



Research Paper

Caring for coca, living with chemicals: Towards ecological harm reduction

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ABSTRACT

In this paper, we show how the materialisation of chemical harms linked to the cultivation of coca and its processing into coca paste reside in a wider politics of structural violence which is also situated ecologically. Drawing on the qualitative interview accounts of coca farmers in Putumayo, Colombia, we attend to practices of care in the field and in the laboratory. We look first at chemicals used in coca's cultivation (herbicides, fertilizers, pesticides), and second at chemicals (such as sulphuric acid, sodium carbonate, magnesium permanganate) used in the processing of coca leaf into paste (before the paste is sold on for refinement into cocaine). Our analysis highlights the tensions which inevitably arise in the balance and multiplicities of care – for crops, livelihood, and environment. We trace how farmers' narratives of the neutralisation of chemical risks habituate chemical harms as mundane, even uneventful, in an economic imperative to 'carry on as normal' in the coca economy. We emphasise health and harm as matters of care which not only affect humans but living environments. Accounts of 'risk environment' can give insufficient attention to Nature, and this leads us to consider 'ecological harm reduction'.

Introduction

Our focus in this qualitative study is the cultivation of coca and its processing into coca paste in Putumayo, Colombia. We concentrate specifically on chemical risks and harms: that is, the ill effects of chemicals used by coca farmers in the cultivation and processing of their crop, and how these chemical risks combine with those produced by crop eradication efforts in a 'war on drugs' (Acero & Thomson, 2022; Acero et al., 2023). Our aim is to show how the materialisation of chemical harms linked to coca's cultivation reside in a wider politics of structural violence affecting health, capital and livelihood.

We also use our analysis to consider an 'ecological approach' to harm reduction (Rhodes et al., 2021). By this, we mean an approach that not only considers human health as a structural effect of social, political and economic 'risk environment' (Bourgeois, 2009; Rhodes, 2009; Rhodes et al., 2012; Collins et al., 2019), but that also draws attention to health as an emergent matter of ecology, for instance in terms of how people, plants, and land, among other elements, evolve together (Lyons, 2014;

Van Dooren et al., 2016; Rhodes et al., 2021). Sociological research tracing drug harms appreciates human agency in a recursive relationship with social structures, in which adaptation, resistance and counter care is also made possible (Gomart, 2002; Lyons, 2018; Harris, 2020; Rhodes et al., 2023). Yet, despite an increasing focus on the agency of nonhuman elements affecting drug use and harm (Vitellone, 2017; Duff, 2013; Dennis, 2019; Fraser, 2020), the 'natural'¹ environment is largely missing in accounts of risk environment (Rhodes et al., 2021). There is a tendency to over emphasise the human in accounts of human-environment interaction (Latour, 2018; Braidotti, 2013). There is also a tendency to separate off different constitutions of environment – social, economic, natural, for instance – from the ecology (Papadopoulos, 2021). An ecological harm reduction resists neglecting the biotic environment, Nature itself.¹ An ecological approach is therefore both 'more-than-human' and 'more-than-natural' because it envisions matter as an entanglement of elements of various kinds (Papadopoulos et al., 2021). Our aim here is to show how the labour of coca's cultivation and processing, and the livelihoods this affords, link with chemicals that

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¹ Our understanding of Nature follows that of Latour (2018), as with other scholars of science and technology and environmental humanities working with 'new materialist' ideas (Tsing, 2012, 2015; Braidotti, 2013; Lyons, 2018; Van Dooren et al., 2016; Papadopoulos et al., 2021), as always 'more-than-nature' in its emergent entanglements with humans and nonhuman elements.

harm, as well as evolve, ecologically. We trace the life and harm of chemicals, which through entanglement with other elements – plants, wind, rain, land, insects, humans, technologies – create an ecology of contaminated living linked to the coca economy.

Coca

The cultivation of the coca leaf is prohibited for anything other than scientific or medical purposes by the United Nations' Single Convention on Narcotic Drugs of 1961. In Colombia, coca has been cultivated for traditional use by indigenous peoples for thousands of years. It is also farmed as a resource of capital and economic survival (Ramírez, 2011; Gutiérrez Sanín, 2021). Tens of thousands of families in Colombia farm coca (UNODC, 2010). Coca is a robust crop, suited to poor agricultural conditions, and can generate six harvests a year. Farmers usually work small areas of land of less than a hectare and up to five hectares. Land ownership in Colombia is highly concentrated, and a minority of small hold farmers have land tenure (Thomson et al., 2022). Coca is a crop that yields returns better than alternatives in these conditions (Gutiérrez Sanín, 2021). The failures of alternative crop substitution efforts pay testament to this (Gootenberg & Dávalos, 2018; Acero & Machuca, 2021; Felbab-Brown, 2020).

The Putumayo region, in the south-west of Colombia, has been subjected to colonial developments promoting construction, settlement and investment projects since the 1960s (Uribe, 2011). Economic migration, and the displacement of local farming communities, has created precarious livelihoods for farmers (Gootenberg & Dávalos, 2018). Development efforts to build roads and to extract capital from the land – for instance, via oil, timber, and cattle ranching – have also introduced ecological harms through deforestation and land degradation (Dávalos et al., 2016). Putumayo is also a site of long standing armed conflict. The region was a focus of the 2016 Peace Accords signed between the Government and the Revolutionary Armed Forces of Colombia (FARC). The part promise of the peace agreements to transform farming livelihoods away from coca towards sustainable alternatives has not been realised (Gutiérrez Sanín, 2021; Gutiérrez, 2021).

At the same time, coca crop eradication campaigns entrench deep mistrust in the state among the *cocaleros* (coca farmers), especially in the absence of state efforts to build viable and sustainable alternative livelihoods (Acero & Thomson, 2022; Gutiérrez Sanín, 2020; Felbab-Brown, 2020). Efforts to eradicate the coca plant have concentrated on the aerial fumigation of crops using the chemical glyphosate dropped from duster planes, until around 2015, combined with enforced manual crop eradication, seizure of illegal chemicals for processing, detention of farmers and workers, and the destruction of coca processing laboratories (Rincón-Ruiz et al., 2016; Lyons, 2018; O'Shaughnessy & Bradford, 2005). The threat of crop eradication is pervasive, with manual eradications intensifying in the period of this study (2018-2021) (Gutiérrez Sanín, 2020; Acero & Thomson, 2022). A 'war on coca' enacts structural violence on the *cocaleros* as well as on the life of the *campesinos* (peasant farmers) more generally (Gutiérrez Sanín, 2015; Acero & Thomson, 2022). This is because coca eradication efforts coincide with broader state efforts which prohibit various aspects of everyday life and farming livelihood, including for instance community efforts to build roads (given inadequate transport infrastructure) and farmers' efforts to cut down trees on their own land (even while transnational corporations cut down swathes of rainforest linked to development projects) (Acero & Thomson, 2022).

The cultivation of coca leaf and the processing of the leaf into paste for onwards sale and refinement into cocaine embodies the precarity of the risk environment. The economic and other capitals afforded by coca, as it is transformed into food and household security as well as access to education, welfare and health (Parada-Hernández & Marín-Jaramillo, 2021), are in fragile recursive relationship with the structural violence of drug and other wars, as well as with the land and ecology. This is not only a complex and evolving 'trade-off' in the sustainability of

livelihoods (Ciro, 2020; Gutiérrez Sanín, 2021), but an *entanglement*, wherein different practices of capital in the sustainability and extinction of life and livelihood, for people and environments, as well as other living things, are inseparable from, and 'become-with', the other (Van Dooren et al., 2016; Tsing, 2015; Lyons, 2018).

Chemicals

As is well documented, state efforts to eradicate the coca plant have concentrated on the aerial fumigation of crops using the chemical glyphosate (Rincón-Ruiz et al., 2016; Lyons, 2018; O'Shaughnessy & Bradford, 2005; Rhodes et al., 2021). From 1997 to at least 2015, this herbicide was used, in concentrated and enhanced forms, in an aerial chemical war waged on the coca plant. Roughly an average of 128,000 hectares a year were targeted in this period (Camacho & Mejía, 2017). More than 1% of the gross domestic product of Colombia was said to be spent fumigating coca, supported by largely U.S. foreign aid, and rationalised in a fusion of wars on drugs and terror (Mejía et al., 2017).

The ecological harms of glyphosate fumigation are clearly visible on the landscape (See, for example, Lyons, 2018). They also enact a slow and less visible violence through 'alterlife' (Murphy, 2017); conditions of life *already altered* as the substance lives on in soil, water, plants, animals, humans, and the environment over time (Van Bruggen et al., 2018; Adams, 2023). The contaminated ecology 'becomes-with' chemicals (Murphy, 2017; Lyons, 2018; Liboiron et al., 2018). Glyphosate aerial spraying was suspended in 2015 after the World Health Organization (WHO) concluded that the chemical was "probably carcinogenic to humans" (Guyton et al., 2015). Many studies have demonstrated an association between prolonged exposure to glyphosate and a range of diseases, including cancers and neurodegenerative conditions (Guyton et al., 2015; Camacho & Mejía, 2017; Van Bruggen et al., 2018). While much of the evidence for the negative health impacts of glyphosate has been gathered in the context of agricultural use, and from *in vitro* studies, Camacho and Mejía (2017) demonstrated an association between aerial fumigation and respiratory disease as well as miscarriage. The chemical harms, and counter claims of benefit, linked to aerial glyphosate fumigation are subject to an 'evidentiary war' which traces to the competing political and economic capitals of coca (Lyons, 2018; Huez, 2019; Rhodes et al., 2021).

A core site of controversy is ecological harm. In justifications of crop eradication, coca farming is presented as a driver of "ecosystem injury" and "environmental degradation" (Burns-Edle, 2016: 1,10), with the *cocaleros* depicted as using chemicals – herbicides, fertilisers, pesticides – to grow their crops without care or responsibility for the environment (Burns-Edle, 2016). Here, the aerial spraying of glyphosate is enacted as a form of ecological harm reduction in a policy of conservation (Burns-Edle, 2016). In this discourse, coca farming is not only presented as a problem of legitimacy but as a crime against the environment (Rincón-Ruiz et al., 2016; Gootenberg & Dávalos, 2018). In addition to the slow burn of chemical harms, deforestation is at the centre of these debates. Here, coca's cultivation is often depicted as a driver of 'slash and burn' land-clearing, despite strong evidence linking deforestation to patterns of migration, development initiatives (for example, road building), and other forms of farming (for example, cattle ranching) (Dávalos et al., 2016; Negret et al., 2019). State efforts to eradicate crops also encourage growing and re-planting in multiple, smaller, and more hidden, plots (Rincón-Ruiz & Kallis, 2013). The evidentiary and political fight over ecological harm becomes especially toxic in combination with the populism for militaristic intervention, with the *cocaleros*, and coca's eradication, presented as the targets (Ciro, 2020; Gutiérrez Sanín, 2020; 2021; Acero & Thomson, 2022). Government efforts to reinstate aerial glyphosate fumigation were prevented by Colombia's Constitutional Court in early 2022, but the enforced manual eradication of crops has intensified (Gutiérrez Sanín, 2020, 2021).

Care

While attention has focused on glyphosate and its intersections with ecological and health harm, little or no attention has focused on the health harms potentiated by chemicals used in the cultivation and processing of coca from the perspectives of the *cocaleros* themselves (Lyons, 2018; Acero et al., 2023). The voice and concerns of coca farmers have often been side-lined in evidentiary and policy debates, as well as in compensation claims linked to the health, environmental and livelihood costs of glyphosate fumigation (Lyons, 2018; Huezo, 2019). In this context of precarity, coca farmers' must develop practices of care to protect their crops and livelihoods (Acero et al., 2023; Ciro, 2020; Lyons, 2018; Huezo, 2019).

In our ethnographic work, we have understood the health risks of chemicals used in coca's cultivation and processing as structural effects of how practices of 'care' come into tension with crop eradication efforts (Acero et al., 2023). The logic of care emphasises how coca farmers seek to take care of their crops, including to maximise its resource potentials. The logic of care also relates to how farmers go about their work carefully, including to minimise injury when working with chemicals. The use of chemicals in the laboratory when processing harvested coca leaf into paste, for instance, is work that is known to be risky, and accordingly, demands 'know how' and care, given the high chance of chemical exposure. Compromises in care when handling chemicals may have to be made when working fast and in a hurry. Working fast is one effect of risk produced by the fear of being caught by state military or anti-narcotic efforts to eradicate the crop, destroy the laboratory, and confiscate the materials. Moving fast presents as the norm in this work environment: "Whenever one is working with coca, fumigating [spraying] the crop or processing it, one is in a hurry" (Acero et al., 2023).

Case study approach

In this paper, we focus on the everyday use, and effects, of chemicals in coca's cultivation and processing. We do not concentrate on the high drama of aerial glyphosate fumigation but instead draw attention to the chemicals less seen, bearing witness to them, as means of production as well as harm, as things that care as well as kill, in the contaminated ecology of Colombia's coca economy. To make our case study, we use data generated through a mix of qualitative interviews and focus groups with 14 coca farmers (*cocaleros*), nine men and five women, in Putumayo. The *cocaleros* participating in this study generally worked small areas of land (of under 5 hectares) nested in the jungle. They were involved in coca's cultivation or the processing of the coca leaf into coca paste, and most often both. Overall, we undertook 45 interviews in this study, which in addition to the households of the *cocaleros* included healthcare workers, pharmacists, agricultural officials, and vendors. Our introduction to the *cocaleros* was enabled by prior research led by Francisco Gutiérrez Sanín (See: Gutiérrez Sanín, 2015, 2021), a collaborator to this project. Interviews were undertaken in 2021 by Linda Sofia Ordoñez and Camilo Acero, as an adjunct to eight months of ethnographic fieldwork undertaken between 2018 and 2020 with four coca-growing families (See Acero et al., 2023). All interviews with *cocaleros* were transcribed, as well as translated from Spanish to English, and coded for analysis in a constructivist grounded approach (Charmaz, 2006). After the fieldwork was completed we facilitated a participative workshop with *cocaleros* focusing on the practical implications of the research for reducing chemical harms at work. Our work was approved by the research ethics committees of the London School of Hygiene and Tropical Medicine and Faculty of Human Sciences of the Universidad Nacional de Colombia. All names reported in this analysis are pseudonyms.

Our analytical approach emphasises the materialisation of chemical harms by attending to risk as an ecological matter (Murphy, 2017; Lyons, 2018). We seek an 'attentiveness' to nonhuman agency by situating human-centred narratives of chemical harms ecologically (van

Dooren et al., 2016; Krzywoszynska, 2019). We see chemicals as elements in what Anna Lowenhaupt Tsing has termed "contaminated diversity" (2012: 95); that is, the "collaborative adaptation to human-disturbed ecosystems" in which life 'becomes-with' processes of contamination and destruction, including eradications and extinctions (Tsing, 2015: 95). Contaminated ecologies create conditions of 'alterlife'; that is, environments and futures that are already altered, including through the embodiment of chemicals (Murphy, 2017). Life and livelihood then, as with risk and harm, are embodied relational effects of the evolving, creative, yet contaminated, ecology, which itself produces agency. By this understanding, agency is not a characteristic of humans alone but a capacity that is affected in an assemblage of human and nonhuman actors and the relations between them (Duff, 2014). This focuses our attention on chemicals as a form of 'molecular species' which alter the ecology as they pass through, and 'become-with', humans and other living things (Murphy, 2008, 2017; Papadopoulos et al., 2021; Dennis, 2023).

We present our analysis in three sections. We first look at the chemicals used in coca's cultivation, before then looking at the use of chemicals in the processing of coca leaf into paste. Third we look at how narratives of the neutralisation of chemical risks may habituate chemical harms as mundane, and even uneventful, thereby sustaining an economic imperative to 'carry on as normal'. Taken together, we explore harm reduction and care – for plants, people, livelihoods and environments – as matters of balance and multiplicity, in which tensions in networks of care inevitably arise (Mol, 2008; Law, 2010; Puig de la Bellacasa, 2017).

Cultivating coca

The agrochemicals used in the cultivation of the coca plant include herbicides, fertilizers, and pesticides. The most common herbicides used to clear land include paraquat and glyphosate. Fertilizers generally include nitrogen, phosphorus, potassium, magnesium, humic acids, and more recently, growth hormones.² These will be used as soon as the coca seed starts to sprout. We are told, for example, that there are three types of fertilizer: "something to keep the leaf from falling-off, something to make the buds grow, and another to make it root". Pesticides include insecticides and fungicides. Insecticides are used to control two forms of leaf-eaters, the *looper* and *murchira* caterpillar, as well as aphids and ants. Insecticides commonly contain cypermethrin, methamidophos, and abamectin.² Insecticides and pesticides will be used after about three months, and until the coca bush is of harvesting age, which might be around six months after planting. Herbicides are also used between harvests, with fertilizers and pesticides used two to three times each harvest cycle.

Chemicals are needed given the poor soil of the Amazon rainforest and the risk of the coca bush becoming infested with leaf eaters and insects. As the plant grows, "you increase the poison because the plant is covered with leaf eaters", and "after about three months you start using strong poison", and then, if needed, "you use a pesticide and nothing else". There are two main infestation threats; the "*looper* caterpillar" that is "long and thin", and the "*murchira* caterpillar", which is "hairy" and "sticks itself underneath the coca leaves". The *looper* "has always been there", though some say there are "more and more" *murchira*. These are the pests that "have always screwed up the coca". Farmers attune their choice and use of chemicals according to emergent threats and the adaptive responses of the plant:

"Sometimes the caterpillars adapt to the poison and sometimes it doesn't kill them. And the plant has also adapted to it already, so you

² All of these chemicals have been evidenced, in different ways, to be potentially harmful to humans and/or environments (Varona et al., 2010; Trujillo and Monsalve, 2005; WHO, 2015).

change the fertiliser so that it is stronger. [...] And sometimes the *muchira* also adapt to the poison, so you have to change it so that it kills them, because these creatures are resistant, they can resist the poison so that it doesn't kill them. The plant, it's like it doesn't want to grow, you change the fertiliser and it gets stronger again, and you carry on like that".

Caring for the crop with chemicals is an adaptation where "you do not get into a routine": "The caterpillar gets immune to the poison, again and again you have to change it, otherwise [the coca] will be screwed, and it [the chemicals] won't do anything". The economics of chemical supply also feeds into this adaptation, because the pesticides "come from the agricultural stores and they change": "The old ones aren't there anymore but others come out, they change their names so you start using new ones, sometimes to save money because it's cheaper". The plants are said to have become so infested with the *muchira* lately that some farmers have begun to suspect that the "*muchira* come in the poison" itself: "They must be in the fertiliser because now there is no coca here". Perhaps, it is speculated, "they [the *muchira*] are sent here, so that we would buy more poison". Here, narratives of the fragility of ecological conditions affecting crops and livelihood entangle with the supply of chemicals themselves in a broader atmosphere of risk and precarity linked to the coca economy.

In addition to the *looper* and *muchira*, there are aphids, described by some as "the biggest pain in the arse" as "no poison will kill them". Here, the tendency is to mix the fertiliser with the pesticide ("poison") to prevent "doing several fertilisations" as "you don't have time to lose", so "you do it all at the same time". There is an urgency to protect the crop "quickly", as soon as insects are detected (which is challenging with some of the aphids which "you can hardly see"), as well as intensifying the dose, for instance by "doubling up", or "investing in other poisons". Pesticides may also be used as 'preventives', to pre-empt outbreaks and avoid slowing down the growth of the plant: "To prevent it [risk of infestation], you have to use it [pesticide]"; "They'll be parts of the crop that doesn't have it [infestation] but maybe further on it might, so you have to use it [pesticide] anyway".

The crop is also threatened by disease. A particular concern here is *mandilacha*, described "like a fungus", which makes the plant "turn grey in patches" and "dry out", and which is said to have jumped species "from peppers to the coca", with the coca plants "drying out in the same way as the peppers". In farmers' accounts, chemicals are treated as one of many elements in the care of the plant which are attuned to evolving ecological conditions. This is an emergent 'know how' that is embodied in "experience", an attentiveness to situation, which is part of an evolving 'care network' that mixes chemicals (herbicides, fertilisers, pesticides) in relation to the varieties and conditions of the plant (including seed variety, for instance, *Orejona* or *Blanca Lisa*), the insects ("each insect has its own poison"), soil (especially according to its "depletion"), weather and climate ("you have to know which fertiliser to use in winter, and which to use in summer", for instance, "with cold weather and a lot of fertiliser you can screw the plant up, but in the summer, the more fertiliser you use the better, because the plant resists"), as well as circulating disease threats (like "fungi" causing "blight").

Forced crop eradications also present as pervasive threats, and risk "debt" for many. Many purchase their coca seed and chemicals on credit, with the means of production and supply of the trade largely controlled by guerrilla organisations and post-demobilisation groups since the 2016 Peace Accords. The money from cultivating and processing coca is "enough to pay off the bank loans we have taken out, make community contributions, pay household and family expenses". But "when your crops get pulled up, that's when you're left with debts". The crop is "everything". "Coca is our money for our food, our children's education, and to pay our debts at the banks, and wherever we have credit". Crop eradications by military and anti-narcotics officials can become relentless ("They come every two or three months and they pull up 100, 200 or

more plants").

Farmers feel that their care for the plant can adapt to the unpredictability of Nature's¹ ecological conditions. For instance, Eduardo says that "right now the plants are in a bad way, but you go back and fertilise, and it rains, and the plant recovers, and starts producing". But eradication is the "worst", for this is a threat of an immediate extinction, "that is your livelihood". Farmers "count on the coca" for survival, but at the same time "can't count on it, because today it is there, and tomorrow, who knows?". If the crop is "pulled up, you lose more, you have to sow again, and wait [six months] for it to grow". It is also more difficult to get further credit to buy seed or chemicals because there is less coca as capital: "They won't lend you any money because when you have coca you can get a financial loan, but if you don't have coca, well, what's this guy going to pay with?". This cycle of crop destruction and recovery "takes out our finances completely", it "wipes us out", both "psychologically and financially". Making the fragile ecology of the coca economy liveable is a delicate, even cruel, adaptation of unpredictable recovery in the face of destruction and extinction (Tsing, 2015; Berlant, 2011). In this ecology, chemicals not only protect and feed the crop, but speed up growth and recovery; an economic imperative in the face of pervasive threat.

Harm reduction in the field

The everyday harms of direct chemical exposures that farmers associate with crop spraying include: dizziness, fatigue, headache, sweating, vomiting, problems breathing, and burn or irritation to the skin and eyes. There is an uneasy balance in the care of the plant and the circulation of chemical risks, including to farmers themselves. We are told, for instance, "The better the poison for the crop, the worse it is for the person". As remarked of some pesticides, like Furadan, now no longer in use, "It was a good poison, although it was very bad for you". Chemicals are at once caring and dangerous, for plants, people and the environment.

Crop spraying is very "physical" work, and involves walking with a 20 litre tank strapped to the back. It is an almost daily activity that takes time. All the time it takes, is time spent with chemicals—mixing them into the tank for spraying, and working in the atmosphere of the spray. Increasingly farmers are working across multiple small plots, which can involve more time handling chemicals. The threat of crop eradication pushes farmers to split up their plots into smaller and more hidden sites to spread their risk, extending the time spent with chemicals.

Chemical exposures are common: "You sometimes see people covered in poison, from head to toe, their boots full". Working in the mist of chemical spray is difficult to escape, as it gets "everywhere". Your "clothes get soaked in it" and it is "inhaled". Chemical spray is on, and in, the body, just as it is on, and in, the plants and atmosphere. Here, Jose describes entangling with chemicals and plants as the coca bush takes shape as it grows:

"When I am doing the second fertilisation I put plastic around here [like a skirt, covering legs and above boots], to stop it getting wet here, because the hose gets you wet, it spreads over the bushes and spreads over you... Because the plant has more leaves, it [the spray] wets the leaves and then it wets you, you get wet as you go past".

Interacting with chemicals is ubiquitous in this job, with most concern centring on pesticides. Here are some examples:

"Sometimes there have been accidents. Sometimes you are rinsing the cup [used to pour chemicals into the spray tank] with water and it splashes and falls into your eyes. And that stings terribly, so you have to throw water on it until it goes away."

"If this [spray] falls into the water and you go and bathe in it, it will sting your face. That happened to me one day. I left the pot [of water] and sprayed. And I forget about the water. As it [the water] was clean I went and washed my face. And it started to burn and burn, and I

couldn't stand it. [...] The breeze obviously took it [chemical spray] and it was left there in the water... It felt like I had been burned, my face was burning. That poison, yes, it's really strong".

"In the countryside you touch everything, don't you? When you're working. And sometimes it's time to eat or drink, and you don't wash your hands. You don't remember."

"If you're spraying and they bring your breakfast up to the field, because it's now quite far away, you eat without washing your hands, so you don't waste time going down to the channel or the well to wash".

"The poisoned sweat gets in your eyes and mouth".

Reducing the risk of chemical exposure when crop spraying is described in pragmatic terms. It requires "making sure that the poison doesn't splash off the undergrowth or plants so it doesn't get into your eyes" and "making sure that the breeze doesn't blow towards you" (see also below). The most common harm reduction practices mentioned included: avoiding poison getting on the face and into the eyes when spraying; "washing really well" when returning from the field; washing hands regularly and repeatedly (as many as "40 times in a day" for some, "when I refill the spray pump, when I go and drink water, when I eat"); wearing protective clothing to cover the body; and maintaining distance from family and others ("Nobody can come near me") until all clothes are removed and washed on return.

Many of these practices are, however, not routine. Gloves, masks and protective clothing, for instance, are rarely used: "Just rubber boots as protection, nobody wears anything else"; "Nothing, nothing, just the same as I look today, and everyone is the same". "Of course", we are told, the chemicals "affect you", especially the pesticides, but "you tell yourself 'nothing has happened to me', that 'nothing has happened to anyone', but no, there is a risk".

Everyday treatments for chemical exposure include: having a "good wash with soap" when chemicals are "impregnated into your skin"; taking time out from crop spraying when feeling "dizzy" or "intoxicated"; "throwing water over your head" when having a "headache"; applying cream (for instance, *Nistatina*, an anti-fungal medication) to irritated skin to treat the "pain" from "burning"; and drinking *agua panela* (water and sugar cane juice) when feeling "intoxicated with poison".

Care situated ecologically: wind, water and land

Farmers' accounts of chemicalised risk affecting health are situated in relation to the balance of livelihood survival and the care of the plant. Care, including for human health, is situated ecologically. Agency, and the capacity to care, is distributed in the ecology in these accounts: "You do not get to choose". The rain and wind are presented as prime elements in this co-dependency. Rain affects the capacity of chemicals to care for the plant. The issue here is farming 'know-how' when timing the spraying of the crop before the rain arrives, given the risk of rain washing away the chemical, rendering it useless, as well as terribly costly for the farmer, especially those who purchase their chemicals in single job lots or on credit. Farmers are ecologically attuned:

"You know your own land. When it gets dark over there, you can see that it's going to rain. But when it gets dark over there, it depends if the cloud is low... If it's dark as it is now, it won't rain, perhaps in the morning. But when it is dark over here, you stop, and in about two hours it is raining, so you have to stop, because otherwise there won't be enough time to kill the caterpillars".

The implication of this for chemical risk for the farmer is a tendency for some to *rush to beat the rain*, to get the job done as *fast as possible*, and this sometimes necessitates compromise when managing the risks of chemical exposure. As one farmer suggests:

"You go out on your work run, you must make the most of the weather. If it's going to rain later, and you get on with it, and think about the consequences later."

This brings us to the wind. The wind is a key actant affecting the chemical risks of crop care. As we are told, "the weather can do you harm", because chemicals are "carried on the breeze". For instance: "The cypermethrin burns your face. When the wind blows, and it's sunny, it makes you itch on your body, it's really harsh". Harm reduction in the field is a matter of "making sure that the breeze doesn't blow in [your] face", and "being really careful with the wind". Taking care in the wind is basic harm reduction 'know how':

"From the start he [father] said to me 'When you spray', he said, 'make sure the breeze doesn't blow towards you'. Yes, 'if the wind changes direction, go round the other side', he said. 'Don't let this fall on you, because it will affect you'. And it did. There are people who knew this. They knew how to spray and not be affected, but I didn't".

Despite such 'know how', care is a matter of multiplicity and balance – for the plant, for the farmer, for the realisation of livelihood – which is affected ecologically. Getting the job done as fast as possible, for instance, is a reaction that resides in an atmosphere of urgency and insecurity linked to various extinction threats, from anti-narcotics and military interventions to rain and the elements, with consequences for increasing the risks of chemical exposures: "To finish quickly, you have to spray against the wind. And the wind blows all the poison onto you. You carry on against the wind whatever, so that you finish faster". Care for human health and for livelihood is in balance with care for the crop, with risk affected by the ecology:

"You release the jet, and if the wind comes towards you, you'll end up with poison on you. You see people who are covered in it... Or there are people who don't look, or went too quickly. Or even worse, are there for the day. You don't care, it's a job. It's about getting the plants done quickly".

"People know, but they don't pay attention... Because earning money is more important than risking health. [...] They don't take any measures. That's how you make money, how you get on. So, some pay for this with their health, don't they?"

Care in relation to the land is also a focus. This is about balancing crop quality and efficiency to extract a good return whilst protecting the land from degradation through having become "overworked". A particular, and highly politicised, concern here is land clearing and deforestation – for the coca plant "likes air and sun" and thus space "with hardly any trees". Here is an account of farming which attunes care towards the land:

"People should have fewer fields, but better planted fields. Produce more and use less. Use fewer forests and fewer mountains, fewer stubble fields. Chop down less, definitely chop down less. Chop down less nature to produce more coca."

Mateo links care of the land with a more careful, discriminate, approach to farming. He says "people shouldn't plant so many fields and should plant them well, plant them with a better quality plant. Don't just plant any old plant that comes your way. No, *choose your plant*, from good seed" (emphasis added). More careful and ecologically attuned farming means that "I kill less on that one hectare and produce more". "Without so much coca scattered around", there is "more coca production"; less waste and the slowing down of land degradation.

But this is a question of resources. As Mateo also comments, many "do not have the resources"; "They don't have enough to buy the seed"; "They can't get the money to replant the field"; and "Sometimes the seed is far away, so it's hard for them to transport it". He says: "If they manage to buy it, they don't manage to transport it. And if they manage to transport it, they don't manage to sow it. Because it all costs money:

buying it, transporting it, sowing it". Choosing – for instance, “good seed” and “a better quality plant” – is agency that is *distributed in the ecology*; not simply a matter of human-centred economic trade-off, but an effect of ecologically entangled economic imperative. Harm reduction efforts to care for the degrading land, for instance, by “adding soil”, and replenishing by “bringing in bulk bags” of new soil, as well as by fertilising “several times when the earth is more depleted”, is also ‘choice’ constrained: “Of course, it costs more”. Furthermore, the displacement and fragmentation of coca cultivation into multiple dispersed plots is an attempt by farmers to ‘spread risk’ in the face of eradication threat, as they hedge their bets trying to keep their crops and livelihoods alive, a practice not without ecological disturbance (Rincón-Ruiz & Kallis, 2013).

Lastly, there is an attentiveness to violence as endemic to farming, for instance, when balancing the right to life of living things with the care of the crop (See also Kazic, 2022). Here, the eradication of pests becomes open to question in proposing a care for the crop that might be done otherwise, without chemicals that harm. The proposal here is “maybe replacing the chemicals with organic ones”, to “repel” rather than “kill”, to live-with rather than eradicate:

“It kills so much. All these poisons kill so many little creatures. While organics just repel them, they repel them... Only with chilli, and all that stuff, it’s only to repel them, it’s not to kill them. And the creatures are still alive. For example, the little birds that come and eat these little poisoned creatures and can die, these little caterpillars and everything, that could be avoided too.”

Processing coca

The process of transforming coca leaf into paste can be described in five stages (Acero et al., 2023; Aschner & Montero, 2020). First, there is macerating and salting the leaf. Lime (an alkaline) is added to leaves scattered on the floor of the laboratory which are chopped with a strimmer. Some farmers also add an ammonia-based fertiliser. Second, coca free base is extracted into a solvent. The macerated mixture is made wet with rainwater and put into big plastic drums, with gasoline added to absorb the alkaloids needed to produce cocaine from the leaves. Third, there is acidification and extraction. The gasoline is separated and saved for later. The leaf residue is discarded, usually into an adjacent field. The gasoline mix is added into water and sulphuric acid to extract the alkaloids. The coca free base has at this point been converted to a sulphate. With alkaloids extracted, it is called *agua de merca*. The next part of the extraction process is separating the *agua de merca* from the gasoline. This is done by sucking on a hose to syphon *agua de merca* from the bottom of the drum (Acero et al., 2023). Using a hose is faster than using a cup or a plastic bag to separate the gasoline, though riskier, as it may lead to accidentally slowing the *agua de merca*. Fourth, sodium carbonate or caustic soda with magnesium permanganate is added to the *agua de merca*, to convert it back from sulphate to base. Caustic soda is not essential but makes the process quicker. Lastly, the paste is filtered using a cloth rag to squeeze out as much water as possible, and dried on a wooden stove to extract any water and contaminants.

All of this work is done in “the laboratory”, usually a “simple construction of six wooden beams that support a plastic roof and old zinc tiles, a dirt floor and some boards that serve as walls but barely reach the knee, like a box” (Acero et al., 2023). The laboratory protects the chemicals and the coca leaf from rain while being processed. Aside from proximity to water, it is critical that the laboratory is “hidden” as this means that “the army won’t detect it and burn it”. The cost margins are fragile. Farmers say “I pray to God that they don’t burn down the laboratory, I always pray to God that they won’t burn it down”, not only because of the income lost from confiscated product but because of having to re-build (for instance, “wood is scarce” and we “would have to buy it”).

Harm reduction in the laboratory

Farmers emphasise that great care is taken when handling chemicals when processing coca into paste, especially when adding sulphuric acid into water during acidification, extracting the *agua de merca* from the gasoline, and adding sodium carbonate or caustic soda with magnesium permanganate to the *agua de merca*. “You have to take care when you are doing this”, and “anyone who doesn’t have that knowledge, they shouldn’t go there”. Chemical exposures happen, for instance if the acid “spills, or you touch it with your hand”. As described when syphoning off the *agua de merca* from the gasoline by sucking on a hose:

“When I take the water from there, I have to be very careful. Because I put a hose there... to separate the water from the petrol, right? That’s where it gets dangerous. If you are going to suck it, and you swallow a bit... If you are going to suck the hose, you have to watch it, when the liquid comes up, you have to, bam!, spit it out. Because if you don’t, if it comes and you get a mouthful that could kill you.”

We hear of stories of accidents:

“He took a mouthful of water [*agua de merca*]... He only swallowed a bit. He said it was only around two teaspoons that he drank. And it almost killed him. He got so ill. Because the acid was eating away at his intestines”.

“I’ve drunk a tiny bit of it. Just a little taste, but it gets you. You feel like you’re drowning. You can’t breathe.”

And as described of the care that is taken when adding sodium carbonate or caustic soda:

“As soon as you start pouring it, the water makes bubbles, it goes trrrrrr, like that. [...] You pour the water *really carefully*, because if you go “bam!”, it’s going to splash up and it might fall on you.”

Again, we hear stories of accidents:

“He was fearless. He said ‘Oh, it looks like milk’, and he licked it. He did that and swallowed it. The man came here and died. He had a heart attack, just like that.”

The emphasis placed on “being careful” in the laboratory, on “having to take care with these substances” is in balance with getting the job done quickly and efficiently, given that “you have to move quickly”, doing “everything fast”, especially “when you see that the army is near” (See also Acero et al., 2023). Mateo, for instance, continues strimming to macerate the leaf to get the job done up until the moment the military arrive at the laboratory:

“The boss said keep going until they are here... I was still going when they came. We turned off the strimmer and they said they were going to burn down the laboratory. Then, the boss asked for help, and the men felt bad, I’m sure, and they only burnt down a few things... They left, we rebuilt it again. We carried on.”

Care in the laboratory is compromised by speed:

“You don’t protect your hands, eyes or nose. You are always here in a hurry, and so there are risks. For example, I could get gasoline and acid on my body and then I would get burned, or even suddenly catch fire. What happens is that the hurry doesn’t let you be careful”.

Care situated ecologically: water and chemical alterlife

Care in relation to the chemical risks of processing extends beyond farmer’s concerns for their product, health and livelihood to include matters of environmental concern. In processing coca, for instance, most materials find their way back into the environment: “The only thing that is reused in this process is the petrol that is left over for next time. The rest doesn’t, it all goes”. Here we see contamination as a process in

which people, with other elements in the ecology, ‘become-with’ their altered environment. Alejandro captures this when he says: “We ourselves are polluting, we are poisoning ourselves”.

A primary concern here, for instance, is water, and specifically, how chemical exposures might flow through water channels and wells; water that is used for washing as well as drinking:

“Where you fill up the tank [for crop spraying], you can’t leave poison. Because it would get on us, wouldn’t it? We’d be at risk. And downstream, there may be a person who is drinking that water, so for them it’s bad. [...] You don’t pollute the river. [...] Because you can’t be sure nobody is drinking the water.”

“Sometimes the channel rises up, and the bag [of discarded chemical containers] gets carried away, and there’s a trail of bottles in the channel”.

Farmers try to take care not to contaminate the water flow by keeping contaminated materials – chemical containers, water collection containers, crop spraying tanks, water and liquids discarded when processing, and discarded coca leaves – separate from the main water channels and wells. Some, for instance, will dig a shallow well away from the channel for use when re-filling their crop spraying tanks (in which there is herbicide, fertiliser or pesticide). For instance, care is taken to dispose of discarded materials used in processing in a single place protected from flooding risk or water flow:

“You throw it away. Somewhere over there, as long as it doesn’t go near the channel, and is far away from the crop, most importantly far away from water... You throw it out down there, and wherever it falls, the grass dries out, it burns. Acid is acid.”

You throw these onto dry ground. It has to be very dry, where the water gets sucked up, like here, I throw it under the house. That keeps it dry, it sucks it all up, it doesn’t even come out of the straw.

The disposal of chemical containers – the “poison bottles” – is a particular environmental concern:

“I don’t keep the bottle but throw it over there, and I throw another, and another, and another, and they still have poison residue in there. When it rains, that bottle fills up and the water flows back again, and you can’t drink it. [...] You see bottles everywhere; we don’t deal with those empty containers... There are loads of bottles in that undergrowth over there, where there used to be coca. You find bottles left there from eight, nine or ten years ago”.

Most bury or store the used containers as a measure of harm reduction, conscious that burning them risks “damaging the environment” and that discarding them risks containers eventually entering, and then contaminating, the water system, as “the floods come and carry it off to your neighbour”. But there is only so much container that can be buried or stored before having to burn these (“Just like I did today, I rinse it twice, put the lid back on and then it goes in the hole. When it gets really full, it’s time to light it”).

The safer disposal of discarded coca leaf used in processing raises similar environmental concerns:

“You don’t want the leaf you throw away to fall where the water is, because it can be bad. So, you avoid anything that is not far away from the channel, from the natural ponds, or where the water springs from.”

Some suggest that in time – “at least after five, six or seven years” – discarded coca leaf will decompose and “becomes like a fertiliser” that can be recycled back into the environment:

“It turns into really black, black earth, and it makes such a powerful fertiliser. You can put it on the bananas and all that, and they go beautifully green. Or your garden plants, and they grow beautifully. There are people who use it for onions, tomatoes, everything...”

There are doubts regarding the ‘vague causations’ of chemicalised ‘alterlife’. As deliberated regarding the decomposition and recycling of discarded coca leaf, and of materials with traces of petrol:

“I think it’s dangerous, so I didn’t use that fertiliser again. Because you can see, it must be true, because you think about it, and say it has petrol in it, lime, nutrimon, all those things, you put in the petrol, and the acid that goes in, that is also there. So all these chemicals must be bad. If residues are left in the earth, the plants eat those residues, and so they are going into the fruits, and that could harm you. It makes sense doesn’t it?”.

“They say the earth stays contaminated with lead,³ because of the petrol and everything, so it gets in the food. Well, people say this sort of thing. And if you don’t understand science, sometimes you believe it, sometimes you don’t”.

The care and concern of risk to the environment voiced by the farmers contrasts in their accounts with the indiscriminate ecological damage wrought by the aerial fumigation of crops using glyphosate in state crop eradication efforts, affecting food and water:

“They spray everywhere. They don’t see that the [water] channel is there. They are like jets of poison. And the channel is down there and they don’t notice that it’s there. So lower down people are taking water from this channel. For example, this tree was sprayed with poison, or the mist went on the banana, the mist went on it, and a stain appeared. Sometimes it goes away with time, then after a while you cut a bunch of bananas and eat them, and that’s how you get foods with residues of poison.”

“They contaminate the water, they contaminate the food, the atmosphere. They come and fumigate the crops, and it dies, and the little that there is of *cassava*.⁴ The aerial fumigations affect health, and also your consumables.”

Risk neutralisation and carrying on as normal

The cultivation and processing of coca is necessary for livelihood, and this contextualises the experience and narration of risk. In farmers’ accounts, risk is not absented, but it is pushed back from attention. We are told, for instance, that “*deep down*” there is a sense of harm, and that the chemicals used are “*said to be harmful*”. There are three ways that risk seems neutralised in farmers’ accounts: It is presented as a problem *deferred* to another and *future time*; it is presented as routine and *mundane*, even *uneventful*; and it is presented as *uncertain*, as a matter of *vague causation*.

The extract below is an example of *risk deferred*. Here, it is said to be a matter of time before risks become actualised as harms. Future harm may be presented as a consequence of accidental exposure yet to happen, or because chemical harm is an uncertain ‘slow burn’ toxicity that builds into the future. Harm is anticipated, even while care is taken in the meantime:

“I’ll tell you one thing. In time, whatever happens, there will be consequences for someone, because they’re toxic. They are poisons. And if you don’t handle them [chemicals] properly, they can make anyone dizzy. It hasn’t happened to me, but there are people who have had problems. There are people who get problems, marks on their skin. You just guess it’s down to that—marks on your skin, hives, you get rashes, hives, allergies. So we guess it’s down to that, because what else can it be? [...] Of course, in time, it will have consequences for our health. If you are not handling it properly, if

³ We cannot verify whether there is risk of lead contamination because unleaded petrol has been available in Colombia since around 1995.

⁴ Here *cassava* refers to fertile land, cultivated by farmers.

you put your hand in it, and it gets on your face, or it drips somewhere, and if you don't have it under control."

As commented when looking back at many years of having cultivated coca:

"I know it's bad but you don't feel it at the time. It's later, like now, the poisons are already starting to harm me... I have sprayed a lot, and I don't care, I mean, it's not instant. You feel like it's burning your eyes, you feel something, it's not like you are going to get ill from it, but you feel like it's bad for you. You can see it happening. The breeze can harm you in time. [...] Old age is coming. Even if you've taken care of yourself, old age is coming".

The narrative of risk deferral is not only an account of future harm potential to the self but is also a navigation of collective "conscience". Commenting on the discarded chemical containers "piled up in the river", chemical risks deferred, according to some, "should be on everybody's conscience, otherwise we will have so many health problems in the future". As Jaun says of the potentiation of environmental risk linked to the discarding of contaminated containers, "even though we know we shouldn't, we do it". He says of the anticipation of illness to come that "so far my time has not come", but "God forbid, it would affect the family and everything because who will provide food for the household?". Deferred harm habituates the presence of risk in the everyday, making it 'uneventful', a necessary contamination of economic imperative.

Here is an example of *risk made mundane and uneventful*. The chemicals used, in this case for crop spraying, are enacted as "not so toxic" because the animals that come into contact with the poisons are evidence of survival. The chickens "carry on as normal" while "covered in poison":

"Those poisons are not so toxic because those chickens, they eat the worms that are wet with poison, and they eat them, and they go under where you are spraying, they get in there, their neck comes out wet with poison, and they don't die, they don't get intoxicated. They carry on as normal, covered in poison."

'Carrying on as normal' is a way of living-with the chemicalised ecology for farmers as they go about their essential daily work.

And here are examples of risk neutralised as *vague causation*. The theme of vague causation is a feature in accounts of the uncertain and slow-burn effect of chemical exposures over time:

"It gives you such fatigue, tiredness. It makes you tired. [...] I hardly do any other work apart from spraying and harvesting, and sometimes sowing. [...] I don't think it can be due to any other task, can it? I think that it might have something to do with the spraying".

"When I'm spraying for three days in a row, I always get a burning in my eyes, and it makes my eyes water... I have to use eye drops. [...] That's why I say that it could be because you mess around so much with it [chemicals]. I blame it on that. I'm not sure. It could be that. Or it could be my age. Or I don't know, it could be the poison."

"For some time now he has had a pain in his chest... He does not know what it is. There are times when he doesn't have it, and there are times when he does... He did say to me, 'Could it be the chemicals that are doing me no good?'"

Without certain cause, not feeling well is difficult to account for. There is essential work to be done. Carrying on as normal is a feature of accounts emphasising vague causation:

"You feel uncomfortable because of the weather. But you don't know if it is caused by the poison, the fumigations, or if there are just problems in your life. You go to the doctor and say, I'm here for this or that, but there are no doctors here who say, specifically, this is because of the fumigation, or this is because of how you handle your chemical supplies. That is why it's not certain. So, I can't say for sure

that the supplies are harming me, I mean the chemicals. I don't have a medical report that says this is harming you. Since I don't have that, I'll continue sowing coca and spraying."

Discussion

Dimitris Papadopoulos writes:

"The toxic regime is a primary source of conflict and war. Elemental destruction, contamination, pollution, climate change, extractivism, and resource depletion render parts of the planet uninhabitable and in turn, perpetuate social injustice. Since anthropogenic chemicals are deeply embedded in matter and operate on temporal registers that are beyond the human, it seems impossible for societies to revert to the ontological configuration of a nontoxic and conflict-ridden Earth". (Papadopoulos, 2021: 35).

Papadopoulos and colleagues also write: "For those who labor, and those who live downstream from the toxic ecologies of late industrialism, the elements and their rearrangements are simultaneously hazards, harms, and hopes" (2021: 7).

We can see parallels with the chemicals used in the care and extraction of potential in coca's cultivation and processing. Chemicals afford life and livelihood, to plants and humans, in the coca economy. These are precarious lives whose existence and agency is made fragile in ecologies shaped by various unpredictable threats – from the wind, rain, land, and leaf eating insects, to military campaigns to eradicate crops and destroy laboratories in a global war and economy linked to coca. The chemicals that assist coca's fragile affordances are at once life giving and life harming. Chemicals, in collaboration with other elements, human and nonhuman, create a conflicted ecology of 'contaminated' living (Murphy, 2008; Tsing, 2015).

Humans are not unaware of this. The *cocaleros* in our study engage in practices of risk neutralisation and risk deferral, which in conjunction with narratives of vague causation, help adapt to a contaminated life with chemicals. There is work to be done to sustain livelihoods; essential labour that is assisted by chemicals. Adapting to life that becomes-with chemicals, and the harms these create, sometimes vague, sometimes less so, demands, through economic imperative, that toxicities are made, at least to some extent, *uneventful*. Chemical harms, in different ways, are pushed back from human attention, as matter that will become, in the ecology, in the future, in a situation of co-dependency.

Elements of hope, harm and cruel optimism

The chemicalised harms and hopes that flow through the labour of coca's cultivation and processing are features of what might be described as a 'cruel optimism' generated by the promise of the illicit drug economy (Berlant, 2011). Luran Berlant outlines 'cruel optimism' as the suffering and harm that is the by-product of the lure, and unrealised promise, of economic and social success embedded in late capitalist systems of extractive capital. In patterns of habituated structural violence and inequality, here materialised in chemical harms, there is what Berlant calls 'slow death' (Berlant, 2007), a situation in which the experience of perpetual harm becomes uneventful, even beyond attention or resistance. Adaptations to chemicalised living in-the-now, through practices such as risk neutralisation and risk deferral, anticipate chemical harms as slow burn yet uncertain potentialities of the future. Toxicity becomes a 'slow death' that is made relatively 'uneventful', at least in-the-now. Toxicity is made relatively 'liveable', all the while coca affords a (contaminated) living. The promises of coca that are enabled by chemicals in the face of contaminated environments as well as crop eradication threats – such as money, food, access to health, medicine and education, and so on – are never free of, and depend on, the contaminated ecology. This then, is a cruel optimism, a hope with harm, a life with contamination, a livelihood incredibly precarious and

possibly short-lived.

This brings us to how care and capital is a creative balance of ecological situation (Mol, 2008; Law, 2010). We have highlighted here, as in our previous work (Acero et al., 2023), that the cultivation of the coca plant is a practice of care, assisted by chemicals, that at once also cares for livelihood. The ‘cruel optimism’ of care accentuates how the care for coca invites risk to farmers and the living environment, by incorporating “non-living ways of being” in the “open-ended gatherings” making-up the ecology (Tsing, 2015: 23). Care here – to plants, people, livelihoods and environment – is a multiplicity that is in tension (Mol, 2008; Law, 2010). In his study of veterinary practice in the UK’s foot and mouth outbreak in 2001, John Law attends to the “multiple cares” in tension, mapping how the four objects of care of ‘caring for the animal’, ‘caring the farmer’, ‘caring for the self [vet]’, and ‘caring for the bigger picture’ are held together simultaneously, yet in uncomfortable, even “chronically problematic”, ways. We can see this awkward, and chronically problematic, balance of cares in the economy and ecology of coca’s cultivation, for plants, people and environments. A good care for one element in the ecology affects the good life of others (Mol, 2008; Krzywoszynska, 2019). Care becomes an “art”, according to Law, of “holding” multiple “versions of care in the air without letting them collapse into collision” (2010). This to us speaks of harm reduction.

Practices of care for the crop then, also seek to reduce risk and harm, to self and environment, to the extent that this is possible while protecting coca’s economic and other potentials. Care in the laboratory, for instance, involves being careful with chemicals, though not without accidents and chemical exposures, in part prompted by the atmosphere of urgency generated by the threats of crop eradication and enforcement intervention. Care focused on the environment seeks to reduce the risk of chemical waste and spills, including into land and water, though not without limits given the economic imperative to get work done. Chemicalised risk, to self and environment, entangles with the care that is done for coca, made worthwhile given the short-term promise of a life more liveable in the face of extinction threats. And as our study has also emphasised, critical to how care is done – for plants, farmers and environment – as well as to how care infuses risk, is Nature¹ itself. The elements of wind, rain, and land play an unpredictable yet critical role in the life of chemicalised risk, as the accounts of farmers emphasise.

Ecological harm reduction

Harm reduction in the field of illicit drugs focuses primarily on reducing the human harms of drug use. Where there has been focus on the environmental harms of drugs production, it has tended to focus on the collateral damage of the illicit drugs economy (Brombacher et al., 2021; UNODC, 2022), and on reducing supply, including through (largely failing) alternative development initiatives (Gootenberg & Dávalos, 2018). A narrow harm reduction perspective here might re-orientate attention towards ‘occupational health’ for workers in the drugs economy. There is potential, for instance, to develop safer working conditions by learning from other areas of farming involving chemicals (Sarkar et al., 2021), including toxic pesticides such as organochlorines, organophosphates and carbamates (Varona et al., 2010). But our analysis emphasises how the labour which cares for, as well as extracts potential from, coca is embedded in patterns of structural violence which trace to global as well as local conflicts in the coca economy. Here, chemical risks are affected by, and materialise, drug, economic and other conflicts (Murphy, 2017; Lyons, 2018; Liboiron et al., 2018). The chemicalised risks of coca’s cultivation highlights “the multiple levels at which our material entanglements – be they cellular, chemical or commercial – might be connected to global politics” (Tsing, 2015: 192). For these reasons, ‘occupational health’ is too narrow a framework for reducing harm related to work in the illicit drug economy. We need, instead, to think and act ecologically.

Ecological harm reduction not only focuses on the structuration of human-centred health in the risk environment, but attends to the biotic,

as well as ‘more-than-natural’, dimensions of health, in which the environment itself is a concern of harm reduction. Attention towards the ‘more-than-human’ dimensions of drug harm have tended to narrow around drugs, technology, and the built environment (Vitellone, 2017; Duncan et al., 2017; Dilkes-Frayne, 2014; Dennis, 2019). ‘Nature’ does not hold much presence in these accounts. The lost ecology of the biotic is an ironic consequence of efforts to trace risk as a materialised effect of environment. We need to move from an approach which splits off for attention different constitutions of risk environment – social, economic, political, and so on – to also incorporate the ‘natural’, as well as to think holistically in relation to ecology (Latour, 2018; Papadopoulos, 2021). Our case study of chemicalised harm in the coca economy, for instance, accentuates health at once as economic imperative and as ecological matter. For this reason, we emphasise that the ‘natural’ is always ‘more-than-natural’ – an emergence affected by the coming together of human and nonhuman elements – just as the ‘human’ is always ‘more-than-human’ (Latour, 2018; Braidotti, 2013; Van Dooren et al., 2016).

The tendency to configure the biotic as simply ‘natural things’, as separated ‘out there’, and thus dislodged from harm reduction attention, fails to appreciate care as *always* an entanglement of more-than-human and more-than-natural agency (Puig de la Bellacasa, 2017; Lyons, 2014). In this sense, the environment is already incorporated, already altered, in harm reduction efforts (Murphy, 2017); as illustrated here in the ecologically infused accounts of farmers as they navigate the multiplicity of care linked to coca’s cultivation. Harm reduction is a practice of care that seeks to navigate the multiple recursions of ecological contamination in which the environment has *always had presence*. We are perhaps then, making belated recognition of the biotic environment, and Nature, as matter of harm reduction concern. In this moment of ‘ecological turn’, harm reduction is re-assembled to not only focus on human-centred health but on the health of the environment as well.

Ecological harm reduction involves navigating networks of care which are unavoidably a matter of balance (Mol, 2008; Law, 2010; Krzywoszynska, 2019); an art in managing interactions of ‘more-than-human’ and ‘more-than-natural’ effect, for instance, between livelihoods and environments, economics and Nature (Papadopoulos, 2021). The balancing of multiple cares, and risks, in the contaminated ecology, as we have seen, is “not always pretty” (Tsing, 2015). Yet re-assembling harm reduction as a balance of cares for humans, other living things, and environments, invites a different way of doing harm reduction. In the case of chemical harms linked to coca’s cultivation, for instance, it not only highlights occupational health and safety for farmers and their immediate working environments as a priority, but it also invites proposals that protect and sustain the ecology in the presence of the coca economy, through reducing the use of toxic chemicals and mitigating against their deleterious impacts on fauna, flora, land and water. This could, for example, include work to ascertain the role of organics instead of toxic chemicals in coca’s cultivation, the recycling and safer disposal of contaminated waste and materials, and the safer regulated supply of chemicals used in the industry. Ecologically oriented practices of care, however, are also contingent on reducing or removing the structural harms linked to the coca economy, especially the criminalisation and forced eradication of coca’s cultivation upon which livelihoods depend. An invitation towards an ecological harm reduction emphasises that we are not alone as elements in how harm and its reduction is done. We – people, plants, land, chemicals and other elements – are “in this together”, even “if we are not one and the same” (Braidotti, 2020).

Research ethics approval

This work was approved by the research ethics committees of the London School of Hygiene and Tropical Medicine and Faculty of Human Sciences of the Universidad Nacional de Colombia.

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Declaration of Competing Interest

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