Final Report

Sustainable Cotton

Towards A Low Carbon Future

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Details

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Table of Contents

List of tables

List of figures

Acronyms and abbreviations

CDM	Clean Development Mechanism
FOD	First Order Decay model
GHG	Greenhouse gases
EF	Emission factor
ha	Hectare
IPCC	Intergovernmental Panel on Climate Change
LULUCF	Land use, land-use change, and forestry
MRV	Monitoring, reporting and verification
SBT	Science-based Targets
SOM	Soil organic matter
tCO2eq	tons of carbon dioxide equivalent

Executive Summary

Less than 1% of cotton around the world is certified organic, according to the Textile Exchange's 2019 Organic Cotton Market Report. Organic cotton is seen as a component which can address global climate change if regenerative soil practices are incorporated. Given these realities, there needs to be a global shift in cotton production to improve soil, sequester carbon, and achieve global climate goals.

For this shift to happen, cotton producers and companies that source cotton need to understand and help improve the following relationships:

- Between climate-compatible agriculture practices and soil improvement: Beyond meeting certification and standards, promoting and incentivizing practices that improve soil, such as composting, improved residue management, cover cropping, etc., will lead to long-term farm productivity and environmental improvements.
- Between soil improvement and carbon sequestration: Healthier soils, as demonstrated by increases in soil organic matter, result in greater carbon sequestration and other impacts, such as reductions in water use, that benefit both farmers and the environment.
- Between sourcing practices and climate goals: As an increasing number of brands commit to Science-based Targets (SBT), sourcing from farms that adopt soil-improvement practices will enable the reduction of Scope 3 emissions[1].

Currently, there is a lack of clear connection between these distinct parts. The missing link is a model that connects these pieces. This report proposes a roadmap of feasible technical interventions with an estimate of how these interventions will reduce and sequester greenhouse gases (GHG). It also aims to help make the business case for farmers to transition from conventional production to improved cotton, or organic production, and how brands can account for any GHG emission reductions as part of their Scope 3 SBT commitments.

This report focuses on two key interventions: composting and improved windbreak tree systems. These interventions build on existing pilot projects in the region and have a higher likelihood of adoption (compared to other practices like cover cropping and reduced tillage). Two different scenarios were explored under composting – one fully organic scenario, and the other an improved scenario of gradually replacing chemical fertilizers with compost over a five-year period. The latter scenario will allow for a more rapid adoption of composting and agroforestry practices to a much larger subset of land, whether it is for Better Cotton Initiative (BCI) or organic purposes.

Based on a rate of adoption of 8-15% on two existing BCI farms which have started transitioning a small portion of their land towards organic, the report found that adopting the recommended practices can lead to a total emission reduction of 36,548 to 73,433 tons of carbon dioxide equivalent (tCO2eq) over five years. The estimated price per tCO2eq from the expansion of the pilots is between EUR $18 and $60. This includes increased costs and production losses for farmers, as well as third party costs for farmer training, soil analysis, audit, and MRV, which will decrease as scale increases. The improved scenario has proved to be the most cost-effective when looking solely at GHG emission reductions. This scenario also assumes that farmers are compensated at 100% for additional costs and losses in production as they transition. These costs can be potentially mitigated through purchase interests or agreements from brands and retailers.

Brands sourcing cotton from these farms can claim a reduction on their emissions factors associated with cotton purchases from China by following the monitoring recommendations in the Gold Standard's Value Change program. As more brands that are already sourcing BCI cotton

[1] If scope 3 emissions represent more than 40% of a company's overall emissions, the SBTi requires a target to be set to cover this impact.

consider adding/ increasing organic into their sustainable fiber mix, this carbon insetting model allows brands to support projects within their value chain which will directly contribute to emission reductions. Brands can work with key local partners like the China Cotton Industry Alliance (CCIA) to get the buy-in of stakeholders across the value chain while supporting farmers as they restore soil and generate co-benefits like water conservation, biodiversity, and climate resiliency.

1 Introduction

1.1 Background

China is one of the world's leading producers of cotton and the largest importer and consumer of cotton globally, but is facing soil degradation, unsustainable water use, and other environmental challenges. China accounts for about 30% of the world's cotton output with only 15% of the world's cotton land (Dai, 2013). 67% of China's cotton is grown in the semi-arid region of Xinjiang (Gu, 2017). This accounts for nearly 10 percent of the world's supply each year (Stratfor, 2017). Cotton makes up nearly a third of Xinjiang's total cultivated land (Hu, 2017).

Decades of unsustainable intensive agriculture practices in Xinjiang have led to severe soil degradation. In addition, the region is losing 5.5 gigatons of terrestrial water storage each year (NASA, 2018). According to the 2016 Xinjiang Water Resource Bulletin, agriculture consumes 94% of the total water usage, especially water-intensive crops like cotton, which is entirely dependent on irrigation. This results in the increasing exploitation of surface and underground water. The over pumping of groundwater with high salinity plus the overuse of chemical fertilizer and long-term mulched drip irrigation has resulted in secondary salinization or salt accumulation in the subsoil and on the surface of soil (Wang, 2018). It is estimated that 48.07% of Xinjiang's soil has changed to salt affected soil as a result (Wang, 2015).

Meeting sustainability standards or certification requirements is often not enough to address these issues. In some cases, certification schemes do not translate into positive environmental impact. It is key to help farmers adopt regenerative, organic and climate compatible agriculture practices such as composting, improving residual management, cover cropping, and reducing tillage. These practices restore soil health, improve the soil's capacity to hold water, increase water infiltration rates, and sequester carbon in the soil. Soil forms the foundation of agriculture and the environmental improvement associated with it, so beyond meeting standards, it is important that farmers understand how their growing practices can improve the soil.

Rare has been working with farmers in China to transition towards organic cultivation including adopting composting and improved residual management in two pilot farms. In partnership with Kering, Rare and South Pole are undertaking a study to further contribute towards the transition of more sustainable and regenerative cotton farming. Leveraging the existing pilots, this study aims to assess the feasibility of scaling up activities that will help farmers improve their soil while enabling international brands/retailers achieve sustainability and climate goals. Brands can do this through insetting models, which refers to carbon emission reductions and removals in or directly linked to the supply or value chain, and also might feature sustainable development outcomes. Insetting interventions might be used to compensate a company's emissions, or to reduce a company's carbon footprint depending on the approach taken. Carbon insetting goes beyond carbon emissions: it is about having a positive impact, building resiliency and restoring ecosystems.

1.2 Objectives

This report assesses the opportunities for scaling up climate-compatible agriculture practices for cotton farmers in China. The report identifies a business case for scaling up technical interventions that enable farmers to improve soil health, transition to more sustainable cotton production systems and maintain high yields. For brands and retailers, the report focuses on the benefits of supporting these interventions, particularly in the form of GHG emission reductions, and how can this contribute to achieving sustainability goals.

This report covers the following objectives:

- Identify a list of feasible technical interventions to reduce environmental impacts from cotton production, particularly GHG emissions, and soil degradation;
- Estimate GHG emission reduction and sequestration potential from selected activities;
- Build a business case for farmers to transition from conventional production to improved cotton, or organic production;
- Provide guidance on relevant carbon methodologies, standards, and monitoring, reporting and verification (MRV).

1.3 Methodology

Rare and South Pole (the Consortium) carried out a literature review and built upon their previous experience with cotton farmers in China to identify feasible technical interventions to reduce specific environmental impacts from cotton production. Selected interventions focused on reducing GHG emission, as well as creating co-benefits such as reductions in water consumption and soil erosion.

The Consortium undertook a site visit covering two pilot farms in Xinjiang, China where representatives interviewed farmers and key stakeholders in the region. The selected farms were chosen because Rare had engaged with these farmers over a period of two years. During this time, farmers implemented a series of good agricultural practices to transition from conventional cotton production to organic cotton production. More details on the characteristics of the pilot farms and their management systems can be found in Section 2 of this document.

The Consortium utilized different methodologies, tools and farm level data to estimate potential GHG emission reductions and carbon sequestration for the identified activities. These included Intergovernmental Panel on Climate Change (IPCC)'s Good Practice Guidance for Land use, land-use change, and forestry (LULUCF), First Order Decay model for generating compost, CDM methodologies, and the Cool Farm Tool. Emission reduction and carbon sequestration potentials were estimated for a projected implementation period of five years. More details on these methodologies and on the calculations can be found in Section 3 of this report.

The Consortium developed a business case for farmers to transition from conventional to improved cotton production, or to organic production based on two different scenarios of adoption rate (8% and 15% of total land area in the two pilot farms). Additionally, the Consortium assessed relevant carbon methodologies, standards and MRV mechanisms, focusing on their potential linkages with SBTs and the process that Kering would have to follow to be able to account for any GHG emission reductions as part of their Scope 3 SBT commitments. Further details can be found in Section 5 of this document.

1.4 Project Stakeholders

- **Rare**, an international environmental conservation non-profit organization, has been supporting cotton farmers in China to transition towards organic cultivation since 2015. This carbon insetting model will initially be based on Rare's key farm partners building on existing relationships, with the potential to scale to nearby farms. Rare will also support farmers in implementing improvements and understanding the business case for the proposed scenarios.
- **South Pole**, a global climate consultancy, acts as the technical partner to evaluate the most environmentally beneficial interventions and suggest how brands/retailers can claim carbon reduction from the climate-compatible agriculture practices performed by the farmers they source from against their Scope 3 (indirect) emissions as part of their SBTs.

- **Kering**, as a global sustainability leader in luxury fashion, has developed an Environmental Profit & Loss tool to measure and quantify the environmental impact of its activities. The EP&L measures carbon emissions, water consumption, air and water pollution, land use, and waste production along the entire supply chain, thereby making the various environmental impacts of the Group's activities visible, quantifiable, and comparable. This report helps to ground truth and augment the assumptions behind Kering's Environmental Profit & Loss related to the environmental impact of cotton from different regions in terms of per kg of cotton while supporting the scale up of improved practices which is of interest for Kering in the scope of their sustainable sourcing ambition. The potential development of insetting projects could support Kering achieving its Science Based Targets while bolstering additional environmental benefits within its suppliers, including improved soil conditions and reduced water consumption.
- **Xinjiang farmers** play a crucial role by adopting the interventions, carrying out the basic monitoring, reporting and verification processes associated with the agricultural management practices and the generation of compost. Xinjiang farmers will also play an important role at providing data and insights on any potential co-benefits such as increased incomes, reductions in water consumption and others.
- **China Cotton Industry Alliance (CCIA)** was initiated in 2016 by the Ministry of Agriculture and Rural Planting Industry Management Department in consultation with the Science and Technology and Education department, led by the Cotton Research Institute, Chinese Academy of Agricultural Sciences, the United National Agricultural Science and Technology Park, Xinjiang Production and Construction Corp. (XPCC), and large cotton-related companies. The purpose of the alliance is to guide the needs of textile enterprises, particularly in science and technology innovation, and promote supply side structural reform of China's cotton. CCIA comprises of 233 members, 46 of which are cotton producers. CCIA is interested in promoting this carbon insetting model to their members and including it as part of their standard. CCIA is a potential key scaling partner going forward.

2 Scaling Up Climate-Compatible Agriculture Practices: Feasibility Assessment

2.1 Business as Usual: Conventional Cotton Practices

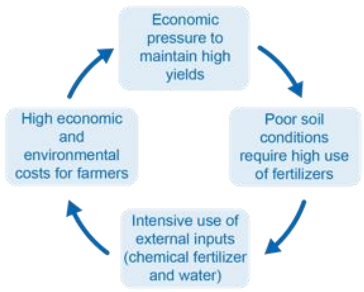

Figure 1: Main challenges faced by cotton farmers in the region

Two of Rare's farm partners are Jintian and Luthai Farms, which transitioned parts of their land towards organic in 2018. These two farms serve as the pilot case studies for this report.

Both farms have grown cotton for decades and increasingly observed severe soil degradation in the form of secondary salinization from years of intensive high input agriculture. In recent years, they have begun to realize that this vicious cycle of high input, high output production system is not sustainable.

2.2 Towards Organic Cotton in China: Summary of Existing Pilot

Jintian Farm, Akesu County: Established in 2004, Jintian Farm is a family business that currently cultivates 666 hectares (ha) of cotton and rice, rotated every three years. The farm transitioned 66 ha of Extra Long Staple (ELS) cotton (10% of total land) towards organic in 2018. Jintian joined the Better Cotton Initiative (BCI) in 2013. Over 200 farming households work and live at Jintian.

Luthai Farm, Awati County: Luthai was the first, and used to be the largest, BCI farm in China (9,967 ha). It transitioned 33 ha (0.3% of total land) of ELS cotton towards organic in 2018. Luthai is vertically integrated from farming to manufacturing. Luthai directly manages the part of the farm where the organic plot is located. They rent the rest of the land out to smallholder farmers.

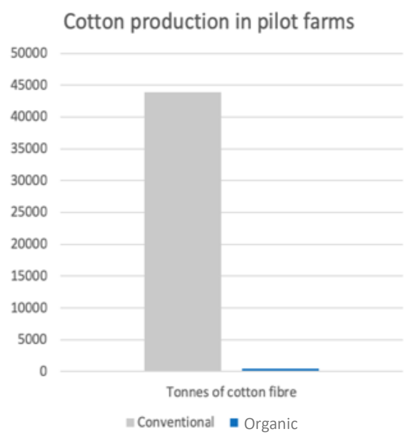

Figure 2: Percentage of cotton seed from the pilot farms produced conventionally

Farmers can benefit from agricultural models that reduce external inputs and costs. There is significant potential to improve local soil conditions and reduce GHG emissions from intensive cotton production. The two pilot farms are starting to explore the use of compost as an alternative to chemical fertilizers. Basic windbreak systems have been adopted by the majority of farmers.

The following sub sections highlights the two main climate-compatible agriculture practices - composting and agroforestry, which are selected based on current uptake in the region and higher likelihood of adoption.

2.2.1 Composting

With Rare, Jintian piloted over 300 tons of on-farm compost production prepared in open air conditions using mostly rice straw and ginning waste, which were then applied on their organic fields (application varied from 7.5 to 22.5 tons of compost per ha) in March 2018, which they have continued to do. The compost is rotated with the use of a tractor. Jintian farmers keep a written record of the quantities of materials being used in the compost (Figure 3).

Figure 3: Preparation of compost

In just six months, soil quality clearly improved, as evidenced below (Figure 4). By 2019, Jintian more than doubled their compost production to 820 tons (application at 11.55 tons of compost per ha). They are exploring the use of different mixes in order to identify a treatment that is most cost effective so that they can adopt composting in the long run.

Jintian mentioned that yield dropped slightly in the first year when they applied compost. However, for 2019, they are expecting to maintain/improve yields compared to fields where compost is not being applied. If this happens, Jintian mentioned that they would prefer compost to chemical fertilizer, as the latter damages the soil (they acknowledged that this is not a sustainable business model) and they would consider gradually expanding the use of compost to the whole farm.

Figure 4: Improvements in soil conditions from application of compost

Within two years of compost application, Jintian obtained the results shown in Table 1.

Table 1: Improvements in soil organic matter from application of compost

	Soil Organic Matter (SOM) %	pH
Pre-sowing (2018)	0.33	7.50
Post-harvest (2018)	0.38	7.86
Post-harvest (2019)	0.78	8.13

(Source: Lab-tested soil results)

After hearing about Jintian's compost experience, Luthai began producing 640 tons of compost in 2019 for their organic cotton plot using goat manure and ginning waste (application at 19.2 tons of compost per ha).

For both farms, organic land accounts for only a tiny percentage of their overall land size but compost application helps improve any soil, and can and should take place on any land, whether it is for organic or BCI. As such, this report looks at two different scenarios under composting – one fully organic scenario, and the other an improved scenario of gradually replacing chemical fertilizers with compost, on 8-15% of the farm's land over five years.

In the process of implementation, we faced the following issues which will be factored into the analysis of potential for scalability:

- **Timing**: Due to the long winter in Xinjiang (low temperatures in winter can reach around -20°C), the composting process only started after the last frost in mid- to late-March. The total duration needed for composting is at least four to six weeks, but cotton sowing starts in mid-April. Investing in a turning machine will greatly reduce labor intensity and enable year-round production of compost;
- **Availability of Materials:** Generally, farms in Xinjiang have a lot of brown materials like rice and cotton straw but not enough green materials like grass, fresh green leaves, kitchen waste, etc. As a result, a "strong starter" i.e. sugar beets and molasses are necessary to kickstart the microbial activity. Depending on when the compost is made, molasses may not be available or the price is too high;
- **Labor Intensity:** The process of making compost can be labor intensive without the right machinery or if the raw materials are not in the right form. For example, if rice or cotton straws are not properly cut, this may affect the quality of the compost, particularly in the application stage requiring manual spreading instead of using machinery;
- **Quality Control:** Each compost pile should be turned when the temperature and CO_2 level reach a certain benchmark. Providing training and ensuring farmers have the right equipment to measure the indicators help to ensure the production of quality compost.

2.2.2 Agroforestry

Agroforestry is a land use management system in which trees, shrubs and crops are grown together - either among each other or in different spatial arrangements. Initially, two models of agroforestry were considered for Xinjiang based on existing practices:

- **Intercropping with commercial food trees:** Rare and South Pole visited a farm that intercrops dates with cotton. Nut and fruit trees were highlighted as the most common species to be harvested together with cotton in an intercropping system, as is the case with one of Rare's other farm partners which intercrops pear with cotton. However, the cotton agroforestry system usually lasts for about eight years, when the trees become large enough that they make cotton harvesting difficult and farmers transition to fruit trees only. Because of this, we decided to focus on windbreak trees.
- **Windbreak:** Windbreak trees prevent soil erosion from strong winds, enhance carbon sequestration and can generate additional income for farmers, depending on the type of trees. Both Jintian and Luthai have established, single or double row of windbreak trees but they are mostly comprised of single-species white poplar trees (populus alba). On average, farmers would leave about 1.5 m between individual trees, resulting in an average density of 250 trees per ha, for each row of windbreak trees. This practice is common because Xinjiang is susceptible to strong windstorms. In general, the government recommends the adoption of this practice in 10% of the farm area. Both farms have windbreak trees at about 7% of their land now.

2.3 Potential for Scalability: Project Scenarios

Based on the lessons from the existing pilots and from the learning during the stakeholder engagement and site visit, the Consortium identified two main scenarios and two sub-scenarios for scaling up composting practices in the region.

The scenarios are defined by the level of implementation of composting practices and the adoption rate. As shown in Table 2, the Organic Scenario considers an ambitious adoption of climate-compatible agriculture practices where farmers transition to organic practices. The Improved Scenario considers a transition approach where farmers gradually adopt better agricultural practices. Both scenarios have two sub-scenarios depending on the rate of adoption from 8% to 15% of the land in five years which will have different cost and total GHG emission reduction implications.

Table 2: Characteristics of the proposed scenarios

	Organic		Improved	
Expansion rate	**8%**	**15%**	**8%**	**15%**
Composting	Full transition to organic. Farmers under this treatment are expected to fully replace the application of conventional fertilizers by applying a combination of organic fertilizers and compost.		Improvement from conventional farming. Farmers on this treatment are expected to gradually phase out the use of chemical fertilizers, by replacing these applications with compost.	
Windbreak	Improving the existing windbreak structures by increasing their density by 50% (from 250 trees/ha of established single-double row to 375 trees/ha)			

3 Potential for Emission Reductions

3.1 Methodology

Based on the interaction and previous work with local farmers, it was assumed that the expansion scenarios would follow an expansion rate of 8% to 15% over a five-year period of time, meaning that by year five, farmers would have adopted the improved cotton management system in 100% of the targeted land. The Consortium applied a 20% risk discount to the total expected GHG emission reductions in line with most certification requirements.

3.2 Emission Reduction Potential

3.2.1 Composting

Emission reductions from compost generation can be claimed if it is assumed that inputs to the composting process would otherwise be left to decay anaerobically in disposal sites, thereby resulting in the release of methane. However, the composting process itself can be a contributor to GHG emissions, namely of methane and nitrous oxide from composting, direct emissions from the use of fuels to operate machines at the composting site, and indirect emissions from electricity consumption.

Based on the local conditions in Xinjiang and data gathered during the site visits, the Consortium estimated methane emissions from anaerobic composting following similar patterns to those of solid waste disposal sites as described by the First Order Decay model (FOD)[2]. The Consortium calculated each main type of feedstock used in the composting process (rice straw, sugar beets, cotton leaf, ginning waste and goat manure) for each of the two pilot farms. With the exception of goat manure, all other inputs used in the composting process were assumed to consist of agricultural waste such as rice/cotton straw and ginning waste. By processing these into compost, methane emissions would be avoided. Emission reductions from goat manure were estimated based on Equation 5 of the CDM methodology AMS-III.D, “Methane recovery in animal manure management systems”[3].

The FOD model was calculated for a period of 20 years in order to take into account the methane release of slowly degrading inputs such as those used on this composting process in each of the farms. Average annual values were used to estimate the potential contribution or reduction of GHG emissions under the five-year span of the project. Table 3 summarizes the results of the emission reductions calculations from compost generation.

Table 3: Estimated contributions to GHG emissions from the generation of compost in organic pilots

Farm	Size (ha)	Total application of compost (t/yr)	Average GHG contribution on a 5-year interval (tCO2eq/ha/yr)
Jintian	66	568	-0.12
Luthai	33	660	1.7

Jintian and Luthai’s emissions reductions differed significantly, which is mainly a result of materials used to produce compost. As shown in Table 3, only the compost generated in Jintian has had a net GHG emission reduction of 0.12 tCO2eq/ha/yr. The materials used to produce the

2 This is also to address the lack of a CDM approved methodology that could specifically be used to calculate emission reductions from a change in composting method. Nonetheless, the physio-chemical processes of anaerobic composting are similar to those occurring in solid waste disposal sites, and therefore the FOD was considered an acceptable method to reasonably estimate GHG emission reductions from anaerobic composting.

3 https://cdm.unfccc.int/methodologies/DB/H9DVSB24O7GEZQYLYNWUX23YS6G4RC

compost in each of the farms contributed to the difference in these net GHG emission reductions. In Luthai, goat manure represented 90% of the compost ingredients. As this material has a very low methane conversion factor according to CDM's methodology, the emission reductions from composting it are not greater than the direct and indirect emissions associated with the composting process. However, the application of compost in both farms is expected to reduce GHG emissions by displacing direct and indirect GHG emissions associated with the use of chemical fertilizers (Table 4), as well as sequester carbon by increasing SOM (Section 3.3.2). Emission reductions associated with the application of compost were estimated through the use of the Cool Farm Tool, using primary data from the pilot farms.

Table 4: Average GHG emissions and reductions from replacing chemical fertilizers with compost in the organic and improved cotton scenarios

Activity	Baseline (tCO2eq/ha)	Organic (tCO2eq/ha)	Improved (tCO2eq/ha)	GHG reductions Organic (tCO2eq/ha)	GHG reductions Improved (tCO2eq/ha)
Residue Management	1.01	0.79	0.79	0.22	0.22
Fertilizer Production	2.11	0.03	1.27	2.08	0.84
Fertilizer Application	1.11	0.52	1.00	0.61	0.12
Total	**4.23**	**1.34**	**3.06**	**2.91**	**1.17**

As seen in Table 4, the Consortium identified that compost generation and application would result in net GHG emission reductions in both the organic and improved scenarios. The organic scenario has a greater potential to reduce GHG emissions, as chemical fertilizers are fully replaced. In total, the organic scenario has the potential to reduce around 2.91tCO2eq/ha per year, while the improved scenario could reduce around 1.17 tCO2eq/ha per year. The potential GHG emission reductions from scaling up both scenarios can be found in Section 4 of this document.

3.3 Carbon Sequestration Potential

3.3.1 Windbreaks

As described in Section 2.2.2, the pilot farms already have established basic windbreak structures, mostly composed of white poplar trees. Based on the site visit and interviews with key stakeholders in China, the Consortium suggests improving the existing windbreak structures by increasing their density by 50% (from 250 to 375 trees/ha).

The Consortium estimated carbon sequestration from the improved windbreak scenario by using IPCC Good Practice Guidance for LULUCF and peer reviewed literature on the characteristics of poplar trees (i.e. stem volumes, height, lifetime). The Consortium assumed an annual mortality rate of 1% based on sources above. The Consortium estimated the sequestration potential of the improved windbreaks systems of increased density was a total of 12.94 tCO2eq (10.79 after a 20% risk adjustment).

3.3.2 Increase in Soil Organic Matter (SOM)

As described in section 2.2.1, the pilot farms have already experienced improvement in the proportion of SOM from compost application. The Consortium used primary data on the application of compost from the pilot farms together with the Cool Farm Tool to estimate carbon sequestration potential from this activity. It was estimated that on average, changes in carbon stocks from the application of compost would result in a sequestration of up to 2.91 CO2eq/ha (2.33 after a 20% risk adjustment).

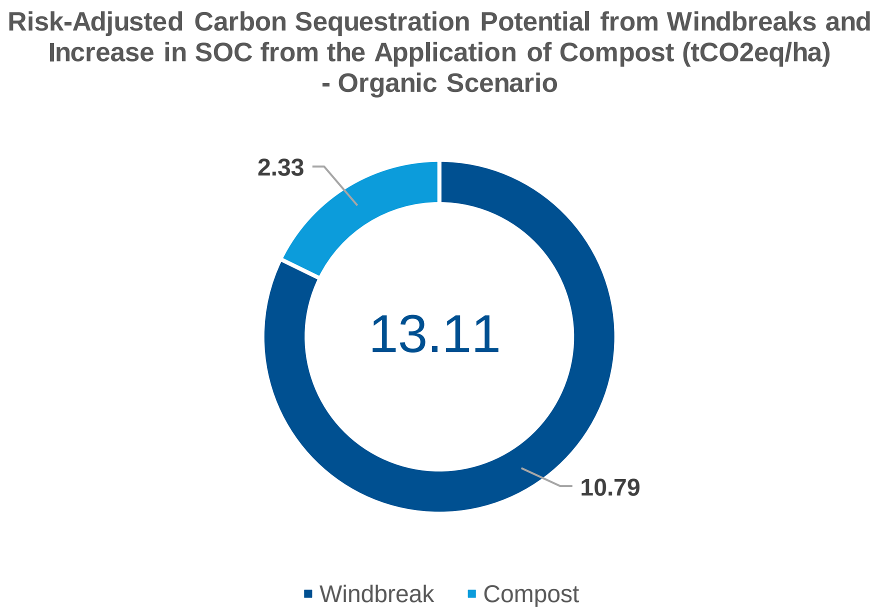

Figure 5: Total sequestration potential (organic scenario)

4 Cost Model and Potential for Scalability

The cost model considers investment costs associated with:

Cotton production in the proposed scenarios (i.e. fertilizers, compost, improved windbreaks, production losses):

- The costs of compost include costs and inputs associated with compost production and application such as diesel consumption, labor, on farm and off farm agricultural materials and others.
- The costs of improved windbreaks include seedling acquisition, planting, watering and maintenance activities.

Third party services (i.e. annual soil analysis, third party audits at the beginning and end of the project, and consultancy services):

- Consultancy services by South Pole include a simplified design document, capacity building and technical support, quality check on local monitoring, GHG estimations and reporting, project management, and annual travel expenses for two staff members.
- Consultancy services by Rare include providing farmer training and technical support together with local experts, ensuring implementation of practices and provision of quality data from farmers for monitoring and reporting purposes, stakeholder management including with CCIA to ensure mainstreaming of practices into local government and industry's priority and policies as well as coordinating any purchase agreement needs with brands/retailers.

Other assumptions:

- Based on yield data from the organic pilot farms, it was assumed that under this model, farmers would experience a 10% reduction in yield during Year 1 and 5% during Year 2. Yield would normalize from Year 3 onwards. No production losses are expected in the improved scenario.
- The Consortium's recommendation to minimize losses is to start with high levels of application of chemical fertilizers and compost and then gradually reduce these as the soil condition improves. Based on the latter, the scenarios consider an annual reduction on the inputs of compost of (12.5%) and fertilizers (12.5%) from Year 2 onwards. This is based on the primary data and observations by the farmers.

Table 5 summarizes cumulative costs of the organic and improved models for five years, on an 8% and 15% expansion rates covering between 866 ha to 1,585 ha and an estimated total annual production of 500 to 2,000 MT of Extra Long Staple cotton lint.

Table 5: Total cost of conversion to organic and improved scenarios (5 years)

	Organic (expansion scenarios)		Improved (expansion scenarios)	
Type of cost (total cumulative for 5 years)	**8%** (866 ha)	**15%** (1,585 ha)	**8%** (866 ha)	**15%** (1,585 ha)
Costs of project scenario (total) (A)	**4,298,413**	**7,251,526**	**2,780,477**	**4,660,534**
Production costs	**3,786,217**	**6,739,329**	**2,268,281**	**4,148,338**
- Fertilizers	2,401,439	4,206,492	1,177,267	2,153,040
- Compost	880,198	1,609,746	880,198	1,609,746
- Production losses	293,764	537,540	-	-
- Improved windbreak	210,816	385,552	210,816	385,552
Third party costs	**512,197**	**512,197**	**512,197**	**512,197**
- Soil analysis	2,520	2,520	2,520	2,520
- Consultancy costs (Rare)	250,053	250,053	250,053	250,053
- Consultancy costs (South Pole)	230,224	230,224	230,224	230,224
- Third party audits	29,400	29,400	29,400	29,400
Cost of business as usual (BAU) (B)	**1,902,426**	**3,479,307**	**1,902,426**	**3,479,307**
Costs of conversion to project scenario (additional cost from BAU) (A) – (B) = (C)	**2,395,987**	**3,772,218**	**878,051**	**1,181,227**
Total emission reductions under project scenario (D)	**40,157**	**73,433**	**36,548**	**66,843**
EUR/tCO2eq (C) ÷ (D)	**$60**	**$51**	**$24**	**$18**

The Consortium identified that the cumulative cost of conversion from BAU to the suggested project scenarios for five years ranges from EUR $878,051 to $3,772,218, as shown in Table 5. The organic scenario has higher costs than the improved scenario as the cost of organic fertilizers in the region is still higher than the one for chemical fertilizers. Additionally, costs for the organic scenario include a compensation for yield decreases of 10% and 5% during the first and second years of the treatment.

The Consortium identified that expanding the suggested scenarios would translate into cumulative GHG emission reductions of between 36,548 tCO2eq and 73,443 tCO2eq. The organic scenarios have a higher emission reduction potential, as described in section 3.2. The estimated price per tCO2eq from the expansion of the pilots is between EUR $18 and $60, with the improved scenarios being the most cost-effective when solely looking at GHG emission reductions. This assumes a 100% compensation for farmers' additional costs and production losses, but this can be negotiated on a case-by-case basis especially when there are purchase agreements in place.

From a farmer perspective, the Consortium expects the cost of fertilizing under both scenarios to be lower than conventional in Year 5 as illustrated in Figure 6 below.

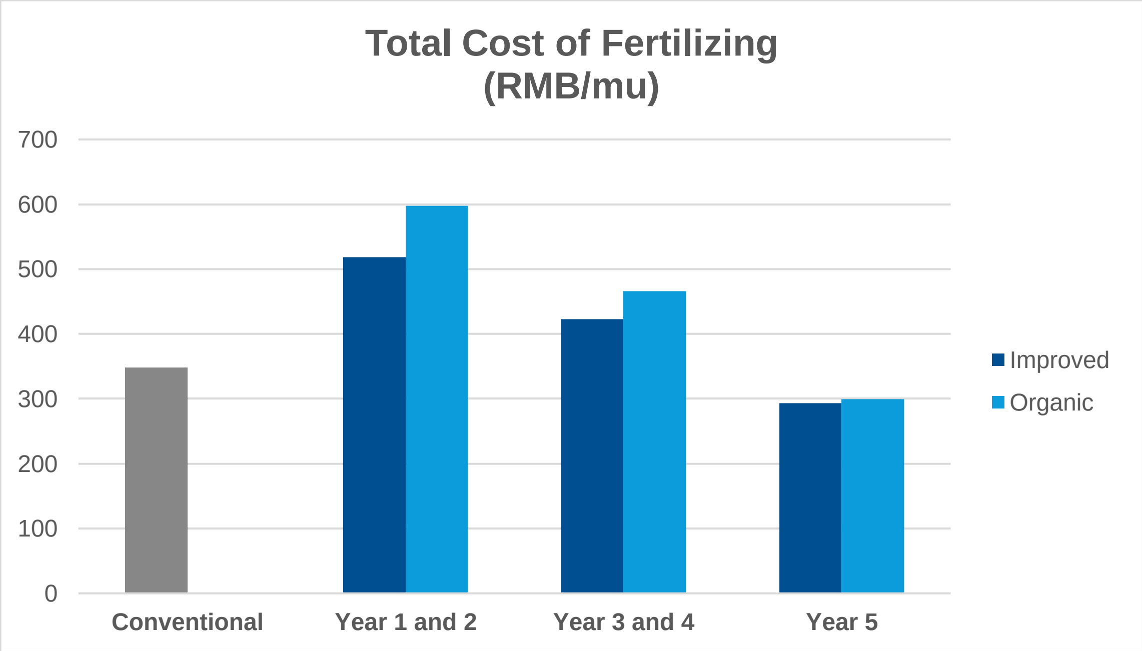

Figure 6: Total cost of fertilizing for farmers under both scenarios compared to conventional

5 Carbon Markets and Science-Based Targets

Several companies with agricultural supply chains have developed GHG emission reduction projects within their value-chain. However, there is still no agreed upon methodology to report progress on these as part of the GHG Protocol and Science Based Targets Initiative. The Consortium suggests to brands/retailers to follow monitoring recommendations by Gold Standard's Value Change program, which is currently looking to achieve 'Built on GHG Protocol' standard, which would align it with the GHG Protocol and Science Based Targets Initiative[4]. The approach suggested by the Value Change program follows a five-step approach, as seen in Figure 6:

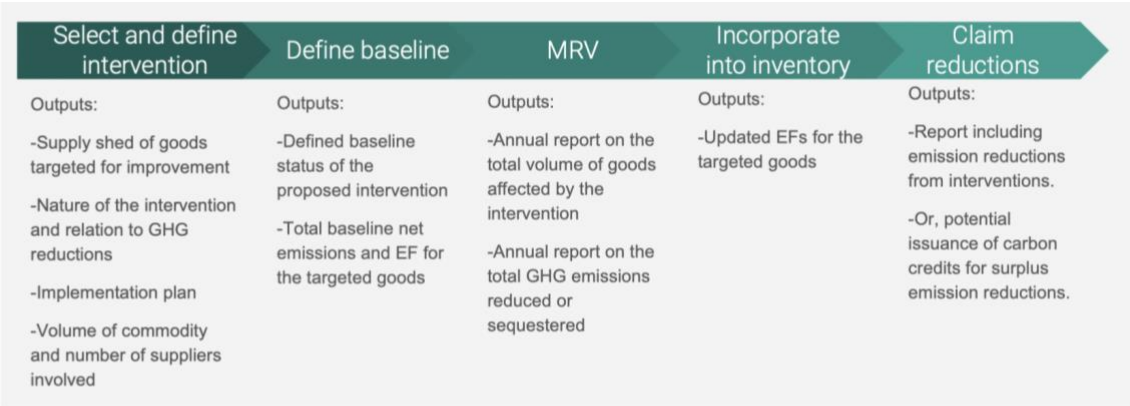

Figure 7: Value Change's framework to account for emissions within supply chains

Monitoring, Reporting and Verification (MRV) is the third step of the approach. For brands/retailers wanting to pursue carbon insetting projects, the Consortium suggests to use primary data from the pilots in combination with peer reviewed and industry agreed-upon methodologies and standards (i.e. CDM, IPCC, Gold Standard) to establish a baseline emission factor for cotton production on the farms, and monitor progress against it. The Consortium suggests to conduct monitoring and reporting on an annual basis, and be transparent regarding assumptions and potential uncertainty regarding the estimations, particularly those for carbon sequestration through increments in SOM.

Monitoring practices should include those related to the farmers own data collection systems (i.e. composting inputs and other parameters, agricultural inputs) as well as third party services including soil tests and third-party audits. The Consortium suggests to carry out two third-party audits, during years one and five of the eventual project implementation.

Assuming that Kering's brands would be sourcing cotton from the proposed projects under the MRV process described above, Kering would be able to effectively claim a reduction on its emission factor (EF) associated with cotton purchases from China. Results from this project suggest that Kering's EF for conventional cotton could be reduced from 22% (improved scenario) to 55% (organic scenario). The specific share of emissions that could be reduced would depend on the actual results during an eventual implementation of the project, as well as the current EF being used by Kering to account for its emissions associated to cotton sourcing from the region, as part of its Environmental Profit and Loss framework.

4 https://www.goldstandard.org/sites/default/files/documents/2018_09_scope_3_guidance_testing_draft_v1pdf.pdf

6 Risk Assessment

A simple yet effective approach was applied to identify and assess risk elements and define risk mitigation strategies. This method identified risk elements based on the information gathered through desk research, interactions with key stakeholders during the site visits, as well as feedback from the farmers.

Each risk identified was then classified according to its likelihood: unlikely 1 to highly likely 3; and severity: low severity 1 to high severity 3. Based on this, risks are classified as priority A-C, as shown in Table 6. Scores 1-2 are considered priority C, scores 3-5 are considered priority B and scores 6-9 are considered priority A. As a guideline, priority A risks should be avoided, priority B risks should be reduced or monitored while priority C risks should be monitored or ignored.

Table 6: Example of risk assessment matrix

	Likelihood			
Severity		**Highly likely (3)**	**Likely (2)**	**Unlikely (1)**
	High (3)	A (9)	A (6)	B (3)
	Medium (2)	A (6)	B (4)	C (2)
	Low (1)	B (3)	C (2)	C (1)

6.1 Results

The Consortium has divided risks into three categories: Implementation, Methodology and Impact. Table 7 summarizes results from the risk assessment.

Table 7: Results from risk assessment

Type of risk	Description of risk	Priority	Risk mitigation	Likelihood	Severity
Methodology	Lack of an MRV methodology that is fully aligned with the GHG methodology	A	Follow recommendations by Gold Standards' 'Value Change Program', and 'Accounting for Natural Climate Solutions' on best practice for Scope 3 accounting and reporting, which is applicable to insetting projects Participate in Gold Standards' Value Change Textiles Working Group which will look into testing, capacity building and piloting interventions that can help partners upstream reduce emissions	2	3
Implementation	Limited capacity on the ground	A	Rare's Xinjiang staff plus local experts and CCIA's involvement ensures capacity on the ground	2	3
Impact	Permanence of climate-compatible agriculture practices beyond project duration	A	The key here is to help farmers reach economic parity between climate-compatible agriculture and conventional practices through the carbon price and having CCIA include	2	3

Type of risk	Description of risk	Priority	Risk mitigation	Likelihood	Severity
			these practices as part of their standards		
Impact	Limited impact on soil organic matter	B	Two-years of soil data from Jintian shows consistent increase in soil organic matter	2	2
Implementation	Willingness of farmers to adopt climate-compatible agriculture practices	B	Showcasing the results of the best practices from existing farms, CCIA's endorsement of the practices and having brand interest and purchase agreement will increase the willingness of farmers to adopt the climate-compatible agriculture practices	2	2
Impact	Carbon reductions/ sequestration is not delivered as expected	B	Discount is in place already	1	3
Implementation	Quality of compost may vary and potentially affect yield	C	Ensuring that farmers receive sufficient training and technical support for a few rounds of compost making is key to refine and optimize the procedure from a cost and quality perspective (including trialing of different materials to find the best "recipe") Investment in a turning machine enables farmers to make large-scale compost year-round (ideally from April to November) instead of only during the off-peak season (in March and December) when the temperature is low, which may affect quality	1	1
Implementation	Compost is not ready in time for sowing	C		1	1

7 Conclusions and Recommendations

The Consortium identified that applying compost and developing improved windbreak tree systems represent opportunities to reduce GHG emissions from chemical fertilizer application, to sequester carbon and improve soils. From a brand perspective, the potential benefits from an insetting project are outlined as follows:

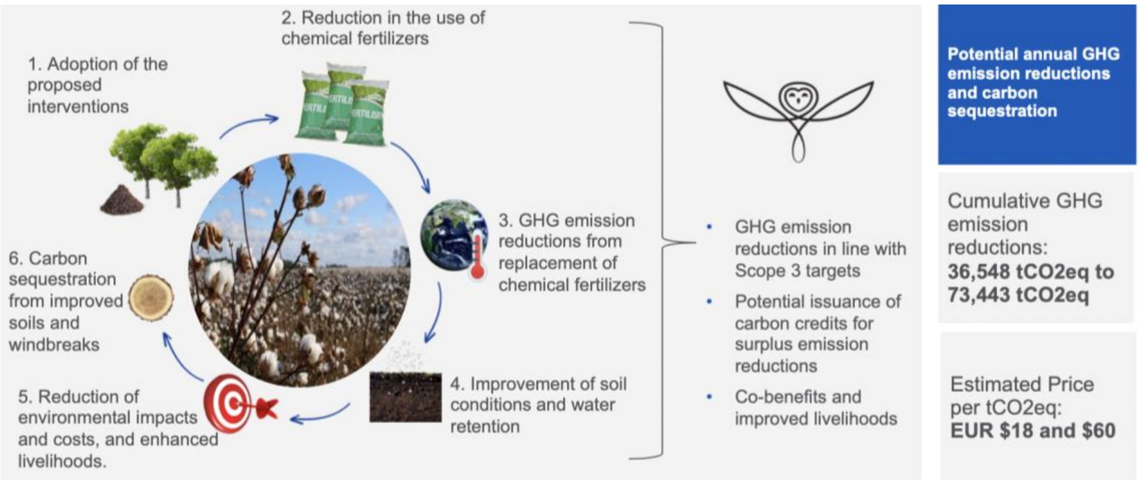

Figure 8: Illustrative an insetting project

When looking solely at GHG emission reductions, the improved scenario is the most cost-effective. However, the adoption of the organic scenarios would contribute more to a series of co-benefits for farmers and nature, such as water management, soil fertility management, biodiversity conservation and others (although an in-depth assessment of impacts on co-benefits is beyond the scope of this report). A recent assessment by Cotton Up and Cotton Connect on the benefits from different sustainable cotton standards, suggests that the transition to organic models can result in water savings of between 16% and 20%. Based on these estimates and primary data on irrigation that farmers in Jintian and Luthai provided, a transition to an organic model in these locations could reduce water consumption by $98m^3/ha$[5].

The Consortium believes that more and more farmers will adopt such practices at scale if soil improvement practices are more intentionally promoted within both BCI and organic systems and are tied to short term impact like physical soil improvements that are visible to farmers, as well as longer term impacts like SOM increase. At the same time, highlighting the best practices of farmer champions like Jintian and Luthai, together with credible key local partners like CCIA, will help to reduce the risk aversion among farmers. Farmer training and technical support need to complement these practices for at least two compost cycle until farmers obtain the right mix of materials and cost, and optimize the process.

However, it is important to note that beyond compensation for additional costs or production losses, farmers would like to see direct market linkages with brands/retailers. Lack of access to markets with a clear demand for in-transition cotton has been one of the major challenges that farmers currently transitioning towards organic face. Therefore, a carbon insetting model as outlined in this report, offers a potential roadmap that can meet the needs of both farmers and brands towards having a positive impact of building resiliency and restoring ecosystems.

[5] It should be noted that farmers have not kept regular records of water consumption, therefore a proper baseline should be established before being able to account for potential water reductions.

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