

An Environmental Justice Perspective on Smallholder Pesticide Use in Sub-Saharan Africa

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Ellinor Isgren¹  and Elina Andersson¹

Abstract

Pesticide use is increasing in many parts of sub-Saharan Africa, and many smallholders purchase, handle, and apply toxic pesticides with inadequate equipment, knowledge, and technical support. Through the frame of environmental justice, this literature-based study analyzes characteristics, impacts, and drivers of smallholder pesticide use in sub-Saharan Africa, with particular attention to Uganda as a case. We find that market liberalization, poor regulation enforcement, and persistent neglect of agricultural extension place the burden of risk largely on farmers, while perceived necessity of pesticides and the elusive nature of impacts (especially under conditions of insufficient monitoring) likely delay social mobilization around pesticides. The environmental justice frame, which has seen limited application in smallholder contexts, importantly helps delineate future directions for research and practice. It is particularly effective for redirecting focus from highly limited managerial solutions for “safe use” toward deeper problem drivers and solutions capable of tackling them.

Keywords

agrochemicals, environmental health, environmental justice, integrated pest management, pest management, pesticides, slow violence, smallholder farming

¹Lund University Centre for Sustainability Studies (LUCSUS), Lund, Sweden

Corresponding Author:

Ellinor Isgren, Lund University Centre for Sustainability Studies (LUCSUS), Lund, Sweden.

Email: Ellinor.isgren@lucsus.lu.se

As part of ongoing pushes for agricultural modernization, pesticide use is increasing in many parts of sub-Saharan Africa (SSA), including in the smallholder sector (de Bon et al., 2014; Sheahan et al., 2017). In this article, we investigate in what ways it is relevant and useful to frame pesticide use in smallholder agriculture in terms of environmental justice (EJ). Our effort originates in a study conducted in 2018 in Paya subcounty, eastern Uganda. As we sought to understand the everyday realities of crop pest challenges in times of climate change, we observed how pesticide use had become norm rather than exception—contrary to the common notion that Ugandan smallholders are “organic by default” (Isgren, 2018a; Preißel & Reckling, 2010). Our survey of 200 farmers found that 84% used pesticides, commonly accessed through informal channels. A vast majority handled pesticides without appropriate (or indeed any) protective gear, with limited knowledge about the chemicals, and no means of safely washing equipment or disposing of empty containers. Most farmers were, however, well aware that they are exposing themselves and their surroundings to risks. Symptoms such as coughs, headaches, running eyes, and itching skin after handling pesticides are common yet have come to be seen as a necessary evil. “The tears just roll from the eyes,” one farmer described, “but because these things are so helpful to us, we just endure.” Even if many know they should use protective gear, there are often more urgent household needs. Thus, a farmer jokingly stated, “we, as poor people, we just go like that, without gloves and these other things. We just go directly to death” (Andersson & Isgren, 2020).

This situation is not unique to Paya or to Uganda. As countries across SSA have sought to “modernize” agriculture through rapid market liberalization and privatization, pesticides have in many places become more accessible and affordable to smallholder farmers while being actively promoted by private actors and/or public extension agents. A ubiquitous ideology that equates pesticides with modernity also fuels the trend (Luna, 2018). Meanwhile, the cutbacks in public service delivery that began with Structural Adjustment Programs have limited governments’ capacity to effectively regulate markets and ensure that farmers receive adequate training and equipment. Thus, millions of smallholders have adopted pesticides without the support needed to minimize the many associated risks (de Bon et al., 2014; London & Rother, 2001; Mengistie et al., 2017). Pushes for a “green revolution” nonetheless continue to encourage or even impose input-intensive forms of agriculture across the continent (Dawson et al., 2016; Moseley, 2016), and the agrochemicals industry plays an active role, having identified Africa as the last “open frontier” (Mbilinyi, 2012). By global standards, pesticide use in much of SSA is still low but has been observed to grow alongside gross domestic product (Snyder et al., 2015), which aligns with global trends (Hedlund et al., 2020). Furthermore, pesticides “can be a concern even at low national rates of application if they are used inappropriately” (Semalulu et al., 2005, p. 162). For example, Uganda officially has some of the continent’s lowest pesticide application rates (Loha et al., 2018),

yet the European Union recently issued repeated warnings to Uganda regarding chemical residues on agroimports (The Independent, 2019).

It is well known that many agricultural pesticides pose risks to ecosystems and human health, which tend to affect certain social groups disproportionately. This has led to framings of pesticides as an issue of EJ among scholars and activists. Typically, this work has revolved around pesticide use in large-scale, input-intensive operations, which put farmworkers and nearby communities at risk (Arcury et al., 2002; Harrison, 2011). In this article, we ask whether smallholder¹ pesticide use in places such as Paya can be meaningfully framed in terms of EJ. We address this question through a two-stage literature review, where we first identified EJ dynamics of smallholder pesticide use in the case of Uganda, and then broadened our focus to SSA as a whole. Based on our findings, we argue that the unequally shared burdens and power asymmetries clearly resonate with and benefit from an EJ framing. By shedding new light on smallholder pesticide use and its deeper drivers, and drawing attention to the serious yet poorly monitored risks faced by smallholders, the EJ lens helps to identify important knowledge gaps and future directions for research and practice.

EJ as an Analytical Frame

As an analytical frame, EJ integrates social and ecological concerns in the examination of the unequal manner in which environmental stressors tend to be distributed in society. Thus, EJ scholarship explicitly links “green” concerns to class, race, gender, and social justice to uncover when, how, and why marginalized groups and communities have borne the greater burden of environmental problems (Bullard, 2008; Taylor, 2014), often with close links to social movements (Brulle & Pellow, 2006; Schlosberg, 2013). As such, it is a politically charged concept that calls for mechanisms for “assigning culpability” and “redressing the impacts with targeted remedial action and resources” (Cutter, 1995, p. 112). The notion originated in North America and is rooted in the struggles of poor (often minority) communities exposed to hazardous land uses like waste sites and polluting industries (Mohai et al., 2009; Shriver & Webb, 2009). However, research from the past few decades has shown that it is analytically useful for a wide range of issues across the globe (e.g., Mkutu et al., 2019; Schroeder et al., 2008; Sze & London, 2008) and can function as an effective frame for popular mobilization (Čapek, 1993).

Over time, influenced by the work of theorists such as Nancy Fraser (2000) and Iris Young (1990), the conception of justice in EJ scholarship has come to include (at least) three distinct yet interlinked dimensions: distribution, recognition, and participation (Schlosberg, 2004). Distributive dimensions relate to how material resources, goods and “bads” are distributed between groups in society, while recognition refers to the cultural sphere and has to do with how social groups are viewed, valued, and represented in society. In the context of

EJ, scholars have emphasized that recognition also relates to different ways of perceiving and valuing nature (Martin et al., 2016). The third dimension, justice in the political sphere, emphasizes equal opportunity to participate in political processes and decision making, with EJ scholarship pointing to the significance of community self-determination in regards to environmental matters (Cole & Foster, 2001). EJ movements around the world tend to reflect the intertwining of all three dimensions (Schlosberg, 2004), as, for example, seen in their calls for respect and representation alongside redistributive claims. Most recently, scholars have increasingly proposed that a “capabilities approach”—rooted in the work of Sen (1999) and Nussbaum (2011)—offers a particularly inclusive framework for understanding EJ concerns and struggles, as this notion encompasses “a range of basic needs, social recognition, and economic and political rights” (Schlosberg, 2013, p. 40).

In the EJ literature on food and agriculture, agrochemicals constitute a central concern—particularly pesticide use in large-scale agriculture and its effects on farmworkers and surrounding communities. Outside of North America² the geographic context that has received the most scholarly attention is Brazil, with its highly unequal land distribution and state-led promotion of chemical-intensive agroindustrial production. Here, Porto (2012) argues for EJ as a useful lens for exploring unequal effects of agrochemical use in large-scale monoculture farming and as a mobilizing “rallying point” for different groups affected by hazards and risks. In the African context, little has been written on pesticides from an explicit EJ perspective, though numerous studies have noted growing exposure of smallholders to risks (Day et al., 2017; Sheahan et al., 2017), and others have demonstrated the particular vulnerability of certain groups, such as women and youth (Naidoo et al., 2010; Nyantakyi-Frimpong et al., 2016; Rother, 2010). Luna (2018) applies the closely related notion of environmental inequality to pesticide use among Burkina Faso cotton farmers and embodies the central ambition of EJ scholarship by revealing deep ideological and material forces that produce unequal outcomes. In the South African context, London and Rother (2001) and London (2003) have also discussed pesticide use in EJ terms. The latter study focuses on health hazards for farm workers, while the former extends the EJ frame to smallholder agriculture. London and Rother (2001) attribute smallholders’ growing pesticide use to macroeconomic policies geared toward commercialization, alongside failure to enforce existing legislation. They further point to institutional gaps that particularly affect smallholders, such as shortcomings in labeling, registration of chemicals based on optimal conditions rather than the typical conditions under which smallholders operate and difficulties accessing medical services. Clear from this research is that smallholders are exposed to pesticides in distinct ways and that structures well beyond the local level shape smallholders’ practices and risk exposure. Both aspects indicate the relevance of an EJ frame, and in our analysis, we deepen and expand upon these initial insights.

Methodology

This article builds on a review of literature on pesticide use and impacts in SSA, conducted in two stages. We started with an in-depth, systematic review of literature from one country: Uganda. Our logic was that understanding EJ dynamics requires cross- and interdisciplinary perspectives (Agyeman et al., 2016), and beginning from a limited geographic scope enabled a more holistic approach than other possible delimitations (e.g., disciplines, journals). While there is no recipe for applying an EJ frame, we sought mainly to (a) understand social differentiation of risks and impacts and (b) critically assess problem drivers and existing solution efforts from both “above” and “below.” Throughout, we operated with broad definition of EJ that understands material inequality (e.g., economic, health), cultural misrecognition, and lack of participatory and democratic rights (Schlosberg, 2013) as interconnected issues that shape individuals’ and communities’ capabilities, or ability to be “free, equal and functioning” (Schlosberg, 2013, p. 15).

Uganda is one of many SSA countries where smallholders constitute the majority of the population, agricultural “modernization” is central to development ambitions, and pesticide use is relatively low but increasing (Food and Agriculture Organization of the United Nations [FAO], 2019a; Isgren, 2018a; Kateregga, 2012). While it might seem intuitive to select a country with relatively high pesticide use (e.g., South Africa) as the point of departure, we reasoned that this choice enabled us to more effectively identify EJ dimensions of smallholder pesticide use which broadly resonate throughout SSA (although we of course recognize that some oversights may have resulted from this). In November 2019, we systematically reviewed scientific literature using the Scopus database.³ As our focus was on crop farming, we excluded articles specifically targeting livestock management, indoor pest control, and disease vector control. We complemented the search using a snowball approach (via the references of the selected literature) to include additional relevant articles and trustworthy gray literature and ultimately analyzed 74 studies in depth. We summarized key findings in a table while also taking note of disciplinary orientation, before categorizing findings thematically (e.g., “pest management practices,” “health effects,” “environmental impacts,” “governance”). We then expanded our focus by strategically reviewing research reporting findings from other SSA countries from the past 10 years, guided by our tentative themes. On one hand, this led us to conclude that the general EJ dynamics initially identified are commonly observed throughout SSA. On the other hand, drawing on a broader range of studies deepened our understanding of those dynamics—especially as this brought in additional methodological and theoretical perspectives. Finally, using EJ as an analytical frame (as defined earlier), we reorganized our findings into the seven thematic areas introduced in the next section.

Analysis: EJ Dynamics of Smallholder Pesticide Use

Through our two-stage literature review, we identified seven thematic areas where an EJ frame contributes to deeper understanding of smallholder pesticide use in SSA. The first four revolve around social differentiation of risks and impacts, while the final three address the limitations and implications of existing responses and interventions:

1. The particular vulnerabilities of smallholder farmers to health risks;
2. Social differentiation of health risks in smallholder settings;
3. An unequally shared economic burden from pesticide use in smallholder contexts;
4. Risks beyond the farm resulting from pesticide drift and pesticide residues;
5. Data gaps, inconsistencies, and unreliability undermining effective responses;
6. The limitations of the dominant “safe use” paradigm; and
7. Emergence of, and barriers to, popular mobilization around pesticide use and impacts.

In the following sections, we elaborate on each and use our more comprehensive review of the Ugandan literature to add depth and concretization.

1. The Specific Vulnerabilities of Smallholders

It is very difficult to say exactly how many smallholders in a given country use pesticides and to what extent, as we return to under Point 5. However, what makes smallholders a vulnerable group is not necessarily the amount of pesticides they purchase and apply but *how* and under what *conditions* they use pesticides. A consistent finding regarding smallholder pesticide use in SSA is the prevalence of highly unsafe handling practices. This includes lack of proper (or any) personal protective equipment (PPE) such as gumboots, gloves, or long-sleeved shirts as well as inappropriate practices such as improper dosage and mixing of pesticides, unclogging nozzles with one’s mouth, spraying in windy conditions, spending longer time spraying than recommended, and not washing afterward (Aidoo et al., 2019; Lekei et al., 2014; Negatu et al., 2016; Oesterlund et al., 2014; Okoffo et al., 2016). One contributing factor is that few smallholders have received training on how to handle pesticides or interpret information labels, an issue that is further exacerbated when there are high levels of illiteracy (Idowu et al., 2017; Jepson et al., 2014; Naidoo et al., 2010). A lack of knowledge is not the only factor at play, however. For example, while low risk awareness can be a barrier to PPE use (e.g., Stadlinger et al., 2011), equipment may also be too expensive, locally unavailable, or uncomfortable (Okoffo et al., 2016). Another type of economic barrier is that farmers may be forced to do their spraying when resource are available, not when weather conditions are

optimal (Muleme et al., 2017). Farmers may also accept known risks because the perceived alternative—*not* protecting the crops—is worse (Muleme et al., 2017).

Most studies focus on pesticide spraying, but there are also problematic practices associated with purchasing, mixing, storing, washing, and disposal. For example, Aidoo et al. (2019) describe in a Ghanaian study how “most farmers dump [empty containers] in the farms or bush, some bury in the farm, a few burn them while others reuse for household purposes” (p. 876). Similar practices have been documented in several other SSA countries (Williamson et al., 2008). Furthermore, it matters how farmers access pesticides. One particularity of smallholder’s pesticide use is their dependence on unauthorized dealers, who often sell products of dubious quality and origin (Ndayambaje et al., 2019; Negatu et al., 2016; Okonya et al., 2019) and with limited knowledge about the products (Yami & van Asten, 2018). Many SSA countries struggle with the problem of illegally sold and/or counterfeit agrochemicals, which may be adulterated or contain banned compounds (Ashour et al., 2019; Okolle et al., 2016). Ashour et al. (2019) found that a majority of the herbicides sampled from Ugandan markets contained a different concentration than advertised. One way this can happen is when sellers repackage pesticides in small containers such as soda bottles to match smallholders’ lower purchasing power. Aside from enhancing the risk of adulteration, this also means the farmer loses access to the information label (Abankwah et al., 2013; Muleme et al., 2017) and increases the risk of accidental poisoning, especially among children (Aidoo et al., 2019). Taken together, these factors clearly illustrate the significant barriers to informed decision making and implementation of safety measures faced by this group of producers, in turn rooted in conditions of poverty, inaccessibility of education, and poorly controlled markets.

While an in-depth discussion of the health implications of pesticide exposure is beyond the scope of this article,⁴ it is important to note that they can severely undermine smallholders’ capabilities, as immediate symptoms commonly experienced by smallholders include headaches, tiredness, runny noses, nausea, dizziness, itching skin, blurred vision, and coughs (Idowu et al., 2017; Oesterlund et al., 2014; Okonya & Kroschel, 2015). Pesticides are also a common cause of acute poisoning in SSA, although many cases go unreported (Lekei et al., 2016; Malangu, 2011). Farmers’ vulnerability is exacerbated by living remotely (limiting access to medical services), and many rural clinics lack capacity when it comes to recognizing and treating symptoms of pesticide exposure (Pedersen et al., 2017). Finally, there are known links between pesticide exposure and several chronic diseases (Carvalho, 2006). On diabetes, for example, Azandjeme et al. (2013) write that “the growing and inadequate use of pesticides may well represent an additional risk factor for diabetes in SSA” (p. 437). Also growing incidences of cancer in Africa is believed to be partly linked to pesticide use (McCormack & Schüz, 2012).

2. Social Differentiation of Pesticide Health Risks in Smallholder Settings

A central theme in EJ scholarship is that environmental risks tend to disproportionately face the most socially marginalized groups, and in the previous section, we highlighted how smallholder farmers in Africa are particularly exposed to the toxic risks of pesticides. While we briefly indicated some underlying factors, an EJ perspective urges for explicit attention to the question of which material, cultural, and political processes create social differentiation of risk. Important to stress here is that these risks can be unevenly distributed also *within* this broad group of producers. As many scholars have noted, “smallholders” is not a homogeneous category but is internally differentiated, for example, in terms of gender, age, income and assets, educational attainment, dependence on agriculture, degree of market participation, and so on (Isgren et al., 2020; Morton, 2007). Within the Ugandan context, few studies on pesticide use and impacts actually analyze this in depth, despite the fact that most household surveys capture socioeconomic variables. Nonetheless, we saw in the literature that three (often interlinked) factors particularly shape the impacts of pesticide use on smallholder farmers and risk, creating a vicious circle from a capability perspective: economic status, education, and gender.

As indicated earlier, farmers who cannot afford products from certified vendors have an elevated risk of buying poor-quality, potentially more toxic products with faulty information. Inability to purchase PPE and other equipment and being forced to store products in one’s home rather than in specifically designated facilities are other obvious risk factors. Wealthier farmers (including smallholders) may even be able to outsource spraying; we found no studies on this, but industry actors have begun to actively promote such approaches (termed “spray service providers” [SSPs]) in several countries.⁵ Education matters for similarly obvious reasons, for example, when it comes to reading and comprehending pesticide labels that are usually written in English using technical language (Amoabeng et al., 2017; Rother, 2018; Stadlinger et al., 2011).

Gender commonly intersects with economic status and education level but is also a crucial factor in its own right. First, social division of agricultural and household tasks influence exposure, and second, biological differences influence health effects from exposure (Naidoo et al., 2008). In Uganda, national census data indicate that pesticides are more often applied on male-headed plots (de la O Campos et al., 2016), and Oesterlund et al. (2014) found indications of higher exposure among men, probably due to spending more time carrying the heavy knapsack sprayers. But while studies on gendered exposure to pesticide risks are scarce, several studies indicate that women in developing countries are exposed to pesticides at significantly higher levels than commonly recognized (London et al., 2002; Ngowi et al., 2016; Nyantakyi-Frimpong et al., 2016). Relevant to note is that pesticide application has increased not only in production of cash crops but also in more subsistence-oriented production (Williamson et al., 2008)

and that exposure can occur during other activities than spraying, including purchase, preparation, storage, washing of equipment and clothes, weeding, harvesting, and soil preparation. Some of these are predominantly done by women and have received little attention. This speaks to the need for attention to issues of recognition not only of smallholders as a group but also of subgroups within this category.

Finally, the issue of repackaging described earlier raises the question of risks to another relatively invisible group: agrodealers and vendors, especially in the informal sector. Few studies exist on this, but in the South African context, Rother (2016) describes pesticide vendors in urban informal markets as a group that is “trading health for income” while the government turns a blind eye. This is an important reminder that it is not only farmers that may be affected by growing pesticide use in smallholder settings. We return to consumers and environmental contamination later, but workers who sell their labor to smallholders (e.g., applying pesticides or working in fields postapplication) are also notably absent from the literature reviewed.

3. The Unequally Shared Economic Burden of Pesticide (Mis)use

Alongside health impacts, pesticide use also has economic consequences that disproportionately harm those afflicted by persistent poverty. First, of course, pesticides cost money. Little attention is paid within the body of literature reviewed to the question of how much money smallholders spend on pesticides;⁶ in Uganda, only Hillocks and Russell (2014) mention that insecticides account for up to 50% of input costs for Ugandan cotton producers (most of whom are smallholders). Of course, there are economic benefits attributable to pesticides (Cooper & Dobson, 2007), most obviously the potential for reduced crop losses and labor saving. However, pesticides do not guarantee this outcome, especially when used incorrectly or when resistance begins to develop. Furthermore, much of the pesticides used around the world are applied unnecessarily—perhaps as much as half (Pretty & Bharucha, 2015). For example, many Ugandan tomato growers spray twice a week, a number that could easily be reduced through better monitoring and agronomic practices (Karungi et al., 2016). Once again, illiteracy and limited knowledge about pesticides is a risk factor. In addition, sometimes farmers have limited knowledge about the crops and pests themselves (Abang et al., 2014; Alibu et al., 2016; Okonya & Kroschel, 2016), for example, when growing new crops. A lack of familiarity with alternative pest control methods is yet another factor causing overreliance on (costly) pesticides (Laizer et al., 2019). Poverty is also a factor that can directly contribute to ineffective pesticide use—for example, farmers may be forced to time their spraying when they have disposable income rather than when it is optimal from a crop protection perspective (Muleme et al., 2017).

Second, pesticides incur costs via associated health problems and environmental degradation or so-called externalities. Pretty and Bharucha (2015) have estimated the global average to be \$4 to \$19 per kilo of active ingredient applied. In SSA more specifically, Sheahan et al. (2017) make an attempt to assess health-related costs using the World Bank's Living Standards Measurement Study - Integrated Surveys on Agriculture (LSMS-ISA) data set and find that pesticide use increases output but is "costly" when considering health expenditures and lost work time. This is concluded despite the fact that such costs are underestimated in the data. Aside from the fact that acute pesticide poisoning cases often go unreported, available indicators fail to capture effects outside smallholder households (e.g., consumers, laborers), the elusive "disutility of feeling unwell," and long-term effects like the aforementioned chronic diseases (Sheahan et al., 2017, p. 40). In an attempt to assess pesticide-related cost of illness among Kenyan vegetable producers, Macharia (2015), for example, estimates this to US\$3.54/farmer/year but warns that "the true health costs are likely to be much higher" (p. 6) given the links to chronic diseases. In Ghana, Williamson et al. (2008) found that farmers reported an average of 21.7 sick days after spraying cotton. In Uganda, estimated annual costs of pesticide use (hospitalization, medical treatment, lost work) were as much as \$273.95 million in 2005, and in 2010, it was estimated that farmers lose 24.6 days/year on average due to pesticide-related health problems (Atuhaire, 2017). And still, the burden born by the most marginalized—for example, landless people in rural areas who engage in occasional farmwork and cannot afford health care—is unlikely to ever be adequately captured by these kinds of cost estimates.

Despite the many uncertainties, there is ample evidence that pesticide exposure constitutes a considerable societal economic burden, with those immediately exposed and least capable to cope bearing the brunt. Notably, despite all the limitations, there is also some evidence that it would in fact make economic sense for countries to invest in measures to reduce these costs (Kateregga, 2012). Widespread failure to do so clearly speaks to the scale of misrecognition of smallholder farmers and their limited political representation.

4. Beyond the Farm: Contamination of Food and the Environment

Around the world, agrochemical residues can be found in food, soils, and terrestrial and aquatic ecosystems (Carvalho, 2006), meaning they can affect groups other than those who directly handle them. So also in SSA; in Ghana, for example, pesticide residues have been detected not only in blood and human breastmilk of rural residents but also in food, water, sediment, and air (Aidoo et al., 2019). We distinguish between two different phenomena

here: environmental contamination caused by “pesticide drift” via air or water and pesticide residues left on food.

When it comes to contamination of food, we found evidence that smallholder pesticide use exposes local consumers to risks in many parts of SSA. In the Ugandan case, national-level data are not available, but studies have analyzed several products from local markets, including milk (Kampire et al., 2011), carrots (Nannyonga et al., 2013), fish (Kasozi et al., 2006; Ssebugere et al., 2014), tomatoes (Atuhaire et al., 2016; Kaye et al., 2015), and honey (Amulen et al., 2017). Most focus on organochlorides, and while levels are often found to be below maximum residue limits set by organizations such as the World Health Organization, bioaccumulation might nonetheless cause health risks to consumers (Kampire et al., 2011). Furthermore, less-studied pesticides may be of concern. Atuhaire et al. (2016) report that many Ugandan tomato farmers apply fungicides near or even after harvest, believing this improves attractiveness and shelf life, and Kaye et al. (2015) indeed detected fungicide residues on tomatoes sampled from markets across Central Uganda. Also in Tanzania, pesticide residues on tomatoes have been identified as a health risk (Kariathi et al., 2016). In Benin, Ahouangninou et al. (2012) found pesticide residues on nearly half the vegetables sampled from small producers, and Nuapia et al. (2016) detected organochlorine residues on raw food from open markets in Johannesburg and Kinshasa. We emphasize local consumers here, because as noted by Williamson et al. (2008), the growing concern about health effects of pesticides in, for example, Europe has focused on *European* consumers, despite the more acute risks faced by many African farmers and consumers. The resulting solutions that revolve around strict control of global value chains can contribute to better farm-level practices (Nanyunja et al., 2015) but do little good for the farmers who are unable to meet the requirements of such value chains and for most local consumers.

Pesticide drift has mostly been discussed in relation to industrial agriculture, where large sprayers or even aerial application can cause significant amounts of wind-borne pesticides. While this certainly occurs also in SSA (e.g., Dalvie et al., 2014), it is less of a concern within the context of smallholder pesticide use. But pesticides can nonetheless be applied, stored, and disposed in ways that cause accumulation in nature (Aidoo et al., 2019; Elibariki & Maguta, 2017). Unfortunately, according to de Bon et al. (2014), relatively little research has been conducted on the environmental impacts of pesticides in tropical areas and especially in Africa. In our review of Ugandan literature, we found 16 studies that measure environmental contamination and impacts (again, often organochlorides) that report detectable levels of a wide range of pesticides and metabolites in several regions. For example, Wasswa et al. (2011) found indications that organochlorides pose a threat to the Lake Victoria ecosystem and thus also livelihoods dependent on this ecosystem. Polder et al. (2014) drew a similar conclusion after analyzing persistent organic pollutants in tilapia from the

Tanzanian side of Lake Victoria and Lake Tanganyika, and a recent literature review by Taiwo (2019) indicates a “serious risk of cancer among the consumers of fish from many surface waters” in Africa due to high levels of organochlorides. Pesticides may also contaminate drinking water; we found few published studies, but the Ugandan nongovernmental organization Uganda National Association of Community and Occupational Health detected at least one pesticide residue in more than 90% of their samples from rural community water sources across the country (Buyinza, 2019).

Pesticide drift has several other ways of affecting humans via ecosystem effects. Some species are particularly vulnerable; in Uganda, a series of studies warn that pesticide contamination is negatively affecting vulnerable species in protected areas (Krief et al., 2017; Lacroux et al., 2019; Spirhanzlova et al., 2019). According to Krief et al. (2017), pesticide use at surrounding (mostly small) farms may pose an “underestimated threat” to primates in Kibale National Park. Lacroux et al. (2019) view these effects as “sentinels” for human health, but they may already affect groups with wildlife and/or forest-based livelihoods. In South Africa, Buah-Kwofie and Humphries (2017) similarly found indications that organochlorine pesticides cause toxicological risks to the ecologically important iSimangaliso Wetland Park. Pesticides may also threaten pollinators such as honeybees and stingless bees (Amulen et al., 2017; Byarugaba, 2004; Munyuli, 2011), the decline of which would clearly have particularly severe effects for farmers. As indicated by Byarugaba (2004), this also calls for recognition of indigenous communities, whose livelihoods are often linked to specific resources and ecosystems.

5. Poor Monitoring of Pesticide Use and Impacts

We now turn from the consequences of pesticide use, to questions of what is or could be done to address the problems identified—starting with the fundamental issue of how well they are actually documented and understood. Information and knowledge about the extent and nature of a problem is essential from an EJ perspective. As noted by Kellogg and Mathur (2003), “access to information about environmental conditions and the administrative decision-making processes that affect them is a prerequisite to effective political participation in environmental policy matters” (p. 573). The FAO’s statistics on pesticide use in the 37 SSA countries for which data are available (FAO, 2019b) suggest that the total amount has only increased slightly between 2008 and 2017. However, 28 countries have reported identical figures for the last 5 years (17 countries report the same figures for all 10 years). In other words, these data (which may be “official, semi-official, estimated, or calculated”) are hardly reliable.

Uganda is a case in point; 88 tons has been reported to the FAO since 1997 (FAO, 2019b). Meanwhile, World Bank figures suggest a gradual yet substantial increase in pesticide imports during the 2000s (World Bank, 2020).

The academic literature does not contain clear answers regarding the actual situation but does provide some important insights. Of the 74 studies, 25 included some quantitative assessment of the frequency of pesticide use. Notably, the five studies that use national-level data from the Uganda National Panel Survey or the World Bank's data set LSMS-ISA (Ali et al., 2016; de la O Campos et al., 2016; Mukasa, 2018; Sheahan & Barrett, 2017; Sheahan et al., 2017) consistently report much lower figures than studies that build on the researchers' own surveys, despite the fact that most such surveys focus on one type of pesticide and/or crop. One possible explanation is that some researchers interested in pesticides purposively select settings where they expect to find it, and indeed, pesticide use varies considerably with locality, cropping system, and production orientation. On the other hand, as in several other countries (Williamson et al., 2008), pesticides have been found to be commonly used not only in "expected" cases such as production of vegetables (e.g., tomatoes, peppers) and export crops such as coffee but also on staple crops such as potato (Okonya & Kroschel, 2016), sweet potato (Okonya et al., 2014), and maize (Ashour et al., 2019; Kalule et al., 2006). The three recent studies that contain primary survey data on overall pesticide use (Clausen et al., 2017; Muleme et al., 2017; Oesterlund et al., 2014) observed it among almost all farmers sampled, a picture that is further supported by cross-country surveys by Uganda National Association of Community and Occupational Health (Buyinza, 2019). This suggests an urgent need to update national panel data. Of course, pesticide use being relatively *common* does not mean that large *volumes* are being used, but as cautioned by Semalulu et al. (2005), even relatively small amounts of pesticides can be reason for concern when used inappropriately.

This leads to the question of what capacity countries have to adequately monitor and document pesticide imports, trade, and use, especially in small-holder contexts. Several studies raise concern about public authorities' lack of inspection and documentation, for example, in Kenya (Route to Food, 2019), Ethiopia (Mengistie et al., 2015), and Nigeria (Oluwole & Cheke, 2009). As argued by Okonya et al. (2019), inspecting retailers and banning certain products "requires strict enforcement of pesticide legislation which needs an expensive monitoring process" (p. 2). But instead, Structural Adjustment Programs initiated dramatic cutbacks in public spending on agriculture in many parts of the continent, and SSA as a region still scores low when it comes to government expenditure on agriculture (FAO, 2019c). Authorities' monitoring can be supported by research institutions, but also here there are gaps. For example, Gwenzi and Chaukura (2018) write that research on organic contaminants in Africa "is currently conducted by isolated research groups in very few countries with limited coordination and communication among the groups" (p. 1510). Furthermore, there is insufficient data on the *impacts* of pesticide use and exposure—certainly when it comes to environmental impacts, but also health effects

have only recently started to be documented scientifically (de Bon et al., 2014). Adequate attention and effective interventions require systematic data collection at the national level, but this is made difficult by the fact that farmers rarely seek medical attention for these symptoms due to the costs or even considering them “normal” (Ajayi et al., 2011; Okonya & Kroschel, 2015). As a whole, the situation described here contributes to rendering the impacts of smallholder pesticide use a “pervasive but elusive” issue (Nixon, 2011, p. 3), something we return to in the concluding discussion.

6. Limitations of the Dominant “Safe Use” Paradigm

Applying an EJ frame means moving beyond descriptive accounts of injustices to also analyze underlying problem drivers and ways these might be tackled (Schlosberg, 2013). Relatively little work has been done on the deeper drivers of increasing pesticide use and the extent of unsafe practices in SSA, but some parts of the puzzle have been revealed. First, it is worth emphasizing that the problem of *crop losses* to pests is a real and serious one, which affects rural people’s capabilities. Several Ugandan studies underscore that farmers see pests and diseases as the primary production challenge for numerous crops, such as rice (Alibu et al., 2016), potato (Namugga et al., 2017; Okonya & Kroschel, 2016), sweet potato (Okonya et al. 2014) maize (Kalule et al. 2006), and tomato (Karungi et al., 2016). Climate change is exacerbating pest problems in many parts of SSA, rendering pesticide adoption a kind of adaptation strategy (Mulinde et al., 2019; Okonya et al., 2013). Unsurprisingly then, much of the literature reviewed frames the problem not as pesticide use per se, but *improper* pesticide use caused above all by a lack of knowledge. As a result, many call for more training on pest identification, pesticide handling practices, and use of PPE (e.g., Atuhaire, 2017; Oesterlund et al., 2014; Okonya et al., 2014).

While these are clearly reasonable suggestions, others caution that promotion of “safe use” is only a partial solution. First, actually achieving “safe use” is tied into broader struggles around the state’s role in development and its allocation of resources. Taking the Ugandan case again, similar to many other SSA countries (see de Bon et al., 2014; Williamson, 2003), neoliberal reforms caused a general decline in state support for agriculture, and the private sector could only partly fill the void left in rural service provision. This has left the needs of many smallholders largely unserved (Bashaasha et al., 2011; Havnevik et al., 2007). In Uganda, Danielsen et al. (2014) add that the political agenda surrounding the decentralization and agricultural extension reforms (initiated in 1997) undermined the effectiveness of extension service delivery. Although the specific mechanisms are contextual, long-standing weaknesses in extension has also been pointed out as a key driver of unsafe practices in places as varied as Ethiopia (Mengistie et al., 2015), South Africa (Rother et al., 2008), and Tanzania (Lekei et al., 2014).

Second, as work by, for example, Murray and Taylor (2000) and Galt (2013) has convincingly shown, knowledge about risks and correct practices does not automatically produce safe outcomes. In Uganda, Muleme et al. (2017) conclude that the awareness campaigns for “safe use” that many actors call for would have limited effect, as socioeconomic factors to a greater extent shape farmers’ practices. Studies from many other countries draw similar conclusions, and while some scholars remain within the knowledge deficit model and call for *different* education (e.g., Macharia et al., 2013), many argue that unsafe practices have more to do with economic hardship and a lack of alternatives than “awareness” (e.g., Luna, 2020; Okoffo et al., 2016; Williamson et al., 2008). When it comes to PPE, there are additional complexities. Even if farmers *can* access them, there are numerous factors that limit their efficacy under real-world conditions, for example, discomfort and exposure through penetration and permeation (Garrigou et al., 2008). For these reasons—and because it only protects the person wearing it—PPE should be treated as a “last line of defense” (Garrigou et al., 2011) after elimination, substitution, engineering, and administrative measures (Lunt et al., 2011). But while some countries do have extensive policy and regulatory frameworks around pesticides, implementation is a recurring critique (Mengistie et al., 2015; Oluwole & Cheke, 2009). Acknowledging the limitations of narrowly knowledge-centered strategies, Mengistie et al. (2017) argue in the Ethiopian context that sustainable pesticide use requires intervention strategies along all three interplaying lines of legislation, control, and education. Wiegatz’s (2016) work in Uganda, however, points to deep structures of the “neoliberal moral economy” that perpetuate the state’s reluctance to intervene in markets despite blatant problems such as adulteration and unsafe practices.

While overemphasis on awareness is a serious shortcoming of the “safe use” paradigm, its most fundamental limitation is its narrow focus on pesticides rather than pest management more broadly. Ngowi et al. (2016) even argues that “safe use” interventions may function as tools for pesticide promotion by reinforcing the necessity of a chemical-intensive approach and invoking a false sense of security (see Murray & Taylor, 2000 for further support of this argument). Limited efforts to develop and disseminate effective alternative strategies meanwhile put farmers in a situation where they feel they have to decide between pesticide exposure or likely crop failure (Muleme et al., 2017). It is well established that there *are* pest management approaches that exclude pesticides or treat them as a last resort; best known is integrated pest management that can effectively reduce the need for pesticides in a wide range of agroecosystems (de Bon et al., 2014). The questions are how much (or how little) institutional support is provided for wider uptake of these approaches and why. In Uganda, although integrated pest management features in official policy discourse (e.g., Ministry of Agriculture, Animal Industry and Fisheries, 2014), several recent studies note how both farmers and extension agents lack knowledge on nonchemical pest management (Alibu et al., 2016; Karungi et al., 2016; Okonya & Kroschel, 2016). This raises questions about

participation and influence in processes of policy implementation, including resource allocation. As alternative approaches are generally knowledge-intensive, they are particularly hampered by the aforementioned problems with extension systems and inadequate public funding of agricultural research (Isgren, 2018b). Also cultural shifts play a role; for example, Mulugo et al. (2019) describe how the use of traditional organic pesticides has decreased dramatically in Ugandan forest communities due to being perceived as “unscientific.” In another illustration from Uganda, Ebregt et al. (2004, p. 73) underscore that this situation must be understood historically:

During the turmoil in the period 1980-early 1990, when many people lost their lives and properties, important traditional information and working knowledge on agricultural technologies declined. In that situation, pesticide agents, often through extension officers, easily obtained a foothold to promote and sell their products [...] The re-introduction of cotton, with its extraordinarily high use of subsidized insecticides, consolidated the idea under many smallholders that these chemicals were the only control measures against pests. So other pest control strategies were neglected.

Luna’s (2018, 2020) research in Burkina Faso similarly depicts the decline of alternatives in favor of pesticides and other labor-saving technologies (despite obvious risks) as a complex interplay between cultural and economic processes rather than simply an outcome of a “lack of awareness,” on one hand, or “rational choice,” on the other.

7. Popular Mobilization Around Pesticid Injustices in SSA: Poorly Studied, but Emerging?

The EJ literature typically targets situations where people are not only experiencing injustices but are also mobilizing against them—indeed, the very notion originate from the emergence of EJ movements. From that perspective, accounts of mobilization around the negative effects of pesticide use and the disproportionate effects on certain groups in SSA are notably absent from the literature reviewed; in neither step did we find mention of civil society campaigns or other forms of popular mobilization around agrochemicals. This does not mean such mobilization does not exist, as our methodological approach limits our ability to assess to what extent and where popular mobilization around pesticides exist, or what has been achieved, beyond mentions in scholarly literature. Briefly stepping outside the boundaries of our literature search, we noted, for example, that the transnational nongovernmental organization Pesticide Action Network has an African branch headquartered in Dakar since 1996. Also the transnational civil society networks PELUM (Participatory Ecological Land Use Management) and La Via Campesina that are active in several SSA countries identify chemical-intensive agriculture and insufficient policies around pesticides as contradictory to their

vision (LVC Africa, 2010; PELUM-Kenya, 2015). However, our methodological approach limited our ability to ascertain what these actors do, concretely, around these particular issues. Unsurprisingly, the most explicitly pesticide-focused mobilization appears to exist in South Africa, where the South African Organic Sector Organisation campaigns to raise awareness on the issue of agrochemicals, influence the revision of legislation, and lobby the parliament to adopt an organic policy (African Climate Reality Project, 2020). Citizen groups have also begun to mobilize under the banner of “genetically modified organism (GMO) & poison-free zones,” although their main focus is pesticide drift from large-scale agriculture (Mentz-Lagrange et al., 2019). Our limitations aside, we nonetheless tentatively argue that pesticides have not yet become a high-profile subject of advocacy or popular resistance in SSA. Understanding why—and the characteristics and achievements of the efforts that do exist—call for further (fieldwork-based) research. As we discuss later, we also urge that this situation is understood in light of our previously reported findings, including poorly monitored and documented extent and impacts, social normalization of health effects, and perceived necessity fueled by the absence of alternatives.

Concluding Discussion

In this article, we have analyzed agricultural pesticide use, impacts, and drivers in SSA, with particular focus on smallholders, through the analytical lens of EJ. Through a systematic interdisciplinary review of research from SSA, with particular attention to Uganda as an in-depth case, we identified seven areas where an EJ frame furthers our understanding of smallholder pesticide use and reveals crucial issues for solution-oriented research and practice.

The smallholder context contains dynamics of environmental (in)justice that in important ways differ from those that have been observed in large-scale, industrial agriculture. Yet there is no question that EJ offers a valid and useful frame—as previously indicated by London and Rother (2001). As a group, smallholder farmers are exposed to considerable risks associated with increasing pesticide use, while social differentiation further creates particularly vulnerable subgroups. This occurs not because smallholders typically use large amounts of pesticides but because lack of basic capabilities causes risks even at low levels of use. The situation in turn threatens to further undermine smallholders’ capabilities, most obviously in the form of direct bodily harm but also economically and via environmental pollution. The material distributive dimensions are here relatively apparent, but the environmental injustices described also arise and get perpetuated through processes situated in the cultural sphere—for example, the devaluation of (traditional or novel) nonchemical alternatives. From an even broader perspective, it is also clear that decades of political underprioritization of smallholders’ needs combined with contemporary top-down imposition of Green Revolution policies feed the current

situation, which through an EJ lens we read as intertwined problems of (mis)recognition and (non)participation.

A peculiarity of smallholder pesticide use from an EJ perspective is that farmers who use pesticides do so “deliberately,” often with some awareness of associated risks, rather than being compelled through labor relations or impacted by neighboring plantations. However, risk awareness does not equal being fully informed. Furthermore, just like poor communities cannot simply relocate when discovering hazardous pollution from a nearby factory (e.g., Shriver & Webb, 2009), farmers understandably employ risky practices if they lack other effective means of crop protection. This underscores the importance of moving beyond knowledge deficit models (Ríos-González et al., 2013) and narratives of free and rational choice (Galt, 2013; Luna, 2020) in explaining the prevalence of unsafe practices. Perhaps most important, EJ urges for more critical analysis of the cross-scalar drivers of increasing pesticide use and unsafe practices. These importantly include political and economic forces such as underfunding of agricultural extension and a lack of regulatory frameworks and/or their implementation, which intertwine with cultural forces that give pesticides their strong appeal. As part of such analysis, we call for attention to the role played by powerful actors, interests, and discourses—for example, those of the Alliance for a Green Revolution in Africa, which critics argue promotes a profit-oriented and particularly chemical-intensive vision of agricultural development (Moseley et al., 2015). As for sociocultural dimensions, emulation of others based on complex social criteria has been shown to be important for understanding farmers’ choice of technology (Stone, 2016), but such processes were scarcely described in the literature reviewed. Judging by the Ugandan literature, deepened understanding of drivers and solution pathways requires more interdisciplinary efforts to analyze interactions between epidemiological, ecological, social, and political-economic processes shaping smallholders’ pest management practices and outcomes. Also in this regard, there is much to gain from EJ scholarship and its evolution toward increasingly interdisciplinary approaches (Agyeman et al., 2016).

A reasonably accurate understanding of the scale and nature of a problem is essential for addressing it, and our review pointed out insufficient data as a factor that perpetuates pesticide injustices in smallholder contexts. That said, tackling these requires not only more data upon which to better design policies and practical interventions but also political struggle over the resources, decision-making processes, and visions that shape agricultural and rural development. There may well be (and, indeed, seem to be) instances of mobilization around agrochemicals not described in the scholarly literature, as part of nascent social movements around agricultural sustainability and agrarian justice issues in SSA (e.g., Isgren, 2018b; Wilson, 2010). But pesticide issues clearly have potential to spur broad mobilization; not only do “smallholders” constitute a large group (albeit not necessarily one with a strong collective identity), but potential participants also include consumers, environmental activists, and

health advocates. Thus, we encourage scholarship to engage with the question of when and how this specific type of *problem* can give rise to *movements* for countering pesticide injustices in the material, cultural, and political spheres—including how to harness the mobilizing power of the EJ frame (Čapek, 1993). We argue that a useful concept for understanding the inherent challenges in this pursuit is Nixon's (2011) notion of "slow violence," which due to being gradual, dispersed, and mainly affecting devalued and disempowered social groups, "is typically not viewed as violence at all" (Nixon, 2011, p. 2). In contrast to cases of pesticide resistance described in places such as the Philippines (Nikol & Jansen, 2020), Costa Rica (Barraza et al., 2013) and Brazil (Porto, 2012), our findings make clear that smallholder pesticide use in SSA represents a particularly "slow" and "unspectacular" form of environmental injustice, which in addition to the characteristics mentioned earlier also lacks clear perpetrators and has come to be seen as a necessary evil. As our introductory vignette from Paya illustrated, and as argued by Davies (2019), the threat of pesticide exposure is not necessarily "out of sight" to smallholders themselves—but calls for methodological approaches capable of conveying these impacts and experiences, as well as social struggles capable of making them count.

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ORCID iD

Ellinor Isgren  <https://orcid.org/0000-0002-8949-2480>

Notes

1. We are aware that "smallholder" is an imprecise term, but in this article, we use it in a very general sense, borrowing Morton's (2007) definition of smallholders as "rural producers . . . who farm using mainly family labor and for whom the farm provides the principal source of income [and who] can be found on a continuum between subsistence production and concentration on crop production for the market."

2. A Scopus search (January 2020) for “environmental justice” AND agriculture OR pesticides resulted in 158 relevant results, the earliest from 1995. Geographically, 94 focus on North America (mainly the United States) and 16 on Latin America and the Caribbean, while only 4 focus on Africa.
3. Our final search string was pesticide* OR insecticide* OR herbicide* OR fungicide* OR agrochemical* OR “pest management” OR “plant health” AND Uganda.
4. An issue that we left outside the scope of this article but deserves mentioning is the frequent use of pesticides for deliberate self-poisoning in rural areas. This is clearly tied to broader issues of poverty and mental health, but easy access to ubiquitous yet highly toxic agrochemicals does play an important role (Holtman et al., 2011; Kinyanda et al., 2004).
5. The SSP concept was developed by CropLife Africa Middle East to increase use of quality pesticides and ensure correct application. SSPs receive special training from the industry organization and then hire out their services to farmers (CropLife International, 2020). In our study in Paya, we also noted that farmers with sufficient resources sometimes outsource spraying in more informal ways (e.g., to neighbors).
6. Pesticide costs often get grouped with other input costs, meaning that some studies that could have shed some light on this issue fell outside the scope of our literature search. Further research on this subject—how pesticide use influences net income, debt, and so forth—should take this into consideration.

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Author Biographies

Ellinor Isgren is a researcher at Lund University Centre for Sustainability Studies (LUCSUS), focusing on the intersection of agriculture, development and sustainability in smallholder contexts, with a particular interest in the socio-political dimensions of food systems. She holds a PhD in Sustainability Science from Lund University.

Elina Andersson is a sustainability researcher at Lund University Center for Sustainability Studies. With a background in development studies, human ecology and gender studies, her work focuses on social-environmental interactions in agriculture and food systems, rural development and natural resource use and governance. Her research is broadly situated in the field of political ecology and focuses particularly on the sub-Saharan African region.