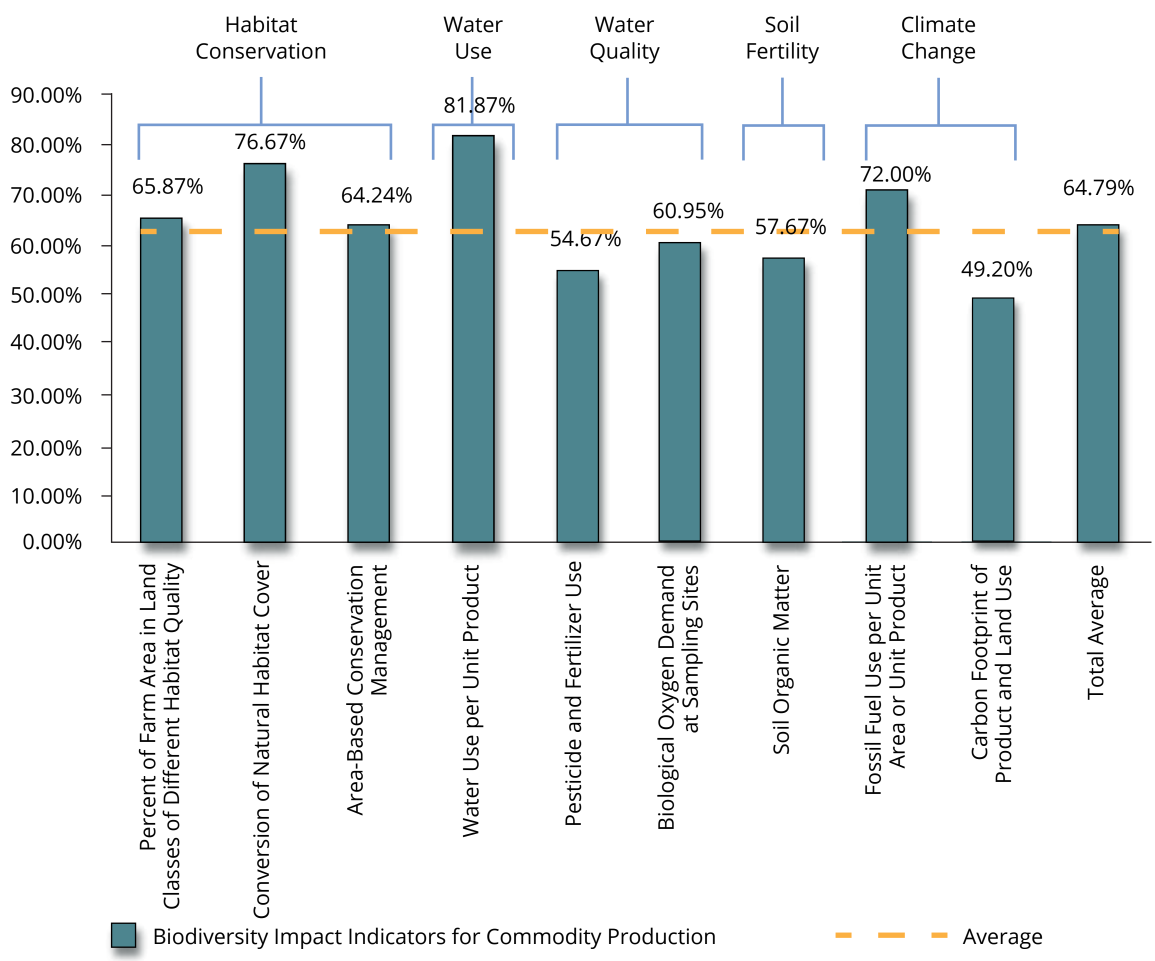
1. **Coverage:** Standards are defined by the requirements they set for their users. Although requirements alone do not determine actual outcomes or impact, they do set the level of ambition of a system, as well as the bar to which systems can be held accountable. Our coverage analysis seeks to measure the degree to which any given initiative sets requirements along key sustainability themes, and it is scored based on the time frame allocated for implementing a named requirement.
2. **Assurance:** The requirements surrounding voluntary sustainability initiatives are typically unverifiable at the point of consumption or elsewhere along the supply chain. The strength of a given system is directly related to the degree of assurance it provides to consumers and other stakeholders that requirements are actually fulfilled. Our assurance analysis assesses the credibility of the claims for compliance that are made by the initiative and whether compliance actually leads to meaningful results.
3. **Responsiveness:** Sustainable development is context and time dependent. Global rules will be of varying relevance to actual sustainability depending on context-specific factors. Our responsiveness analysis seeks to provide a measure of an initiative's ability to respond to local conditions while moving producers toward continuous improvement on an ongoing basis.
4. **Engagement:** Sustainable development is premised on the idea that a minimum level of equity needs to be provided through political and economic processes. Participatory governance is one of the few systemic tools available for ensuring equity across diverse systems and forms the basis for the long-term sustainability of the initiative. Our engagement analysis measures an initiative's inclusiveness, transparency and dispute-resolution mechanisms.

[i] A more in-depth analysis of the governance systems of the related standards can be found in Potts et al. (2014).

4.1 Major Thematic Coverage

The nine BIICP indicators are grouped according to five major biodiversity-related impact pathways. An analysis of supply chain initiatives through these broad groups provides a streamlined window for understanding the potential contribution of voluntary standards to biodiversity protection.

Figure 1. Overall average intensity scores by BIICP indicator and indicator group. Overall coverage across all BIICP indicator groups is 63 per cent, signalling a general alignment between VSS criteria and biodiversity objectives, while nevertheless signalling relative diversity in the level of intensity or prioritization among initiatives. Habitat conversion-related criteria and water use criteria carry the highest overall average coverage scores, while climate-specific criteria score among the lowest.



Source: VSS criteria information obtained from ITC Standards Map[25]

25 As described in Box 2, data for the coverage analysis of standards was derived from ITC standards maps and subsequently verified by participating standards bodies. All tables and graphs directly analyzing criteria coveragedata were drawn from the ITC and will be cited as "VSS criteria information obtained from ITC Standards Map."

Table 2. Top ten biodiversity-related criteria measured by frequency of critical requirements

Indicator	Critical	Critical per cent	Average score	Average per cent
Principles and criteria for the conversion of forests into production lands	13	87%	4.3	87%
Criteria for the monitoring and protection of HCV area	12	80%	4.0	80%
Criteria related to legally protected and internationally recognized areas for their biodiversity	12	80%	4.2	84%
Surface and groundwater contamination / pollution	11	73%	4.1	83%
Prohibition of production on land with HCV with conversion cut-off date no later than 2009 or at least five years	11	73%	3.7	73%
Criteria related to natural wetlands and/or watercourses affected by production	11	73%	4.4	88%
Chemical use and application records	10	67%	4.3	85%
Water extraction/irrigation	10	67%	4.3	87%
Criteria related to maintaining or protecting rare, threatened or endangered ecosystems	10	67%	3.8	76%
Spatial management criteria (creating/maintaining/protecting set asides, buffer zones or conservation areas)	9	60%	4,1	81%

Note: Pink shading refers to habitat-loss-related criteria, which account for seven out of the top 10 in terms of critical requirement frequency; dark blue shading refers to water-related criteria; light blue shading refers to chemical management criteria. The prioritization of habitat conservation criteria across the standards reviewed reveals a close alignment with biodiversity objectives.

4.2 Habitat Loss

Habitat loss, principally due to land conversion, represents the single most important driver of biodiversity loss arising from agriculture, with approximately 38 per cent of global land area being appropriated for agricultural production (Food and Agricultural Organization, 2016a; World Bank Group, 2016). The degree to which sustainability standards address the problem of forest conversion and habitat loss is therefore key to the role they play in promoting biodiversity. Three of the BIICP indicators relate to habitat preservation. Our analysis maps 16 criteria to these three indicators (see Appendix A: Methodology).

As a rule, habitat conservation-related criteria have higher-than-average intensity levels pointing toward a general alignment of voluntary standards with core biodiversity conservation objectives. The average of the three habitat conservation indicator scores is 69 per cent, compared to an average of 66 per cent across the set of nine indicators. Notably, the average intensity score across our Conversion of Natural Habitats Index is 77 per cent, making it the second "most important" BIICP indicator in terms of actual practice across the standards reviewed.

Major drivers behind the high score across the set of habitat loss indicators include specific requirements against forest conversion, with 87 per cent of standards reporting having some form of critical criterion prohibiting the conversion of forestlands for agricultural purposes; requirements on the protection of areas with HCV, with 80 per cent having critical criteria; and requirements for the protection of areas legally recognized as being of high biodiversity value, with 84 per cent of standards specifying critical requirements. In fact, seven of the top 10 criteria across our entire set of 48 criteria (ranked in terms of number of standards with critical requirements; see Table 2 above) relate to protection against habitat loss.

In light of their relative importance to biodiversity preservation and the potential opportunity costs they impose on producers, such requirements should not be underestimated. One of the outstanding questions and major determinants of the actual impact of such requirements in preventing habitat loss relates to the applicability of such requirements to potential producers since habitat loss protection, for the most part, can only be enforced prior to conversion. Although 73 per cent of the standards surveyed stipulate prohibitions against the production of lands with HCV converted in 2009 or later, where the vast majority of conversion to agricultural land has already occurred in some distant past, such requirements will have little effect. On the other hand, by targeting recently converted land, standards have the potential to influence the distribution of agricultural production where it matters most by incentivizing production on lands outside of HCV areas. The relevant impact of habitat loss criteria, as with all potential impact pathways, is closely linked to the distribution of standard-compliant production (see Section 5: Standard-compliant Markets and Spatial Distribution and Appendix C – Criteria Coverage Analysis Results).

4.2.1 BIICP 1: Farm Area in Land of Different Habitat Quality

Establishing and monitoring areas of different habitat quality within agricultural landscapes helps protect ecosystem diversity, which represents the essential foundation of broader species biodiversity. By focusing on monocropping, intensive agricultural practices have historically diminished habitat diversity. However, with proper planning, agricultural landscapes can support ecosystem services that form the basis for agricultural production[26] including biodiversity by providing habitats for several species.[27] Although voluntary standards do not have a strong

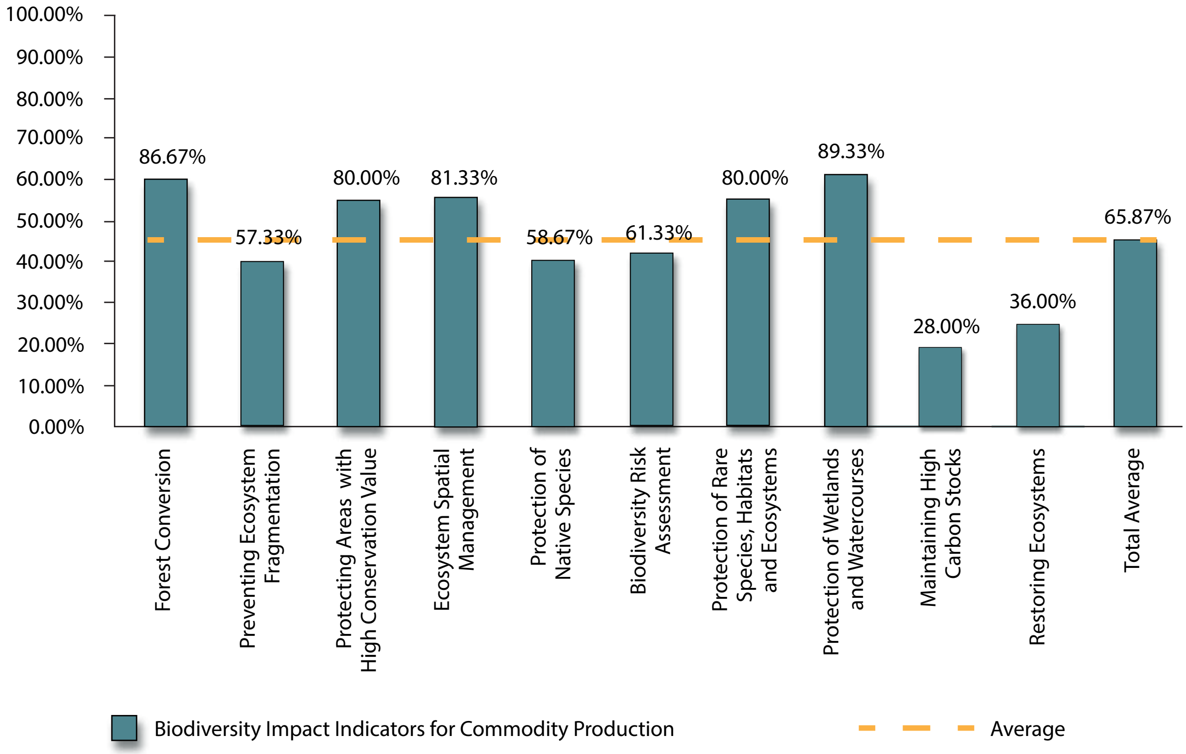
26 Ecosystem services that support agricultural production includes soil fertility, water retention, micro-climate, genetic diversity, etc.

27 For instance, shelterbelts preventing wind erosion also provide habitats for birds, smaller animals and insects that prey on agricultural pests. Numerous approaches can be used to establish habitat qualities within agricultural landscapes, including overlapping areas with HCV, tree density and species diversity.

history of explicitly including "habitat diversity" as a requirement, several more common criteria have the effect of enhancing or promoting habitat quality by requiring the management, protection or restoration of specific types of habitats or prohibiting ecosystem fragmentation (see Appendix B: BIICP Sub-indicators for Criteria Coverage Analysis).

Across the select set of habitat diversity subindicators, requirements related to the protection of wetlands and waterways have the highest average intensity at 89 per cent. Requirements against the conversion of natural forest, as noted above, are also well above the average at 87 per cent. Other themes with strong overall coverage across the full group of standards reviewed include the protection of areas with HCV (80 per cent), ecosystem spatial management (81 per cent), and the protection of rare species and their habitats (80 per cent). Coverage for requirements related to the maintenance of high carbon stocks and restoring ecosystems were notably low at 28 and 36 per cent, respectively, while the protection of ecosystems from fragmentation, protection of native species and biodiversity risk assessment all had slightly lower coverage than the average coverage for the entire index.

Figure 2. Habitat Diversity Index: All standards. Requirements related to protecting and promoting habitat diversity have comparatively high coverage across the standards reviewed. Particularly notable is the high number of critical requirements (12 or more standards with critical requirements) across the subindicators for the prohibition of forest conversion, protection of wetlands and the protection of areas with HCV.



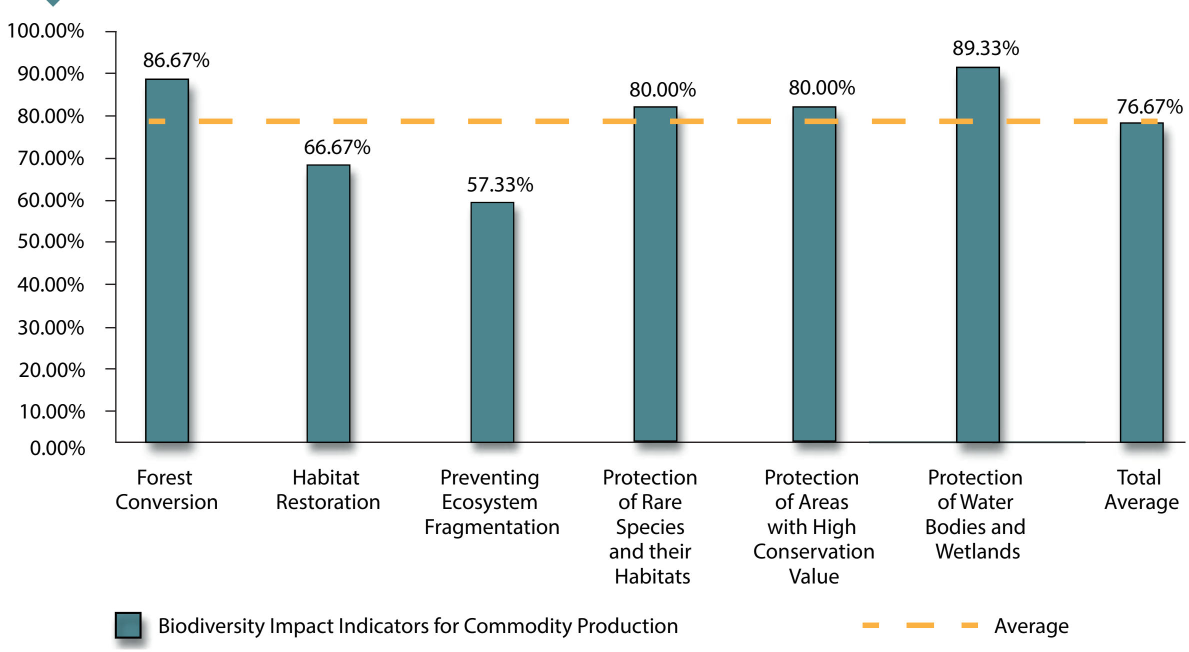
Source: VSS criteria information obtained from ITC Standards Map

4.2.2 BIICP 2: Conversion of Natural Habitat Cover in Terms of Land use Change over Time

As noted above, the conversion of natural habitats into agricultural production, particularly intensive monocrop systems, represents the single most important source of biodiversity loss arising from agriculture. Voluntary standards face challenges in addressing conversion in light of the vast areas that have been converted leading up to the end of the 20th century. Realistically speaking, voluntary standards have fairly limited avenues for preventing or reducing further conversion. The most popular mechanisms include prohibiting certification for farms where conversion has occurred after a certain reference date (e.g., 2009), prohibiting the conversion of existing forests located on farms in order to allow expansion of productive area, and actions to protect and restore natural habitats more generally (see Appendix B: BIICP Sub-indicators for Criteria Coverage Analysis).

Notwithstanding the challenges in addressing conversion, voluntary standards have recognized the importance of land use change in promoting sustainability, as is indicated by the higher-than-average coverage (77 per cent) across our Conversion of Natural Habitat indicators. Requirements protecting wetlands and prohibiting forest conversion have the highest coverage, but all of the indicators other than protection against ecosystem fragmentation have higher-than-average coverage across all BIICP indicators. The breadth and intensity of requirements related to habitat conversion in voluntary standards is encouraging for proponents of biodiversity protection; however, the role of voluntary standards in preventing conversion more generally must be considered in light of the powerful market forces driving the agricultural expansion that operates well outside of the individual farm. This is an impact pathway that demands particular attention by policy-makers to ensure that incentives against forest conversion are sufficiently robust.

Figure 3. Conversion of Natural Habitat Index (BIICP 2) and average coverage intensities for individual index indicators. Protections against the loss of natural habitat criteria are among the most common and demanding biodiversity-related criteria. Forest preservation through prohibiting forest conversion and protecting water bodies are virtually industry norms for agricultural sustainability standards with average coverage scores above 85 per cent and with 87 and 73 per cent of initiatives specifying critical criteria on these themes respectively.



Source: VSS criteria information obtained from ITC Standards Map

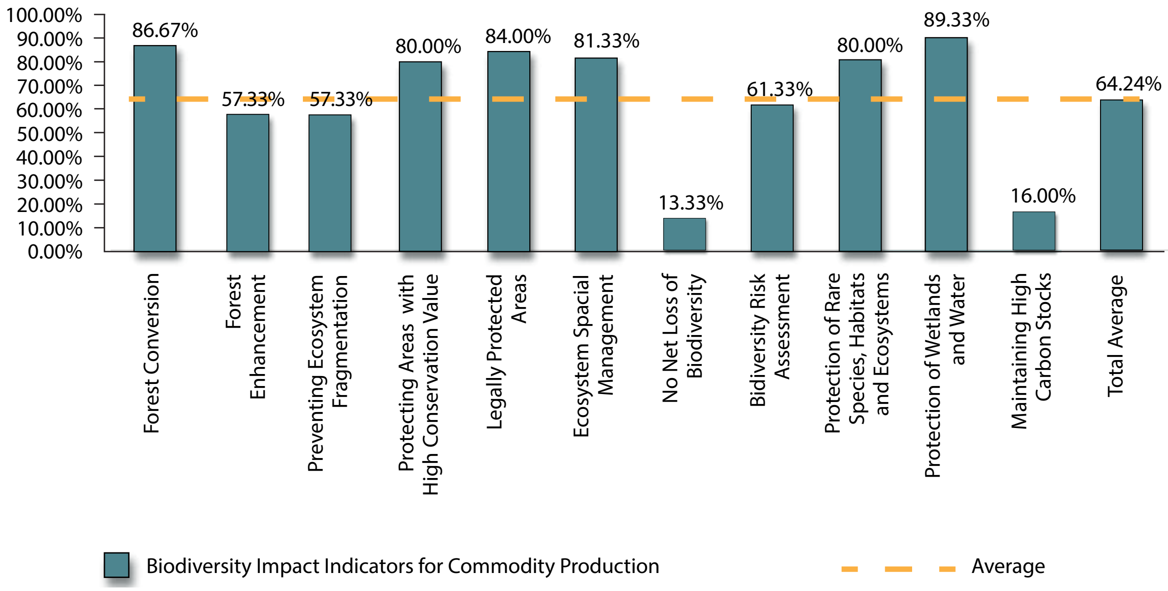
4.2.3 BIICP 3: Area-based Conservation Management by Land Area

Voluntary standards perform two important roles in meeting biodiversity conservation objectives: identifying and enforcing specific practices that promote biodiversity. Ultimately, however, the impact of such practices on global biodiversity will depend on the degree to which they are able to protect habitats on a meaningful scale across connected areas. There are two ways in which standards can proactively promote such an outcome. The first is by including requirements that are specifically related to area-based habitat protection and/or preventing biodiversity loss. The second is by offering market advantage to the adopters of standards, thereby stimulating the uptake of biodiversity-friendly practices across a wide spectrum of the market and land area (See Section 5.9.1: Spotlight on Tea Production and Area-based Conservation Management. Appendix B lists the set of subindicators for assessing the coverage by standards aimed explicitly at protecting habitat and biodiversity loss through area-based management approaches.

Overall coverage of area-based conservation management requirements is relatively high across the standards reviewed. As already noted, requirements against forest conversion and for the protection of wetlands and watercourses have the highest coverage across the range of requirements reviewed. Similarly, requirements for the protection of areas with HCV, legally or internationally recognized biodiversity zones, ecosystem spatial management, and the protection of rare species and their habitats each have average coverage scores of 80 per cent or greater. Although the index, as a whole, has slightly lower coverage than the nine indices altogether (64 per cent rather than 66 per cent), the main explanation is traced to the low frequency of requirements that farming practices result in no net loss of biodiversity and maintain areas with high carbon stocks.

The strong presence of area-based requirements within voluntary standards is a testament to their recognition of the importance of land use and land area as the foundation of terrestrial ecosystems (and biodiversity). As with all requirements related to habitat or area-based protection within farm production systems where the majority of area has already been converted to agricultural use, the ability to "protect" areas can be quite limited, underlining the importance of public policy as a complement to the standard practices (see Section 4.17: Restoration, Protection and Management-oriented Criteria).

Figure 4. Area-based Conservation Management Index (BIICP 3). Although the coverage of area-based management requirements as a group is lower (64 per cent) than the average for all nine BIICP indices (66 per cent), the actual coverage of the majority of requirements within the index is significantly higher-than-average coverage scores across all biodiversity-related requirements.



Source: VSS criteria information obtained from ITC Standards Map

4.3 Water Use

Water use, as distinct from water quality management, can affect biodiversity through the depletion of surface water and the destruction of corresponding habitats. Soil leeching can also give rise to acidification and a general reduction of life-supporting organic matter. It has been estimated that 20 per cent of total cultivated and 33 per cent of irrigated agricultural lands globally are subject to high salinity, with the affected area growing 10 per cent per annum (Jamil, Riaz, Ashraf, & Foolad, 2011). Soil acidity, in turn, has been directly linked to lower levels of species diversity (Roem & Berendse, 2000). Irrigation efficiency, water management and conservation in accordance with local scarcity are all important vectors for determining the impact of water usage on biodiversity.

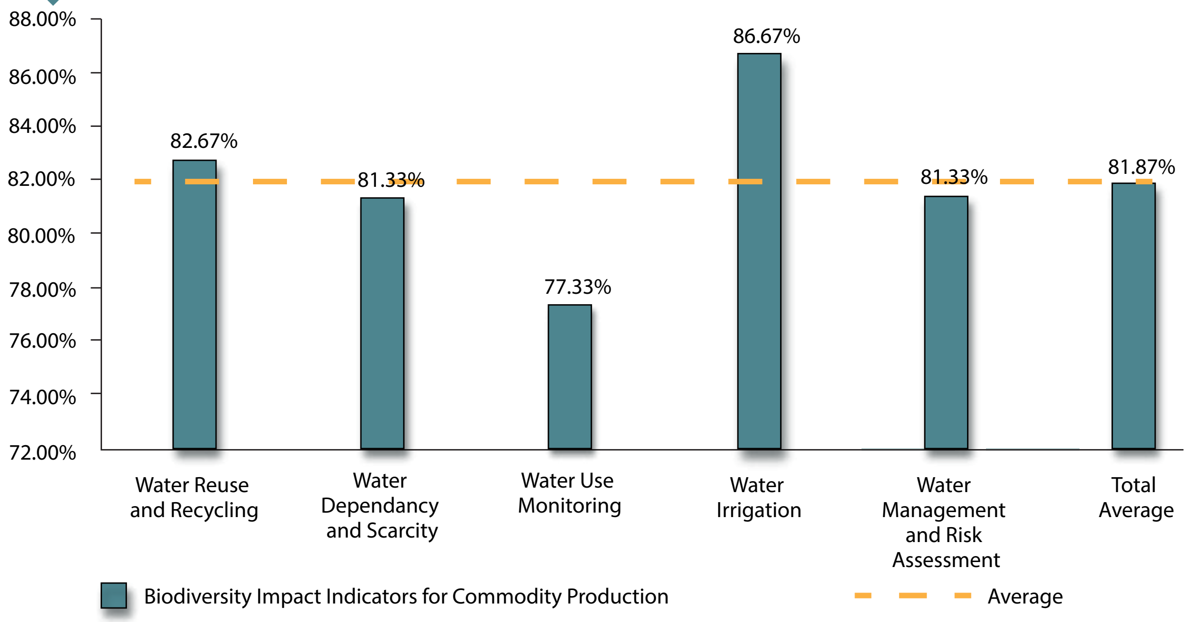
4.3.1 BIICP 4: Water Use Per Unit Product or Unit Area

Coverage intensity across our Water Use Index was the highest among all the indices, with an average score of 82 per cent. Water irrigation and water recycling requirements have the highest intensity of coverage with 87 per cent and 83 per cent of standards specifying critical requirements in these areas, respectively. Requirements for water management plans have the lowest coverage in the Water Use Index, but a majority of standards (67 per cent) still specify this as a critical criterion.

One of the potential explanations for the high level of coverage across standards relates to the relatively low opportunity cost associated with water use requirements. Water management plans and water efficiency represent basic elements of good agricultural practices and have the potential to reduce production costs while improving yields and revenue. The close alignment between water use requirements and producer economic interests presumably makes the specification and implementation of such requirements particularly appealing among standards and producers alike.

1 INTRODUCTION
2 VOLUNTARY SUSTAINABILITY STANDARDS
3 BACKGROUND
4 CRITERIA COVERAGE ANALYSIS
5 MARKETS
6 CONCLUSION
7 POLICY OPTIONS
8 APPENDICES

Figure 5. Water Use Index (BIICP 4), average coverage intensities for individual index indicators. Water use efficiency represents one of the most common biodiversity-related themes addressed by agricultural standards. Since water use efficiency is closely related to maximizing net revenue at the farm level, both economic and environmental objectives are aligned toward the adoption of such practices.



Source: VSS criteria information obtained from ITC Standards Map

4.4 Water Quality

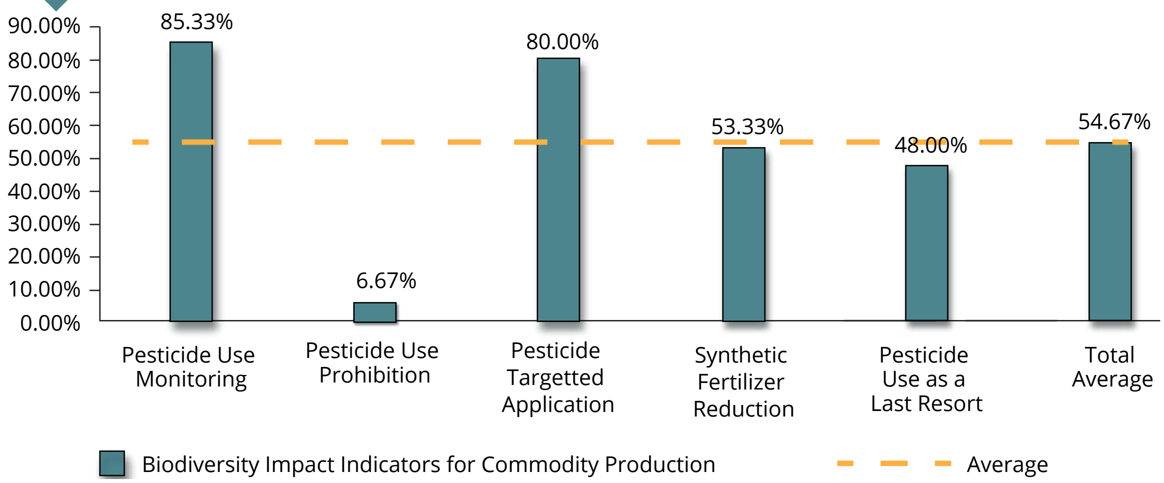
Agricultural production is closely associated with water pollution arising from wastewater and chemical runoff into watercourses. While pesticide runoff arising from non-targeted application can lead to the death of non-target organisms in waterways, by far the most important water quality impact from agriculture arises from the runoff of excess nutrients linked to the application of chemical fertilizers. High nutrient levels in agricultural runoff water promote the growth of algae with high biological oxygen demand, which results in the eutrophication of oceans and lakes. Agricultural production in many regions has led to widespread algal blooms representing dead zones with reduced aquatic life and low levels of biodiversity with the frequency and size of such blooms on the increase (Hautier, Niklaus, & Hector, 2009). The effects of agricultural production on water quality are measured by two BIICP indicators: (1) chemical inputs and (2) biological oxygen demand.

4.4.1 BIICP 5: Pesticide and Organic Fertilizer Use Per Unit Area or Unit Product

As direct inputs to the farming process, voluntary standards are well positioned to promote efficiencies and reductions in the use of pesticides and fertilizers, thereby resulting in improved water quality. The standards reviewed do indeed place a clear priority on the efficient use of synthetic inputs, with average coverage of 85 per cent for pesticide use monitoring and 80 per cent for the targeted application of pesticides. General criteria requiring chemical use records are the only criteria in the Pesticide and Fertilizer Use Index (see Appendix B: BIICP Sub-indicators for Criteria Coverage Analysis), with a significant majority of standards (67 per cent) reporting critical requirements. Just over half of the standards reviewed (eight) specify critical requirements for ensuring targeted application pesticides.

Practically speaking, however, voluntary standards are faced with the dilemma that fertilizer and pesticide inputs can be directly related to increased yields. As a result, it is perhaps not surprising that requirements prohibiting the use of pesticides altogether, for example, are rare (only covered by Organic standards). This context probably also explains the reluctance of standards to require reductions in the use of fertilizers (53 per cent average coverage) and/or the use of pesticides only as a last resort (48 per cent average coverage).

Figure 6. Pesticide and Fertilizer Index (BIICP 5), average coverage intensities for individual index indicators. The use and treatment of synthetic inputs represents one of the most important sources of water pollution arising from agricultural production, though they are subject to varying degrees of restrictions by agricultural standards. While there appears to be broad consensus about the value and importance of monitoring the use of pesticides and ensuring efficiency in the application of pesticides, commitments to absolute reductions, avoidance or prohibitions on the use of pesticides are far less frequent. One of the outstanding questions for policy-makers will therefore be whether "efficient use levels" represent "sustainable use levels."



Source: VSS criteria information obtained from ITC Standards Map

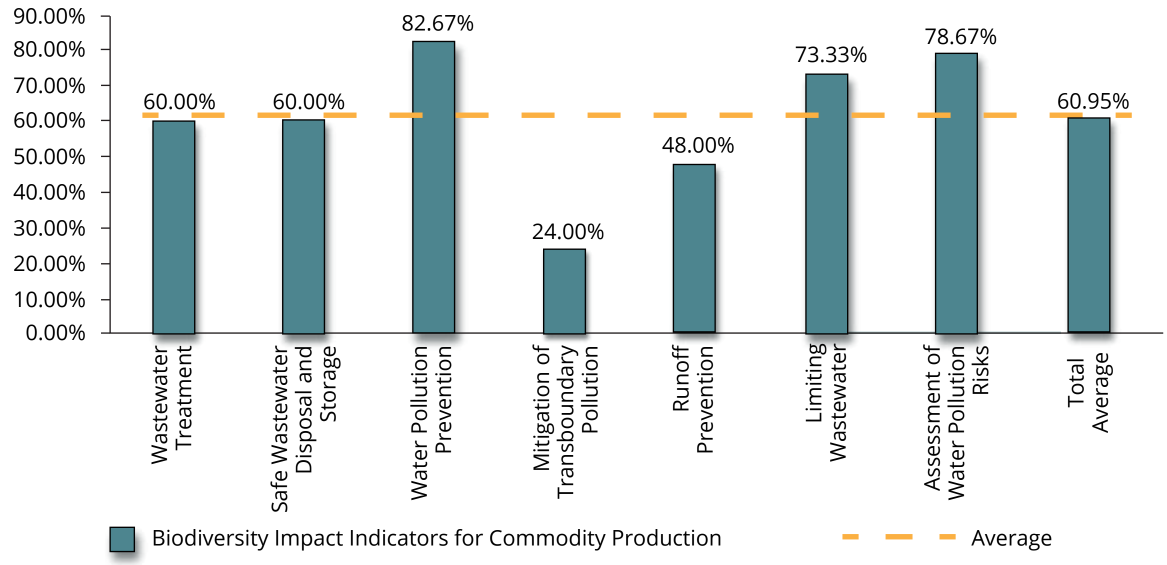
4.4.2 BIICP 6: Biological Oxygen Demand at Sampling Sites

Although standards may require the measurement of biological oxygen demand at sampling sites or include it as one means for assessing the risks and impacts on water quality, none of the standards reviewed imposes specific limits or performance requirements related to biological oxygen demand. Since biological oxygen demand is a function of practices to limit the flow of excess nutrients and other wastes into waterways, the Biological Oxygen Demand Index assesses criteria coverage of specific practices aimed at managing and reducing the flow of wastewater off the farm.

Overall, wastewater management criteria fall slightly below the average coverage for the entire group of BIICP indicators. General criteria on pollution prevention of surface and groundwater is the only criteria in the Biological Oxygen Demand Index with a significant majority of standards reporting critical requirements (73 per cent). Meanwhile, just over half (eight) of the standards reviewed have critical requirements for the prevention of chemical runoff and assessment of impacts on water quality. Although the standards reviewed appear to place a lower priority on the treatment or limitation of wastewater, it is possible that the assumption is that wastewater is covered by the prevention of pollution of surface and groundwater requirements more generally. Requirements related to the mitigation of transboundary water pollution are notably low.

A potential explanation for the slightly lower priority put on wastewater treatment generally may be that these requirements are less relevant to actual agricultural output. Protecting downstream watercourses, in contrast to the efficient application of inputs, is an additional financial burden offering limited direct benefits to producers and, as such, may be more difficult to implement in the absence of premiums or other economic benefits.

Figure 7. Biological Oxygen Demand Index-BIICP 6. Overall, wastewater management criteria fall slightly below the average coverage for the entire group of BIICP indicators, though general criteria requiring the prevention of pollution of surface and groundwater as well as requirements related to limiting runoff of chemicals and nutrients from the farm, are widely covered across the standards reviewed.



Source: VSS criteria information obtained from ITC Standards Map

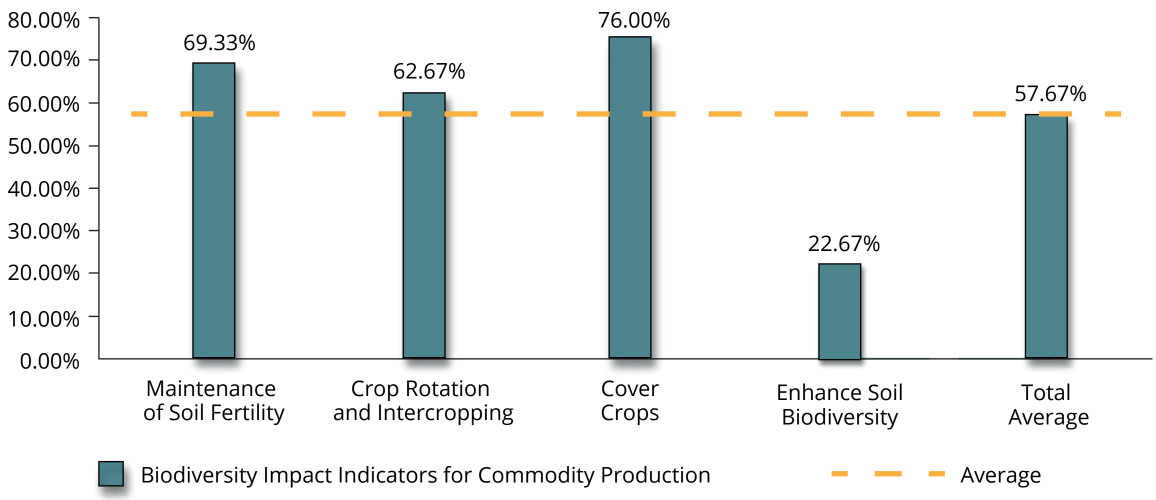
4.5 Soil Fertility

Soil fertility, or more specifically the organic matter present in soil, is a direct indicator of the soil's ability to support life and thus promote biodiversity. The maintenance of soil fertility through practices for reducing soil erosion can also promote biodiversity in water by minimizing eutrophication and across global ecosystems by acting as a carbon sink. Although organic content is also beneficial for improving yields, the relevance of organic matter to yields has been moderated by the widespread use of chemical fertilizers.

4.5.1 BIICP 7: Soil Organic Matter Per Unit Volume

The overall average intensity of requirements related to soil fertility is 58 per cent or lower. Requirements for the use of cover crops have an average coverage of 76 per cent, with critical requirements specified for eight of the standards reviewed. Requirements related to crop rotation and/or intercropping have an average intensity of 63 per cent and are considered critical for seven of the standards reviewed. As a general rule, standards provide guidance on exemplary soil-quality-enhancing practices but do not require the application of any specific practices or performance outcomes (see Section 4.18: Performance Requirements for Biodiversity Protection below), leaving considerable discretion to farmers.

Figure 8. Soil Fertility Index (BIICP 7), average coverage intensities for individual index indicators. Most standards specify some level of requirements related to the protection of soil fertility. Typically the requirements are open-ended, specifying the use of a broad list of possible soil-fertility-enhancing actions without requiring any specific actions per se. The broad discretionary authority of auditors to determine whether farm-level practices are sufficient can be expected to lead to a wide range of results in soil fertility among certified farms.



Source: VSS criteria information obtained from ITC Standards Map

4.6 Climate Change

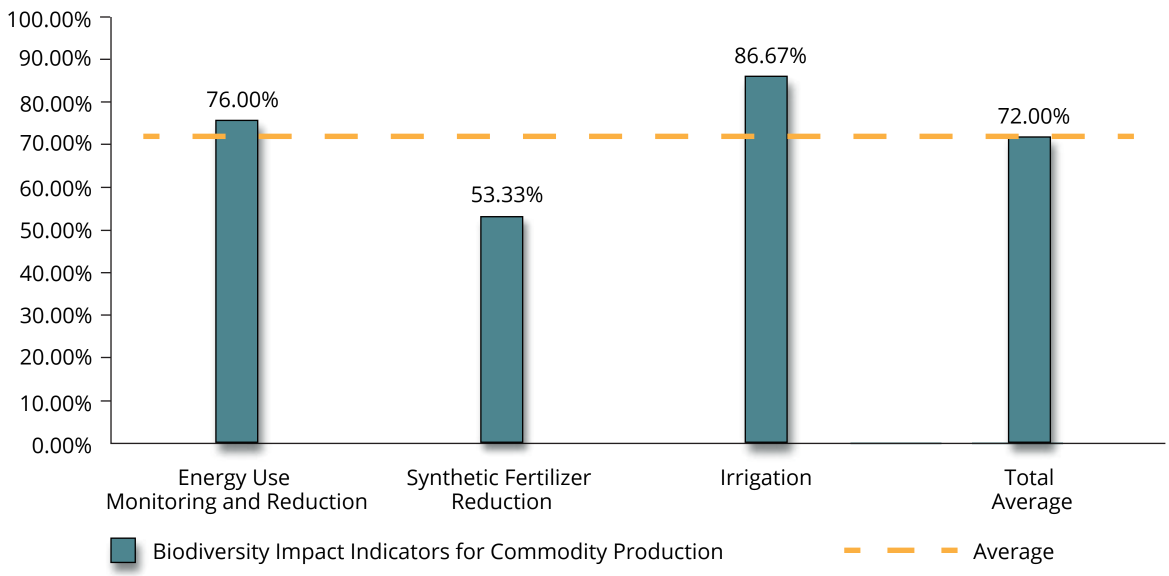
Rapid rates of climate change have been associated with high rates of species extinction due to reduced opportunities for adaptation (Bellard et al., 2012). Recent estimates put the global mean extinction risk due to climate change at between 9 and 17 per cent, depending on the species type (Maclean & Wilson, 2011). Accounting for more than 25 per cent or more of global GHG emissions, agriculture's contribution to climate change represents a major vector of its impact on global biodiversity. The main agricultural sources of GHG emissions are land conversion, livestock, soil management, fertilizers and fossil fuel use. Since our selection of standards for analysis does not cover livestock, it cannot speak to this particular source of GHGs. On the other hand, we have already noted the significant attention given to land conversion across the standards analyzed and relatively lower attention given to soil quality management and fertilizer management. Complementing these indicators, the BIICP climate indicators focus on: (1) the contribution from fossil fuels and energy use and (2) product carbon footprint.

4.6.1 BIICP 8: Fossil Fuel Use Per Unit Area or Product

Although agricultural production emits GHGs through a variety of manners, one important pathway is through the use of fossil fuels in production processes. In most agricultural systems, the principal sources of fossil fuel use are in the production of fertilizers, the extraction and movement of irrigation water, and energy use through machinery and other operations such as drying or preprocessing. Our subindicators are thus grouped into these three categories.

The most widely covered fossil fuel-related criteria are those related to ensuring irrigation efficiency, with an average coverage score of 87 per cent and a full two thirds of standards specifying critical requirements related to irrigation. Criteria requiring actions to reduce energy consumption through farm operations are also quite prevalent but less than half (six) of the standards reviewed considered energy reduction as a critical requirement. Finally, fertilizer reduction requirements were lower than the average for BIICP indicators, at 53 per cent with only three initiatives considering fertilizer reduction as a critical requirement.

Figure 9. Fossil Fuel Index (BIICP 8). Coverage of requirements related to major pathways of embedded fossil fuels is higher-than- average coverage across BIICP indicators as a whole. Direct energy use reduction and water irrigation efficiency requirements are the most widely covered, while fertilizer reduction requirements are covered with less frequency and intensity.



Source: VSS criteria information obtained from ITC Standards Map

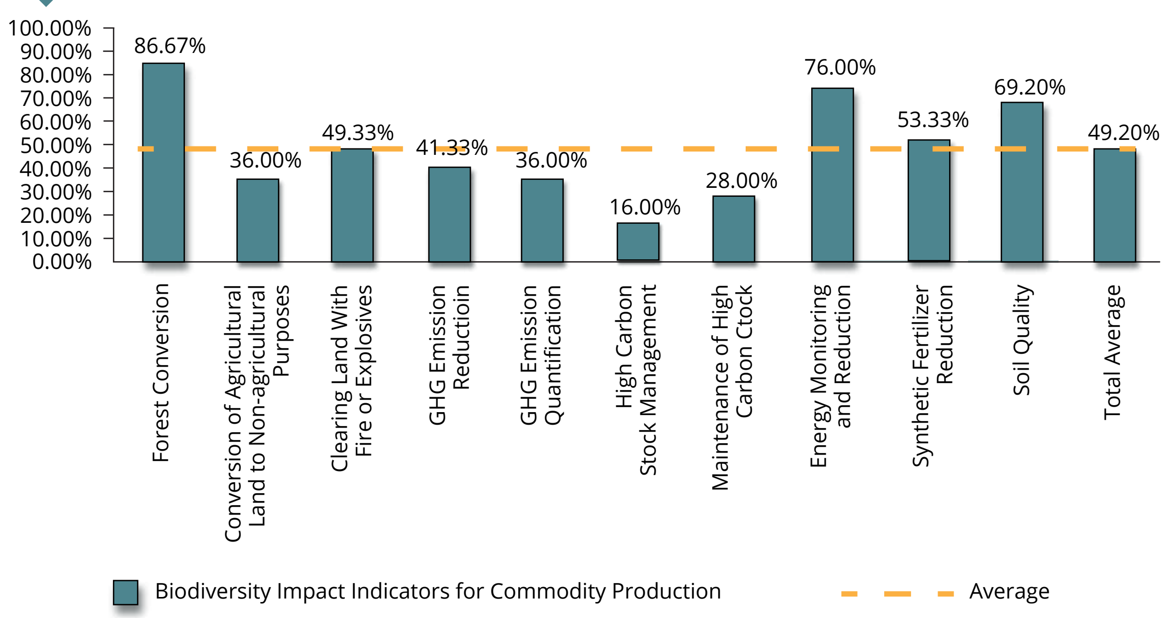
4.6.2 BIICP 9: Carbon Footprint of Product or Land Area

To assess the role of standards in promoting a reduced carbon footprint, we measured a combination of requirements addressing the major substantive contributors to agriculturally sourced GHG emissions (e.g., forest conversion, soil quality, fertilizer use, energy use) and requirements specifically associated with the monitoring, management and reduction of GHG emissions. Many of the criteria substantively related to GHG emissions from agriculture have relatively robust coverage, with averages ranging from 53 per cent (requirements to reduce the use of synthetic fertilizers) to 87 per cent (requirements prohibiting forest conversion for agricultural production). However, the average score for the resulting composite product carbon footprint index is 49 per cent, significantly lower than all of the other BIICP indices. Figure 10 reveals that only a minority of initiatives have any criteria, let alone critical criteria, *explicitly* linked to GHG measurement or management.

A possible explanation could be that, while the efficient management of many of the inputs to agricultural production has a potential benefit to both producer economic outcomes and producer carbon footprint outcomes, the actual measurement and management of GHG emissions offers no such double dividend. This may be particularly important in light of the potential complexity associated with measuring GHG emissions. As an additional management cost with no direct returns to producers, standards may have found it overly onerous to impose such requirements on farmers—particularly smaller farmers with limited resources. While this explanation is only hypothetical, the result, namely that voluntary standards have few requirements related to the measurement of GHG emissions, is not; it points toward an important gap in the ability of such standards to offer concrete evidence of their contribution to GHG emission reductions.

To the extent that GHG monitoring at the field level is indeed cost prohibitive, it may be that macro landscape and impact analyses offer a more pragmatic and efficient way of managing GHG emissions across agricultural sectors. Standards can be useful tools in forwarding and implementing climate objectives, but efficient and strategic prioritization of climate change mitigating actions may need to rely on meta-analysis and corresponding policy guidance.

Figure 10. Carbon Footprint Index (BIICP 9), average coverage intensities for individual index indicators. As a general rule, agriculture standards may have positive impacts on mitigating climate change through the prevention of land conversion, better soil management, fertilizer use and enhanced energy efficiency. However, the standards reviewed specified little in the way of intentional monitoring and management of GHG emissions.



Source: VSS criteria information obtained from ITC Standards Map

4.7 Biodiversity-Specific Criteria

Our review of the breadth and depth of criteria specified by agricultural standards reveals that many of their requirements have clear relevance to biodiversity protection. Requirements for prohibiting the conversion of forests to agricultural land, for example, address one of the most important sources of global biodiversity loss and are considered critical across almost all of the standards reviewed. Similarly, other important biodiversity-related parameters, such as the targeted application of pesticides and protection of water from contamination, are covered by a wide spectrum of agricultural standards. But while the criteria specified by agricultural standards bear direct relevance to biodiversity protection, it is worth noting that there is relatively little criteria requiring the explicit measurement, management and protection of biodiversity. For example, only 40 per cent of standards stipulate biodiversity risk assessment as a critical requirement. Requirements for no net loss in biodiversity resulting from production were even more rare, with only 13 per cent of standards considering this as critical. The absence of explicit biodiversity management criteria suggests that voluntary standards may play a weak role in facilitating broader biodiversity management strategies at the community and regional levels. At the same time, as with GHG emissions, the relatively low frequency of requirements for the explicit management of biodiversity may represent an opportunity for voluntary standards seeking to play a more proactive role in the promotion of broader public biodiversity strategies.

4.8 Restoration, Protection and Management-Oriented Criteria

Optimizing the use of voluntary standards in the protection of biodiversity implies an understanding of thematic coverage of the various practices prescribed by such systems. We have already noted the importance of the quality of such requirements, as measured by the degree or obligation, as an important and complementary variable. Another relevant feature to managers and proponents of biodiversity protection relates to the degree to which a requirement is engaged in minimizing negative impact versus maximizing positive impact, or to put it another way, the degree to which a criterion proactively seeks to improve biodiversity. With this in mind, any given criteria specified by a standard can be characterized as one of the following:

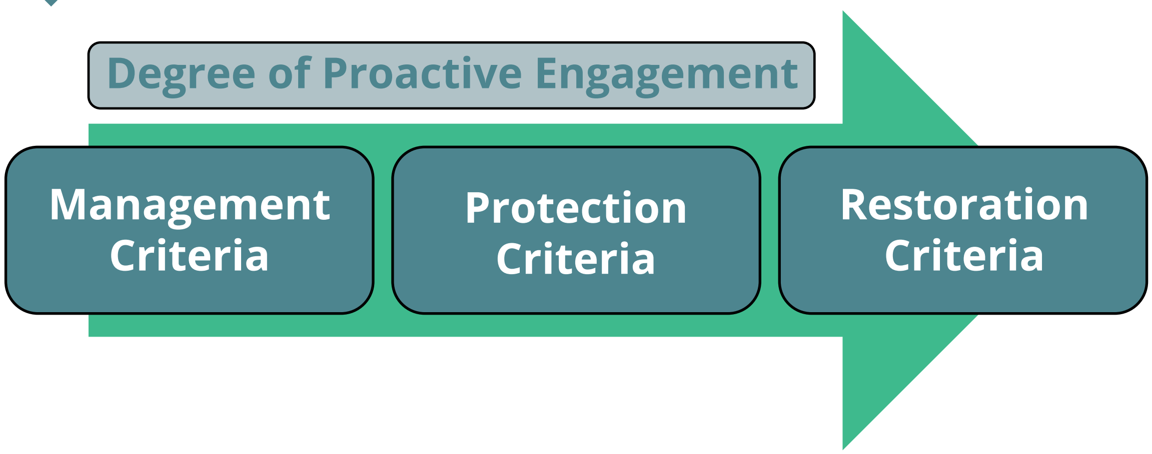
- Management criteria—criteria targeting the measurement and management of biodiversity-related public goods without necessarily prescribing specific practices to protect or restore such public goods.
- Protection criteria—criteria targeting the protection of biodiversity-related public goods.
- Restoration criteria—criteria related to the restoration and enhancement of biodiversity-related public goods.

Looking at system requirements through this window reveals that standards have a clear propensity for specifying criteria oriented toward protecting specific biodiversity-related public goods. The greatest level of detail (number of specific criteria) is devoted to protection-oriented criteria, followed by management-oriented criteria, followed by restoration criteria. Similarly, nine of the top 10 indicators (in terms of frequency of critical requirements) are protection-oriented criteria.

Management and record-keeping criteria are predominantly focused on chemical usage (average coverage 85 per cent) and water management (average coverage 70 per cent). Carbon and energy management criteria, on the other hand, have relatively low coverage at 47 per cent.

Restoration criteria are the least common, perhaps not surprisingly in light of the implied expectation of proactive interventions potentially beyond regular farming activities, but are nevertheless spread across a wide range of targets and overall have average coverage equal to that of protection and management criteria at 59 per cent.[28]

Figure 11. Assessing the degree of engagement in biodiversity maintenance. The majority of criteria specified, and the majority of critical criteria in agriculture standards, are focused on biodiversity protection with less attention given to biodiversity management and restoration.



4.9 Performance Requirements for Biodiversity Protection

Overall, voluntary standards are defined by specifying pro-sustainability *production practices*, but without specifying actual performance outcomes.[29] There is long-standing debate over the relative importance of (management) practice requirements versus performance outcome requirements. On the one hand, as geographic conditions vary, so too, will the levels of what constitutes "sustainable" resource use. Following this observation, fixed performance indicators can result in sub-par outcomes due to excessive rigidity. On the other hand, practice-based requirements offer no guarantees regarding actual outcomes and may result in misqualifying unsustainable outcomes as "sustainable" by virtue of the adoption of these preferred practices. In an ideal situation, voluntary standards would require performance outcomes tailored to each region of production, allowing producers to apply the practices most appropriate to their region and context. However, as a practical reality, voluntary standards have largely preferred the specification of practice-based requirements, rather than performance requirements.

The major biodiversity-relevant criteria reviewed in our analysis confirm this general trend with an average of 1.4 standards per criteria-specifying performance requirement. In fact, 31 of the 48 criteria covered by our analysis had one or no standard specifying performance outcomes. Some criteria, however, were associated with a relatively high presence of performance outcomes, as follows:

28 Notwithstanding the relative prioritization across restoration-, protection- and management-oriented criteria in terms of the number of criteria addressing each type of objective, we found the average intensity (average of coverage scores across the indicators within each group) to be identical across each group (restoration, protection and management) at 59 per cent each.

29 When specifying performance outcomes, standards typically do so in one of two ways: by setting resource use or output targets (in terms of specific volumes per hectare or other units) or by requiring compliance with local legislation. By referencing local legislation, standard setters are able to piggyback off of local rule-setting processes as a means of identifying appropriate performance outcomes for local conditions.

- Roughly half of the standards surveyed specify performance outcomes for protection against forest conversion (8 standards; 53 per cent) and protection of areas legally recognized for their biodiversity (7 standards; 47 per cent)

- Roughly one third of standards surveyed specified further performance outcomes for:
  > Habitat conservation:
    - Principles and criteria to enhance the conservation of forests (5; 33 per cent)
    - Criteria for the monitoring and protection of HCV areas (4; 27 per cent)

  > Water quality:
    - Wastewater management and treatment (5; 33 per cent)
    - Principles and practices related to water disposal and storage (4; 27 per cent)

These findings underscore the focus of voluntary standards on mandating management practices rather than performance outcomes. While this approach has the advantage of maximizing flexibility for different producing conditions, it also raises important questions regarding the actual impacts of such standards. At a minimum, it points to the importance of carrying out regular and independent impact assessments as part of the continual improvement program of any voluntary standard.

4.10 Criteria Coverage Summary

Conceptually, the major international voluntary standards in agriculture are closely aligned with global biodiversity priorities. Land conversion is generally both recognized as one of the most important sources of agriculturally driven biodiversity loss *and* represents one of the most consistently covered areas within the standards reviewed. Other areas with significant coverage by standards include indicators related to water use and pesticide use. These criteria are arguably among the least controversial among stakeholders in light of the convergence between economic and environmental objectives. By contrast, restrictions on fertilizer use are less prominent and may reflect a degree of conflict between interests in increasing yields and those seeking to reduce the negative impacts of fertilizers. While the substantive drivers of climate change such as land use conversion, organic soil matter, energy use conservation and fertilizer use all have an average coverage score of 50 per cent or greater, specific requirements related to GHG emission reductions and management are relatively rare among agriculture standards.

The vast majority of criteria specified by voluntary standards focus on the protection of ecosystems and other environmental public goods. There is a slightly lower concentration on criteria specifying measurement and monitoring systems for environmental protection. Criteria focused on ecosystem restoration are the least common. The distribution among these types of criteria spells out an implicit theory of change across agricultural standards that focuses on “avoiding or reducing” practices that are harmful to the environment. Voluntary standards appear to be less inclined to dictate farm management practices or that farms take proactive actions in restoring ecosystems.

An overview of requirement coverage has significant limitations as a tool for assessing the potential impacts of initiatives. On the one hand, the vast majority of standards stipulate practice-based requirements rather than performance requirements. Moreover, practice requirements are often open ended, leaving considerable room for discretion by auditors regarding sufficient compliance. On the other hand, context and distribution of standards uptake can have important implications for potential impacts. For example, prohibitions against the conversion of land for agricultural use will have little effect in cases where land conversion has occurred in some distant past. Similarly, where each commodity faces its own unique sustainability challenges, actual effectiveness in reducing the prominence of these challenges will depend on their adoption in areas where such challenges are most pronounced. Our review of markets and spatial distribution below provides an overview of these issues as they relate to specific commodities and the BIICP.

5 Standard-Compliant Markets and the Biodiversity Impact Indicators for Commodity Production

1 INTRODUCTION
2 VOLUNTARY SUSTAINABILITY STANDARDS
3 BACKGROUND
4 CRITERIA COVERAGE ANALYSIS
5 MARKETS
6 CONCLUSION
7 POLICY OPTIONS
8 APPENDICES

Biodiversity loss and agricultural expansion have become inextricably linked over time, with rapid expansion and intensification over the course of the past century. More land was converted to cropland in the 30 years after 1950 than in the 150 years between 1700 and 1850 (Millennium Ecosystem Assessment, 2005). And although a large portion of useable natural habitats have already been converted to agricultural production, the expansion nevertheless continues today at an alarming pace: from 2000 to 2014 alone, the area of soybeans under cultivation increased by 43 million hectares, oil palm by 9 million hectares and sugarcane by 8 million hectares.[30] Together, the expansion of these three crops alone represents 4 per cent (1.5 billion hectares) of the total land currently under cultivation. Meanwhile, the area under cocoa, tea and cotton cultivation each expanded by more than 1 million hectares over the same period (FAO, 2016b). Of the 11 agricultural commodities considered in this review, only coffee has diminished in cultivated area since 2000, decreasing by 550 thousand hectares or 0.4 per cent of total area cultivated. And yet, even in this special case, the reduction in total coffee area cultivated has been enabled by a 20 per cent decrease in biodiverse-rich agroforestry production systems between 1996 and 2010, replaced by more intensive sun-grown coffee production systems[31] —again resulting in an increase in the sector's overall contribution to biodiversity loss.[32]

While declining biodiversity is currently felt most intensely by local communities, particularly across emerging economies, the forces driving biodiversity impacts are often international in character—for example, international markets account for 83 per cent of coffee production, 77 per cent of palm oil production, 76 per cent of cocoa production and 63 per cent of soy production. Moreover, it is estimated that 60 per cent of palm oil trade has been linked to the displacement of forests in Malaysia and Indonesia since 2000, while 50–70 per cent of soybean exports have displaced forests in Brazil, Bolivia, Uruguay and Paraguay (Lawson et al., 2014). The heavy reliance of global agricultural production on international demand and the close relationship between production for international markets and continued growth in land conversion suggest, at a minimum, a shared burden of responsibility in attending to the implications of agricultural production on biodiversity loss. In the complex system of global markets and shared resources, improvements may be achieved through coordinated multistakeholder efforts and an improved transfer of information throughout the supply chain.

It is within this context that VSSs, often focused on heavily traded commodities with significant consumption in Northern economies, have come to prominence within many agricultural markets. Over the past three decades, the number and variety of initiatives offering verified or certified production according to the basic principles of

30 Representing growth of 3.3, 4.5, and 2.4 per cent per annum, respectively (FAO, 2016b)

31 The proportion of coffee grown under forest shade cover has decreased from 43 per cent to 24 per cent between 1996 and 2010 (Jha et al., 2014)

32 The conversion to conventional agricultural production systems from shade, or agroforestry systems, leads to the destruction of microhabitats and soil degradation, typically requiring increased use of agrochemicals. The absence of the soil retention of agroforestry systems can lead to soil erosion, increased agrochemical runoff, and waterbody eutrophication. After natural habitat conversion, the trend toward intensification, at least in the case of traditional agroforestry production systems, represents one of the most important factors in biodiversity loss due to agriculture.

sustainable agricultural production has grown exponentially. While the earliest global labelling schemes can be traced back to the 1980s, the large-scale adoption of "standard-compliant" production did not begin until the turn of the millennium with the heightened global awareness of sustainability issues related to specific agricultural crops.[33] Since then, a growing number of commodities have seen upwards of 10 per cent of production certified or verified by third parties as compliant with one or another sustainability standard. This growth has been made possible, in large part, due to the growing number of public corporate commitments to sustainable sourcing.

The trade value of the 10 leading standard-compliant commodities (bananas, cotton, coffee, cocoa, tea, sugar, palm oil and soybeans, seafood and forestry) is estimated to be USD 293.2 billion in 2015 from 238.7 billion in 2012. While certified seafood and forestry represent the largest components of total trade value (USD 8.9 billion and USD 231.8 billion respectively in 2015), the eight agricultural commodities have grown the fastest, up more than 65 per cent from USD 31.6 billion in 2012 to USD 52.5 billion in 2015.[34]

33 The penetration of voluntary standards into mainstream markets has typically been associated with major non-governmental organization (NGO) campaigns highlighting one or another sustainability issue associated with production. Major drivers in the growth of voluntary standards include: (1) campaigns led by OXFAM, Fairtrade International and others highlighting the coffee crisis of 2001–2002; (2) campaigns led by WWF, Solidaridad and others highlighting massive land conversion due to the expansion of soy and palm production from 2000 onwards; (3) campaigns by Fairtrade International, Rainforest Alliance, Banana Link and others highlighting labour issues in banana production (1990s) and by Fairtrade International and UNICEF for cocoa production (2000–2002); and (4) campaigns by the Pesticide Action Network and WWF highlighting pesticide and water intensity in cotton production (2009 onwards).

34 Note the trade value of certified seafood grew from USD 6.8 billion in 2012 to USD 8.9 billion in 2015 or 30 per cent. The trade value of certified forest products grew from USD 200.3 billion in 2012 to USD 231.2 billion in 2015 or 16 per cent. All figures calculated by the SSI using average volume-based trade values across sectors. See www.iisd.org/SSI for more info.

BOX 5: Major corporate commitments to sustainable sourcing

Major corporations have become the main drivers behind rapid increases in VSS-compliant production across a select group of commodities. The following is a select list of corporate commitments driving market demand for sustainable products.

Adidas:

- Committed to sourcing 100 per cent Better Cotton by 2018. By 2015 the company reached compliance for 43 per cent of purchases (Adidas, n.d.) .

Coca-Cola:

- Committed to sourcing 100 per cent of sugar in compliance with the company's in-house Sustainable Agricultural Guiding Principles (SAGP) by 2020. Bonsucro is the company's preferred standard for demonstrating compliance with these principles. By 2016 the company reached compliance for 15–20 per cent of sugar purchases (Coca-Cola, 2016b).
- By 2015 sourced more than 95 per cent of coffee from compliant[35] sources (Coca-Cola, 2016a).
- By 2015 sourced more than 95 per cent of per cent of tea from compliant[36] sources (Coca-Cola, 2016a).

Hershey's:

- Committed to sourcing 100 per cent of cocoa from certified sources by 2020, and by 2015 reached compliance for 50 per cent of purchases from UTZ, Fairtrade USA, or Rainforest Alliance (Hershey's, 2016).
- By 2014, 100 per cent of palm oil purchases were compliant with Roundtable on Sustainable Palm Oil (RSPO) standards through the mass balance supply chain model, and the company is working to achieve 100 per cent traceability at the plantation level (Hershey's, 2016).

Ikea:

- By 2015, 100 per cent of cotton purchases were Better Cotton Initiative (BCI) compliant, from farmers working to achieve BCI compliance, or from regional standards such as e3 in the USA (Ikea, 2015).

McDonald's Europe:

- Committed to sourcing 100 per cent certified soy by 2020. By 2015, 35 per cent of soy purchases used for chicken feed in Europe were certified by either Roundtable on Responsible Soy (RTSO) or Proterra (McDonald's, 2016).
- In Western European markets, McDonald's sources 100 per cent of coffee from UTZ Certified, Rainforest Alliance- or Fairtrade-certified sources (excluding decaf) (McDonald's, 2016).

Mars:

- Committed to sourcing 100 per cent of cocoa from certified sources by 2020. By 2015 the company reached compliance for more than 40 per cent of purchases from UTZ, Rainforest Alliance or Fairtrade (Mars, 2016).
- In 2014 reached 100 per cent compliance for coffee purchases through UTZ or Rainforest Alliance (Mars, 2016).
- In 2015 reached 100 per cent compliance for tea purchases through UTZ or Rainforest Alliance (Mars, 2016).

35 Refers to Rainforest Alliance, UTZ, Fairtrade International, SAI Platform, 4C with additional audited criteria, or supplier's own standards that have been approved by Coca-Cola as fulfilling SAGP and then third-party audited to confirm compliance (Coca-Cola, 2013).

36 With the Ethical Tea Partnership Global Standard, SAI Platform Farm Sustainability Assessment, UTZ, Rainforest Alliance/ Sustainable Agricultural Initiative, Fairtrade International, Fairtrade USA, or SAGP third-party audit (Coca-Cola, 2013).

BOX 5: Major corporate commitments to sustainable sourcing (continued)

Mondelez International:

- Sources 100 per cent RSPO-certified palm oil (Mondelez International, 2015).
- By 2015 sourced 21 per cent of cocoa from certified sources or its in-house "Cocoa Life" program, through which the company aims to eventually source all its cocoa (Mondelez International, 2015).

Jacobs Douwe Egberts:

- In 2015 the Mondelez coffee division was divested and merged with D.E. Master Blenders 1753 to form Jacobs Douwe Egberts. While the company has not made any public commitment to standard-compliant coffee sourcing, by 2013 it sourced 44 per cent of its coffee from 4C-verified or Rainforest Alliance-certified sources. Also by 2013, 25 per cent of coffee purchases from D.E. Master Blender's 1753 were from UTZ Certified sources (Jacobs Douwe Egberts, 2017).

Nestle:

- While the company has not made any public commitment to standard-compliant coffee sourcing, by 2013 it sourced 30 per cent of coffee from 4C, its in-house Nespresso AAA standard, Fairtrade or Organic-compliant sources (Nestle, 2016a).
- 100 per cent of palm oil purchases are RSPO-certified (Nestle, 2016b).

Nike:

- Committed to sourcing 100 per cent of cotton from either Organic, recycled or BCI sources by 2020 (Nike, 2016).

Unilever:

- Committed to sourcing 100 per cent of palm oil through identity-preserved supply chains by 2019. By 2015 the company sourced 100 per cent RSPO-certified palm oil through identity-preserved, mass balance, or GreenPalm certificate-based (81 per cent in 2015) supply chain models (Unilever, 2016).
- Committed to sourcing 100 per cent of tea from certified sources by 2020, and by 2015 reached 66 per cent (Unilever, 2016).
- Committed to sourcing 100 per cent Sustainable Agriculture Initiative (SAI) or Bonsucro-compliant sugar by 2020, and by 2015 reached 60 per cent (Unilever, 2016).
- Committed to sourcing 100 per cent compliant soy oil by 2020. The company works with RTRS in Latin America and self-verification in USA. By 2015, 100 per cent of soy bean purchases were RTRS-certified and 43 per cent soy oil purchases were compliant (Unilever, 2016).

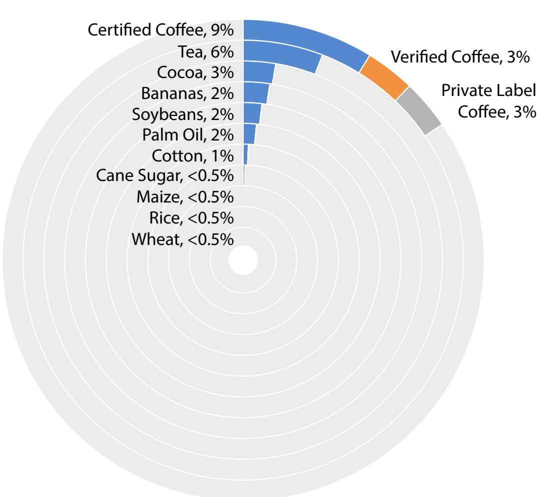
Wilmar International:

- Aims to source 100 per cent RSPO-certified pam oil, including from smallholders, by the end of 2019 (Wilmar International, 2017).

The recent growth in the value of standard-compliant agricultural products is result of a steady and rapid growth in production volumes of standard-compliant products over the past decade. From 2008 to 2014, standard-compliant production volumes grew at an average rate of 35 per cent per annum across the banana, cotton, coffee, cocoa, tea, sugar, palm oil and soybean sectors. In absolute terms, compliant production has scaled up over the last two years of the observed window, with the compliant land area certified between 2012 and 2014 representing approximately two-thirds of the land area certified up to 2012. Based on current market trends and existing "unimplemented" corporate commitments to sustainable sourcing, standard-compliant production for each of the eight markets is expected to reach 10 per cent or more of total global production by 2020.

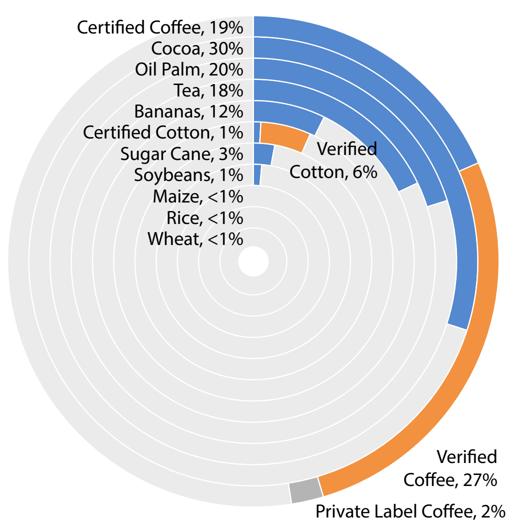
While it is tempting to consider the degree of the potential contribution of certification to biodiversity conservation in terms of percentage of global production certified, variations in both per-hecatre productivity and regional biodiversity vulnerability suggest the need and rationale for a spatially situated analysis (Koellnor et al., 2013; Chaudhary et al., 2015). Global mappings of biodiversity vulnerability reveal that the greatest biodiversity risk is found in tropical and subtropical regions, particularly across South America, Africa and South East Asia (Newbold et al., 2015; Bellard et al., 2015; Chaudhary et al., 2015). All other things being equal, land use and change for agricultural purposes in these regions are susceptible to higher rates of biodiversity loss than northern regions. Figure 14 shows the regional concentration of certified crop area as a percentage of total agricultural area overlayed onto estimated biodiversity vulnerabilities using ecoregion-specific characterization factors. At a high level, the general concentration of standard-compliant production on tropical and subtropical agricultural commodities aligns well with the distribution of global biodiversity vulnerabilities. However, this global perspective does not account for the specific pathways of biodiversity vulnerability by region, nor the ways in which specific crops interact with those pathways.

Figure 12. Standard-compliant production for select crops as a percentage of global total (2008) , adjusted for multiple certification.The coffee sector is the most maturemarket for sustainability standards with standard-compliant production reaching 15 per cent in 2008.



Source: ITC, FIBL, SSI, FAOstat data[37], SSI

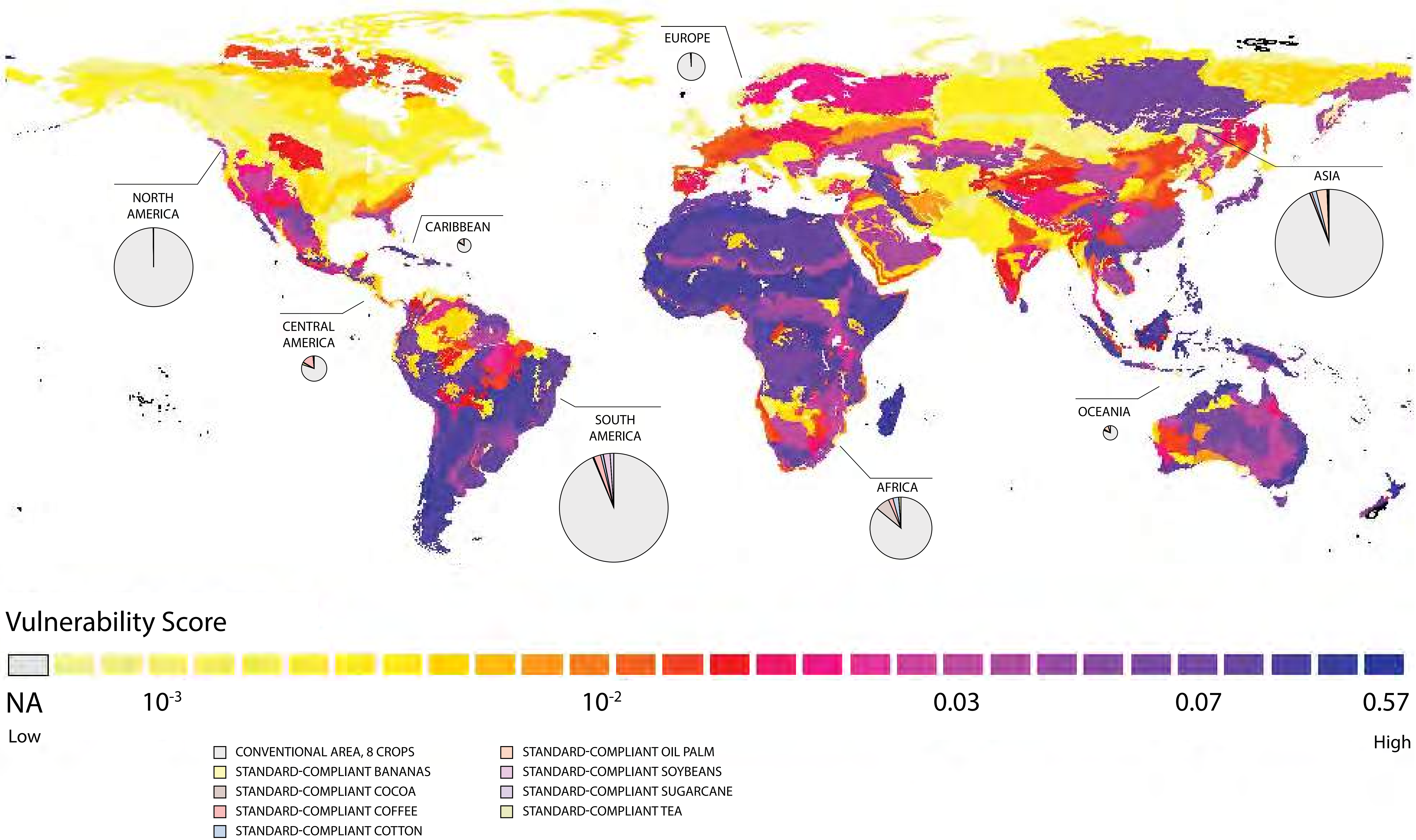
Figure 13. Standard-compliant production for select crops as a percentage of global total (2014), adjusted for multiple certification. Standard compliant production has, or is in the process of becoming mainstream, across 8 agricultural commodities.



Source: ITC, FIBL, SSI, FAOstat data, SSI

37 All tables and figures directly analyzing markets were drawn from a combination of FAOstat data and the authors' own internal market survey process carried out directly with standards bodies in collaboration with the ITC and FIBL through joint data collection partners, and will be cited in text as: ITC, FIBL, SSI, FAOstat data.

Figure 14: Standard-compliant production and global biodiversity vulnerability due to land use change from annual crops. The use of ecoregion-specific characterization factors to determine regional biodiversity vulnerabilities gives an assessment of the exposure of different regions to species loss due to land use. Pie charts reveal the percentage area certified, by continent, as a proportion of the total area dedicated to the eight crops where standards are most active (bananas, cocoa, coffee, cotton, palm oil, sugarcane, soy, tea). Although the range of crops where certification is highly active is relatively limited, the majority of standard-compliant production in those crops occurs in areas of higher biodiversity vulnerability.



Data Sources: Chaudhary et al., 2015; FAOStat; Lernoud et al., 2015

The BIICP offer a framework for characterizing key biodiversity pressure points related to agricultural production. Any given crop will draw upon and affect ecosystem resources in different ways. A mapping of the interaction between identified crops and specific biodiversity-relevant parameters (e.g., specific BIICP) can provide a more precise window into the potential threats posed by agricultural production on a regional basis and, correspondingly, the potential for voluntary standards to prevent biodiversity loss on a crop-regional basis.

Table 3: Different crops impose distinct pressures on ecosystems and their ability to support biodiversity. Below is a rough characterization of the pathways by which crop production can impact biodiversity. "I" represents critical and immediate impact pathway; "II" represents important pathway; "III" represents a moderate pathway.

Crop	Habitat Conservation			Water Use	Water Quality		Soil Fertility	Climate Change	
	BIICP1	BIICP2	BIICP3	BIICP4	BIICP5	BIICP6	BIICP7	BIICP8	BIICP9
Bananas	II	II	II	III	I	I	II	II	II
Cocoa	II	II	II	III	III	III	II	II	II
Coffee	II	II	II	III	I	II	III	II	II
Cotton	II	II	II	I	I	I	III	II	II
Palm Oil	I	I	I	III	III	III	III	I	I
Soy	I	I	I	III	III	II	II	I	I
Sugar	II	II	II	I	I	I	I	II	II
Tea	II	II	II	III	III	III	III	II	II

In our spatial analysis spotlights below, we consider the spatial distribution of standards from the perspective of some of the BIICP pathways individually as a way of understanding how standards might be interacting with those pathways. While we have tried to select among the more notable crop-relevant impact pathways for our spatial analysis (as per Table 3), being issue specific as they are, and principally intended as an exploratory application of the BIICP, they should not be considered as proxies for biodiversity impacts on their own. Understanding the full biodiversity potential of voluntary standards on a crop-by-crop basis would necessitate a proper life-cycle analysis per crop and region, which is beyond the scope of this paper.

5.1 Bananas

Table 4: Banana Standards, Key Market Statistics (2014)

Voluntary Standard	Compliant Production 2014 (mt)	Compliant Area 2014 (ha)	Portion of Global Trade	Portion of Global Production	Portion of Global Area
Fairtrade	793,820	38,654	4%	1%	1%
GLOBALG.A.P.	8,876,908	251,565	44%	8%	5%
Organic	1,036,500	52,551	5%	1%	1%
Rainforest Alliance	5,923,183	90,293	29%	6%	2%
Total (Adjusted for Multiple Certification)	13,572,982	353,446	68%	12%	7%

Source: ITC, FIBL, FAOstat data

Commercial bananas have a special relationship to biodiversity in that they reproduce asexually, and all major production over the past 10,000 years has been realized through the cloning of specific hybrids (Leatherdale, 2016). The resulting concentration of global production in a few specific (and genetically identical) varieties has resulted in relatively low genetic diversity and relatively high susceptibility to pests and disease across the banana sector. The Cavendish banana, for example, which currently represents about half of global production (Arias, Dankers, Liu, & Pilkauskas, 2003), is renowned for its susceptibility to blights, notably Black Sigatoka and Panama Disease; the former is only controllable with large amounts of fungicides (The Economist, 2014), and the latter, for which there is no known effective treatment, is responsible for the eradication of its predecessor the "Gros Michel" in the 1950s.[38] This sensitivity is exacerbated by commercial bananas being almost exclusively grown in monocultures, which also renders them especially susceptible to pest damage. As a result, the banana industry is the world's second largest consumer of agrochemicals, after cotton (Banana Link, 2016c). Environmental concerns such as these, along with a long history of social conflict combined with pressure from civil society, have resulted in growing corporate interest in voluntary standards.

Four companies, Chiquita (U.S.), Fyffes (Ireland), Dole (U.S.) and Del Monte (U.S), account for more than 40 per cent of the world's banana trade (Banana Link, 2016a), although this is down from 62 per cent in 2002, and has been decreasing since the 1980s (Banana Link, 2016b). The EU and the United States import more than half of all traded bananas, while Ecuador, Guatemala, Costa Rica and Colombia (all Latin American countries) account for more than 60 per cent of the world's exports.

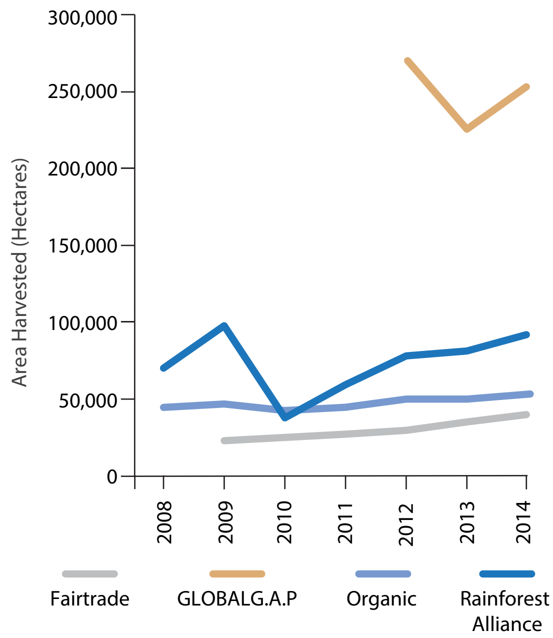
Given the concentrated nature of the banana trade, the banana sector holds special promise for wide-scale compliance with voluntary standards. This is vindicated by the relatively large and rapid adoption of standard-compliant production among globally traded bananas over the past decade. By 2014, standard-compliant banana production had reached 7.2 million mt, or 36 per cent of globally traded bananas, up from 2.3 million mt, or 10 per cent of traded bananas in 2008. The main international standards operating in the banana sector are Fairtrade, Organic and Rainforest Alliance. Rainforest Alliance, through

38 The Cavendish replaced the Gros Michel due to its higher disease resistance. However, a new strain of the disease has infected several thousand hectares of plantations in China, Indonesia, Malaysia and the Philippines (Panama Disease, 2017).

a major partnership with Chiquita, has been a major driver in the growth of standard-compliant production both historically and even recently, with a 58 per cent increase in compliant production (equivalent to 2.2 million mt, or 12 per cent of global banana trade) between 2013 and 2014 alone. Fyffes has also been especially involved with VSS, having certified its entire banana supply chain under GLOBALG.A.P., while simultaneously operating as the largest supplier of Fairtrade bananas in Europe (Fyffes, 2015). Notwithstanding these impressive achievements, the portion of global banana production deemed compliant with a voluntary sustainability standard had only reached 12 per cent by 2014, up from 2 per cent in 2009, highlighting the current challenge in using voluntary standards in sectors with significant production destined for local consumption. Indeed, based on our calculations, we estimate that upwards of 65 per cent of globally traded bananas are currently certified, suggesting that Northern-driven demand may be nearing saturation.

The banana context points toward the need for alternative means to enable the continued expansion of certified production. While the most obvious options are those focused on developing demand for certified products in local and Southern markets, it may be more realistic for policy-makers and other stakeholders to consider the use of industrial planning policies, direct fiscal incentives and technical assistance approaches to expanding the adoption of certified production.

Figure 15. Standard-compliant banana area, by initiative, 2009–2014



Average Annual Growth:

Fairtrade: 13%
GLOBALG.A.P.: -3%
Organic: 4%
Rainforest Alliance: 4%

Source: ITC, FIBL, FAOstat data

Standards and Biodiversity – Thematic Review 58

5.2 Cereals

Table 4: Cereals Standards, Key Market Statistics (2014)

Cereal	Compliant Organic Area 2014 (ha)	Portion of Global Area
Maize	140,572	0.10%
Rice	149,732	0.10%
Wheat	749,168	0.30%

Source: ITC, FIBL, FAOstat data

Maize, rice and wheat are the most important crops to global food security, accounting for 42.5 per cent of global calorie supply (FAO, 2016d), and planted on 38 per cent of the world's cropland. These three crops are also considered responsible for approximately 40 per cent of global biodiversity loss (European Commission, 2016). The largest producers are China (22 per cent), the United States (17 per cent), India (11 per cent), Brazil (4 per cent) and Indonesia (4 per cent). Together, these crops grew in area by 0.8 per cent per annum from 2000 to 2014, while their production increased by 2.5 per cent per annum.[39]

It is estimated that production will need to grow at a rate of about 0.8 per cent per annum through 2050 to maintain global food security—which will need to occur mostly on already planted areas (FAO, 2016d). While the green revolution helped boost yields in these crops from the 1970s onward, continued yield growth is far from certain. To the contrary, certain agricultural practices that characterized the green revolution, such as intensive monocropping and its associated agrochemical use, will have contributed to the degradation of agricultural land at the expense of future yields (Pingali, 2012). Indeed, the top three producers of rice—China, India, and Indonesia—are not experiencing yield growth across 79 per cent, 37 per cent, and 81 per cent of their rice area, while the top three producers of wheat—China, India and the United States—are not experiencing yield growth across 56 per cent, 70 per cent and 36 per cent of their wheat area (Ray, Ramankutty, Mueller, West, & Foley, 2012). Furthermore, despite the scaling-up of agriculture since the green revolution, current practices are far from optimized, with an estimated 50 per cent of agrochemical use not needed across most agroecosystems (Pretty & Bharucha, 2015), and water use efficiency for irrigated areas often 50 per cent or less (FAO, 2016a). Soil salinization is a major factor limiting cereal yields, with 35 million hectares of irrigated cropland affected (Sustainable Rice Platform, n.d.).

International VSSs operating in these cereals are Fairtrade, Organic and the Sustainable Rice Platform (SRP). While less than 1 per cent of all maize, rice, and wheat production is VSS compliant, cereals as a group account for more organic area than any other crop (and more agricultural area has been certified organic than any other standard). In 2014, 1.2 million hectares of wheat, 336 thousand hectares of maize, and 269 thousand hectares of rice were certified Organic, equivalent to 0.5, 0.2 and 0.2 per cent of total planted area, respectively. The countries with the largest amount of cereals under organic cultivation are China (17 per cent), USA (10 per cent), Canada (7 per cent), Italy (6 per cent) and Germany (7 per cent).

39 From 2000 to 2014, the area harvested under maize, rice and wheat grew by 2.1 per cent, 0.4 per cent and 0.2 per cent per annum, respectively, two thirds of which occurred in China (19 per cent), Russia (7 per cent), India (7 per cent), Brazil (7 per cent), Ukraine (7 per cent), Tanzania (6 per cent), Nigeria (6 per cent), Indonesia (6 per cent) and Kazakhstan (3 per cent) (FAO, 2016b).

Launched in 2011,[40] the SRP is the first major international roundtable standard to be established directly targeting any of the three major staple crops. Rice is the most important crop in the world in terms of caloric contribution, and accounts for between 34 and 43 per cent of the world's irrigation water and 5 to 10 per cent of methane emissions (SRP, n.d.). In this way, SRP is the most ambitious sustainability standard to date.

SRP also makes an important link between food security and sustainability, and is the first roundtable-style VSS to be active in a sector where the vast majority of the relevant crop is not traded internationally (93–95 per cent of rice is consumed domestically). Notwithstanding, the major international buyer, Mars Food, the owner of Uncle Ben's, has already committed to 100 per cent sourcing through the SRP program by 2020 (Mars Food, n.d.).

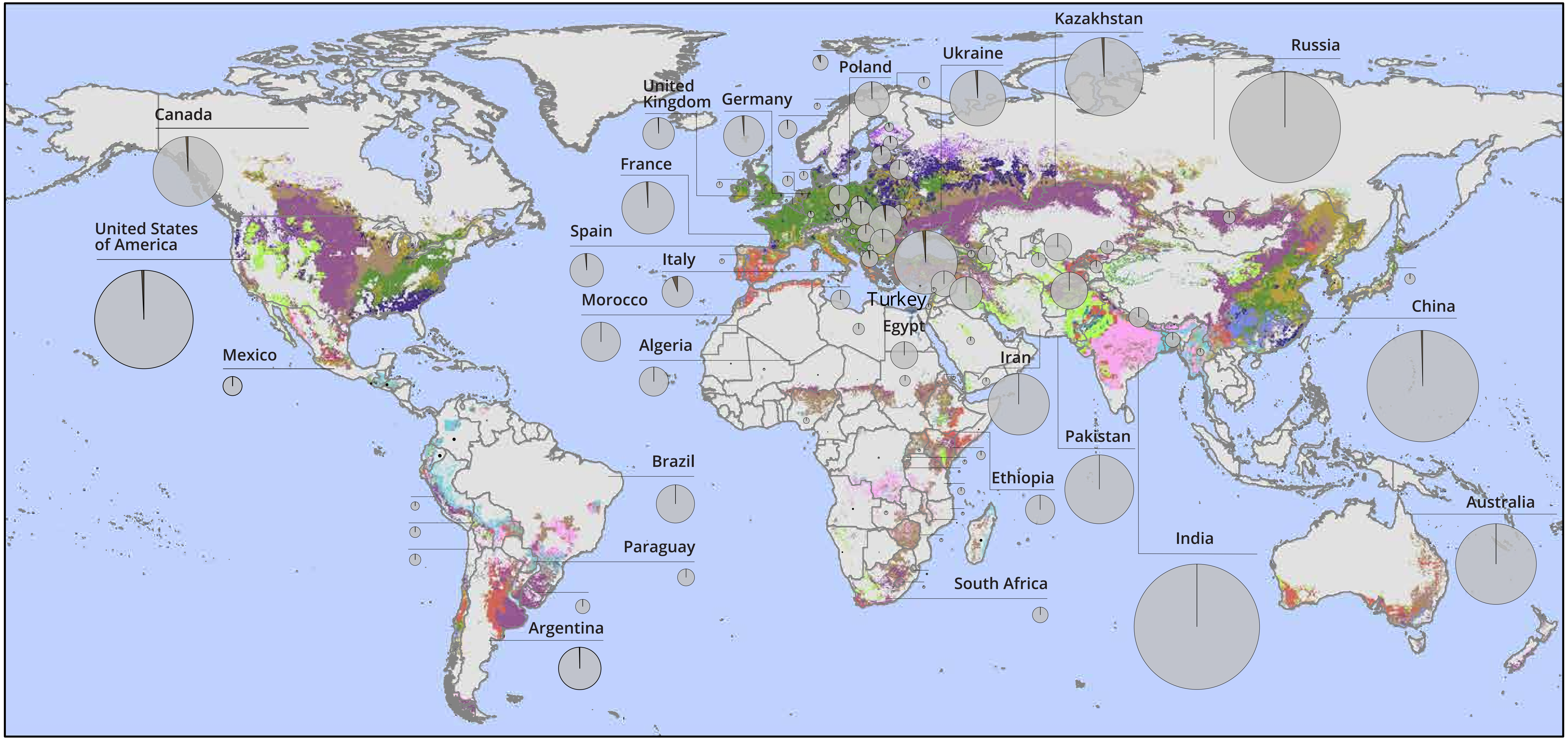
5.2.1 Spotlight on Wheat Production and Loss of Natural Vegetation

As one of the world's most important staples, wheat covers approximately 17 per cent of the world's agricultural land (International Development Research Centre, n.d.). Due to its proportionately large footprint, wheat has displaced a significant amount of natural vegetation, primarily grassland/steppe since they typically offer rich fertile soils and a flat topography, which are desirable qualities for its cultivation (see Figure 16). Savannas as well as shrublands have also been greatly displaced by wheat as well as temperate deciduous and mixed forests. With Organic certification as the only major international sustainability standard operational in the wheat sector (accounting for 0.5 per cent of planted wheat area globally), practically speaking, the role of voluntary standards in promoting biodiversity in the wheat sector can be considered minimal at best. The majority of Organic-certified wheat is grown in the United States, Turkey and China; other important Organic wheat growing areas include Kazakhstan, Canada, Ukraine and several countries in Europe.

40 Note that the SRP only became operational in 2015.

Standards and Biodiversity: Thematic Review

Figure 16. Potential loss due to global wheat production and global distribution of Organic wheat production. Historically, wheat represents one of the most important agricultural drivers in the loss of natural vegetation and, consequently, one of the most important sources of biodiversity loss caused by agriculture. VSS-compliant production represents only a small fraction of global wheat production.



Potential Vegetation Lost to Wheat Cultivation

Biome Classification

- Boreal Deciduous Forest 584,736 ha
- Boreal Evergreen Forest 1,059,412 ha
- Dense Shrubland 21,098,280 ha
- Desert 3,006,451 ha
- Evergreen/Deciduous Mixed Forest 21,533,543 ha
- Grassland/Steppe 54,227,089 ha
- Open Shrubland 18,809,707 ha
- Savanna 27,377,392 ha
- Temperate Broadleaf Evergreen Forest 4,756,065 ha
- Temperate Deciduous Forest 24,592,315 ha
- Temperate Needleleaf Evergreen Forest 7,869,501 ha
- Tropical Deciduous Forest 17,672,228 ha
- Tropical Evergreen Forest 2,265,547 ha

Area (HA)

0
10,000,000
20,000,000
30,470,000

Type

- Conventional Wheat
- Organic Wheat

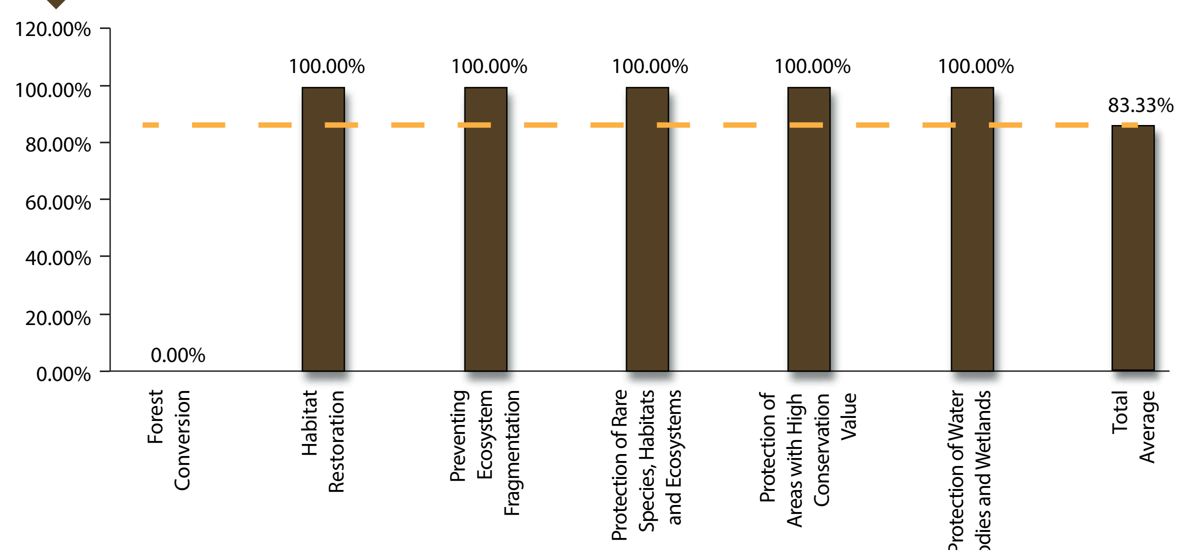
Data Sources: Chaudhary et al., 2015; FAOStat; Lernoud et al., 2015

1 INTRODUCTION
2 VOLUNTARY SUSTAINABILITY STANDARDS
3 BACKGROUND
4 CRITERIA COVERAGE ANALYSIS
5 MARKETS CEREALS
6 CONCLUSION
7 POLICY OPTIONS
8 APPENDICES

Apart from not having specific requirements articulated for the preservation of forests, the Organic standard has critical requirements for all of the subindicators in our Conversion of Natural Habitats Index. In addition to preventing and protecting ecosystems, areas of high conservation values, water bodies and wetlands as well as rare species and their habitats, the Organic standard also requires the restoration of habitats, which could include forests. Although Organic standards offer higher-than-average protections against natural habitat conversion, it seems unlikely that significant market uptake (and therefore impact) can be expected without a dedicated effort involving mainstream industry. In other sectors where Organic operates, it has not managed to secure significant portions of the mainstream market. The development of a specific international wheat (or cereals) initiative with prohibitions on forest conversion could offer a special opportunity for expanding market uptake and the overall role of voluntary standards in the protection of natural habitats threatened by wheat expansion (and other cereals).

Organic certification (as defined under the International Federation of Organic Agriculture Movements) includes critical requirements on all measured pathways within the index except for prohibitions against forest conversion. While Organic certification scores well above the average intensity of 75 per cent for the group of standards reviewed across the Conversion of Natural Habitat Index, 87 per cent of the larger group of standards include prohibitions against forest conversion as critical requirements.

Figure 17. Conversion of Natural Habitat Index-Wheat Standards: Average intensities for Organic agriculture across key pathways for protection of natural habitats in agricultural production



Source:VSS criteria information obtained from ITC Standards Map

5.3 Cocoa

Table 5. Cocoa Standards, Key Market Statistics (2014)

Voluntary Standard	Compliant Production 2014 (tonnes)	Compliant Area 2014 (ha)	Portion of Global Trade	Portion of Global Production	Portion of Global Area
Fairtrade	176,448	424,863	5%	4%	4%
Organic	118,700	229,458	4%	3%	2%
Rainforest Alliance	574,830	846,522	17%	13%	8%
UTZ	879,771	1,502,424	25%	19%	14%
Total (Adjusted for Multiple Certification)	1,362,027	2,337,780	40%	30%	22%

Source: ITC, FIBL, FAOstat data

It is estimated that around 70 per cent of cocoa is cultivated with various levels of shade using one or another agroforestry model (Gockowski & Sonwa, 2011; Somarriba et al., 2012). As such, cocoa production is recognized as offering a particularly compelling opportunity for combining agricultural production with the maintenance of biodiverse-rich landscapes and ecosystems (Schroth & Harvey, 2007; Utomo et al., 2016; Vaast & Somarriba, 2014). However, efforts to increase yields over the past several decades have fuelled a growing trend toward the adoption of full sun varieties in some regions, leading to forest conversion and a general decline in ecosystem integrity (Ruf, 2011; Vaast & Somarriba, 2014). Although the transition toward full-sun production has nominally been fuelled by the desire for increased yields, overall, cocoa yields remain systemically low, averaging around 450 kg/ha (Andres et al., 2016) against a theoretical maximum of about 1.5 tonnes/ha (Terazono, 2014). This is attributed largely to the old-age farms supplying a large portion of African production as well as the absence of adequate pest management and fertilizer use (Wessel & Quist-Wessel, 2015). More than three quarters of cocoa beans traded on international markets with Europe and the United States account for 36 and 23 per cent of global consumption, respectively. Recently, Asia has been playing an increasingly important role in global consumption and represents an important driver of growing demand (Pipitone, 2015).

Low yields, combined with a steadily growing global demand, have driven a 32 per cent increase (by 2.4 million hectares) in the global cocoa area between 2000 and 2013 (Terazono, 2014). Roughly 90 per cent of the expansion of cocoa cultivation has occurred in the West African countries Cote D'Ivoire, Cameroon, Nigeria and Ghana (accounting for 47 per cent of expansion area), and in Indonesia (accounting for 42 of expansion area) (FAO, 2016b). Both the Guinean rainforest and the entirety of Indonesia are designated biodiversity hotspots, with cocoa operating as a driver of deforestation in both areas.[41] The potential impact of cocoa production on biodiversity is therefore significant. Meanwhile, it is generally recognized that capacity building and innovation aimed at a rejuvenation of global production will be key to ensuring the long-term sustainability of the cocoa sector (Terazono, 2014; Vaast & Somarriba, 2014).

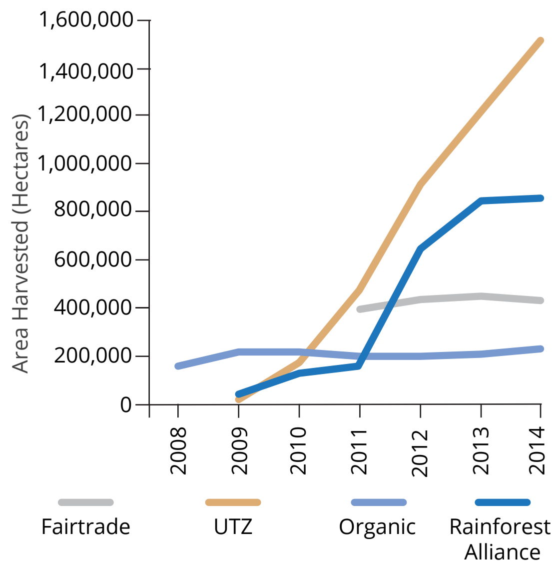
41 The International Institute for Tropical Agriculture and the Center for International Forestry Research have reported unnecessary deforestation and forest degradation in the Guinean rainforest of West Africa due to low productivity cocoa farming at a minimum of 2.1 million ha since 1960, accounting for 1.4 billion tonnes of carbon dioxide released into the environment (Gockowski & Sonwa, 2011).

The adoption of voluntary standards by mainstream actors in the cocoa sector has principally been driven by the desire to manage reputational risks associated with widespread reports of child and slave labour within the sector (Tulane University, 2015; U.S. Department of State, 2001), as well as by the growing recognition of the need for improved management at the farm level. Affiliation with a voluntary standard is often regarded as a vehicle for facilitating both objectives.

By capitalizing on these forces, the cocoa market has, over just five years, taken a leadership role, in terms of the percentage of global production compliant with an international sustainability standard. By 2014, standard-compliant cocoa production had reached 1.4 million tonnes, or 30 per cent of global production, up from 111,000 tonnes, or 3 per cent of production in 2008. The main voluntary standards operating in the cocoa sector are Fairtrade, Organic, Rainforest Alliance and UTZ. UTZ and Rainforest Alliance-certified production account for 85 per cent of certified cocoa globally and also represent virtually all the growth since 2009, with production volumes increasing by 177 per cent (UTZ) and 168 per cent per cent (Rainforest) per annum between 2009 and 2014. As of 2014, certified cocoa production is predominantly located in Cote d'Ivoire (53 per cent), Ghana (14 per cent) and Indonesia (6 per cent) (see Figure 18).

Certification in the cocoa sector has been stimulated by the proactive engagement of major cocoa processors in seeking sustainable sourcing for cocoa supply, with three of the top five largest confectioners having committed to sourcing sustainably by 2020 (including Hershey's, Ferrero, Mars and Lindt) (Fountain & Hütz-Adams, 2015). Mondelez and Nestle, the two largest confectioners in terms of volume of cocoa sourced, while not having made commitments to 100 per cent VSS-compliant sourcing, nevertheless sourced 11 and 33 per cent of their cocoa from certified sources respectively by 2016 (Fountain & Hütz-Adams, 2015).

Figure 18. Standard-compliant cocoa area, by initiative, 2009–2014



Average Annual Growth:

Fairtrade: 3%
Organic: 7%
Rainforest Alliance: 87%
UTZ: 166%

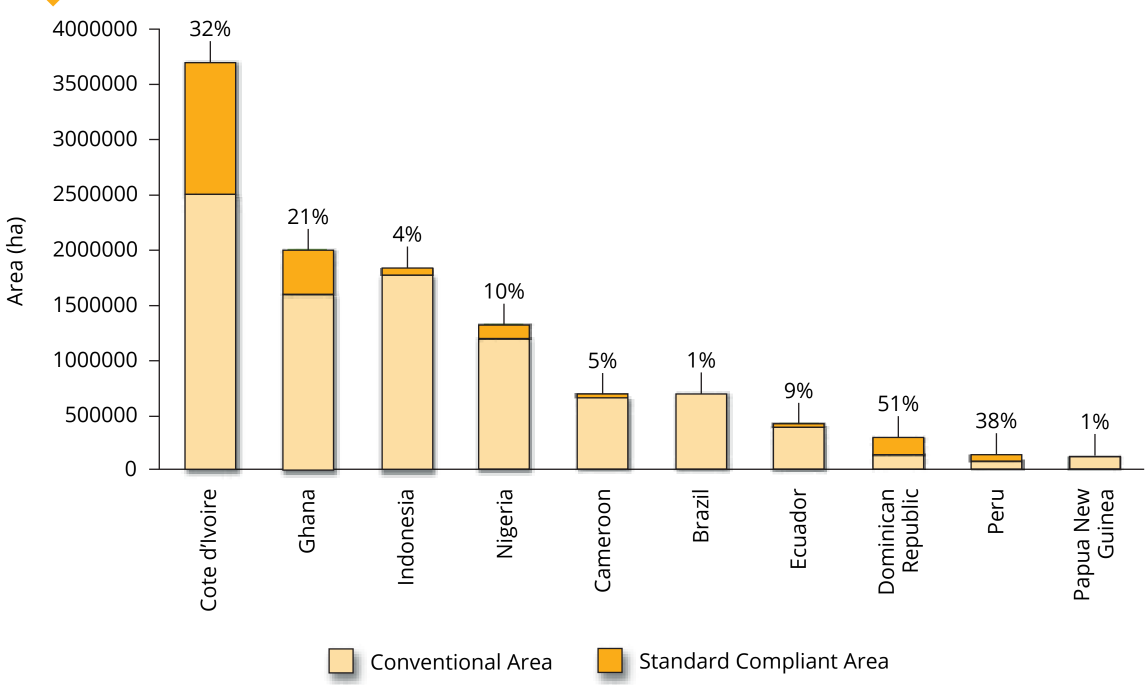
Data Source: Lernoud et al., 2015

5.3.1 Spotlight on Cocoa Production and Soil Fertility

Although cocoa is native to Latin America, Africa became the most important commercial source of cocoa following the Second World War and currently accounts for 65 per cent of global production. The cocoa sector has increasingly been plagued with low yields due, in large part, to production practices that extract the soil nutrients of appropriated forestland without adequate nutrient recycling practices (Asare, 2005). As cocoa farms around the world, but particularly in Africa, age, biodiversity and soil fertility have continued to decline, leading to increasingly reduced yields. This general trend toward soil degradation across most African cocoa-producing countries has been exacerbated over the past several decades through a long-term trend toward full-sun cocoa production, which has been associated with aggravating long-term soil degradation on the continent (Schroth & Harvey, 2007; Siebert, 2002; Tondoh et al., 2015).

Figure 19 shows the level of topsoil organic matter within the cocoa-growing regions of the world with corresponding levels of standard-compliant cocoa production. The major African producing regions have some of the lowest organic top soil, which is indicative of the production challenges these countries face, but they also have the highest levels of standard-compliant areas in terms of absolute numbers. Where sustainability standards in other commodities are typically regarded as tools for managing reputational risk or gaining a market advantage, standards in the cocoa sector have also been promoted as tools for securing supply by increasing yields through improved management practices leading to major adoption rates in the African producing countries.

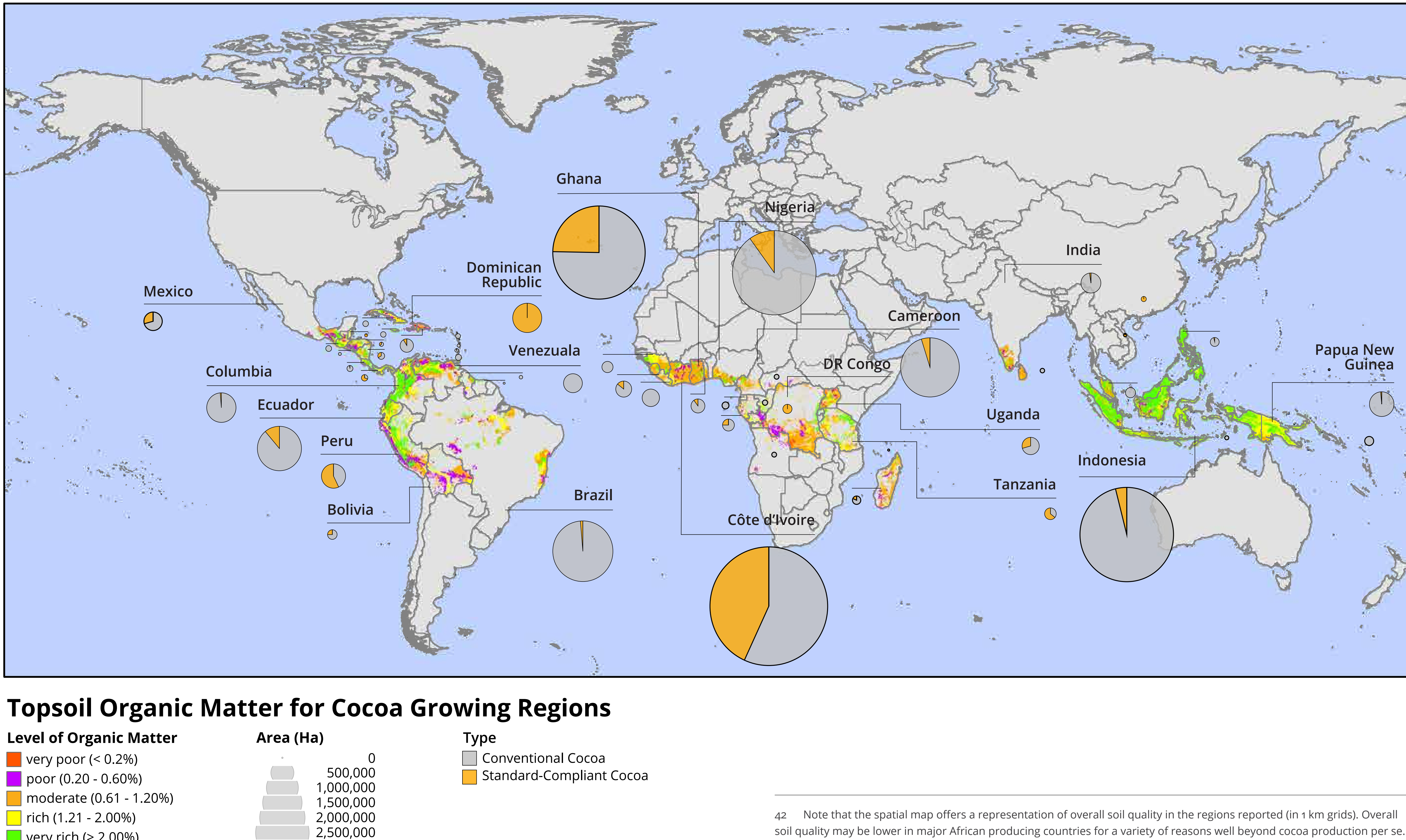
Figure 19. Percentage of standard-compliant area across the top 10 cocoa-producing countries (2014)



Source: ITC, FIBL, FAOstat data

Standard-compliant cocoa production area has increased significantly in recent years, with the largest producing countries including Cote d'Ivoire (54 per cent of global), Ghana (19 per cent of global), Dominican Republic (7 per cent), Indonesia (3 per cent of global) and Peru (3 per cent of global). As with other commodity sectors, standard-compliant cocoa production is more concentrated than conventional production and is dominated by leading cocoa exporters. Thus, while African source countries account for 65 per cent of global cocoa production by volume, they account for 73 per cent of global standard-compliant production. Indonesia, however, which is also a major exporter and accounts for 11 per cent of global production by volume, only accounts for 6 per cent of global standard-compliant production. The disproportionately high adoption of standards in the African region may be explained by the more demanding sustainability challenges related to forced labour and poor soil management conditions. Indonesia, although currently experiencing a relatively lower percentage of standard-compliant production than its African counterpart producing countries, may represent an opportunity in the opposite direction in coming years. There is a potential role for certification to play in ensuring the conservation of the country's peat-rich soils as cocoa production expands. The Dominican Republic, on the other hand, points toward the potential for individual countries to use voluntary standards in a strategic manner for product differentiation. Although the Dominican Republic only accounts for 1.6 per cent of global cocoa production, it accounts for a stunning 12 per cent of global standard-compliant production. The distribution of standard-compliant production in the cocoa sector aligns well with potential soil quality challenges arising at supply. Both the Dominican Republic and Africa face significant soil quality challenges and are also leaders in cocoa certification.

Figure 20. Soil organic matter in cocoa-producing regions with standard-compliant production. Historically, cocoa production has drawn soil fertility from previously forested lands without adequate recycling of organic matter. The map below reveals a significant degradation of soil quality in the more mature cocoa-growing regions across Africa. Soil degradation, in addition to being both an indicator and consequence of biodiversity loss, is associated with declining yields across the African continent[41]



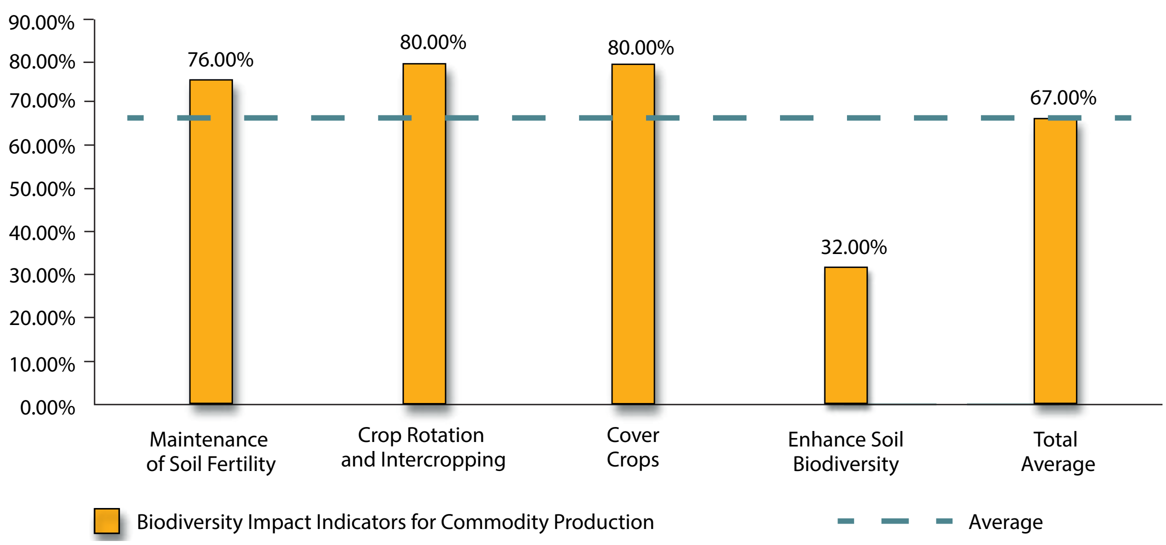
Data Sources: Chaudhary et al., 2015; FAOStat; Lernoud et al., 2015

42 Note that the spatial map offers a representation of overall soil quality in the regions reported (in 1 km grids). Overall soil quality may be lower in major African producing countries for a variety of reasons well beyond cocoa production per se. The moderate level of soil quality in the African region generally presents a challenge for cocoa producers and speaks to the importance of production practices that enhance soil quality.

Overall, cocoa sustainability standards with an average coverage intensity of 67 per cent (see Figure 21) have higher coverage than agriculture standards as a whole (58 per cent). Organic certification, perhaps not surprisingly in light of its long-standing focus on soil health, has the highest overall coverage of critical requirements for each of the indicators in the Soil Organic Matter Index with an average score of 100 per cent. Nevertheless, all of the remaining standards, with the exception of Fairtrade standards for smallholders, have higher-than-average coverage for soil requirements.

All of the cocoa standards have provisions for maintaining soil health in the form of generally maintaining soil fertility but also more specifically by adopting crop rotation, intercropping and cover crops. In addition to the soil health criteria mentioned above, Organic and Rainforest Alliance also have provisions for specifically maintaining soil biodiversity, which can be instrumental in maintaining soil health by enabling aeration, waste decomposition, carbon storage, pest control and nitrogen fixing (European Commission, 2010).[43]

Figure 21. Soil Organic Matter Index-Cocoa Standards: Cocoa standards have higher-than-average coverage of requirements aimed at maintaining soil organic matter. (Standards covered: Organic, Fairtrade, Rainforest Alliance and UTZ Certified)



VSS criteria information obtained from ITC Standards Map

43 It should be noted that all of the practices measured in the Soil Organic Matter Index are associated with increased soil biodiversity. Requirements specifically related to the maintenance of soil biodiversity help farmers focus on choosing the most effective strategies for maintaining soil biodiversity.

5.4 Coffee

Table 6. Coffee Standards, Key Market Statistics (2014)

Voluntary Standard	Compliant Production 2014 (tonnes)	Compliant Area 2014 (ha)	Portion of Global Trade	Portion of Global Production	Portion of Global Area
4C (FIRST PARTY VERIFI-CATION)	2,871,682	1,657,819	41%	33%	16%
Fairtrade	473,604	1,012,023	7%	5%	10%
Nespresso AAA (PRIVATE LABEL)	55,000 (2013 purchases)	255,818 (2012 area)	1%	1%	2%
Organic	264,310	620,428	4%	3%	6%
Rainforest Alliance	495,461	364,785	7%	6%	3%
Starbuck's C.A.F.E. Prac-tices (PRIVATE LABEL)	199,637 (2014 purchases)	372,631 (2012 area)	2%	2%	4%
UTZ	729,918	475,578.0	10%	8%	5%
Total (Adjusted for Multiple Certification)	4,183,107	3,295,768	60%	48%	31%

Source: ITC, FIBL, FAOstat data

Coffee, like cocoa, has traditionally been grown in agroforestry or "shade" systems that incorporate native species and multi-level canopy cover, allowing for relatively low impacts to biodiversity. However, over time, the proportion of land used for shade-grown coffee has decreased, accounting for a mere 24 per cent of cultivated area in 2010, down from 43 per cent in 1996 (Jha et al., 2014). The main driver behind the decrease in shade systems is the perceived increase in yields that may be enabled through more intensive production systems, including full-sun systems, accounting for 41 per cent of production in 2010, or sparse-shade systems, accounting for 35 per cent of production. This "technification" of production has coincided especially in Vietnam, Brazil and parts of Africa, with increased plantings of the Robusta species of coffee, whose yields are higher (Marsh, 2007) and more stable than Arabica coffee (International Trade Centre, 2011). It is less clear how shade cover affects yields, although studies have shown that the optimal conditions for maximizing coffee yields may in fact be semi-shaded systems with, for example, between 35 and 50 per cent shade cover (Perfecto, Vandermeer, Mas, & Pinto, 2005; Soto-Pinto, Perfecto, Castillo-Hernandez, & Caballero-Nieto, 2000). The net result of the coffee sector's shift in farming materials and methods has enabled a 36 per cent increase in global production volumes with a mere 9 per cent expansion in land area harvested between 1996 and 2010.

This "accomplishment," however, must be considered with caution from the perspective of biodiversity conservation. On the one hand, coffee is grown in 13 of the world's 25 biodiversity hotspots, with more than 80 per cent of the total land area devoted to coffee cultivation in areas of current or former rainforest (Halweil, 2002). Sun coffee production entails not only the complete removal of native plant species in these areas but also increased application of agrochemicals and irrigation, greater exposure to soil erosion and reduced carbon sequestration.[44] On the other hand, coffee, like cocoa offers an exceptional opportunity for the production of the highest quality product with only minimal disturbance on local ecosystems (Vaast, Bertrand, Perriot, Guyot, & Génard, 2006). Coffee thus has the potential to play a key role in providing a market-driven force for the protection of critical biodiversity regions across the world. This potential is augmented by the structure of the market, which sees 80 per cent of global production being sold on international markets, of which 65 per cent is consumed in North America (21 per cent) and Europe (44 per cent)—both markets with significant consumer support for certified sustainable coffees.

Sustainability standards in the coffee sector are among some of the earliest among internationally traded commodities, with Fairtrade labelling and Rainforest Alliance offering dedicated coffee standards by the late 1980s (Potts, Lynch, Wilkings, Huppé, & Voora, 2014). The adoption of standards in the coffee sector were initially driven by poverty-reduction efforts (Fairtrade) and rainforest protection (Rainforest Alliance) and aimed at niche markets. However, these and a number of newer initiatives have since adopted a broad-based approach aimed at tackling a host of sustainability issues ranging from labour rights to general ecosystem protection while simultaneously targeting mainstream markets.

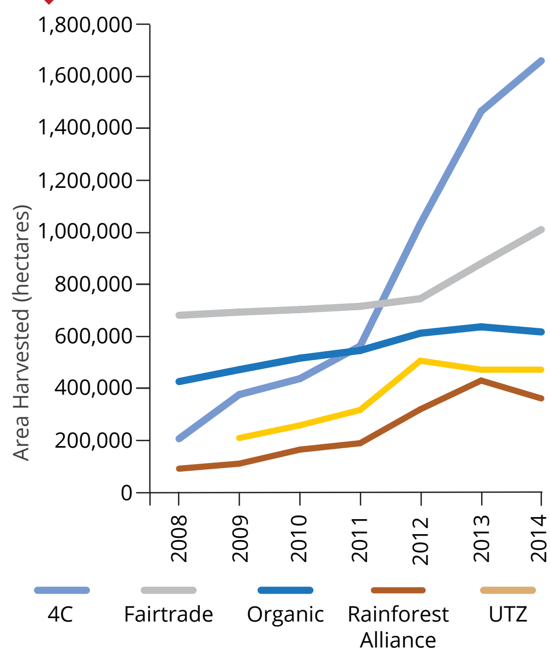
The maturity of markets for sustainable coffee has allowed it to play a leading role among globally traded commodities in paving the way to mainstream adoption of standard-compliant production. As early as 2009 an estimated 17 per cent of global production was certified or verified as "sustainable" (Potts, Van der Meer, & Daitchman, 2010). By 2014 *standard-compliant coffee production had reached 4.2 million mt, accounting for 48 per cent of global production, up from 1.3 million tonnes, or 15 per cent of production in 2008. The main voluntary standards operating in the coffee sector are 4C, Fairtrade, Organic, Rainforest and Utz Certified*. The rapid growth in standard-compliant production over the past decade has been driven primarily by growth in 4C, UTZ Certified and Rainforest-compliant coffees, each of which grew at rates of 36 per cent, 15 per cent and 22 per cent per annum between 2009 and 2014, respectively. Standard-compliant coffee production is primarily located in Latin America (69 per cent of global sustainable production) with Brazil (41 per cent), Colombia (12 per cent), Honduras (5 per cent), Peru (5 per cent) and Mexico (3 per cent) also playing leadership positions in supply (see Figure 23).

44 See Perfecto et al. (1996) and May, Mascarenhas and Potts (2004)

As with other sectors, formal commitments by mainstream coffee manufacturers have driven mainstream growth in the adoption of standards. Leading examples of such commitments include:

- Nestle – to source a minimum of 180,000 tonnes of coffee from 4C-compliant farms, equivalent to about 25 per cent of total coffee sourced, achieved by 2013 (Nestle, 2016a; Panhuysen & Pierrot, 2014)
- Smuckers – to source 10 per cent of coffee from compliant sources, achieved by 2016 (Panhuysen & Pierrot, 2014; Smucker's, 2016)
- Starbucks – to source 100 per cent of coffee from 4C, Fairtrade, or other compliant sources by 2015; achieved 99 per cent by 2015 (Panhuysen & Pierrot, 2014; Starbucks, 2016)
- Tchibo – To source 25 per cent from compliant sources by 2015, achieved 30 per by 2013 (Panhuysen & Pierrot, 2014; Tchibo, n.d.).
- Keurig Green Mountain – committed to 100 per cent standard-compliant sourcing by 2020, and achieved 23 per cent by 2015 (Keurig, 2016; Panhuysen & Pierrot, 2014).

Figure 22. Standard-compliant coffee area, by initiative, 2009–2014



Average Annual Growth:

4C: 41%
Fairtrade: 7%
Rainforest Alliance: 25%
UTZ: 17%

Data Source: Lernoud et al., 2015

5.4.1 Spotlight on Coffee Production and Biological Oxygen Demand

The application rates of nitrogen and phosphorus can only give an indication of the potential water quality impacts that agriculture may have. Measuring the BOD of water bodies, potentially affected by agricultural activities, is a more direct measure of water quality and aquatic health, which can affect the biodiversity. The grey water footprint of agricultural crops estimates the amount of water required to assimilate the pollution from nitrogen fertilizer-enriched runoff from agricultural fields and is used as a proxy for measuring BOD at sampling points.[45]

Coffee can be grown in shade as well as full sun environments. Overall, coffee-growing regions have not traditionally been associated with significant water quality impacts since agroforestry crops are less susceptible to agricultural runoff. However, driven by the desire for higher yields, over the course of the 1990s, many shade-grown coffee farms were converted to full-sun systems, which, in turn require the increased use of fertilizers.

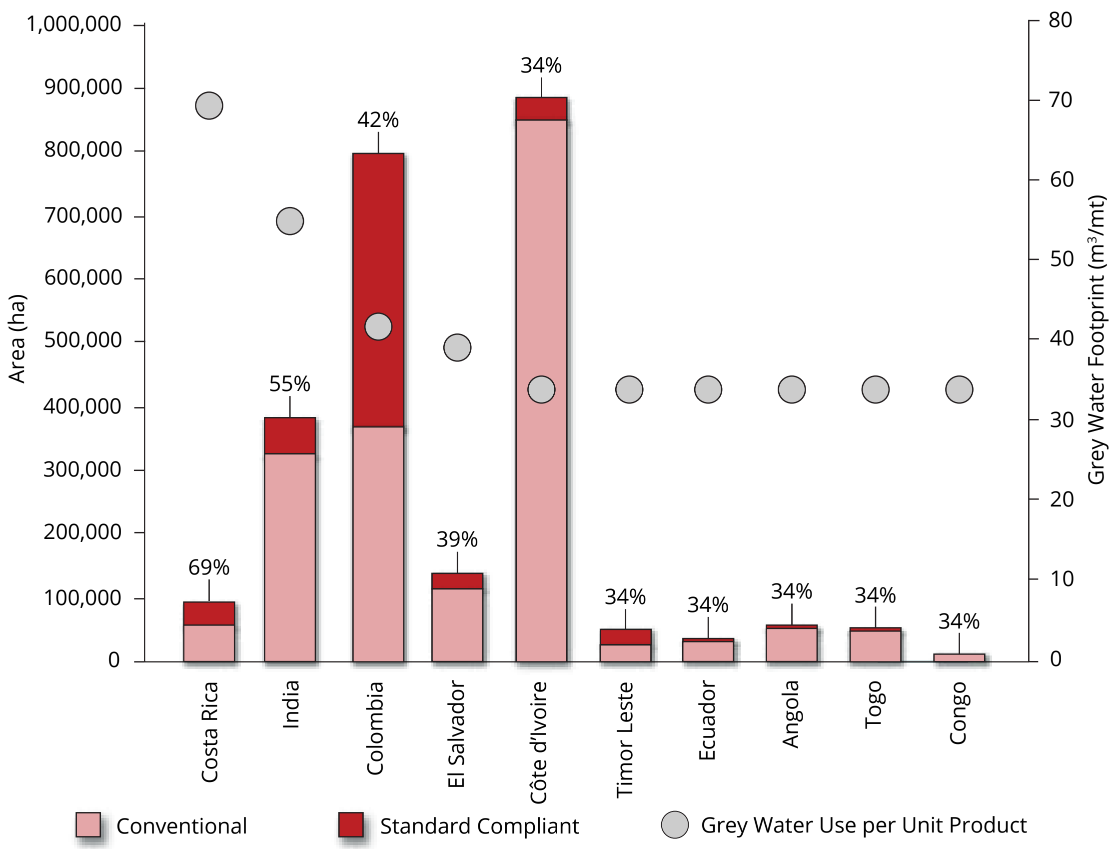
It is estimated that 1.1 million ha (41 per cent) were converted from shade-grown to sun cultivation in Latin America during the 1990s alone (Rice & Ward. 1996). Although the rate of transition from shade-grown to sun-grown coffee has slowed over the past two decades, the trend toward sun-based production has continued to grow. Of the roughly 10 million hectares of coffee production globally in 2014, only 23 per cent consisted of diverse shade systems, as opposed to 43 per cent in 1996 (Jha et al, 2014). The cultivation of, or transition to, sun-grown coffee is particularly pronounced in Brazil, Vietnam, Indonesia, Colombia, Costa Rica, El Salvador, Nicaragua and Guatemala (Jha et al, 2014).

A mapping of the grey water footprint of coffee-growing regions (Figure 23) reveals a close association between sun-grown coffee and an increased grey water footprint from coffee production. From the perspective of reducing the BOD of coffee production, voluntary standards have a particular interest in addressing regions where sun-grown coffee has increased or become dominant. However, with the extremely dynamic nature of coffee production and the potential for virtually any shade-grown farm to convert to sun, voluntary standards also have an important role to play in preserving existing shade-grown systems by enabling specialty markets that favour them.

Brazil, Colombia, Mexico and Peru lead in area covered by standard-compliant production, with 27.8 percent, 13.9 per cent, 10.1 per cent and 8.7 per cent, respectively. In terms of grey water use, (per unit of product) Costa Rica, India and Colombia lead, with each registering more than 40 m^3 of grey water per tonne.

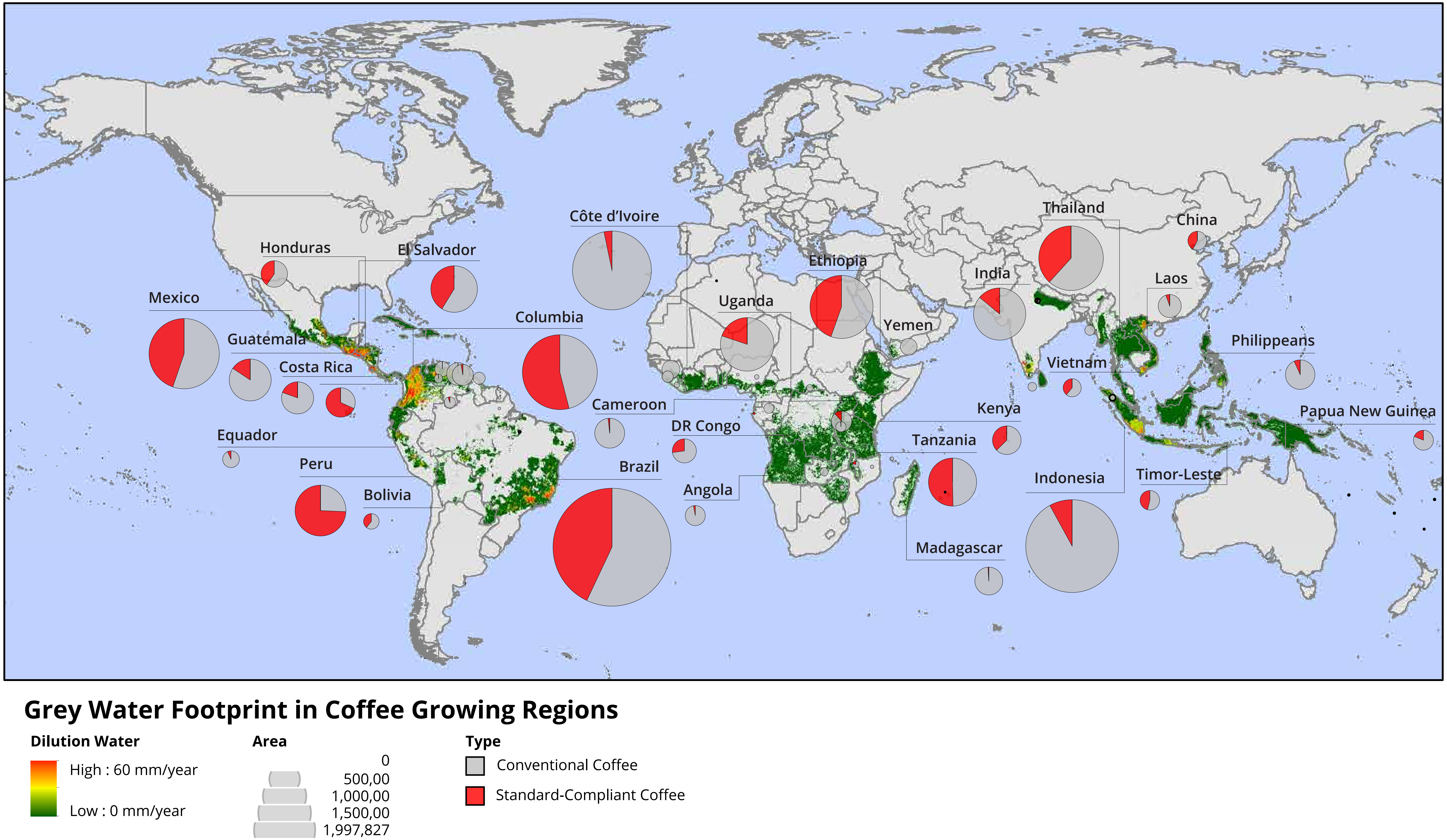
45 "The grey component of the water footprint (m^3/ton) is calculated by multiplying the fraction of nitrogen that leaches or runs off by the nitrogen application rate (kg/ha) and dividing this by the difference between the maximum acceptable concentration of nitrogen (kg/m^3) and the natural concentration of nitrogen in the receiving water body (kg/m^3) and by the actual crop yield (ton/ha)" (Chapagain, Hoekstra, Savenije, & Gautam, 2005, p. 10).

Figure 23. Top ten coffee-producing countries in terms of grey water footprint



Source: Mekonnen & Hoekstra (2010); ITC, FIBL, FAOstat data

Figure 24. Grey water footprint across coffee-growing regions. Although coffee production has historically been associated with low-input shade production and, correspondingly, a low grey water footprint, the last three decades has given rise to a growing presence of sun-grown coffee and significant increases in biological oxygen demand from coffee production. High grey water use aligns with high presence of sun-grown coffee.

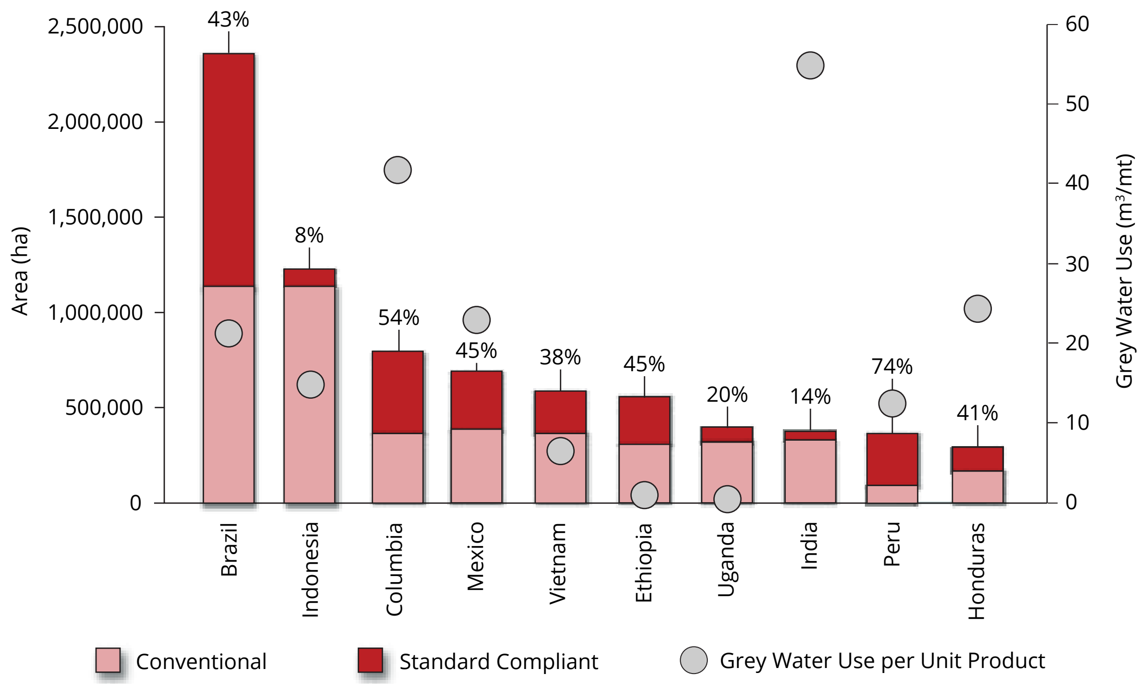


Data Sources: Chaudhary et al., 2015; FAOStat; Lernoud et al., 2015

Taking into consideration, total hectares for coffee production, standard-compliant area and grey water footprint per unit of coffee produced, the greatest opportunities for standards to reduce the grey water footprint of coffee production seem to be in Brazil, Colombia and India as shown in Figure 24. Based strictly on grey water footprint per tonne of coffee production, Costa Rica, India and Colombia represent important opportunities for standards to address potential water quality impacts associated with coffee production (see Figure 25).

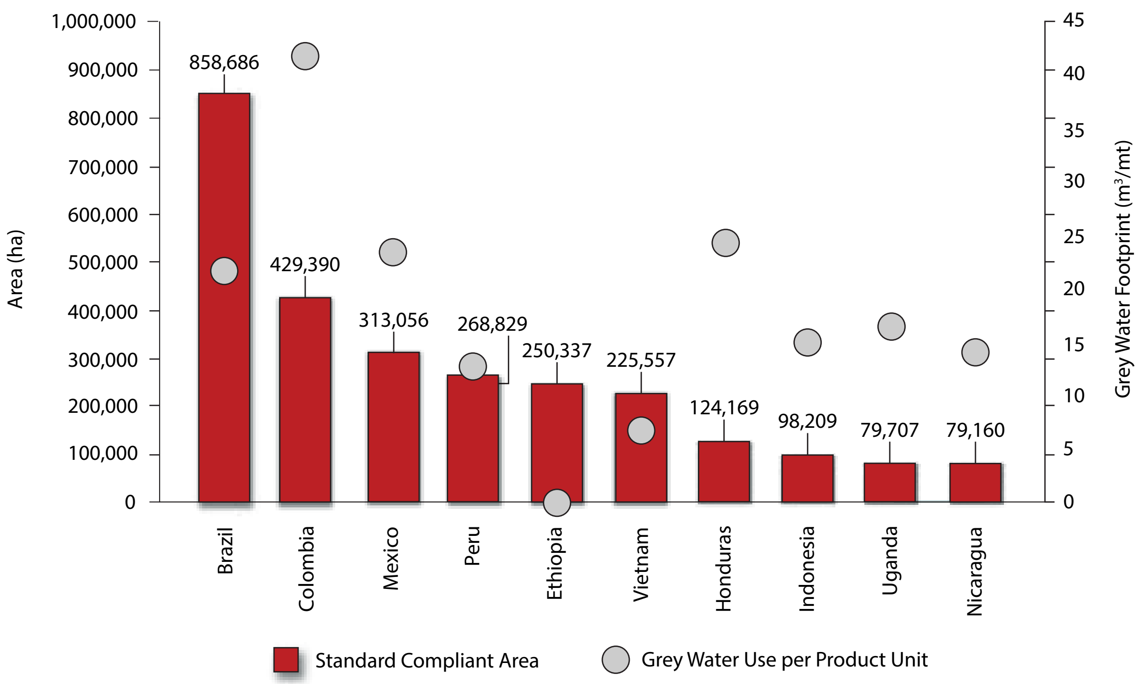
As we note below, however, not all standards treat wastewater management equally. The Global Coffee Platform (GCP), for example, has only the most minimal requirements related to wastewater management. Importantly, the GCP is also the most widely present standard in major sun-growing regions, accounting for 73 per cent of Brazilian, 61 per cent of Colombian, 94 per cent of Thai, 41 per cent of Indonesian and 75 per cent of Vietnamese standard-compliant coffee. The concentration of GCP-compliant production in regions where wastewater management is most likely to be an issue represents a potential concern for the management of the BOD-related impacts of coffee production and/or a potential opportunity for GCP or other standards to bring improved wastewater management practices to these areas.

Figure 25. Grey water footprint across the top ten coffee-producing countries (2014)



Source: Mekonnen & Hoekstra (2010); ITC, FIBL, FAOstat data

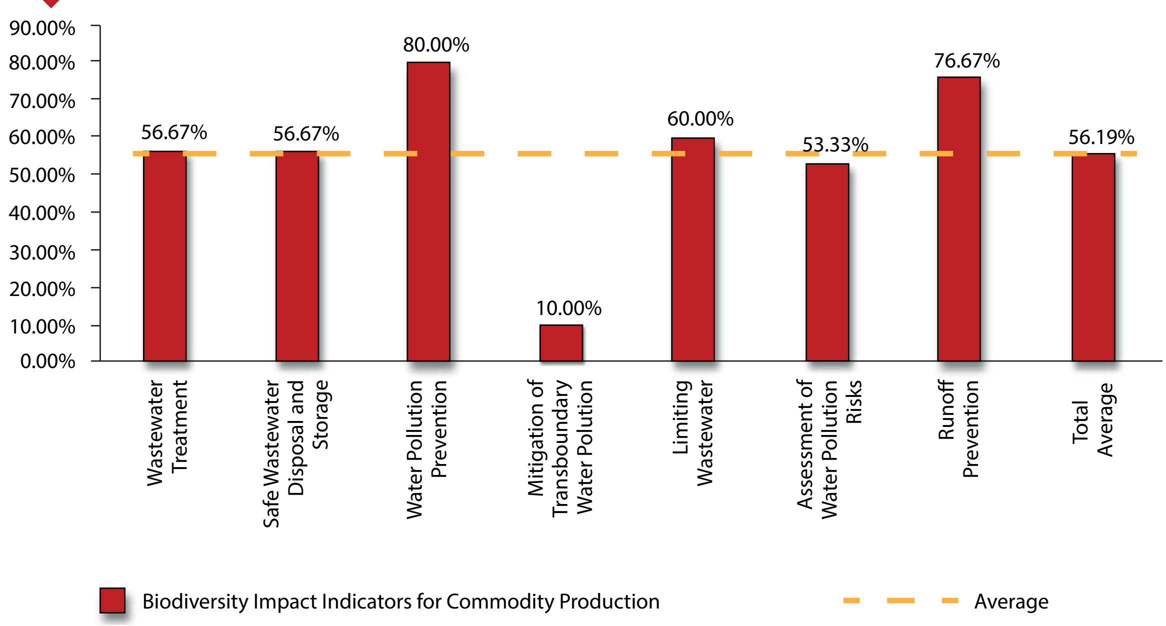
Figure 26. Grey water footprint in leading countries in terms of standard-compliant area (2014)



Source: Mekonnen & Hoekstra (2010); ITC, FIBL, FAOstat data

Coffee standards as a group have a lower-than-average intensity for coverage of wastewater management requirements (56 per cent average intensity for coffee as opposed to 61 per cent average intensity for all agriculture standards). All the standards examined have provisions for preventing water pollution, but only one (Rainforest Alliance) has a provision for mitigating transboundary water pollution. This can be explained in part by the focus that coffee standards have on the farmland where they implement their programs as opposed to a larger landscape, regional or transboundary scope. Rainforest Alliance has the highest overall average intensity with 83 per cent coverage, while the GCP has the lowest at 26 per cent. Organic standards, on the other hand stand out for having the highest number of critical criteria (5 out of 7), suggesting a higher wastewater management bar for initial entry into the system. Fairtrade standards offer a relatively low wastewater management bar for smallholder farmers due to the higher costs of implementing such practices across a smaller farm area.

Figure 27. Biological Oxygen Demand Index: Coffee standards (Rainforest Alliance, Utz Certified, Organic, Fairtrade, GCP). Coffee standards as a group have lower-than-average coverage (as compared to all agriculture standards) of requirements related to reductions in biological oxygen demand. Assessment of water pollution risks represents an area where coffee standards reveal lower-than-average coverage. Rainforest Alliance registers the highest overall average intensity at 87 per cent, while Organic registers the highest number of critical requirements related to wastewater management. (Rainforest Alliance, Utz Certified, Organic, Fairtrade, Global Coffee Platform)



Source: VSS criteria information obtained from ITC standards Map

5.5 Cotton

Table 7. Cotton Standards, Key Market Statistics (2014)

Voluntary Standard	Compliant Production 2014 (tonnes)	Compliant Area 2014 (ha)	Portion of Global Trade	Portion of Global Production	Portion of Global Area
BCI	1,623,700	1,612,000	16%	6%	5%
CmiA	152,942	585,339	2%	1%	2%
Fairtrade	49,949	86,834	1%	0.2%	0.2%
Organic	116,974	220,765	1%	0.4%	0.6%
Total (Adjusted for Multiple Certification)	1,865,089	2,348,183	18%	7%	7%

Source: ITC, FIBL, FAOstat data

Cotton is one of the world's most pesticide- and water-intensive crops. Prior to the widespread introduction of genetically modified Bt cotton over the last decade, cotton production accounted for 25 per cent of all insecticides applied in agriculture (Social Environmental and Economic Performance of Cotton, 2012). By 2015, genetically modified (GMO) cotton accounted for 75 per cent of global plantings and has directly resulted in significant declines in pesticide usage (James, 2015). Cotton therefore represents something of a global example for the environmental potential of GMO crops. From a biodiversity perspective, the massive reduction in the use of synthetic inputs enabled by Bt cotton represents a significant and undeniable reduction of the chemical burden of cotton production on local ecosystems (Barfoot & Brookes, 2005; Lu et al., 2012; Qaim & Kouser, 2013; Wu et al., 2008). The widespread transition to a limited number of GMO strains across production, however, represents a major threat to the biodiversity of cotton strains available to farmers as well as the biodiversity of local ecosystems as they adapt to single-strain cotton production on a global scale (Gilbert, 2013). Moreover, there are indications that the effectiveness of existing GMO strains may be in decline due to resistance development (Mortensen et al., 2012). The achievements enabled by GMO cotton production need to be balanced with the increased risk resulting from global reliance on a few select strains of cotton.

Cotton's water footprint is also remarkable among agricultural crops. The global average water demand for cotton production is estimated to be 3,644 m^3/mt.[46] It is estimated that it can take up to 20,000 litres of water to produce a single t-shirt due to significant and often inefficient irrigation needs for production. Water usage for cotton production has been associated with significant impacts on local water resources, (Hoskins, 2014). Reliance on heavy irrigation can also lead to reduced soil biodiversity through soil salinization. Overall, it is estimated that one third of irrigated cotton production globally is affected by salinity or is expected to become affected by salinity in the near future (Chapagain, Hoekstra, Savenije, & Gautam, 2006). Salinization also increases the need for synthetic fertilizers, which, in turn, can provoke eutrophication.

The aforementioned environmental concerns, combined with concerns for the well-being of African cotton producers in light of pervasive global subsidies in more developed economies, has stimulated the growth of several voluntary

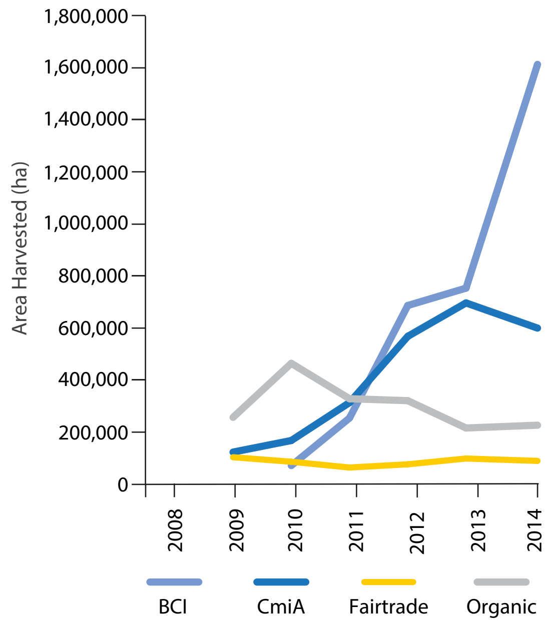
46 This figure is based on an assessment of the most important cotton-producing countries, accounting for 95 per cent of global production (Chapagain, Hoekstra, Savenije, & Gautam, 2006).

standards in the cotton sector. By 2014, 1.9 million mt or 7 per cent of global cotton lint production was VSS compliant, up from 163,000 tonnes or 1 per cent in 2008. The major voluntary standards operating in the cotton sector are the BCI, Fairtrade, Organic and Cotton Made in Africa. BCI-compliant production, also known as "Better Cotton," is by far the dominant initiative, growing by 56 per cent per annum between 2012 and 2015. Remarkably, compliant volumes for other cotton standards either shrank or remained stable. Standard-compliant cotton production is predominantly spread across Brazil (41 per cent) and Pakistan (17 per cent). BCI is harmonized with Cotton Made in Africa, Australia's my Better Management Practices and Brazil's Algodão Brasileira Responsável (Responsible Brazilian Cotton), which has enabled rapid uptake of the standard. BCI aims to have 30 per cent of the world's cotton production licensed through the program by 2020.

As with other sectors, formal commitments by mainstream cotton manufacturers has driven mainstream growth in the adoption of standards. Leading examples of such commitments include:

- Levi Strauss & Co: Committed to sourcing 75 per cent from BCI suppliers by 2020; by 2016 the company had reached 6 per cent (Levi Strauss, 2016).
- Adidas: Committed to sourcing all cotton from "more sustainable sources" by 2018; by 2015 the company sourced 43 per cent from BCI (Adidas, n.d.).
- H & M: Committed to sourcing 100 per cent from recycled, Organic or BCI by 2020; by 2015 the company sourced 31 per cent of cotton from these sources (H & M, 2016).
- Ikea: Currently sources 100 per cent from either BCI, cotton from farmers working toward BCI or from regional standards such as e3 cotton in the United States (Ikea, 2015).
- Nike: Committed to sourcing 100 per cent of cotton from either Organic, recycled, or BCI by 2020; by 2015 the company had reached 26 per cent, 10 per cent of which was Organic, 19 per cent BCI, of which at least 3 per cent was double-certified by BCI and Organic (Nike, 2016).
- Marks and Spencer: Committed to sourcing 70 per cent of its cotton from either Organic, recycled, Fairtrade or BCI sources by 2020; by 2016 had reached 33 per cent (Marks and Spencer, 2015).

Figure 28. Standard-compliant cotton area, by initiative, 2009–2014



Average Annual Growth:

BCI: 123%
CmiA: 38%
Fairtrade: -2%
Organic: -3%

Data Source: Lernoud et al., 2015

5.5.1 Spotlight on Cotton Production and Water Use

Cotton is known as a "thirsty crop," often requiring irrigation to give sufficient yields. Perhaps the most striking example of excessive water use for cotton production is the shrinking of the Aral Sea in Central Asia, which lost 60 per cent of its area and 80 per cent of its volume over a 40-year period, between 1960 and 2000, due in large part to cotton irrigation in the dry regions of Central Asia (Chapagain, Hoekstra, Savenije, & Gautam, 2005). Since this trend has continued, the Aral Sea, formerly the world's fourth largest lake supporting 24 species of fish, bordering forests and wetlands, has almost entirely disappeared (Hoskins, 2014). Concerted efforts will be needed to avert replicating the Aral Sea experience in other parts of the world.

Cotton can be produced using rainwater, irrigation or a combination of both. Water stress from cotton production primarily arises from irrigation ("blue" water). Among major cotton producers, the climatic conditions vary considerably through evaporative demand and annual rainfall levels, leading to significant variations in water stress depending on the volume of irrigation or "blue" water[47] required to produce a given crop. Virtual blue water use calculates the amount of irrigation water per volume of cotton yield, offering an indication of the per-unit pressure on water resources from cotton production. Across the 15 most important cotton-producing countries, countries with high levels of per unit volume cotton-related water stress include Turkmenistan, Uzbekistan, Egypt, Pakistan, Syria, Turkey, Argentina and India. Each of these countries must be a priority for cotton-related water conservation strategies. In terms of the proportion of the cotton production land area affected by high water stress, and thus where special effort is required, India stands out among all producers, dedicating a stunning 13 million hectares to cotton production. Pakistan (2.9 million ha), Uzbekistan (1.3 million ha) and Turkmenistan (540,000 ha) are also leaders in terms of area devoted to high-water-stress cotton production.

Perhaps the first thing to note regarding the distribution of standard-compliant cotton production is that, overall, compliant production only represents a marginal portion of the overall cotton water footprint, accounting for a mere 7 per cent of global production. This points toward significant opportunities for increased impact on water use through expansion of standards across all cotton-producing countries. With BCI undergoing rapid growth and a target of reaching a 30 per cent market share by 2020, realization of this opportunity is well underway. Furthermore, although reducing the impact of cotton production on water use has been one of the major drivers of standards development within the cotton sector, the majority of the area certified to date (59 per cent of total) has a historically low blue water footprint (see Figure 29).

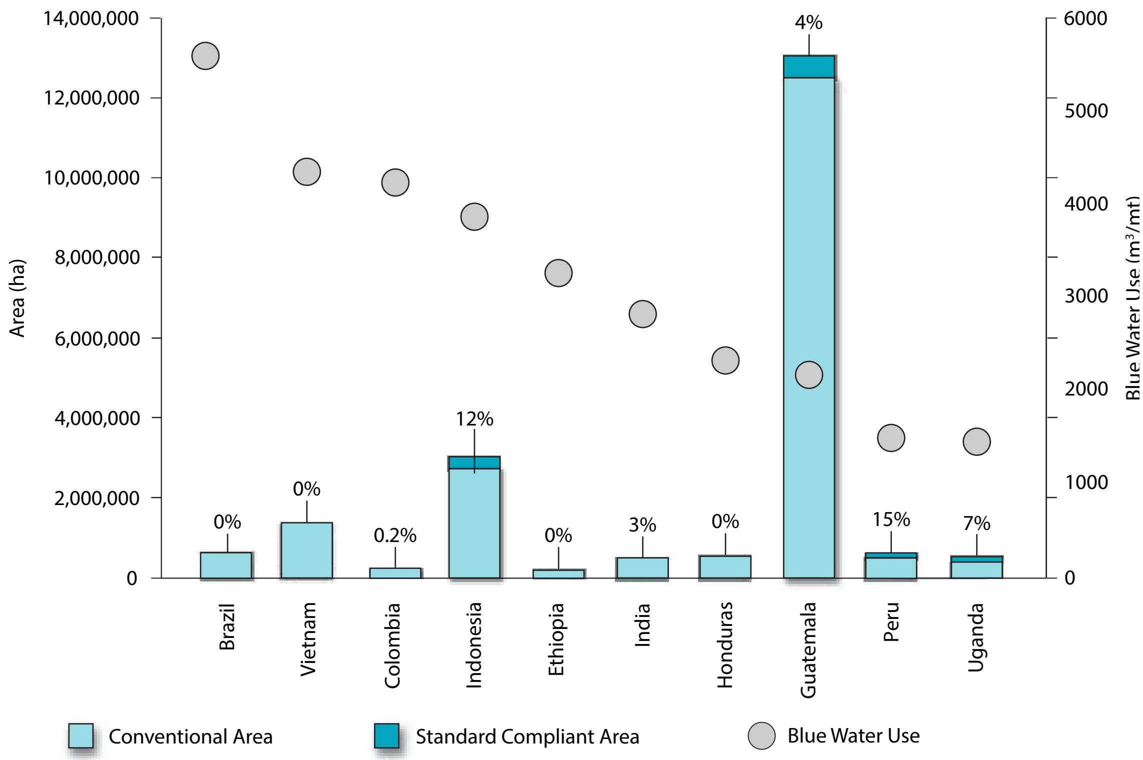
By way of example, with 49 per cent of the total cotton growing area considered standard compliant, Brazil has the highest intensity of certified cotton production. While India has approximately the same area of standard-compliant cotton production as Brazil, the country's relatively low yields, combined with its significantly larger footprint, result in a standard-compliant intensity of only 4 per cent for the country. As both the world's largest source of cotton and a country with one of the highest blue water footprints for cotton, India thus represents a major strategic opportunity for the expansion of cotton standards with a view to reducing the water footprint of cotton globally. Similarly, Uzbekistan, Turkey and Argentina represent major cotton-producing regions with high blue water footprints and low uptake of voluntary standards.

Based on the distribution of standard compliance, it would appear that voluntary standards are mainly operating as a basis for allowing low-water-use cotton producers to market

47 Blue water refers to the amount of water taken up by plants from irrigation drawn from surface and groundwater.

themselves as such, rather than significantly stimulating the adoption of better water management in high-water-stress areas. To the extent that this is the case, standards may play a role in stimulating the transition from high-water-stress regions to low-water-stress regions.[48] The one major exception to this trend is Pakistan, which, with the fourth highest blue water footprint globally, also displays the third largest area of standard-compliant production (350,000 ha) and the second highest intensity of standard-compliant production (10 per cent of total cotton production). Pakistan thus represents an important example whereby voluntary standards are being applied in a significant manner to reduce the water burden of cotton production in an area with exceptionally high water stress.

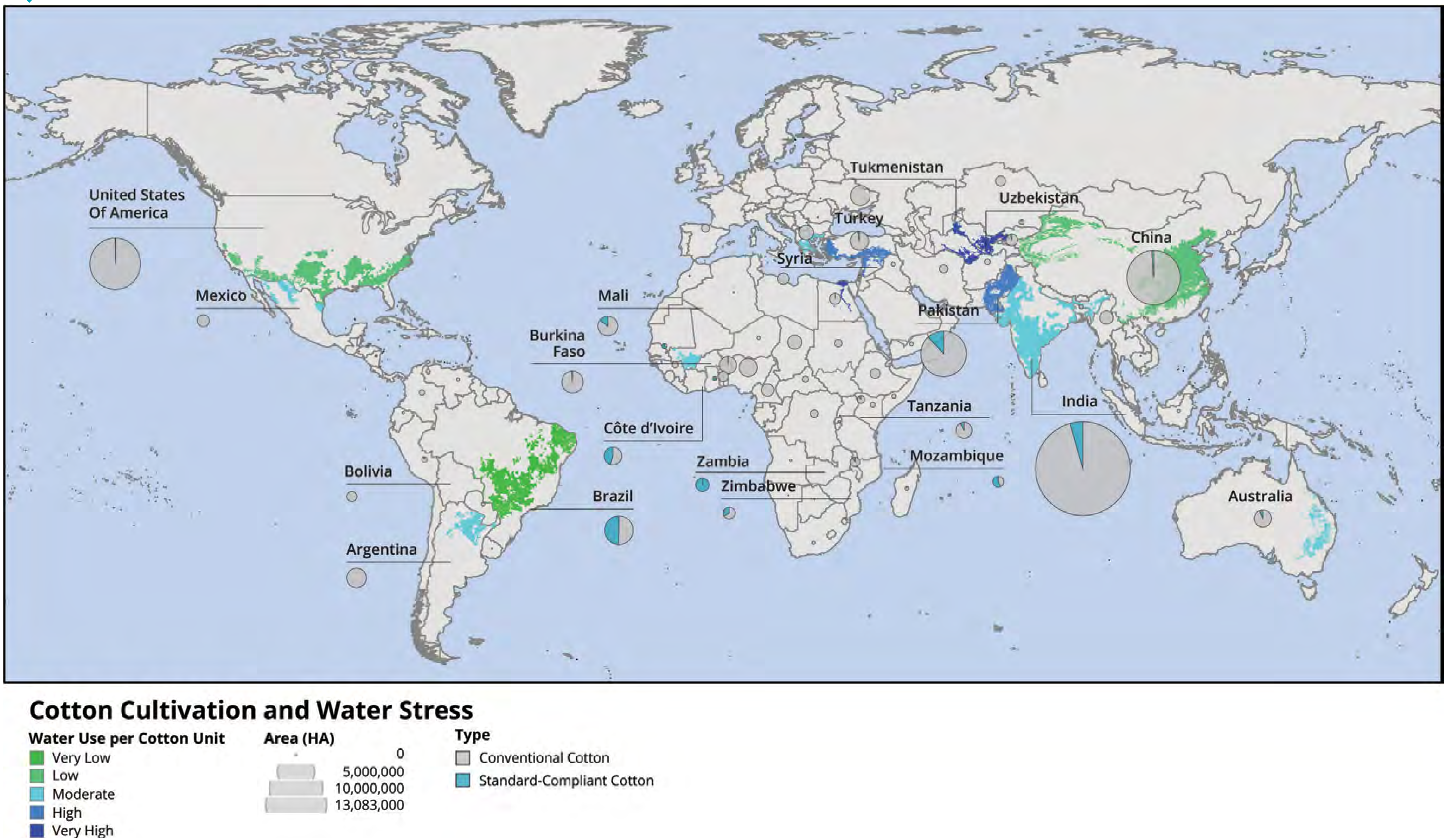
Figure 29. Leading cotton-producing countries by blue water consumption levels. Blue water, or irrigation water, represents the greatest threat to water reserves in cotton-producing countries. Virtually all of the cotton-producing countries with high blue water use also face high levels of water scarcity. India and Pakistan, with their particularly high area devoted to cotton production, represent particular threats to local water resources.



Source: Mekonnen & Hoekstra (2010); ITC, FIBL, FAOstat data

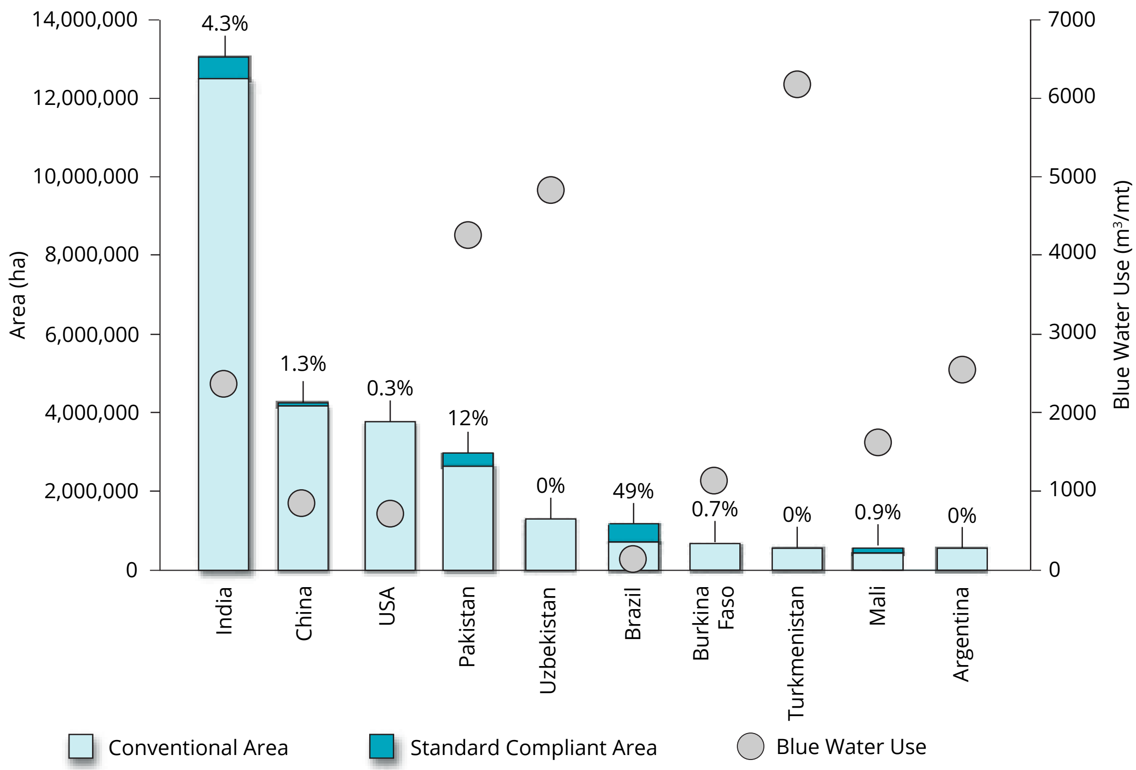
48 Chapagain et al. (2005) remark that countries with high evaporative demand and low rainfall are least attractive for cotton cultivation (i.e., Egypt, Uzbekistan and Turkey) as they require more irrigation, while countries with low evaporative demand (i.e., the United States and Brazil) are better suited, requiring less or no irrigation. This observation brings up the question of whether certain areas across the world should be involved in cotton cultivation altogether.

Figure 30. Cotton blue water use and standard-compliant production (2014) by region. Low-blue-water-use countries typically rely on rainwater to support cotton production and represent a relatively lower cotton-related water burden. Approximately 59 per cent of certified cotton production is located in regions with historically low blue water use.



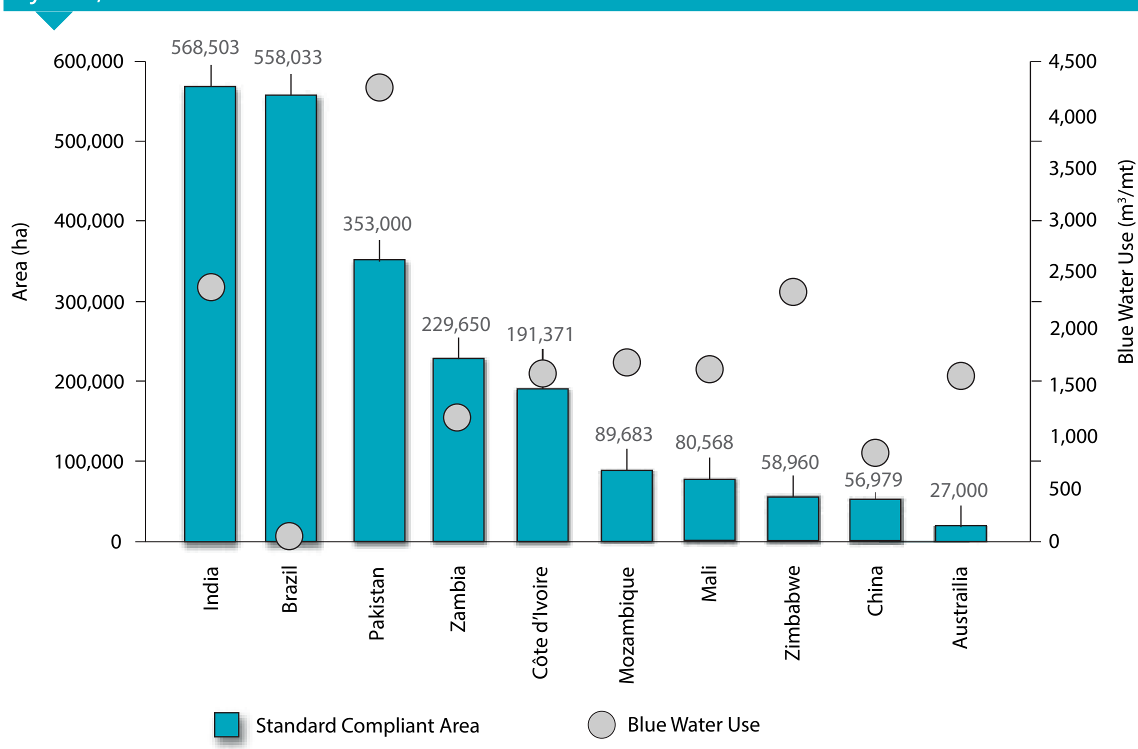
Data Sources: Chaudhary et al., 2015; FAOStat; Lernoud et al., 2015

Figure 31. Top ten cotton-producing countries by area devoted to cotton production with blue water overlay and percentage of standard-compliant area (2014)



Sources: Mekonen & Hoekstra, 2010; Chapagain et al., 2005; Lenourd, 2015

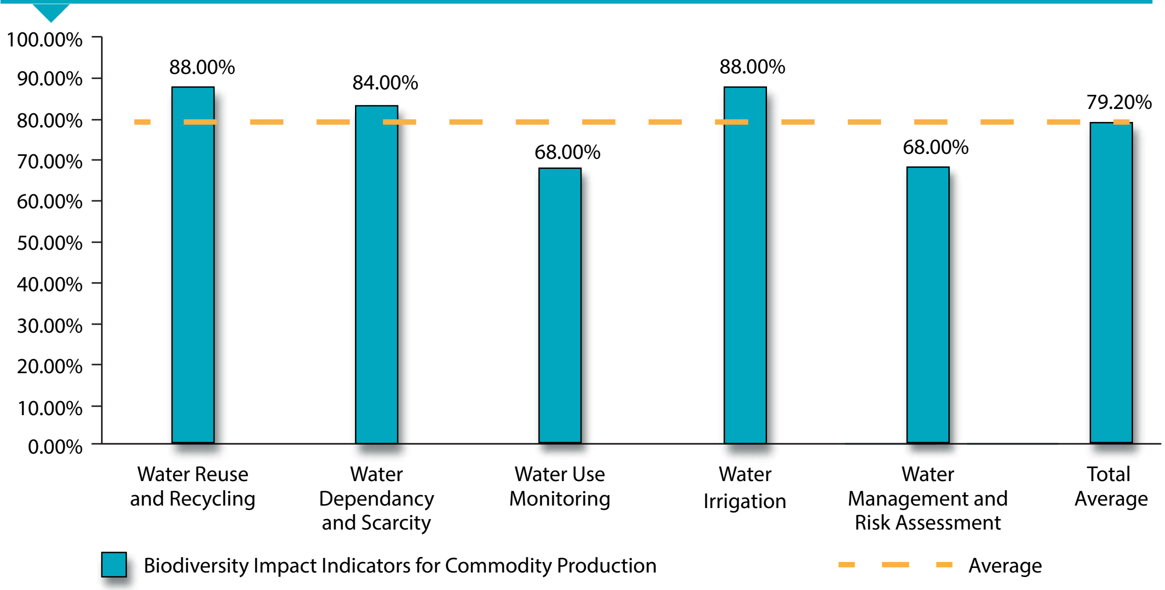
Figure 32. Top ten standard-compliant cotton-producing countries with blue water footprint overlay, by area, 2014.



Sources: Mekonen & Hoekstra, 2010; Chapagain et al., 2005; Lenourd, 2015

Overall, cotton standards display a high level of coverage across water management indicators, although it is worth noting that the average coverage of water management criteria across cotton-relevant standards, at 79 per cent, is just below the average of 82 per cent for the full group of agricultural standards. Nevertheless, the leaders in global cotton certification (BCI) and Organic certification report critical requirements across all five water management indicators with Cotton Made in Africa and Fairtrade placing a lower emphasis on water management. The relatively low priority given to water management under Cotton Made in Africa in particular can largely be attributed to the initiative's focus on African rainfed cotton production, where cotton-related water stress is relatively low. Together BCI and Organic certification account for 93 per cent of total standard-compliant production, underscoring the high-level presence of water management requirements across the majority of standard-compliant production.

Figure 33. Water Use Index—cotton standards. Although the total average coverage of cotton standards under the Water Use Index is slightly below the average for agricultural standards as a whole, they nevertheless display relatively high water management requirements. Notably, the most significant standard in terms of area and production volumes (BCI) has critical requirements in all five subindicators under the Water Use Index.



Source: VSS criteria information obtained from ITC standards Map

5.6 Oil Palm

Table 7. Oil Palm Standards, Key Market Statistics (2014)

Voluntary Standard	Compliant Production (fruit) 2014 (tonnes)	Compliant Area 2014 (ha)	Portion of Global Production	Portion of Global Area	Portion of Global Area
Organic	43,750	2,380	0.0%	0.0%	5%
RSPO	54,429,901	2,619,436	20%	14%	2%
Rainforest Alliance	1,089,465	51,663	0.4%	0.3%	0.2%
Total (Adjusted for Multiple Certification)	55,369,314	2,666,704	20%	14%	0.6%

Source: ITC, FIBL, FAOstat data

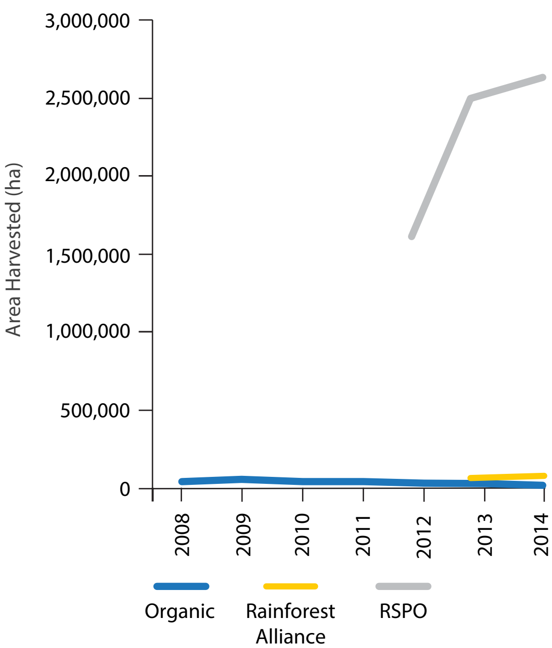
Among the class of oil crops, palm oil is one of the most efficient in terms of land use. With a per-acre productivity between five and 10 times higher than the other major oil crops, rape, sunflower and soybean (RSPO, n.d.), palm oil has the potential to provide an efficient source of calories to a growing world population at relatively low cost to biodiversity. In practice, however, this has not been the case. Over 80 per cent of palm oil exports come from the biodiversity hotspots of Indonesia and Malaysia, 60 per cent of which are estimated to have directly displaced forests since the year 2000. Moreover, palm cultivation continues to expand rapidly with 3 per cent growth in Malaysia and 6 per cent growth per annum in Indonesia between 2010 and 2014, and 5 million hectares to be added to Indonesia alone by 2020 (representing a growth rate of 16 per cent per annum) (Indonesia Investments, 2016). Estimates put rates of illegal logging in Indonesia at 80 per cent in 2010, highlighting the inability of government alone to manage the ecological destruction associated with palm oil production (Environmental Investigation Agency, 2014).

International attention was turned to the sustainability of oil palm plantations amid the great fires of 1997, during which time much of Southeast Asia was covered by smoke from clearing for palm plantations. The degree of destruction associated with this rapidly growing commodity has led to the growth of several voluntary initiatives, the most notable of which are the RSPO, Rainforest Alliance and Organic. With more than three quarters of palm oil production traded on world markets, market-based trade instruments hold particular potential in stimulating more sustainable production practices. Shipments of palm oil from Indonesia and Malaysia to India and China, where it is used as cooking oil, account for more than 40 per cent of the trade flow (UN Comtrade Database, 2016). Some 10–20 per cent of trade goes to the EU, much of which is used for biodiesel (Arthur Nelsen, 2016).

By 2014, 55.4 million mt or 20 per cent of the world's oil palm (fruit) was VSS compliant, up from around 2 per cent in 2008. The RSPO accounted for 99.5 per cent of all standard-compliant production in 2014. The Rainforest Alliance only began certifying palm oil in 2013, with volumes growing 17 per cent between 2013 and 2014 and reaching just over 1 million mt in 2014. Organic certified palm oil is limited to niche and specialty markets. The International Sustainability and Carbon Certification standard is a relative newcomer to certifying sustainable palm oil, but no market information is currently available.

Wilmar International, Golden Agri Resources and Cargill, which account for 60 per cent of the palm oil trade, have committed to zero-deforestation policies (Environmental Investigation Agency, 2014). The major downstream buyers and co-founders of the RSPO—AarhusKarlshamn, Kuala Lumpur Kepong Berhad, Unilever and Sainsbury's—have also committed to zero-deforestation sourcing through RSPO (Sainsbury's, 2014; Unilever, n.d.). The effort to build demand for RSPO palm oil has also included the innovative strategy of building national coalitions consisting of multiple industry players making commitments to source sustainable palm oil. The following countries have set goals for 100 per cent sustainable palm oil sourcing by between 2014 and 2020: Norway, Denmark, Belgium, France, Germany, Austria, Switzerland, the United Kingdom, the Netherlands, Sweden and Italy (RSPO, 2016).

Figure 34. Standard-compliant oil palm area, by initiative, 2009–2014



Average Annual Growth:

Organic: -28%
Rainforest Alliance: 41%
RSPO: 27%

Data Source: Lernoud et al., 2015

5.6.1 Spotlight on Oil Palm and GHG Emissions

Agriculture accounts for approximately 25 per cent of the total GHG emissions, mainly in the form of methane (primarily from ruminants and rice production) and nitrous oxide emissions (primarily from the use of synthetic and natural nitrogen fertilizers) (PBL Netherlands Environmental Assessment Agency, 2014). Land use change, fossil fuels use for farming, transport and preserving food as well as the production of fertilizers are the other important sources of agricultural GHG emissions.

The expansion of agricultural lands is the main driver of global deforestation, in part due to increased cultivation of bioenergy crops in response to curbing climate change (PBL Netherlands Environmental Assessment Agency, 2014). Within the agricultural sector, crop production accounts for approximately 13 per cent of energy consumption and 30 per cent of GHGs in carbon dioxide equivalent, while the livestock sector represents approximately 5 per cent in energy consumption and almost 40 per cent in GHG carbon dioxide equivalent (FAO, 2011).

BOX 6: Fossil fuel use per unit product (BIICP 8)

Tracking the fossil fuel use per unit area or unit product provides a basis for establishing the impacts that agricultural energy use and carbon emissions have on biodiversity. For the most part, direct fossil fuel use is not the principal component of GHG emissions arising from commodity production. Taking palm oil as an example, with estimated emissions of 16,000–96,000 kg CO_2/ha per annum, only 4,000– 6,000 kg CO_2/ha per annum are due to actual operations (see Table 9).[49] Put another way, between 63 and 96 per cent of total GHG emissions from palm oil production are related to land use changes. Even among GHG emissions arising from operations, only an estimated 200-400 kg CO_2/ha (0.2–2.5 per cent of total) are associated with direct fossil fuel use, with the majority of operations-level emissions associated with wastewater treatment and fertilizer use.[50]

Fossil fuel use per unit area or unit product will, of course, vary from farm to farm depending on the agricultural practices adopted. High GDP countries consume approximately 20.4 GJ of fossil fuel per hectare, whereas low GDP countries consume approximately 11.1 GJ of fossil fuel per hectare. However, fossil fuel consumption can lead to lower energy intensities per unit of production volume for a given crop if it can increase yields (FAO, 2011). The FAO breaks fossil fuel consumption for the agricultural sector per country down by fuel types consumed and their corresponding GHG emissions.[51] In 2002, the agricultural sector consumed the equivalent of approximately: 1 million TJ of coal, 3 million TJ of electricity, 0.35 million TJ of energy for power irrigation, 0.06 million TJ of fuel oil, 4.5 million TJ of gas diesel oil, 0.14 million TJ of liquefied petroleum gas, 0.39 million TJ of motor gasoline and 0.39 million TJ of natural gas (FAO, 2012).

49 All figures for land use change are discounted over a 25-year period and include the net contribution to carbon stocks associated with palm oil plantations.

50 Due to the relatively low role of direct fossil fuel use as a source of GHG emissions in agricultural production, our Fossil Fuel Index considers embedded fossil fuel from fertilizers and irrigation (see BIICP 8: Fossil Fuel Use per Unit Area or Product above).

51 Crop-specific spatial data for fossil fuel consumption was not available.

Oil palm is an important driver of tropical deforestation and peat fires releasing vast amounts of carbon (Page et al., 2009; Petrenko, Paltseva, & Searle, 2016) with land use change representing, by far, the single most important source of GHG emissions arising from production (see Table 9).[52] Given the relative importance of the different contributors to GHG emissions in oil palm, we apply an analysis of biomass carbon change in palm oil-producing regions from 2000 to 2010 as a proxy to examine the carbon footprint of product and land use associated with palm oil production (see Figure 34).[53]

Table 9. GHG emission ranges for palm oil production. The vast majority of GHG emissions from palm oil production result from reduced carbon stocks due to land use change. On farm operations, GHG emissions are driven by methane releases from wastewater treatment and fertilizer use. The largest GHG emissions arise when virgin forests with peatlands are converted to oil palm plantations.

Activity	Emissions per ha $kgCO_2$	Emissions per tonne $kgCO_2$/Tonne
A. Operations		
i. Fossil fuel use for transportation and machinery	+180 to + 404	+45 to + 125
ii. Fertilizer use	+1,500 to +2,000	+ 250 to + 470
iii. Fuel for mill	0	0
iv. Wastewater treatment	+2,500 to +4,000	+ 625 to + 1,467
Total Operations	**+4,180 to +6,225**	**+920 to + 2,007**
B. Emissions from land use change		
i. 25 years discounted emission from conversion of grassland or forest	+1,700 to + 25,000	+425 to +7,813
ii. Annual carbon sequestration by oil palms	- 7,660	-1,915 to -2,393
iii. Emissions from oil palm on peat	+18,000 to + 73,000	+4,500 to +22,813
Total Land Use	**+12,040 to +90,340**	**+3,010 to + 28,233**
Total GHG at Production	**+16,220 to 96,565**	**+3,930 to +30,240**

Source: RSPO, 2009

52 GHG emissions from forest burning range from 207 Mg CO_2-equivalent/ha on mineral soils, to 1,500 Mg CO_2 equivalent/ha on peatlands (Danielsen, 2009). Peat fires have been estimated to release 190 million tonnes of carbon per year globally (Page et al., 2002; van der Werf et al., 2008). Porter (2016) estimated that the GHG emissions from Indonesia's 2015 fires were roughly equivalent to the annual emissions of Brazil.

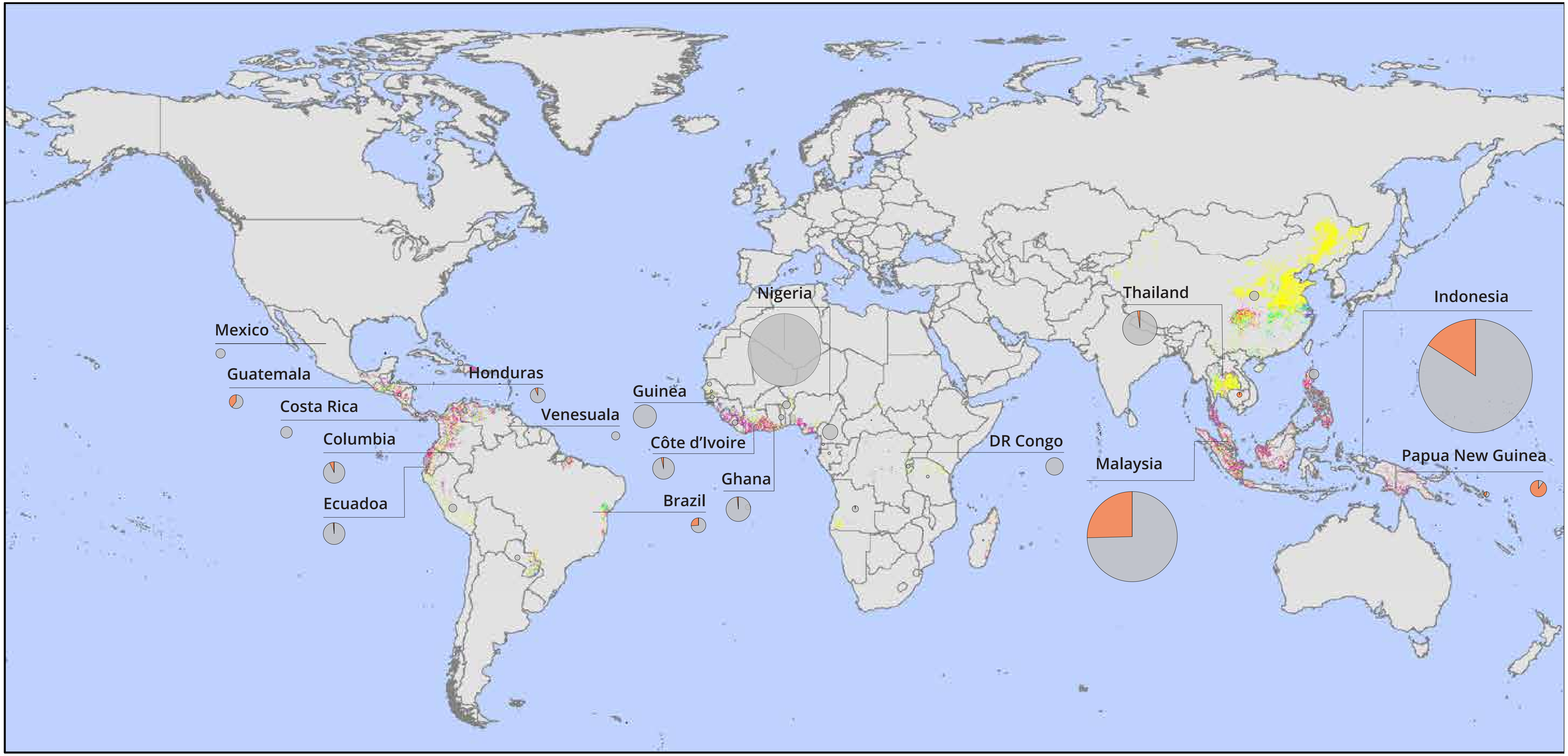
53 These global data sets allow for identifying opportunities to address deforestation and biomass carbon losses on agricultural lands by intersecting them with the spatial extent of a given crop. Carbon biomass change on agricultural lands between 2000 and 2010 spatial data with 1 km grid resolution is intersected with average agricultural crop land use between 1996 to 2005 at a 10-km grid resolution (Zomer et al., 2016).

Biomass carbon change between 2000 and 2010 within oil palm growing regions is mapped in Figure 35. The major countries growing standard-compliant oil palm include Malaysia, Indonesia and Papua New Guinea. Oil palm growing regions experienced a fairly equivalent loss and gain in tree cover and biomass carbon globally.[54] Figure 35 reveals that pockets of high to moderate levels of biomass carbon losses are located along the northwestern coast of South America (primarily within Ecuador and Colombia) and in the Western Guinean Forest in West Africa (primarily within Ghana, Ivory Coast, Liberia, Sierra Leone and Guinea). Apart from a pocket of high deforestation and biomass carbon loss in the northern Philippines, deforestation and biomass carbon losses are uniformly dispersed across the peninsula and islands of Malaysia and Indonesia, where most of the world's palm oil is produced.

While standards are clearly targeting high biomass carbon areas, they nevertheless do face significant challenges in reducing expansion due to the significant demand for conventional palm oil from major importers such as China and India, which, together, account for 40 per cent of global demand. Unless buyers in these countries require compliance with standards, significant markets for uncertified palm oil can be expected to continue to drive deforestation in producing regions, potentially limiting the effectiveness of certification in the prevention of production at biodiversity sensitive sites.

54 Within oil palm growing regions, 0.16 million ha experienced high levels of deforestation (14–61 per cent tree cover loss), 0.62 million ha experienced moderate levels of deforestation (3–13 per cent tree cover loss) and 2 million ha experienced a negligible loss to a gain in tree cover (2 per cent tree cover loss to 57 per cent tree cover gain). With respect to biomass carbon, 0.11 million ha experienced high levels of biomass carbon loss (30 to 132 tonnes), 0.57 million ha experienced moderate levels of biomass carbon loss (7–27 tonnes), while 4.17 million ha experienced a negligible loss to a gain in biomass carbon (from 6 tonnes in losses to 130 tonnes in gains).

Figure 35. Change in biomass carbon in oil palm growing regions, 2000–2010. With the exception of China, the vast majority of oil palm growing regions is associated with biomass carbon loss.



Biomass Carbon Change between 2000 to 2010 in Oil Palm Growing Regions

Biomass Carbon Change

- -132 to -30 tonnes C
- -29 to -7 tonnes C
- -6 to -1 tonnes C
- 0 to 8 tonnes C
- 9 to 32 tonnes C
- 33 to 130 tonnes C

Area (HA)

- 0
- 2,000,000
- 4,000,000
- 6,000,000
- 7,428,752

Type

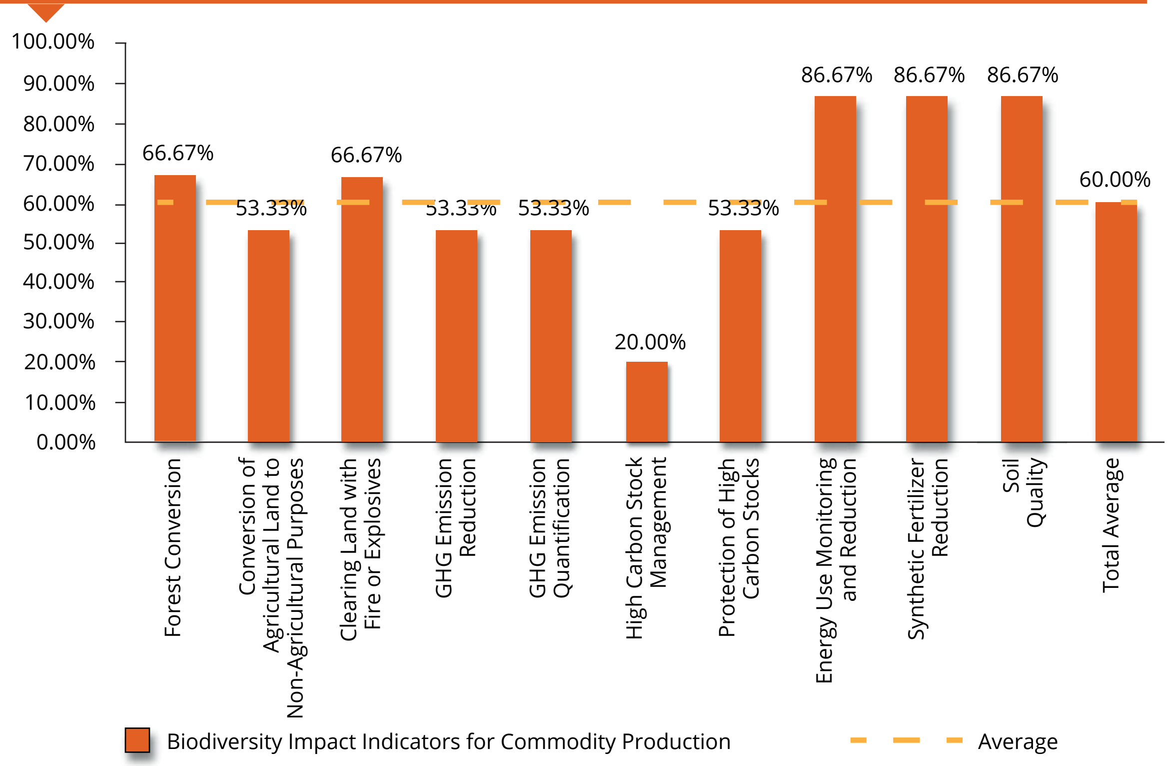
- Conventional Oil Palm
- Standard-Compliant Oil Palm

Data Sources: Chaudhary et al., 2015; FAOStat; Lernoud et al., 2015

Standards serving the oil palm sector have higher-than-average coverage for carbon footprint-related requirements. Areas where oil palm standards have notably higher coverage include protection of high carbon stocks, energy monitoring and reduction, fertilizer reduction and soil quality. Although prohibitions on deforestation are lower than average for the group as a whole, the main standards in terms of volume produced (RSPO and Rainforest Alliance) include critical requirements prohibiting some forms of deforestation. RSPO offers the most specific requirements in this regard, prohibiting the certification of farms on land converted from primary forest or areas of high conservation value post-2005 but does not prevent land clearing or deforestation for new plantations outright.[55] Rainforest Alliance has mandatory requirements for protecting forests and preventing land clearing using fire and/or explosives, but has more lenient requirements for most of the criteria listed than either RSPO or Organic. Organic has critical requirements for the restoration of natural lands, preventing land clearing using fire or explosives, energy consumption and management, fertilizer use and soil quality. RSPO and Rainforest Alliance also have provisions for the protection of high carbon stocks.

As with all standards, the requirements specified only represent the framework of accountability. The rigour with which that accountability is implemented is known to vary significantly across initiatives. RSPO, in particular, has been alleged to have significantly failed in the implementation of its criteria, leading several NGOs to question its credibility and overall viability as a solution to deforestation-related sustainability concerns.[56]

Figure 36. Carbon Footprint Index—Oil palm standards: Standards serving the oil palm sector have higher-than-average coverage for carbon footprint-related requirements. Areas where oil palm standards have notably higher coverage include protection of high carbon stocks, energy consumption management, monitoring and reduction, fertilizer use reduction and soil quality. Although prohibitions on deforestation and forest conversion are lower than average for the group as a whole, the main standards in terms of volume produced (RSPO and Rainforest Alliance) include critical requirements for such prohibitions.



Source: VSS criteria information obtained from ITC Standards Map

55 It is worth noting, however, that the limitation of the deforestation ban under RSPO to "primary" forests has subjected the standard to considerable criticism in light of the relative rarity of such primary forests in many oil palm growing regions.

56 See, for example, Environmental Investigations Agency, 2015; Greenpeace, 2013

5.7 Soy

Table 10. Soy Standards, Key Market Statistics (2014)

Voluntary Standard	Compliant Production 2014 (tonnes)	Compliant Area 2014 (tonnes)	Portion of Global Trade	Portion of Global Production	Portion of Global Area
Organic	500,900	332,566	0.5%	0.2%	0.3%
ProTerra	2,430,698	1,215,349	2.2%	1%	1%
RTRS	1,408,052	483,403	1.3%	0.5%	0.4%
Total (Adjusted for Multiple Certification)	3,856,263	1,869,757	3.5%	1%	2%

Source: ITC, FIBL, FAOstat data

Natural habitat conversion and a high GMO adoption stand out among the concerns related to biodiversity and soy production. While soybeans serve a variety of functions in the economy, including food, biodiesel and personal care products, the most important is as a feed source for livestock, which accounts for approximately 70 per cent all soybean production. As emerging economies increase meat consumption, the demand for soybeans has grown significantly faster than most agricultural commodities, averaging 6 per cent per annum over the past decade. The rapid growth in demand has led to a correspondingly rapid expansion in the land area being devoted to soybean production, exerting significant pressure on local ecosystems. By far, the most severe of these impacts have been felt in South America, particularly Brazil, which is the world's second largest producer of soybeans and experienced a 30 per cent increase in land area devoted to soybeans between 2010 and 2014.[57] Although soy can be (and is) typically grown on previously cleared pastureland and other marginal lands, its expansion in Brazil has been directly linked to deforestation in the biodiverse Cerrado region.[58] Current estimates put between 50 and 60 per cent of soy imports coming from deforested areas in the main South American producing countries.[59]

Expansion of soy production in much of Latin America has been enabled by, among other things, the development of GMO breeds suitable to the region. Brazil is now the second largest user of GMO soy after the United States, and soybeans are the most expansive biotech crop in the world, grown on 92 million hectares, representing an adoption rate of 83 per cent (International Service for the Acquisition of Agri-biotech Applications, 2016). The massive transition to monoculture GMO production represents a major stimulus toward genetic homogeneity on a global scale, and thus must be considered a significant threat to biodiversity in its own right (See Box 7).

Close to two thirds of soybean production is traded on world markets. China imported two thirds of the traded soybeans in 2015, 87 per cent of which came from the United States and Brazil. While the main driver of growing demand for soy is increased meat consumption, soy's use as a biofuel also represents an important growth market, with 16 per cent of soy cultivated in Brazil being destined for use as fuel (Pacheco, 2012).

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57 As compared with a 6 per cent increase in land area in U.S. soy production and an 8 per cent increase in land area in Argentinian soy production (FAO, 2016b).

58 In the Cerrado region, 13 per cent of deforestation is attributed to soybean production while 80 per cent of deforestation is attributed to cattle production. Where soy displaces cattle grazing as a source of livestock feed, it may be a better alternative from a biodiversity perspective due to its higher protein efficiency (Hansen, 2015; Pacheco, 2012; Lawson et al., 2014).

59 These estimates include previously deforested areas for cropland. Natural habitat conversion is also a concern in Paraguay and in Uruguay, where soybean expansion was 31 per cent and 56 per cent between 2010 and 2014, respectively.

While the environmental concerns around soy production have been highlighted by a number of non-governmental organization campaigns over the past decade,[60] the actual production of standard-compliant soy has remained relatively small, revealing virtually no growth over the past several years. One idiosyncrasy of the standard-compliant soy market is its degree of reliance on the identity preservation chain-of-custody model, as opposed to mass balance or credit trading systems more common to other industries, as demand is to a large degree driven by non GMO.

As of 2015, 3.9 million tonnes of standard-compliant soybeans were produced, accounting for 1.3 per cent of global production—a level lower than that of 2008. This is due to a decline in Proterra-certified soybeans from the 2012 to 2013 season, although certification in 2015 is expected to rebound (Proterra Foundation & Danube Soy Association, 2015). The major source of demand for standard-compliant soy to date has been from Europe, which imports about 12 per cent of global soy trade. European demand is expected to reach 10 million tonnes of certified soy by 2020 (Proterra, n.d.), more than double current volumes certified.

BOX 7: The GMO enigma

GMO production carries the strange characteristic of being the one agricultural input that, prima facie, has the most direct impact on biodiversity (the very nature of the input affects biodiversity!) but where the nature and degree of that impact remains the most elusive. This result is no doubt due to the conflicting forces at play in the use of GMOs. For example, while the development of new gene strains nominally increases the gene pool, the development and distribution through multinational companies through monocrop systems, fuels reliance upon, and maintenance of, a smaller gene pool. On the other hand, GMOs have the potential to reduce the need for the application of environmentally harmful pesticides. For example, widespread adoption of Bt cotton has resulted in a substantial decrease in pesticide use across the cotton sector over the past 20 years (International Service for the Acquisition of Agri-biotec Applications, 2012). But more recently, GMOs have been associated with increases in pesticide use due to the development of pest resistance (Perrry et al., 2016; Qiao, 2015).

Without doubt, however, it is clear that GMOs have the potential to significantly affect local and global gene pools in ways that are not always intended. With this in mind, the careful and controlled application of GMOs represents a pillar of safe biodiversity management as enshrined within the Convention on Biological Diversity and the Cartagena Protocol. Standards have embodied the ambivalence the respect to GMOs displaying a diversity of approaches to their management. While six of the initiatives reviewed in this report have strict prohibitions against the use of GMOs, 10 have one or another form of requirements on the safe management of GMOs. As with other variables related to biodiversity protection, voluntary standards offer a promising, albeit inconsistent, opportunity for implementing policy objectives.

60 Most notably, WWF and Solidaridad

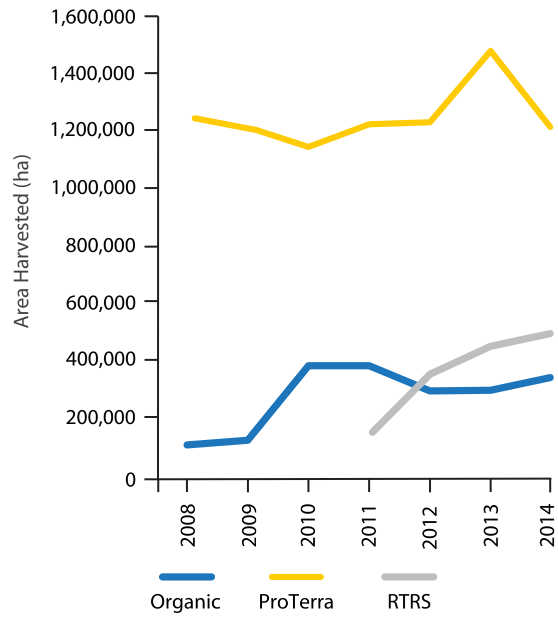
The main voluntary standards operatives in the soy sector are the Roundtable for Responsible Soy (RTRS), Proterra and Organic. While there exists a strictly non-GMO standard (by Cert-ID, the founder of the Proterra standard), 80 per cent of Cert-ID non-GMO soy is also compliant under the comprehensive Proterra standard. The Danube Soy Initiative is an initiative launched in 2012 to promote sustainable non-GMO soy cultivated in Europe, although its volumes remain relatively small (Proterra Foundation & Danube Soy Association, 2015).

Proterra and RTRS, whose volumes grew by 50 per cent and 63 per cent from 2014 to 2015, respectively, dominate the sustainable soy market. The RTRS-led Task Force Europe, of which the Proterra Foundation is a member,[61] is a coalition of national initiatives that work to gain industry commitments to RTRS-compliant soy (RTRS, 2014), with the objective of securing demand for 10 million tonnes of certified soy.

Major commitments to certified soy are as follows:

- Unilever: Committed to sourcing 100 per cent certified soy by 2020. Unilever purchases 1 per cent of global soy production (Unilever, 2016).
- McDonald's Europe: Committed to sourcing 100 per cent certified soy by 2020. By 2015, 35 per cent of soy purchases used for chicken feed in Europe were certified by either RTRS or Proterra (McDonald's, 2016).
- Arla Foods (the largest producer of dairy products in Scandinavia): Committed to 100 per cent compliant sourcing; currently completed 420,000 RTRS credits[62] (Arla Foods, 2014).

Figure 37. Standard-compliant soybean area 2009–2014, by initiative



Average Annual Growth:
Organic: 22%
ProTerra: 0%
RTRS: 49%

Data Source: Lernoud et al., 2015

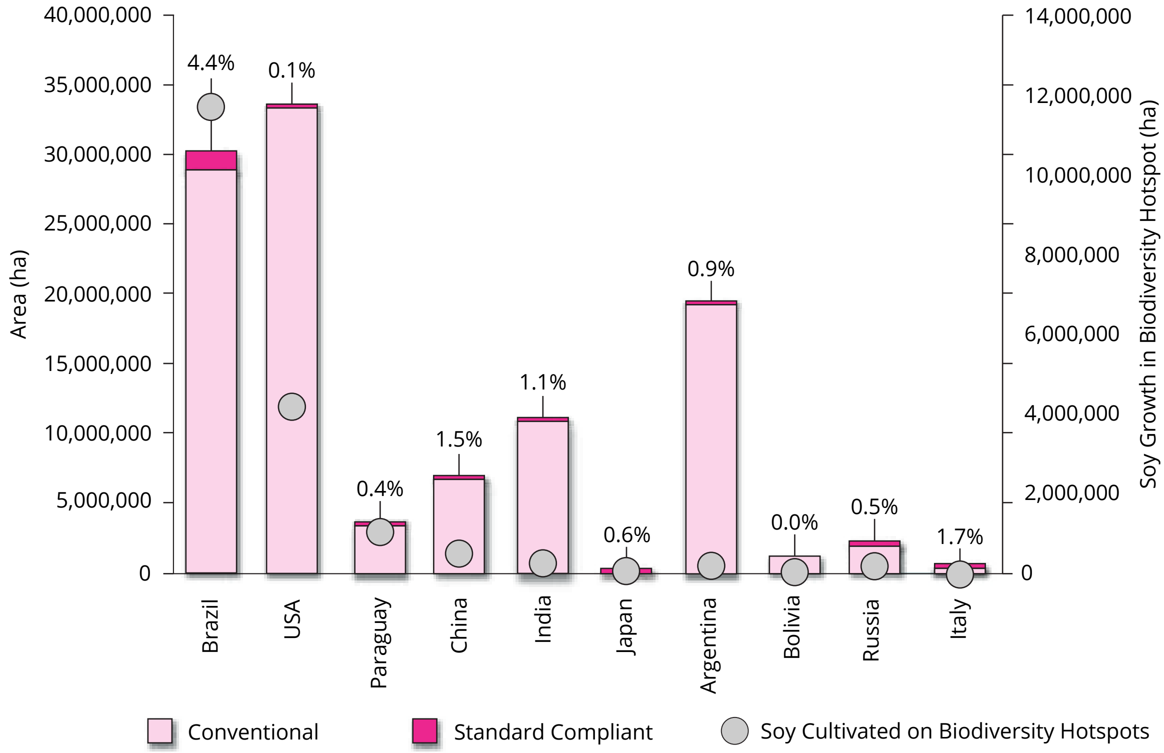
61 Proterra and RTRS work together under a Memorandum of Understanding.

62 One tonne of certified soy generates one credit. Credits are traded on the RTRS credit-trading platform and may be purchased there in lieu of the direct purchase of certified soy. This allows companies to support certified soy production without compromising their existing supply channels.
See http://www.responsiblesoy.org/contribute-to-change/adquiriendo-creditos-de-soja-rtrs/?lang=en.

5.7.1 Spotlight on Soy Production and Biodiversity Hotspots

As global demand for soy continues to grow, expansion of production has led to land conversion in many regions around the world recognized for the high levels of biodiversity. However, the geographic and climatic conditions under which soy is produced exhibit significant diversity themselves, thus presenting variable threats to habitat quality. The high rate of GMO planting in highly biodiverse areas raises additional concerns (See Box 7). In an effort to identify areas where the threat of soy production to habitat quality and diversity is particularly acute, we mapped the areas where soy production overlaps with biodiversity hotspots as identified by Conservation International (see Figure 40).[63] While representing only 2.3 per cent of the Earth's surface, these biodiversity hotspots support more than 50 per cent of plant and almost 43 per cent of mammal, reptile and amphibian endemic species (Conservation International, 2016).

Figure 38. Soybean-producing countries with leading overlap of biodiversity hotspots; standard-compliant production as a percentage of total production, by country.

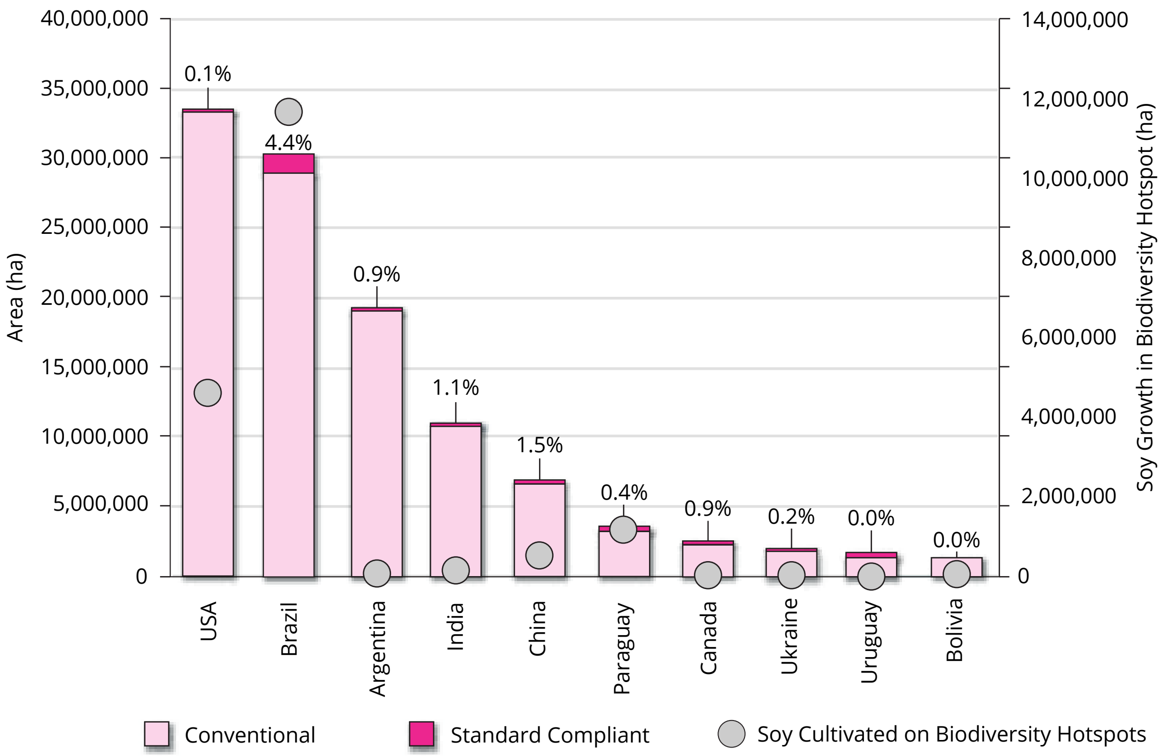


Source: ITC, FIBL, FAOstat data

63 Conservation International identified 35 biodiversity hotspots across the globe based on areas that are "irreplaceable" and "under threat," defined by areas with a minimum of 1,500 endemic vascular plant species and 30 per cent of its original natural vegetation (Conservation International, 2016).

Soy is cultivated in 27 of the 36 hotspots identified by Conservation International and has been identified as a particularly important driver of deforestation in Brazil.[64] In terms of area affected, soy production has its most pronounced overlap with biodiversity hotspots in Brazil, the United States and Paraguay, accounting for 11.6 milion ha, 4.6 million ha, and 1.1 million ha or 64 per cent, 25 per cent and 6 per cent of the total global ha of soy production, respectively, with biodiversity overlap (see Figure 39). Soy production in these countries represents a particular concern for biodiversity conservation.

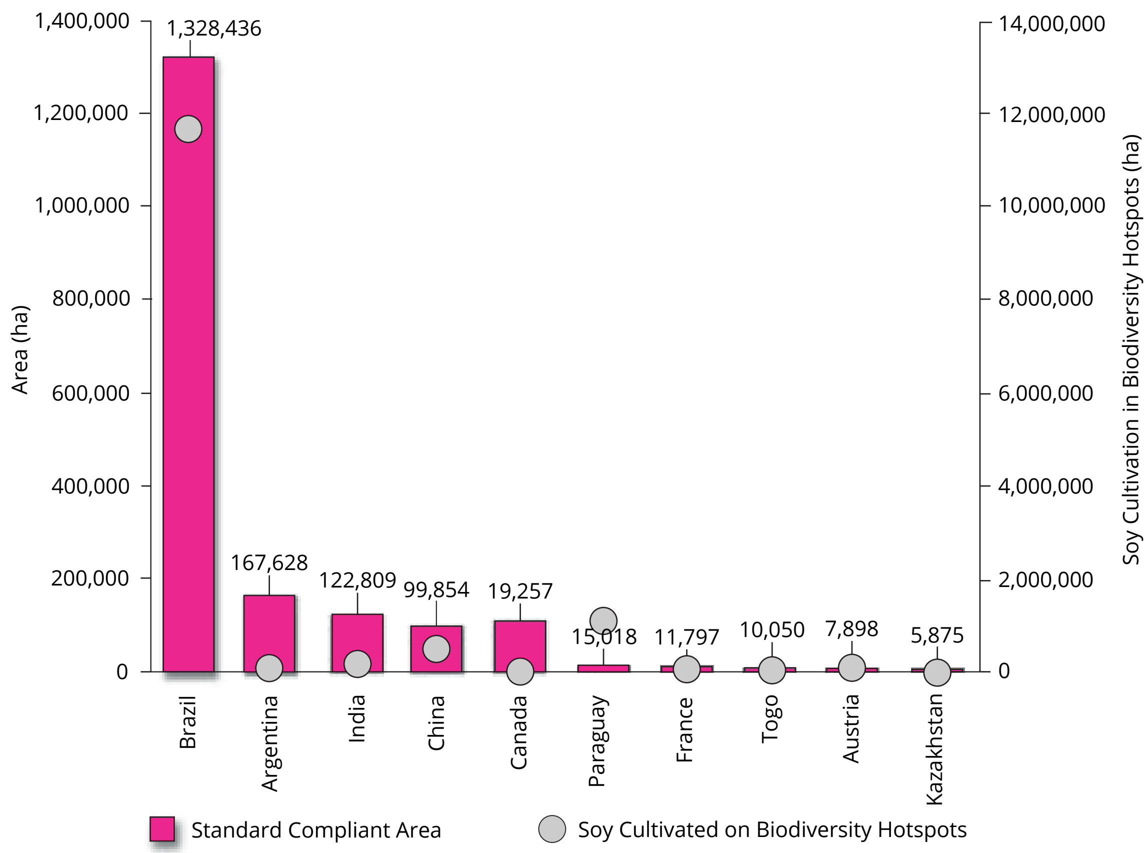
Figure 39. Top ten soy-producing countries by area devoted to soy production with biodiveristy hotspot overlay and percentage of standard-compliant area, 2014



Source: ITC, FIBL, FAOstat data

64 See, for example, Morton et al., 2006; Gollnow & Lakes, 2014.

Figure 40. Top 10 countries in terms of standard-compliant hectares with soy cultivation in biodiversity hotspot overlay, 2014



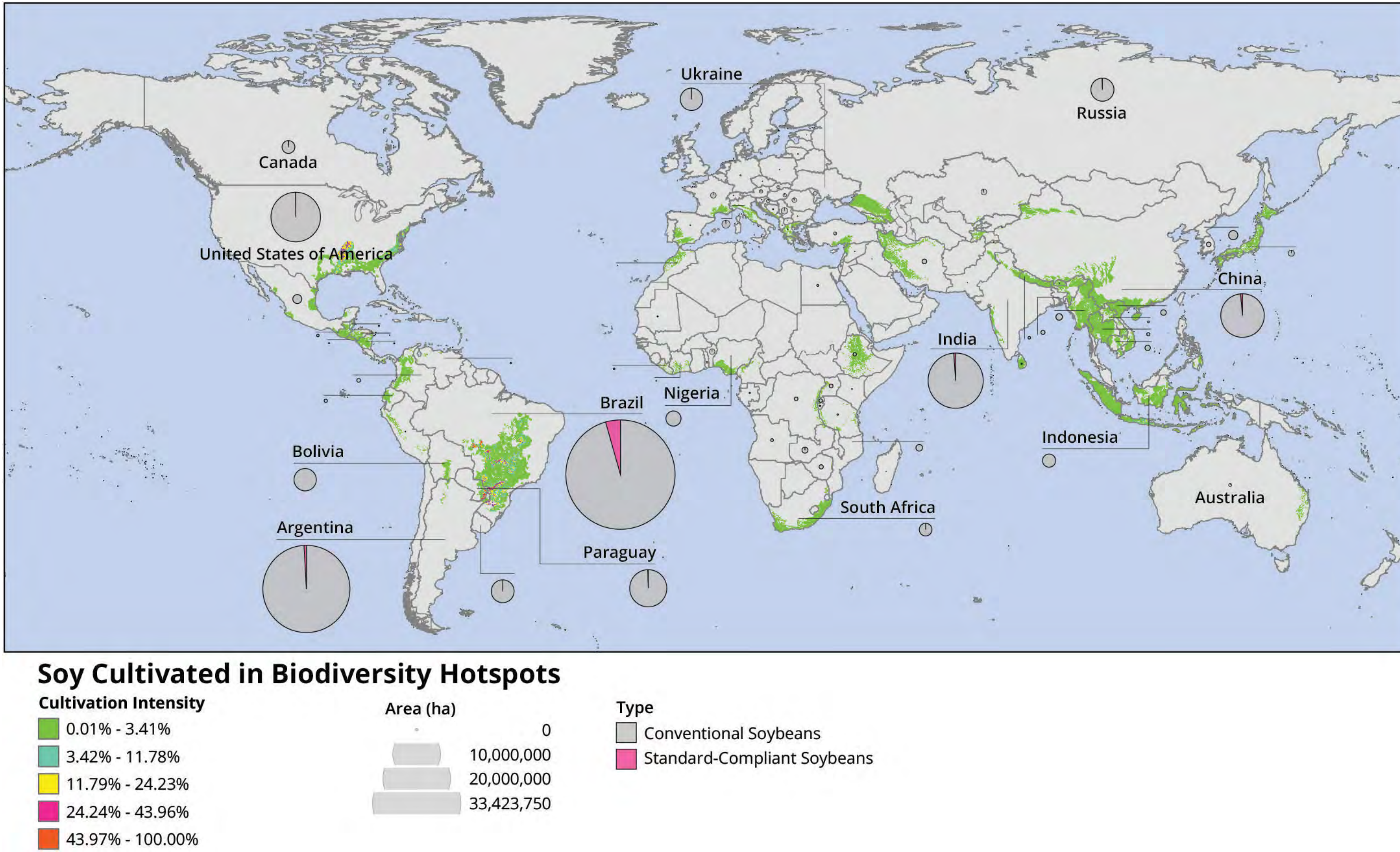
Source: ITC, FIBL, FAOstat data

Figure 39 shows that the vast majority of standard-compliant soy production is located in Brazil and Argentina: 2.8 million ha (73 per cent) and 451,000 ha (12 per cent) of global compliant soy, respectively. The next three leading producers of standard-compliant soy—China, India and the United States—account for 190,000 ha, 121,000 ha and 98,000 ha of standard-compliant soy, respectively, or a total of 11 per cent of the global total combined. Given the prominence of soy production encroachment on biodiversity hotspots in the Cerrado and Atlantic Forest regions, the concentration of compliant soy from these regions aligns well with strategic priorities for reducing the global biodiversity threat posed by soy production.[65] The United States, on the other hand, represents a major area of opportunity for more proactive adoption of standard-compliant production. Although the United States represents 25 per cent of the global soybean production biodiversity overlap area, it only represents 3 per cent of global standard-compliant production.

One of the major obstacles to more substantive adoption of certified soy is the absence of demand from major consumer markets, most notably China and North America. Moreover, because one of the largest uses of soy is as a feedstock for seafood and livestock, it has relatively low consumer presence, potentially limiting the ability of consumer markets to drive the transition to widespread compliance.

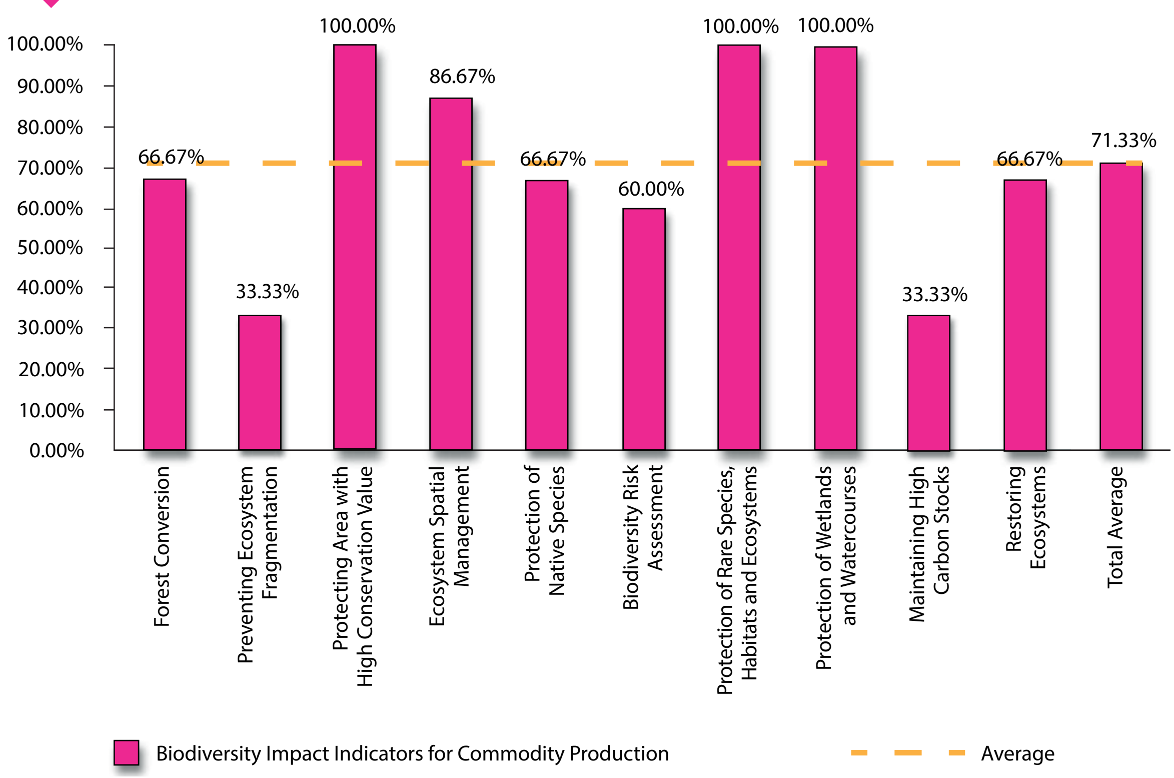
65 It is worth noting that the prominence of standard-compliant production in South America is a direct result of the intentional efforts by WWF and its business partners to establish sustainable production in the region. The most important standard operating in the soy sector (in terms of volumes produced) is RTRS, which had its launch assembly in Brazil and began by targeting Brazilian production. RTRS's head office is located in Argentina.

Figure 41. Soybean cultivated in biodiversity hotspots with standard-compliant soy cultivation areas shown per country. Brazil and the United States have the highest soy cultivation intensities (purple and red) in biodiversity hotspots, but even lower-intensity production (green) represents a concern for the potential of soy production to have an impact on hotspots.



Overall, the standards operational in the soy sector display a higher-than-average intensity score (71 per cent as compared to 66 per cent) across the Habitat Diversity Index. All three standards have critical requirements on the protection of areas with HCV, protection of ecosystems and protection of wetlands and watercourses. While only Proterra and RTRS have critical requirements prohibiting forest conversion, Organic is the only standard with critical requirements prohibiting the fragmentation of ecosystems and requiring biodiversity risk assessment as a critical requirement. Proterra has the highest overall average intensity at 86 per cent, listing critical requirements for eight of the 10 subindicators constituting the Habitat Diversity Index.

Figure 42. Habitat Diversity Index—Soybean standards: Average intensity scores for RTRS, Proterra and Organic as a group and by initiative according to the Habitat Quality Index. Voluntary standards in the soy sector, as a whole, have a higher average intensity score for the Habitat Diversity Index (71 per cent) than the average of the larger group of 15 agricultural standards (66 per cent).



Source: VSS criteria information obtained from ITC Standards Map

5.8 Sugarcane

Table 11. Sugarcane Standards, Key Market Statistics (2014)

Voluntary Standard	Compliant Production 2014 (tonnes)	Compliant Area 2014 (tonnes)	Portion of Global Production	Portion of Global Area
Bonsucro	57,543,583	963,990	3 per cent	4 per cent
Fairtrade	NA	152,153	NA	1 per cent
Organic	4,278,250	81,794	0.2 per cent	0.3 per cent
Total (Adjusted for Multiple Certification)	60,641,159 (Excluding Fairtrade)	1,163,718	3 per cent (excluding Fairtrade)	4 per cent

Source: ITC, FIBL, FAOstat data

Sugarcane is exceptional for its photosynthetic efficiency, which has made it a major ethanol feedstock in addition to being the world's primary sugar source. However, historically sugarcane has also been associated with significant environmental impacts, including deforestation in Brazil's Atlantic Forest, extensive soil erosion, high water consumption in production and processing, and the release of vinasse from processing mills, leading to the eutrophication of waterways (Gunkel et al., 2006; Martinelli & Filoso, 2008; Schiesari & Corrêa, 2016).

In 2014, 1.9 billion metric tonnes of sugarcane were produced, harvested on 26 million hectares, across 120 countries—equivalent to 0.5 per cent of the world's agricultural area. Sugarcane production is associated with a wide variety of environmental impacts. Historically, one of the major impacts of sugarcane production has been through the conversion of highly biodiverse tropical regions into cane growing fields. Today, most sugarcane expansion occurs on previously used croplands, particularly pasturelands. In Brazil, where sugarcane expansion is concentrated, research suggests that a 90 per cent loss in soil macrofauna (e.g., earthworms and termites), and a 40 per cent loss in macrofauna diversity has been observed in Brazilian growing regions when moving from pastureland to sugarcane (Franco et al., 2016).

Since sugarcane is typically produced as a monoculture, the systemic impacts of intensive agricultural production are closely linked with sugar production as well. Sugarcane is associated with high levels of soil erosion and depletion due to growth on steep slopes and high levels of irrigation. According to WWF, 5 million–6 million hectares of soil are depleted annually through sugarcane production (WWF, 2005). Similarly, soil organic carbon declined by 40 per cent in Papua New Guinea between 1979 and 1996 in cane cultivation areas (WWF, 2005). Overall, cane production is associated with soil salinization and soil acidification over the long term.

While sugarcane is not a major user of pesticides among agricultural crops,[66] nitrogen application rates for sugarcane are high as are losses (Brackin et al., 2015), which is directly linked to the eutrophication of local water bodies and corresponding declines in biodiversity (Gunkel et al., 2006; Martinelli & Filoso, 2008; Schiesari & Corrêa, 2016). Eutrophication is further exacerbated in sugarcane processing through the regular cleaning of processing facilities, which releases large amounts of plant matter and sludge (Clay, 2004).

66 Of course, any pesticide application will be subject to environmental issues and sugarcane production has been linked to problematic pesticide pollution as well (Lehtonen, 2009; Storr, 2012).

Sugarcane production's heavy reliance on flood irrigation and the corresponding impact on water resources has increasingly become an issue, as water resources become more scarce in many sugar-producing regions. An estimated 1,500 litres of water is required to produce 1 kg of sugar from sugarcane. In order to supply sufficient water, natural watercourses are often modified to fulfill the needs of cane production. In Pakistan, there has been an estimated 90 per cent reduction in the volume of fresh water reaching the Indus Delta due to, among other things, cane production (WWF, 2005).

Notwithstanding the potential negative impacts, sugarcane is a perennial crop with exceptional photosynthetic efficiency, making it a major ethanol feedstock. Indeed, the growth of the use of sugarcane for ethanol production has been one of the major drivers of sugarcane production in recent years.

Global consumption of sugar grew by 31 per cent between 2000 and 2014 (United States Department of Agriculture, 2016), while the area of harvested sugarcane grew by 40 per cent or 7.8 million hectares, 72 per cent of which occurred Brazil.[67] Brazil is the largest producer (736 million tonnes in 2014) and exporter (accounting for 58 per cent of global sugarcane exports)[68] of sugarcane and, as such, represents the locus of sugarcane's potential and actual impacts on biodiversity.[69]

As a result of its combined impacts, WWF has suggested that sugarcane may be the single most important cause of biodiversity loss resulting from agriculture (WWF, 2005). In light of this, and the current rapid expansion of cane production, in 2005 WWF led a campaign to mainstream the adoption of better management practices within the sugar industry. Eventually these efforts led to the establishment of Bonsucro in 2005. Although Fairtrade and Organic standards have been active in the sugar sector for several decades already, the establishment of Bonsucro represents a major shift in emphasis from the transition of mainstream cane production processes to environmentally preferable practices.

Presently Bonsucro represents the most important VSS in terms of compliant volumes; however, its growth has been somewhat slower than other mainstream standards, with total standard-compliant production (across all three VSS) only reaching 52 million tonnes (or 3 per cent of global production) by 2014. Nevertheless, this represents a significant increase from the estimated 408,000 tonnes certified in 2008 to today, when virtually all compliant production comes from Bonsucro.

Several major users of sugar—most notably, Coca-Cola, Ferrero Group, General Mills, PepsiCo and Unilever—have partnered with Bonsucro and have made commitments to 100 per cent responsible or more sustainable sourcing, which incorporates the Bonsucro program to varying degrees.[70] Tate and Lyle Sugars already sources 100 per cent Fairtrade-certified sugar; however, it remains to be seen how Fairtrade sugar will perform in the coming years in light of the recent increased price differential between Fairtrade-certified and conventional sugar.[71]

67 The ratio of use for ethanol and cane sugar has remained stable at about 60/40 during this period, suggesting that growth in ethanol demand is driving expansion in addition to growth in cane sugar demand (Valdes, 2011)

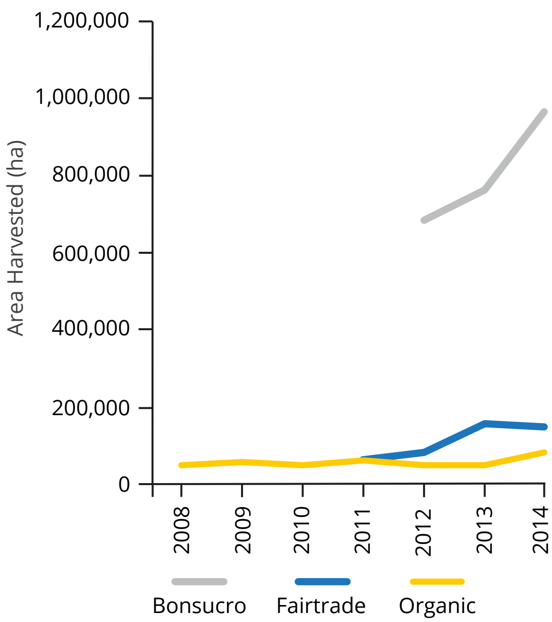
68 Including beet sugar sources, Brazil accounts for 35 per cent of global sugar exports. (UN Data, 2015)

69 The vast majority of Brazilian sugarcane's production occurs in the Cerrado—most commonly on land previously dedicated to pasture. It is expected that an additional 6.4 million hectares of sugarcane production will be added to Brazil's production base by 2021. While the land conversion involved in Brazilian sugarcane expansion does not typically involve the removal of native vegetation, it does have important impacts on biodiversity, soil and water quality (Franco et al., 2016).

70 See the Bonsucro commitments page (Bonsucro, 2016)

71 Initial reports are that purchases of Fairtrade sugar are on the decline as a result (Fairtrade, 2015).

Figure 43. Standard-compliant sugarcane area 2009–2014, by initiative



Average Annual Growth:

Bonsucro: 19%
Fairtrade: 37%
Organic: 7%

Data Source: Lernoud et al., 2015

5.8.1 Spotlight on Sugarcane Production and Water Quality

Sugarcane is grown on almost every continent and is an important consumer of fertilizer on a per-hectare basis.[72] In 2010/2011, sugar crops (sugarcane and sugar beets) accounted for 4.2 per cent of the total global consumption of mineral fertilizers (Heffer, 2013). The consumption and production of sugar are projected to grow significantly over the next decade, with total production expected to reach 210 mt by 2025. Fertilizer application for its cultivation will likely follow (Organisation for Economic Co-operation and Development & FAO, 2016). Brazil is by far the world's largest sugarcane producer, accounting for 39 per cent of global production. Other important producing countries include India (19 per cent), China (6.7 per cent), Thailand (5.5 per cent) and Pakistan (3.3 per cent) (2014 production year; FAOStat, 2016a).

Application rates of nitrogen and phosphorus per unit of product are used as proxies to examine the potential water quality impacts of agricultural commodity production (Chapagain et al., 2005). Agricultural lands with greater concentrations of nitrogen- and phosphorus-based fertilizers are more prone to nutrient-rich agricultural runoff.[73] Nitrogen fertilizers can be especially damaging, as they can leach nitrate into groundwater, which is detrimental to human health at higher concentrations (Knobeloch et al., 2000).[74] In order to assess the relative fertilizer burden posed by sugarcane production, we map nitrogen and

72 Recommended fertilizer application for crop production can range widely depending on climatic and soil conditions. The recommended application for nitrogen and phosphorus for sugar cultivation varies from 250 to 300 kg/ha and 100 to 200 kg/ha, respectively, which is greater than the recommended application for wheat (40 to 120 kg N/ha, 90 kg P/ha), rice (160 kg N/ha, 20 to 80 kg P/ha) and maize (50 to 300 kg N/ha, 30 to 100 kg P/ha) (Roy, Finck, Blair, & Tandon, 2006).

73 Nutrient runoff can also be influenced by farming practices, topography, soil types and precipitation intensity, among other things.

74 Blue baby syndrome is linked to a high concentration of nitrate in water, which affects blood oxygenation.

phosphorus application rates across sugarcane-producing countries alongside rates of compliance with international sustainability standards (Figures 44–46). [75]

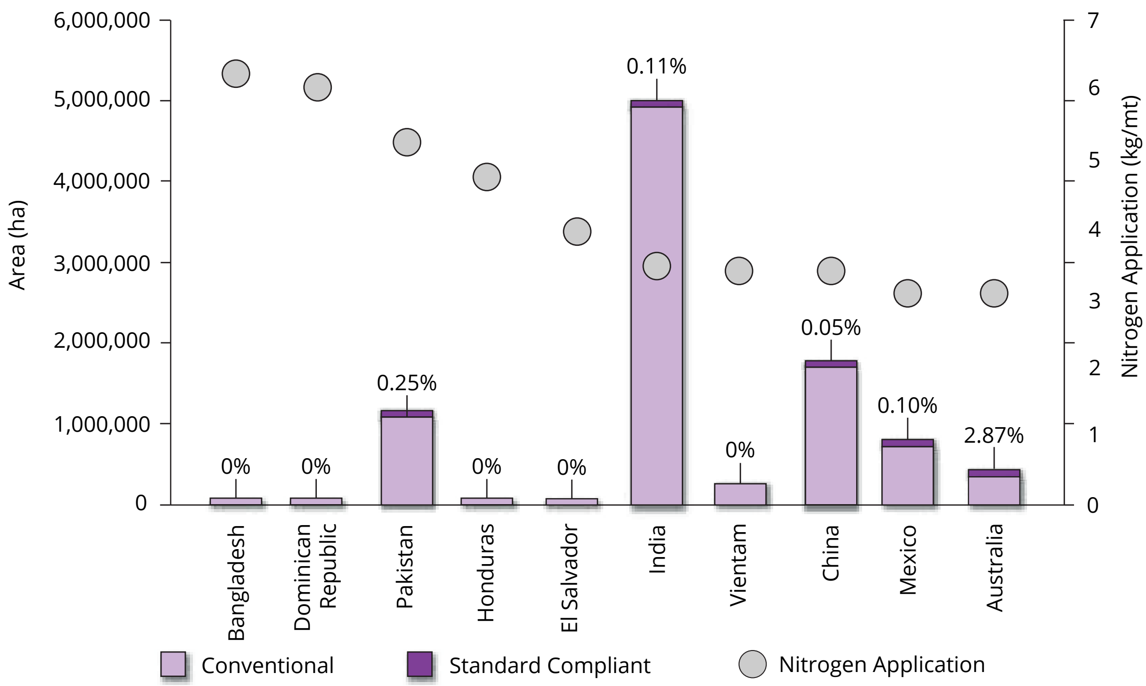
The average rate of nitrogen and phosphorous use among sugarcane-producing countries is 2.1 kg/tonnes and 0.45 kg/tonnes, respectively, which serves as a reference point for understanding where fertilizer use associated with sugarcane production is likely to be most problematic. Among the top 10 producers, India, China, Pakistan, Mexico, Colombia and Australia stand out with higher-than-average nitrogen use, while all but Indonesia and the United States have higher-than-average phosphorous use. Bangladesh and the Dominican Republic offer the highest per-unit levels of fertilizer application globally and thus represent natural targets for improved application practices. From the perspective of maximum impact, India, China, Pakistan and Mexico stand out for their relatively high use of fertilizer and corresponding importance in overall sugarcane production. While these countries represent natural targets for voluntary sugarcane standards, the vast majority of sugarcane is produced for local consumption, and thus may face limited demand for certified products in many countries. In this regard, Brazil, which accounts for 58 per cent of global sugarcane trade, represents an obvious target for certified sugarcane production.

Figure 43 shows the importance of existing international trade flows in determining the actual distribution of standard-compliant production. As noted above, sugarcane exports are highly concentrated in Brazil. Brazil's dominance in international sugarcane trade is magnified within the context of standard-compliant sugarcane production, where Brazil accounts for 79 per cent of the global standard-compliant area (as compared with 58 per cent of sugarcane exports). The trend toward an increased concentration of standard-compliant production in countries with well-established trade channels points toward a possible challenge for countries with less active sugar trade in attracting markets for sustainable sugarcane.[76] From a trade perspective, Thailand (11 per cent of global exports), Guatemala (7 per cent of global exports) and Mexico (3 per cent of global exports) represent potential low-hanging fruit for the expansion of standard-compliant sugarcane production.

75 Note that to fully assess opportunities for standards to curb potential water-quality impacts associated with nitrogen and phosphorus application, one would have to determine farming practices, soil fertility, climatic conditions, the topography of sugar cultivated areas as well as the proximity to surface water bodies and groundwater profile. This would allow for understanding the potential risks that fertilizers applied for sugar production could potentially have on water quality. It would also assist in determining if farmers are overfertilizing their fields for the sugarcane yields they are achieving. Reducing fertilizer will lower agricultural input costs, which is important due to price volatility and rising demands. Inputs for nitrogen-, phosphorus- and potassium-based fertilizers all experienced an important price increase in 2011 (Food and Agriculture Organization, 2015, 2016e).

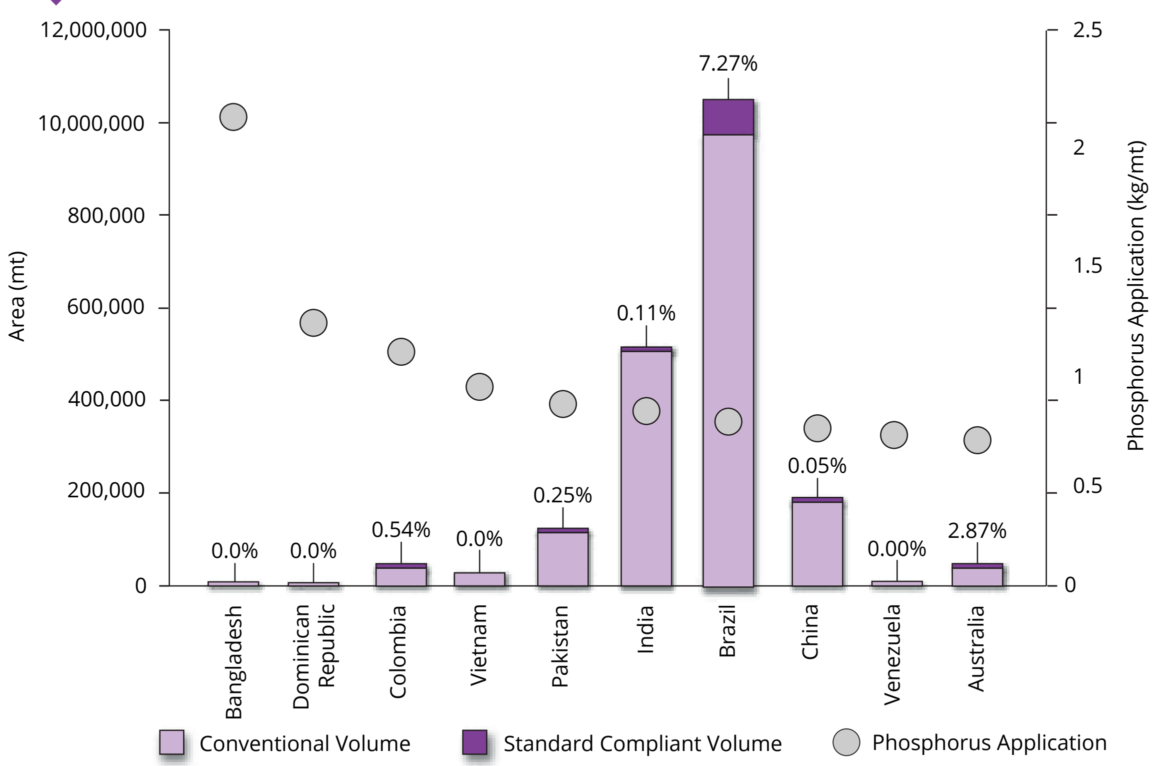
76 There is a growing body of evidence that supply for standard-compliant commodities is more concentrated than for conventional commodities. Although the rapid growth of markets for sustainable commodities represents an opportunity for all producing countries, it would appear that those with existing trade channels are likely to capture and dominate markets for certified products more effectively than those with less developed channels. Existing market access may be one of the most important determinants of whether a given country can take advantage of markets for standard-compliant products. In addition to having implications for the strategic application of standards for environmental purposes, the reification of existing trade channels through standard-compliant markets may reduce the effectiveness of such instruments in enabling economic growth and poverty reduction where it is needed most. See also Potts et al., 2014.

Figure 44. Nitrogen application rates for sugarcane production, top 10 countries



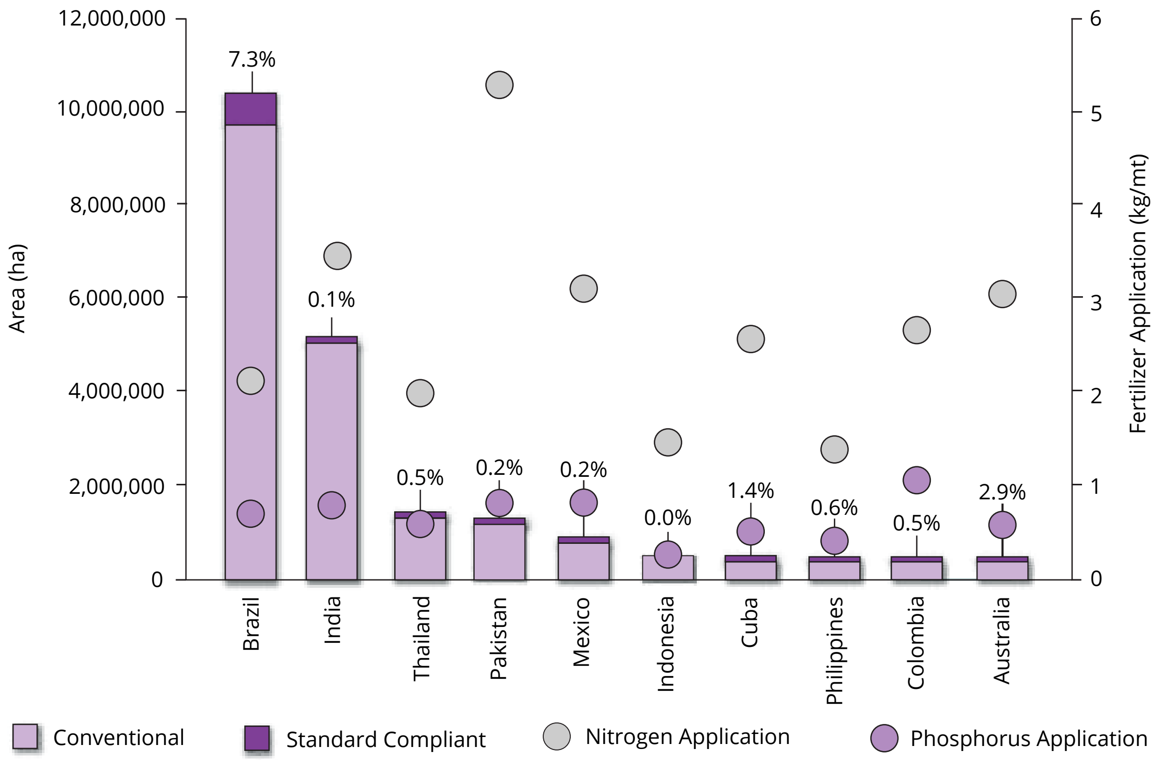
Source: Earthstat (n.d.); ITC, FIBL, SSI, FAOstat data

Figure 45. Phosphorus application rates for sugarcane production, top 10 countries



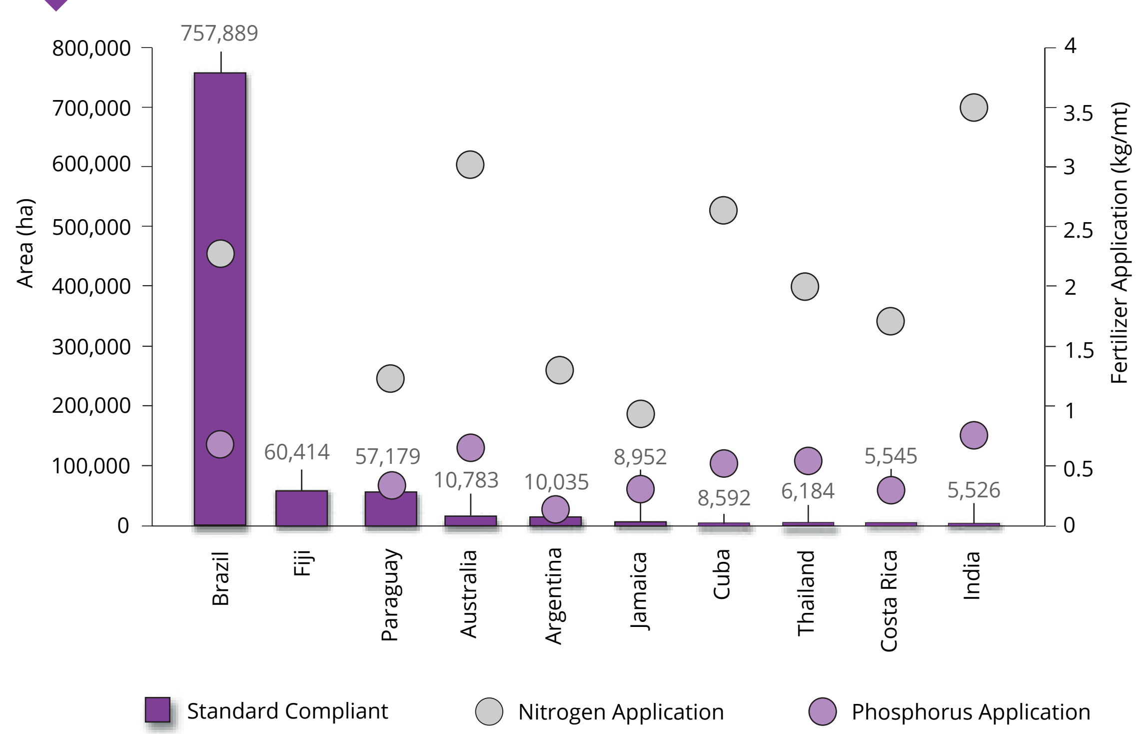
Source: EarthStat n.d., ITC, FIBL, SSI, FAOstat data

Figure 46. Nutrient application rates for top 10 sugarcane producers. India, China, Pakistan, Mexico, Colombia and Australia represent hotspots for high rates of fertilizer application in sugarcane production.



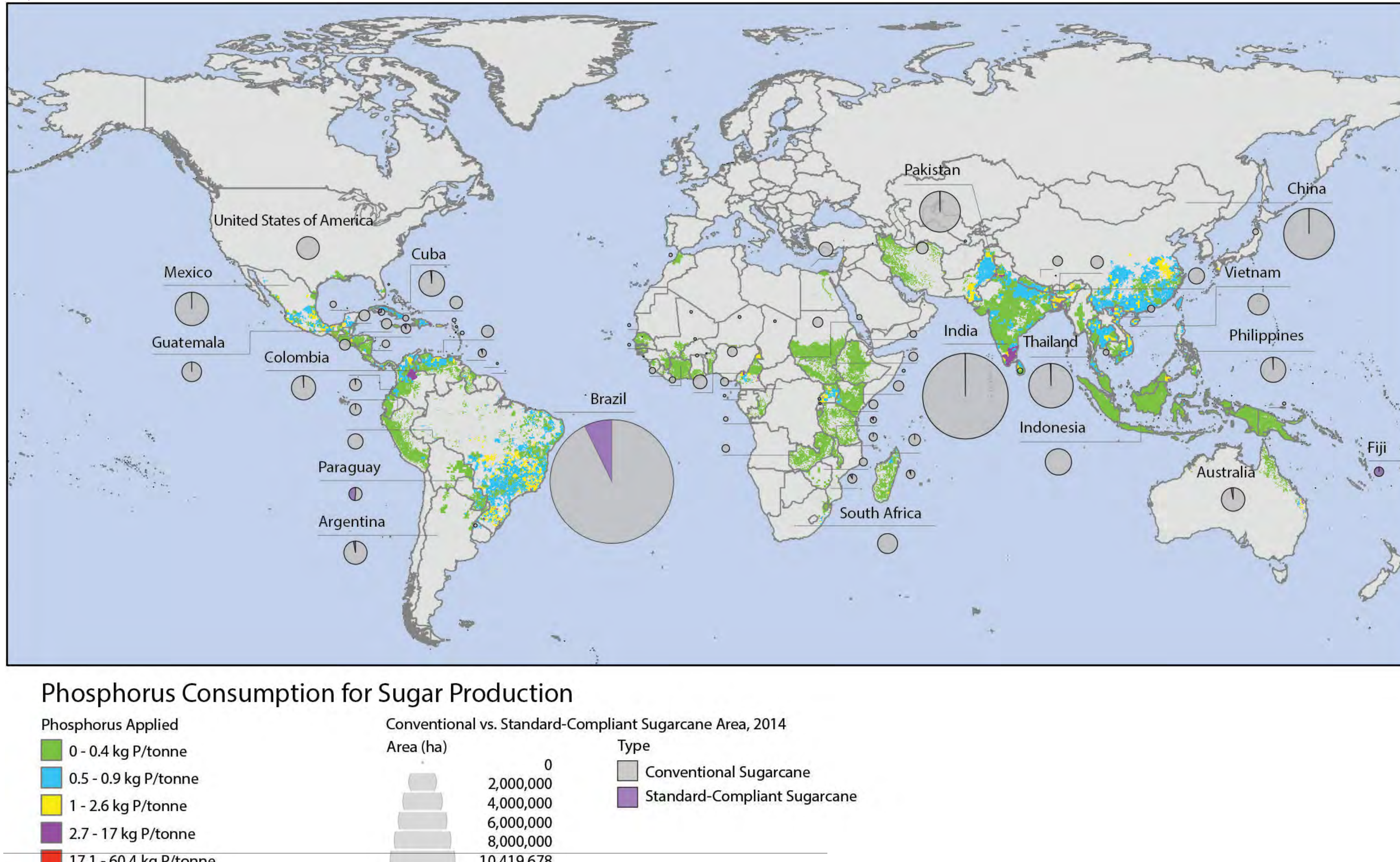
Source: Earthstat (n.d.); ITC, FIBL, SSI, FAOstat data

Figure 47. Top ten countries in terms of standard compliant hectares with sugarcane cultivation with nitrogen use overlay, 2014



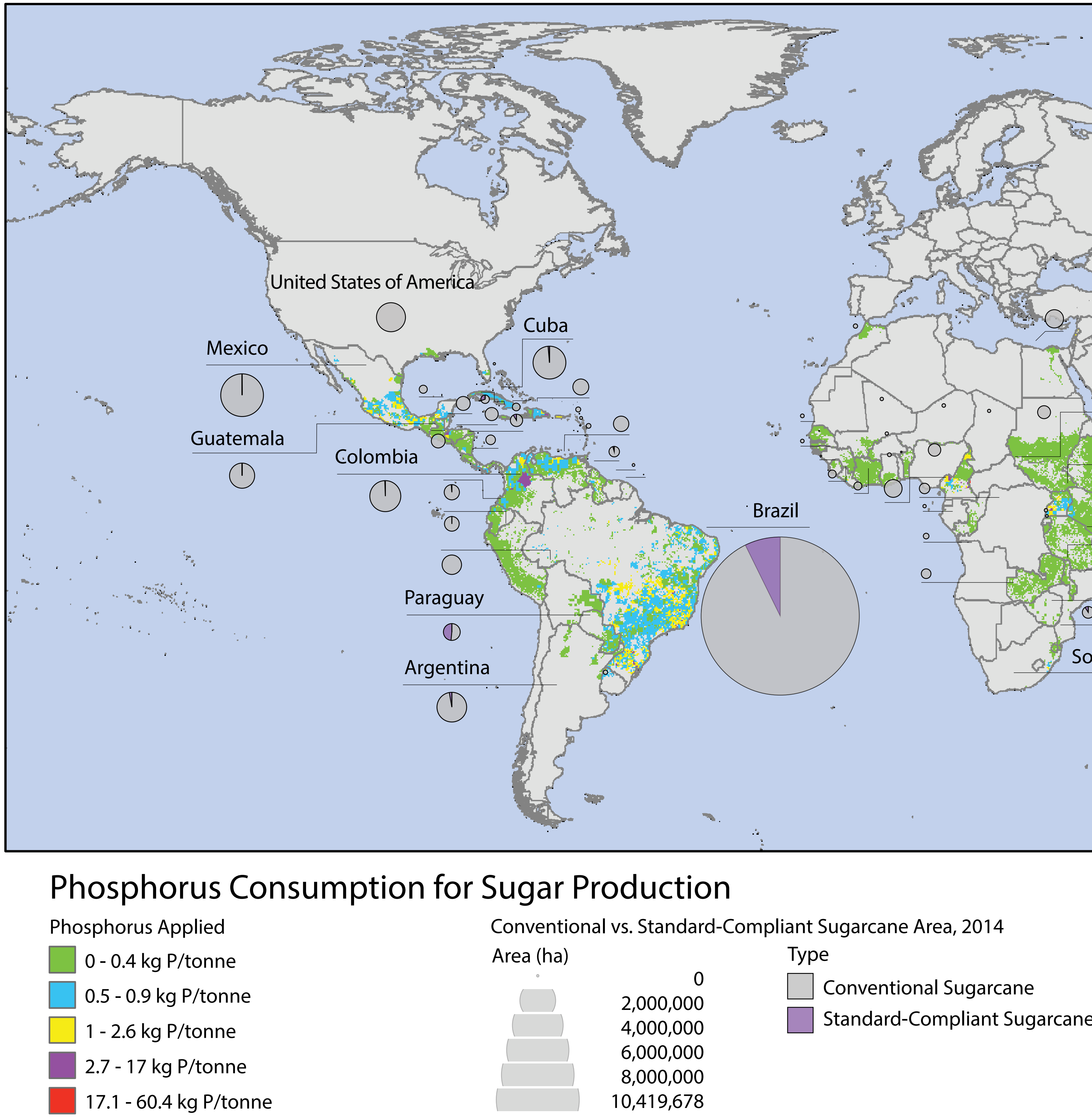
Source: Earthstat (n.d.); ITC, FIBL, SSI, FAOstat data

Figure 48. Nitrogen load by sugarcane-producing region. Yellow, purple and red designate above-average nitrogen application[76]



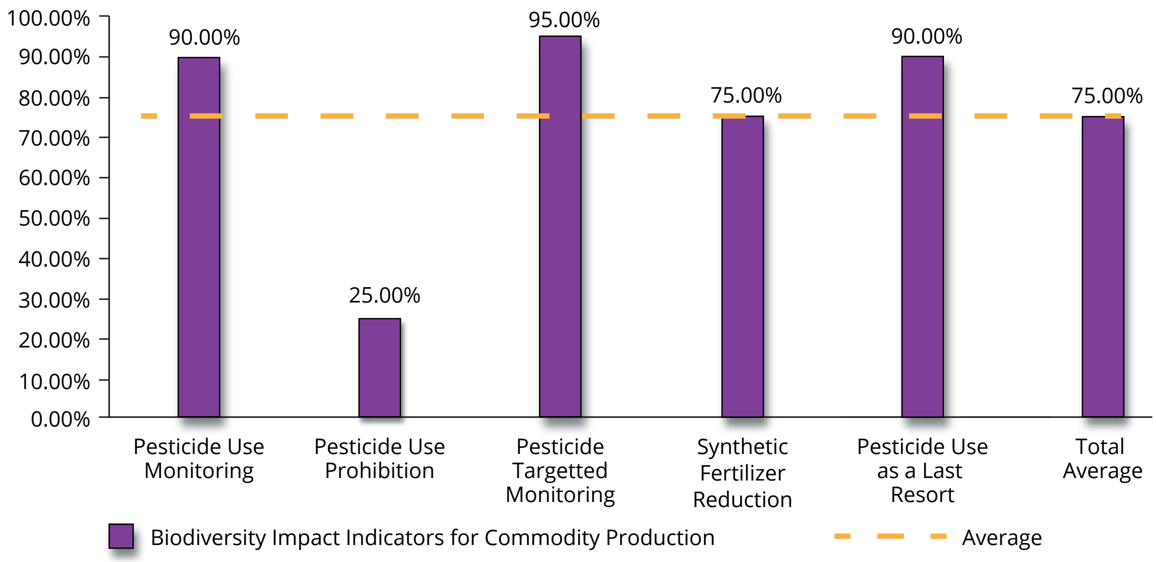
77 The nitrogen load in the form of mineral fertilizers, manure and atmospheric deposition, and phosphorus load in the form of mineral fertilizers and manure per tonne of sugar produced were mapped based on application rates per hectare for the year 2000 divided by sugar yields and averaged between 1997 and 2003 at a 10-km grid resolution (Monfreda, Ramankutty, & Foley, 2008; Mueller et al., 2012; West et al., 2014). For instance, nitrogen is applied at 57 kg/ha with a yield of 84 mt/ha of sugar within the same area, which therefore gives a nitrogen load per metric tonne of sugar of 0.68 kg/tonne. The nitrogen load per unit product grid cell values are then averaged across all the 10-km grid cells in a given country to give a national estimate.

Figure 49. Phosphorus load by sugarcane-producing region. Blue, yellow, purple and red designate above-average phosphorus application



Sugarcane standards have significantly higher criteria coverage under the Fertilizer and Pesticide Index than for the group of agriculture standards as a whole (75 per cent average intensity for sugarcane standards versus 56 per cent for all agriculture standards). With the exception of pesticide use prohibition, all of the sugarcane standards have relatively strong provisions for criteria listed in the index. Requirements for the reduction of synthetic fertilizer use are either a short-term or critical requirement for three of the four active standards. Organic stands out as the only standard with critical requirements related to each of the indicators under the index, including pesticide prohibition and an average intensity score of 100. Bonsucro, the largest sugarcane standard (more than six times Fairtrade by volume) (Lernoud et al., 2015; Potts, Lynch, Wilking, et al., 2014), revealed above-average intensity scores across the range of indicators. Fairtrade for smallholder farmers has the least demanding requirements under the index, which is likely due an intentional effort to keep the standard accessible to farmers with reduced resources.

Figure 50. Pesticide and Fertilizer Index—Sugarcane standards have higher-than-average intensities for requirements related to the management and reduction of synthetic fertilizers and pesticides.



Source: VSS criteria information obtained from ITC Standards Map

5.9 Tea

Table 11. Tea Standards, Key Market Statistics (2014)

Voluntary Standard	Compliant Production 2014 (tonnes)	Compliant Area 2014 (ha)	Portion of Global Trade	Portion of Global Production	Portion of Global Area
Fairtrade	187,913	107,360	9%	4%	3%
Organic	57,300	54,422	3%	1%	1%
Rainforest Alliance	808,332	381,536	39%	15%	10%
UTZ	71,234	38,605	3%	1%	1%
Total (Adjusted for Multiple Certification)	986,171	503,025	48%	18%	13%

Source: ITC, FIBL, FAOstat data

In 2014, 5.6 million tonnes of tea on 3.8 million ha (accounting for 0.07 per cent of all agricultural land) was produced. Over the past decade, production of black and green teas has grown at an above-average rate of approximately 4.8 per cent per annum. Tea area harvested expanded by 49 per cent between 2000 and 2013, 76 per cent of which occurred in China. Although tea can be grown in an agroforestry environment preserving significant forest diversity, productive efficiency has dictated that almost all tea is grown in full sun on plantations.

As with all forms of intensive agriculture, tea production has resulted in significant impacts on the ecosystems where it is produced. Arguably the most important biodiversity issue concerning tea cultivation is habitat conversion, caused when the plantations themselves replace tropical forests, and the removal of timber for use in the tea-drying process (Clay, 2004). Tea is often cultivated on sloped land, and when combined with the effects of forest removal, it can cause high levels of soil erosion (van der Wal, 2008). Because tea is a perennial with a potential productive life of more than a century from a given plant and with relatively low water consumption, synthetic inputs represent one of the principle ongoing environmental and consumer safety concerns (Griffith-Greene, 2014)

In 2014, China, India, Sri Lanka and Kenya accounted for 3.7 million mt (67 per cent of global production). The vast majority of tea production occurs in developing countries and is consumed locally. Both China and India, the most important producers of tea globally, only export 20 per cent of their tea. Kenya and Sri Lanka, however, the world's third and fourth largest producers, each export over 90 per cent of their tea and together account for more world trade (35 per cent) than China and India (28 per cent). The top five importers are Russia (11 per cent), Pakistan (11 per cent), the United Kingdom (9 per cent), the United States (9 per cent) and Egypt (6 per cent) (UN Comtrade Database, 2016: 2015 data).

The growth of voluntary standards in the tea sector is linked primarily to concerns for worker well-being and safety rather than environmental impacts.[78] Fairtrade and Organic standards have been operational in the tea sector since the 1990s but were primarily focused on niche markets. The entry of Rainforest Alliance, Utz and Ethical Tea Partnership certified teas in 2007, 2009 and 1997, respectively, signalled a new wave of interest in tea certification for mainstream markets, which has led to rapid growth in market coverage by voluntary standards in the sector.[79]

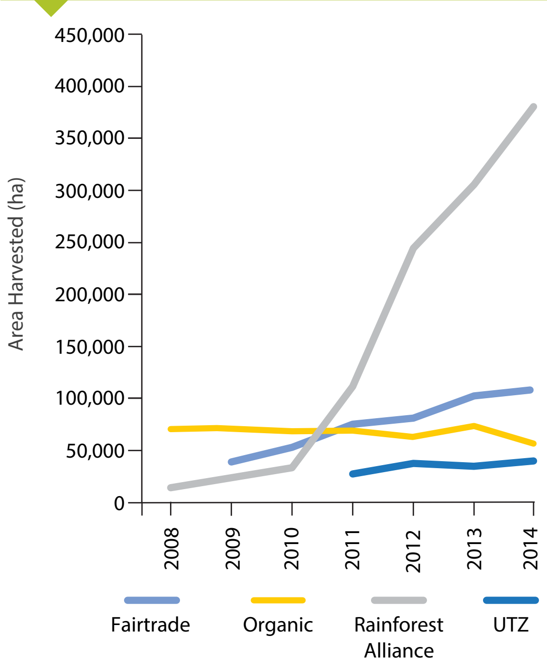
78 Fairtrade and the Ethical Tea Partnership, for example, largely focus on stipulating worker conditions.

79 For a comprehensive history of the growth of standards in each sector see Potts et al., 2014.

By 2014, VSS-compliant tea accounted for 18 per cent of global production, up from 6 per cent in 2008. Rainforest Alliance-certified production grew at a rate of 25 per cent per annum from 2012 to 2014, driven by commitments by Unilever and Tetley, the two largest tea companies, to sustainable sourcing by 2020 and 2016 respectively. By 2015, Lipton, a Unilever brand, had reached 100 per cent compliant sourcing of its tea bags, putting total Unilever compliance levels at 66 per cent (Unilever, 2016).

The vast majority of certified teas come from those countries where tea production is primarily focused on export markets, namely Kenya and Sri Lanka. And while the producing regions have been able to meet demand for Northern markets, the potential of those markets to transform practices within the tea sector remains questionable in light of the importance of production for domestic markets, which, for the most part, have not developed markets for labelled products to date.

Figure 51. Standard-compliant tea production area, 2009–2014, by initiative



Average Annual Growth:

Fairtrade: 23%
Organic: -4%
Rainforest Alliance: 73%
UTZ: 14%

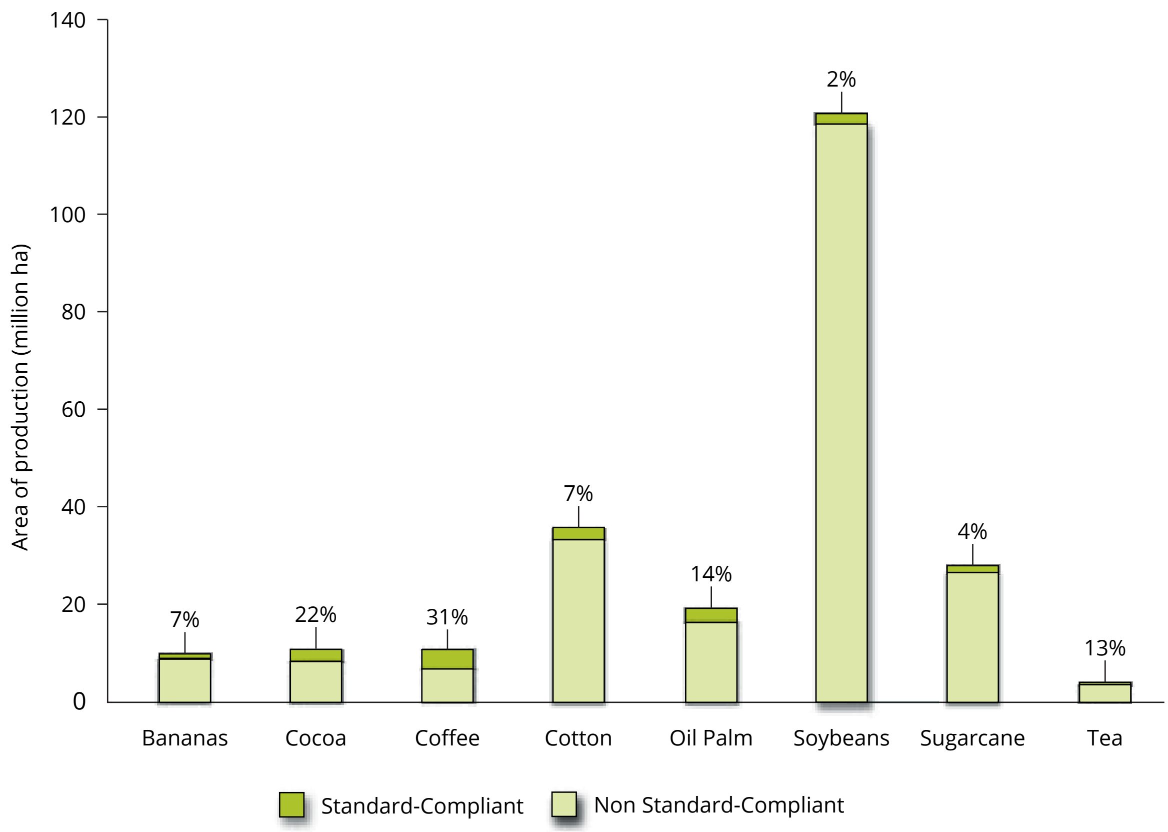
Data Source: Lernoud et al., 2015

5.9.1 Spotlight on Tea Production and Area-based Conservation Management

In many respects, voluntary standards represent the natural outcome of a more general effort to promote area-based conservation management. By identifying credible practices for conservation and then applying independent conformity assessment processes, voluntary standards offer a vehicle for markets to promote area-based conservation management through product consumption. While area-based conversation management can also occur through regulatory action as well as through informal (local) supply chains, voluntary standards offer a uniquely international and transparent basis for assessing and measuring area-based conservation.

The overall success of standards in promoting area-based conservation management is easily measured as a ratio of standard-compliant production area to conventional production area. Figure 51 offers a high-level view of the relative success of voluntary standards across those agricultural commodities where standards have been most active. Whereas voluntary standards were principally regarded as vehicles for market differentiation in niche markets in their early development, since the turn of the millennium, a growing number of initiatives have explicitly targeted mainstream markets resulting major and rapid growth in standard-compliant areas for many crops. Coffee, cocoa, palm oil and tea stand out with double-digit penetration in terms of total production areas considered standard compliant and, as such, as being recognized as applying conservation-based management practices.

Figure 52. Percentage of standard-compliant production area to conventional production area for eight crops where standards are most active in 2014



Source: ITC, FIBL, FAOstat data

Currently, 62 per cent of standard-compliant tea area is located in Kenya (39 per cent) and India (23 per cent). China (accounting for 7 per cent of global compliant area) and India, as the most important producers of tea globally, represent the most significant opportunities for further certified tea growth. Sri Lanka, Vietnam and Turkey also represent areas with significant tea production but nominal presence of standard-compliant production.

Tea offers a sort of generic example of the trends and early growth curve for standards as they enter mainstream markets. Following a decade of relatively slow growth through the operations of Fairtrade and Organic certification through the 1990s, cooperation between mainstream companies and Rainforest Alliance around 2006 led to a series of corporate commitments and the rapid expansion of Rainforest-certified production resulting in 25 per cent growth per annum between 2008 and 2014. Rainforest Alliance's specific targeting of mainstream markets not only gave it a dominant position in the standard-compliant tea market but also operated as a constraint on the market growth of its competitors as it claimed the territory. This pattern, whereby a single player catering to the mainstream companies dominates the global market and defines the overall impact of standards for the sector with the remainder of standards playing a relatively minor role, has played out across virtually every commodity market where standards have entered the mainstream.

Four key lessons can be extracted from this history. First, policy-makers and other stakeholders seeking to obtain significant coverage of the area under conservation management using standards are most likely to succeed by working in collaboration with mainstream companies through the development and implementation phases of a system. Second, where mainstream players are part of the development process, standards can leverage the significant reach of their existing supply chains leading to rapid adoption of standard-compliant practices at production. Third, rapid uptake of standards by mainstream actors is likely to target producing regions where the transition to standard compliance is least costly (e.g., where practices are already in, or close to, compliance). The total area under conservation management may eventually peak when the supply of "low-cost" compliance diminishes.[80] For example, Kenya, along with donor partners,[81] has capitalized on its favourable climatic and economic conditions for sustainable tea production by proactively investing in capacity building for sustainable tea production, enabling rapid adoption on a wide scale. The systemic concentration of tea certification in more productive (profitable) growing regions is further evidenced by the observation that certified tea accounts for 18 per cent of global tea production but only 13 per cent of global tea producing area. Fourth, the total area under conservation management may be limited by the proportion of production that is sold on global markets. This last point is particularly important in the case of tea, given that it is almost entirely produced in developing countries and only 35 per cent of global tea production is traded on world markets. Since developing countries are not, as of yet, significant consumers of certified tea, new strategies for attending to the remaining 65 per cent of the market will likely be necessary. This point is particularly salient in the case of China, which, despite holding the title as the world's most important producer and consumer of tea, only accounts for 7 per cent of global standard-compliant tea production area.

Tea also offers a case in point of a larger issue related to the use of standards as a vehicle for managing area-based conservation. Total land area under tea production globally is approximately 3.6 million hectares. Even if 100 per cent of global tea production were certified, it would only account for 0.24 per cent of global agricultural land (arable and permanent cropland) (Small Planet Institute, n.d.).[82] Similarly, if each of the eight crops where international standards are active were to achieve 100 per cent standard-compliant production, total area under standard-compliant practices would only account for 12 per cent of global agricultural land area. As of 2014, we estimate that standard-compliant production accounts for approximately 1 per cent of global agricultural land. Thus, although standards have passed the "proof of concept" phase, they remain very much in their infancy as significant tools for conservation management in agriculture as a whole.[83]

80 This general trend is most clearly observed in the coffee, banana and cocoa sectors, where standard-compliant production is disproportionately located in more economically developed producing regions (see Potts et al., 2014).

81 The Dutch Sustainable Trade Initiative has co-invested with Rainforest Alliance, Unilever and the Kenyan Tea Development agency to train 560,000 tea farmers in Kenya. Programs such as these have enabled 95 per cent of Kenya's tea production area to become certified. See https://www.idhsustainabletrade.com/initiative/kenya-tea-program

82 Calculations for total agricultural land exclude permanent pasture.

83 "The IRRI [International Rice Research Institute] and the United Nations Environment Programme inaugurated the Sustainable Rice Program in December 2011 as a multistakeholder partnership to promote resource efficiency and sustainability throughout the value chain in the rice sector" (Andrade, 2015). If similar initiatives aimed at mainstream cereal markets were developed, they could significantly increase the area covered by voluntary standards.

Figure 53. Standard-compliant and conventional tea production area (ha) by country, 2014

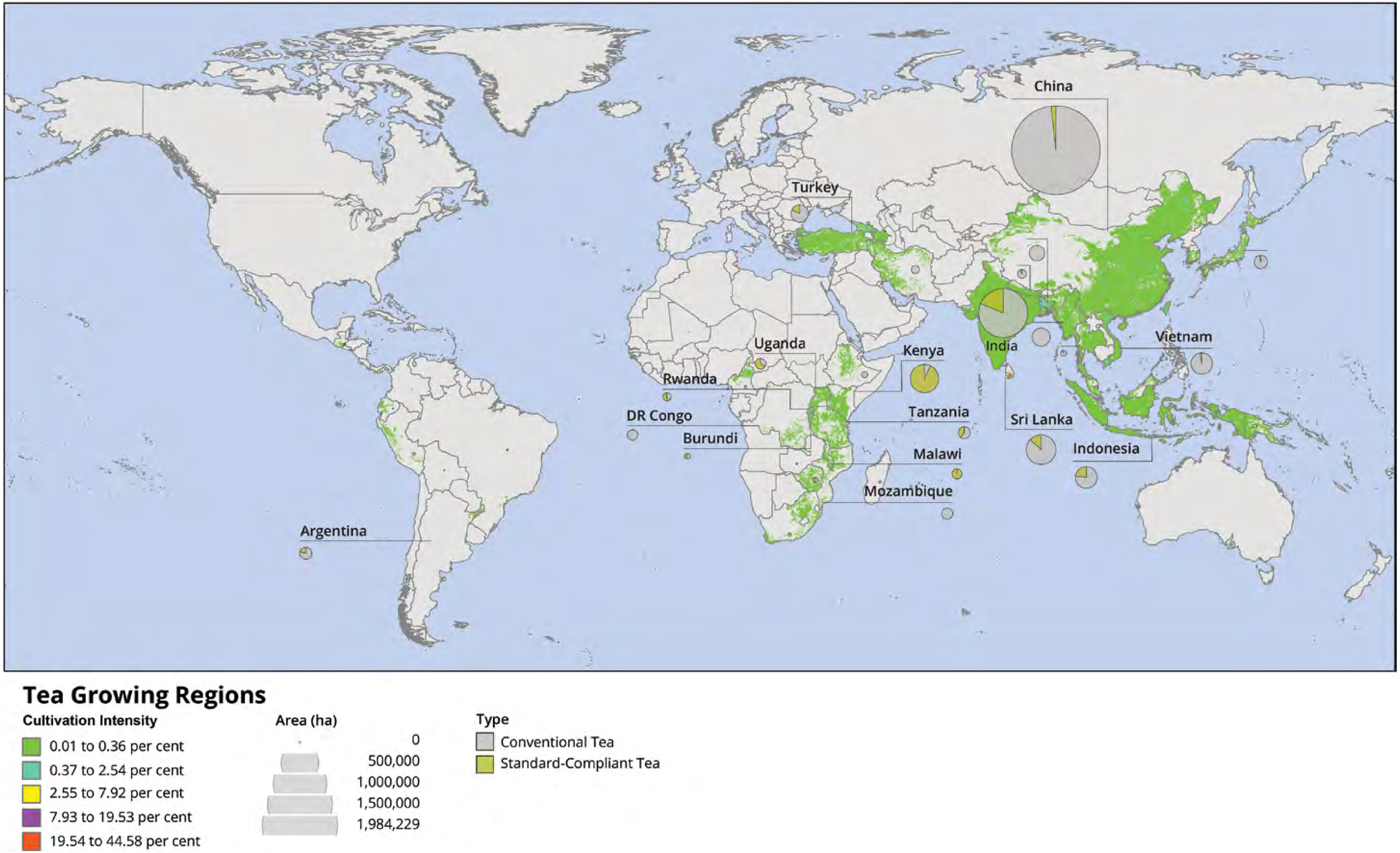
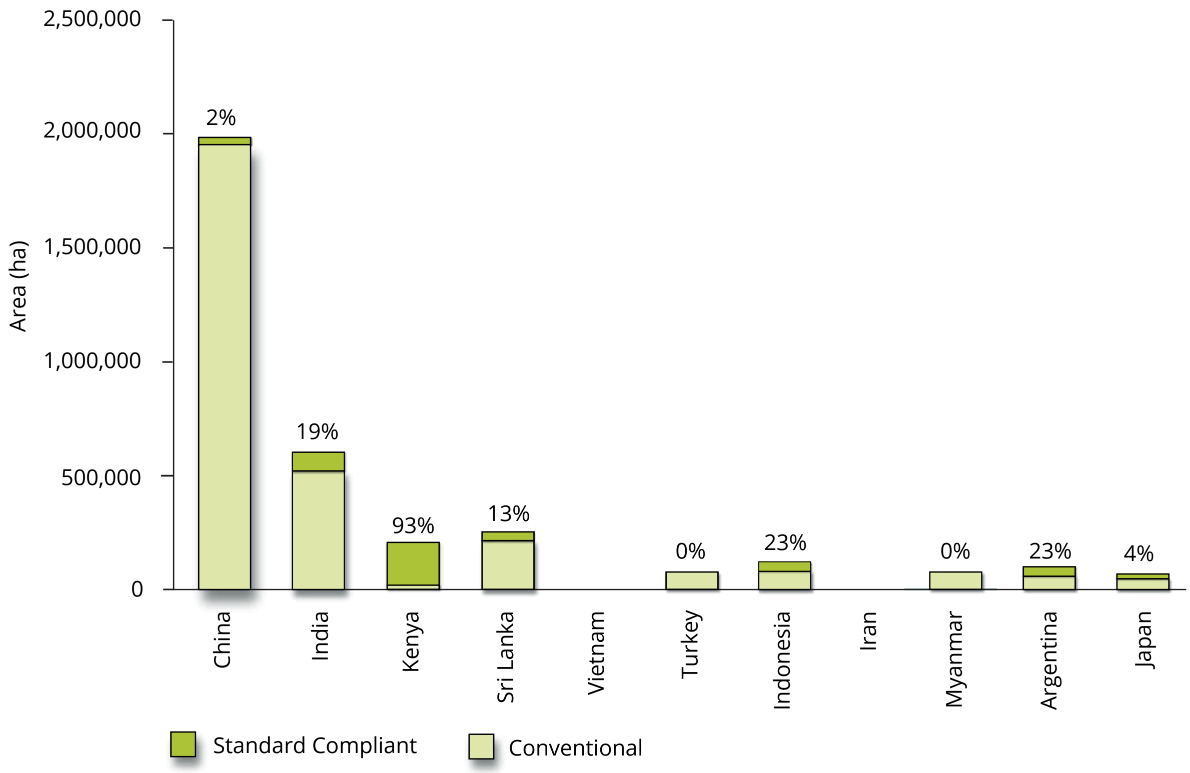


Figure 54. Top 10 tea producers by area under production, standard-compliant production as a percentage of total tea production, by country.

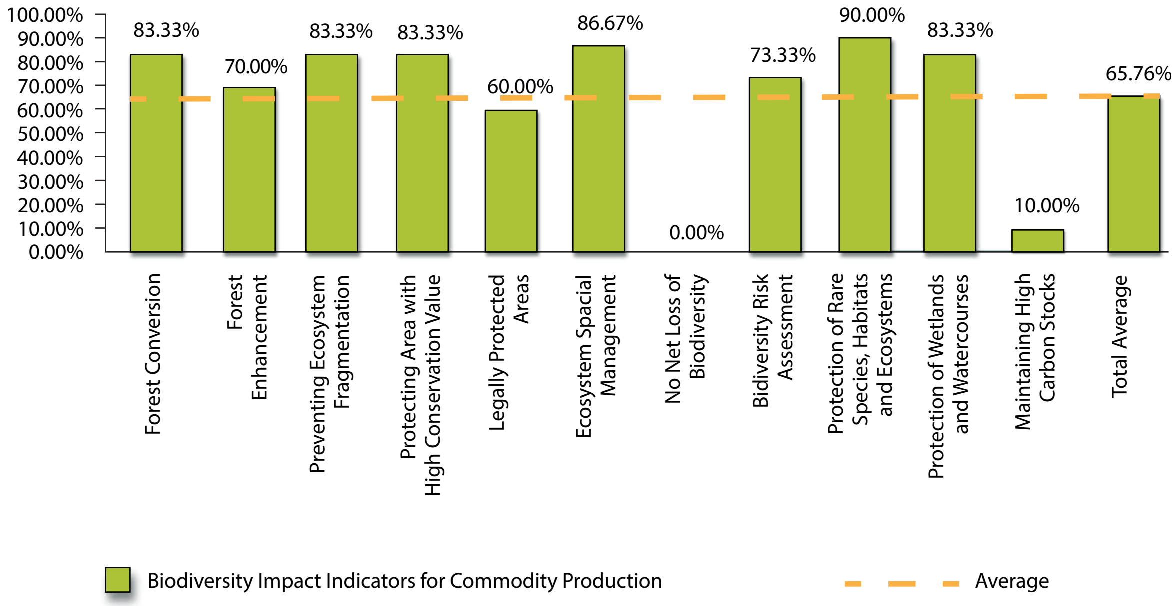


Source: Lernoud et al., 2015

The majority of the standards operating in the tea sector have critical criteria related to the preservation of biodiversity and their habitats including forests, wetlands, water courses, areas of high conservation value and ecosystems. By contrast, none of the standards have provisions against the net loss of biodiversity and only Rainforest Alliance has provisions for maintaining high carbon stock areas. Only two of the five standards require a biodiversity risk assessment, with the rest allowing for implementation of such risk assessments post-certification. Maintaining high carbon stocks is also important within the context of preventing land use change that can exacerbate climate change.

Tea standards include area-based requirements in similar proportion to other agriculture standards, placing a priority on ecosystem management and little to no requirements related to protection of high carbon stocks or net loss of biodiversity.

Figure 55. Area-based Conservation Management Index: Tea standards include area-based requirements in similar proportion to other agriculture standards placing a priority on ecosystem management and little to no requirements related to protection of high carbon stocks or net loss of biodiversity.



Source: VSS criteria information obtained from ITC Standards Map

6 Conclusion

As voluntary sustainability standards grow in prominence, policy-makers and other stakeholders can benefit from a better understanding of the degree to which such initiatives may or may not contribute to biodiversity protection. The BIICP indicators, which establish a common basis for assessing the status of the relationship between agriculture production and biodiversity protection, also offer an important tool for understanding the degree to which voluntary standards address key biodiversity threats in the requirements.

Our review of VSS operating in the agriculture sector documents the rapid growth of such initiatives across a number of commodity sectors with special relevance to biodiversity conservation. More specifically, volumes compliant with internationally recognized standards grew at an average rate of 35 per cent per annum from 2008 to 2014 across the banana, cotton, coffee, cocoa, tea, cane sugar, palm oil and soybean sectors combined.

In absolute terms, the land area covered by voluntary standards has now become a non-negligible factor in those commodity markets where standards have been most active historically. By 2014, four of the eight markets where standards are most active had achieved compliance rates of 10 per cent or more of global production. Based on current market trends and existing "unimplemented" corporate commitments to sustainable sourcing, we expect that standard-compliant production for each of the eight markets will have reached 10 per cent or more of total global production by 2020.

Voluntary standards offer systems of "private" governance aimed at facilitating positive sustainability outcomes. Although the mechanisms by which standards operate reach well beyond the requirements they employ, through the rule making, stakeholder engagement and capacity building activities that accompany them, an initiative's requirements nevertheless provide the most explicit evidence of prioritization and potential impact with respect to specific issues such as biodiversity.

In terms of requirement coverage, the standards reviewed have given clear priority to habitat conservation among their criteria, with 87 per cent of the standards reviewed prohibiting production on recently converted land. Meanwhile, seven of the 10 most rigorous requirements across the initiatives reviewed targeted habitat conservation. The primacy given to habitat preservation by voluntary standards represents a deep alignment between such initiatives and efforts to promote biodiversity-friendly agricultural production.

Water use represented the highest intensity of coverage across all of the BIICP themes, probably due to the direct alignment over efficient water use with improved incomes and environmental outcomes. Meanwhile, climate change requirements revealed the lowest overall average intensity of criteria coverage among the initiatives reviewed, likely due to the complexity and non-production-related burden that such requirements impose on producers.

Although the standards reviewed revealed relatively broad coverage of key biodiversity-related pathways, criteria *explicitly* focusing on biodiversity protection are relatively rare among the initiatives surveyed, with only 40 per cent of initiatives specifying critical requirements for risk assessment of biodiversity impacts and 13 per cent requiring that agricultural practices produce no net loss of biodiversity.

Overall, the standards reviewed focus on the protection of environmental systems rather than the measurement and monitoring or restoration of such systems. Similarly, the vast majority of requirements focus on farm-level ***practices*** rather than actual ***outcomes***. These two observations underscore the principle method of action—namely through to promotion of farm-level practices that tend to protect ecosystems—applied by voluntary standards.

The current and ongoing focus of voluntary standards on practice-based requirements through farm-specific interventions potentially limits their ability in bringing about broader landscape or regional changes. Meanwhile the relative absence of performance-oriented outcomes or requirements related to the measurement of such outcomes represents an important opportunity for policy-makers and standards systems to work together in defining relevant indicators that can support the implementation of policy objectives. Regardless, it is clear that improved information on outcomes associated with standards implementation will be key to enabling strategic policy interventions for biodiversity conservation.

Spatial and Market Analysis

Our analysis of the market uptake and spatial distribution of voluntary standards with respect to key biodiversity impact pathways reveals, above all else, the diversity and circumstantial nature of adoption patterns. This diversity suggests that there are a variety of drivers behind the eventual transition to standard compliance at production. Understanding how these drivers influence uptake will be essential to the strategic use of voluntary standards in support of biodiversity.

At the highest level, it is worth underscoring our observation that the eight commodities where standards are most active have substantial production in tropical and subtropical regions—regions with generally higher vulnerability to biodiversity loss. Similarly, the majority of standard-compliant production across these crops is found in areas with relatively higher vulnerabilities to biodiversity loss. This is a positive finding that reinforces the overall observation regarding the alignment between the most popular agricultural voluntary standards and biodiversity protection.

However, it is also important to note that standard-compliant production is most likely to excel where the cost of compliance is least—which is to say, where either factor endowments such as climate or geography or socioeconomic conditions allow for lower-cost sustainable production. In principle, this is the miracle of voluntary standards, and markets more generally—they can automatically promote a concentration of production where sustainable production is most efficient. However, this outcome can be entirely undermined where markets allow for leakage in the form of conventional production. Under such cases, which, to date, is the general rule, the most egregious production practices (those that are the most important to correct to protect biodiversity) may also be the least likely to "transition" to standard-compliant production.

The cotton sector offers a clear example where such forces are at play. Although one of the principal drivers behind cotton standards in mainstream markets has been the elimination of unsustainable irrigation practices in water-scarce areas, more than half of certified cotton comes from areas that either do not rely on irrigation or historically use efficient irrigation techniques. Similarly, within the coffee sector, more than 65 per cent of all standard-compliant coffee is produced under the Global Coffee Platform (4C standard), which is recognized as having the lowest level of requirements among coffee standards[84] and is specifically designed to be accessible to large-scale, low-cost producers.

The systemic market pressure to recognize compliance where it "matters least" may represent one of the most significant challenges facing the VSS sector. At a minimum, the reliance of voluntary standards on market forces for determining the distribution and intensity of compliance points toward a potential misalignment between the intentions of such initiatives and their actual outcomes or impacts. It also provides a strong rationale for policy supporting the design and rollout of standards explicitly targeting areas of greatest need for biodiversity protection.

Another potential limitation in the ability of voluntary standards to exert influence on global commodity production where it matters most stems from the historical reliance of voluntary standards on North American and European markets to generate demand. Our market analysis suggests that standards uptake at production is driven principally by commitments to sustainable sourcing by major retailers and manufacturers serving developed country markets. To date, beyond niche markets for organic products, there has not been any significant demand for standard-compliant products across the developing world. This raises the question of what role voluntary standards might play in South-South trade or domestic production within developing countries.

The sugar, tea and banana sectors all provide clear examples where the overall impact of standards, in the short term at least, appears to be limited by the relatively small portion of global production that is traded on international markets. Soy and palm oil certification, on the other hand, face challenges in light of the dominance of Chinese demand for conventional products. Consumer concerns about the sustainability of production may largely be a factor related to demographics—as developing country populations improve their own standard of living, they may be more inclined to demand sustainable products. Or, perhaps, VSSs will find harbour within traditional health and safety standards (building on the model established under the GLOBALG.A.P. program), enabling them to build on existing consumer concerns within emerging economies in a manner that extends to sustainable practice. Or, it might be that the future of voluntary standards in such countries lies in their operating as a guide to the development of capacity building, as well as regulatory and enforcement mechanisms implemented through public policy or public-private partnerships. One thing that remains clear is that voluntary standards can only be expected to have limited impact on global biodiversity where their success relies, as they have historically, solely on developed country markets.

Evidence of the systemic market limitations facing voluntary standards is particularly pronounced when one considers the current actual and potential reach of existing voluntary standards based on the sectors that they currently serve. Notwithstanding the significant market growth and uptake of voluntary standards over the past two decades, overall standard-compliant area still only represents an estimated 1 per cent of global agricultural area. In fact, the eight commodities where standards are most active (e.g., bananas, cocoa, coffee, cotton, palm oil, soy, sugar, tea) only represent 12 per cent of total agricultural land area. The main sectors where standards are operational largely reflect the North–South trade channels that have supported them. The vast majority of standards adoption has been targeted at emerging economies with the expectation that the Northern consumption of Southern production represents the most important threat to (and solution for) sustainability. But if voluntary standards are to play a major role in reducing the impacts of agriculture on biodiversity loss at large, they will have to establish a presence among other trade channels such that other crops, most notably staple crops such as wheat, maize and rice, can benefit from their presence.

84 See Potts et al, 2014

Given that agriculture sustainability standards have prioritized habitat protection within their criteria, they may have a special role to play in reducing market pressures that promote land use change in areas of high biodiversity. The spatial distribution of standards in the soy, palm oil, cocoa and coffee[85] sectors reveals a concentration of voluntary standards in zones where land use change is a current concern. Moreover, with the majority of standards stipulating a fixed date (2009) whereupon land use change is no longer considered "sustainable," there appears to be some potential for standards to offer legacy protection of forests by limiting the market potential for newly cleared lands. The concentration of standards in areas where sustainability challenges are greatest is encouraging and is a testament to the role of civil society in driving both the issues and standards adoption process to public purview in priority regions. However, the overall success of standards in the prevention of land use change will ultimately rely on both the specific locations of certified farms and the strength of the incentives for standard-compliant production.

The coffee and cocoa sectors offer a specific example where price premiums, or the promise thereof, have driven significant standards adoption in regions susceptible to forest conversion. With the potential to produce coffee either with or without tree cover, coffee farmers have been encouraged to produce under more biodiverse shade conditions through higher prices offered with certification.

The oil palm and soy sectors, on the other hand, have relied more heavily on market-access, as determined by corporate and public commitments to sustainable sourcing, as the major drivers for adoption. In these sectors, where the majority of commodity markets still operate without requirements for standard compliance, there is plenty of reason to believe that conventional market forces, without any preoccupation for land use change impacts, will continue to drive deforestation for the foreseeable future. Moreover, once these new "uncertifiable" production sites are established, so too is the market pressure for their being recognized as "sustainable." That is to say, if the current buyers of these products ***do*** eventually feel the pressure to show compliance with sustainability standards, there is nothing to stop them from either lobbying for changes in existing requirements or simply establishing a new standard of their own that matches their specific needs.

The potential for voluntary standards to adapt to the needs of specific stakeholders may be both their greatest strength and their greatest weakness. On the one hand, the flexibility associated with voluntary standards allows their efficient integration within a wide diversity of corporate and supply chain structures. On the other hand, this flexibility can threaten the credibility and meaningfulness of any and all voluntary standards available on the market. Ensuring the optimal degree of flexibility while preserving meaningfulness points to an important area where stronger policy regulating sustainability claims will be necessary if voluntary standards are to offer meaningful benefits over the long term.[86]

A key part of any effective incentive structure will be ensuring an appropriate alignment between incentives and actual biodiversity preservation priorities. As already noted, the adoption of biodiversity-friendly practices in areas of low-grade threat to biodiversity can be expected to have

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85 While the majority of standard-compliant coffee falls under the 4C initiative, which has significant production in Brazil and Vietnam where coffee-driven land use change is less of a concern, virtually all of the other standards operating in coffee have a strong presence in areas with high biodiversity but that are nevertheless subject to pressures for conversion to full-sun production practices.

86 Typically, market claims are regulated under national competition policy, which protects against fraudulent advertising and establishes legal requirements related to on-package claims. The organic sector has a well-established history of regulatory management of on-package claims for production practices related to a voluntary standard.

lower impacts than adoption in higher priority areas. Enabling the specific targeting of incentives whether by private actors or the public sector will require better knowledge of the locations of standard-compliant production. To date, geographic information system-specific location data for standard-compliant farms has not been readily available. Geographic information system data represents a critical element in the strategic implementation of voluntary standards and should be considered a prerequisite to the future rollout of any and all voluntary standards programs.

This final observation underscores the ultimate "value add" of voluntary standards more generally. By identifying preferable production practices and creating credible systems for linking such practices with physical products at consumption, one of the principal assets of voluntary standards lies in their promise of improved communication within the market. Improved access to information is fundamental to virtually every theory of change that voluntary standards embody and improved information can improve overall market performance, efficiency and sustainability outcomes. There are limits to the power of information however—and these become most apparent in the face of long-standing market imperfections where key public goods are not subject to property rights or traditional market pricing. Tackling these larger market challenges inevitably requires policy intervention.

But the information generated by voluntary standards does have a role to play in the design of such policy intervention. By helping policy-makers understand the limits of voluntary market actions, voluntary standards can also help stakeholders identify where external intervention is most needed to fulfill desired policy objectives. In this sense, standards can play a more direct role in correcting for market imperfections. Realizing this aspect of their potential, however, will require better data collection, analysis and sharing between standards and the public sector. Working from this basis, one of the first and most important roles of policy-makers will be in assisting existing standards in the deepening of their data-generation and sharing capacities.

With the diverse and increasingly widespread application of voluntary sustainability standards across commodity markets, the voluntary sector has effectively completed its "proof of concept" phase. Large-scale rollout of voluntary mechanisms that preserves evidence-based policy relevance will, however, require more proactive engagement among policy-makers, standards bodies and other implicated stakeholders. At the same time, the global community's recognition of the importance of measurability through the sustainable development goals offers a unique opportunity for extracting mutually reinforcing outcomes from such a process. Ever since their initiation, voluntary sustainability standards have blurred the lines between public and private governance. Moving forward in a manner that ensures that outcomes support biodiversity objectives will require a dismantling of this blurred horizon by way of an explicit and dedicated policy framework for the credible design and implementation of voluntary initiatives.

7 Policy Options

Although sustainable agriculture is not explicitly named as a Sustainable Development Goal (SDG), it represents a foundation, without which, achievement of the vast majority of SDGs simply will not be possible. Meeting SDG 2 (Zero Hunger) and SDG 15 (Life on Land) necessarily implies more efficient, biodiversity-friendly agriculture—without it, each of these goals runs the risk of impeding achievement of the other. SDG 12 (Sustainable Consumption and Production), particularly through the operation of credible, evidence-based voluntary standard systems, can play an important role in ensuring that both SDG 2 and SDG 15 are effectively managed such that they are mutually supportive.

To the extent that VSSs enable market forces toward a transition to sustainable agriculture, they must be welcomed and encouraged by the policy community. With respect to biodiversity preservation, VSSs have the potential to directly and concretely support all the Strategic Goals within the CBD's Strategic Plan 2011–2020 (The Aichi Targets; see Table 13).

However, meeting this potential is fundamentally dependent on the actual performance of individual standards in operation. Based on our review, the following broad conclusions can be drawn:

> Voluntary sustainability standards offer a promising complement to biodiversity policy by:

- Addressing key biodiversity issues through their criteria coverage
- Offering a non-negligible supportive infrastructure for the implementation of biodiversity protection-related policy
- Having, through their auditing processes, the potential to provide invaluable data on sector performance such as the area and intensity of biodiversity-friendly production to policy-makers
- Representing a legitimate (and major investment) vehicle for implementing and mainstreaming biodiversity protection through global supply chains

> The reliance of voluntary standards on market forces for their adoption, however, also subjects them to a number of significant challenges by forcing a reliance on:

- Lowest cost compliance, thereby promoting a concentration of adoption in areas where biodiversity may matter least
- North–South trade, potentially limiting the overall land area subject to standards-based markets
- Major buying blocks for the market success (and hence the "approval") of standards and standard content potentially threatening their meaningfulness and credibility
- Standard formation and implementation protocols, subject to the forces of the market and allowing for discrepancies between market claims and actual outcomes

Another major conclusion to be drawn from our review is that the focus of voluntary standards on practice-based rather than performance requirements, at the farm rather than landscape level, combined with the absence of accessible, real-time performance, location and outcome data, reduces the ability of stakeholders and policy-makers to leverage standards effectively.

The CBD has recognized the potential of voluntary standards in promoting biodiversity. In its most recent Conference of the Parties, delegates agreed to place an emphasis on the mainstreaming of biodiversity protection. Within Decision XIII/3, paragraph 17 (h) in particular calls on the parties to, "make use of voluntary sustainability standards and/or of voluntary certification schemes, and promote their further development."

This review highlights the potential for misalignment between market forces and policy objectives, underlining the need for policy engagement at a higher level of verification and quality control through regulatory or fiscal means as a foundation for ***enabling*** their effective use by policy-makers. This suggests that policy-makers will likely need to take a more hands-on approach in the monitoring and managing such programs if they are to be leveraged effectively for public policy objectives.

Table 13. Potential contribution of voluntary sustainability standards to the CBD Strategic Plan 2011–2020 ambitions and performance of individual standards.

CBD Strategic Plan 2011–2020: Aichi Strategic Goals	Potential Contribution of Voluntary Sustainability Standards
Strategic Goal A: Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society	By entering mainstream commodity markets, standards are potentially enabling the mainstreaming of biodiversity-friendly production
Strategic Goal B: Reduce the direct pressures on biodiversity and promote sustainable use	Promoting biodiversity protection and sustainable production by stipulating requirements for sustainable production
Strategic Goal C: Improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity	Safeguarding ecosystems by requiring buffer zones and the restoration of high-biodiversity ecosystems
Strategic Goal D: Enhance the benefits to all from biodiversity and ecosystem services	Improving productive efficiency and market access (farmer benefits) while improving global food security (consumer benefits)
Strategic Goal E: Enhance implementation through participatory planning, knowledge management, and increasingly rely on multistakeholder participatory processes for governance and capacity building	Increasingly relying on multistakeholder participatory processes for governance and rule development, and thus can promote participatory governance in international supply chains

Based on the above observations, there is a clear rationale for policy-makers to support the evolution of VSSs in ways that can help ensure that they play a constructive role in meeting biodiversity targets. Following our analysis, we propose five areas where policy intervention could significantly support the contribution of standards to biodiversity protection:

POLICY OPPORTUNITY 1

Support Biodiversity-Driven Implementation: Policy-makers can collaborate with voluntary standards during their rollout strategies in their respective countries to facilitate and provide incentives for adoption in areas where they will have maximum impact. Setting national targets and/or requirements for levels of standard-compliant production could support the achievement of SDG2, SDG12 and SDG15 simultaneously.

POLICY OPPORTUNITY 2

Offer Leadership in the Development of Integrated Data Systems: Policy-makers can finance the development of national, regional and international data collection and sharing systems that enable voluntary standards (and other stakeholders) to share data with the general public and policy-makers along harmonized parameters so that their role as data collectors can be leveraged to support effective biodiversity management at the national and regional levels.

POLICY OPPORTUNITY 3

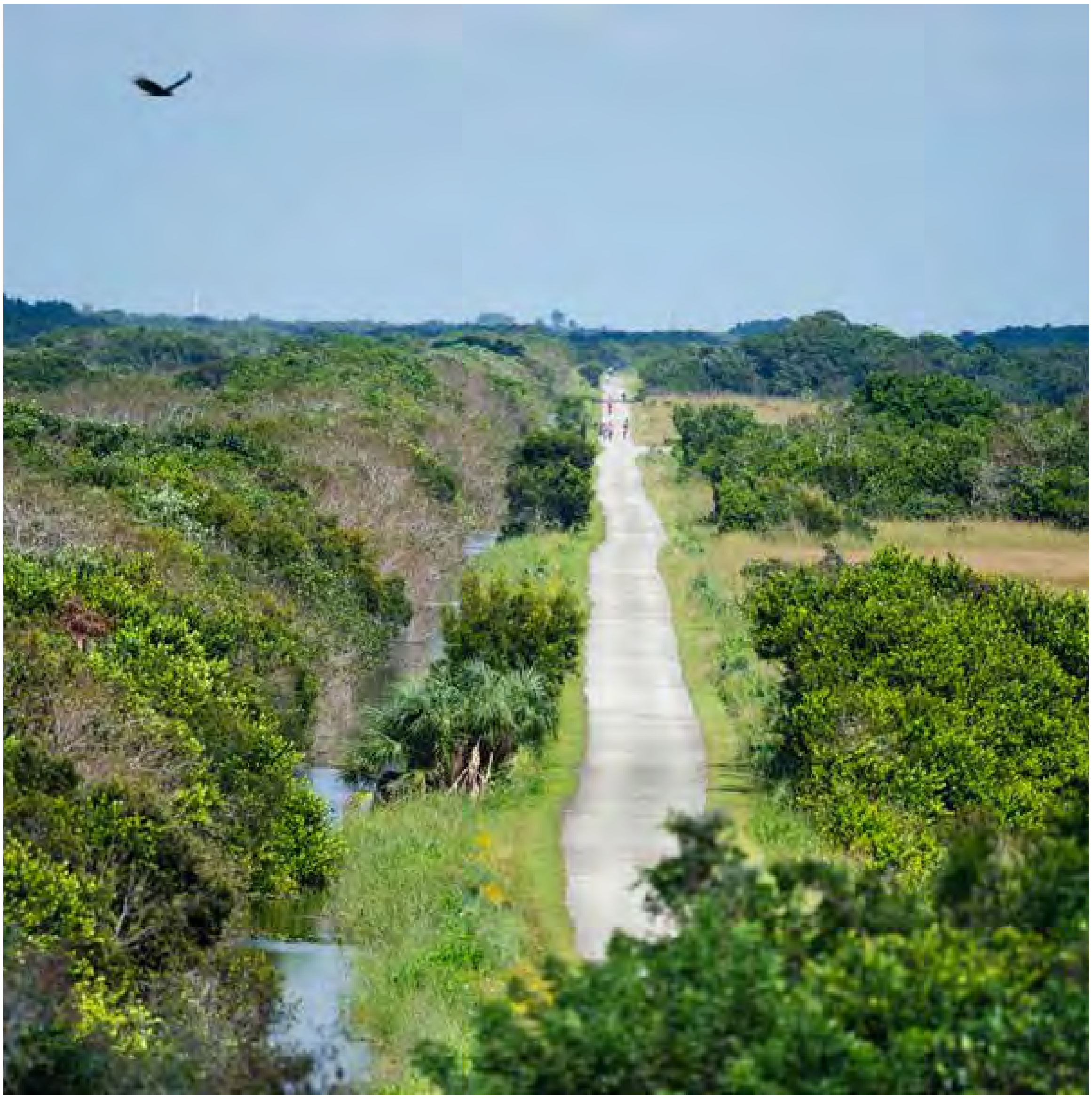
Support Voluntary Sustainability Standards in the Development of Effective Requirements: Policy-makers can provide financing to standards and research partners to determine the biodiversity-specific impacts of agricultural production within specific crops so that these can be effectively integrated into the standards development and implementation processes.

POLICY OPPORTUNITY 4

Support Impact Research and Analysis: Policy-makers can provide financing to researchers to determine the biodiversity impacts of voluntary standards operating in key sectors as a basis for continual improvement and for determining the strategic application of policy support to such initiatives. Impact data and analysis at the field level as well as data on market distribution and trends should be prioritized, allowing for farmers and other stakeholders to make real-time course corrections toward sustainability and biodiversity protection.

POLICY OPPORTUNITY 5

Implement a Policy Framework for Credibility Assurance: To ensure market fairness and the overall effectiveness of the voluntary sustainability standards sector in meeting stated (biodiversity) objectives, policy-makers can set credibility, accuracy and evidence-based ground rules to ensure that market claims are supported by responsible practice and expected outcomes.



References

Achard, F. (2009). *Vital forest graphics*. UNEP/Earthprint.

Adidas. (n.d.). Materials. Retrieved from http://www.adidas-group.com/en/sustainability/products/materials/

Andrade, J. (2015). *Sustainable Rice Platform 5th Plenary Meeting and General Assembly* (The Standards Reporter No. 8). Winnipeg, Canada: International Institute for Sustainable Development. Retrieved from http://www.iisd.org/ssi/wp-content/uploads/2016/01/The-Standards-Reporter-Report-8.pdf

Andres, C., Comoé, H., Beerli, A., Schneider, M., Rist, S., & Jacobi, J. (2016). Cocoa in monoculture and dynamic agroforestry. In E. Lichtfouse (Ed.), *Sustainable agriculture reviews* (pp. 121–153). Springer International Publishing. Retrieved from https://doi.org/10.1007/978-3-319-26777-7_3

Arias, P., Dankers, C., Liu, P., & Pilkauskas, P. (2003). *The World Banana Economy*, 1985–2002. Rome: FAO. Retrieved from http://www.fao.org/docrep/007/y5102e/y5102e00.HTM

Arla Foods. (2014). Arla Foods: Towards 100% of RTRS Soy. Retrieved from http://www.responsiblesoy.org/arla-foods-towards-100-of-rtrs-soy/?lang=en

Arthur Nelsen. (2016). Leaked figures show spike in palm oil use for biodiesel in Europe. *The Guardian*. Retrieved from https://www.theguardian.com/environment/2016/jun/01/leaked-figures-show-spike-in-palm-oil-use-for-biodiesel-in-europe

Baer, E. (2014, June 5). New palm oil production maps mark a milestone in transparency. Retrieved from http://www.wri.org/blog/2014/06/new-palm-oil-production-maps markmilestone-transparency

Banana Link. (2016a). Companies. Retrieved from http://www.bananalink.org.uk/content/companies

Banana Link. (2016b). Multinationals lose grip on global banana exports. Retrieved from http://www.bananalink.org.uk/multinationals-lose-grip-global-banana-exports

Banana Link. (2016c). The problem with bananas. Retrieved from http://www.bananalink.org.uk/the-problem-with-bananas

Barfoot, P., & Brookes, G. (2005, September 19). GM Crops: The global economic and environmental impact: The first nine years 1996–2004. Retrieved from http://www.agbioforum.org/v8n23/v8n23a15-brookes.htm?&sa=U&ei=KojTVOKAL9CyogTSqYCgCg&ved=0CBQQFjAA&usg=AFQjCNH-zn1ERidarL6-x-Pnq3lsHjPUeg

Beck, M. B., & Villarroel Walker, R. (2013). On water security, sustainability, and the the water-food-energy-climate nexus. *Frontiers of Environmental Science and Engineering*, 7(5), 626–639. Retrieved from https://doi.org/10 1007/s11783-013-0548-6

Bellard, C., Bertelsmeier, C., Leadley, P., Thuiller, W., & Courchamp, F. (2012). Impacts of climate change on the future of biodiversity. *Ecology Letters*, 15(4), 365–377. Retrieved from https://doi.org/10.1111/j.1461-0248.2011.01736.x

Bonsucro. (2016). Bonsucro member pledges. Retrieved from http://bonsucro.com/site/members/member-pledges/

Brackin, R., Näsholm, T., Robinson, N., Guillou, S., Vinall, K., Lakshmanan, P., ... Inselsbacher, E. (2015). Nitrogen fluxes at the root-soil interface show a mismatch of nitrogen fertilizer supply and sugarcane root uptake capacity. *Scientific Reports*, 5, 15727. Retrieved from https://doi.org/10.1038/srep15727

Business and Biodiversity Offsets Programme. (n.d.). BBOP. Retrieved from http://bbop.forest-trends.org/

Chapagain, A. K., Hoekstra, A. Y., Savenije, H. H. G., & Gautam, R. (2005). *The water footprint of cotton consumption* (Research Report No. 18) (p. 40). Delft, The Netherlands: UNESCO-IHE.

Chapagain, A. K., Hoekstra, A. Y., Savenije, H. H. G., & Gautam, R. (2006). The water footprint of cotton consumption: An assessment of the impact of worldwide consumption of cotton products on the water resources in the cotton producing countries. *Ecological Economic*s, 60(1), 186–203. Retrieved from https://doi.org/10.1016/j.ecolecon.2005.11.027

Clay, J. W. (2004). *World Agriculture and the Environment: A Commodity-By-Commodity Guide to Impacts and Practices*. Island Press.

Coca-Cola. (2016a). 2020 sustainability commitments. Retrieved from http://www.coca-colacompany.com/stories/2020-sustainability-commitments

Coca-Cola. (2016b). Coca-Cola to source over 1 million tons of more sustainable sugar in 2016. Retrieved from http://www.coca-colacompany.com/stories/coca-cola-to-source-over-1-million-tons-of-more-sustainable-sugar-in-2016

Conservation International. (2016). Why hotspots matter. Retrieved from http://www.conservation.org/How/Pages/Hotspots.aspx

Convention for Biological Diversity Secretariat. (n.d.). Aichi Biodiversity Targets. Retrieved from https://www.cbd.int/sp/targets/

Convention on Biological Diversity. (Undated). Convention text. Retrieved from https://www.cbd.int/convention/articles/default.shtml?a=cbd-02

Convention on Biological Diversity (2016, December 16). Decision adopted by the conference of the parties to the convention on biological diversity. CBD/COP/DEC/XIII/3. Retrieved from https://www.cbd.int/doc/decisions/cop-13/cop-13-dec-03-en.pdf

Danielsen, F., Beukema, H., Burgess, N. D., Parish, F., Brühl, C. A., Donald, P. F., … Fitzherbert, E. B. (2009). Biofuel plantations on forested lands: double jeopardy for biodiversity and climate. *Conservation Biology: The Journal of the Society for Conservation Biology*, 23(2), 348–358. Retrieved from https://doi.org/10.1111/j.1523-1739.2008.01096.x

Dubreuil, A., Assoumou, E., Bouckaert, S., Selosse, S., & Maizi, N. (2013). Water modeling in an energy optimization framework: The water-scarce Middle East context. Applied Energy, 101, 268–279. Retrieved from https://doi.org/10.1016/j.apenergy.2012.06.032

Earthstat. (n.d.). Data download. Retrieved from http://www.earthstat.org/data-download/

Environmental Investigation Agency. (2014). Permitting crime: How palm oil expansion drives illegal logging in Indonesia. Retrieved from https://eia-international.org/wp-content/uploads/Permitting-Crime.pdf

Environmental Investigation Agency. (2015). Who watches the watchmen? Auditors and the breakdown of oversight in the RSPO. Retrieved from https://eia-international.org/wp-content/uploads/EIA-Who-Watches-the-Watchmen-FINAL.pdf

European Commission (Ed.). (2010). The factory of life: Why soil biodiversity is so important. Luxembourg: Office for Official Publications of the European Union.

Fairtrade. (2015). Scope and benifits of Fairtrade, Seventh Edition. Fairtrade International. Retrieved from http://www.fairtrade.net/fileadmin/user_upload/content/2009/resources/2015-Monitoring_and_Impact_Report_web.pdf

Food and Agriculture Organization. (2011). "Energy-smart" food for people and climate (Issue Paper). Rome, Italy: FAO. Retrieved from http://www.fao.org/docrep/014/i2454e/i2454e00.pdf

Food and Agriculture Organization. (2012). FAOSTAT: Energy Use. Retrieved from http://www.fao.org/faostat/en/#data/GN

Food and Agriculture Organization. (2015). World fertilizer trends and outlook to 2018. Rome: Food & Agriculture Organization of United Nations.

Food and Agricultural Organisation. (2016a). Aquastat: FAO's Information System on Water and Agriculture. Retrieved from http://www.fao.org/nr/water/aquastat/water_use/index.stm

Food and Agricultural Organisation. (2016ab). FAOSTAT Database. Retrieved from http://www.fao.org/faostat/en/#home

Food and Agriculture Organization. (2016ac). Genetic resources. Retrieved from http://www.fao.org/genetic-resources/en/

Food and Agricultural Organization. (2016bd). Save and grow in practice: Maize, rice, wheat : A guide to sustainable cereal production. Retrieved from http://www.fao.org/3/a-i4009e.pdf

Food and Agriculture Organization. (2016be). World fertilizer trend and outlook to 2019: Summary Report. Retrieved from http://www.fao.org/3/a-i5627e.pdf

Fountain, A. C., & Hütz-Adams, F. (2015). Cocoa Barometer 2015. Retrieved from http://www.cocoabarometer.org/Download_files/Cocoa%20Barometer%202015.pdf

Franco, A. L. C., Bartz, M. L. C., Cherubin, M. R., Baretta, D., Cerri, C. E. P., Feigl, B. J., … Cerri, C. C. (2016). Loss of soil (macro)fauna due to the expansion of Brazilian sugarcane acreage. The Science of the Total Environment, 563–564, 160–168. Retrieved from https://doi.org/10.1016/j.scitotenv.2016.04.116

Fyffes. (2015). Fyffes annual report 2015. Dublin: Fyffes plc. Retrieved from http://ww7.global3digital.com/fyffesplc/uploads/finreports/FyffesAR2015.pdf

GEO BON Working Group on Biodiversity Indicators. (2015). Global Biodiversity Change Indicators: Model-Based Integration of Remote-Sensing and In Situ Observations that Enables Dynamic Updates and Transparency at Low Cost (Ad Hoc Technical Expert Group Meeting on Indicators for the Strategic Plan for Biodiversity 2011-2020). Geneva, Switzerland: Convention on Biological Diversity. Retrieved from http://orbit.dtu.dk/ws/files/118856454/GBCI_Version1.2_low_Biodiversity_Index.pdf

Gilbert, N. (2013). Case studies: A hard look at GM crops. Nature News, 497(7447), 24. https://doi.org/10.1038/497024a

Gockowski, J., & Sonwa, D. (2011). Cocoa intensification scenarios and their predicted impact on CO2 emissions, biodiversity conservation, and rural livelihoods in the Guinea Rain Forest of West Africa. Environmental Management, 48(2), 307–321. Retrieved from https://doi.org/10.1007/s00267-010-9602-3

Gollnow, F. & Lakes, T. (2014, December). Policy change, land use, and agriculture: The case of soy production and cattle ranching in Brazil, 2001–2012, Applied Geography, 55, 203–211. Retrieved from https://doi.org/10.1016/j.apgeog.2014.09.003.

Greenpeace. (2013). Certifying destruction: Why consumer companies need to go beyond RSPO to stop forest destruction. Retrieved from http://www.greenpeace.org/international/Global/international/publications/forests/2013/Indonesia/RSPO-Certifying-Destruction.pdf

Griffith-Greene, M. (2014). Pesticide traces in some tea exceed allowable limits. Retrieved from http://www.cbc.ca/news/canada/pesticide-traces-in-some-tea-exceed-allowable-limits-1.2564624

Gunkel, G., Kosmol, J., Sobral, M., Rohn, H., Montenegro, S., & Aureliano, J. (2006). Sugar cane industry as a source of water pollution: Case study on the situation in Ipojuca River, Pernambuco, Brazil. Water, Air, and Soil Pollution, 180(1–4), 261–269. Retrieved from https://doi.org/10.1007/s11270-006-9268-x

H & M. (2016). H&M sustainability report 2015. Retrieved from http://sustainability.hm.com/

Halweil, B. (2002). Why your daily fix can fix more than your head: Coffee, if grown right, can be one of the rare human industries that actually restore the Earth's health. World Watch. Retrieved from http://www.thefreelibrary.com.Why+your+daily+fix+can+fix+more+than+your+head%3A+coffee,+if+grown...-a085920463

Hansen, K. (2015). Soybeans in the Brazilian Cerrado: Image of the day. Retrieved from http://earthobservatory.nasa.gov/IOTD/view.php?id=85364

Hautier, Y., Niklaus, P. A., & Hector, A. (2009). Competition for light causes plant biodiversity loss after eutrophication. Science (New York, N.Y.), 324(5927), 636–638. Retrieved from https://doi.org/10.1126/science.1169640

Heffer, P. (2013). Assessment of fertilizer use by crop at the global level 2010/11. Paris, France: International Fertilizer Industry Association. Retrieved from http://www.fertilizer.org/en/images/Library_Downloads/AgCom.13.39%20-%20FUBC%20assessment%202010.pdf

Hershey's. (2016). Hershey's 2015 CSR report. Retrieved from https://www.thehersheycompany.com/content/dam/corporate-us/documents/csr-reports/hershey-2015-csr-report.pdf

Hoskins, T. (2014, October 1). Cotton production linked to images of the dried up Aral Sea basin. The Guardian. Retrieved from https://www.theguardian.com/sustainable-business/sustainable-fashion-blog/2014/oct/01/cotton-production-linked-to-images-of-the-dried-up-aral-sea-basin

Ikea. (2015). 2015 Ikea sustainability report. Ikea. Retrieved from http://www.ikea.com/ms/en_US/img/ad_content/2015_IKEA_sustainability_report.pdf

Indonesia Investments. (2016). Palm oil in Indonesia: Indonesian CPO production & export. Retrieved from http://www.indonesia-investments.com/business/commodities/palm-oil/item166

International Development Research Centre. (Undated). FACTS & FIGURES on Food and Biodiversity. Retrieved February 10, 2017, from https://www.idrc.ca/en/article/facts-figures-food-and-biodiversity

International Trade Centre. (2011). ITC coffee exporters guide. Geneva. Retrieved from http://www.intracen.org/The-Coffee-Exporters-Guide---Third-Edition/

International Service for the Acquisition of Agri-biotec Applications. (2012). Global status of commercialized biotech/GM crops: 2012. Retrieved from http://wwwisaaa.org/resources/publications/briefs/44/default.asp

International Service for the Acquisition of Agri-biotec Applications. (2016). Biotech crop highlights in 2015. Retrieved from http://www.isaaa.org/resources/publications/pocketk/16/

Jacobs Douwe Egberts. (2017). At the source. Retrieved from https://www.jacobsdouweegberts.com/CR/source/

James, C. (2015). Executive summary: Global status of commercialized biotech/gm crops: 2014. ISAAA Brief 51-2015. International Service for the Acquisition of Agri-Biotech Applications. Retrieved from http://isaaa.org/resources/publications/briefs/51/executivesummary/default.asp

Jamil, A., Riaz, S., Ashraf, M., & Foolad, M. R. (2011). Gene expression profiling of plants under salt stress. Critical Reviews in Plant Sciences, 30(5), 435–458. Retrieved from https://doi.org/10.1080/07352689.2011.605739

Jha, S., Bacon, C. M., Philpott, S. M., Méndez, V. E., Läderach, P., & Rice, R. A. (2014). Shade coffee: Update on a disappearing refuge for biodiversity. BioScience, 64(5), 416–428. Retrieved from https://doi.org/10.1093/biosci/biu038

Keurig. (2016). Keurig sustainability report. Retrieved from http://www.keuriggreenmountain.com/~/media/Sustainability/PDF/ReportsDisclosures/KeurigSustainabilityReport_2015.ashx

Knobeloch, L., Salna, B., Hogan, A., Postle, J., & Anderson, H. (2000). Blue babies and nitrate-contaminated well water. Environmental Health Perspectives, 108(7), 675–678.

Kok, M., Alkemade, R., Bakkenes, M., Boelee, E., Christensen, V. … Zagt, R. (2014). How sectors can contribute to sustainable use and conservation of biodiversity. Secretariat of the Convention on Biological Diversity (Ed.), CBD Technical Series. The Hague: PBL Netherlands Environmetnal Assessment Agency.

Lawson, S., Blundell, A., Caberle, B., Basik, N., Jenkins, M., & Canby, K. (2014). Consumer goods and deforestation: An analysis of the extent and nature of illegality in forest conversion for agriculture and timber plantations. Forest Trends.

Leadley, P.W., Krug, C.B., Alkemade, R., Pereira, H.M., Sumaila U.R., … Mumby, P.J. (2014). Progress towards the Aichi Biodiversity Targets: An assessment of biodiversity trends, policy scenarios and key actions. Technical Series 78. Montreal, Canada: Secretariat of the Conventionon Biological Diversity.

Leatherdale, D. (2016, January 24). The imminent death of the Cavendish banana and why it affects us all. BBC News. Retrieved from http://www.bbc.com/news/uk-england-35131751

Lehtonen, M. (2009). Status report on sugar cane agrochemicals management. Ethical-Sugar.

Lernoud, J., Potts, J., Sampson, G., Voora, V., Willer, H., & Wozniak, J. (2015). The State of Sustainable Markets: Statistics and emerging trends 2015. Geneva: International Trade Centre.

Levi Strauss. (2016). Levi Strauss: Sustainability – Raw materials. Retrieved from http://www.levistrauss.com/sustainability/production/

Lu, Y., Wu, K., Jiang, Y., Guo, Y., & Desneux, N. (2012). Widespread adoption of Bt cotton and insecticide decrease promotes biocontrol services. Nature, 487(7407), 362–365. Retrieved from https://doi.org/10.1038/nature11153

Maclean, I. M. D. & Wilson, R. J. (2011). Recent ecological responses to climate change support predictions of high extinction risk. Proceedings of the National Academy of Sciences, 108(30), 12337–12342. Retrieved from https://doi.org/10.1073/pnas.1017352108

Marks and Spencer. (2015). About our sourcing: Cotton. Retrieved from https://corporate.marksandspencer.com/plan-a/our-stories/about-our-sourcing/cotton

Mars. (2016). Our raw materials. Retrieved from http://mars.com/global/sustainability/raw-materials

Mars Food. (n.d.). Mars food announces first global rice sustainability standard in partnership with the Sustainable Rice Platform. Retrieved from http://www.prnewswire.com/news-releases/mars-food-announces-first-global-rice-sustainability-standard-in-partnership-with-the-sustainable-rice-platform-300165786.html

Marsh, A. (2007). Diversification by smallholder farmers: Viet Nam, Robusta Coffee. Rome: FAO.

Martinelli, L. A., & Filoso, S. (2008). Expansion of sugarcane ethanol production in Brazil: environmental and social challenges. Ecological Applications: A Publication of the Ecological Society of America, 18(4), 885–898.

May, P. H., Mascarenhas, G. C. C., & Potts, J. (2004). Sustainable coffee trade, the role of coffee contracts. Retrieved from http://www.iisd.org/sites/default/files/publications/sci_coffee_contracts.pdf

McDonalds. (2016). Sustainable sourcing priority products: McDonald's. Retrieved from http://corporate.mcdonalds.com/mcd/sustainability/sourcing/priority-products.html

Mekonnen, M. . & Hoekstra, A. Y. (2010). The green, blue and grey water footprint of crops and derived crop products (Research Report No. 47). Delft, The Netherlands: UNESCO-IHE.

Merriam-Webster. (2017). Definition of SHELTERBELT. Retrieved from https://www.merriam-webster.com/dictionary/shelterbelt

Millennium Ecosystem Assessment. (2005). Ecosystems and human well-being. Washington D.C.: Island Press.

Mondelez International. (2015). The call for well-being: 2015 progress report. Retrieved from http://www.mondelezinternational.com/Well-Being/~/media/MondelezCorporate/uploads/downloads/cfwbprogressreport.pdf

Monfreda, C., Ramankutty, N., & Foley, J. A. (2008). Farming the planet: 2. Geographic distribution of crop areas, yields, physiological types, and net primary production in the year 2000. Global Biogeochemical Cycles, 22(GB1022). Retrieved from https://doi.org/10.1029/2007GB002947

Mora, C., Tittensor, D. P., Adl, S., Simpson, A. G. B., & Worm, B. (2011). How many species are there on earth and in the ocean? PLOS Biol, 9(8). Retrieved from https://doi.org/10.1371/journal.pbio.1001127

Mortensen, D. A., Egan, J. F., Maxwell, B. D., Ryan, M. R., & Smith, R. G. (2012). Navigating a critical juncture for sustainable weed management. BioScience, 62(1), 75–84. Retrieved from https://doi.org/10.1525/bio.2012.62.1.12

Morton, D.C., DeFries, R., Shimabukuro, Y.E., Anderson, L.O., Aral, E., … Morisette J. (2006). Cropland expansion changes deforestation dynamics in the southern Brazilian Amazon. Proceedings of the National Academy of Sciences of the United States of America, 103, 14637–14641.

Mueller, N. D., Gerber, J. S., Johnston, M., Ray, D. K., Ramankutty, N., & Foley, J. A. (2012). Closing yield gaps through nutrient and water management. Nature, 490(7419), 254–257. Retrieved from https://doi.org/10.1038/nature11420

Nassauer, J. I., Santelman, M. V., & Scavia, D. (Eds.). (2007). From the corn belt to the gulf. Washington D.C.: RFF Press: Routledge.

Nestle. (2016a). Nestle coffee sourcing. Retrieved from http://www.nestle.com/csv/rural-development-responsible-sourcing/nescafe-plan

Nestle. (2016b). Palm oil. Retrieved from http://www.nestle.com/csv/rural-development-responsible-sourcing/responsible-sourcing/palm-oil

Nike. (2016). Nike FY14015 sustainable business report. Retrieved from http://about.nike.com/pages/sustainable-innovation

OECD-FAO. (2016). Sugar in OECD-FAO agricultural outlook 2016-2025. Paris: OECD Publishing. Retrieved from http://dx.doi.org/10.1787/agr_outlook-2016-9-en

Pacheco, P. (2012). Soybean and oil palm expansion in South America: a review of main trends and implications. Center for International Forestry Research. Retrieved from https://doi.org/10.17528/cifor/003776

Page, S., Hoscilo, A., Langner, A., Tansey, K., Siegert, F., Limin, S., & Rieley, J. (2009). Tropical peatland fires in Southeast Asia. In Tropical Fire Ecology (pp. 263–287). Springer Berlin Heidelberg. Retrieved from https://doi.org/10.1007/978-3-540-77381-8_9

Panama Disease. (2017). Panama disease. Retrieved from http://panamadisease.org/

Panhuysen, S., & Pierrot, J. (2014). Coffee Barometer 2014. Retrieved from https://hivos.org/sites/default/files/coffee_barometer_2014_report_1.pdf

PBL Netherlands Environmental Assessment Agency. (2014). How sectors can contribute to sustainable use and conservation of biodiversity. CBD Technical Series No. 79. The Hague, Netherlands.

Perfecto, I., Vandermeer, J., Mas, A., & Pinto, L. S. (2005). Biodiversity, yield, and shade coffee certification. Ecological Economics, 54(4), 435–446. Retrieved from https://doi.org/10.1016/j.ecolecon.2004.10.009

Perry, E.D., Ciliberto, F., Hennesy, D.A., Moschini, G. (2016, August 31). Genetically engineered c rops and pesticide use in U.S. maize and soybeans. Science Advances, 2(8). Retrieved from http://advances.sciencemag.org/content/2/8/e1600850

Petrenko, C., Paltseva, J., & Searle, S. (2016). Ecological impacts of palm oil expansion in Indonesia. International Council of Clean Transportation. Retrieved from http://www.theicct.org/sites/default/files/publications/Indonesia-palm-oil-expansion_ICCT_july2016.pdf

Pingali, P. L. (2012). Green revolution: Impacts, limits, and the path ahead. Proceedings of the National Academy of Sciences, 109(31), 12302–12308. Retrieved from https://doi.org/10.1073/pnas.0912953109

Pipitone, L. (2015). Presentations: Cocoa Market Outlook Conference 2015. Retrieved from http://www.icco.org/about-us/international-cocoa-agreements/cat_view/252-cocoa-market-outlook-conference-september-2015/253-presentations-cocoa-market-outlook-conference-2015.html

Porter, S. (2016, March 14). Can Indonesia’s forest fires be put out for good? BBC News. Retrieved from http://www.bbc.com/news/business-35770490

Potts, J., Lynch, M., Wilking, A., Huppe, G., Cunningham, M., & Voora, V. (2014). State of Sustainability Initiatives Review 2014: Standards and the green economy. Winnipeg, Canada: International Institute for Sustainable Develoment, International Institute for Environment and Development.

Potts, J., Van der Meer, J., & Daitchman, J. (2010). The State of Sustainability Initiatives Review 2010: Sustainability and transparency. Winnipeg, Canada: International Institute for Sustainable Development. Retrieved from http://www.deslibris.ca/ID/225909

Pretty, J. & Bharucha, Z. P. (2015). Integrated pest management for sustainable intensification of agriculture in Asia and Africa. Insects, 6(1), 152–182. Retrieved from https://doi.org/10.3390/insects6010152

Proterra. (n.d.). Round Table on Responsible Soy (RTRS). Retrieved from http://www.proterrafoundation.org/index.php/alliances/round-table-on-responsible-soy-rtrs

Proterra Foundation and Danube Soy Association. (2015). Non-GMO soy synopsis. Retrieved from https://www.cert-id.eu/getattachment/Certification-Programmes/Non-GMO-Certification/Non-GMO-Soy-Certification/ProTerra-Cert-IDNonGMO_Soy_Synopsis_DEC_2015.pdf

Qaim, M. & Kouser, S. (2013). Genetically modified crops and food security. PLOS ONE, 8(6). Retrieved from https://doi.org/10.1371/journal.pone.0064879

Qiao, F. (2015, June). Fifteen years of Bt cotton in China: The economic impact and its dynamics. World Development, 70, 177–185. Retrieved from http://dx.doi.org/10.1016/j.worlddev.2015.01.011

Ray, D. K., Ramankutty, N., Mueller, N. D., West, P. C., & Foley, J. A. (2012). Recent patterns of crop yield growth and stagnation. Nature Communications, 3, 1293. Retrieved from https://doi.org/10.1038/ncomms2296

Reid, W. V., Mooney, H. A., Cropper, A., Capistrano, D., & Carpenter. (2005). Ecosystems and human well-being: Synthesis. A report of the Millennium Ecosystem Assessment. Washington, D.C.: Island Press.

Rice, R. A., & Ward, J. R. (1996). Coffee, conservation, and commerce in the Western Hemisphere: How individuals and institutions can promote ecologically sound farming and forest management in northern Latin America. Washington, D.C.: Smithsonian Migratory Bird Center; New York, NY: Natural Resources Defense Council.

Rockstrom, J. (2009). A safe operating space for humanity. Nature, 461(24).

Roem, W. J. & Berendse, F. (2000). Soil acidity and nutrient supply ratio as possible factors determining changes in plant species diversity in grassland and heathland communities. Biological Conservation, 92(2), 151–161. Retrieved from https://doi.org/10.1016/S0006-3207(99)00049-X

Roy, R. N., Finck, A., Blair, G. J., & Tandon, H. L. S. (2006). Plant nutrition for food security: A guide for integrated nutrient management (Bulletin No. 16). Rome: FAO. Retrieved from ftp://ftp.fao.org/agl/agll/docs/fpnb16.pdf

Roundtable on Sustainable Palm Oil. (n.d.). Palm oil factsheet. Retrieved from http://www.rspo.org/files/pdf/Factsheet-RSPO-AboutPalmOil.pdf

Roundtable on Sustainable Palm Oil. (2016). RSPO: National commitments. Retrieved from http://www.rspo.org/certification/national-commitments

Roundtable for Responsible Soy. (2014). RTRS: Task Force Europe [RTRS]. Retrieved from http://www.responsiblesoy.org/about-rtrs/governance/task-forces/task-force-europe/?lang=en

Ruf, F. O. (2011). The myth of complex cocoa agroforests: The case of Ghana. Human Ecology, 39(3), 373–388. Retrieved from https://doi.org/10.1007/s10745-011-9392-0

Sainsbury's. (2014). Sainsbury's increases sustainable palm oil products. Retrieved from http://www.j-sainsbury.co.uk/media/latest-stories/2014/1231-sainsburys-increases-sustainable-palm-oil-products/

Schiesari, L. & Corrêa, D. T. (2016). Consequences of agroindustrial sugarcane production to freshwater biodiversity. GCB Bioenergy, 8(3), 644–657. Retrieved from https://doi.org/10.1111/gcbb.12279

Schroth, G. & Harvey, C. A. (2007). Biodiversity conservation in cocoa production landscapes: An overview. Biodiversity and Conservation, 16(8), 2237–2244. Retrieved from https://doi.org/10.1007/s10531-007-9195-1

Secretariat of the Convention on Biological Diversity. (2014). Global Biodiversity Outlook 4 (p. 155). Montreal: Secretariat of the Convention on Biological Diversity.

Secretariat of the Convention on Biological Diversity & United Nations Environment Programme. (2000). Sustaining life on earth: How the Convention on Biological Diversity promotes nature and humal well-being. Châtelaine, Switzerland: CBD; United Nations Environment Programme, Division of Environmental Conventions/IUC International Environment House.

Social Environmental and Economic Performance of Cotton. (2012). Fact sheet on pesticide use in cotton production. International Cotton Advisory Committee: The Expert Panel on Social, Environmental and Economic Performance of Cotton Production (SEEP)The Expert Panel on Social, Environmental and Economic Performance of Cotton Production.

Smucker's. (2016). Smucker's 2016 corporate responsibility report: Commodity sourcing. Retrieved from http://corporateresponsibility.jmsmucker.com/sourcing/commodity.html

Somarriba, E., Beer, J., Alegre-Orihuela, J., Andrade, H. J., Cerda, R., DeClerck, F., ... Campos, J. J. (2012). Mainstreaming agroforestry in Latin America. In P. K. R. Nair & D. Garrity (Eds.), Agroforestry: The future of global land use (pp. 429–453). Springer Netherlands. Retrieved from https://doi.org/10.1007/978-94-007-4676-3_21

Soto-Pinto, L., Perfecto, I., Castillo-Hernandez, J., & Caballero-Nieto, J. (2000). Shade effect on coffee production at the northern Tzeltal zone of the state of Chiapas, Mexico. Agriculture, Ecosystems & Environment, 80(1–2), 61–69. Retrieved from https://doi.org/10.1016/S0167-8809(00)00134-1

Starbucks. (2016). Starbucks ethical sourcing: Coffee. Retrieved from http://www.starbucks.com/responsibility/sourcing/coffee

Stigson, P. (2013). The resource nexus: Linkages between resource systems. In Reference Module in Earth Systems and Environmental Sciences. Elsevier. Retrieved from http://www.sciencedirect.com/science/article/pii/B9780124095489058978

Storr, W. (2012, October 14). What is killing sugar-cane workers across Central America? The Guardian. Retrieved from https://www.theguardian.com/world/2012/oct/14/kidney-disease-killing-sugar-cane-workers-central-america

Sustainable Rice Platform. (n.d.). SRP overview. Retrieved from https://www.dropbox.com/s/nmqgwc53llhnu76/SRP%20Overview.pdf

Tayleur, C., Blamford, A., Buchanan, G. M., Butchart, S. H. M., Ducharme, H. ... Phelan, B. (2016, November 9). *Global coverage of agricultural sustainability standards, and their role in conserving biodiversity*. Retrieved from http://onlinelibrary.wiley.com/doi/10.1111/conl.12314/full

Tchibo. (n.d.). Coffee - Corporate responsibility - TchiboCorporateWebsite. Retrieved from https://www.tchibo.com/servlet/content/893082/-/starteseite-deutsch_en/tchibo-unternehmen_en/verantwortung_en/kaffee_en.html

TEEB. (2015). TEEB for agriculture and food: An interim report. Geneva, Switzerland: United Nations Environment Programme. Retrieved from http://img.teebweb.org/wp-content/uploads/2015/12/TEEBAgFood_Interim_Report_2015_web.pdf

Terazono, E. (2014, January 21). African farming: Initiatives about to increase cocoa yields. Retrieved from https://www.ft.com/content/8218cfbc-5dc8-11e3-95bd-00144feabdc0

The Economist. (2014, February 27). We have no bananas today. The Economist. Retrieved from http://www.economist.com/blogs/feastandfamine/2014/02/bananas

Tulane University. (2015). Survey research on child labor in West African cocoa growing areas. Tulane University. Retrieved from http://www.childlaborcocoa.org/images/Payson_Reports/Tulane%20University%20-%20Survey%20Research%20on%20Child%20Labor%20in%20the%20Cocoa%20Sector%20-%2030%20July%202015.pdf

UN Comtrade Database. (2016). UN Comtrade. International Trade Statistics Database. Retrieved from https://comtrade.un.org/

UNEP-WCMC. (2011). Review of the biodiversity requirements of standards and certification schemes: A snapshot of current practices (Technical Series No. 63). Monteal, Canada: Secretariat of the Convention on Biological Diversity.

Unilever. (2016). Sustainable sourcing. Retrieved from https://www.unilever.com/sustainable-living/the-sustainable-living-plan/reducing-environmental-impact/sustainable-sourcing/sustainable-tea-leading-the-industry/

Unilever. (n.d.). Sustainable soy & oils. Retrieved from https://www.unilever.com/sustainable-living/the-sustainable-living-plan/reducing-environmental-impact/sustainable-sourcing/our-approach-to-sustainable-sourcing/sustainable-soy-and-oils.html

United Nations Department of Economic and Social Affairs. (2014, December 1). SDG 2: End hunger, achieve food security and improved nutrition, and promote sustainable agriculture. Retrieved from https://sustainabledevelopment.un.org/?page=view&nr=164&type=230&menu=2059

U.S. Department of State. (2001). Country reports on human rights practices for 2000: Côte d'Ivoire. Retrieved from http://www.state.gov/j/drl/rls/hrrpt/2000/af/773.htm

USDA. (2016). World agricultural supply and demand estimates (No. WASDE-557). Retrieved from http://www.usda.gov/oce/commodity/wasde/latest.pdf

Utomo, B., Prawoto, A. A., Bonnet, S., Bangviwat, A., & Gheewala, S. H. (2016). Environmental performance of cocoa production from monoculture and agroforestry systems in Indonesia. Journal of Cleaner Production, 134, Part B, 583–591. Retrieved from https://doi.org/10.1016/j.jclepro.2015.08.102

Vaast, P., Bertrand, B., Perriot, J.-J., Guyot, B., & Génard, M. (2006). Fruit thinning and shade improve bean characteristics and beverage quality of coffee (Coffea arabica L.) under optimal conditions. Journal of the Science of Food and Agriculture, 86(2), 197–204. Retrieved from https://doi.org/10.1002/jsfa.2338

Vaast, P. & Somarriba, E. (2014). Trade-offs between crop intensification and ecosystem services: the role of agroforestry in cocoa cultivation. Agroforestry Systems, 88(6), 947–956. Retrieved from https://doi.org/10.1007/s10457-014-9762-x

Valdes, C. (2011, December 1). Can Brazil meet the world's growing need for ethanol? Retrieved from http://www.ers.usda.gov/amber-waves/2011/december/can-brazil-meet-the-world-s-growing-need-for-ethanol/

Valoral Advisors. (2015, January). Global food and agriculture investment outlook: Institutional investors meet farmers. Issue 5. Retrieved from http://www.responsability.com/investing/data/docs/en/15524/market-news-doc-valoral-03072015.pdf van der Wal, S. (2008, June). Sustainability issues in the tea sector: A comparative analysis of six leading producing countries. Retrieved from https://www.somo.nl/sustainability-issues-in-the-tea-sector/

Wallace, S. (n.d.). Farming the Amazon. Retrieved from http://environment.nationalgeographic.com/environment/habitats/last-of-amazon/

West, P. C., Gerber, J. S., Engstrom, P. M., Mueller, N. D., Brauman, K. A., Carlson, K. M., … Siebert, S. (2014). Leverage points for improving global food security and the environment. Science, 345(6194), 325–328. Retrieved from https://doi.org/10.1126/science.1246067

Wilmar International. (2017). Roundtable on Sustainable Palm Oil. Retrieved from http://www.wilmar-international.com/sustainability/progress/certifications/roundtable-on-sustainable-palm-oil/

World Bank Group. (2016). Agricultural land (% of land area): Data. Retrieved from http://data.worldbank.org/indicator/AG.LND.AGRI.ZS

Wu, K.-M., Lu, Y.-H., Feng, H.-Q., Jiang, Y.-Y., & Zhao, J.-Z. (2008). Suppression of cotton bollworm in multiple crops in China in areas with bt toxin–containing cotton. Science, 321(5896), 1676–1678. Retrieved from https://doi.org/10.1126/science.1160550

WWF. (2005). Sugar and the environment. Retrieved from http://wwf.panda.org/?22255/Sugar-and-the-Environment-Encouraging-Better-Management-Practices-in-Sugar-Production-and-Processing

Zomer, R. J., Neufeldt, H., Xu, J., Ahrends, A., Bossio, D., Trabucco, A., … Wang, M. (2016). Global tree cover and biomass carbon on agricultural land: The contribution of agroforestry to global and national carbon budgets. Scientific Reports, 6, 29987. Retrieved from https://doi.org/10.1038/srep29987

Appendix A: Methodology

Three types of analyses were undertaken to complete this report. A criteria coverage analysis, consisting of mapping voluntary sustainability standard (VSS) criteria onto the Biodiversity Impact Indicators for Commodity Production (BIICP) developed under the facilitation of the Convention on Biological Diversity Secretariat, allowed for exploring how certain standards are designed to slow or prevent biodiversity losses. A market analysis, consisting of examining how much market share standards have been captured in select agricultural commodities and how they are likely to expand based on private sector commitments, helped to understand how the potential expansion of standards may assist with slowing and preventing biodiversity losses. A spatial analysis, consisting of intersecting where conventional and standard-compliant agricultural production is occurring across the world and where biodiversity hotspots based on the BIICP are located, allowed us to identify where opportunities may exist for standards to expand and address biodiversity losses. The subsections below describe in detail the methodologies used to undertake the analysis described above.

Market Analysis

Standard-Compliant Market Data: Market data for rates of standard-compliant production and areas were collected directly from voluntary standards as part of a joint effort by the International Trade Centre (ITC), Research Institute of Organic Agriculture (FiBL) and the International Institute for Sustainable Development (IISD) to report on the market performance of VSSs across the world in select agricultural commodities. The information collected as part of this process is published in the State of Sustainable Markets report, which is released on an annual basis.

Adjusting for Multiple Certification: Standard-compliant commodities are often double or multiple-certified. To minimize the potential for double counting production volumes and area, multiple certification must be taken into account. To do so, the following approach was used:

1. **Establishing the minimum standard compliance –** This step consists of assuming complete multiple certification between the standards operating within a given commodity and country. This is done by using the largest VSS, in terms of production and area, to represent the absolute minimum in standard-compliant production and area for a given commodity and country.
2. **Establishing the maximum standard compliance –** This step consists of assuming no multiple certification between the standards operating within a given commodity and country. This is done by adding all the standard-compliant production and areas for a given commodity and country to give an absolute maximum in standard-compliant production and area.
3. **Establishing an average standard compliance –** This step consists of calculating the average of steps one and two for each country. These averages are then aggregated to arrive at a global "average" or adjusted figure for each commodity.

This process of adjusting for multiple certification was used for all standard-compliant totals in this report. The degree to which these adjustments temper the global "maximums" depends on the degree to which multiple standards are present (in volumes or area certified) in the same countries for a given commodity.

Annual Average Growth: Average annual growth for standard-compliant areas was calculated based on the number of years for which data is presented in corresponding graphs. In most cases, annual growth is calculated from 2008–2014, except where data were only available over a shorter period of time.

Conventional Commodity Market Data: Data for the total amount of production, area and trade for the individual commodities are from the FAOSTAT database (http://www.fao.org/faostat/en/#home).

Criteria Coverage Analysis

BIICP offers a framework for analyzing the potential contribution of sustainability standards to conserve and sustainably use biodiversity (see Table A1). The nine BIICP are grouped according to the following five major biodiversity-related impact pathways: Ecosystems/Habitats and Species/ Wildlife, Water Use, Water Quality, Soil Health, Energy Use and Carbon Emission. The BIICP were used to assess the potential for sustainability standards to slow and prevent biodiversity losses. We mapped their criteria to the BIICP by undertaking steps 1 to 5 described below. Each potential impact pathway is examined based on the frequency and implementation timelines for specific requirements.

Table A1. Biodiversity impact indicators for commodity production

1	Percentage of farm area in land classes of different habitat quality
2	Conversion/loss of natural habitat cover (land use change over time)
3	Area-based conservation management
4	Water use per unit product
5	Pesticide and inorganic fertilizer use per unit area or unit product
6	Biological oxygen demand at sampling sites
7	Soil organic matter
8	Fossil fuel use per unit area or unit product
9	Carbon footprint of product and land use

1. **Data Collection:** Information on VSS criteria was collected from the ITC Standards Map database.
2. **Indicator Mapping:** As part of the ITC Standards Map database structure, VSS criteria categories have been developed. These ITC criteria categories were mapped onto the BIICP by reviewing them in detail, leading to the selection of 48 ITC criteria categories matched up with the nine BIICP in Table A1.
3. **Mapping Review:** The VSS criteria falling into the 48 ITC criteria categories (see Appendix B) were cross-checked with the most recent and publicly available VSS Principles and Criteria documents and with the VSS themselves.
4. **Degree of Obligation:** The VSS criteria are assigned a degree of obligation number (DON) based on the categories below. To this end, different terms such as "minor must," "major," "immediate" etc. used by VSS in the ITC Standards Map were translated based on a process utilized by ITC.

   a. 1 = recommendation – implementation suggested in guidance but not required

   b. 2 = longer-term requirement (3-5 years)

   c. 3 = medium-term requirement (2-3 years)

   d. 4 = short-term requirement (within first year)

   e. 5 = critical requirement – must be compliant upon recognition of standard compliance.
5. **Aggregated Numbers:** The DONs were then aggregated by examining similar VSS criteria and allotting the highest number among them to give the final number for a given criteria category. For instance, criteria *700369 Protection of rare and threatened species and their habitats* and *700370 Maintaining or protecting rare, threatened or endangered ecosystems* are aggregated into *BIICP1-7 Protection of Species, Habitat & Ecosystem* by taking the highest DON between the two.

The SSI aims to provide an overview of how different VSSs are addressing biodiversity by examining the criteria that form the agricultural practices that they are promoting. The analysis is not intended to delineate "good" versus "bad" performance. While we recognize that there will be a natural tendency to regard more complete coverage as "better," this may not necessarily be the case. To the extent that more stringent criteria also represent a higher bar for producers to cross, increased competitiveness may decrease the accessibility of sustainable markets to those most in need, thereby restricting the ability of such initiatives to promote poverty-reduction objectives among the most marginalized producers.

Spatial Analysis

To further examine the potential interrelations between the BIICP and agricultural VSS, global spatial datasets can be used as proxies to depict where biodiversity hotspots are occurring and where agricultural VSS are operating. The spatial analysis adopted, generally described below, used a funnel approach to generate insights for identifying opportunities to slow or prevent biodiversity losses via agricultural VSS:

1. BIICP spatial data proxies were used to identify areas with biodiversity conservation value and where drivers of biodiversity loss are most severe across the world (see Table A2).

2. Agricultural lands used to grow an agricultural commodity relevant to the BIICP examined were then mapped. For instance, agricultural water use, as a driver of biodiversity loss, focuses on "thirsty crops" such as cotton, and palm oil is examined within the context of carbon footprint due to its association with deforestation.

3. Lastly, countries where VSSs are operating are examined and intersected with the biodiversity hotspots and agricultural lands used for production to identify opportunities where they can slow and/or reverse biodiversity losses.

Figure A1. The funnel approach used for the spatial analysis consisting of mapping proxies for the BIICP indicators, examining relevant crops and identifying where VSSs are and are not operating.

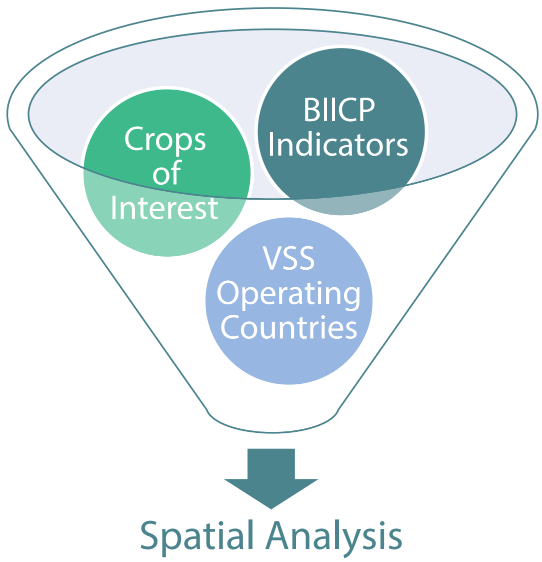


Table A2. Spatial data used as proxies for the BIICP

BIICP	Proxy Data Sets and Analysis
Percentage of farm area in land classes of different habitat quality Unit: per cent in each class, or weighted index score Spatial and Temporal Scales: Farm and Landscape - 3–5 years	Biodiversity Hotspots combined with Crop Area showing Country-level Standard-Compliant Crop Area. Conventional Crop Area – EarthStat located in the Harvested Area and Yield for 175 Crops tab (www.earthstat.org/data-download/), Resolution: 10x10 km. Standard-Compliant Area – The State of Sustainability Markets: Statistics and Emerging Trends (www.intracen.org/publication/The-State-of-Sustainable-Markets), Resolution: Country Level. Biodiversity Hotspots – Critical Ecosystem Partnership Fund (www.cepf.net/resources/hotspots/Pages/default.aspx), Resolution: Shapefile converted into a 10x10km raster layer.
Conversion/loss of natural habitat cover (land use change over time) Unit: ha/yr or km^2/yr Spatial and Temporal Scales: Region and landscape - 5 - 10 years	Potential Vegetation combined with Crop Area showing Country-level Standard-Compliant Crop Area. Conventional Crop Area – EarthStat located in the Harvested Area and Yield for 175 Crops tab (www.earthstat.org/data-download/), Resolution: 10x10 km. Standard-compliant Area – The State of Sustainability Markets: Statistics and Emerging Trends (www.intracen.org/publication/The-State-of-Sustainable-Markets), Resolution: Country-level Potential Vegetation – EarthStat located in the Potential Natural Vegetation tab (www.earthstat.org/data-download/), Resolution: 10x10 km.
Area-based conservation management Unit: per cent of certified land area (ha or km^2) Spatial and Temporal Scales: Landscape - 3–5 years	Conventional Area versus Standard-compliant area per country showing Country-level Standard-Compliant Crop Area. Conventional Crop Area – EarthStat located in the Harvested Area and Yield for 175 Crops tab (www.earthstat.org/data-download/), Resolution: 10x10 km. Standard-Compliant Area – The State of Sustainability Markets: Statistics and Emerging Trends (www.intracen.org/publication/The-State-of-Sustainable-Markets), Resolution: Country Level.
Water use per unit product Unit: m^3/tonne Spatial and Temporal Scales: Farm and landscape - 1–3 years	Blue Water Footprint showing Country-level Standard-Compliant Crop Area Standard-Compliant Area – The State of Sustainability Markets: Statistics and Emerging Trends (www.intracen.org/publication/The-State-of-Sustainable-Markets), Resolution: Country Level. Blue Water Footprint – Chapagain et al., September 2005 (waterfootprint.org/media/downloads/Report18.pdf), Resolution: Country Level.
Pesticide and inorganic fertilizer use per unit area or unit product. Unit: kg/ha/yr or kg/tonne Spatial and Temporal Scales: Farm and Landscape - Annual	Nitrogen Application combined with Crop Area and Yield and Phosphorus Application combined with Crop Area and Yield. Conventional Crop Area – EarthStat located in the Harvested Area and Yield for 175 Crops tab (www.earthstat.org/data-download/), Resolution: 10x10 km. Standard-Compliant Area – The State of Sustainability Markets: Statistics and Emerging Trends (www.intracen.org/publication/The-State-of-Sustainable-Markets), Resolution: Country Level Fertilizer Application Rate – EarthStat located in the Fertilizer Application for Major Crops tab (www.earthstat.org/data-download/), Resolution: 10x10 km.

Table A2. Spatial data used as proxies for the BIICP (continued)

BIICP	Proxy Data Sets and Analysis
Biological oxygen demand at sampling sites Unit: BOD_5 (mg O_2/L over 5 days) Spatial and Temporal Scales: Landscape - 1–3 years	Grey Water Footprint combined with Crop Area Conventional Crop Area – EarthStat located in the Harvested Area and Yield for 175 Crops tab (www.earthstat.org/data-download/), Resolution: 10x10 km. Standard-Compliant Area – The State of Sustainability Markets: Statistics and Emerging Trends (www.intracen.org/publication/The-State-of-Sustainable-Markets), Resolution: Country Level Grey Water Footprint – Water Footprint Network under Product water footprint statistics (waterfootprint.org/en/resources/water-footprint-statistics/), Resolution: 10x10 km
Soil organic matter Unit: organic carbon content (per cent) of topsoil Spatial and Temporal Scales: Farm and Landscape - 1–3 years	Topsoil Organic Matter overlapped with Crop Area Conventional Crop Area – EarthStat located in the Harvested Area and Yield for 175 Crops tab (http://www.earthstat.org/data-download/), Resolution: 10x10 km. Standard-Compliant Area – The State of Sustainability Markets: Statistics and Emerging Trends (http://www.intracen.org/publication/The-State-of-Sustainable-Markets), Resolution: Country Level Topsoil Organic Mater – Harmonized World Soil Database (http://webarchive.iiasa.ac.at/Research/LUC/External-World-soil-database/HTML/HWSD_Data.html?sb=4), Resolution: 1x1 km.
Fossil fuel use per unit area or unit product Unit: kg C/ha/yr or kg C/tonne Spatial and Temporal Scales: Farm - 1–3 years	N/A
Carbon footprint of product and land use Unit: kg C/ha/yr or kg C/tonne Spatial and Temporal Scales: Farm and landscape - 1–3 years	Tree Cover and Biomass Carbon change on agricultural lands between 2000 and 2010 overlapped with Crop Area Data Sources: Conventional Crop Area – EarthStat located in the Harvested Area and Yield for 175 Crops tab (http://www.earthstat.org/data-download/), Resolution: 10x10 km. Standard-Compliant Area – The State of Sustainability Markets: Statistics and Emerging Trends (http://www.intracen.org/publication/The-State-of-Sustainable-Markets), Resolution: Country Level. Tree Cover and Biomass Carbon change – World Agroforestry Centre (http://www.worldagroforestry.org/global-tree-cover/data-download.html), Resolution: 1x1km.
Pesticide and inorganic fertilizer use per unit area or unit product. Unit: kg/ha/yr or kg/tonne Spatial and Temporal Scales: Farm and Landscape - Annual	Nitrogen Application combined with Crop Area and Yield and Phosphorus Application combined with Crop Area and Yield. Conventional Crop Area – EarthStat located in the Harvested Area and Yield for 175 Crops tab (www.earthstat.org/data-download/), Resolution: 10x10 km. Standard-Compliant Area – The State of Sustainability Markets: Statistics and Emerging Trends (www.intracen.org/publication/The-State-of-Sustainable-Markets), Resolution: Country Level Fertilizer Application Rate – EarthStat located in the Fertilizer Application for Major Crops tab (www.earthstat.org/data-download/), Resolution: 10x10 km.

The global data sets available dictated the analysis undertaken for each BIICP. The spatial data sets depicting the crops examined were all based on a 10-km grid resolution with information in each cell on the hectares used for cultivating that particular crop, typically ranging from 1 to 10,000 ha.[87] For this reason, the combine raster function in ArcGIS, which fuses together two spatial raster grids with similar cell sizes into a new raster, was used to keep all original values of the overlapping cells of the rasters from being combined, which allowed us to use actual areas cultivated for a given crop for most of the spatial analysis undertaken.[88] More specifically, the following four types of analysis were undertaken based on data availability:

1. **Agricultural commodity spatial data sets directly relevant to BIICP:** Spatial data sets of relevant crops were used directly in the analysis by combining them with yield data to give production intensity values. For instance, spatial data sets were available for the nitrogen and phosphorus application of sugar allowing for mapping the sugar fertilizer application rate per unit product when combined with corresponding yield data.[89] Spatial data sets for nitrogen and phosphorus application and grey water footprint were available for developing production intensity values.

2. **Proxy spatial data sets relevant to BIICP with a 10-km grid resolution:** Spatial data sets that can suitably depict a BIICP with a 10-km grid resolution were combined with the crop examined to give the area that overlaps with the proxy data set used to identify potential biodiversity hotspots. For instance, Conservation International has identified biodiversity hotspots across the world, which when combined with the agricultural lands used to cultivate soy gives the total amount of land used for soy cultivation located in a biodiversity hotspot. This approach allowed for mapping the biodiversity hotspots overlapping with agricultural lands used to cultivate a given crop as well as the potential vegetation lost to growing a particular crop.

3. **Proxy spatial data sets relevant to BIICP with a 1-kim grid resolution:** Spatial data sets that can suitably depict a BIICP with a 1-km grid resolution were mapped based on the extent of the crop examined. It must be noted that since the proxy spatial data sets and crop areas have different spatial resolutions (1-km versus 10-km grid resolution), the combine function could not be used, limiting the precision with which the biodiversity impact of cultivating a crop could be ascertained. For instance, biomass carbon change within agricultural lands is mapped based on the extent of oil palm growing regions to visually examine where there are pockets of carbon loss without knowing with great precision how these areas align with more or less intensive oil palm growing regions. This approach allowed for mapping soil organic matter, tree cover change and biomass carbon change overlapping with a given crop.

4. **Proxy spatial data set not available:** Where global spatial data sets were not available, country-level data was used to examine a particular BIICP. This approach was adopted to examine the Area-Based Conservation BIICP where the spatial extents of land dedicated to conventional and standard-compliant agricultural production could be examined for a given crop as well as the water use BIICP by examining national blue water footprints for cotton cultivation. Since country-level data could not be obtained for fossil fuel use associated with the cultivation of a given crop, spatial analysis was not undertaken for the *fossil fuel use per unit area or unit product BIICP*.

87 Some grid cells may have more than 100 per cent coverage to take into consideration multiple harvests. For instance, a cell can have a value of 140 per cent if 70 per cent of the cell area is farmed twice a year (Monfreda et al., 2008).

88 The ArcGIS combine tool discards all cell values from the rasters being combined that do not overlap.

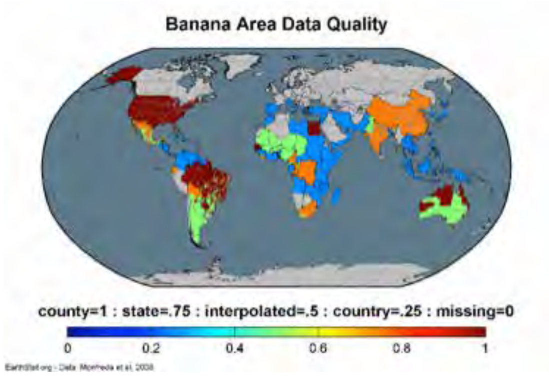
89 The nitrogen load in the form of mineral fertilizers, manure and atmospheric deposition and phosphorus load in the form of mineral fertilizers and manure per tonne of sugar produced were mapped based on application rates per hectare for the year 2000 divided by sugar yields averaged between 1997 and 2003 at a 10-km grid resolution (Monfreda et al., 2008; Mueller et al., 2012; West et al., 2014). For instance, nitrogen is applied at 57 kg/ha with a yield of 84 mt/ha of sugar within the same area; therefore, it gives a nitrogen load per metric tonne of sugar of 0.68 kg/tonne. The nitrogen load per unit product grid cell values are then averaged across all of the 10-km grid cells in a given country to give a national estimate.

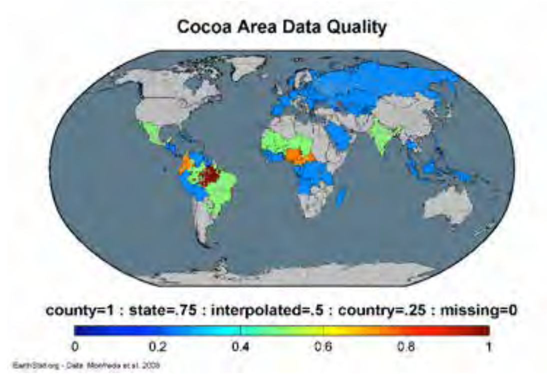
Overall the analysis aimed to provide a spatially explicit picture of opportunities for slowing and preventing biodiversity losses by identifying where the VSSs are and are not operating, and if their content and criteria are suited to addressing the drivers of biodiversity loss. It is important to be cognizant of inherent errors associated with spatial data. The spatial resolution of the underlying data sets can greatly affect the accuracy and utility of the analysis. Since the analysis was undertaken at the global scale, finding high-resolution datasets was a significant challenge.[90] Despite the inherent limitations associated with spatial data, the analysis provided a means to establish a more geographically explicit assessment of where VSSs could play a greater role in slowing and preventing biodiversity losses.

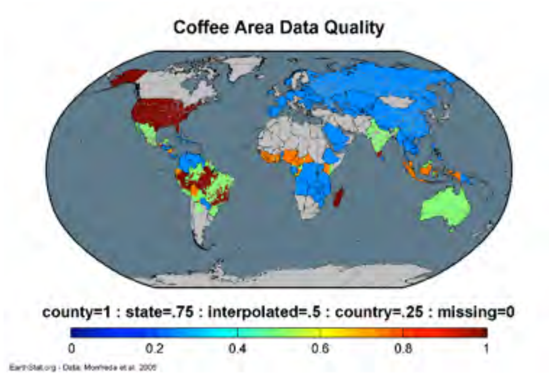
90 Global spatial datasets are being leveraged to monitor biodiversity indicators at 1-km grid resolution to better account for the dynamics between species and habitats. The Species Habitat Index, Biodiversity Habitat Index, Species Protection Index, Protected Area Representativeness and Connectedness Indices were all developed using more MODIS and LandSat imagery data (GEO BON Working Group on Biodiversity Indicators, 2015).

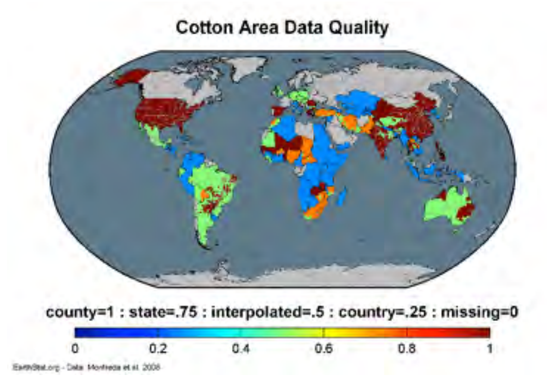
Reliablility of Spatial Data

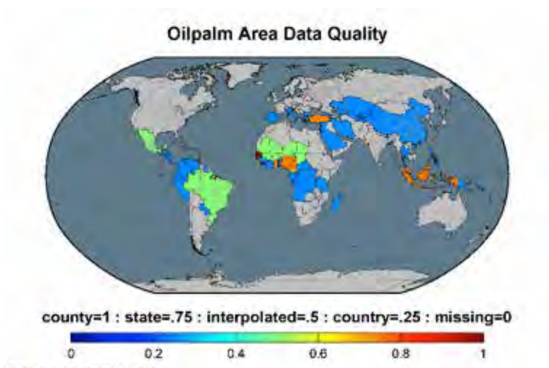
The maps below explicitly depict the level of accuracy of the spatial data that was used in the spatial analysis undertook for this study.

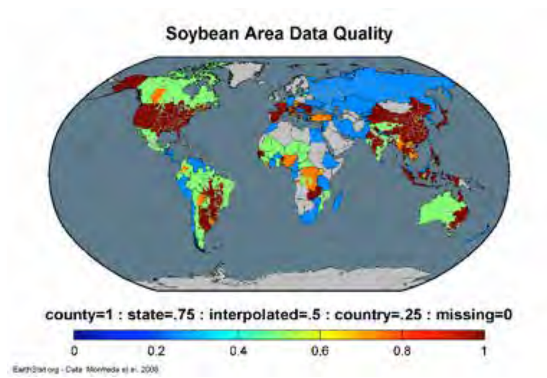


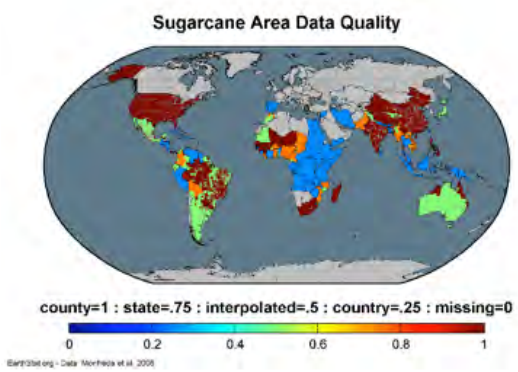











Sugarcane Area Data Quality
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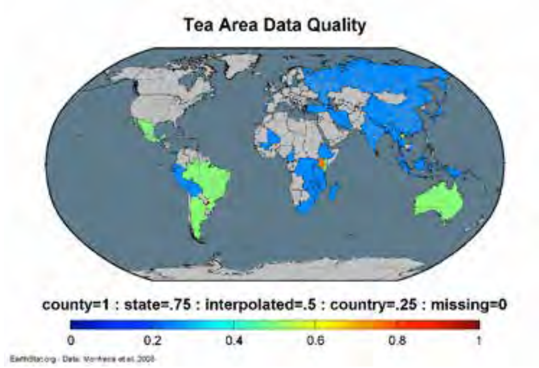
Tea Area Data Quality
county=1 : state=.75 : interpolated=.5 : country=.25 : missing=0
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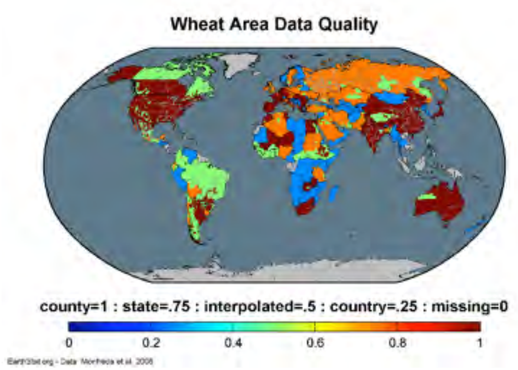
Wheat Area Data Quality
county=1 : state=.75 : interpolated=.5 : country=.25 : missing=0
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1

Appendix B: BIICP Sub-indicators for Criteria Coverage Analysis

Habitat Diversity Index-BIICP 1: Percentage of farm area in land classes of different habitat quality

No.	Index Indicator	ITC No.	Index Sub-indicator (as named in ITC Standards Map)
1	Forest Conversion	2072	Principles and criteria for the conversion of forests into production.
2	Preventing Ecosystem Fragmentation	2126	Safeguards against fragmentation of ecosystems/habitats (creating / maintaining /protecting ecological niches / corridors)
3	Protecting Area with High Conservation Value	4090	Criteria for the monitoring and protection of High Conservation Value Area
		700372	Prohibition of production on land with High Conservation Value (HCV) with conversion cut-off date no later than 2009 or at least five years
4	Ecosystem Spatial Management	4091	Spatial management criteria (creating / maintaining / protecting set asides, buffer zones or conservation areas)
5	Protection of Native Species	10072	Criteria related to maintaining, restoring, prioritizing native species (e.g. native vegetation along streams and watercourses)
6	Biodiversity Risk Assessment	300457	Criteria for assessment risks and impacts on biodiversity in (as well as outside) management or production unit
7	Protection of Rare Species, Habitat and Ecosystem	700369	Protection of rare and threatened species and their habitats
		700370	Criteria related to maintaining or protecting rare, threatened or endangered ecosystems
8	Protection of Wetlands and Watercourses	700374	Criteria related to natural wetlands and/or watercourses affected by production
		800009	Natural wetlands are maintained in undrained conditions.
9	Maintaining High Carbon Stocks	700397	Criteria related to the protection of high carbon landscapes / land with High Carbon Stock (HCS)
10	Restoring Ecosystems	700333	Principles and criteria for the conversion of agriculture land to non-agriculture purposes

(Note 1: numbers denote indicator number in ITC Standards Map; Note 2: Where subindicators capture similar types of requirements they have been combined into a single measure in the analysis taking the highest score among the relevant candidates)

Conversion of Natural Habitat Index-BIICP 2: Conversion of natural habitat cover in terms of land use change over time

No.	Index Indicator	ITC No.	Index Sub-indicator (as named in ITC Standards Map)
1	Forest Conversion	2072	Principles and criteria for the conversion of forests into production lands
2	Habitat Restoration	2124	Habitat / ecosystem restoration / rehabilitation
		700333	Principles and criteria for the conversion of agriculture land to non-agriculture purposes
3	Preventing Ecosystem Fragmentation	2126	Safeguards against fragmentation of ecosystems/habitats (creating / maintaining /protecting ecological niches / corridors)
4	Protection of Rare Species, Habitat and Ecosystem	700369	Protection of rare and threatened species and their habitats
		700370	Criteria related to maintaining or protecting rare, threatened or endangered ecosystems
5	Protecting Area with High Conservation Value	700372	Prohibition of production on land with High Conservation Value (HCV) with conversion cut-off date no later than 2009 or at least five years
		4090	Criteria for the monitoring and protection of High Conservation Value Area
6	Protection of Wetlands and Watercourses	700374	Criteria related to natural wetlands and/or watercourses affected by production
		800009	Natural wetlands are maintained in undrained conditions.

Area-Based Management Conservation Index-BIICP 3: Area-based conservation management by land area

No.	Index Indicator	ITC No.	Index Sub-indicator (as named in ITC Standards Map)
1	Forest Conversion	2072	Principles and criteria for the conversion of forests into production lands
2	Forest Enhancement	2073	Principles and criteria to enhance conservation of forests
3	Preventing Ecosystem Fragmentation	2126	Safeguards against fragmentation of ecosystems/habitats (creating / maintaining /protecting ecological niches / corridors)
4	Protecting Area with High Conservation Value	4090	Criteria for the monitoring and protection of High Conservation Value Area
		700372	Prohibition of production on land with High Conservation Value (HCV) with conversion cut-off date no later than 2009 or at least five years
5	Legally Protected Areas	30022	Criteria related to legally protected and internationally recognized areas for their biodiversity
6	Ecosystem Spatial Management	4091	Spatial management criteria (creating / maintaining / protecting set asides, buffer zones or conservation areas)
7	No Net Loss in Biodiversity	30018	Requirements for no net loss in biodiversity
8	Biodiversity Risk Assessment	300457	Criteria for assessment risks and impacts on biodiversity in (as well as outside) management or production unit
9	Protection of Rare Species, Habitats and Ecosystems	700369	Protection of rare and threatened species and their habitats
		700370	Criteria related to maintaining or protecting rare, threatened or endangered ecosystems
10	Protection of Wetlands and Watercourses	700374	Criteria related to natural wetlands and/or watercourses affected by production
		800009	Natural wetlands are maintained in undrained conditions.
11	Maintaining High Carbon Stocks	800011	High Carbon Stock areas monitoring and management

Water Use Index-BIICP 4: Water use per unit area or unit product

No.	Index Indicator	ITC No.	Index Sub-indicator (as named in ITC Standards Map)
1	Water Re-use and Recycling	2032	Water reuse, recycling and harvesting
2	Water Dependency and Scarcity	2036	Water dependencies and water scarcity
3	Water Use Monitoring	2037	**Water resources monitoring, use and consumption
4	Water Irrigation	10086	Water extraction / irrigation
5	Water Management and Risk Assessment	300455	Criteria for assess risks and impacts on water usage
		300663	Water management plan

Pesticide and Fertilizer Use Index-BIICP 5: Pesticide and organic fertilizer use per unit area or unit product

No.	Index Indicator	ITC No.	Index Sub-indicator (as named in ITC Standards Map)
1	Pesticide Use Monitoring	2098	Chemicals use and application records
2	Pesticide Use Prohibition	2108	Prohibition of use of any pesticides, biological control of pests and other related chemical substances.
3	Pesticide Targeted Application	60024	Chemicals : selective targeted application
4	Synthetic Fertilizer Reduction	700349	Criteria related to on synthetic fertilizers
5	Pesticide Use as a Last Resort	700363	Criteria related to the principle to use pesticides as last resort only

Biological Oxygen Demand Index-BIICP 6: Biological oxygen demand at sampling sites

No.	Index Indicator	ITC No.	Index Sub-indicator (as named in ITC Standards Map)
1	Wastewater Treatment	2031	Wastewater quality management and treatment
2	Safe Wastewater Disposal and Storage	2035	Principles and practices related to water disposal / storage
3	Water Pollution Prevention	10084	Surface and ground water contamination / pollution
4	Mitigation of Transboundary Pollution	30032	Mitigation of transboundary effects of water pollution
5	Runoff Prevention	300661	Criteria related to prevention of runoff of waste chemicals, mineral and organic substances
6	Limiting Wastewater	700392	**Criteria relating to limitations of wastewater
7	Assessment of Water Pollution Risks	700415	**Criteria for assessment of risks and impacts on water quality of water resources used (surface and/or ground water)

Soil Fertility Index-BIICP 7: Soil organic matter per unit volume

No.	Index Indicator	ITC No.	Index Sub-indicator (as named in ITC Standards Map)
	Maintenance of Soil Fertility	2055	Soil quality
	Crop Rotation and Intercropping	300622	Soil enhancement by crop rotation or intercropping
	Cover Crops	701332	Soil enhancement by use of cover crops
	Enhance Soil Biodiversity	800003	Soil biodiversity

Fossil Fuel Index-BIICP 8: Fossil fuel use per unit area or product

No.	Index Indicator	ITC No.	Index Sub-indicator (as named in ITC Standards Map)
	Energy Use Monitoring and Reduction	2084	Criteria to reduce use of energy resources
		2091	Criteria on energy consumption monitoring / recording
		800010	Other criteria related to energy consumption and management
		800048	Criteria related to energy consumption in the production phase
	Synthetic Fertilizer Reduction	700349	Criteria related to synthetic fertilizers
	Water Irrigation	10086	Water extraction / irrigation

Carbon Footprint Index-BIICP 9: Carbon footprint of product or land area

No.	Index Indicator	ITC No.	Index Sub-indicator (as named in ITC Standards Map)
1	Forest Conversion	2072	Principles and criteria for the conversion of forests into production lands
2	Conversion of Agriculture Land to Non-agriculture Purposes	700333	Principles and criteria for the conversion of agriculture land to non-agriculture purposes
3	Clearing Land with Fire or Explosives	4094	Criteria and practices relating to the clearing of land with fire or explosives
4	GHG Emission Reduction	2117	Criteria for reducing GHG emissions
		4288	Principles and criteria for Carbon Neutrality
5	GHG Emission Quantification	30040	Requirements to quantify GHG emissions
6	High Carbon Stock Management	800011	High Carbon Stock areas monitoring and management
7	Protection of High Carbon Stocks	700397	Criteria related to the protection of high carbon landscapes / land with High Carbon Stock
8	Energy Use Monitoring and Reduction	800010	Other criteria related to energy consumption and management
		2084	Criteria to reduce use of energy resources
		2091	Criteria on energy consumption monitoring / recording
		800048	Criteria related to energy consumption in the production phase
9	Synthetic Fertilizer Reduction	700349	Criteria related to on synthetic fertilizers
10	Soil Quality	2055	Soil quality

1 INTRODUCTION
2 VOLUNTARY SUSTAINABILITY STANDARDS
3 BACKGROUND
4 CRITERIA COVERAGE ANALYSIS
5 MARKETS
6 CONCLUSION
7 POLICY OPTIONS
8 APPENDICES

Appendix C: Criteria Coverage Analysis Results

The results obtained for the criteria coverage analysis is succinctly presented per BIICP. As mentioned, the percentages reflect a DON assigned to VSS criteria based on whether they are an immediate requirement (DON = 5 or 100 per cent), required to be fulfilled within 1 year (DON = 4 or 80 per cent), required to be fulfilled within 3 years (DON = 3 or 60 per cent), required to be fulfilled within 5 years (DON = 2 or 40 per cent), a recommended requirement (DON = 1 or 20 per cent) or simply not covered (DON = 0 or 0 per cent).

Table C1. Percentage of farm area in land classes of different habitat quality

Voluntary Sustainability Standard	IFOAM	FT-S	FT-HL	RA	GG	UTZ	PT	RTRS	GCP	ETP	BON	RSPO	RSB	BCI	CmiA	AVG
Percent farm area in land classes of different habitat quality																
Forest Conversion	0%	100%	100%	100%	0%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	87%
Preventing Ecosystem Fragmentation	100%	40%	100%	60%	0%	100%	0%	0%	0%	100%	100%	0%	100%	60%	100%	57%
Protecting Area with HCV	100%	100%	100%	100%	100%	100%	100%	100%	100%	0%	100%	100%	100%	0%	0%	80%
Ecosystem Spatial Management	100%	60%	100%	60%	100%	100%	80%	80%	40%	100%	100%	100%	100%	100%	0%	81%
Protection of Native Species	0%	60%	100%	60%	100%	80%	100%	100%	0%	0%	80%	0%	100%	100%	0%	59%
Biodiversity Risk Assessment	100%	40%	60%	60%	100%	80%	80%	0%	0%	100%	100%	100%	100%	0%	0%	61%
Protection of Rare Species, Hab. & Ecosyste	100%	100%	100%	60%	0%	80%	100%	100%	60%	100%	100%	100%	100%	0%	100%	80%
Protection of Wetlands & Water Courses	100%	40%	100%	60%	100%	100%	100%	100%	40%	100%	100%	100%	100%	100%	100%	89%
Maintaining High Carbon Stocks	0%	0%	40%	60%	0%	0%	100%	0%	0%	0%	20%	100%	100%	0%	0%	28%
Restoring Ecosystems	100%	40%	0%	60%	20%	0%	100%	0%	0%	20%	100%	0%	100%	0%	0%	36%
Total Average	70%	58%	80%	68%	52%	74%	86%	58%	34%	62%	90%	70%	100%	46%	40%	66%

Table C2. Conversion/loss of natural habitat cover

Voluntary Sustainability Standard	IFOAM	FT-S	FT-HL	RA	GG	UTZ	PT	RTRS	GCP	ETP	BON	RSPO	RSB	BCI	CmiA	AVG
Conversion/loss of natural habitat cover																
Forest Conversion	0%	100%	100%	100%	0%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	87%
Habitat Restoration	100%	40%	60%	100%	20%	100%	100%	80%	0%	100%	100%	0%	100%	100%	0%	67%
Preventing Ecosystem Fragmentation	100%	40%	100%	60%	0%	100%	0%	0%	0%	100%	100%	0%	100%	60%	100%	57%
Protection of Rare Species, Hab. & Ecosyste	100%	100%	100%	60%	0%	80%	100%	100%	60%	100%	100%	100%	100%	0%	100%	80%
Protection of Areas with HCV	100%	100%	100%	100%	100%	100%	100%	100%	100%	0%	100%	100%	100%	0%	0%	80%
Protection of Wetlands & Water Courses	100%	40%	100%	60%	100%	100%	100%	100%	40%	100%	100%	100%	100%	100%	100%	89%
Total Average	83%	**70%**	**93%**	**80%**	**37%**	**97%**	**83%**	**80%**	**50%**	**83%**	**100%**	**67%**	**100%**	**60%**	**67%**	77%

Table C3. Area-based conservation management

Voluntary Sustainability Standard	IFOAM	FT-S	FT-HL	RA	GG	UTZ	PT	RTRS	GCP	ETP	BON	RSPO	RSB	BCI	CmiA	AVG
Area-based conservation management																
Forest Conversion	0%	100%	100%	100%	0%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	87%
Forest Enhancement	100%	0%	100%	100%	0%	100%	100%	100%	40%	20%	0%	100%	100%	0%	0%	57%
Preventing Ecosystem Fragmentation	100%	40%	100%	60%	0%	100%	0%	0%	0%	100%	100%	0%	100%	60%	100%	57%
Protection of Areas with HCV	100%	100%	100%	100%	100%	100%	100%	100%	100%	0%	100%	100%	100%	0%	0%	80%
Legally Protected Areas	100%	100%	0%	60%	100%	100%	100%	100%	100%	0%	100%	100%	100%	100%	100%	84%
Ecosystem Spatial Management	100%	60%	100%	60%	100%	100%	80%	80%	40%	100%	100%	100%	100%	100%	0%	81%
No Net Loss of Biodiversity	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	13%
Biodiversity Risk Assessment	100%	40%	60%	60%	100%	80%	80%	0%	0%	100%	100%	100%	100%	0%	0%	61%
Protection of Rare Species, Hab. & Ecosyste	100%	100%	100%	60%	0%	80%	100%	100%	60%	100%	100%	100%	100%	0%	100%	80%
Protection of Wetlands & Water Courses	100%	40%	100%	60%	100%	100%	100%	100%	40%	100%	100%	100%	100%	100%	100%	89%
Maintaining High Carbon Stocks	0%	0%	0%	60%	0%	0%	0%	0%	0%	0%	80%	0%	100%	0%	0%	16%
Total Average	**73%**	**53%**	**69%**	**65%**	**55%**	**78%**	**69%**	**62%**	**44%**	**56%**	**80%**	**73%**	**100%**	**42%**	**45%**	64%

Table C4. Water use per unit product

Voluntary Sustainability Standard	IFOAM	FT-S	FT-HL	RA	GG	UTZ	PT	RTRS	GCP	ETP	BON	RSPO	RSB	BCI	CmiA	AVG
Water use per unit product																
Water Reuse and Recycling	100%	60%	80%	60%	100%	100%	80%	100%	60%	100%	0%	100%	100%	100%	100%	83%
Water Dependancy and Scarcity	100%	60%	60%	60%	100%	20%	80%	100%	40%	100%	100%	100%	100%	100%	100%	81%
Water Use Monitoring	100%	60%	80%	60%	100%	60%	100%	80%	40%	100%	80%	100%	100%	100%	0%	77%
Water Irrigation	100%	40%	100%	60%	100%	100%	100%	80%	40%	100%	80%	100%	100%	100%	100%	87%
Water Management & Risk Assessment	100%	60%	80%	60%	100%	100%	80%	100%	40%	100%	100%	100%	100%	100%	0%	81%
Total Average	**100%**	**56%**	**80%**	**60%**	**100%**	**76%**	**88%**	**92%**	**44%**	**100%**	**72%**	**100%**	**100%**	**100%**	**60%**	82%

Table C5. Pesticide and inorganic fertilizer use per unit area or unit product

Voluntary Sustainability Standard	IFOAM	FT-S	FT-HL	RA	GG	UTZ	PT	RTRS	GCP	ETP	BON	RSPO	RSB	BCI	CmiA	AVG
Pesticide and inorganic fertilizer use per unit area or unit product																
Pesticide Use Monitoring	100%	100%	60%	60%	100%	60%	100%	100%	40%	100%	100%	100%	100%	100%	60%	85%
Pesticide Use Prohibition	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	7%
Pesticide Targetted Application	100%	80%	100%	60%	100%	80%	80%	100%	40%	100%	100%	100%	100%	0%	60%	80%
Synthetic Fertilizer Reduction	100%	40%	80%	60%	100%	60%	80%	0%	0%	0%	100%	80%	0%	60%	0%	48%
Pesticide Use as a Last Resort	100%	60%	100%	60%	100%	100%	0%	0%	40%	100%	0%	100%	0%	0%	0%	91%
Total Average	100%	56%	68%	48%	80%	60%	52%	40%	24%	60%	60%	76%	40%	32%	24%	62%

Table C6. Biological oxygen demand at sampling sites

Voluntary Sustainability Standard	IFOAM	FT-S	FT-HL	RA	GG	UTZ	PT	RTRS	GCP	ETP	BON	RSPO	RSB	BCI	CmiA	AVG
Biological oxygen demand at sampling site																
Wastewater Treatment	0%	40%	60%	100%	100%	100%	80%	0%	40%	100%	80%	100%	100%	0%	0%	60%
Safe Wastewater Disposal and Storage	100%	40%	60%	100%	100%	0%	80%	0%	40%	100%	80%	100%	100%	0%	0%	60%
Water Pollution Prevention	100%	40%	100%	100%	100%	100%	100%	100%	40%	100%	100%	100%	100%	60%	0%	83%
Mitigation of Transboundary Pollution	0%	0%	0%	60%	0%	0%	100%	0%	0%	100%	0%	0%	100%	0%	0%	24%
Limiting Wastewater	100%	40%	60%	100%	0%	60%	80%	0%	0%	100%	80%	0%	100%	0%	0%	48%
Runoff Prevention	100%	40%	100%	60%	100%	100%	100%	80%	60%	100%	80%	0%	100%	100%	60%	79%
Assessment of Water Pollution Risks	100%	40%	60%	60%	100%	60%	100%	80%	0%	100%	100%	100%	100%	100%	0%	73%
Total Average	71%	34%	63%	83%	71%	60%	91%	37%	26%	100%	74%	57%	100%	37%	9%	61%

Table C7. Soil organic matter

Voluntary Sustainability Standard	IFOAM	FT-S	FT-HL	RA	GG	UTZ	PT	RTRS	GCP	ETP	BON	RSPO	RSB	BCI	CmiA	AVG
Biological oxygen demand at sampling site																
Wastewater Treatment	0%	40%	60%	100%	100%	100%	80%	0%	40%	100%	80%	100%	100%	0%	0%	60%
Safe Wastewater Disposal and Storage	100%	40%	60%	100%	100%	0%	80%	0%	40%	100%	80%	100%	100%	0%	0%	60%
Water Pollution Prevention	100%	40%	100%	100%	100%	100%	100%	100%	40%	100%	100%	100%	100%	60%	0%	83%
Mitigation of Transboundary Pollution	0%	0%	0%	60%	0%	0%	100%	0%	0%	100%	0%	0%	100%	0%	0%	24%
Limiting Wastewater	100%	40%	60%	100%	0%	60%	80%	0%	0%	100%	80%	0%	100%	0%	0%	48%
Runoff Prevention	100%	40%	100%	60%	100%	100%	100%	80%	60%	100%	80%	0%	100%	100%	60%	79%
Assessment of Water Pollution Risks	100%	40%	60%	60%	100%	60%	100%	80%	0%	100%	100%	100%	100%	100%	0%	73%
Total Average	71%	34%	63%	83%	71%	60%	91%	37%	26%	100%	74%	57%	100%	37%	9%	61%

Table C8. Fossil fuel use per unit area or unit product

Voluntary Sustainability Standard	IFOAM	FT-S	FT-HL	RA	GG	UTZ	PT	RTRS	GCP	ETP	BON	RSPO	RSB	BCI	CmiA	AVG
Fossil fuel use per unit area or unit product																
Energy Use Monitoring and Reduction	100%	60%	80%	60%	100%	60%	80%	100%	60%	100%	80%	100%	100%	60%	0%	76%
Synthetic Fertilizer Reduction	100%	40%	80%	60%	100%	60%	80%	0%	40%	0%	80%	100%	0%	60%	0%	53%
Irrigation	100%	40%	100%	60%	100%	100%	100%	80%	40%	100%	80%	100%	100%	100%	100%	87%
Total Average	100%	47%	87%	60%	100%	73%	87%	60%	47%	67%	80%	100%	67%	73%	33%	72%

Table C9. Carbon footprint of product and land use

Voluntary Sustainability Standard	IFOAM	FT-S	FT-HL	RA	GG	UTZ	PT	RTRS	GCP	ETP	BON	RSPO	RSB	BCI	CmiA	AVG
Carbon footprint of product and land use																
Forest Conversion	0%	100%	100%	100%	0%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	87%
Conversion of ag. land to non-ag. land	100%	40%	0%	60%	20%	0%	100%	0%	0%	20%	100%	0%	100%	0%	0%	36%
Clearing land with fire or explosives	100%	0%	0%	100%	0%	80%	100%	100%	0%	100%	100%	0%	60%	0%	0%	49%
GHG Emission Reduction	0%	40%	0%	60%	0%	0%	100%	100%	0%	20%	100%	100%	100%	0%	0%	41%
GHG Emission Quantification	0%	0%	0%	60%	0%	0%	100%	60%	0%	20%	100%	100%	100%	0%	0%	36%
High Carbon Stock Management	0%	0%	0%	60%	0%	0%	0%	0%	0%	0%	80%	0%	100%	0%	0%	16%
Protection of High Carbon Stocks	0%	0%	40%	60%	0%	0%	100%	0%	0%	0%	20%	100%	100%	0%	0%	28%
Energy Use Monitoring and Reduction	100%	60%	80%	60%	100%	60%	80%	100%	60%	100%	80%	100%	100%	60%	0%	76%
Synthetic Fertilizer Reduction	100%	40%	80%	60%	100%	60%	80%	0%	40%	0%	80%	100%	0%	60%	0%	53%
Soil Quality	100%	60%	80%	60%	100%	80%	100%	100%	0%	100%	0%	100%	100%	60%	0%	69%
Total Average	50%	34%	38%	68%	32%	38%	86%	56%	20%	46%	76%	70%	86%	28%	10%	49%

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