

Pesticide Usage and Health Consequences for Women in Developing Countries: Out of Sight, Out of Mind?

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Pesticide exposures of women in developing countries are aggravated by economic policy changes associated with structural adjustment programs and globalization. Women in these countries, particularly in the agricultural sector, are increasingly exposed. Since they are concentrated in the most marginal positions in the formal and informal workforces, and production is organized in a gender-specific way, opportunities for women to control their exposures are limited. Data from developing countries show that: 1) women's exposures to pesticides are significantly higher than is recognized; 2) poisonings and other pesticide-related injuries are greatly underestimated for women; 3) for a given adverse outcome from exposure, the experience of that outcome is gender-discriminatory; 4) erroneous risk perception increases women's exposures. The hiatus in knowledge of gender-specific exposures and effects is related to gender biases in the nature of epidemiologic inquiry and in the literature, and the gendered nature of health workers' practices and surveillance. Recommendations are made for strong, independent organizations that provide opportunities for women to control their environments, and the factors affecting their health, as well as gender-sensitive research to address the particularities of women's pesticide exposures. *Key words:* gender; exposure; policy; surveillance; epidemiologic bias.

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No health and safety measures in the workplace can be effective, however, if we do not make rapid improvements in social policies and services to support women's participation in the labour force. This

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in turn will require stronger representation and participation of women in decision making related to such policies. —GRO HARLEM BRUNTLAND¹

Agriculture plays a critically important role in the economies of many developing countries. For example, in Latin America, agriculture provides economic support for some 112 million people,² while in Central America, the livelihoods of almost half of the population depend on farming and, at the turn of the millennium, 4.3 million people or 41% of the economically active population were agricultural workers.³ Similar data confirming the central economic role of agriculture are to be found for countries of Sub-Saharan Africa.^{4,5}

However, traditional agricultural production in developing countries is coming under growing pressure from globalization and market forces, with the result that high-input agriculture is increasingly being seen to play a major role in rural economies in the poorest of countries.^{6,8} Among the inputs encouraged by this form of intensified agriculture are potentially hazardous chemicals used widely to combat pests and boost production, but which also carry significant risks to human health.^{9,10} Sales of pesticides to developing countries, while remaining a relatively small proportion of global turnover (about 25%), have increased significantly in some developing countries.¹¹ Ironically, this is occurring at a time when many developed countries have begun to implement pesticide-reduction programs¹²⁻¹⁵ in the belief that excessive use of pesticides is harmful to workers, consumers, and the environment in the developed world.

It is particularly countries in economic and political transition dominated by agricultural economies that have identified opportunities for potential foreign revenue from agricultural exports, involving high-input agricultural technologies [including pesticides, fertilizers and genetically modified crops (GMOs)] as crucial to national development strategies.^{16,17} For example, South African agricultural policy explicitly targets high growth in agricultural exports in excess of national targets, and the presidential opening address to parliament in 2001 singled out agriculture as having the potential to promote higher growth rates and job creation.¹⁸ Not sur-

prisingly, this has driven a commitment to expanding access to a range of inputs,¹⁹ manifesting in the promoting of GMOs²⁰ and preoccupations with promoting crop-protection inputs for emergent farmers.²¹

Evidence for the link between economic policy and expanded pesticide usage is widespread in the developing world. In Zimbabwe, the implementation of structural adjustment reforms was associated with a 67% increase in pesticide usage between 1991 and 1995, which was more than twice the moderate increase of 26% experienced in the four years preceding structural adjustment.²² Liberalization of trade policy in Tanzania resulted in large increases in pesticide imports and altered the patterns of pesticide supply and distribution, with increases in the involvement of private retailers 80-fold between 1988 and 1997.²³ Agriculture in Latin America, particularly the production of ornamental plants, tropical fruits, and vegetables, relies heavily on chemical inputs,^{3,24,25} while in Central America, pesticide use increased significantly during the 1990s.²⁶ Pesticide use on the non-traditional export crops in Central America may be even higher than use in the cultivation of cotton or bananas, traditionally quoted as extremely pesticide-dependent.⁹ Policies that promote intensive use of pesticides have extended to small producers and households.^{9,27} An institutionalized culture that favors pesticide use has arisen in Costa Rica²⁴ and South Africa.²⁸

One of the characteristics of the agricultural sector in much of the developing world is the high level of participation of women (and children) in production, both formal and informal.^{7,29-34} Women do at least three fourths of agricultural work in Africa, and women produce 60–80% of basic foodstuffs in sub-Saharan Africa.^{30,35-37} It is estimated that in rural South Africa, women provide 70% of the total labor used in farming activities, and that 90% of hired labor is provided by women.³⁸ Half the agricultural labor force in Asia is female, while approximately 40% of the “economically active female population” in Malaysia are engaged in the agricultural sector.³⁰

Floriculture and fruit culture have become an important agricultural activity in developing countries geared to meeting the needs of developed country markets.^{16,39-41} In Chile,^{33,42,43} South Africa,^{44,45} and Tanzania³⁹ the employment of agricultural workers in the fruit industry relies heavily on the female work force, particularly as seasonal workers. Beginning in the mid-1980s, in most Central American countries job opportunities opened for women in the production of nontraditional export crops such as flowers, melons, pineapple, and vegetables.⁶

Because women's work is in both the formal and the informal sectors, there is an underestimation of their participation in the production process, with few statistics on the informal workforce. Data from Ecuador,⁴⁶ Costa Rica,³ and Chile⁴³ suggest that official statistics are poor indicators of the extent of women's work. The massive participation of women and children in coffee har-

vesting in Latin America is not quantified, and little is known about work on family farms. Unpaid agricultural tasks for women on family farms in South Africa are frequent^{44,47} but not counted in the official statistics.

We argue that both the exposures to pesticides experienced by women and the resultant impacts on their health are grossly underestimated for women in developing countries. This hiatus arises partly from the gendered nature of biomedical science and its methods of investigation, informed by the dominant patriarchal social order, but it can also be traced to the way production is organized in both the formal and the informal sectors of the economy, with the non-recognition and undervaluing of women's work. The social construction of women's roles in agricultural production also places them at significantly higher levels of exposure than men. Despite this, it is commonly believed that high levels of exposure to pesticides are a male phenomenon, and that women's exposures are either lesser or of shorter duration. Until the data are subjected to a gendered critique, women's occupational and environmental health concerns will remain out of sight and therefore out of mind.

THE NATURE OF WOMEN'S WORK IN AGRICULTURE

Although women actively participate in informal and formal agriculture throughout developing countries, social organization differs between countries and cultures. For example, in Africa, much of women's work in agriculture takes place in the context of traditional subsistence farming, sometimes known as communal farming,⁴⁸ and typically ranges across the full spectrum of agricultural production, including tilling, weeding, planting, and harvesting.⁴⁹ In Southern Africa such work often occurs in the absence of male family members, who have moved to urban areas as migrant laborers, with the result that the full burden of agricultural production falls to women and often children.

In commercial agriculture women are concentrated in various sectors, such as the production of flowers, ornamental plants, fruits, vegetables, coffee, cotton, and sugar cane. Their jobs may be related to the packaging and processing of agricultural products, but women are also often involved in plant care in the field, for example, for grapes and flowers.^{33,50,51}

Women are typically located in lower-paid, low-status work, often casually employed,^{33,44,48,51,52} with little opportunity for promotion or access to safety measures. Kitumbo and Riwa³⁹ noted that in Tanzania employment in floriculture is dominated by young women, often with little education and hired on a casual basis. More than half of the temporary women workers in Chile are not covered by labor insurance, and two thirds do not contribute to a social security or pension system.⁵³ Women's work also frequently involves monotonous and repetitive movements and awkward postures, resulting in

TABLE 1 Pesticide Exposures of Rural Agricultural Women

Exposure	Contextual Factors
Mixing of pesticides	Lack of personal protective equipment
Application of pesticides	Lack of water water (e.g., gender violence)
Disposal	Poor unionization
Acting as marker for aerial spray	Multiple jobs
Contact with residues during field work: weeding, thinning, harvesting, collecting cotton sticks	Poverty
Packaging	Patriarchy
Domestic pesticide use	Undernutrition
Vector control	Alcohol consumption
Domestic storage	HIV/TB
Drift into domestic environment	Some forms of traditional dress
Food and water contamination	Lack of training and access to information
Contamination of fodder for animal use	Availability of pesticides for intentional self-injury
Washing of contaminated clothing	Vector-borne diseases
Reuse of pesticide containers	Poor housing
	Poor access to garbage disposal

ergonomic hazards,^{29,39,45} and the application of piece-work, resulting in work paces that are contrary to safe practices.^{32,39} Similar problems have been reported in other Latin American countries.^{33,42,46}

In much of commercial agriculture in developing countries, women's work status may be unrecognized under labor systems that assume the contribution of the woman's labor to be a condition of employment of her male spouse or partner.⁵⁴ For example, women farm workers in South Africa are entirely dependent on the continued employment of their male partners for housing and benefits and have, until very recent law reforms, enjoyed no security of tenure.^{44,45} Indeed, it is the case that women's work in both communal and commercial agriculture almost always takes place under the control of men, often with adverse consequences for women's independence.^{31,45} For example, Hussain⁵⁵ reports the remuneration of women workers involved in cotton picking in the south Punjab, Pakistan, being appropriated by male family members at the end of the season when paid out by "parchi" (cash slips).

Women's work hours are typically longer than men's,⁵⁶ and studies have shown that women in rural Africa work up 16 to 18 hours a day.³² This is true for traditional agriculture as much as it is for new market-driven agricultural production typical of globalization, such as floriculture.³⁹ For temporary women workers in Chile, the ordinary 48-hour workweek is often extended to 16 hours a day or more, six days a week.^{33,42}

WOMEN'S EXPOSURES TO PESTICIDES

Occupational Exposures

Women's exposures to pesticides in both commercial and small-scale farming may be by multiple routes and modes (Table 1).

The gender division of labor is such that male workers often appear to conduct the main pest-control operations. For example, field pesticide applicators in com-

mercial fruit and grape farming in South Africa,^{57,58} tobacco farms in Zimbabwe,⁵⁹ floricultural and horticultural farms in Kenya,⁴¹ potato farms in Ecuador,⁶⁰ cooperative farms in Nicaragua,⁶¹ and banana plantations in Costa Rica⁶² are typically male.

However, this is not the case uniformly across and within developing countries. For example, research on coffee plantations in the Northern Province of South Africa⁶³ showed that most pesticide application was conducted by women, usually by backpack device. Further, women on fruit farms in the Western Cape province of South Africa were mainly responsible for painting pesticides onto the trunks of the fruit trees.⁶⁴ Kimani⁶⁵ showed that in a rural agricultural community in Kenya women's exposures were higher than men's. Arumugam³⁰ found that there were approximately 300,000 women pesticide applicators in the plantation sector in Malaysia, in both permanent and seasonal positions. In a survey in Chile, 19% of the temporary women workers reported direct handling of pesticides, and only 20% of them used any type of protective equipment.⁴² On banana plantations in Costa Rica, women often apply fungicides in the packing plant to prevent rotting of bananas during transportation.^{62,66} The pesticide-poisoning surveillance system in Nicaragua has detected numerous cases of poisonings in women applicators.⁶⁷ Women in the flower industry dip flowers in basins of water containing dissolved pesticides^{50,68} or may directly apply insecticides and fungicides.⁶⁹

Where women are involved in direct applications of pesticides, the technologies used are often those with the greatest possibility of contamination. For example, in South Africa, a common practice in the fruit industry in the Western Cape is application of herbicides from a hose with a series of punctures carried horizontally behind a moving tractor. The hose is hand-held by a number of women, such that the herbicide drips down constantly from the puncture holes, with considerable potential for direct contamination of the workers.⁷⁰

Because this work requires little skill, and is regarded as suited for temporary labor, it is frequently women who undertake it, often with little or no protective clothing. Herbicides commonly used in the fruit industry in South Africa⁴⁰ include the highly hazardous paraquat or the phenoxyacetic-acid herbicides, thought to be endocrine disruptors. Similar application practices, where women carry spray booms involving high potential exposures to pesticides, are reported in the rest of the Southern African Development Community.⁴⁹

Even where women do not directly apply pesticides, opportunities for exposure may be substantial.⁷¹ A pilot study among small-scale cotton farmers in the rural Northern KwaZulu Natal (KZN) province found that women were widely responsible for key high-exposure activities, such as the mixing of the chemical solutions for backpack and tractor sprayers used by men.⁷¹ Although they did not physically apply the pesticides in this area, women were usually present during application activities, either weeding or harvesting in adjoining sections of sprayed fields or working in recently sprayed fields. Men often held their wives responsible for functions that they saw as routine or less critical, but which subjected them to high exposures to chemicals. Research among women farm workers in the Western Cape indicated that the women themselves did not perceive certain high-risk tasks as "exposure" because pesticide exposure is associated only with crop spraying, which is regarded as "men's work."⁴⁴

Women's work is also often dictated by stereotypes related to perceptions of gender-specific biologic abilities. Thus, work requiring meticulous handedness, such as thinning of fruit on deciduous trees or micro-trellising of vines, is often allocated to women, ostensibly because of their "natural" abilities to do this work better than male workers. For example, women's employment in greenhouses in Zimbabwe and Ecuador is said to be related to the "nature of the work, which requires a delicate touch"^{48,49} or "nimble fingers."⁴⁴ However, this gender allocation probably has more in reality to do with the requirement for available pools of temporary labor for such tasks, and societal acceptance of pay discrimination. Nonetheless, the timing of these activities frequently coincides with the period of peak application of pesticides, with the result that residues are a significant potential exposure for many women. Hand protection tends to interfere with the dexterity needed for the thinning work, reducing the willingness and ability to wear gloves and prevent or reduce dermal absorption or skin damage. Because women's employment in agriculture may be concentrated in sectors that are high users of pesticides, such as floriculture and fruit growing, opportunities for indirect exposures for women workers may be multiplied.

In Costa Rica, a wide variety of occupational exposures of women have been documented and characterized by observational methods in the field during the production

of several crops and by review of medical files. Two quantitative exposure-assessment studies have shown substantial dermal contamination of flower cutters to methomyl,⁶⁸ and of fungicide applicators at a banana-packing plant to thiabendazole and imazalil.⁶⁶ Most of these workers were women. Research in Tanzania³⁹ and Colombia⁷² has shown that practices in floriculture there involved high levels of usage of multiple pesticides, an absence of provision of safety data sheets, a lack of emergency treatment procedures, a lack of medical surveillance, and a lack of personal hygiene facilities.

Furthermore, because women are often employed as casual labor, tasks that can be done without requiring high levels of training are often allocated to them. These tasks may include participating in particularly unsophisticated and high-exposure activities. Until only a few years ago, women, and often also their children, opened plastic bags impregnated with the insecticide chlorpyrifos used in banana plantations to protect the fruit.⁶⁶

Low levels of awareness of the hazards of pesticides characterize rural agriculture as a result of the lack of provision of information to women in patriarchal societies.^{37,55} All these factors are aggravated by unfavorable conditions of employment associated with seasonal work or piecework, where women are predominantly located.^{33,47,73} For example, they may be less likely to receive adequate training or protective clothing (often reserved for men), or they may be unfamiliar with poisons and thus may be more likely to be involved in mass poisonings.⁷⁴

Developing countries lack the regulatory frameworks typical of developed countries that mandate posting of fields to prevent re-entry. Indeed, direct exposure often occurs as a result of drift where women workers undertake fieldwork while spraying is taking place. For example, Bailie and London⁷⁴ reported a case of 20 workers in the Western Cape Province of South Africa, including 19 women, who were poisoned while weeding from spray drift from a tractor spraying an adjacent orchard with a mixture of a fungicide and two organophosphates.

Personal protective clothing is often not available to women, or when provided is either not suitable^{48,52} or inadequately maintained.³⁹ Traditional African women's dress (e.g., thin cotton cloth wrapped around the body) may increase the surface area for contamination and exposure beyond the immediate period of application or contact with chemicals.⁴⁸ Further, women suffer more than men from the lack of sanitary facilities in the fields, particularly where they labor under the control of a supervising male.^{31,45,55} The potential threats of violence against women⁷⁵ may also deter women from walking long distances⁴⁵ to seek protective clothing, or to reach water sources for drinking or washing before consuming food or drink in the field, an important potential source of exposure. Even where showers are provided, they are usually available only to spray operators, who are usually men, and not to women workers, whose jobs are seen as non-exposed.⁶⁴

"Non-occupational"

Because of the nature of women's paid and unpaid work, it is much harder to make the distinction between occupational and non-occupational exposure for women than for men. One particular domestic duty likely to increase their exposures to pesticides to significantly more than those of male family members is the responsibility to wash household members' overalls. Frequently, such overalls are brought home for washing^{52,58} and, if soaked in pesticides, can give rise to significant indirect exposure. In a study of 33 male Costa Rican sprayers for insect vectors of disease, 22 (66.7%) reported that their work clothes were washed by their wives, eight (18.2%) stated that this was done by their mothers, sisters, or sisters-in-law or by female employees, while only three (9.1%) said that they washed them themselves. No facilities were available to wash the clothes in the workplace (Mergler, unpublished data, 2001). Some rural women rely on washing of overalls to generate income. Often these kinds of exposures are not recognized by the women themselves as problematic, even in environments of high levels of male workers' consciousness of health and safety, reflecting the internalization of roles expected of women.⁷⁶

Rural domestic pest control is often treated as an extension of pest-control approaches used in the field, resulting in the usage of inappropriate pesticides and/or inappropriate concentrations of chemicals to control lice, fleas, cockroaches, etc.⁷¹ Women generally bear the brunt of such usage, since the maintenance of the house is seen as women's work. Chemicals may be readily stored at home, often in proximity to food or drink,⁷⁷ or contaminated fodder may be taken home to feed small livestock kept around the house.⁵⁵ In the Northern Province of South Africa, the wife of a malaria-control sprayman explained in an interview how her husband used to bring home DDT to mix in the floor polish used for the control of insects in her home (Rother, unpublished data 1999). Home storage facilitates easy access for intentional poisoning, such that suicide with pesticides, particularly among younger women, may be extremely common.^{55,78}

Both commercial and subsistence agriculture are characterized by the close proximity of housing to areas of pesticide application. London⁵⁸ reported that about 33% of the total duration that fruit farm workers lived on farms had been within 5 m of a sprayed orchard or field. Under such circumstances, opportunities for exposures through drift directly into the house are multiplied.⁴⁵ In Costa Rica, aerial spraying of houses and schools close to rice fields, banana plantations, and pineapple plantations has been frequently observed (database, IRET). In Latin America several studies have documented pesticide exposures among family members of agricultural workers⁷⁹ or in communities near aerially sprayed plantations.^{80,81} Contamination of food stores, household water sources,

and clothing may mean greater exposures for women in rural areas because they are more likely to have domestic duties on top of any field production.

Another important route of exposure, sometimes at catastrophic levels, is the reuse of pesticide containers for cooking, storage, or washing in rural areas, where potable water is not readily available. While it is often children who are at highest risk, women are usually the people most in contact with the containers, again elevating their exposures. In many rural areas, the lack of safe containers for water and food storage render empty pesticide containers a tempting, sought-after, and basically "free" commodity.⁷¹ Knowledge, attitude, and practice surveys in six Central American countries found that between 26% and 45% of the interviewed farmers reused pesticide containers for storage purposes, often for water and food (15% and 22% in Honduras and Nicaragua, respectively).⁷⁷ In a Pakistan study, 90% of women indicated that they exchanged pesticide containers with hawkers for crockery and edibles.⁸²

Many developing countries have significant burdens of vector-borne disease, such as malaria, dengue fever, sleeping sickness, schistosomiasis, and Chagas disease, all of which may prompt extensive applications of insecticides for vector control. These applications may significantly increase women's likelihood of exposure. For example, for malaria control, pesticides are applied indoors and intended to remain as residue on the inside walls of rural huts. Since women spend more time in the home, the durations and intensities of their exposures to such pesticides are increased. Research in South Africa,^{83,84} Swaziland,⁸⁵ Zimbabwe,⁸⁶ and Thailand⁸⁷ has shown that women in rural areas who are subject to indoor DDT application for malaria control have significantly increased levels of DDT and its metabolites in blood and breast milk. In malaria control measures using insecticide-impregnated bed nets, the mixing of the solution and the dipping of the nets are predominantly conducted by women, tasks considered part of women's domestic responsibilities, and women's participation in bed-net programs is actively encouraged.⁸⁸⁻⁹⁰

Given that research in the United States has shown increased concentrations of pesticide in housedust and metabolites in urine among children living in houses within a 60-m radius of orchard-spray activity,^{91,92} it is plausible to anticipate that in developing countries, where pathways for domestic contamination are multiplied and more direct, domestic exposure opportunities are likely to be considerably magnified.

All the factors outlined above, which increase opportunities for domestic exposures from both direct and indirect routes, are far more important in developing countries, and make the distinction between occupational and non-occupational exposures somewhat contrived. Schilling and Andersson⁹³ have argued that illness that arises from increased access to hazards should also be considered to be causally related to occupation. In the agricultural setting in developing countries,

where the home is not separable from the workplace, such considerations are highlighted.

Socioeconomic Context

Consideration of women's exposures to pesticides in developing countries cannot be made without reference to the socioeconomic context in which women's domestic, formal, and informal work takes place. For the vast majority of women in developing countries, poverty is the driving factor behind their undertaking work that is poorly paid, potentially hazardous, and onerous. Inadequate social security, particularly evident in the absence of or the application of severely discriminatory provisions regarding maternity leave, serves to keep women locked into the labor market under extremely marginal conditions. Patriarchal societal norms ensure that women's paid work is additional to numerous domestic labor responsibilities, with the result that women's work is a constant double shift.^{31,33,94,95} In environments of food insecurity, paid work may provide income to supplement household revenue but may actually remove women further from food production for household use and aggravate household levels of malnutrition, both for adults and for children.²⁹ Of itself, chronic undernutrition in adults may aggravate chronic health impacts of pesticides, as evidenced in data on neurotoxicity of organophosphates among South African farm workers.⁹⁶

Many other general health hazards may interact with pesticide exposures to present particular hazards for women. For example, heavy alcohol consumption, common in parts of South Africa where historically farm workers were paid with alcohol (the DOP system),⁹⁷ may influence the metabolism of many pesticides, either increasing or decreasing toxicity, or their interactions with other hazards. The burden of HIV infection in sub-Saharan Africa is disproportionately borne by women, both as victims of infection and as family members having to take on increasing responsibilities as adult family members fall ill or die. The potential immunotoxic and carcinogenic effects of some pesticides are well known, and the interactions of these with the immunosuppression of HIV infection are not adequately characterized at present. Gender-based violence, prevalent in many developed and developing countries,⁷⁵ may further reduce rural women's capacity to control their potential exposures to hazardous chemicals. For example, violence against farm-worker women in South Africa has been suggested to be associated with greater risk for accidental injury as a result of depression, low self-esteem, and reduced alertness at the workplace.⁹⁸

Workplace organization for labor rights is traditionally weakest in the agricultural sector because of obstacles related to distance, isolation of workplaces, and coercive employers. Globalization has aggravated these difficulties through increasing casualization of the workforce,⁹⁹ intensified competition for insecure jobs,¹⁰⁰ and signifi-

cant job losses in agricultural sectors where women are concentrated, such as the fruit-canning industry in the Western Cape province of South Africa.¹⁰¹ Many trade unions in developing and developed countries also tend to have inconsistent approaches to issues of gender, and women often have to struggle both against oppressive labor conditions and against apathy and sexism within workers' organizations to have their voices heard. Levels of unionization among women farm workers in agriculture in developing countries are therefore low.^{39,43,51,52} Lack of power and job insecurity generally mean that women are constrained in asserting rights to better working and living conditions.²⁹ Despite this, fledgling trade unions have, in the South African context, often been the only means of obtaining access to commercial farms to assist with occupational health and safety training.¹⁰²

LACK OF GENDER ANALYSES IN OCCUPATIONAL AND ENVIRONMENTAL HEALTH

In light of the various sources of women's exposures to pesticides, as well as the social and physical conditions surrounding such exposures, there is probably significant underestimation of the resulting health problems. Indeed, there is a growing literature on the importance of gender-based analyses in occupational and environmental health and the recognition of the differences between men's and women's working and living conditions.^{30,82,103-105} The assumption that women's work is not hazardous for their health has led to underestimation of women's work-related health problems.¹⁰⁶ For pesticide exposures in developing countries, the situation is even more complicated because of the underrecognition of the multitude of women's exposure sources. Three of the factors (or issues) contributing to the present paucity of a gender-informed analysis in occupational and environmental health are described here.

1—Underreporting/Under-ascertainment of Acute Poisonings/Surveillance

Whereas underreporting of poisonings due to pesticides is widely recognized as a significant obstacle to ascertaining the true burden of disease,¹⁰⁷ the presence of gender bias in the nature of underreporting is less commonly recognized. For example, evidence from South and Central America suggests that acute poisoning outbreaks among women working in recently sprayed fields often remain unpublicized. In Viña del Mar, Chile, two such mass poisonings were detected. In 1996, 58 of the 64 reported poisonings concerned women; during 1997, 120 poisoning cases were captured by the system, and 108 of the 110 women were temporary workers, nearly all employed in the flower industry.⁴³ Similar unpublished episodes have occurred among women workers of ornamental plant companies in Costa Rica (database

IRET). Most symptomatic episodes are mild and not captured by any surveillance systems, yet they represent a significant source of worker concern.³³

Bailie and London⁷⁴ showed that intensification of surveillance for pesticide poisonings in a high-incidence region of the Western Cape province of South Africa demonstrated that underreporting (of the order of 80%) was differentially concentrated among women. While routine notification suggests that close to 70% of pesticide poisonings occur in men,¹⁰⁸ the intervention study cited above found the reverse—61% of the cases involved women, and the majority were occupational.⁷⁴ Underreporting of acute intoxications is important not only for immediate attention but also to prevent long-term neurobehavioral sequelae. Indeed, several studies have shown long-term nervous system effects subsequent to acute pesticide poisonings among men.¹⁰⁹⁻¹¹²

Even in the absence of systemic poisonings among women reported by surveillance systems, high and increasing rates of dermal lesions have been found among female agricultural workers in Costa Rica,¹¹³⁻¹¹⁶ with rates as high as 7.5 topical injuries per 100 women working in the banana and ornamental plant industries.¹¹⁵ Incidence rates for pesticide-related illnesses nearly doubled among female wage-earning workers during the time period 1982–1992. The risk for skin and eye injuries was 2.7 times higher for women than for men in 1992.¹¹³ The upward trend of dermal lesions indicates increasing contact with pesticides, which may not have high acute toxicity but which are often suspected of having mutagenic, carcinogenic, or reproductive effects. Such subacute or chronic effects are unlikely to be detected on routine surveillance. In Nicaragua and El Salvador, dermal lesions do not appear in the surveillance statistics.¹¹⁷ Thus, reliance on flawed surveillance data, without critical scrutiny of the basis of the data, may give rise to flawed policy conclusions.¹¹⁸ Interventions to improve the accuracy and coverage of reporting may be better able to show where women bear the brunt of poisonings due to pesticides.

The risks of agricultural use of pesticides extend to the community. During 1992–1993, 16 women and 11 children under age 18 were hospitalized because of suicidal and accidental poisonings in Guápiles, a region in Costa Rica with about 120,000 inhabitants and high pesticide use. Ten of them died (database, IRET). This reflects only the most extreme part of the non-occupational risk, including health effects among family members of agricultural workers¹¹⁹ or in communities near plantations.^{80,81} In addition, the increased use of pesticides, involving formulating factories, huge storage facilities, and ever-augmenting obsolete stocks, makes the risk for major environmental accidents a realistic possibility. In Costa Rica, nine such episodes (gas escapes from formulating factories, major industrial spills, illegal disposals, and a fire in a storehouse), resulting in acute poisonings of community members, including many

women, were reported to the National Emergency Commission between 1995 and 2000.¹²⁰

The role of pesticides in official reports is generally regarded as one of agent rather than cause of suicide. However, given the known neurotoxicity of some pesticides, notably the organophosphates, pesticides themselves may both be responsible for the depression that leads to suicide and provide the agent, thereby visiting a double hazard upon rural women. Indeed, evidence is increasingly beginning to emerge that organophosphate insecticides may play an important role in the etiology of suicides,¹²¹⁻¹²³ although the gender implications of such a link have been poorly characterized to date.

2—Gender Biases in Health Care Providers' Practices

Misdiagnosis of outbreaks of women's occupational health disorders as "mass hysteria" or psychogenic illness has been pointed out by several authors^{124,125} and may explain some of the gender gaps in surveillance data. This is clearly illustrated in a 1985 case study from a rural dried fruit factory in the Western Cape Province in South Africa.¹²⁶ Due to increasing pest resistance to the usual pyrethroid treatments, a subcontractor was brought in to fumigate the fruit under plastic sheeting. However, the fumigant leaked out from the plastic and caused widespread morbidity in the form of headaches, nausea, dizziness, salivation, and weakness throughout the workforce, resulting in closure of the factory the next day. Twenty-five women were diagnosed by the local general practitioner as suffering from "mass hysteria." Only after investigation by a union-linked health program did it emerge that methyl bromide had been used to treat the fruit, and that poor industrial hygiene had resulted in accidental exposures.¹²⁶

The propensity of general practitioners to label non-specific ailments as "malingering" or psychological reinforces the fiction that women are not at high risk for pesticide-related illness and illustrates the gendered nature of biomedical knowledge in this area. Moreover, none of the above cases was reported to the health or labor authorities, thereby reinforcing the myth that women have little exposure to hazardous pesticides. The previously mentioned mass poisonings among women workers of the flower industry in Chile were, according to a representative of the labor insurance company as well as reports in the mass media, greatly attributable to mass hysteria.⁴²

3—Gender Analysis and Chronic Health Effects of Pesticide Exposures

The perception that women are not at risk for pesticide exposure and the underestimation of women's occupational and non-occupational exposures to pesticides reflect as well on research design and selection of exposed populations for studies of chronic health effects. McDuffie,¹²⁷ reviewing the literature on women's cancers

in relation to pesticide exposures, points out that the large majority of occupational studies have targeted only male farmers and farm workers. This is an important observation for women's occupational health; also, the absence of women in these occupational studies means that there is limited information to support hypotheses linking low-level pesticide exposures to different cancers among women, since much of our knowledge stems from occupational studies where exposures are higher.

In a recent review of biologic monitoring of pesticide exposure,¹²⁸ based on more than 300 studies published over the period 1980–1999, only one of the 49 references related to studies about organophosphate-exposed subjects reported on women agricultural workers. Similarly, of the 24 studies on carbamate effects, none related specifically to women agricultural workers. In fact, studies and their related results were presented in this review without any mention of or reflection on participants' gender. This lack of precision with respect to gender has important implications since, as McDuffie¹²⁷ aptly points out, several large surveys of tissue and serum pesticide residues have shown inconsistent gender differences. Among the reasons evoked for such results are: 1) the exposure patterns of men and women differ; 2) because women have higher proportions of adipose tissue, erroneous conclusions could be drawn if residue is measured only in serum; and 3) women's biologic response to chemical hazards may differ substantially, based on physiologic gender differences.¹²⁹ To this we can add women's life events, such as pregnancy and menopause, that may affect the ways in which these substances are metabolized and excreted. It is interesting to note that male–female differences are likewise supported by results of numerous animal studies.^{130–132} The consequences of not considering and studying biologic measures within the context of gender may be considerable for women since, given women's pattern of exposure, biological monitoring may be critical in documenting the combination of exposures from occupational and non-occupational sources.

In the area of pesticide neurotoxicity, several studies have examined neurobehavioral effects associated with chronic exposures or sequelae of pesticide poisonings among male applicators and/or farmers^{110,112,133–140}; a few studies have included at least one woman worker,^{109,141–143} and one study has examined neurotoxic effects among women greenhouse workers.¹⁴⁴ Most of these studies have shown neurobehavioral deficits and/or a high prevalence of neuropsychiatric symptoms among the exposed populations. Unfortunately, the paucity of women in these studies means that we know little about the long-term effects of pesticide exposures on women's neurologic status, mental health, and well-being.

Despite most researchers' inattention to gender, there is some evidence that the chronic effects of women's occupational exposures in agriculture may be as important as those of men's. Robins and co-workers¹⁴⁵

found that of 32 health problems reported to be caused by work conditions in sugar-cane farming, all but one were equally distributed among male and female farm workers. A survey of 14 men and 16 women workers in a banana-packaging plant in Costa Rica, using a modified version of the Q16 questionnaire for neurotoxic symptoms,¹⁴⁶ found that although the women reported significantly more symptoms than did the men, the differences were for specific symptoms only (Mergler, unpublished data). Previous studies of gender differences in other workplaces have shown that differences in symptom reporting may derive from differences in working conditions, rather than gender differences in propensities to report symptoms.¹⁴⁷ It is interesting to note that among the banana packers, no one reported having difficulty buttoning and unbuttoning, a symptom that has been used to identify overreporting or to exclude persons with previous neurologic disease.

In women with agricultural exposures to pesticides, excesses for several types of cancers have been reported, including non-Hodgkin's lymphoma, leukemia, multiple myeloma, soft-tissue sarcoma, and cancers of the breast, ovary, lung, bladder, cervix, and sinuses.¹²⁷ Studies of cancers and various pesticide exposures are slowly increasing in Latin America, among both women and men. In Colombia, exposure to organochlorine pesticides was detected as a risk factor for female breast cancer,¹⁴⁸ whereas similar studies in Rio de Janeiro and Mexico City failed to confirm this result.^{149,150} However, a recent Mexican report related high levels of exposure to DDE with increased breast cancer risk, particularly for postmenopausal women.¹⁵¹ In Costa Rica, women banana workers had increased incidences of cervical cancer and leukemia, the latter possibly associated with formaldehyde derivatives used for cleaning the water basins in the packing plant.¹⁵²

Among female workers of packing plants of banana plantations with exposure to the fungicides thiabendazole and imazalil, an increased prevalence of genotoxic changes was observed.¹⁵³ One study of congenital malformations in Colombia among female workers in the cultivation of flowers found an increased risk only for hemangiomas,¹⁵⁴ whereas in Chile a high prevalence of malformations in Rancagua was attributed to pesticide exposures of temporary women workers in the fruit industry.¹⁵⁵ In Colombia, pesticide-exposed women in the flower industry had more abortions and premature children in pregnancies that occurred after they started working in floriculture.¹⁵⁶ Wilms' tumor was found in excess among children of pesticide-exposed women in Brazil.¹⁵⁷ Two studies^{158,159} have demonstrated an association between pesticide exposure and increased time to pregnancy for women.

Despite repeated reports from international agencies and other sources on the high use of pesticides in developing countries,^{3,8–11,22–25,40,41,66,107} most of the studies of health effects of pesticide exposures have been

performed in industrialized countries. It is noteworthy that what is commonly called the "grey literature," i.e., studies published in non-peer-reviewed journals, in reports to governmental or non-governmental agencies, etc., contain important and relevant data on women's morbidity related to pesticides in developing countries. For example, many of the studies reviewed here^{3,33,42,43,50,69,70,77,78,81,160} have not been published in the international, mainly English-language, scientific literature compiled by Medline. Yet, these studies confirm the high prevalence of pesticide-related morbidity among women in developing countries. For example, in a survey published by a women's NGO on 134 temporary women workers exposed to pesticides in the fruit industry in Chile, almost half had experienced symptoms of systemic poisoning, 23% reported dermal injuries, 19% eye irritation, and 10% respiratory problems that they attributed to pesticides, the latter often in relation to drifts from fumigation chambers towards the packing plant.³³ Women cotton pickers in Pakistan experienced equivalent or worse cholinesterase inhibition than their male counterparts, who were pesticide applicators.¹⁶¹

Researchers have pointed out that on the one hand there are proportionally few studies of women's occupational health in relation to the proportion of women workers, and on the other hand, the majority of studies that do focus on women and the workplace have examined reproductive effects.¹⁰⁶ This does not appear to be the case for agricultural workers. The impression that women workers are not occupationally exposed to pesticides has led to a paucity of studies even in the area of reproductive health. The majority of studies of pesticide exposures and women appear to be on the risks for cancers, particularly breast cancer, but even these focus primarily on women's non-occupational exposures in industrialized countries; most are case-control studies comparing pesticide-exposure levels among cases and controls. Little attention has been given to women working and living in agricultural settings in developing countries.

There is thus a clear lack of information about the long-term effects of pesticide exposures among women. Researchers need to consider focusing on women in pesticide studies and developing new techniques for evaluating their exposures, both occupational and non-occupational.

SOCIAL CONSEQUENCES OF NEGLECT OF THE EFFECTS OF PESTICIDE EXPOSURES ON WOMEN

Neglect of gender-specific exposures and outcomes also has implications for policy research. For example, a study in Cote d'Ivoire that modeled the human health costs from exposures to pesticides relied on exposure questionnaires that failed to take account of women's indirect exposures and relied on spraymen's status only.¹⁶² Failure to take account of the full range of potential adverse impacts

of pesticides significantly underestimates human and social costs, and particularly disadvantages women.

The lack of data on the chronic effects of pesticide exposures is amplified in developing countries, where there are low levels of awareness of pesticide hazards, and where training and awareness programs are severely under-resourced. However, it is precisely in these countries where the consequences of such lack of information may be most significant, and where the gender implications may be substantial. For example, in societies where witchcraft accusations are culturally accepted, health effects from pesticides may not be seen as a consequence of exposure to toxins, but as the result of a curse, bewitching, or similar traditional belief. Distortion of social and cultural norms of traditional societies has seen the suspicion of witchcraft result in violence against women, particularly older women living alone, in some rural parts of South Africa.*

Similarly, even for a given health outcome, the experience of women of that outcome may be highly gender-specific. For example, many Ndebele women in Southern Africa are not considered "married" until they have borne their first child and, if unable to bear a child, may be subject to divorce and ill treatment. Infertility among men is globally on the rise, and scientific data point to increased exposure to pesticides as one possible cause.^{163,164} However, even if the male partner is infertile from exposure to pesticides, the woman will typically have to bear the brunt of this social and cultural shame, as barrenness in most cultures, including traditional African cultures, is identified as the fault of the women. Failure of a woman to conceive a child is grounds for her to be divorced, ridiculed, and subjected to possible community ostracism (Rother HA, unpublished research, Kanyembe, Zibabwe, 1990).

Where an adverse outcome affects a family member, the woman's caregiving role means that she must carry a disproportionate burden. Research in Mexico¹⁶⁵ found, for example, that Yacqui Indian children in Mexico showed evidence of developmental delay in response to pesticide exposure. In such circumstances, the burden of the loss of children's capacities falls to their mother, whose work is increased by getting less help from the children and by the consequences of the children's poorer performances in school. These kinds of second-

*Two examples: 1) In 1993 a television documentary in South Africa called "Ordinary People" examined the fate of a 71-year-old woman accused of being a witch. The woman, who lived in a remote rural township, was chased out of her home and threatened with murder after the death of a neighbor, whom she was supposed to have bewitched, <<http://www.mg.co.za/mg/mgtv/mgtv-op3>>. 2) A daily on-line newspaper reported in 1998 that three women accused of witchcraft were burnt to death shortly after they were abducted from their home at Dengwane village in the Eastern Cape province of South Africa (<'WITCHES' BURNED TO DEATH, ZA*NOW October 29, 1998>, <<http://www.mg.co.za/mg/za/archive/98oct/29octpm-news.htm>>).

ary effects are rarely taken into account when considering the impacts of pesticides on human health.

Moreover, perceptions of risks due to pesticides are influenced by the social, economic, political, and cultural context within which an individual lives and makes decisions, and are therefore socially constructed.¹⁶⁶ Studies show that knowledge of actual dangers makes little difference to protecting human health and the environment.¹⁶⁷ Instead, it is the "adversarial context" that has the greatest influence on behavior.¹⁶⁸ For example, several women interviewed in a pilot study conducted in KwaZulu Natal, South Africa, felt that pesticide containers could be "cleaned" for reuse either by soaking the container for a week in a cattle-dung solution or by rinsing the container with hot water.⁷¹ Thus, the women were aware that the container had a poison in it, as indicated by their attempts to clean the container, but this did not translate into safer practices. In societies where women's roles are subjugated to male authorities, women's perceptions of personal risks may facilitate their increased exposures to pesticides.

RESPONSES

Legislation, including occupational health legislation, in most African countries is gender-blind³¹ and is therefore an important area for intervention. However, Ali³² points out the danger of "protective" legislation that results in exclusion of women from hazardous occupations rather than eliminating risk for all workers, such as is the case with South Africa's lead regulations.¹⁶⁹ International experience has shown that employers deal with women's vulnerability by excluding women, or putting them on special leave or sick leave, rather than controlling exposures.¹⁷⁰

Restriction of the use of pesticides to people licensed for or familiar with their use has been suggested⁸⁷ but does not directly address the complex circumstances of women in rural agriculture. In the context of ongoing poverty, such legislative measures are unlikely to deter women from practices that may be harmful to their health but which are forced on them by poverty and underdevelopment. Moreover, analyses have shown that despite the existence in some developing countries of pesticide-use legislation that conforms in outline to international best practice, the key obstacle is one of effective enforcement and coordination of such legislation.^{28,171}

Mass information and awareness-raising directed at rural populations on the hazards of pesticides have been advocated,^{31,37} particularly to address local taboos.²⁹ However, others have argued that training should be focused on occupational health and safety knowledge and skills^{32,55} as well as labor rights.⁴⁵ Indeed, there is compelling evidence that a human-rights approach combining a recognition of labor rights, socioeconomic rights, and gender rights offers significant possibilities

for securing greater protection for women workers generally.³² By addressing basic needs, such as the needs for water, electricity, safety, and literacy,^{44,45} as well as occupational health services specifically geared to women workers,³² it may be possible to change the context in which gender discrimination takes place in relation to protecting women's health. South Africa's constitution confers the right to a safe environment, to reproductive health services, and to access to health care, but requires considerable attention to implementation.⁴⁵

As highlighted above, there is a need to redirect research toward addressing pesticide hazards specific to women, and toward a gender-sensitive approach^{29,31,82} using participatory research methods.^{45,55} Agricultural policy should also be informed by appropriate research to promote pesticide-reduction strategies such as organic farming and integrated pest management.^{29,55} Data collection should be gender-sensitive, of demonstrable validity, and able to inform appropriate prioritization.^{32,118}

This review of the problems faced by women in developing countries in relation to exposures to pesticides highlights the critical importance of involving women as active agents in decision making that bears on their health and that of the environment. Self-help groups for women in rural areas can become a compelling force for change, but have met with resistance from men.³¹ Similarly, unionization offers women a critical opportunity to assert collective rights if the organization is able to translate gender into its programs and policies. Ultimately, until women in developing countries are empowered, pesticide usage and its health consequences for women will remain out of sight and out of mind for most of the world.

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