Climate Change and Tea

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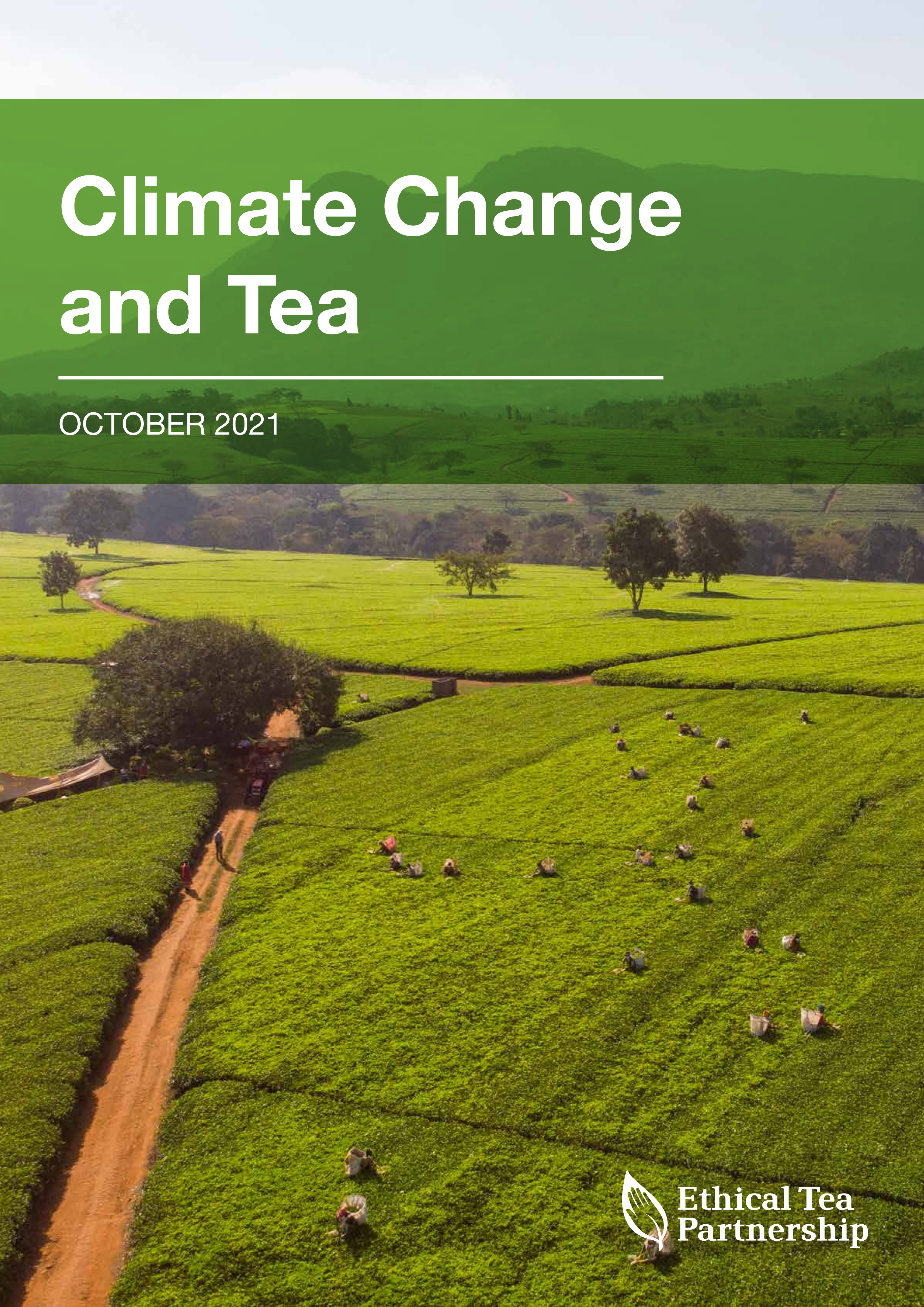


Ethical Tea Partnership

Introduction

Tea is the second most consumed drink globally after water. It is one of the most widely grown cash crops in the world and is planted in 58 different countries spanning across all five continents. The industry is estimated to be worth $20 billion and plays a major role in rural development, poverty reduction and food security.[1]

Climate change is having serious implications for the tea sector and for the farmers and communities who rely on it for their living. Its effects will impact how and where tea can be grown and pose a significant threat to the livelihoods of millions.

This briefing document pulls together data points from third party sources to shed light on the environmental footprint of Camellia sinensis (the tea plant) and where emissions occur in its lifecycle. It also looks at the impacts of climate change on crop yields and livelihoods and the adaptation measures that can be taken to address them.

Tea production alone employs 13 million people globally

nine million of whom are smallholder farmers, while the rest work on tea estates.[56]

The impacts of climate change are already being felt on agricultural systems, with the worst of its effects being felt in developing nations, where tea is usually produced. These include temperature changes and unpredictable and extreme weather events such as heavy rain, drought, hail, and frost. Smallholder farmers are disproportionately vulnerable to these changes because of high poverty levels and a reliance on natural resources for their income and to feed themselves and their families.

Building farmers' resilience to climate change through adapting farming practices, improving access to better tea clones, and decreasing their dependency on tea, is thus becoming increasingly important as climate change persists. The Ethical Tea Partnership (ETP) supports farmers across the globe to adapt their farms and farming practices to deal with climate change Our programmes improve farmers' incomes and resilience to climate shocks as we support them in diversifying their income streams, creating savings opportunities, and helping them develop their business skills.

Mitigation and adaptation

Climate change mitigation and adaptation are both ways to address climate change and it is important to understand the difference between the two.

Climate change mitigation is classed as any activity that reduces the concentration of greenhouse gases (GHG) - the gases responsible for climate change - in the atmosphere.

In the tea sector, mitigation can include a number of different activities, including improving energy efficiency in tea factories, enhancing access to renewable energy sources, educating farmers on correct fertiliser use, and changing consumer behaviour to name just a few.[57]

Through investing in mitigation measures that reduce emissions, such as switching to low carbon energy sources or expanding forests that reduce carbon, the scale of climate change and its impact on livelihoods can be minimised.

Climate change adaptation describes activities that help manage the social, environmental, and economic impacts of climate change. In other words, adaptation activities reduce a population's vulnerability to climate change. Because tea farmers are already feeling the effects of climate change, adaptation is already needed on the ground. Adaptation measures include planting drought and frost tolerant clones, diversifying sources of income, and effective soil management. However, as the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) confirms, the climate will continue to change over the coming decades and therefore adaptation needs to be a process of change that is applied in response to a continually changing environment.

Importantly, both mitigation and adaptation often go hand in hand. If energy-saving is addressed, this can free up finance for investing in adaptation, whereas mitigation measures, albeit on a large scale, will lessen the need for adaptation.

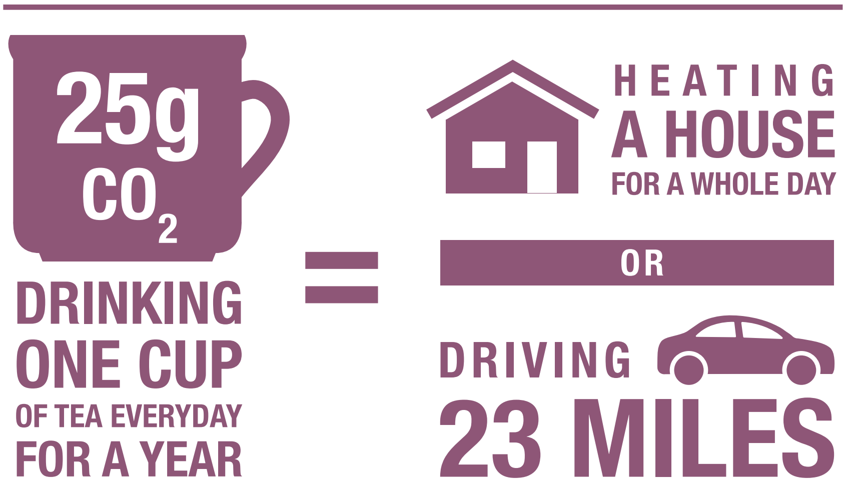
Emissions in the tea sector

Tea has a relatively low carbon footprint when compared to other crops. However, hot beverages produce substantial GHG emissions not just in the cultivation and production phases, but also from preparation by consumers.

Although the ‘cradle to grave’ (i.e. from growth right up to the disposal of the product) carbon footprint of tea varies by region, drinking one cup of black tea per day is said to contribute around 9kg of emissions per year, or approximately 25g CO_2 per cup.[2] This is the equivalent to the emissions produced when heating a typical house in the UK for a whole day or driving a petrol car 23 miles.

By comparison, coffee’s product carbon footprint (PCF) is significantly higher than tea, producing up to ten times the amount of CO_2 emissions.[3] This can be explained by differences in cultivation yields and processing methods and a higher amount of coffee berries compared to tea leaves required to produce a kilogram of finished product.

The key hotspots for greenhouse gas emissions in the life cycle of tea include fertiliser use during cultivation, energy use during manufacturing, and electricity use when consumers boil their kettles.[4]



Emissions at farm level

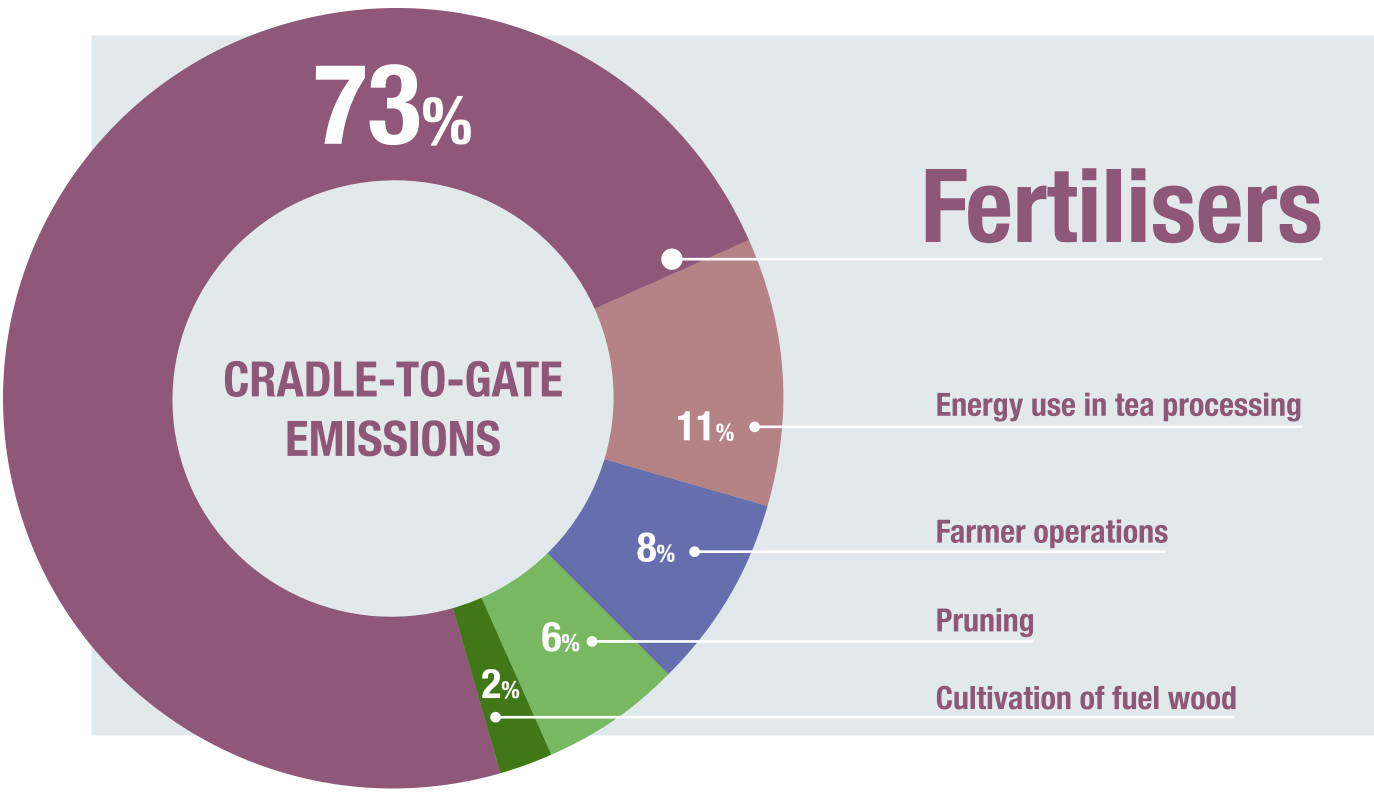
Chemical fertilisers are usually the main source of greenhouse gas emissions at the farm level. After they are applied, excess fertiliser either runs off into waterways or is broken down by soil, releasing the greenhouse gas nitrous oxide (N_2O) into the atmosphere.

Agriculture is responsible for the majority of N_2O emissions, and despite only making up a fraction of global emissions, it has a global warming potential 300 times that of carbon dioxide.[5] In addition, chemical fertilisers require a significant amount of heat energy during their production, and this is usually obtained from fossil fuels.

In China, fertiliser production alone accounts for 32% of tea's emissions from when it is grown to the point it reaches the factory gate (also known as cradle-to-gate emissions).[6]

As well as this, fertilisers require their own packaging and transport, which further contributes to emissions. In Kenya, a study by Unilever that looked at management interventions to mitigate emissions during tea cultivation, showed that fertiliser use (including its production, application, packaging, and transport) contributes to 73% of tea's emissions before its exported. Promoting the use of natural fertilisers, as well as the judicious application of chemical fertilisers, is therefore an important way to mitigate the environmental impact of tea.

The study, which focused on tea's cradle-to-gate emissions in Kenya, also found that after fertiliser, energy use in tea processing was the second highest contributor to emissions (11%), followed by farmer operations (ploughing, pesticide use, harvesting and transport of leaves to factory) (8%), pruning (6%), and the cultivation of fuel wood (2%).[7]



Emissions at factory level

Beyond the farm, the processing and production of tea requires a substantial amount of electrical and thermal energy. Producing one kilogram of tea takes around 3-6 kWh of thermal energy — supplied either by fuelwood or coal — and 0.2-0.5 kWh of electrical energy from national grids and diesel generators.[8] This is about the same amount of energy an electric car uses to travel between 10–20 miles (16-32 kilometres).

Thermal energy is used in factories to wither and dry tea leaves and is typically obtained from burning fuel wood, releasing greenhouse gas emissions. At the same time, electrical energy is used to power motors for tea processing, fans for the withering and drying and motors for sorting and grading the tea. Lighting the factories also requires a small amount of electricity.

Fans alone often account for around 40% of the total electricity consumption in factories; however, due to the outdated and inefficient equipment often seen in factories, it is possible to reduce this to just 10% if modern fans are installed.[9]

The environmental impact of fuelwood use in tea production varies depending on its source. If sourced from sustainably managed plantations, fuelwood can be a renewable energy source. This is because forests remove carbon from the atmosphere during photosynthesis, meaning there is potential for the amount of carbon released from deforestation and combustion to equal the amount of carbon forests take in. For this to be the case, the amount of fuel wood used must be the same as the amount grown on a year-by-year basis.

Consumption

Boiling water is the most significant component of the overall ‘cradle to grave’ emissions from tea. A study that looked at UK consumption of Kenyan tea showed that emissions from the ‘consumption phase’ are mostly made up from water and electricity used for tea preparation and account for up to 85% of the total environmental impact from ‘cradle to the grave’. This compares to just 10% for cultivation and processing combined.[10]

The study also stated that the environmental effects of tea consumption could be 2–3 times higher if consumers boil more water than needed.[11] The Smart Boil Campaign, led by the UK Tea and Infusions Association (UKTIA), acknowledges this and encourages consumers to become ‘Smart Boilers’ and switch to renewable energy sources in their homes.[12] Energy efficient kettles and product efficiency labelling that helps consumers make more sustainable purchasing decisions can also help reduce emissions.

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Impact of climate change on livelihoods

Tea is one of the most important cash crops worldwide and plays a significant role in rural development, poverty reduction and food security in developing countries.[13] Due to tea's dependence on stable temperatures and consistent rainfall, climate change poses a significant threat to the livelihoods of millions of tea workers and farmers, many of whom are already feeling its impacts.

Unusual weather patterns caused by climate change are creating challenging growing conditions for tea producers, resulting in declining crop yields and poorer quality tea that must be sold at a lower price. To address these issues, producers are using more fertilisers and pesticides and are having to invest in adaptation measures such as irrigation and drainage systems to reduce damage from heavy rainfall and drought. These measures have increased production costs and will continue to do so as climate change worsens [14]

Among tea communities, women and their children are particularly vulnerable to the effects of climate change because of unequal access to resources and decision-making processes regarding mitigation and adaptation measures. This, combined with the higher levels of poverty that we see among women, means that they are often disadvantaged in dealing with the adverse impacts of climate change.[15]

Moreover, climate change is affecting the growth of sustenance crops grown by farmers for consumption by themselves and their families, causing a severe threat to food security in tea-producing countries. Smallholder tea farmers are among the highest risk due to limited resources and capacity to deal with shocks. This means that any reductions in crop yields can significantly impact their food security, nutrition, and health. For example, studies indicate that even moderate temperature increases will negatively affect the growth of maize, which is typically the main cereal crop of smallholder tea farmers.[16]

Some of the key issues faced by tea farmers include:

- abnormally high temperatures during the daytime and extended dry seasons;
- abnormally cold temperatures at night and extended cold seasons;
- increasing occurrences of pest attacks and diseases that were less active in the past;
- regular and prolonged droughts, reducing the quality and quantity of tea produced;
- heavy rains and landslides, causing soil erosion and reducing farmers' accessibility to local markets;
- frosts and hail in areas not previously affected, killing bushes, and reducing quality; and,
- unpredictable and changing seasons resulting in delayed rainfall, making it difficult to manage farms.

Rising temperatures

The IPCC report suggests that the world will experience more heatwaves, longer warm seasons, and at least a 1.5°C rise in global temperatures over the next two decades; with the potential for heat extremes to reach critical tolerance levels for agriculture.[17] Such instances of extreme temperatures, particularly in excess of 30°C (86°F), are damaging for tea growth and can result in devastating crop losses when accompanied by low humidity.[18]

Studies in Assam have found that an additional one degree above an average temperature of 28°C reduces tea yields by around 4%.[19] Similarly, research in Sri Lanka has indicated that one degree increase in average temperature will cause a 4.6% reduction in yields.[20] High temperatures and intense sunlight can also cause damage to tea leaves and dry out the soil, decreasing the overall quality and taste of the product and making it more difficult for farmers to sell.

In addition, there is a strong association between increasing temperatures and the prevalence of pests and plant diseases.[21] Higher temperatures have been linked to faster bug population growth and a greater risk of attacks.[22] The 'tea mosquito bug' is a concern to tea farmers globally and has been responsible for crop losses in Africa and Asia.[23] Eighty per cent of tea-growing areas in India are now affected by this, and it is estimated to cause up to a 50% reduction in annual yields.[24]

Rising temperatures have increased pest attacks.

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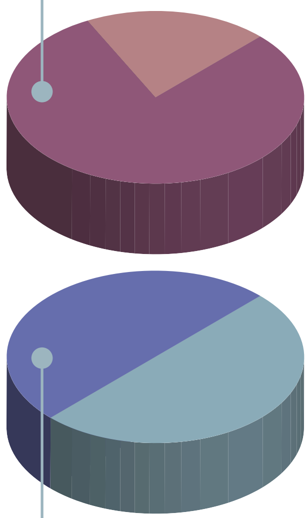

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Heavy and irregular rainfall

Changes in the reliability and consistency of rainfall also have damaging consequences for tea yields and quality.[25]

Due to human-driven climate change, rains are becoming increasingly heavier and are more likely to wash away soil, destroy tea bushes and cause landslides and flooding.

Damage is greater on croplands along hill slopes, a typical feature in tea growing regions, and can lead to reduced yields as topsoil (the section of soil rich in organic matter and nutrients) is lost to the lowlands.

In Assam, increased instances of intense rainfall and variations in rainfall patterns have also impacted tea yields.[26] Estate managers have noted how this has caused delayed growth and waterlogged fields, affecting the profits during the first and second harvests.[27]

Wet conditions also dilute the compounds in tea that determine its quality and favour. Concentrations of these compounds can be halved during periods of heavy rain, resulting in poorer quality tea and a lower market price, putting pressure on income and wages.[28] Tea harvested during the monsoon season and periods of heavy rain can result in a 50% decrease in farmers' householder income from tea sales.[29] On top of this, Inconsistent rainfall creates additional challenges for farmers, such as uncertainty in when to apply fertilisers.[30]

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Drought

Combined with lower overall precipitation rates, rising temperatures cause evaporation, which reduces surface water and dries out the soil. Although droughts' effect on tea quality can be managed, lower soil moisture decreases the rate of photosynthesis, limiting the growth and yield of tea crops.[31] Droughts have become more common in nearly all major tea growing countries, including India[32], Kenya[33], Sri Lanka[34], and China[35].

In Assam, one of India's wettest states, tea estates received less than 50% of the rainfall required during the first harvest period in 2021[36]

and 18% less rain than usual between June and September 2021.[37] Correspondingly, a recent study across India showed that 81 out of 135 tea estates surveyed suffered significantly lower yields because of drought between 2018 and 2020.[38]

Tea producers in Kenya have experienced similar, with droughts causing average reductions in tea yields of between 12-20%.[39] Lower yields have caused wide-ranging financial losses across the value chain, resulting in lower incomes for smallholders and reducing the amount of work for tea pickers – who are often the most vulnerable and lowest paid in the supply chain.

Hail and Frost damage

It is anticipated that hailstorm intensity will increase with climate change due to changing moisture levels in the atmosphere.[40]

Evidence has shown that hail causes severe and long-lasting damage to tea bush stems, killing bushes and making future plants more susceptible to pests and diseases. As a result of hail damage, Kenyan tea growing areas Kericho, Sotik and Nandi Hills are already estimated to suffer a net loss of 2.7 million kilograms of tea leaf per year.[41] In some instances, hail damage has suspended tea plucking for several months in Kenya.[42]

Frost damage is also becoming increasingly common in these areas and is having devastating effects on yields. The Kenya Tea Development Agency (KTDA) – an organisation responsible for over 600,000 smallholder farmers in Kenya, recorded $9.6 million worth of losses within a week following an extreme frost event in January 2012.[43]

Farmers commonly lack the resources and management systems needed to mitigate these impacts and have thus had to bear the burden of losses from frost and hail damage.

Future predictions

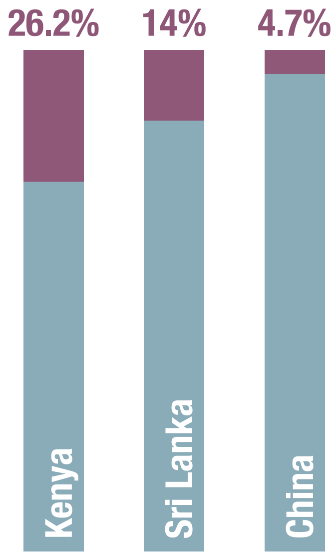
To understand the extent of the problems climate change will impose on tea production, various modelling has been developed to assess the future climatic suitability of tea growing regions. Studies have shown significant declines in suitability for most major tea producing countries by the middle of the century.

By 2050, the optimal suitability of tea growing regions in Kenya, Sri Lanka and China will be reduced by 26.2%, 14%, and 4.7%, respectively, and by 2070 suitability in Sri Lanka will decline by nearly 30%.[44]

Significant climate changes are expected even in a best-case emissions scenario, but if action is not taken to curb our impact, effects will be even more devastating for the millions that depend on the sector.

For example, the Kenyan tea industry – the largest supplier of tea to the UK - offers direct or indirect employment to over 10% of the population, generating roughly 26% of the total export earnings,[45] while in Sri Lanka, the tea industry supports around 2 million people, about one-tenth of the total population.[46] However, with improved clones and agricultural practices (climate change adaptation), it may be possible to grow tea in areas identified as unsuitable.

By 2050, optimal tea growing areas could decline by



Climate change adaptation

The inevitability of climate change means that without implementing adaptation measures, tea yields and incomes will continue to decrease. Smallholder tea farmers in rural areas such as the tea-growing regions of Kenya will be heavily impacted unless action is taken to improve awareness and address climate challenges using locally appropriate solutions.

Those that depend on tea for a living tend to have lower resilience to climate impacts due to limited financial and technical help to support adaption.

ETP helps farmers and producers understand how climate change will affect tea growing regions and develop and implement approaches to adapt to its impacts.

This involves working closely with communities to adapt farming practices, improve and diversify incomes and build resilience to the imminent threat caused by climate variability and change.

Adaptation measures vary in type and size depending on the unique context of a community and can range from changing agricultural practices to improving business skills. In partnership with the German development agency, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), ETP has developed a training manual to support tea farmers to implement climate change adaptation activities.[47] Below are a few examples of adaptation measures that can be taken to improve resilience and protect livelihoods.

Adapting farming practices

Heavy rains and droughts caused by climate change will accelerate soil erosion, stripping away nutrients and reducing the yields of tea and food crops. Activities that reduce soils susceptibility to erosion and waterlogging are thus an important method of adaptation.

Helpful soil management methods include protecting soil in tea farms and kitchen gardens against the extreme weather with cover crops and mulch and applying compost as an alternative to chemical fertiliser. Compost not only provides a steady release of nutrients that are important for growth, but it also improves soil structure, drainage, and the amount of water the soil can hold. This lowers the risk of soil erosion and creates resilience against intense rainfall caused by climate change.[48]

Correct soil drainage can effectively support livelihoods during climate change, with optimal drainage estimated to boost tea yields by up to 50%.[49] Installing water management systems and drainage channels will therefore become crucial as climate change persists. Still, it is important to acknowledge that farm improvements like these will greatly increase production costs, thus posing a risk of lower incomes for farmers.[50]

Drought resilient clones

Using drought and frost resistant tea clones is another cost-effective and environmentally friendly measure for farmers and producers to adapt to climate change.[51]

New clones developed by tea research institutes have been shown to perform well during drought and frost and show better resistance to pests and diseases. These clones typically have a higher water use efficiency than regular clones, which means they can still produce a substantial yield in dry environments and have faster recovery rates from stress caused by drought and frost. New tea clones can also improve yields by as much as 68% compared to standard clones.[52]

ETP has accelerated efforts to develop new tea clones, which are better adapted to suit future conditions, and helped farmers access these clones so that they can continue to depend on tea to make a living.

Ethical Tea Partnership

Diversifying sources of income and food

As the suitability of tea growing regions decline, depending entirely on tea as a source of income puts tea farmers and their families at risk of reduced income and poverty. Diversification of food and income sources is, therefore, another way tea farmers can adapt to climate change.

Research conducted by ETP and GIZ has identified alternative crops including passion fruit, banana and pea that could thrive in traditional tea growing areas, even under predicted levels of climate change.[53] By planting cash crops that can better withstand the impact of climate change, farmers can diversify their income streams and build resilience against extreme weather events.[54]

Climate change will impact food security both in the short term, from more frequent and more intense and erratic weather, and long term, by changing temperatures and precipitation patterns. This will impact malnutrition levels and disease, which is already a significant concern in many tea growing countries.[55] Farmers may need to prioritise growing highly nutritional crops that can easily be grown and perform well under drought conditions, such as sweet potato, cassava, and cowpeas.

ETP has worked with farmers to address these threats by installing kitchen gardens, setting up nurseries and demonstration plots, distributing seedlings for alternative crops, and training farmers on income diversification to build climate resilience.

Considerations

As discussed above, climate change will continue to reduce the suitability of tea growing areas, and this will have enormous implications for tea production and the livelihoods that depend on it. Whilst it is important that farmers are supported to take adaptation measures in the short-term, it is vital that efforts are made to mitigate climate change in order to lessen the impact on future generations of tea farmers and workers. The following actions can be considered when addressing the impact of climate change on tea.

- **Tea brands and producers** can work towards achieving net-zero by monitoring and measuring their emissions and committing to making reductions using robust and credible science-based targets.
- **Producers** can transition to sustainable energy sources where possible and undertake detailed energy audits in their factories to understand emissions hotspots and energy saving opportunities.
- **Governments** in tea-producing countries can seek to access global climate funds to support the industry in transitioning to low carbon operations, working in partnership with research associations and other key stakeholders. Policies that support adaptation and mitigation activities should also be developed.
- **Consumers** can be mindful of their own environmental impact and use renewable energy suppliers where possible.

ETP will continue to run programmes with an environmental focus, working with industry stakeholders globally to reduce emissions and support tea communities in building resilience to climate change.

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