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Pesticide Use Practices among Female Headed Households in the Amhara Region, Ethiopia

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Abstract: Drawing on social practice theory (SPT), we extend our understanding of the existing pesticide use practices among female-headed households (FHHs) in the Amhara region of Ethiopia. We used mixed research methods combining household surveys, focus group discussions (FGDs), key informant interviews, and field observations complemented by photography. A binary logistic regression model was used to investigate the factors that influence the adoption of personal protective equipment (PPE) among FHHs. This finding suggests that pesticide use is an activity consisting of purchasing and using practices with several interacting elements such as materials, competences, and meanings. The main meaning or material element for pesticide purchasing are the perceptions of efficacy on pests, diseases, and weeds (65%), cost and availability in smaller quantities (60.7%), and a woman's available time and mobility (58.9%). Pesticide hazards to human health or the environment seem not to be relevant for most FHHs. Pesticide use practices among FHHs are done in violation of safety recommendations, motivated by not only material elements (labor, income, time, and the provisioning system), but are notably shaped by competences (skills and knowledge), and meanings (norms, values, rules, and shared ideas). As the regression results show, age and retailers information ($p < 0.05$) are the significant factors that influence PPE adoption among FHHs. We suggest a change of the practices and processes that sustain women's lives, a foundational shift of the socioeconomic and cultural environment, and promoting new meanings and competences through advisory services or training.

Keywords: competences; Ethiopia; female headed households; materials; meanings; pesticide purchasing; pesticide using; social practice theory

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Citation: Asmare, B.A.; Freyer, B.; Bingen, J. Pesticide Use Practices among Female Headed Households in the Amhara Region, Ethiopia. *Sustainability* **2022**, *14*, 15215. https://doi.org/10.3390/su142215215

Academic Editor: Rajeev Bhat

Received: 14 September 2022
Accepted: 14 November 2022
Published: 16 November 2022

1. Introduction

With global population projected to increase above 9.7 billion by 2050 [1], reducing crop losses due to pests, diseases, and weeds remains an important part of agenda for researchers, policymakers, and practitioners worldwide [2–4]. Despite this, crop losses remain one of the major causes of concern regarding food security in most of Sub-Saharan Africa (SSA) [2–4] including Ethiopia [5–7]. About 30–40% [8] and 49–65% [9] of crop losses in Ethiopia are caused by pests and diseases, and weeds, respectively. In Ethiopia, where subsistence and small-scale farmers dominate, coupled by low agricultural productivity and rapid population growth, crop losses would cause severe food shortages, leading to hunger, malnutrition, and extreme poverty [5,7].

To avoid crop losses, smallholder farmers in Ethiopia heavily rely on the use of pesticides [5,6,10]. However, pesticides are misused and abused in Ethiopian agriculture, where there are reports of unsafe practices such as the use of cocktails, unrecommended products, incorrect dosage, and frequent application [11,12]. Unsafe and repeated use of pesticides have resulted in the continuous development of pest resistance in the field and storage [10,13]. This is often the reason why higher amounts and new chemical compounds are used to protect crops every year, raising the costs of food production, causing human exposure to pesticides, and threatening agricultural and environmental sustainability [10,13].

Women in SSA in general and Ethiopia, in particular, are specifically susceptible to pesticide hazards due to higher illiteracy [14–16], limited access to information or training [16–18], safety equipment [14,19,20], and poverty [21,22] exacerbated by an unregulated market [12,14].

However, most research in Ethiopia (e.g., [12,23–31]) are primarily based on pesticide use practices among male farmers and farm workers, with little or no emphasis on women. Specifically, FHHs (consisting of widowed, divorced, and unmarried) are largely neglected in pesticide use research. However, these social groups are at a disadvantage in terms of access to land, household labor, time, income, and gender roles [14] that may affect the way pesticides are purchased and used. Most of these studies also focus on pesticide use practices in the field, with little investigation of the postharvest practices that may expose and affect women differently as part of their domestic duties.

Moreover, advisory or policy interventions aimed at reducing pesticide impacts are focused on persuading individuals to change their behavior [32]. This approach has met with limited success as it underestimates the extent to which individual behavior is influenced by the wider social, cultural, economic, or structural contexts [33,34]. This approach has been critiqued by the theory of social practices, which considers the transition to sustainability requires shifting attention away from individual attitudes, behaviors, and choices, and that 'practices' should be the main unit of analysis [35] and intervention [36].

Nevertheless, empirical studies on pesticide use practices inspired by social practice theory remain scarce in SSA in general and Ethiopia in particular. A few exceptions are studies conducted in Ethiopia [12] and Uganda [37]. These studies have applied the theory of practices as a framework specifically built on the concepts of Giddens' [38] structuration theory to understand routine pesticide use practices of smallholder farmers. These studies elaborate on how pesticide use practices are influenced by the lifestyle of farmers (agency) and the system of provision (structure), while farmers exercise degrees of agency in pesticide choices and decisions. However, these wider studies on pesticide use have tended to neglect the role of the broader social, material, and cultural contexts that may enable or constrain pesticide use practices among smallholder farmers. Further, these studies have no specific focus on women farmers.

Referring to pesticide use as a practice, we adopted Shove et al.'s [35] concept of practices to generate insights on (i) pesticide purchasing and using practices among FHHs, elaborating how materials, competences, and meanings configure the enabling or constraining conditions for the practices; and (ii) how pesticide use practices can ultimately be part of (un)sustainable practices. We hypothesize that PPE adoption is positively associated with FHHs' age, education, income, time, family size, retail information, knowledge of pesticide hazards, risk perception, and social norms.

2. The Social Practice Perspective on Pesticide Use

This section introduces the approaches of social practice theory and applies to understand the existing pesticide use practices on female-headed farms. The behavior-oriented approach that has received much attention in pesticide use research [39–47] is the theory of planned behavior (TPB) [48], which centers on individual attitudes, behaviors, and choices. Behavioral-based approaches assume that individuals are primarily responsible for the problems being addressed and they should be the target of intervention [49], undermining other dynamic factors that influence how and why practices are created and performed in a specific situation [34,50–53].

In order to overcome the shortcomings of reductive and individualistic approaches [54], the theory of practice came to exist as a useful theoretical framework that focuses on practices instead of individual attitudes, behaviors, and choices. Therefore, social practice theory has become an increased interest in many research areas and has been adopted for use in diverse disciplines [55]. This is observed in the latest research on pesticide use practices in Africa [12,37], but research on women represents a new field.

Social practice theorists argue that for intervention and policymaking towards sustainability, there is a need to focus on the practices (what people actually do, how what they do changes over time, and what values, institutions, standards, technologies, and rules influence those changes) [35,55]. Not the individuals but practices are the main units of inquiry [56]. Individuals simply act as carriers of practices, performing the various activities and tasks that the practice requires [56]. However, their role may not be underestimated as practices depend on individual will [35]. Berg and Henriksson [57] noted that practice theory assumes that environmentally damaging practices are not driven by individual values and attitudes, but rather embedded in material and institutional conditions. Their study further elaborates that by influencing or manipulating these elements, it is possible to change or modify the practice and subsequently the behavior of large populations.

Social practice theory has developed in two relevant waves [54]. The first is based on the work of Bourdieu [58,59] and Giddens [38], who consider social life as the performance of practices and shared behavioral routines which are reproduced by informed and capable agents (agency), using rules and resources (structures). The second, much more recent, strand of practice theories is work from various authors [35,56,60–63].

Building on theoretical reflections from Bourdieu [58] and Giddens [38], various meanings exist of what constitutes a practice. According to Schatzki [60], a practice is a coordinated nexus of doings and sayings" (p. 89). For Reckwitz [56], a practice is "a routinized type of behavior which consists of several elements, interconnected to one another: forms of bodily activities, forms of mental activities, 'things and their use, a background knowledge in the form of understanding, know-how, states of emotion and motivational knowledge" (p. 249). Reckwitz [56] argues that "not only bodies but also artefacts are sites of understanding practices" (p. 212). According to Schatzki [64], the term 'a routinized behavior' does not simply show individuals' habits but a nexus of actions produced by activities with relevant knowledge and skills. Warde [63] noted that the doings and sayings that make practice involve understanding, procedures, and engagements.

Following these interpretations, a concise and empirically applicable framework that identifies three key elements of practice has been proposed by Shove et al. [35]. The key elements of practices are materials, competences, and meanings (see Figure 1) which are interlinked, integrated, and coordinated. This concept becomes the base for understanding the dynamics of social practices, to trace how practices develop, evolve, and change over time in a social system [35,56]. Materials are defined as objects, tools, technologies, and infrastructures that are necessary to perform a practice [35]. Materials enable, shape, or constrain practices [65]. According to Giddens [38], materials are resources that are by nature allocative or authoritative means of power. However, materials alone have no relevance unless integrated into competences and meanings [66]. While materials are an element of a practice, they are not used without the skills and knowledge required to undertake the practice [56]. Competences, therefore, draw our attention to the know-how, techniques, background knowledge, and understanding needed to perform a practice [35], whether it is in the form of what Giddens [38] referred to as practical consciousness, skill, or shared understanding. Reckwitz [56] calls competence a 'practical understanding' that enables the practitioner to perform the practice. Competences can be learned through performing practices every day [35], by experience, training, learning from peers and family, and by repeatedly doing [35,60,67]. Finally, meaning is defined as the norms, values, rules, and shared understandings [35]. Røpke [67] described meaning as making sense of practice. While the material elements explain what constrains or enables a practice, competence explains how a practice is performed, and meaning explains why a practice is performed [68]. In general, while the material elements explain what constrains or enables practices, competence explains how a practice is enacted, and meaning explains the 'why' behind any practice [68].

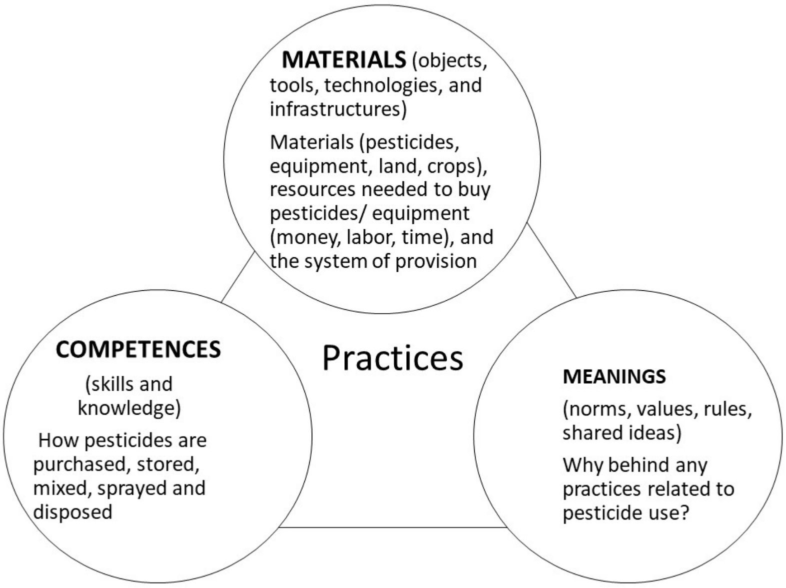

Figure 1. Three key elements of practices. Source: Own construction based on Shove et al.'s [35] concept of three key elements of a practice framework.

The complexity of practices as composed of materials, competencies, and meanings means that more than a change in attitude is necessary to create sustainable behaviors, and change can be made through the alteration of one or more of these elements [35]. This implies the practice-based approach is relevant for understanding processes of change in various (un)sustainable practices [36]. In order to show how materials, competences, and meanings are enacted and reproduced, the analytic distinction between practice-as-entities and practice-as-performance also proves useful [35]. Practices can be studied as entities, which means that we can talk about them (for example, driving, showering, and doing laundry). They may be recorded and learned but they do not exist in society unless they are performed or exercised [35]. Practices as entities are made of material arrangements (i.e., materials, technologies, and tangible, physical entities), know-how and routines, institutionalized rules, and teleo-affective structures (the domain of symbols, meanings, beliefs, and emotions) [60,63,69,70]. Practice-as-performance is the doing of practices by individuals in a specific set of time and space [60,63,69].

Shove et al.'s [35] concept of practices has been adopted in the latest research on farming practices, such as crop protection in Switzerland [50], agricultural fertilization in Finland [51], urban planning for agriculture in The Netherlands [71], animal husbandry in Alberta [72], organic food production and consumption in the Philippines [73], and the transformations to organic farming [74]. Moreover, the approach was also useful to study practices of tourism [75], eating [76,77], cooking [78], drinking [79,80], cycling [49], mobility [53], energy consumption [52], travel [81], and online grocery shopping [57], though research on pesticide use practices is scarce. These findings suggest that practices are an interplay between the materials, competences, and meanings.

Applied to the issue of pesticide use, such analysis emphasizes that pesticide use practices cannot be seen as an issue constrained or enabled by women's attitudes, behaviors, or choices but by the existing practices that comprise materials, competences, and meanings. As a result, SPT as developed by Shove et al. [35] is more applicable to our empirical understanding of the existing pesticide use practices among FHHs that can benefit policymakers or practitioners through new insights into the existing practices (i.e., purchasing and using) within the broader context of materials, competences, and meanings.

As an illustration, the practice of pesticide uses in female-headed farms depend on material elements: physical resources: infrastructure including the systems of provision, transport, tools, pesticides, equipment, fields, crops and financial resources (income), and the resources to buy or use the material (money, labor, and time). It also demands competences that include not only knowing where and what to purchase but also how to store, apply, and dispose of chemicals. It also involves knowing/understanding relevant rules, regulations, and instructions [50] in pesticide use practices. Meanings include women's understanding of pesticides, personal values, as well as norms specifically associated with pesticides.

3. Materials and Methods

This study was conducted in the nine kebeles (the lowest administrative unit) of the three districts in the Amhara region of Ethiopia (see Figure 2). These districts (Dera, Lay Gaint, and Jawi) are located in different agroecological zones of the region with different farming systems and crops that justify differences in pesticide use practices [12,82].

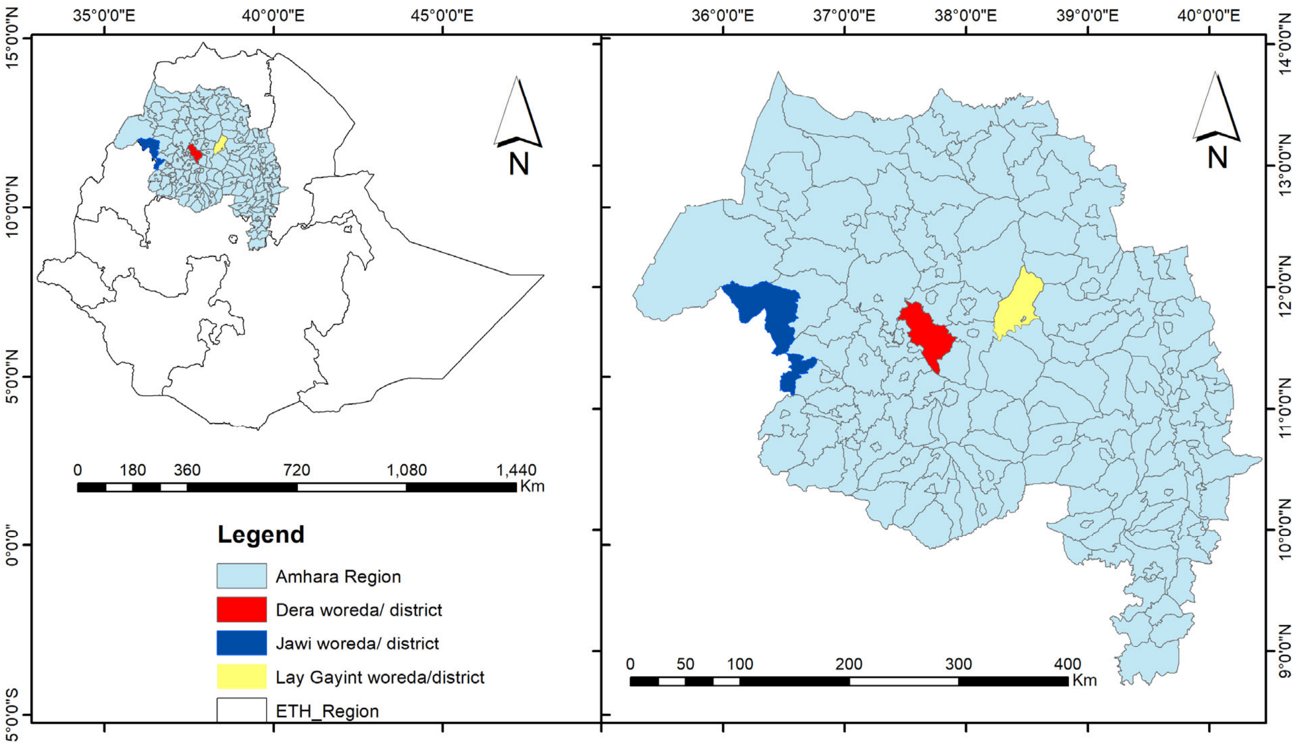

Figure 2. Map of the study area. Source: Own construction.

This study is built upon the theoretical framework broadly framed by SPT. In order to understand the factors that influence behavior, qualitative methods are considered relevant [34–36,83,84]. Studying agricultural fertilization practices in Finland based on SPT, Huttunen and Oosterveer [51] suggest qualitative interviews to document the changes that occurred over recent years in relation to the materials, competences, and meanings. Using SPT to study mobility practices in the UK, Williams [85] employed qualitative methods to draw out contextual factors, motivations, norms, values, attitudes, and other factors. Using the same approach, Supski et al. [80], studying drinking practices in Australia, used qualitative interviews to investigate how, when, why, and with whom the practices are enacted, attitudes and opinions towards practices, and the influence of family, society, and institutions. Addressing methodological challenges in using practice theory in consumption research, Halkier and Jensen [76] highlight the relevance of qualitative research, due to the fact that practice is referred to what is said and done routinely in everyday life. According to Schatzki [60], interviews refer to the 'sayings' of the practice and can be explored as the voices of the participants 'doing' the practice. To enable an additional insight into the practice, SPT "directs research attention towards the practical accomplishment or doing of everyday practices" [83]. Thus, instead of relying only on what people say about their behavior through surveys or interviews, it is important to observe what they actually do on the ground and the materials and competences involved. In a study carried out on household food waste in South Manchester, Evans [86] used qualitative methods, with a broader ethnographic approach (interviews and observations). For the analysis of current crop protection practices based on a practice approach, qualitative interviews and observations were adopted [50].

Although the majority of practice-based research has used qualitative methods, Meier et al. [79] and Hess et al. [52] studying practices of drinking and routinized energy consumption, respectively, noted the benefits of quantitative measurement of the three key elements that make up practices. On the other hand, Fraser [87] and Spotswood et al. [49] call for more qualitative and quantitative approaches to better explore how the elements of practices come together to (re)produce and sustain practices. Spotswood et al. [49] used FGDs for the qualitative interview, to dig out a shared understanding of routines, cultural conventions, beliefs and attitudes, experiences, social norms, and different practices, and to analyze how the elements of practices are connected.

In keeping with a broader interpretation of practice theory, this study explored through mixed research methods combining both qualitative and quantitative approaches to better understand the existing pesticide use practices among FHHs in line with the existing materials, competences, and meanings. As practices are defined as the nexus between sayings (entities) and doings (performances), we studied the actual performances of FHHs related to pesticide use through field observations and their practices as entities through face-to-face interviews. Practices as entities can be, for example, measured in surveys while practice as performances can be studied through qualitative interviews [86]. The study further noted that "methodologically, it is difficult to study performances unless one is conducting some form of ethnographic fieldwork, although studies of how people describe their daily performances are also common, such as studies using qualitative interviews of different sorts" (p. 85). Accordingly, the data collection instruments used were: (i) household surveys conducted with 318 FHHs; (ii) FGDs carried out with 36 purposely selected FHHs and their children; (iii) semi-structured interviews with 18 key informants such as pesticide suppliers and extension workers; and (iv) field observations of farms and homes in three villages of the study districts complemented by photography.

A multi-stage sampling procedure was applied to draw the representative households. In the first stage, a total of three districts were purposely selected based on their representation of the three major agroecological zones of the region, i.e., highlands, lowlands, and midlands. In the second stage, three kebeles were randomly selected from each of the three districts, leading to a total of nine. Third, 38 villages from the nine kebeles in total were randomly selected. Fourth, based on Yamane's [88] formula, the final sample was determined, leading to a total of 318 FHHs; 146 from Lay Gaint, 72 from Jawi, and 100 from Dera (Table 1).

The survey was grouped into four main parts. The first part was about the individual characteristics (i.e., age, marital status, family size, level of education, income, farm size, and land ownership) of the FHHs. The second part introduced how pesticide purchasing and using practices were performed in line with the existing elements: materials, competences, and meanings. The third part was about safety practices during and after pesticide handling, storage facilities, and disposal. It also discussed the factors influencing safety practices based on the binary logistic regression model. In the last section, self-reported poisoning symptoms were discussed. Using the SPT as a framework and the literature on the subject, structured and semi-structured questions were prepared. Interviews lasted between 40 and 60 min. In order to ensure the adequacy of the survey, the questionnaire was pretested in a few farms in the Dera district. The selected FHHs were accessed via snowball sampling. This technique helps to identify new respondents through other respondents [89].

Table 1. Sample size description of study districts, kebeles, households, and villages.

Study Districts	Study Kebele	Households	Female-Headed Households	Sampled Households	Total Villages	Sampled Villages
Dera (Midland)	Jigina	1242	210	43	10	5
	Zara	1897	142	29	10	5
	Wonchit	1382	138	28	10	5
Lay Gaint (Highland)	Hager Genet	1339	193	39	5	3
	Titira	1447	231	47	5	3
	Moseb Terara	1552	297	60	8	4
Jawi (Lowland)	Kebtele	1652	137	28	13	7
	Kezikazit	417	92	19	4	2
	Ali Kurand	1434	122	25	8	4
	Total	16,266	1562	318	73	38

Source: Unpublished reports from each kebele, 2018.

In order to explore FHH experiences of pesticide use practices in more detail, qualitative methods were applied. Six FGDs involving FHHs and their children in three of the study districts, covering a total of 36 participants, were carried out. In most households, children were generally involved in pesticide purchasing and using practices. The interviews provided a more in-depth understanding of (i) how the division of labor in the household and agriculture was organized, (ii) how pesticide purchasing and using practices were performed, and (iii) how their practices were enabled or constrained by the existing materials, competences, and meanings.

In order to capture the 'doings' of the respondents in relation to pesticide use, field observations were carried out in female-headed farms and homes. We observed the places where pesticides were purchased, stored and disposed of, pesticide usage in the field, garden, and home, the use of equipment, the division of labor in the household and agriculture, personal hygiene, and the elements involved in their practices. The field observation was complemented by photographs that captured the material elements in which pesticide use practices were enacted. While text materials and interviews are central to answering questions on what is enacted, visual tools are becoming more prevalent to answer what is actually observed on the ground [90] and also supplement data from surveys [91].

In order to obtain information on training, technical support, and other pesticide-related practices, semi-structured interviews were undertaken with a total of eighteen licensed and unlicensed pesticide suppliers, and agricultural staff. They were asked about the types of information, advisory services, or technical support offered to farmers in general and women in particular. Their level of knowledge of pesticide products, hazards, and toxicity were also assessed.

Data analysis was guided by the social practice theoretical framework, using categories from Shove et al's [35] concept of materials, competences, and meanings. For quantitative data analysis, descriptive statistics such as percentages, means, standard deviations, and cross-tabulations were used while a chi-square test ($\chi 2$) was used to find out whether there were significant differences regarding risk perceptions, knowledge, and practices across the study districts. Further, a binary logistic regression model was used to determine the significant factors that influenced PPE adoption among FHHs. This model was used because the dependent variable was coded as dichotomous [92–97]. The model describes the relationship between a binary dependent variable, i.e., PPE adoption (1 = yes, 0 = no) and independent variables such as age, education, income, time, family size, retail information, knowledge of pesticide hazards, risk perception, and social norms. A probability of $p < 0.05$ was considered statistically significant. Multicollinearity, Nagelkerke R2, Hosmer–Lemeshow, and Omnibus tests were conducted to check model fitness.

Guided by the theoretical framework, qualitative data from the FGDs and key informant interviews were first transcribed. Then, the materials, competences, and meanings related to pesticide use practices were identified and analyzed through narrative and content analysis. We took methodological insights from both [90,98] on qualitative and visual data analysis. The photographs were simply used as supportive material for the interviews see, [90,91]. Finally, the results of the qualitative and quantitative data were connected to each other as they wove back and forth around similar concepts [99].

4. Results and Discussion

4.1. Socio-Economc and Demographic Characteristics

The socioeconomic and demographic characteristics are presented in Table 2. About 47.5% of FHHs were divorced, widowed (49%), and single (3.5%) with significant differences across the study districts ($\chi2 = 27.8$, $p < 0.001$). About 78% of the respondents were in the age group of 31–60 ($\chi2 = 11.4$, $p > 0.05$). With significant differences across the study districts ($\chi2 = 10.11$, $p < 0.05$), more than 85% of FHHs were without formal education, similar to many other regions of Ethiopia [100]. Family size differed across the study districts ($\chi2 = 45.61$, $p < 0.001$). The average family size was 3.63, comparable to most regions of Ethiopia [101], but lower than the national average of 5.1 people per household [102]. Farm size was typically less than 1 hectare on average, slightly smaller than the average household landholding size in Ethiopia with 1.17 hectares [103]. Farm size differed across the study districts ($\chi2 = 173$, $p < 0.001$) with 87.5% of the households in the Jawi district owning more than 1 hectare. With no significant differences ($\chi2 = 0.43$, $p > 0.05$), 98% of the respondents owned land while 2% rented their land. More than 80% of the FHHs fell below the poverty line of approx. 200USD per annum ($\chi2 = 110.4$, $p < 0.001$). About 44% of the FHHs were subject to a sharecropping arrangement for field work, while 45.6% of them cultivated their land together with their children and 10.4% with their relatives.

Table 2. Socioeconomic and demographic characteristics.

Respondent Category	Variables	Dera (%)	Lay Gaint (%)	Jawi (%)	Total
Marital status X^2 = 27.8 ***	Single, never married	0	4.1	6.9	3.5
	Widowed	32	56.8	56.9	49.1
	Divorced	68	39	36.1	47.7
	Total	100	100	100	100
Age χ^2 = 11.4	Under 21	2	1.4	1.4	1.6
	21–30	2	2.1	4.2	2.5
	31–40	14	22.6	26.4	20.8
	41–50	28	26.7	33.3	28.6
	51–60	30	28.8	26.4	28.6
	Above 60	24	18.5	8.3	17.9
	Total	100	100	100	100
Education level χ^2 = 3.93	No formal education	88	82.2	88.9	85.5
	Primary education	8	14.4	6.9	10.7
	Secondary education	4	3.4	4.2	3.8
	Total	100	100	100	100
Family size χ^2 = 45.6 ***	1–3	39	43.8	70.8	48.4
	4–6	45	55.5	27.8	45.9
	Above 6	16	0.7	1.4	5.7
	Total	100	100	100	100

Table 2. *Cont.*

Respondent Category	Variables	Dera (%)	Lay Gaint (%)	Jawi (%)	Total
Land ownership $\chi^2 = 0.43$	Owned	98	97.3	98.6	97.8
	Rented	2	2.7	1.4	2.2
	Total	100	100	100	100
Farm size $\chi^2 = 173$ ***	<1 ha	81	95.9	12.5	72.3
	>1 ha	19	4.1	87.5	27.7
	Total	100	100	100	100
Annual income $\chi^2 = 110.4$ ***	<3000ETB (approx. USD 75)	64	7.5	15.3	27
	3000–6000ETB (approx. USD 75 to 150)	19	37	37.5	31.4
	6000–9000ETB (approx. USD 150 to USD 225)	5	37.7	25	24.5
	9000–12,000ETB (approx. USD 225 to USD 300)	12	17.8	22.2	17
	Total	100	100	100	100

Chi-squared test: $\alpha = 0.05$ *** $p < 0.001$. Source: Household survey 2019–2020.

4.2. Pesticide Purchasing Practices

4.2.1. Pesticide Supply Channels

The interviews with FHHs, retailers, and extension workers found that the supply channels for enacting pesticide purchasing were characterized by (i) formal (i.e., licensed retailers, authorized government extension workers, and farmers' cooperatives) and (ii) informal retail outlets (unlicensed, unregistered traders operating via local shops). In both cases, pesticide products were provided in containers (ranging from 0.5–5 L) or packets (0.5–25 kg).

Costs of products were generally higher in the formal channels than those from the informal channels. Moreover, smaller quantities (Figure 3) filled in any type of self-made packaging were provided in informal markets at a discounted price. This finding is in line with a previous study in Ethiopia [12], where more than 50% of the pesticides were provided for sale in their original packages. During the field visit in 2019, we observed a local retailer purchasing two packets of pesticides from licensed retailers for ETB 1000 (approx. 25 USD).

Figure 3. Smaller bottles are used for pesticide repackaging. Source: Field observation 2019–2020.

The lower purchasing power, limited farm size, and low mobility that influenced pesticide purchasing among FHHs were clearly discussed in the FGD as follows:

> *As we have limited access to pesticides from extension workers and farmers' cooperatives due to discrimination, we want to purchase recommended products from licensed retailers,*

but we never do that because the price is higher, the pesticides are available in big volumes, and are not easily accessible in villages.

The material element of pesticide purchasing in informal markets was also discussed in the semi-structured interviews with retailers.

Most women are quite interested to purchase pesticides from us because we provide pesticides in smaller quantities at a reduced price, and we are mobile and accessible in villages. Due to this, the market demand is increasing, and business is profitable from it.

This description illustrates the unfavorable environment in the formal provisioning system that forces FHHs to develop new meanings for purchasing. Informal markets have come to be considered convenient, affordable, and relevant forms of efficient pesticide provision for most FHHs.

The flexible nature of the informal market, conveniently accessible to everyone through village traders at a discounted price, and with a range of different options including the sale of toxic but thought-to-be-effective pesticides, are important aspects of meanings and materials that enabled 65% of FHHs to always rely on this market. This finding is in line with a study carried out in Uganda [14], where the gender dimension of pesticide purchasing practices was studied through a political ecology lens. The study found that as opposed to 72% of male-headed households, 96% of FHHs relied on informal markets.

The limited capacity of government institutions to enforce directives regulating pesticide sale opens up an opportunity for informal markets to deal with pesticides that are fake, repacked, banned, or restricted (e.g., DDT, Endosulfan), and marked with manipulated information without labeling of the new content. The interviews with informal suppliers found that "we see no pressure either from the local, regional, or federal government. We sell whatever we want".

There are also other pieces of evidence showing the rapidly growing informal markets for pesticides in Ethiopia and Africa at large [11,12,14,31]. Therefore, promoting safe behaviors in pesticide purchasing does not only depend upon educating individuals to make the right decisions, but on transforming practices that consist of the materials, competences, and meanings to make them sustainable.

4.2.2. Pesticide Purchasing

This section describes the materials, competences, and meanings that were relevant in pesticide purchasing among FHHs. One of the main meanings relevant to pesticide purchasing was perceptions of efficacy on pests, diseases, and weeds (65%). For example, Endosulfan, officially registered for cotton, is a pesticide most FHHs purchased and used because the organochlorine insecticide was perceived to be efficient to combat insects on vegetables. In addition, DDT, introduced for public health, has been globally banned, or severely restricted from use for all agricultural purposes since 2004 [104,105] but was widely purchased and used in the study areas not only to control pests in the field but also in storage (see also previous studies in Ethiopia [12,31,105–109]). These two insecticides are mostly accessible through informal markets (see also [14]). Usage of these pesticides shows that health and environmental sustainability (meaning) are less valued.

The other material and meaning aspects for purchasing were the cost and availability of pesticides in smaller quantities (60.7%). Since large quantities of pesticides are not suitable for the smaller plots of FHHs, smaller quantities were preferred. Larger amounts of pesticides were only purchased if there was an option for sharing with others. Moreover, women's lower income led to them purchasing smaller quantities of pesticides that were often cheap, but older and more toxic.

Pesticide purchasing was also organized around a woman's available time and mobility (58.9%) (material and meaning). Even when the material element (e.g., money) to purchase safer pesticides was in place, women's workload was a factor; daily routines in the household, childcare, and agricultural duties did not give FHHs the time to purchase in distant markets. Time was claimed to be a scarce resource in many of the FHHs. As a result, purchasing pesticides from informal channels eased their everyday lives, via reducing the required travel, in some cases with infants. As Shove [110] noted, time is an essential part of practice: it takes a certain time to carry out a practice in a proper way. In addition to the material factors and meanings, sexual harassment and lack of transport presented additional problems for women.

Contrary to the assumptions that pesticide purchasing is simply a result of individual choices (agency) and structure (the system of provision) [see, [12,37]], this finding confirms the influence of materials, competences, and meanings on purchasing practices among FHHs. According to Reckwitz [56], practices depend on the existence and specific interconnectedness of elements that mutually shape each other.

4.3. Pesticide Using Practices

4.3.1. Pesticide Use in the Field and Garden

Materials, competences, and meanings are the key elements [35] to answer where, when, and why pesticides are used. FHHs understood pesticide use as a 'necessity' associated with 'family survival' (meaning). The FGDs informed us that:

> *In light of pesticide poisoning, we just compromise every time because pesticides are a necessity for family survival as we know little about other options for pest management. As our main purpose is to reduce yield losses in a shrinking land, our personal health, consumers, and the environment are secondary.*

This finding is in line with the study in Uganda [14], where pesticides were seen as a 'necessary evil' (p. 83) by smallholder farmers.

An example of the influence of the materials and meanings was discussed in the FGDs as follows:

> *Three decades ago, pests, diseases, and weeds were less. Promoted via government extension programs, the introduction of pesticides and improved plant varieties threatened traditional farming practices. Thus, out of a desire to reduce crop losses, we often use pesticides. However, it becomes more unsustainable over time and no longer appears to protect crops from pests, diseases, and weeds. We often rush to markets to purchase one product after another. We used to do this several times. We sell our grains to purchase pesticides due to the development of pest resistance. It is not because we lack the motivation to change the practices but because there are no other means of pest management.*

With the possible exception of the Lay Gaint district, where pest infestation was generally lower, many of the FHHs (see Table 3) in the Dera and Jawi districts, respectively, appeared to use pesticides on their crops. Different pesticides including DDT were used on crops cultivated in the field or garden (see Table 4).

Table 3. Use of pesticides in the study districts.

Variables	Items (%)	Dera	Lay Gaint	Jawi
Insecticides χ^2 = 209.1 ***	Yes	83	6.8	94.4
	No	17	93.2	5.6
Herbicides χ^2 = 63.4 ***	Yes	75	28.1	69.4
	No	25	71.9	30.6
Fungicides χ^2 = 11.7 **	Yes	22	11	29.2
	No	78	89	70.8
Rodenticides χ^2 = 6.45 **	Yes	92	97.3	88.9
	No	8	2.7	11.1

Chi-squared test: $\alpha = 0.05$ ** $p < 0.05$ *** $p < 0.001$. Source: Household survey 2019–2020.

Table 4. Pesticide types, common name, WHO class, and types of crops.

Pesticide Type	Common Name	WHO Class	Types of Crops Used
Insecticides (50.6%)	Malathion	III	Field pests on chat, maize, rice, tomato, and storage pests on grains
	Dimethoate	II	Field pests on chat, cereals, grain legumes, vegetables, fruits
	Diazinon	II	Field pests on chat, cereals, grain legumes, vegetables, fruits
	Chlorpyrifos	II	Field pests on pepper
	DDT	II	Field pests on chat and storage pests on maize and legumes
	Endosulfan	II	Field pests on vegetables
	Lamda-cyhalothrin	II	Field pests on onions and cereals
Herbicides (52.2%)	2-4D	II	Weed on maize, finger millet, teff (Eragrostis tef), wheat, barley
	Glyphosate	III	Weed on maize, finger millet, teff, wheat, barely
	Paraquat	II	Weed on maize, finger millet, teff, wheat, barley
Fungicides (18.6)	Mancozeb	U	Field diseases on wheat
Others (6.3%)	Zinc phosphide	Ib	Rodent control on the harvested grains
	Aluminum phosphide	FM	Storage insects on rice, maize, grain legumes

Class Ib—highly hazardous; class II—moderately hazardous; class III—slightly hazardous; U—unlikely to pose an acute hazard in normal use; FM—not classified [111]. Source: Household survey 2019–2020.

Pesticide use in female-headed farms was an activity that involved all family members (women, male/female children). About 9.7% and 21.7% of FHHs reported pesticide spraying by themselves on the field and garden, respectively. While men did most of the spraying operations in the field and garden, women undertook hazardous tasks such as mixing, weeding, cleaning farms, harvesting, and packaging crops, thereby, opportunities for indirect exposure for them were multiplied as they had physical contact with the residues.

4.3.2. Pesticide Use on the Postharvest

About 75% of the respondents used traditional grain storage containers (materials), prepared from mud, cow dung, and straw, known as gotta, while 25% used plastic sacks (Figure 4). The traditional grain storage containers are cheap and can be made easier with the available local resources but provide little protection from pests and diseases. According to a report from the Food Agriculture and Organization [5], "the storages are ineffective and often vulnerable to weevil and termite infestation and spoiled by mold and moisture" (p. 6). Midega et al. [112] found smallholders in most of rural Africa do not use modern storage facilities (such as the metal silo) because they cannot afford them. Due to fear of storage losses from pests and diseases, some FHHs used to sale their grains immediately after harvest when prices are lowest.

More than 70% of the respondents in the districts of Dera and Jawi and 30% in Lay Gaint reported pest attacks on their stored grains, causing substantial damage to the crops. Fungi, weevils, termites, and rodents were the most destructive of the stored produce (see also studies in Ethiopia [6], Tanzania [4], and Western Kenya [112]). In addition to crop losses, rodents can contaminate food and water sources via urine. According to Stejskal et al. [113], rodent contamination of the stored products can reduce the nutritional value, market price, and risks several pathogens being transmitted to humans. Fungi, on the other hand, destroy the stored produce by deteriorating its quality [114]. With agriculture under pressure coupled with food shortages, crop losses through pests or diseases are intolerable in the area. Owing to this, any agronomic practices are necessary to reduce food losses.

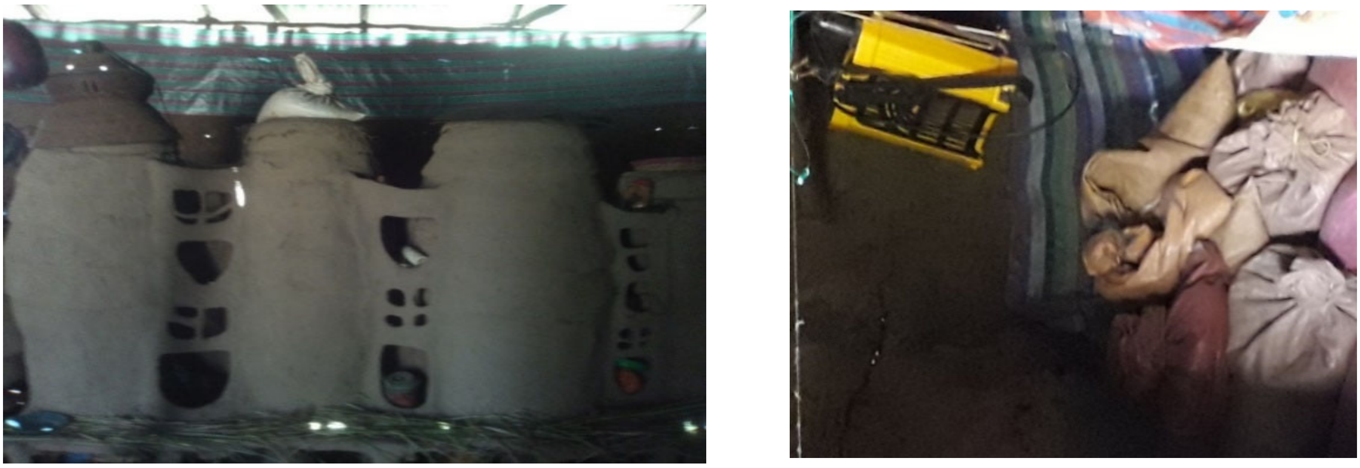

Figure 4. Traditional grain storage containers and gunny bags. Source: Field observation 2019–2020.

In a point of great interest, it was found that 80% of the respondents in the Dera and Jawi districts applied pesticides on harvested grains. Quite often, pesticides not recommended for food crops, e.g., DDT, were also used in the treatment of storage pests against weevils, beetles, and termites in maize, rice, bean, pea, cowpea, soya bean, and grass-pea. Aluminum phosphide and malathion remained the two most popular fumigants and insecticides, respectively, used intensively on storage pests. Zinc phosphide, classified as highly hazardous (class Ib), was also used against rodents in storage. One woman shared a story from another household, where a pesticide-treated tomato, to which the chemical was applied to kill rodents, was unintentionally consumed by a daughter and proved fatal.

The majority of FHHs (94.6%) mixed and applied pesticides on the harvested grain inside their houses (Figure 5), while few (3.1%) did so outside the house or in the fields (2.3%). They mentioned cleaning the floor inside the house with cow dung and water before application. Doors and windows were closed to protect pesticides from the wind. This shows a lack of knowledge and limited risk perception (competences) of pesticide hazards.

Figure 5. Example of a living room where pesticides were applied to the harvested maize. Source: Field observation 2019–2020.

Indoor application and pesticide-treated grains can increase exposure for household members in general and women in particular. Pesticide application is often done in the same room where they live, eat, and sleep. It can also contaminate food, water, and clothes. Pesticide residues from such use contaminate the food chain, with possible risks to those handling the grain including traders and consumers [20,115]. Not only women but also all household members are indirectly endangered by the uptake of pesticide residues via contaminated food and water. Smaller children, who are not directly involved in pesticide applications, while sharing time closely with their mother may face the greatest risk of being contaminated and taking in residues in and outside the house. We observed children playing on the floors, the place where pesticides were mixed and sprayed. Moreover, we observed some women carrying and breastfeeding their infants during pesticide mixing and spraying. Women, often responsible for cleaning the house (due to the social construction of household work as women's responsibility) are also exposed to the residues via household dust. Women were also present for other household tasks such as winnowing, grinding, and preparing food from the treated grains, which pose health risks through physical contact with the crops that contain residues. The family members were also exposed via ingestion of pesticide-treated grains. The FGDs informed us that the foods they prepared usually smelled of pesticides.

4.3.3. Pesticide Mixtures, Frequency, and Dosage

FHHs reported mixing two or more pesticides, a so-called 'cocktail', and applying it on a single crop. However, cocktails raise serious health risks since pesticides can become more harmful when combined [116,117] and may increase resistance against pesticides [118]. A typical effect of using cocktails is the development of pest resistance in the field as well as storage. As instructions about mixtures do not exist on pesticide containers, FHHs follow either pesticide suppliers' recommendation, their social networks, or refer to their personal experience.

About 52% of the FHHs in the Dera and Jawi districts used pesticides in higher doses than recommended and on unrecommended crops. Compared to other cereals, storage maize received 2–3 insecticide applications in the field and storage. Chat, cultivated in the garden, received the highest frequency of pesticide applications, ranging from 20 to 25 times per cropping season. FHHs in the Lay Giant district had the lowest frequency of pesticide applications in the field ranging from 1 to 2 on wheat and barley.

The materials, competences, and meanings that drive frequent application and overdoses of pesticides are pest infestation, pesticide resistance, pressure from suppliers, availability of pesticides without restriction in smaller quantities, limited knowledge and risk perception of pesticide hazards, and limited farm sizes (motivating uncritical application of pesticides). Unsafe practices may place a disproportionate risk on women, their children, consumers, and the environment. Like the women, the children helped with supporting work, were not trained in pesticide use, and thus contributed to unsafe practices (Figure 6).

As pests are becoming resistant to pesticides, a number of approaches ranging from cultural to biological have been used by FHHs (Table 5). Some FHHs used holy water due to the perception that pest infestation was a punishment from God for people´s sins.

Such knowledge could be a basis for the development of alternative approaches [4] that are simply not promoted in the study areas.

4.3.4. Network of Social Relationships

Pesticide use practices occur in a network of social and institutional relationships which go beyond the individual and the household (i.e., women, and children). Due to lower levels of education, which is needed to read pesticide labels (competence), and unclear and invisible pictograms (materials), many of the FHHs depended solely on information from neighbors, retailers, and their own experience.

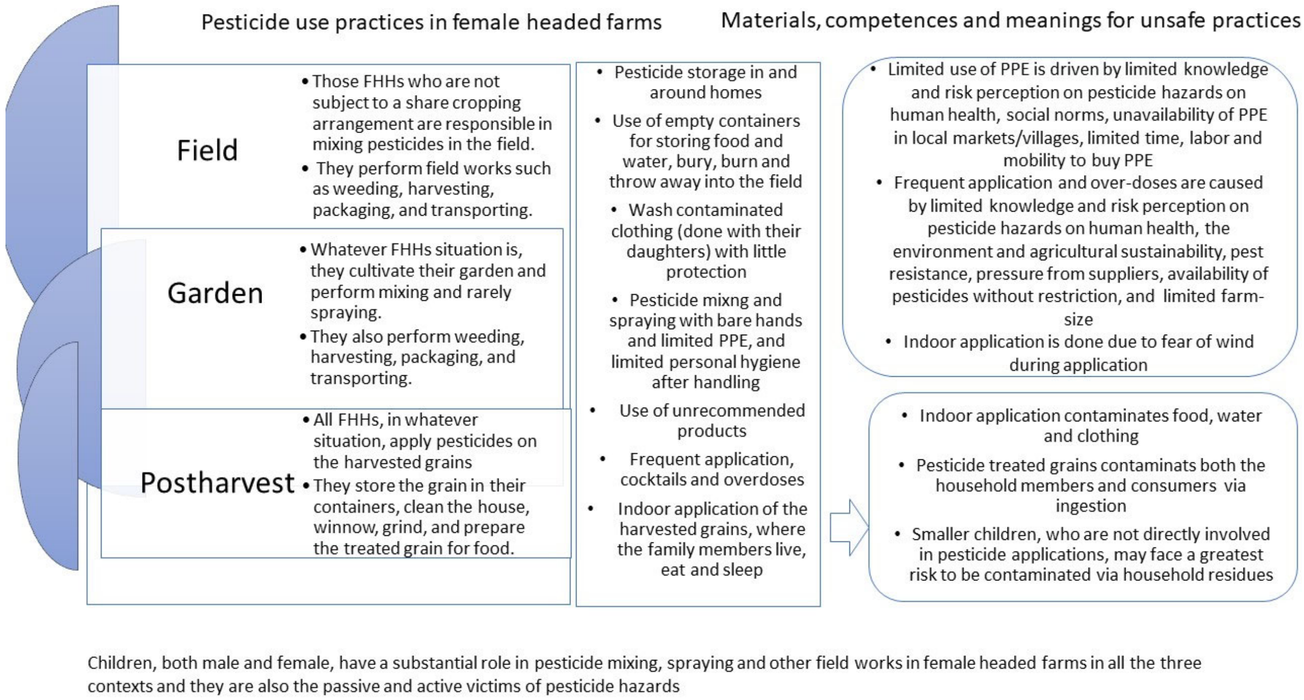

Figure 6. Pesticide use practices in the postharvest period. Source: Own construction.

Table 5. Alternative methods used against storage pests.

Pest Management Components	Strategies Against Field Pests	Strategies Against Storage Pests	No. of Respondents	Preparation Against Storage Pests
Biological	Neem tree to use on flies	Neem tree	1.6%	The leaves are air-dried, grinded, and the powder is thoroughly mixed with the crops mostly on maize
Mechanical	Handpicking of insects and weeds	Cold treatment of fruits	21.7%	They put the fruits in colder areas in the house
	Removal of diseased parts	Vapor heat treatment	35%	They use vapors to remove flies from mango and papaya
Cultural	Animal urine	Crop roasting	15.4%	Roasting the maize slightly
		Wood ash	21.7%	The wood ash is mixed with the crops (maize and legumes) before storage
		Cow dung	95%	They used cow dung to polish the traditional grain storage container to prevent pest entry
		Wood ash	15.4%	Applied on the crop
		Pepper chilies	12.9%	The red pepper is dried and grinded and applied on crops. They also smoke the traditional containers with chilies before storage
		Garlic	56%	The garlic is air-dried and grinded and applied on the crops
		Holy water	75%	Sprayed on the field and storage areas

Source: Household survey 2018–2019.

However, pesticide suppliers, whom women trust for their information, lacked the competence to advise on specific products they sell, recommended dosage, and product quality and had little interest in promoting alternatives that would decrease their business. Retailers were motivated by opportunities to do business; therefore, in their own interest promoted unsafe practices, provided wrong pesticides, and erroneous information. A study in Ethiopia [12] also reported a lack of knowledge on toxicity, efficacy, and safety among retailers. During the field visit, we found unprofessional retailers in the licensed/registered shops selling products to farmers.

Due to their social value of relationships, women considered information from neighbors as valid and trustworthy. However, they were not professionals; thus, most of the information might not be adequate for the safe handling of pesticides.

Access to extension services on pesticide use appears to be gender discriminatory. Extension workers have little awareness of pesticide hazards related to the postharvest treatment of pests and other agricultural tasks. Exposure is often associated with crop spraying in the field. A study in Ethiopia also found that extension packages are often targeted in male-headed households [17]. These preconceived notions of gender relations are out of the power of women to change without institutional support, indicating the relative importance of the transformation of competences among extension workers, suppliers, and FHHs, through education, technical support, and training.

4.4. Safety Practices

4.4.1. Protection Measures

Our observation in the field, garden, and home revealed that FHHs did not adopt full PPE (Figure 7); instead, they wore everyday clothes during pesticide application or other agricultural tasks. About (23.9%) of FHHs used gloves, (17%) boots, (6.9%) hats, (3.5%) goggles, and (10.1%) masks. The overalls that some of them wore were inadequate since they did not cover the body; thereby enhancing direct contact with pesticides. This finding confirms previous studies in SSA, where women either in commercial [31,119–122] or smallholder farms [14,15,19] were presumably less protected.

Figure 7. A pesticide bought in smaller bottle, mixing and spraying without protective clothing. Source: Field observation 2019–2020.

The materials, competences, and meanings that constrained PPE adoption among FHHs were, first, lower risk perception and knowledge of pesticide risks, driven by limited access to advisory services and higher illiteracy. Second were the limited income, time, and labor needed to purchase PPE. PPE was mostly not available in local markets/villages. Third, the socio-cultural factors categorized as meanings in practice theory present another challenge for women to protect themselves from pesticide hazards. For example, some forms of PPE, such as boots, hat, and goggles, are socio-culturally considered men's clothing. Following the perspective of practice theory [35], this sense of meaning, caused by norms and the material conditions and competences, is powerful in influencing PPE adoption and these elements are closely related. However, wearing PPE during pesticide application can mitigate farmers' risk of exposure [30].

4.4.2. Hygiene Practices

The survey revealed that most FHHs in all the study districts were presumably less protected from pesticide hazards (Table 6). However, FHHs in the Lay Gaint district less often followed hygiene measures than those in the Dera and Jawi districts ($p < 0.001$). These variations are more likely to be related to different understandings of pesticide hazards.

Table 6. Hygiene behavior.

Personal Hygiene	Items	Dera (%)	Lay Gaint (%)	Jawi (%)	Total
Washing hands $\chi^2 = 156.2$ ***	Never	9	65.1	5.6	34
	Sometimes	5	17.1	5.6	10.7
	Always	86	17.8	88.9	55.3
	Total	100	100	100	100
Showering $\chi^2 = 37$ ***	Never	44	65.8	50	55.3
	Sometimes	13	21.9	8.3	16
	Always	43	12.3	41.7	28.6
	Total	100	100	100	100
Change clothes $\chi^2 = 26$ ***	Never	42	66.4	54.2	56
	Sometimes	6	12.3	6.9	9.1
	Always	52	21.2	38.9	34.9
	Total	100	100	100	100

Source: Household survey 2019–2020, *** $p < 0.001$.

Personal hygiene in the study areas was influenced by material elements (i.e., scarcity of water, lack of washing facilities, and time scarcity); competences (i.e., limited knowledge and risk perception); and meanings (i.e., the belief of not needing to wash bodies immediately after work).

About 55.3% of the FHHs used contaminated clothing without washing while 27.7% and 17% of them, respectively, washed the clothes always and sometimes. A similar finding has been reported in SSA [14–16,20,120], where women typically represent the most at-risk group that performs other forms of pesticide handling, i.e., washing contaminated clothing. Washing clothing is shared between a woman and her daughter(s), revealing the importance of gender relations. This finding is in line with other studies [123] that show gender roles in the household and associated risks.

4.4.3. Storage Facilities and Disposal

The materials, competences, and meanings that enable or constrain FHHs pesticide storage practices were discussed. With no significant differences across the study districts ($\chi^2 = 11.5$, $p > 0.05$) FHHs appeared not only to store pesticides and equipment inside their homes (47.2%) but also outside the home hanging on walls (29.8%) (see Figure 8), which may place children or other household members at an increased risk of poisoning. The remaining (11.7%) kept pesticides locked and (11.3%) in the stable ($\chi^2 = 11.5$ $p > 0.05$). This finding confirms previous studies in SSA [15,16,20], where most women prefer to store pesticides in and around homes because they have more control over these places. In a study carried out in Uganda, Andersson and Isgren [14] noted a number of intentional and unintentional poisonings due to pesticide storage.

Figure 8. Pesticide storage in and outside home. Source: Field observation 2019–2020.

With no significant differences across the study districts ($\chi^2 = 5$, $p > 0.05$), many of the respondents did not dispose of the empty pesticide containers in a safe manner, driven by materials, competences, and meanings. More than 41% of the FHHs described empty containers as valuable for water or food storage (meaning). However, as women and children were often in contact with the empty, often not adequately cleaned containers, their risk of poisoning would be high. About (9.4%) of women also threw away the empty containers in the field, where the risk is that residues will be washed out into the environment and may easily contaminate soils, water sources, grazing land, and risk children's health. Others (27.8%) either buried or burned (35.5%) the containers. According to World Health Organization [124], open burning of empty pesticide containers generates environmentally persistent toxic fumes that might be taken in by animals or humans, causing serious harm to health. About 22.6% of women resold the containers to suppliers for new pesticide mixtures.

4.4.4. Factors Influencing PPE Adoption among FHHs

The important variables that influenced PPE adoption among FHHs are listed in Table 7. About 56% of the respondents did not know of the harmful impacts of pesticides on human health, in line with the finding in Ethiopia [12]. Nearly 49% of the FHHs perceived no pesticide risks; about 49.3% of the FHHs had access to information from pesticide retailers. About 78.3% and 74.2% of the respondents, respectively reported time constraints and social norms as barriers to PPE adoption.

Table 7. Importance of variables for women's unsafe behavior.

Respondents' Category	%	%
Are you aware of pesticide hazards?	Yes	32.1
	No	11.9
	I do not know	56
Do you have access to pesticide retailer information?	Never	50.6
	Always	26.7
	Sometimes	22.6
Do you perceive pesticide risks to your own health?	Strongly disagree	16.7
	Disagree	17
	Uncertain	15.1
	Agree	9.4
	Strongly agree	41.8
I feel personally too busy to buy PPE	Yes	78.3
	No	21.7
Peer farmers/neighbors or the society at large do not expect that I wear PPE.	Yes	74.2
	No	25.8

Source: Household survey 2019–2020.

A binary logistic regression model was used to identify the factors that influenced the adoption of PPE among FHHs (Table 8). The model was also used in [92–97] to determine the factors affecting safe pesticide use and PPE adoption. We checked the data fitness and overall model validations of the binary logistic regression through multicollinearity, Nagelkerke R2, Hosmer–Lemeshow, and Omnibus tests [see also [125]]. Multicollinearity was checked through tolerance and variance inflation factor (VIF) values. Multicollinearity problems occur when tolerance is less than 0.10 or VIF is greater than 10 [125]. The results from the collinearity statistics showed that the tolerance and VIF values were greater than 0.10 and less than 10, respectively, indicating no collinearity problems among the predictor variables. This means that the variables were strongly correlated. The Omnibus test is used to check whether the explained variance in a set of data is significantly greater than the unexplained variance in the overall model [126]. The chi-square statistics under the omnibus test are crucial in determining the overall statistical reality of logistic regression models. In our study, the statistical result of the Omnibus test ($\chi2$ = 36.1, df = 9, $p < 0.001$) showed that the model fitted. The Hosmer–Lemeshow test is also used to check the goodness of fit of a model in the case of binary outcomes [127]. As the Hosmer and Lemeshow test indicated (p = 0.170), the model fitted because the *p-value* was greater than 0.05 (see also [125]). When the significance of the *p-value* increases (usually to less than 0.05) the significant difference between the observed and expected value becomes less [125]. The value for the Nagelkerke R-square was 0.231, which indicates the model was useful in predicting PPE adoption as the value covered the full range from 0 to 1 (see also [125]). The model showed an overall predictive accuracy of 90.6%. The important variables for the regression analysis are mentioned in Table 9.

Table 8. Data fit and model validation statistical parameters.

No.	Parameters	Collinearity Statistics Tolerance	VIF	Pseudo R-Squares and Hosmer–Lemeshow Test		
1.	Age	0.909	1.100	Hosmer–Lemeshow test		
2.	Education	0.950	1.052	Chi-square	df	Sig.
3.	Income	0.843	1.186	11.6	8	0.170
4.	Family size	0.966	1.036			
5.	Knowledge of pesticide hazards	0.878	1.139	Omnibus test		
6.	Risk perception	0.936	1.068	Chi-square	df	Sig.
7.	Retail information	0.756	1.324	36.1	9	0.000
8.	Time	0.853	1.075	Nagelkerke R Square 0.231		
9.	Social norms	0.930	1.072			

Source: Household survey 2019–2020.

Table 9. Results of regression analysis.

Explanatory Variables	B	S.E.	Wald	df	Sig.	Exp(B)
Age	−0.542	0.212	6.555	1	0.010	0.582
Education	0.635	0.792	0.642	1	0.423	1.887
Family size	−0.096	0.335	0.081	1	0.775	0.909
Income	0.455	0.244	3.485	1	0.062	1.577
Time	−0.392	0.507	0.597	1	0.440	0.676
Social norms	−0.167	0.513	0.106	1	0.745	0.846
Retail information	−0.578	0.273	4.464	1	0.035	0.561
Knowledge	0.467	0.239	3.823	1	0.051	1.596
Risk perception	−0.229	0.146	2.458	1	0.117	0.796
Constant	5.006	2.186	5.245	1	0.022	149.336

Source: Household survey 2019–2020.

The result from binary logistic regression showed that age and retail information were significant predictors of PPE adoption while other variables such as education, income, family size, knowledge of pesticide hazards, risk perception, value of time, and social norms were not significantly associated (see Table 9).

Age had negative coefficients but showed a significant association with PPE adoption ($p < 0.05$), indicating the probability of safety behavior decreased with age, suggesting that older women may pay less attention to PPE adoption. This finding confirms a previous study carried out in Greece [128], highlighting that older farmers perceive lower risks and follow unsafe practices. Another study [129] found younger age to be related to safer practices. Conflicting results have been reported in another study [130], in which older and experienced farmers had a better understanding of pesticide hazards and were found more likely to adopt safety measures. Access to information from retailers ($p < 0.05$) was found to be negatively correlated, but showed a significant association with PPE adoption, indicating that information from retailers was generally less important in the usage of PPE. Though few studies [131–133] identify education as the major driver behind safety behaviors in pesticide use, this is not true in our case, as many of the respondents were illiterate. Further, a study of practices of energy consumption [52] and pesticide use among male smallholder farmers [12] using SPT as an analytical tool found household income was a significant variable that influenced practices.

4.5. Pesticide Poisoning Symptoms

FHHs in Dera and Jawi districts experienced a much higher frequency of poisoning symptoms than women in the Lay Gaint district ($p < 0.05$). Poisoning symptoms such as headache, stomach pain, vomiting, skin irritation, cough, shortness of breath, and unconsciousness were reported in the survey. Some of the women reported such illness after routine pesticide application while others did not link their symptoms to pesticide use. Some women reported respiratory problems such as asthma. Ill-defined symptoms were also reported, which may be an indication of chronic disease [29]. Unless symptoms were life-threatening, many of the poisoning symptoms went unreported and untreated, as information on pesticide-driven health issues was unavailable, nor did women have the financial means to cover medical costs. Further, well-equipped health services and professionals were simply not available to make a proper diagnosis of pesticide-induced diseases.

5. Conclusions

Drawing on the theory of practice, we have shown that the materials, competences, and meanings surrounding pesticide use provide relevant information about what, why, and how practices are performed. These three elements are resources that may enable or constrain pesticide use practices among FHHs.

Despite pesticide resistance, residues in stored food grains, and risks to human health and the environment, pesticide use continues to be the dominant pest control strategy on female-headed farms. Pesticides are considered the only solution for family survival due to the lack of alternative pest management. Pesticides are indiscriminately used in the field, garden, and home. Using unrecommended and potentially hazardous products, cocktails, frequent application, overdoses, unsafe storage, and disposal are the characteristic features of pest management in female-headed farms. PPE and personal hygiene rules are simply not followed, which increases susceptibility to pesticide hazards. Hence, current pesticide use practices among FHHs are not only risky but also highly inefficient and costly, calling for interventions to support more effective and responsible pest management.

Almost all FHHs in the studied areas were less privileged and unable to afford sustainable pesticide use practices. They were the most disadvantaged specifically endangered through their societal status (widows, divorced, and single), living and working in harsh conditions, and with higher illiteracy. These groups of women may be also under increasing pressure due to limited access to land and the labor force. However, having less land may motivate them to uncritically apply pesticides to obtain the best yield on their shrinking land. Money, labor, and time are scarce resources for these women, which limits safer practices in pesticide purchasing and use. They bear full responsibility in the household and agriculture, further limiting their income inclusive of any off-farm activity.

FHHs are often ignored, e.g., when it comes to advisory services, and in factors that are regulated by the institutional environment. Many of the FHHs surveyed were illiterate, which limited their ability to read, understand, or follow label instructions, and were unaware of the risks of the specific products they purchased or used; most information on labels is technical and not easy to understand. They also lacked access to information and technical support on safe pest management. They were dependent on their personal experience, their societal networks, and retail information in purchasing pesticides. Neither the awareness of women, suppliers, nor neighbors were such that it could lead to a change of practices. Many FHHs lacked access to extension services on pesticide use practices—constructed as experiences of discrimination, a sense of injustice, and unequal rights. As a result, FHHs were unable to adopt safety practices on pesticide applications. Thus, an insufficient effort to adequately protect them from pesticide hazards clearly places a disproportionate risk on an already vulnerable group. To conclude, safe pesticide use practices may be enabled when adequate material elements (e.g., financial resources, labor, transportation, regulated markets, alternative approaches) are in place and also when time is available to purchase and handle pesticides, and is not required for other activities (e.g., farming or other household activities).

To change unsustainable pesticide use practices in female-headed farms, all of the three key elements that constitute a practice could be targeted for intervention as they are interconnected. Recognizing pesticide use as a practice may help policymakers to go beyond individual decisions and choices, and instead focus on a foundational shift in the economic, social, and cultural environment and a change of the social practices and processes that organize and sustain FHHs lives. Therefore, the first intervention with the material elements should include adopting effective policies, advisory services, and research institutions targeting eco-friendly, safer, and sustainable alternative approaches integrating women's knowledge, skills, and experiences. Such approaches can integrate integrated pest management, agroecological practices, biopesticides, and organic farming to reduce costs in smallholder settings, and risks to human health and the environment. Second, there should be enforcement of pesticide laws and regulations that ban the import, distribution, sale, and use of potentially hazardous pesticides in agriculture. Third, the local pesticide provision system that regulates marketing, training, licensing, and certification must contain provisions for controlling these activities and inform punitive actions. Fourth, safer products, that are more targeted, with a minimum impact on non-target species are needed. Finally, there should be the provision of pesticides that are affordable and easily accessible, preferably in smaller quantities, considering FHH plot sizes, purchasing power, time, and mobility. To intervene in the area of competences, policies, advisory services, and research institutions should target increasing the awareness of all stakeholders and women along the value chain through education, technical support, and training. Extension services need to reach these groups of women. With meanings, the social norms need to be reconfigured through awareness-raising campaigns among both men and women at all levels. Further, the value given to pesticides, as a necessity needs to be changed by the introduction of alternative approaches.

In general, regulatory or policy interventions that aim to change individual behavior without considering the role of such connected factors in shaping or constraining practices are insufficient. FHHs' socioeconomic status needs to be changed to better integrate them into formal markets, provide advisory/extension services, and even bring them together in groups to boost their collective bargaining power. This means that the social dimension has to be changed or improved by empowering women through specific training and organizing women in groups for income opportunities. This in general requires all actors (women, suppliers, extension workers, government, pesticide companies) and also the community along the value chain to act collectively towards a new safer practice of pest, disease, and weed management.

Author Contributions: Conceptualization, B.A.A. and B.F.; methodology, B.A.A.; software, B.A.A.; validation, B.A.A., B.F. and J.B.; formal analysis, B.A.A.; investigation, B.A.A.; resources, B.A.A., B.F. and J.B.; data curation, B.A.A.; writing—original draft preparation, B.A.A.; writing—review and editing, B.A.A., B.F. and J.B.; visualization, B.A.A.; supervision, B.F. and J.B.; project administration, B.F.; funding acquisition, B.A.A. and B.F. All authors have read and agreed to the published version of the manuscript.

Funding: The Ph.D. studies of Birtukan Atinkut Asmare (corresponding author) have been funded by the Austrian Partnership Program in Higher Education and Research for Development (APPEAR) (grant number: 0894-00/2014). This research also received small grants from International Foundation for Science-IFS (grant number: I-3-S-6337-1), African Economic Research Consortium (AERC), Parks Foundation PhD Award, Fiat Panis Foundation (grant number: 21/2019), Civil Society Scholar Award (CSSA), and PERI PERI U project at Bahir Dar University.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data presented in this study can be accessed via email request.

Acknowledgments: We are grateful to the informants, including experts, for their valuable information on the topic.

Conflicts of Interest: The authors declare no conflict of interest.

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