Environmental health impacts of tobacco farming: a review of the literature

Natacha Lecours,[1] Guilherme E G Almeida,[2] Jumanne M Abdallah,[3] Thomas E Novotny[4]

[1]Non-Communicable Disease Prevention program, International Development Research Centre, Ontario, Canada
[2]Alliance for the Control of Tobacco Use, Brasília/DF, Brazil
[3]Department of Forest Economics, Sokoine University of Agriculture, Morogoro, Tanzania
[4]Division of Epidemiology and Biostatistics, Graduate School of Public Health, San Diego State University, San Diego, California, USA

Correspondence to
Natacha Lecours, International Development Research Centre, 150 Kent Street, Ottawa, Ontario K1P 0B2, Canada; nlecours@idrc.ca

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ABSTRACT

Objective To review the literature on environmental health impacts of tobacco farming and to summarise the findings and research gaps in this field.

Methods A standard literature search was performed using multiple electronic databases for identification of peer-reviewed articles. The internet and organisational databases were also used to find other types of documents (eg, books and reports). The reference lists of identified relevant documents were reviewed to find additional sources.

Results The selected studies documented many negative environmental impacts of tobacco production at the local level, often linking them with associated social and health problems. The common agricultural practices related to tobacco farming, especially in low-income and middle-income countries, lead to deforestation and soil degradation. Agrochemical pollution and deforestation in turn lead to ecological disruptions that cause a loss of ecosystem services, including land resources, biodiversity and food sources, which negatively impact human health. Multinational tobacco companies' policies and practices contribute to environmental problems related to tobacco leaf production.

Conclusions Development and implementation of interventions against the negative environmental impacts of tobacco production worldwide are necessary to protect the health of farmers, particularly in low-income and middle-income countries. Transitioning these farmers out of tobacco production is ultimately the resolution to this environmental health problem. In order to inform policy, however, further research is needed to better quantify the health impacts of tobacco farming and evaluate the potential alternative livelihoods that may be possible for tobacco farmers globally.

INTRODUCTION

The World Health Organization Framework Convention on Tobacco Control (WHO FCTC; http://www.who.int/fctc/en/) has addressed, in Article 17, the need to offer economically sustainable livelihood alternatives for those affected by an eventual reduction in global tobacco leaf demand. The FCTC has also stressed, in Article 18, the need to protect the environment from the adverse effects of tobacco farming and the health of persons engaged in tobacco cultivation. Developing and implementing policies that respond to these Articles is important because arguments defending the livelihoods of farmers and emphasising economic contributions of tobacco production to national economies are widely used by the tobacco industry to oppose supply-side tobacco control policies.[1 2]

In recent years, a growing number of studies have documented the many negative impacts of tobacco growing.[2–4] Although high-income countries (HICs) and low-income and middle-income countries (LMICs) experience adverse effects related to tobacco production, their impact differs greatly between HICs and LMICs.[4] Since recent decades have seen a steady shift of tobacco production from HICs to LMICs, assessing the environmental impacts of tobacco production in LMICs is now a crucial consideration as an environmental justice issue. (The share of tobacco produced in the developing world increasing from 57% in 1961 to 86% in 2006, the share of land under tobacco worldwide increasing from 70% in 1961 to 90% in 2006 in LMICs.)[5] While some of the negative environmental impacts are also caused by other agricultural cash crops, it can be argued that tobacco production exercises an extra stress on LMIC ecosystems and causes specific health and socioeconomic problems for poor populations engaged in tobacco growing.

Insufficient research has been performed on policies that might address the many negative health, environmental and socioeconomic impacts associated with tobacco production as well as viable livelihood alternatives in LMICs. However, the effects of forest depletion and soil degradation, the main reported environmental impacts of tobacco growing, are well known. These effects include: erosion and loss of soil productivity for food crops, acute shortages of timber for construction, deficiencies of fuel wood for cooking and reduced production of other forest products important in LMIC economies. In addition, tobacco farming may be associated with destruction of ground water resources; sedimentation of rivers, reservoirs and irrigation systems; climate change; and species extinction due to habitat fragmentation and overexploitation.[6] Obviously, these environmental impacts have huge repercussions on human health and livelihoods. The aim of this paper is to review the literature on the environmental and health impacts associated with tobacco farming, to synthesise the findings and to identify research gaps in these areas.

METHODS

A standard literature search was performed using multiple electronic databases (Academic Search Complete, CAB abstracts, GEOBASE, Google Scholar, SciELO and Scopus) for identification of peer-reviewed articles using the search words 'tobacco farm*' AND environment*, 'tobacco farm*' AND *forest*, and 'tobacco farm*' AND

health*. The internet and organisational databases and websites (World Health Organization, Food and Agriculture Organization, International Development Research Centre, Southeast Asia Tobacco Control Alliance) were also used to identify books, reports, and other grey literature on the topics. The selection of literature was based on a clear reference to the environmental and/or health impacts of tobacco farming.

RESULTS AND DISCUSSION

The combined search of publicly available reports and peer-reviewed articles generated a total of 57 reports, of which 45 were found to be relevant to this review. The selected documents are predominantly case studies that have discussed agricultural practices and the effects of these on forests and soil. Most also documented the negative environmental effects of tobacco production at the local level, often linking those effects with social and health problems. The main tobacco farming practices in LMICs that are responsible for environmental degradation are the use of agrochemicals and deforestation to clear land for tobacco growing and for fuel wood used in the flue curing of tobacco. These practices lead to two major environmental consequences: ecosystem disruptions and soil degradation, which consequently lead to loss of land resources, biodiversity and food insecurity.

Agrochemical use in tobacco farming

Although tobacco-related agrochemical use is well known in LMICs, the specifics of its use and related health and environmental impacts are not well documented. As a monocrop, tobacco plants are vulnerable to a variety of pests and diseases, which require the application of large quantities of chemicals.[2 4 7] (table 1) These include pesticides (insecticides, herbicides, fungicides and fumigants) and growth regulators (growth inhibitors and ripening agents), which are applied to the tobacco plants during different stages of growth.[4] In LMICs, pesticide and growth inhibitors are usually applied with hand-held or backpack sprayers, without the use of the necessary protective equipment.[4] In addition to pesticides and growth regulators, tobacco plants also require intensive use of chemical fertilisers. Studies have shown that tobacco absorbs more nitrogen, phosphorus and potassium than other major food and cash crops, and therefore, tobacco growing decreases soil fertility more rapidly than other crops.[2] The specific agricultural practices of 'topping' and 'desuckering', designed to attain high levels of nicotine and high leaf yields, also contribute to the depletion of soil nutrients.[2 8]

In many LMICs, the multinational tobacco companies provide, through loans, large quantities of agricultural inputs to support leaf production.[9] Moreover, the easy availability of persistent organic pesticides such as dichlorodiphenyltrichloroethane (DDT) (and others) that have been banned in HICs but sold in LMICs may create environmental health problems in tobacco-farming communities.[2 4] These are often sold in bulk without proper labelling and instructions, and LMIC farmers are largely unaware of the toxicity of the products as well as the right dosage and safety measures they should use.[2 10] One study assessed the dermal and respiratory exposures of mixers and sprayers to two common pesticides and a growth regulator; it found that mixing and spraying led to significant chemical exposure.[11] Other studies have shown that even tobacco workers who do not directly manipulate pesticides (eg, harvesters) are vulnerable to pesticide poisoning. In Kenya, 26% of tobacco workers showed pesticide poisoning,[12 13] while in Malaysia, a third of 102 tobacco workers presented with 2 or more symptoms of pesticide exposure.[14]

Others have found that pesticide sprayers may have increased risk of neurological and psychological conditions due to poor protection practices.[15 16] These include extrapyramidal (parkinsonian) symptoms, anxiety disorders, major depression and suicidal ideation.[4 16] Although research on specific exposure risks for tobacco farmers is limited, Arcury and Quandt state that the 'accumulating evidence of a link between organophosphate exposure and psychiatric diagnoses (depression and suicidal tendencies) among agriculturalists supports these allegations of psychiatric pesticide hazards among tobacco workers'.[4]

Farming communities are also exposed to health risks caused by chemical pollution of their environment. For example, in Bangladesh, chemicals used to control a weed commonly found in tobacco fields were found to be polluting aquatic environments and destroying fish supplies as well as soil organisms needed to maintain soil health.[17]

These limited studies suggest that there are observable and important dermal, respiratory, neurological and psychological problems associated with tobacco farmers' exposure to agrochemicals. Pesticides used in tobacco farming may in fact be an important risk for a number of adverse health conditions that can lead to death.[2] Beyond farmers and tobacco workers, the victims of this health risk include many children, pregnant women and older people who all participate in tobacco production or live near tobacco-growing fields.[18]

Green tobacco sickness (GTS)

A health problem exclusively related to tobacco growing, GTS is a consequence of nicotine dermal absorption due to skin exposure to tobacco leaves. Risk for this illness is created by certain working conditions, mostly handling wet tobacco or alcohol

Table 1 Common pesticides used in tobacco farming

Pesticide	Description
Aldicarb	One of the most acutely toxic pesticides registered in the USA: its lethal toxicity to humans is in the range of one-hundredth of a gram. In laboratory animals, aldicarb causes chronic damage to the nervous system, suppresses the immune system and adversely affects fetuses. In human cells, aldicarb causes genetic damage. It is also toxic to birds, fish, honeybees and earthworms. Aldicarb's agricultural formulation contains a toxic contaminant, dichloromethane, that causes damage to hearing, vision, kidneys and liver, and is carcinogenic and mutagenic.
Chlorpyrifos	A broad-spectrum organophosphate insecticide, chlorpyrifos affects the nervous system by inhibiting an enzyme that is important in the transmission of nerve impulses. Symptoms of acute poisoning include headache, nausea, muscle twitching and convulsions. In addition to acute poisonings, exposure to chlorpyrifos products has also been associated with human birth defects. The pesticide has caused genetic damage in human blood and lymph cells and has also been found to affect the male reproductive system. Chlorpyrifos is known to contaminate air, groundwater, rivers, lakes and rainwater, with residues being found up to 25 km from the site of application.
1,3-D (1,3-dichloropropene, also known as Telone)	A highly toxic soil fumigant, 1,3-D causes respiratory problems in humans, as well as skin and eye irritation and kidney damage. 1,3-D causes cancer in laboratory and genetic damage in insects and mammal cells. It leaches through soil easily and has been found in US groundwater, drinking water and rainwater.

Adapted from Campaign for Tobacco Free Kids, Golden leaf barren harvest, the costs of tobacco farming, 2001.[2]

consumption while working with tobacco leaf.[3] Some symptoms of GTS are similar to organosphosphate poisoning and heat exhaustion, which may include weakness, headache, nausea, vomiting, dizziness, abdominal cramps, breathing difficulty, diarrhoea, chills, fluctuations in blood pressure or heart rate, and increased perspiration and salivation.[19] However, GTS should not be confused with organosphosphate poisoning, as the last application of pesticides normally occurs several weeks before tobacco harvesting, when GTS would be most common. In addition, there were cases of GTS documented before widespread pesticide use, and this illness also occurs among workers on farms that do not use pesticides.[19] Heat exhaustion is sometimes confused with GTS, but GTS has been reported during cool conditions when harvesters mentioned feeling chilled rather than overheated.[19] Most published research on GTS is descriptive and focused on US tobacco harvesters.[19] However, a study from the north-east of Brazil used epidemiological and laboratory data to evaluate possible GTS among 107 harvesters who presented with blood cotinine levels >10 ng/ml (by gas-liquid chromatography).[20] Other studies on GTS among young persons in Southern Brazil demonstrated a relationship between age, time of exposure (handling tobacco leaves) and the rate of nicotine absorption. The study suggested that older subjects with greater time spent working with tobacco leaf had higher cotinine levels.[21]

Deforestation

Land clearing for tobacco agriculture has impacted forest reserves in LMICs. In Tanzania, for example, Sauer and Abdallah found that tobacco production 'is still dominated by small-scale subsistence farmers highly dependent on family labour, hand tools, natural resources as well as animal drawn farming implements'.[22] With more technical agricultural practices beyond the reach of small-scale tobacco growers, production expansion is only possible through the clearing of additional forest land. Also in Tanzania, Mangora found that virgin land is preferred for tobacco growing because of the fear of soil-borne diseases and the increased yield it provides.[23] According to this study, 69% of tobacco farmers in the Urambo District clear new areas of woodlands for tobacco cultivation every season, while only 25% of them grow tobacco on the same plot for two consecutive seasons and only 6% do so for more than two consecutive seasons. According to Abdallah *et al*, 'Shifting cultivation is, by far, the leading land-use change associated with nearly all deforestation cases (96%)', making small-scale subsistence farming in the region one of the major threats to forest biomes.[24]

The production of Virginia tobacco (for which there is higher demand and therefore higher price) requires flue curing, which is performed in kilns by burning wood at constant heat temperatures for several days.[2] Thus, for this type of crop, farmers in LMICs must acquire wood from the surrounding forests, their own land, or from public lands. These wood resources are less and less available as a result of shifting cultivation.

The environmental impacts of shifting cultivation and curing have received scant research attention. Concerns around tobacco-related deforestation in LMICs started to be raised in the 1980s by organisations such as the Food and Agriculture Organization (FAO) and the WHO.[25 26] However, the scientific data necessary to estimate the extent of tobacco-related deforestation are lacking, and thus impact assessments have resulted in inconsistent and highly criticised reports.[25]

In response to rising international criticism, the multinational tobacco industry commissioned a report to evaluate its impact on global deforestation. Known as the International Forest Sciences Consultancy report, it was commissioned by the International Tobacco Information Centre (INFOTAB) and published in 1986 by AI Fraser.[25] The report described fuel wood consumption for tobacco agriculture in Argentina, Brazil, Kenya, Malawi, Zimbabwe, India and Thailand, then extrapolated the data to 69 other tobacco-growing developing countries. Unsurprisingly, the study showed a remarkably low average specific fuel consumption (SFC) index of 7.8 kg of wood/kg of tobacco, much lower than the reported, but also criticised, estimates of 100 kg to 230 kg of wood/kg of tobacco.[25]

After the publication of the International Forest Sciences Consultancy report, it took another 13 years for the first independent study to assess the global level of tobacco-related deforestation.[26] Contrary to the industry-commissioned report, this study clearly implicated tobacco production as a cause for global deforestation.[26] In addition, the impact of tobacco-related deforestation is felt more dramatically by certain producer countries and regions of the developing world:

> 'The average amount of natural vegetation removed per developing country is more than 2000 ha or about 5% of total national deforestation, while it rises, on average, to around a quarter of all deforestation in the group of seriously affected producers. As a major factor contributing to crop-specific deforestation, the global mean of flue-cured produce using wood is only about 12%, but increases to a mean 62% in the producer countries with minor-to-serious tobacco-related deforestation.'[26]

Deforestation is of most concern in the fragile dry lands and upland environments in which tobacco is grown. One of these is the African region covered with Miombo woodlands. The impacts on the forest ecosystem of Tanzania were briefly evaluated in the 1990s, but were more carefully studied in the past decade.[22–24 27] These studies confirm that there is serious tobacco-related deforestation in the region, as well as soil degradation. Because tobacco cultivation is dominated by small-scale farming, these studies also conclude that tobacco farming is not sustainable as currently practiced. According to Mangora and Abdallah *et al*, the shortened fallow periods for reforestation threaten the recovering capacity of the woodlands, and this will eventually cause a change of land cover from woodlands to bush, or permanent deforestation.[23 24]

Global ecosystem disruptions

Unlike many food crops, tobacco production offers no replenishment to the soil or to other parts of the farm ecosystem. The biomass (stalks or plant residue) left after harvest is of no food value to livestock and poultry. The stalks or plant residue are required to be cut and burnt to reduce tobacco diseases and weeds before onset of another planting season. In turn, the diminished animal resources reduce animal manure, which is essential to maintain soil health in developing countries.[17]

In Cambodia, most tobacco farmers bought firewood from the local markets to cure tobacco, as it was not easily available from natural environments. However, a number of farmers also reported obtaining fuel wood from nearby forests and backyards; they also reported that rubber trees (used for economic products) were being cut for tobacco curing.[28] In Kenya, tobacco-related environmental problems that were documented in Africa in the 1990s[29–31] are still present, including widespread deforestation and the felling of indigenous trees for curing, soil erosion, change of local streams from permanent to seasonal, and water pollution from agrochemicals used in tobacco production.[32] In Brazil, a number of studies have identified excessive agrochemical residues in waterways adjacent to

tobacco farming communities, and these further noted that water pollution was exacerbated by reduced forested land cover.[33–35] Monitoring of a catchment area in Southern Brazil concluded that the shift to more intensive tobacco production in ecologically fragile areas, such as wetlands, riparian zones and steep slopes, resulted in severe impacts on hydrological systems and sediment yield.[36]

Food insecurity

Recent research in Bangladesh has shown that illegal logging of government forests for wood used in tobacco curing is also of concern. In addition to the destruction of forest resources, Akhter *et al* also argue that tobacco production is responsible for the displacement of food and other economic crops in Bangladesh.[17] For example, the very fertile region of Kushtia (the second largest tobacco-producing district in the country) had been a food-surplus region. Today, tobacco occupies the best lands in the district, having displaced vegetables, pulses, sugar cane and jute crops. A similar pattern takes place in the Chittagong Hill Tracts, where tobacco is replacing the traditional rice and vegetable growing economies. In areas where fuel wood is already scarce, tobacco farmers use fodder, rice straw and fruit trees to cure tobacco. These practices may then affect food production resources (cooking fuel and food for milk cows) and overall food security. In Kenya, land under tobacco has also grown in acreage at the expense of food crops.[32] This shift towards tobacco production has made traditional crops such as cassava, millet and sweet potatoes scarce, and has caused reductions in livestock production. While little evidence is available on worldwide food crop displacement due to tobacco growing, a continued expansion of tobacco farming is foreseen for some of the main tobacco producing countries, mainly due to the political economy of low-cost production.[26] In this context, the overall health and socio-economic impacts of tobacco production should be considered by governments in their assessment of tobacco production's contribution to national economies.

Tobacco industry responsibility

Contract farming, a common tobacco production system in place in LMICs,[17 37 38] allows tobacco companies to directly engage with tobacco farmers and therefore avoid intermediaries in order to reduce their production costs.[9] In such arrangements, farmers commit to follow the technical guidance of the tobacco company and to then provide it with their tobacco leaves according to the price classification scheme set by the firm. Contract farming thus allows tobacco manufacturers to control species variety, volume and production costs, and creates asymmetric bargaining powers between tobacco firms and farmers.[7 37] Studies show that contract farming creates a cycle of indebtedness for farmers, who find themselves owing companies significant sums for payments advanced as agricultural inputs year after year.[2 7 17 37 38] For many tobacco growers in India and Bangladesh, the income gained from this system is barely enough to sustain themselves, or is insufficient to meet the most basic of needs.[39] It was reported in 1998 that tobacco leaf companies in the Rio Azul region of Paraná state in Brazil 'were set to make $2 million just from selling chemicals to the farmers, never mind the profits made on selling the tobacco to cigarette manufacturers'.[2] By actively controlling the production system and the sale of agrochemicals, multinational tobacco companies around the globe encourage the use of products that have proved very harmful to environmental and human health and have essentially indentured the small tobacco farmers within the production system.

Shifting production from degraded to fertile environments is another problematic industry practice observed in LMICs. There were two recent examples of this shift in production practices in Bangladesh. In Rangpur district, the largest producer of tobacco in the country, production has shifted from high-quality (kiln-dried) leaves to low-quality (sun-dried) leaves for local bidi manufacture.[17] (Bidis are hand-rolled cigarettes using low quality tobacco and tendu leaves (instead of paper), and are manufactured by hand in South and Southeast Asia.) The decline in soil fertility and the loss of fuel wood sources in this district account for that transition. Ownership of the tobacco industry in the district has also shifted from a trans-national corporation (British American Tobacco (BAT)) to many smaller national companies that produce bidis for the national market. However, the production of high-quality leaves and BAT's presence have increased steadily in the forested Chittagong Hill Tracts, particularly on the fertile banks of the Matamuhuri river.[17] One may expect this area to then be degraded environmentally as agricultural productivity declines there as well.

A study by Loker that examines 'the rise and fall' of flue-cured tobacco production in Honduras' Copán Valley, observes similar patterns of resource mining and environmental consequences.[40] In Brazil, Vargas and Campos noted that tobacco companies have moved 'into new areas in the southern zone of Rio Grande do Sul, where yield and quality are similar to traditional tobacco producing regions like the Rio Pardo Valley'.[37] The tobacco companies' patterns are also observed in Kenya, where BAT plans to expand its activities to other districts in the Nyanza region and in the southern part of the Rift Valley.[32] As the previous discussion on increased food insecurity has suggested, this pattern is worrisome as it means that tobacco production impacts land on which tobacco is currently grown and land on which it was grown in the past, which will have become degraded as a result of tobacco cultivation.

Finally, rather than addressing the many problems associated with tobacco production in LMICs, the tobacco industry's corporate social responsibility (CSR) activities and campaigns represent another threat to environmental and social justice. In 1994, a series of articles in this journal highlighted the inadequacy of the industry's attempts at reforestation.[25 29–31] The main problems identified were that reforestation initiatives involved only fast-growing exotic trees such as cypress and eucalyptus. This means that the ecologically suited indigenous trees of the region were not replaced.[29] These replacement species were inappropriate because of the extra care and large quantities of ground water needed, leading to additional adverse ecological outcomes.[29 30] A recent study in Tanzania found that the tobacco industry's efforts to establish wood supplies for tobacco curing were inadequate.[41] For example, in the Iringa region in 2004, tobacco growers afforested only 6.7% of the total Miombo area cleared annually for tobacco production. A report from the Campaign for Tobacco Free Kids has also pointed out that, despite the high number of trees the industry claims to have distributed, no monitoring was performed to measure the number of trees that were actually planted and survived.[2] In addition, the report states:

> 'Around the world, the companies have engaged in a sophisticated campaign designed to shift attention away from their role in keeping tobacco prices down and undermining the bargaining power of farmers and towards the perceived impact that tobacco-control policies will have on farmers' (and countries') incomes. This has involved a two-pronged strategy of (a) exaggerating the impact of tobacco control activities on the global demand for tobacco leaf and (b) misrepresenting the goals and programmes of the WHO.'[2]

The report continues: 'the industry has worked directly, with sympathetic politicians and business people, and indirectly, through front organisations that it has created and funded' (such as the International Tobacco Growers Association, ITGA).[2] In commissioning front groups and partnering with renowned organisations, the tobacco industry's CSR activities have been shown by tobacco control researchers to undermine efforts to address real problems associated with tobacco production (such as child labour and other environmental, health and socioeconomic problems) by positively influencing public opinion in favour of the companies.[42–44]

Conclusions

The past decades have seen a steady shift of tobacco cultivation from HICs to LMICs, which has allowed multinational tobacco corporations to access cheaper labour resources and to lower their production costs. Because smallholder tobacco farmers in LMICs lack modern agricultural resources, such as advanced curing technologies or mechanised pesticide spraying equipment, their working conditions are more difficult and their practices more harmful to their health and to the environment than tobacco growing in HICs. The available literature on the topic has shown that tobacco cultivation in LMICs is causing environmental degradation and ecosystem disruption due to the intensive use of agrochemicals and the felling of wood for tobacco leaf curing. In turn, these practices have negatively impacted the health of the smallholder farmers through high agrochemical exposure and increased food insecurity. The tobacco industry has responded to these problems by working with agricultural front groups to lobby against tobacco control measures, using the arguments that such measures would hurt farmers and national economies. They have also instituted misleading CSR campaigns and programmes, which are designed to shift attention away from the real issues, rather than responsibly addressing them. In addition, this review has shown that, by encouraging the excessive use of harmful agrochemicals and the shifting of tobacco growing into more fertile lands, the tobacco industry contributes to the environmental health impact of tobacco cultivation in LMICs.

The FCTC includes two Articles (17 and 18) that address the need to offer economically sustainable livelihood alternatives to tobacco farmers, as well as the need to protect the environment and the health of persons engaged in tobacco cultivation. As we have shown, the development and implementation of policies that respond to the challenges tobacco farmers face is crucial. However, literature on the negative environmental impacts of tobacco production is limited, and peer-reviewed scientific literature is very scarce. As recommended by Geist and colleagues, a close monitoring of tobacco farming activities is needed at national and international levels to provide data on levels of deforestation and environmental degradation related to tobacco farming.[25 26]

The grey literature surveyed in this review also revealed many other negative impacts of tobacco cultivation, such as GTS, respiratory problems, child labour, economic exploitation and indebtedness, which also need additional research. In addition, there is a need for more research on the economic viability of alternative livelihoods to tobacco farming in order to counter the economic argument so frequently used by tobacco companies in defence of LMIC tobacco farmers. Recent research on this topic[17 32] has shown that smallholder farmers are receptive to shifting out of tobacco production, but that policies and programmes are needed to improve their access to markets for alternative crops. Given the important commercial influence of tobacco companies in the development of policies in LMICs, country case studies and global analyses of the tobacco industry's practices and influence over supply-side and demand-side tobacco control policies are urgently needed.

What this paper adds

- The present article provides an overview of the published literature on the environmental health impacts of tobacco farming in low-income and middle-income countries.
- The literature review synthesises research results that highlight tobacco farming problems such as intensive use of agrochemicals and extensive deforestation, which have in turn caused health and environmental harms to farming communities.
- In the broader context of tobacco control, the article presents tobacco farming as a central issue that is very frequently used by the tobacco industry as an argument to undermine the adoption and implementation of tobacco control measures globally, and especially in low-income and middle-income countries.
- The paper calls for more research on the negative impacts of tobacco farming and the tobacco industry's corporate social responsibility (CSR) campaigns. It also argues that policies that address the challenges faced by smallholder farmers in shifting out of tobacco production are urgently needed.

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Invited commentary

Apart from the authors' highlights on the environmental impacts of tobacco production,[1] additional problems include farmers smoking raw tobacco, which leaves the majority of them sick; for example, more than 75% of tobacco farmers in Tanzania smoke raw tobacco.[2] Farmers also die in curing barns due to carbon monoxide poisoning.[3] Increased tobacco farming due to industry sensitisation has resulted in increased labour demands with people engaging in human trafficking; for example, in Tanzania, people sold to big farmers for between US $80 and US $100 are subjected to harsh conditions, working long hours for just food and substandard shelter, ending up as slaves.[3]

The problems of tobacco companies' policies and practices are common to both high income as well as low- and middle-income countries although the latter are more vulnerable. These companies lure government and other leaders into believing that tobacco is an economically viable crop and a major source of revenue, while hiding the truth about the accompanying environmental and health losses. For example, while Tanzania earns about US $50 million annually from tobacco revenue, more than US $40 million is spent to treat tobacco-related cancers alone.[4] Environmentally, tobacco farming is responsible for causing more than 4% of the desert area in Tanzania and, Urambo, one of the major tobacco growing districts, lost about 1.3 m^3 trees worth more than US$10.5 million in 2010/2011 alone.[5] Tobacco companies also lie in claiming that farmers have no economically viable alternative crops. In Tanzania, more than 70% of tobacco farmers interviewed preferred alternative crops which they also identified; their only worry was sustainable markets for such crops.[6 7]

Apart from further research to quantify the health impacts of tobacco farming and evaluate potential alternative crops, collaboration at national, regional and global levels is necessary to strategise on how best to counter the emerging solidarity among tobacco companies that are working towards paralysing tobacco control efforts, particularly in low- and middle-income countries.

Environmental health impacts of tobacco farming: a review of the literature

Natacha Lecours, Guilherme E G Almeida, Jumanne M Abdallah, et al.

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