

Gender and Pest Management in Ghana: Implications for the Introduction of an IPM Program for Tomato

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ABSTRACT

The purpose of this research is to identify gender-based constraints and opportunities to the introduction of an Integrated Pest Management (IPM) program for tomato crops based on a case study of tomato farmers in the town of Tuobodom in the Brong Ahafo region of Ghana. The study seeks to identify the knowledge, practices, perceptions, and access to resources of men and women tomato farmers in Tuobodom, specifically with respect to pesticides and pest management. A mixed methods approach combined quantitative and qualitative methodologies including focus group discussions, household interviews, participatory mapping, field visits, key informant interviews, participant observation, and a survey. Key findings in the areas of health and safety, markets and the tomato value chain, and information and training reveal general and gender-specific issues that an IPM program should address when working with farmers to develop an effective and sustainable IPM package for tomato in this area. The results of this study also demonstrate the importance of gender analysis in identifying context-specific gender issues. For example, while this study confirmed that men's roles in tomato production place them at higher risk of exposure to pesticides, results challenge the assumption that women's reproductive roles (e.g., food preparation, caring for the sick, and washing clothes) make them more aware of the risks of pesticides.

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Chapter 1: Introduction and Statement of Purpose

1.1 Introduction

Agriculture is a vital sector in developing countries for food security as well as income generation. Agricultural research initiatives and development programs play an important role in advancing methods of agricultural production and value chain development. In order to achieve sustainable results, these programs must address the ways in which gender relations in a project context may be affected by, or have impacts on, program activities. Women comprise nearly half of the agricultural labor force in developing countries, yet they are much less likely than men to have access to agricultural inputs and resources including land, livestock, fertilizer, credit, education, and extension services (FAO, 2011; World Bank, 2009). Therefore, agricultural development programs need to consider the concerns and issues of both men and women farmers.

In the West African country of Ghana, agriculture accounts for one-third of the Gross Domestic Product and more than half of the nation's labor force. The majority of these agricultural producers are small landholders. Numerous development projects in Ghana focus on agriculture. The Integrated Pest Management Collaborative Research Support Program (IPM CRSP) funded by the U.S. Agency for International Development (USAID)¹ works to reduce crop losses due to pests, damage to ecosystems (including biodiversity loss), and contamination and pollution of food and water supplies by developing sustainable integrated pest management approaches (IPM CRSP, 2011). The IPM CRSP is working in Ghana to develop a "package" of IPM technologies (such as pest-resistant varieties of crops, biological and physical control

¹ Under Cooperative Agreement No. EPP-A-00-04-00016-00

methods, modification of the environment, and biopesticides) for tomato, a high value vegetable crop. In doing so, the project must recognize how gender relations may affect or be affected by program activities.

Gender analysis frameworks provide a mechanism for identifying and examining gender relations and inequalities in a development context. The Gender Dimensions Framework (Rubin, Manfre, & Barrett, 2009), developed to provide guidance to USAID staff and partner organizations promoting equitable opportunities in agricultural value chains, explores gender relations from the perspective of four categories: access to and control over key productive assets (tangible and intangible, including knowledge); beliefs and perceptions; practices and participation; and laws, legal rights, policies, and institutions. These domains often overlap, and issues of power exist in all four dimensions. By using the Gender Dimensions Framework, the IPM CRSP can explore the context of gender relations in Ghana and identify gender-based constraints or opportunities that may affect or be affected by the project. In so doing, the IPM CRSP is better able to adapt the development of its IPM package for tomato to be more effective and sustainable.

1.2 Statement of Purpose

The purpose of this research is to determine gender-based constraints and opportunities to the introduction of an IPM program for tomato crops based on a case study of tomato farmers in the town of Tuobodom in the Brong Ahafo Region of Ghana. A mixed methods approach combines quantitative and qualitative methodologies including focus group discussions, household interviews, participatory mapping, field visits, key informant interviews, participant observation, and a survey. The study seeks to identify the knowledge, practices, perceptions, and access to resources of tomato farmers in Tuobodom, specifically with respect to pesticides and pest management. These findings will help the IPM CRSP gain a better understanding of

potential gender-based constraints or opportunities to address when developing a package of IPM technologies suitable to tomato farmers in Ghana.

The following two chapters of this thesis situate this research in existing literature and provide the findings of this study. Chapter 2 reviews previous research on gender and agriculture, agriculture in Ghana, and pesticides and IPM. Chapter 3 is prepared as a manuscript for publication in the journal *Development in Practice*. It includes an introduction and summarized version of the literature review in Chapter 2 as well as methods, results, and discussion sections.

1.3 References

- Food and Agriculture Organization of the United Nations (FAO). (2011). Women in agriculture: Closing the gender gap for development. *The State of Food and Agriculture*. Rome, Italy: FAO.
- Integrated Pest Management Collaborative Research Support Program (IPM CRSP). (2010). IPM CRSP: Integrated Pest Management Collaborative Research Support Program. Retrieved from <http://www.oired.vt.edu/ipmcrsp>
- Rubin, D., Manfre, C., & Barrett, K. N. (2009). Promoting gender equitable opportunities in agricultural value chains: A handbook. Prepared under the Greater Access to Trade Expansion project of the WID IQC. Washington, DC: USAID.
- World Bank. (2009). *Gender in Agriculture Sourcebook*. Washington, DC: The World Bank.

Chapter 2: Literature review

This research seeks to explore gender relations and pest management among tomato farmers in Ghana to determine gender-based constraints and opportunities to a planned integrated pest management (IPM) program. The study draws on previous research in the areas of gender and agricultural development, gender and agriculture in Ghana, and pesticides and Integrated Pest Management (IPM). The following chapter reviews research in these areas germane to the objectives of this study.

2.1 Gender and Agricultural Development

On average, nearly half of the agricultural labor force in developing countries consists of women (FAO, 2011). Yet until the 1970s, development programs failed to recognize women's fundamental role in agriculture. More recently, international development efforts have prioritized gender equality and women's empowerment in agriculture (FTF, 2012; USAID, 2012b). As this section describes, studies show that gender differences in knowledge and access to and control over resources are affected by the different roles and responsibilities of men and women. These gender differences can have significant impacts on the effectiveness and sustainability of agricultural development programs. To achieve impact and sustainable results, programs must examine how gender relations are constructed in specific localities. A context-specific perspective on gender will help programs determine how these relations may produce gender differences that could impact the extent to which men and women are affected by or participate in agricultural development.

2.1.1. Women, gender, and development

Gender is the social construction of the categories ‘male’ and ‘female.’ Gender changes by time, location, culture, and other contextual variables and is different than the biological category of sex. Until the 1970s, development discourses did not address gender. Women were considered beneficiaries of development projects that targeted men, but not agents of change themselves. The field of Women in Development (WID) emerged as development practitioners began to notice that men and women benefited—or, in many cases, did not benefit—from development projects in different ways. In 1970, Esther Boserup wrote *Woman’s Role in Economic Development*, a defining work on the subject of women in development. As a trained economist, she explored a range of issues related to women’s roles in the economies of developing countries, particularly the underreporting of women’s activities in statistics on agricultural and industrial production (Boserup, 1970). Boserup’s analysis of women’s marginalized position in economic development led to recommendations for development projects to more fully incorporate women in the economic modernization process (Benería & Sen, 1981). While Boserup’s work illuminated gender inequalities, she called for action to address them within, rather than challenging, the dominant social, political, economic, and development frameworks that existed at that time (Kanji, Tan, & Toulmin, 2007).

The assumption that the inclusion of women in the productive sphere, producing goods with exchange value in the market, would lead to their equality with men informed most early international development efforts to include women and still persists within the international development community (Barriteau, 2000). But as Benería and Sen (1981) note, Boserup’s analysis ignored women’s reproductive work supporting the maintenance of domestic units and the workforce, as well as the ways in which women’s subordination is located in deeply embedded gender relations. Boserup’s research also generated an assumption accepted by

development programs for many years that men grow cash crops and women grow subsistence crops. This is a problematic dichotomy because women are often involved in cash crop production on their own land or contribute to production on the farms of their male kin (Doss, 2002; Moser, 1993). Moreover, the colonial imposition of a Western perspective of men as breadwinners and women as dependents changed men's and women's roles in agriculture in many countries because this model served the interests of men in these countries and was adapted into existing systems of production (Padmanabhan, 2007).

Gender and Development (GAD) approaches emerged in the mid- to late 1980s, growing out of criticisms of the WID approach and calling for a fundamental reworking of development that challenges the political and economic systems as well as those of gender relations that subordinate women (Parpart, 1995). Critics of WID approaches suggest that they construct Third World Women as a homogenous group and fail to recognize the ways in which differences among women can differentiate benefits from development projects (Jaquette & Staudt, 2006; Peet & Hartwick, 2009). Escobar (1995, p. 179) suggests this over-simplification serves to reinforce a partial understanding of women's realities constructed by Western development institutions. GAD approaches thus seek to recognize the many lived realities of men and women, and focus on the construction of gender relations in specific contexts.

2.1.2 Gender and agriculture

Gaining an understanding of the construction of gender and local gender relations in a particular context is a critical element of development projects. Gender, as a social construction, results in different experiences of development for men and women (Momsen, 2010). This is particularly true for agricultural development projects, as men's and women's different roles and responsibilities within agriculture result in different knowledge and practices (Ferguson, 1994; Gururani, 2002; Sachs, 1996; Thomas-Slayter & Rocheleau, 1994). Gender differences also

interact with other social differences to shape access to and control over resources, often affecting environmental management and ecological changes (Rocheleau, Thomas-Slayter, & Wangari, 1996). Men's and women's different roles and responsibilities in productive and reproductive work result in gender differences in experiences of environmental degradation and related gender differentiated participation in environmental conservation projects (Jackson, 1995). In order for agricultural development programs to be effective and sustainable, "they must address the concerns of men and women and the ways they, individually and collectively, relate to the state, economy, and the resource base" (Thomas-Slayter & Sodikoff, 2001, p. 58).

In Malawi, for example, Ferguson (1994) determined that men's and women's knowledge varied according to the crops for which they were responsible. She argues that if farmers are considered a homogenous group, women or other marginalized groups may be left out of the analysis, valuable information may be lost, and planned development programs may not be appropriate for the needs of a community (Ferguson, 1994). However, development practitioners should take care to recognize how social, political, and power relations affect knowledge production and exchange between and among men and women, and not overestimate women's agroecological knowledge as part of an essentialist assumption about women's connection to nature or their role as "authentic subjects of pure local knowledge" (Gururani, 2002, p. 314). Doss (2001) contends that gender must be taken into account in agricultural technology transfer programs because households and gender roles are complex and changing and will have important implications for the adoption of technologies by men and women farmers.

Agricultural development projects must also recognize men's and women's labor burdens and how a planned intervention may affect them, particularly women's "triple role" (Moser,

1993). Moser contends that gendered divisions of labor create the perception, often upheld by development programs, that women only do reproductive work, such as childbearing and rearing, cooking, cleaning, etc. In actuality, most women in developing countries bear a triple burden of work—reproductive, productive, and community work—as social expectations strongly encourage women to care for the household, support productive livelihood activities for additional income (i.e., the production of crops or goods for sale), and participate in the management of collective resources (Moser, 1993). This observation is an extension of Boserup's early work on the failure to account for women's productive work. However, Moser and other scholars have gone beyond Boserup's argument to account for women's productive work; they argue for counting women's other forms of work, in particular because women are often overrepresented in subsistence, informal, domestic, and volunteer work, and are therefore disproportionately affected by the failure to fully account for these areas (Benería, 1992).

Failure to recognize women's productive work often results in development projects assuming that labor will be reallocated within the household to accommodate new activities introduced by the project. This may increase pressures on women to work on their husbands' farm and reduce the time and resources available for women to earn income or in-kind payment from their own smallholdings (Moser, 1993). Programs may also assume that women will provide the necessary unpaid labor to provide selected services, and claim this as a 'participatory' approach (Moser, 1993; Schroeder, 1993).

Moser suggests that, like gender, divisions of tasks change over time and by location. She notes that many feminists have challenged the dualist conceptualization of women's work as productive or reproductive, arguing that it is problematic because reproductive work is

productive or necessary for production, even if it does not have a recognized market exchange value. However, Moser (1993, p. 32) contends,

“[n]evertheless, in developing the conceptual principles for gender planning the purpose of distinguishing between women’s productive and reproductive roles is precisely to highlight the multiple forms of women’s work. This reveals the severe limitations of contemporary planning categories, which in emphasizing the difference between men’s productive work and women’s reproductive work, have so effectively rendered women’s productive work invisible.”

Jackson (1995, p. 119) echoes this sentiment suggesting, “[w]hat gender analysis offers is not a set of generalizations about, for example, men’s and women’s contributions to farm production, but a means of rethinking, for any specific location, the implications of a gender-disaggregated account of farm production.”

2.1.3 Gender and agricultural development institutions

Development institutions, and agricultural development programs more specifically, now recognize the importance of gender analysis and the inclusion of women in projects. Major development actors like the World Bank, United Nations Food and Agriculture Organization (FAO), U.S. Agency for International Development (USAID), and others have explicitly recognized women’s fundamental role in agriculture and the importance of examining how gender relations may affect, or be affected by, development projects targeting agriculture.

Women account for 43% of the agricultural labor force in developing countries and 50% in Sub-Saharan Africa (FAO, 2011). However, they are much less likely than men to have access to agricultural inputs and resources including land, livestock, fertilizer, credit, education, and extension services (FAO, 2011; World Bank, 2009). FAO estimates that if women had access to inputs and resources equal to men, they could increase their yields up to 30%; this would increase overall agricultural production in developing countries and potentially reduce the number of people in the world living with hunger by up to 17% (FAO, 2011).

In 2009, the World Bank, FAO, and the International Fund for Agricultural Development (IFAD) compiled the *Gender in Agriculture Sourcebook*, examining the importance of women in agricultural development and poverty reduction and the need for gender-sensitive policy and program design (World Bank, 2009). FAO's annual report on "The State of Food and Agriculture" for 2010 – 2011 also focused on gender and agriculture and was titled "Women in Agriculture: Closing the gender gap for development" (FAO, 2011). This report outlines gender gaps in agricultural production and resources, with attention to the different situations in various countries and cultural contexts, calling for policy interventions to address the root causes of these gaps. USAID recently strengthened requirements for all projects/activities, project proposals, and strategic plans to incorporate gender analysis (USAID, 2012a). This gender analysis is built around two "key questions":

- 1) "How will the different roles and status of women and men within the community, political sphere, workplace, and household (for example, roles in decision-making and different access to and control over resources and services) affect the work to be undertaken?"
- 2) "How will the anticipated results of the work affect women and men differently?" (USAID, 2012a).

USAID also announced its new Gender Equality and Female Empowerment Policy in March 2012 (USAID, 2012b). Additionally, the U.S. Government's new global hunger and food security program, Feed the Future, has made gender integration one of its six focus areas. A collaboration between USAID, the International Food Policy Research Institute (IFPRI), and Oxford Poverty and Human Development Initiative (OPHI) has produced a "Women's Empowerment in Agriculture Index" which presents monitoring and evaluation requirements focused on women for all Feed the Future projects (Feed the Future, 2012). Furthermore, the Bill and Melinda Gates Foundation recently developed a "Strategy for Gender-Responsive Agricultural Development Programs" to guide and support grantees' and partners' efforts to

better address gender in agricultural programs and initiatives (Bill and Melinda Gates Foundation, 2012).

2.1.4 Gender, agriculture, and situated knowledge

While recognizing that the roles played by women in agriculture is important, so is recognizing the differences among and between women and men, and the ways in which social status, cultural context, or other factors impact women's and men's experiences, knowledge, access to resources, and decision-making. Feminist theory and scholarship has produced a large body of work pertaining to gendered experiences, perceptions, and production of knowledge (e.g., Bordo, 1986; Haraway, 1988; Harding, 1986; Mohanty, 1984). A key argument of this literature is that the production of knowledge is mediated by factors such as historical and social context and identity. Consequently, knowledge and science are never entirely 'objective' since they are products of specific perspectives and socially constructed. Haraway (1988) argues for "feminist objectivity" that is rooted in lived experience rather than from a distant, detached "view from above" which, by her account, is irresponsible because it ignores the power relations between producers and objects of knowledge. The "situated" approach for which she advocates is cognizant of its partiality and often complex, paradoxical nature as a way of avoiding the pitfalls of extreme relativism or extreme positivism, and it acknowledges the power relations involved in the construction of knowledge. From this perspective, objects of knowledge are agents engaged in the conversation rather than resources for discovery.

Accordingly, development practitioners must recognize how their own identities produce a distinct worldview and assumptions about development and intended benefits of development

projects.² Moreover, men and women involved in agricultural development programs will have knowledge and perceptions “situated” in their own lived experiences, influenced by factors of identity such as gender, class, and education. It is therefore important for these programs to identify both men’s and women’s knowledge to create a more comprehensive understanding of a given context, and to recognize the positionality of development practitioners and the methods by which they gather information for a given project (Nightingale, 2003).

2.2 Gender and Agriculture in Ghana

While services and industry account for a majority of Ghana’s Gross Domestic Product, fifty-six percent of the workforce of Ghana is in agriculture (primarily small landholders), which accounts for 28.3% of the GDP (CIA, 2012). Nearly half of the country’s female population is self-employed in the agricultural sector, the majority of which are primarily involved in food production (MoFA, 2007). Ghana is the world’s second-largest producer of cocoa (USDA Foreign Agricultural Service, 2012) and other major agricultural products include rice, cassava, peanuts, corn, shea nuts, bananas, and timber (CIA, 2012). Eighty-five percent of rural households are involved in agriculture in contrast to 28% of urban households (GSS, 2008). The majority of agriculture in Ghana is dependent on rainfall, though approximately 6,000 farm enterprises in the country are estimated to use some form of irrigation (MoFA, 2007).

2.2.1 Agriculture and land

Ghana’s Ministry of Food and Agriculture estimates that 80% of the country’s agricultural output is produced on smallholder farms (MoFA, 2007). The Ministry of Food and Agriculture also approximates that nationwide, 90% of farm holdings are less than 2 hectares. Throughout the country, women’s landholdings are estimated to be about half the size of men’s

² See Escobar (1995, p. 45) for a thorough exploration of development as a “historical construct that provides space in which poor countries are known, specified, and intervened upon” and the problematic nature of “discourses of development.”

and of poorer quality (Bortei-Doku Aryeetey, 2002). The majority of households in Ghana surveyed for the World Food Programme's Comprehensive Food Security and Vulnerability Analysis report having access to land for agriculture through extended family relations, community access, or ownership (CountrySTAT Ghana, 2012). The study found that other households access land through share-cropping, permission from a chief, or short- or long-term leasing or renting. Land tenure in Ghana is complex, consisting of overlapping and sometimes conflicting customary laws and formal administrative systems. Traditional³ land rights and tenure vary by ethnic group and region. Rights to particular plots of land are negotiable and multidimensional within these systems as well: "The act of cultivating a given plot may—or may not—also be associated with the right to lend the plot to a family member, the right to rent out the land, the right to make improvements, or the right to pass cultivation rights to one's heirs" (Goldstein & Udry, 2008, p. 985). Access and control may be further disaggregated by particular plants, products, activities, or points in time (Rocheleau & Edmunds, 1997).

Ghanaian women's access to and control over land is largely mediated by male-dominated kinship systems and power relations (Bortei-Doku Aryeetey, 2002). Women often lack access to information on their land rights under formal administrative systems and lack the resources to assert those rights through complex and costly procedures (Rünger, 2006). Rünger asserts that although customary laws protect women's usufruct rights in principle, a variety of factors affect women's access to land including gender divisions of labor and production, availability of land, gender bias in distribution of land, and changes in residence after marriage. However, women do develop strategies to extend their claims to resources (Bortei-Doku

³ As Rocheleau and Edmunds (1997) note, the term "traditional" is problematic when referring to land rights that have evolved and changed over time for cultural and environmental reasons, aside from the introduction of modern, European statutory law.

Aryeetey, 2002). Studies in several African countries demonstrate that women often use “in-between” spaces, such as areas of bush or the spaces around men’s trees that are not highly desired by men, and that women have well-established rights to many of the resources in these areas (Rocheleau & Edmunds, 1997). But as Runger (2006, p. 8) argues “[b]y granting men and boys primary rights of inheritance of land and property, and granting women and girls user rights mediated through their relationship to men, a situation of unequal power relations, drawn along gender lines, is entrenched in land tenure and production relations.”

In the Brong Ahafo region of Ghana, men and women farmers do own land, but most married women generally work on part of their husbands’ land (Afikorah-Danquah, 1997). Afikorah-Danquah suggests that rights to land for these farmers, men and women, are typically secure. In Western Ghana, land tenure has traditionally been based on matrilineal inheritance where land is primarily passed down by and to men on the woman’s side of the family, though gifts of land from husbands to wives have increased women’s individualized land rights more recently (Quisumbing, Payongayong, Aidoo, & Otsuka, 2001). Gifts are often dependent upon women contributing to the wealth of the benefactor, however, and closely tied to the gains made from the land (i.e., gifts commonly come from cash crop areas) (Bortei-Doku Aryeetee, 2002).

Scholarship examining gender equity and land tenure have demonstrated that insecure land rights, which are often the case for women, are associated with less sustainable management and production practices (Meinzen-Dick, Brown, Feldstein, & Quisumbing, 1997). This is because farmers with insecure land rights have less incentive to consider the long-term effects on land to which they may no longer have access in the future and, as a result, more incentive to focus on intensification to increase production of goods over which they do have control. Similarly, tenure insecurity may lead farmers to reduce or eliminate periods of fallow for their

plots as this is a time when rights to a plot can be lost (Goldstein & Udry, 2008; Otsuka, Quisumbing, Payongayong, & Aidoo, 2003). The relationship between land tenure and management decisions also depends on the particular crops grown on a plot. A study of pineapple farmers in the Eastern Region of Ghana determined that decisions regarding fertilizer are made by the individual cultivating the plot, not necessarily the household head or landowner (Goldstein & Udry, 1999). Other research has found that planting trees, specifically cocoa, strengthens land rights and that management decisions do not vary greatly among cocoa farmers with different land rights (Otsuka et al., 2003). However, as Otsuka et al. found, management decisions are affected by land rights in food crop fields, where plots characterized by weak land rights leave land fallow less often.

While increasing land titling may seem like a possible solution to increasing women's land secure land rights, scholars have argued that this can actually strengthen men's land rights at the expense of women's rights (Deere, 2003). According to Rocheleau and Edmunds (1997, p. 1354), "[t]he focus on land titling often underplays the significance of women's existing resource use and ownership rights as encoded in the customary law of many societies." While women in Africa are much less likely than men to hold formal title to land, they do have access rights to many resources in the landscape (Bortei-Doku Aryeetey, 2002; Rocheleau & Edmunds, 1997). Increased land tenure reforms that emphasize exclusive individual rights to land can undermine women's access to resources on that land. When women do gain rights to land, they often still lack access to other important resources. For example, women contribute significantly to food production in the Western, Ashanti, and Brong Ahafo regions of Ghana but only a small number of female farmers are reached by extension services, including those of the Women in Agricultural Development Directorate of the Ministry of Food and Agriculture (Bortei-Doku

Aryeetey, 2002). Increases in women's land ownership alone will not necessarily increase women's incentives to adopt more sustainable management practices if they still have unequal access to inputs or other resources like time and information (Bortei-Doku Aryeetey, 2002).

2.2.2 Agricultural production

The majority of agricultural labor in Ghana is provided by household members or hired temporary labor (CountrySTAT Ghana, 2012). Agricultural production is organized by many factors such as gender, age, ethnicity, and wealth. Gender divisions of labor play an important role in the allocation of farm tasks in the Brong Ahafo Region. Labor for difficult agricultural tasks is frequently mobilized through *nnoboa*, or cooperative work groups. In many cases female farmers are unable to draw on this source of labor because such tasks are often considered men's work and therefore women do not participate in, or benefit from, collective groups that do this kind of work; instead women have to seek hired labor or help through informal social networks (Afikorah-Danquah, 1997).

While there are gendered patterns in agricultural production in Ghana, it is difficult to categorize specific crops as men's or women's. This is due in large part to how the "farmers" growing these crops are defined: as household heads, plot holders, or the person who keeps revenue from the plot (Doss, 2002). In her study of Ghanaian farmers, Doss found that men are more likely than women to use their plots to grow crops for sale, but women are also involved in cash crop production for all of the country's major crops including cassava, maize, pepper, plantain, cocoa, okra, yam, and tomatoes. This demonstrates how the assumed dichotomy of men growing for sale and women for consumption does not hold in all cases. In general, Doss found that some crops are grown disproportionately by male-headed households (tobacco, coffee, maize, yam, rice, and sorghum) or female-headed households (cocoyam, plantain, onions, and eggplant) but when these numbers are disaggregated by agroecological zone this is no longer the

case; this is likely the result of different proportions of women farmers in the three zones. Male plot-holders disproportionately grow maize and yams in some zones and women plot-holders disproportionately grow cocoyam, though this is not the case for the country as a whole.

Moreover, no crops are disproportionately grown on plots where women control the revenue.

Gendered divisions of production also vary by ethnic group. Among the Dagomba and Kusasi people in northern Ghana, men are responsible for providing “staple” crops such as millet, maize, or yams while women are responsible for contributing ingredients for the “soup” that accompanies the staple (Padmanabhan, 2007). The gender division and complementarity of production represent the specific constructions and performance of gender among these ethnic groups. Padmanabhan found that access to, control over, and labor for crops may be associated with men or women at different points in time, phases of the crop or production process (e.g., seed vs. processed product), or agricultural activity (weeding, spraying pesticides, etc.).

The existence of gender patterns of cropping has implications for agricultural policy because policies directed toward certain crops may not have equal implications for men and women (Doss, 2002). Doss suggests that changes in these patterns are important to monitor because of evidence that men often move into production of crops as they become more profitable.⁴ For example, farmers in the forest zone of Ghana reported that tomatoes used to be considered women’s crops but men now grow them for sale (Doss, 2002). Changes in gender-based patterns of agricultural production often stem from the introduction of new crop varieties, inputs, or technologies such as mechanized tools for production or in the case of IPM. Research has demonstrated that decisions to adopt technologies are closely linked to access to resources such as land, labor, and extension services (Doss & Morris, 2001). This has important

⁴ However, as discussed earlier, this does not necessarily mean men only produce crops for sale while women only produce crops for subsistence consumption.

implications for the gender equity of agricultural development projects and policy if access to resources is gendered.

Financial resources are another important determinant of improved production. Most smallholder farmers in Ghana depend on informal institutions for credit, which may have limited lending capacities or high interest rates (World Food Programme, 2009). Women are particularly disadvantaged in accessing credit because they lack the adequate or quality assets to serve as collateral: “Based on Ghanaian tradition women generally do not enjoy ownership over any significant or valuable assets, specifically productive agricultural assets, which in turn prevents them from applying for any formal credits, unable to offer the valuable collateral” (MOFA, 2007 as cited in World Food Programme, 2009, p. 51).

Men and women are involved in different ways in agricultural activities beyond production, such as processing and marketing. Processing of produce is common in both urban and rural areas, with 53% of urban households and 65% of rural households involved (GSS, 2008). The Ghana Statistical Service (2008) reports that among processors, women have the majority of responsibility accounting for 87% of processing countrywide. Trading and marketing of the major local food crops are also activities predominately carried out by women in Ghana, as in similar areas in West Africa (Clark, 1994).

Carr (2008) cautions that development scholars and practitioners must be careful not to generalize gender categories or overlook other livelihood, identity, or community-based factors that contribute to men’s and women’s vulnerabilities in agriculture: “Gendered vulnerabilities are not the simple outcome of a social categorization, but are created and recreated through social practices that operate at scales as small as the household. The aggregation of these experiences into the general categories ‘woman’ or ‘man’ can erase very real and practical

differences between those contained within these categories as well as across them” (Carr, 2008, p. 901). Carr’s study of gendered crops in southern Ghana found that men’s production is much more vulnerable to market fluctuations while women producers are more vulnerable to environmental shocks. Carr asserts that in this specific place and time, women’s vulnerabilities, and those of female-headed households in particular, are closely linked to the highly gendered land tenure system in the study area. Carr suggests that without examining the modes of livelihood and identification of social groups within the community, this nuanced understanding of men’s and women’s different vulnerabilities would not have been possible.

2.3 Pesticides and Integrated Pest Management (IPM)

Since the 1960s scientists have been exploring the harmful effects of toxic chemical pesticides for humans, animals, and plants. This section explores the extensive research that has demonstrated the health risks associated with pesticide exposure and the need for education and increased awareness among producers and consumers. In many cases, exposure and awareness is differentiated by gender. Pesticides are used on many crops in Ghana, often incorrectly or in excess. Studies in the country have found evidence of pesticide residues in human fluids, the environment, and food. Integrated Pest Management (IPM) is an approach that seeks to develop pest management systems that pose the least risk to people, crops, and the environment. Agricultural development programs that utilize IPM approaches can help farmers to increase their crop quality and quantity while reducing their use of pesticides and impact on the environment. However, if programs promoting IPM are to be effective and sustainable, they must account for gender differences in knowledge, perceptions, access to, and practices of pesticides and pest management.

2.3.1 Health and safety

Rachel Carson's *Silent Spring* (1962) drew widespread public attention to the harmful effects of pesticides on the environment, animals, and humans, as well as the need for stricter monitoring and control of pesticide use. Since then, scholars have continued to explore the use and effects of pesticides in the developed and developing world. Weir and Schapiro (1981) described what they called the "circle of poison" after studying the cyclical path of hazardous pesticides from production in the U.S. and other developed countries, where they are often banned and thus exported to developing countries, to unregulated redistribution and use in developing countries on crops for export that are ultimately consumed by U.S. citizens. They also note the dangers of overuse of pesticides (for plants and humans), increases in pesticide-resistant insect species, lack of pesticide regulations in developing countries, repackaging of pesticides in various reused containers without correct labeling, and the lack of workers' rights to organize and fight against the dangerous conditions in which they are expected to work with harmful pesticides. The concept of a "circle of poison" is limited, however, because it overemphasizes the dangers of pesticide residues rather than pesticide use in general, and leads some policy-makers to believe that restricting imports from developing countries solves the problem; such restrictions have severe economic repercussions for developing countries (Gips, 1987).

Ecobichon (2001) argues that pressure on developing countries to intensify production of non-traditional agricultural products for the global market has led to increased dependence on chemical pesticides in those countries. Moreover, farmers in these countries are more likely to use older, non-patented, toxic chemicals because they are inexpensive, readily available (partly due to restrictions on distribution in developed countries), and farmers lack information about their harmful effects (Ecobichon, 2001; Weir & Schapiro, 1981). The health effects of

pesticides have been widely explored in terms of risks for farmers who apply the chemicals. Studies have also found that farmer families are at risk for harmful effects of pesticides due to residues, water and soil contamination, the reuse of chemical containers for food, and exposure to residues on clothing or equipment brought home (Ecobichon, 2001; Garcia, 2003).

Men and women may be affected by pesticides in different ways. Studies have documented women who were exposed to pesticides having deficiencies in reproductive functions or increased numbers of birth defects in children (Garcia, 2003), while men who handled dibromochloropropane (DBCP) experienced low sperm counts or complete sterility (Babich, Davis, & Stotzky, 1981). Traces of organochlorine pesticides have been found in breast milk among women in Ghana (Ntow, 2001), signaling the potential for negative effects of pesticides on both women and nursing children who consume the breast milk. Women may also be more susceptible than men to certain cancers because many of the chemicals in pesticides act as endocrine disrupters, leading to hormone-related cancers that affect women more than men (Garcia, 2003).

Studies also show that knowledge, perceptions, and practices of pesticide use differ by gender. In some cases, women have significantly lower literacy rates than men, decreasing their ability to read warning labels; they also have lower rates of knowledge of the risks of pesticides and are less likely to use protective clothing (Atreya, 2007; Garcia, 2003). In other contexts, women's concern for the health of family members may actually increase their awareness of the risks of pesticides. Research in the Ecuadorian Andes demonstrates an association between households where women and men have more equal participation in decision-making and roles, productive and household, with lower use of hazardous pesticides, particularly on non-commercial farms (Cole et al., 2011). It is therefore imperative to understand gender differences

in knowledge, practices, and perceptions of pesticides in order to better address the risks of pesticide use for women and men.

In addition to the dangers of pesticides to humans, insects and plant pathogens can develop resistance to these chemicals. This leads to increased levels of pesticide use in response to increased pests, and keeps farmers locked into a “pesticide treadmill” (PANNA, 2012). Moreover, research suggests that pesticide use leads to pesticide resistance in addition to the weakening of the plants themselves. In one study, plants treated with pesticides experienced twice as much disease as plants treated with water (Gips, 1987).

2.3.2 Pest Management in Ghana

Pesticide use on crops is common in Ghana. Rates of insecticide, herbicide, and fungicide use have increased significantly since the 1960s (Ntow, 2001). Among Ghanaian farmers’ expenditures for crop inputs, nearly 16% went to pesticides (insecticides and herbicides) (GSS, 2008). While the Pesticides Control and Management Act of 1996 outlines registration requirements for pesticides and pesticide distributors as well as classifications and restrictions of pesticides, there is extensive evidence of the use of restricted chemicals and misuse or repackaging of hazardous chemicals on crops for which they are not intended (Danquah, Ekor, & Asuming-Brempong, 2009; Essumang, Dodoo, Adokoh, & Fumador, 2008; Ntow, 2001; Obiri-Danso, Adonadage, & Hogarh, 2011).

As demand for vegetables grows in Ghana, farmers have had to develop ways to address the major pest problems to which vegetable production is susceptible. Chemical pesticides are often perceived to be the best, and sometimes only, solution (Danquah et al., 2009; Marfo, 2006; Ntow, Gijzen, Kelderman, & Drechsel, 2006). Studies of vegetable producers in Ghana have found that most farmers use a variety of insecticides, some of which are not recommended for use on vegetables, and spray several applications which could lead to the build-up of residues or

pesticide resistance (Danquah et al., 2009; Ntow et al., 2006). In some cases, farmers report getting information on insecticides from a source other than the agricultural extension agent, specifically agro-chemical sellers and other farmers (Danquah et al., 2009), while farmers in other contexts rely primarily on extension agents for information (Ntow et al., 2006). This can have implications for the kind of information farmers receive since agrochemical vendors have little interest in promoting methods of pest management that would decrease business at their stores, such as non-pesticide methods.

Farmers in Ghana use a variety of methods, recommended and not, to measure and apply pesticides (Ntow et al., 2006). Few wear protective clothing (Marfo, 2006; Ntow et al., 2006), and one study found that 80% of farmers surveyed reported experiencing illness due to pesticide exposure (Ntow et al., 2006). Farmers dispose of pesticide containers by leaving them in the field or throwing or burying them nearby (Marfo, 2006; Ntow et al., 2006).

High demands for produce and low perceptions of risks or residues of pesticides in food lead some farmers in Ghana to harvest prematurely (Darko & Akoto, 2008), increasing the likelihood of residues and potential harmful effects for both harvesting farmers and consumers. Studies have found evidence of pesticide residues in blood and breast milk (Ntow, 2011), surface and groundwater (Obiri-Danso & Adonadaga, 2011), and tomatoes to an extent that could cause health risks such as cancer (Darko & Akoto, 2008; Essumang et al., 2008). Extensive use of fertilizer in tomato production in Ghana has also been linked to significant greenhouse gas emissions (Eshun, Apori, & Oppong-Anane, 2011). Nearly all of the studies reviewed, examining both pesticide use and residues in Ghana, recommend training and education for farmers and pesticide distributors as a means of reducing indiscriminate use of hazardous chemicals and increasing awareness of the risks of pesticide use.

Application of pesticides varies by crop and other factors such as gender or wealth.

Dagomba women in northern Ghana prefer to cultivate local varieties of cowpea because they do not require agrochemicals to grow well, in contrast to improved and introduced varieties that do (Padmanabhan, 2007). Padmanabhan found that this preference is associated with the perception among Dagomba people that insecticides are “medicine”; since the diagnoses of problems and handling of medicine is considered the domain of men, and taboo for women, pesticides have been constructed as a gendered technology. In contrast, the application of fertilizer is considered part of sowing, which is considered female work in this context. This case demonstrates the importance of considering the cultural context and constructions of gender in a particular place because these factors will give meaning to and affect the way new technologies are introduced to and adopted by a community.

2.3.3 Integrated Pest Management (IPM)

Integrated pest management (IPM) is an approach used in many agricultural development programs to manage pests through strategies that pose the least risk to people, crops, and the environment:

"Integrated Pest Management, or IPM, is a long-standing, science-based, decision-making process that identifies and reduces risks from pests and pest management related strategies. It coordinates the use of pest biology, environmental information, and available technology to prevent unacceptable levels of pest damage by the most economical means, while posing the least possible risk to people, property, resources, and the environment" (National Information System for the Regional IPM Centers, 2004).

IPM is a holistic approach that takes into consideration the pest complex of a crop and the agroecosystem in which it exists (van de Fliert & Proost, 1999). By using a variety of methods to reduce pest damage to crops, IPM interventions help reduce crop losses and pesticide use, curtail damage to ecosystems, improve crop quality, increase income, and provide educational opportunities for farmers and researchers (IPM CRSP, 2011). IPM techniques include

“biological, environmental, and economic monitoring, predictive models such as economic thresholds, and a variety of genetic, biological, cultural, and, when necessary, chemical control measures” (Norton, Heinrichs, Luther, & Irwin, 2005). Some scientists argue that “the pressures for high quality and attractive produce and maximization of crop production together with other socioeconomic constraints contradicts some of the basic founding principles of integrated pest management. ... Most programs continue to be centered more on pesticide management than pest management” (Altieri et al., 1983 as cited in Gips, 1987, p. 32). These challenges suggest that, despite the wealth of information on the risks of pesticides, there is a continued need for education—for producers and consumers—on the hazards of toxic chemical pesticides and the benefits of IPM.

Since IPM programs depend on knowledge of the ecosystem, many projects in recent years have emphasized empowering farmers as decision-makers in IPM rather than consumers of technologies developed by researchers from afar (van de Fliert & Proost, 1999). However, as van de Fliert and Proost found, because women’s roles as farmers are often invisible, their knowledge is ignored in these programs, to the detriment of the projects’ success and sustainability. Several studies have demonstrated that increasing women’s access to IPM information and trainings is key to their involvement in IPM programs (Atreya, 2007; van de Fliert & Proost, 1999; Vander Mey, 1999), but so too is the education and gender awareness of trainers, researchers, and development officials (van de Fliert & Proost, 1999). In particular, one study of an IPM program for cowpea in Ghana demonstrated the importance of a gender-sensitive approach and inclusion of women in training and activities (Vander Mey, 1999). This study also found that women’s roles in cooking and childcare affected their knowledge of the importance of cowpea as a nutritious crop for family consumption.

IPM programs represent a viable alternative to, or reduction of, intensive use of toxic, persistent chemical pesticides. However, like other technology transfer programs, IPM projects can also alter men's and women's practices as well as access to and control of resources (Doss, 2011; Moser, 1993). Such programs require research for the development of appropriate IPM techniques in a particular context as well as outreach to encourage the adoption of these techniques. In order to be effective and sustainable, IPM programs must account for gender differences in knowledge, perceptions, access to, and practices of pesticides and pest management.

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Chapter 3: Gender and Pest Management in Ghana: Implications for the Introduction of an IPM Program for Tomato

Abstract

The purpose of this research is to identify gender-based constraints and opportunities to the introduction of an Integrated Pest Management (IPM) program for tomato crops based on a case study of tomato farmers in the town of Tuobodom in the Brong Ahafo region of Ghana. The study seeks to identify the knowledge, practices, perceptions, and access to resources of men and women tomato farmers in Tuobodom, specifically with respect to pesticides and pest management. A mixed methods approach combined quantitative and qualitative methodologies including focus group discussions, household interviews, participatory mapping, field visits, key informant interviews, participant observation, and a survey. Key findings in the areas of health and safety, markets and the tomato value chain, and information and training reveal general and gender-specific issues that an IPM program should address when working with farmers to develop an effective and sustainable IPM package for tomato in this area. The results of this study also demonstrate the importance of gender analysis in identifying context-specific gender issues. For example, while this study confirmed that men's roles in tomato production place them at higher risk of exposure to pesticides, results challenge the assumption that women's reproductive roles (e.g., food preparation, caring for the sick, and washing clothes) make them more aware of the risks of pesticides.

3.1 Introduction

This study explores gender relations and pest management among tomato farmers in the Brong Ahafo region of Ghana. Based on these findings, the study identifies gender-based constraints and opportunities to the introduction of an Integrated Pest Management (IPM)

program for tomato crops in Ghana. The country has experienced significant economic development in recent decades, a large part of which is still based on agriculture. While cash crops such as cocoa and staple crops including maize, yam, and plantain account for the majority of agricultural production, tomatoes have increasingly become an income-generating enterprise for many farmers. However, farmers face major pest and disease problems in tomato production. This research was conducted in the town of Tuobodom in the Techiman district of the Brong Ahafo region of Ghana as part of the IPM Collaborative Research Support Program (IPM CRSP) funded by the United States Agency for International Development (USAID).⁵ The IPM CRSP works to develop IPM strategies with farmers around the world to reduce crop losses and pesticide use, increasing yields and farmer incomes. This study was part of the Gender Global Theme of the IPM CRSP in collaboration with the Council for Scientific and Industrial Research—Crops Research Institute (CSIR-CRI) of Ghana. A case study of tomato farmers in Tuobodom illustrates key issues that the IPM CRSP should account for when developing its planned IPM package for tomato farmers in Ghana.

3.2 Background

This section provides background information on the context of this study including a brief description of agriculture in Ghana, the role of tomatoes in Ghanaian agriculture, the IPM CRSP structure, and the site where field research was conducted.

3.2.1 Ghana Context

⁵ Under Cooperative Agreement No. EPP-A-00-04-00016-00

The Republic of Ghana is a coastal West African nation bordered by Côte d'Ivoire to the west, Burkina Faso to the north, Togo to the east, and the Gulf of Guinea to the south (Figure 1). In 1957, it became the first country in the region to gain independence from a colonial power (Britain) and, after several years of corruption and military rule following independence, is now regarded as a model of political and economic reform for Africa (BBC News, 2012). The total land area of Ghana is approximately 238,000 square kilometers, or about the size of the state of Oregon (CIA, 2012). An estimated 24.3 million people live in Ghana with more than eight ethnic groups, the largest of which are the Akan, Mole-Dagbon, Ewe, and Ga-Dangme (CIA, 2012).



Figure 1: Map of research site

Agriculture accounts for approximately one third of Ghana's Gross Domestic Product. The country is the world's second-largest producer of cocoa (USDA Foreign Agricultural Service, 2012) and other major agricultural products include rice, cassava, peanuts, corn, shea nuts, bananas, and timber (CIA, 2012). The Ministry of Food and Agriculture estimates that 80% of the country's agricultural output is produced on smallholder farms (MoFA, 2007). In general, women have less, and poorer quality, land than men in all areas of the country (Bortei-Doku Aryeetey, 2002). Women comprise the majority of the rural poor and crop farmers in Ghana (National Development Planning Commission, 2005) and are therefore a key group to include and consider in any agricultural program such as IPM.

3.2.2 Tomatoes in Ghana

The last account of annual national tomato production in Ghana was approximately 96,000 tons in 1989 (CountrySTAT Ghana, 2012). More recent studies estimate that tomato production grew to over 200,000 tons during the 1990s but has since declined somewhat (Robinson & Kolavalli, 2010a). Within the category of root crops, fruits, and vegetables produced in Ghana, tomatoes rank third in terms of harvest value (GSS, 2008). The Ghana Statistical Service estimates that over 500,000 households nationwide harvested tomatoes in 2008, over half of which were located in the agroecological zone where the study site for this research lies. In this zone, tomatoes are disproportionately grown on plots held by men though men do not disproportionately grow them (Doss, 2002). In other words, women are involved in tomato production but do not own the land on which tomatoes are grown. A study of tomato production in the Brong Ahafo Region revealed that cultivation of tomatoes as cash crops for urban markets is more restricted for women farmers (Lyon, 2000).

Different regions of Ghana produce the bulk of the country's tomatoes at various times throughout the year; the bi-modal rainfall patterns in the Brong Ahafo Region contribute to its predominance in production from June through December (Robinson & Kolavalli, 2010a). Compared to other tomato-producing countries, many farmers in Ghana do not achieve yields as high as are potentially possible, though some do, indicating that if best practices were implemented by farmers nationwide tomato production could increase significantly (Robinson & Kolavalli, 2010a). Some of the factors that contribute to low yields include recycling of seeds (increasing the risk of in-breeding or disease transmission), poor land husbandry practices, lack of technical support, and lack of access to labor (Robinson & Kolavalli, 2010a). Farmers report constraints to tomato production in terms of financial resources, inputs, costs of production, land preparation, disease and pest problems, and issues of land tenure or acquisition (Adu-Dapaah &

Oppong-Konadu, 2002). Tomato production in the Brong Ahafo Region is characterized as “low input—high yield” in comparison to other regions, particularly because of the limited use of irrigation. However, hired labor is the largest driver of costs for farmers in the Brong Ahafo Region (and is a larger proportion of cost than in other regions) and farmers primarily produce local varieties that sell to the fresh market but are not preferred by consumers or processors (Robinson & Kolavalli, 2010a). Social networks are central to the survival of microenterprises in the tomato sector where formal legal institutions are often unreliable or inaccessible. For example, tomato producers and traders rely on one another at various times for credit, and tomato producers often purchase inputs from agrochemical sellers on credit (Lyon, 2000).

Farmers primarily sell their tomatoes to traders, nearly all of whom are women, who take on the risks of transportation and sale: “The tomato value chain in Ghana is characterised by a ‘two-level’ system in which itinerant traders—market queens—are the direct link between rural farm producers and urban consumption, rather than by a set of assembly markets which bulk the produce before being sold to urban wholesalers at relay markets” (Robinson & Kolavalli, 2010b, p. 1). This system reduces transportation and transaction time, which is crucial for a highly perishable product like tomato. The level of organization of these “market queens” enables them to control the distribution of tomatoes into urban markets and reduce the risks of spoilage, though dominant narratives in the press, grey literature, and among farmers portray this as a detrimental situation that inflates prices for consumers and lowers prices for producers (Robinson & Kolavalli, 2010b). However, there is evidence that farmers who sell to traders receive higher prices than they would if they sold directly to local markets (Robinson & Ngeleza, 2011). This two-level system generally does not transmit consumer demands back to farmers (Robinson & Kolavalli, 2010b). Organization among farmers can increase their bargaining

power with traders, though this may be limited since traders often have the option of moving on to different farmers who will accept lower prices (Robinson & Kolavalli, 2010b). While government officials and agricultural experts have called for an increase in domestic processing plants to offer an alternative market to tomato producers, this would require varieties that most farmers do not currently grow. It would also increase demand for tomatoes, which would benefit farmers but increase the price of tomatoes to the point that domestic processors could not compete with inexpensive imports of tomato paste (Robinson & Kolavalli, 2010c).

The commitment of the government and agricultural institutions to the tomato sector has been limited beyond ineffective processing plants and data collection, which ended in the 1980s (Robinson & Kolavalli, 2010d). Key stakeholders involved in the tomato sector have expressed the need for increased research on tomato production and specialized inputs for tomatoes, increased extension services, improved relations between farmers and traders, the development of marketing standards and protocol, and a comprehensive approach that examines the full tomato value chain (Robinson & Kolavalli, 2010e). These issues represent key areas to which an IPM program could contribute.

3.2.3 Integrated Pest Management and the IPM CRSP

Integrated Pest Management (IPM) is a systems approach to reducing pest damage by coordinating “the use of pest biology, environmental information, and available technology to prevent unacceptable levels of pest damage by the most economical means, while posing the least possible risk to people, property, resources, and the environment” (National Information System for the Regional IPM Centers, 2004). In an agricultural context, an IPM approach will depend on specific contextual variables including the targeted crop, pests, and ecosystem, but generally incorporates methods such as pest-resistant varieties of crops, biological and physical control methods, modification of the environment, and biopesticides (IPM CRSP, 2011). IPM

programs represent a viable alternative to, or reduction of, intensive use of toxic, persistent chemical pesticides. Such programs require research for the development of appropriate IPM techniques in a particular context as well as outreach to encourage the adoption of these techniques. In order to be effective and sustainable, IPM programs must account for gender differences in knowledge, perceptions, access to, and practices of pesticides and pest management.

The IPM CRSP seeks to “raise the standard of living while creating sustainable development” through research for development of IPM packages around the world. The IPM CRSP works to reduce crop losses due to pests, damage to ecosystems (including biodiversity loss), and contamination and pollution of food and water supplies (IPM CRSP, 2011). The program consists of 11 long-term projects—six regional and five global—working in 17 countries and collaborating with 17 U.S. universities and 52 host-country institutions, international agricultural research centers, non-governmental organizations, and private institutions. The IPM CRSP is in its fourth five-year phase and is managed by Virginia Tech. The research for this study was conducted in collaboration with the West Africa regional program and CSIR-CRI as part of the

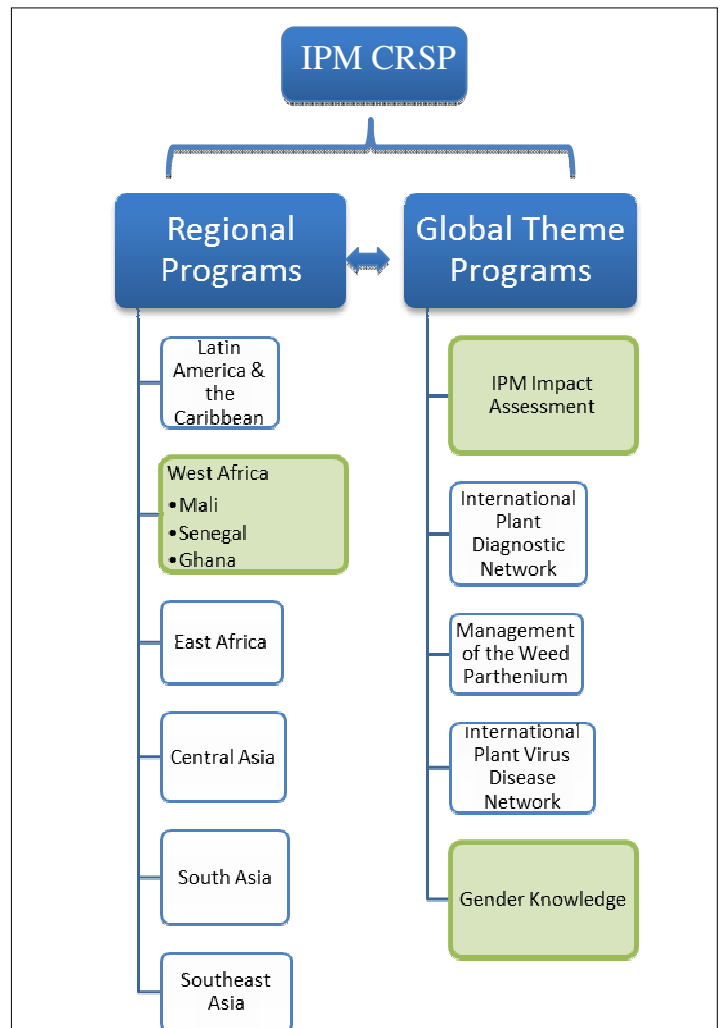


Figure 2: Organization of the IPM CRSP and elements involved in this research

Gender Global Theme, a cross-cutting effort which works to integrate gender issues and increase the participation of and benefits to women. This research also involved collaboration with the Impact Assessment Global Theme to develop and implement a survey (Figure 2).

3.2.4 Study Site (Tuobodom)

The work of the IPM CRSP in Ghana focuses on tomato crops. The research site for this study, Tuobodom, is one of seven key areas of tomato production identified by CSIR-CRI (Figure 1). The IPM CRSP had no previous history in Ghana prior to this phase, though tomato farmers may have exposure to IPM techniques through other programs or projects. A primary purpose for this research was to explore the existing context of pest management among tomato farmers and provide this baseline information to the IPM CRSP so that scientists can work with farmers to develop an appropriate package of IPM technologies for tomato.

Tuobodom is a large agricultural community located in the Brong Ahafo region of Ghana. The last official census report from 2000 estimated a population of 7,757 people, comprised of 3,750 men and 4,007 women (Representative for the Techiman Municipal Office of the Ghana Statistical Service, personal communication, August 9, 2011). This census also estimated 1,595 households in the community with an average household size of 4.9 persons. Census data from 2010 is still being processed, but the population is estimated to have grown to around 11,000 people (Agricultural Extension Agent of Tuobodom, personal communication, August 9, 2011). Agriculture is a primary activity for the residents of Tuobodom. Major crops cultivated include maize, yam, cassava, tomato, and pepper. While farmers have several streams of income in Tuobodom, tomatoes are an important part of livelihood strategies because of the vegetable's high value relative to the small plot size required to cultivate it. Tuobodom is approximately 10 km from the district capital, Techiman. This city is the center of district business and activity, hosts several municipal offices, and has a major market for agricultural

produce that draws customers from around the country and even from some neighboring countries.

Fieldwork for this research was conducted during July and August of 2011. At this time, most tomato farmers had finished harvesting their crops from the minor growing season and were in the process of preparing nurseries and cultivating seedlings for the major growing season. This generally involved creating a small bed in the field to grow the tomato seedlings, and by the end of this research, some of the farmers had started to transplant their seedlings to the field.

3.3 Literature Review

In an effort to advance inquiry in the field of gender and development, this study draws on previous research in the areas of gender and agricultural development, gender and agriculture in Ghana, and pesticides and IPM. The following section examines research in these areas germane to the objectives of this study.

3.3.1 Gender and Agricultural Development

Gender is the social construction of the categories ‘male’ and ‘female.’ Gender changes by time, location, culture, and other contextual variables and is different than the biological category of sex. Until the 1970s, development discourses did not address gender. The field of Women in Development (WID) emerged as development practitioners began to notice that men and women benefited—or, in many cases, did not benefit—from development projects in different ways. In 1970, Esther Boserup wrote *Woman’s Role in Economic Development*, exploring a range of issues related to women’s roles in the economies of developing countries, particularly the underreporting of women’s activities in statistics on agricultural and industrial production (Boserup, 1970). Boserup’s analysis of women’s marginalized position in economic

development led to recommendations for development projects to more fully incorporate women in the economic modernization process (Benería & Sen, 1981).

The assumption that the inclusion of women in the productive sphere, producing goods with exchange value in the market, would lead to their equality with men informed most early international development efforts to include women and still persists within the international development community (Barriteau, 2000). But as Benería and Sen (1981) note, Boserup's analysis ignored women's reproductive work supporting the maintenance of domestic units and the workforce, as well as the ways in which women's subordination is located in deeply embedded gender relations. Boserup's research also generated an assumption accepted by development programs for many years that men grow cash crops and women grow subsistence crops. This is a problematic dichotomy because women are often involved in cash crop production on their own land or contribute to production on the farms of their male kin (Doss, 2002; Moser, 1993). Moreover, the colonial imposition of a Western perspective of men as breadwinners and women as dependents changed men's and women's roles in agriculture in many countries because this model served the interests of men in these countries and was adapted into existing systems of production (Padmanabhan, 2007). Gender and Development (GAD) approaches emerged in the mid- to late 1980s, growing out of criticisms of the WID approach and calling for a fundamental reworking of development that challenges the political and economic systems as well as those of gender relations that subordinate women (Parpart, 1995).

Gaining an understanding of the construction of gender and local gender relations in a particular context is a critical element for agricultural development projects, as men's and women's different roles and responsibilities within agriculture result in different knowledge and

practices (Ferguson, 1994; Gururani, 2002; Sachs, 1996; Thomas-Slayter & Rocheleau, 1994). Gender differences also interact with other social differences to shape access to and control over resources, often affecting environmental management and ecological changes (Rocheleau, Thomas-Slayter, & Wangari, 1996). Men's and women's different roles and responsibilities in productive and reproductive work result in gender differences in experiences of environmental degradation and related gender differentiated participation in environmental conservation projects (Jackson, 1995). In order for agricultural development programs to be effective and sustainable, "they must address the concerns of men and women and the ways they, individually and collectively, relate to the state, economy, and the resource base" (Thomas-Slayter & Sodikoff, 2001, p. 58).

Agricultural development projects must also recognize men's and women's labor burdens and how a planned intervention may affect them, particularly women's "triple role" (Moser, 1993). Moser contends that gendered divisions of labor create the perception, often upheld by development programs, that women only do reproductive work, such as childbearing and rearing, cooking, cleaning, etc. In actuality, most women in developing countries bear a triple burden of work—reproductive, productive, and community work—as social expectations strongly encourage women to care for the household, support productive livelihood activities for additional income (i.e., the production of crops or goods for sale), and participate in the management of collective resources (Moser, 1993). This observation is an extension of Boserup's early work on the failure to account for women's productive work. However, Moser and other scholars have gone beyond Boserup's argument to account for women's productive work; they argue for counting women's other forms of work, in particular because women are

often overrepresented in subsistence, informal, domestic, and volunteer work, and are therefore disproportionately affected by the failure to fully account for these areas (Benería, 1992).

Moser suggests that, like gender, divisions of tasks change over time and by location. She notes that many feminists have challenged the dualist conceptualization of women's work as productive or reproductive, arguing that it is problematic because reproductive work is productive or necessary for production, even if it does not have a recognized market exchange value. However, Moser (1993, p. 32) contends,

“[n]evertheless, in developing the conceptual principles for gender planning the purpose of distinguishing between women's productive and reproductive roles is precisely to highlight the multiple forms of women's work. This reveals the severe limitations of contemporary planning categories, which in emphasizing the difference between men's productive work and women's reproductive work, have so effectively rendered women's productive work invisible.”

Jackson (1995, p. 119) echoes this sentiment suggesting, “[w]hat gender analysis offers is not a set of generalizations about, for example, men's and women's contributions to farm production, but a means of rethinking, for any specific location, the implications of a gender-disaggregated account of farm production.”

Major development actors like the World Bank, United Nations Food and Agriculture Organization (FAO), U.S. Agency for International Development (USAID), and others have recognized women's fundamental role in agriculture and the importance of examining how gender relations may affect, or be affected by, development projects targeting agriculture. Women account for 43% of the agricultural labor force in developing countries and 50% in Sub-Saharan Africa (FAO, 2011). However, they are much less likely than men to have access to agricultural inputs and resources including land, livestock, fertilizer, credit, education, and extension services (FAO, 2011; World Bank, 2009). FAO estimates that if women had access to

inputs and resources equal to men, they could increase their yields up to 30%; this would increase overall agricultural production in developing countries and potentially reduce the number of people in the world living with hunger by up to 17% (FAO, 2011).

In 2009, the World Bank, FAO, and the International Fund for Agricultural Development (IFAD) compiled the *Gender in Agriculture Sourcebook*, examining the importance of women in agricultural development and poverty reduction and the need for gender-sensitive policy and program design (World Bank, 2009). FAO's annual report on "The State of Food and Agriculture" for 2010 – 2011 also focused on gender and agriculture and was titled "Women in Agriculture: Closing the gender gap for development" (FAO, 2011). This report outlines gender gaps in agricultural production and resources, with attention to the different situations in various countries and cultural contexts, calling for policy interventions to address the root causes of these gaps. USAID recently strengthened requirements for all projects/activities, project proposals, and strategic plans to incorporate gender analysis (USAID, 2012a). This gender analysis is built around two "key questions":

- 3) "How will the different roles and status of women and men within the community, political sphere, workplace, and household (for example, roles in decision-making and different access to and control over resources and services) affect the work to be undertaken?"
- 4) "How will the anticipated results of the work affect women and men differently?" (USAID, 2012a).

USAID also announced its new Gender Equality and Female Empowerment Policy in March 2012 (USAID, 2012b). Additionally, the U.S. Government's new global hunger and food security program, Feed the Future, has made gender integration one of its six focus areas. A collaboration between USAID, the International Food Policy Research Institute (IFPRI), and Oxford Poverty and Human Development Initiative (OPHI) has produced a "Women's Empowerment in Agriculture Index" which presents monitoring and evaluation requirements

focused on women for all Feed the Future projects (Feed the Future, 2012). Furthermore, the Bill and Melinda Gates Foundation recently developed a “Strategy for Gender-Responsive Agricultural Development Programs” to guide and support grantees’ and partners’ efforts to better address gender in agricultural programs and initiatives (Bill and Melinda Gates Foundation, 2012).

While recognizing that the roles played by women in agriculture is important, so is recognizing the differences among and between women and men, and the ways in which social status, cultural context, or other factors impact women’s and men’s experiences, knowledge, access to resources, and decision-making. Feminist theory and scholarship has produced a large body of work pertaining to gendered experiences, perceptions, and production of knowledge (e.g., Bordo, 1986; Haraway, 1988; Harding, 1986; Mohanty, 1984). A key argument of this literature is that the production of knowledge is mediated by factors such as historical and social context and identity. Consequently, knowledge and science are never entirely ‘objective’ since they are products of specific perspectives and socially constructed. Haraway (1988) argues for “feminist objectivity” that is rooted in lived experience rather than from a distant, detached “view from above” which, by her account, is irresponsible because it ignores the power relations between producers and objects of knowledge. The “situated” approach for which she advocates is cognizant of its partiality and often complex, paradoxical nature as a way of avoiding the pitfalls of extreme relativism or extreme positivism, and it acknowledges the power relations involved in the construction of knowledge. From this perspective, objects of knowledge are agents engaged in the conversation rather than resources for discovery.

Accordingly, development practitioners must recognize how their own identities produce a distinct worldview and assumptions about development and intended benefits of development

projects.⁶ Moreover, men and women involved in agricultural development programs will have knowledge and perceptions “situated” in their own lived experiences, influenced by factors of identity such as gender, class, and education. It is therefore important for these programs to identify both men’s and women’s knowledge to create a more comprehensive understanding of a given context, and to recognize the positionality of development practitioners and the methods by which they gather information for a given project (Nightingale, 2003).

3.3.2 Gender and Agriculture in Ghana

Agriculture plays a key role in Ghana’s economy, employing 56% of the labor force (CIA, 2012). Smallholders carry out the majority of agricultural production, and approximately 90% of farm holdings in Ghana are less than 2 hectares (MoFA, 2007). Land tenure in Ghana is complex, consisting of overlapping and sometimes conflicting customary laws and formal administrative systems. Rights to particular plots of land are negotiable and multidimensional within these systems (Goldstein & Udry, 2008), and access to and control of land may be further disaggregated by particular plants, products, activities, or points in time (Rocheleau & Edmunds, 1997). Although customary laws protect women’s usufruct rights in principle, a variety of factors affect women’s access to land including gender divisions of labor and production, availability of land, gender bias in distribution of land, and changes in residence after marriage (Rünger, 2006). Women do develop strategies to extend their claims to resources (Bortei-Doku Aryeetey, 2002), but these rights are mediated by women’s relationships with men under unequal power relations (Rünger, 2006). Increases in women’s land ownership alone will not necessarily increase women’s incentives to adopt more sustainable management practices if they still have unequal

⁶ See Escobar (1995, p. 45) for a thorough exploration of development as a “historical construct that provides space in which poor countries are known, specified, and intervened upon” and the problematic nature of “discourses of development.”

access to inputs or other resources like time and information (Bortei-Doku Aryeetey, 2002; Rocheleau & Edmunds, 1997).

The majority of agricultural labor in Ghana is provided by household members or hired temporary labor (CountrySTAT Ghana, 2012). Agricultural production is organized by many factors such as gender, age, ethnicity, and wealth. While there are gendered patterns in agricultural production in Ghana, it is difficult to categorize specific crops as men's or women's. This is due in large part to how the "farmers" growing these crops are defined: as household heads, plot holders, or the person who keeps revenue from the plot (Doss, 2002). In her study of Ghanaian farmers, Doss found that men are more likely than women to use their plots to grow crops for sale, but women are also involved in cash crop production for all of the country's major crops including cassava, maize, pepper, plantain, cocoa, okra, yam, and tomatoes. This demonstrates how the assumed dichotomy of men growing for sale and women for consumption does not hold in all cases. In general, Doss found that some crops are grown disproportionately by male-headed households (tobacco, coffee, maize, yam, rice, and sorghum) or female-headed households (cocoyam, plantain, onions, and eggplant) but when these numbers are disaggregated by agroecological zone this is no longer the case; this is likely the result of different proportions of women farmers in the three zones. Male plot-holders disproportionately grow maize and yams in some zones and women plot-holders disproportionately grow cocoyam, though this is not the case for the country as a whole. Moreover, no crops are disproportionately grown on plots where women control the revenue.

The existence of gender patterns of cropping has implications for agricultural policy because policies directed toward certain crops may not have equal implications for men and women (Doss, 2002). Doss suggests that changes in these patterns are important to monitor

because of evidence that men often move into production of crops as they become more profitable.⁷ For example, farmers in the forest zone of Ghana reported that tomatoes used to be considered women's crops but men now grow them for sale (Doss, 2002). Changes in gender-based patterns of agricultural production often stem from the introduction of new crop varieties, inputs, or technologies such as mechanized tools for production or in the case of IPM. Research has demonstrated that decisions to adopt technologies are closely linked to access to resources such as land, labor, and extension services (Doss & Morris, 2001). This has important implications for the gender equity of agricultural development projects and policy if access to resources is gendered.

Financial resources are another important determinant of improved production. Most smallholder farmers in Ghana depend on informal institutions for credit, which may have limited lending capacities or high interest rates (World Food Programme, 2009). Women are particularly disadvantaged in accessing credit because they lack the adequate or quality assets to serve as collateral: "Based on Ghanaian tradition women generally do not enjoy ownership over any significant or valuable assets, specifically productive agricultural assets, which in turn prevents them from applying for any formal credits, unable to offer the valuable collateral" (MOFA, 2007 as cited in World Food Programme, 2009, p. 51).

Men and women are involved in different ways in agricultural activities beyond production, such as processing and marketing. Processing of produce is common in both urban and rural areas, with 53% of urban households and 65% of rural households involved (GSS, 2008). The Ghana Statistical Service (2008) reports that among processors, women have the majority of responsibility accounting for 87% of processing countrywide. Trading and marketing

⁷ However, as discussed earlier, this does not necessarily mean men only produce crops for sale while women only produce crops for subsistence consumption.

of the major local food crops are also activities predominately carried out by women in Ghana, as in similar areas in West Africa (Clark, 1994).

Carr (2008) cautions that development scholars and practitioners must be careful not to generalize gender categories or overlook other livelihood, identity, or community-based factors that contribute to men's and women's vulnerabilities in agriculture: "Gendered vulnerabilities are not the simple outcome of a social categorization, but are created and recreated through social practices that operate at scales as small as the household. The aggregation of these experiences into the general categories 'woman' or 'man' can erase very real and practical differences between those contained within these categories as well as across them" (Carr, 2008, p. 901). Carr's study of gendered crops in southern Ghana found that men's production is much more vulnerable to market fluctuations while women producers are more vulnerable to environmental shocks. Carr asserts that in this specific place and time, women's vulnerabilities, and those of female-headed households in particular, are closely linked to the highly gendered land tenure system in the study area. Carr suggests that without examining the modes of livelihood and identification of social groups within the community, this nuanced understanding of men's and women's different vulnerabilities would not have been possible.

3.3.3 Pesticides and Integrated Pest Management (IPM)

Since Rachel Carson's *Silent Spring* (1962) drew widespread public attention to the harmful effects of pesticides on the environment, animals, and humans, scholars have continued to explore the use and effects of pesticides in the developed and developing world (Ecobichon, 2001; Weir & Schapiro, 1981). Studies have found that farmer families, in addition to farmers who apply pesticides, are at risk for harmful effects of pesticides due to residues, water and soil contamination, the reuse of chemical containers for food, and exposure to residues on clothing or equipment brought home (Ecobichon, 2001; Garcia, 2003). Men and women may be affected by

pesticides in different ways. Studies have documented women who were exposed to pesticides having deficiencies in reproductive functions or increased numbers of birth defects in children (Garcia, 2003), while men who handled dibromochloropropane (DBCP) experienced low sperm counts or complete sterility (Babich, Davis, & Stotzky, 1981). Traces of organochlorine pesticides have been found in breast milk among women in Ghana (Ntow, 2001), signaling the potential for negative effects of pesticides on both women and nursing children who consume the breast milk. Women may also be more susceptible than men to certain cancers because many of the chemicals in pesticides act as endocrine disrupters, leading to hormone-related cancers that affect women more than men (Garcia, 2003).

Studies also show that knowledge, perceptions, and practices of pesticide use differ by gender; in some cases, women are less likely than men to be able to read warning labels, to have knowledge of the risks of pesticides, and to use protective clothing (Atreya, 2007; Garcia, 2003) while in other contexts, women's concern for the health of family members may actually increase their awareness of the risks of pesticides (Cole et al., 2011). In addition to the dangers of pesticides to humans, insects and plant pathogens can develop resistance to these chemicals, leading to increased levels of pesticide use in response to increased pests, and keeping farmers locked into a "pesticide treadmill" (PANNA, 2012). Moreover, research suggests that pesticide use not only leads to pesticide resistance but also to the weakening of the plants themselves (Gips, 1987).

Pesticide use on crops is common in Ghana. Rates of insecticide, herbicide, and fungicide use have increased significantly since the 1960s (Ntow, 2001). Among Ghanaian farmers' expenditures for crop inputs, nearly 16% went to pesticides (insecticides and herbicides) (GSS, 2008). Chemical pesticides are often perceived to be the best, and sometimes only, solution to

address the major pest problems to which vegetable production is susceptible (Danquah, Ekor, & Asuming-Brempong, 2009; Marfo, 2006; Ntow, Gijzen, Kelderman, & Drechsel, 2006). In some cases, farmers report getting information on insecticides from a source other than the agricultural extension agent, specifically agro-chemical sellers and other farmers (Danquah et al., 2009), while farmers in other contexts rely primarily on extension agents for information (Ntow et al., 2006). This can have implications for the kind of information farmers receive since agrochemical vendors have little interest in promoting methods of pest management that would decrease business at their stores, such as non-pesticide methods.

Few Ghanaian farmers wear protective clothing (Marfo, 2006; Ntow et al., 2006), and one study found that 80% of farmers surveyed reported experiencing illness due to pesticide exposure (Ntow et al., 2006). Farmers in Ghana dispose of pesticide containers by leaving them in the field or throwing or burying them nearby (Marfo, 2006; Ntow et al., 2006). High demands for produce and low perceptions of risks or residues of pesticides in food lead some farmers in Ghana to harvest prematurely (Darko & Akoto, 2008), increasing the likelihood of residues and potential harmful effects for both harvesting farmers and consumers. Studies have found evidence of pesticide residues in blood and breast milk (Ntow, 2011), surface and groundwater (Obiri-Danso & Adonadaga, 2011), and tomatoes to an extent that could cause health risks such as cancer (Darko & Akoto, 2008; Essumang, Dodoo, Adokoh, & Fumador, 2008). Extensive use of fertilizer in tomato production in Ghana has also been linked to significant greenhouse gas emissions (Eshun, Apori, & Oppong-Anane, 2011). Nearly all of the studies reviewed, examining both pesticide use and residues in Ghana, recommend training and education for farmers and pesticide distributors as a means of reducing indiscriminate use of hazardous chemicals and increasing awareness of the risks of pesticide use.

Application of pesticides varies by crop and other factors such as gender or wealth.

Dagomba women in northern Ghana prefer to cultivate local varieties of cowpea because they do not require agrochemicals to grow well, in contrast to improved and introduced varieties that do (Padmanabhan, 2007). Padmanabhan found that this preference is associated with the perception among Dagomba people that insecticides are “medicine”; since the diagnoses of problems and handling of medicine is considered the domain of men, and taboo for women, pesticides have been constructed as a gendered technology. In contrast, the application of fertilizer is considered part of sowing, which is considered female work in this context. This case demonstrates the importance of considering the cultural context and constructions of gender in a particular place because these factors will give meaning to and affect the way new technologies are introduced to and adopted by a community.

Integrated pest management (IPM) is an approach used in many agricultural development programs to manage pests through strategies that pose the least risk to people, crops, and the environment. By using a variety of methods to reduce pest damage, IPM interventions help reduce crop losses and pesticide use, curtail damage to ecosystems, improve crop quality, increase income, and provide educational opportunities for farmers and researchers (IPM CRSP, 2011). Since IPM programs depend on knowledge of the ecosystem, many projects in recent years have emphasized empowering farmers as decision-makers in IPM rather than consumers of technologies developed by researchers from afar (van de Fliert & Proost, 1999). However, because women’s roles as farmers are often invisible, their knowledge is ignored in these programs, to the detriment of the projects’ success and sustainability (Atreya, 2007; van de Fliert & Proost, 1999; Vander Mey, 1999). In particular, one study of an IPM program for cowpea in Ghana demonstrated the importance of a gender-sensitive approach and inclusion of women in

training and activities and found that women's roles in cooking and childcare affected their knowledge of the importance of cowpea as a nutritious crop for family consumption (Vander Mey, 1999).

This research contributes to the literatures of gender and agricultural development, agriculture in Ghana, and IPM by exploring the intersection of gender and pest management among tomato farmers in Ghana and its implications for the introduction of an IPM program.

3.4 Methodology

I conducted the fieldwork component of this research over five weeks in July and August of 2011. The purpose of this research was to explore gendered activities in productive and reproductive spheres in Ghana and how gender relations affect the knowledge base and use of agrochemicals, particularly pesticides.

The broad research question for this study was: **What are the gender-based constraints and opportunities for the introduction of IPM among tomato farmers in the Brong Ahafo region of Ghana?** The hypothesis was that there are gender-based constraints and opportunities that stem from gender differences in knowledge, practices, perceptions, and access to resources, specifically with respect to pesticides and pest management. A secondary hypothesis was that these gender differences are largely the result of gendered activities in productive and reproductive spheres. As stated above, productive work refers to the production of goods and services for payment in cash or kind, including subsistence production with a use-value and potential exchange value; reproductive work is the care and maintenance of a domestic unit, including birth and rearing of children, that maintains the current and future workforce (Moser, 1993). Community work refers to collective work carried out to support a community, often involving its own gender divisions (Moser, 1993). Literature shows these categories can be problematic and may contribute to the devaluation of reproductive work. However, as Moser

(1993) suggests, the use of these categories can actually serve to highlight the areas of overlap within activities and provide a useful tool to explore the complexity of men's and women's livelihoods.

Studies have found participatory methods to be particularly effective in documenting women's perspectives and knowledge as well as productive and reproductive activities (Awumbila & Momsen, 1995; Colfer, 1994; Flora, 1994; Grandin & Avila, 1994; Lyon, Bell, Croll, Jackson, & Gratton, 2010; Thomas-Slayter, 1993; Trauger et al., 2008; Wollenberg, 1994) and have called for the increased use of participatory methods in sustainable agriculture programs (Dlott, Altieri, & Masumoto, 1994; Nelson, 1994; Pretty, 1995; Röling & van de Fliert, 1994). This research sought to use participatory methodologies to document men and women tomato farmers' knowledge, perceptions, practices, and access with regards to pesticides and pest management. To do so, the study employed a gender analysis tool called the Gender Dimensions Framework (GDF) and a mixed methods approach including focus group discussions (FGDs), household visits, timeline generation, photo interpretation, activity profiles, participatory mapping, semi-structured and unstructured interviews, household and field observations, and a survey.

The Gender Dimensions Framework (GDF) is based on the Domains Framework for Gender Analysis developed by Deborah Rubin and Deborah Caro of Cultural Practice LLC under USAID contracts (the WID IQC and the Health Policy Initiative). It was developed to provide guidance to USAID staff and partner organizations working with USAID projects promoting equitable opportunities in agricultural value chains (Rubin, Manfre, & Barrett, 2009). The GDF examines four overlapping dimensions that help elucidate gender inequalities: access to and control over key productive assets (tangible and intangible, including knowledge); beliefs

and perceptions; practices and participation; and laws, legal rights, policies, and institutions (Figure 3). There is overlap in these dimensions such that a particular finding in one dimension may also appear in others. For example, this research found that farmers wear little protective clothing when applying pesticides. This falls within the category of practices and participation because it refers to the safety precautions farmers take when *practicing* pest management. However, farmers may not wear protective clothing in part because of limited availability in agrochemical stores or lack of income, and thus they do not have *access* to protective clothing. Power is a crosscutting issue for all of the dimensions (Rubin et al., 2009).

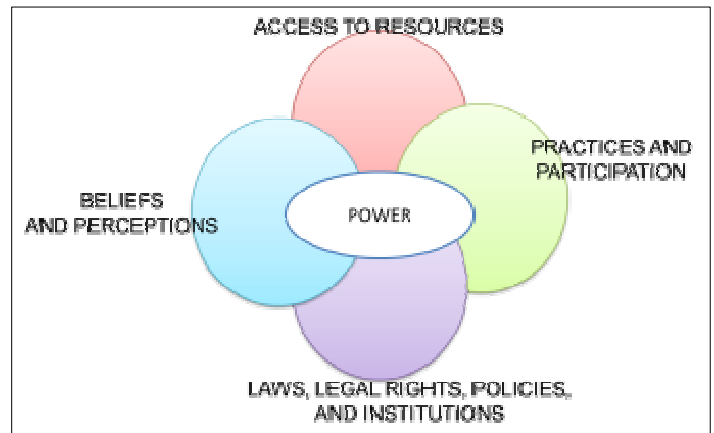


Figure 3: Gender Dimensions Framework

The population for this study was smallholder tomato farmers in the town of Tuobodom, Brong Ahafo Region. There is no official estimate of the number of tomato farmers in Tuobodom, though the local agricultural extension agent estimated the town’s population at 11,000 people and said the majority of community members engaged in agriculture grow tomatoes (Agricultural Extension Agent of Tuobodom, personal communication, August 9, 2011). Participants were selected through different sampling methods for the FGDs, household visits, and survey, as explained in the following sections.

Research methodologies were pretested in the town of Agogo, Ashanti Region, a tomato-producing area similar to Tuobodom. Research instruments for the survey, FGDs, and household visits were revised to increase clarity and cultural appropriateness. The field research began when the IPM CRSP hosted a four-day Gender and Participatory Methodologies Workshop in

the city of Techiman in the Brong Ahafo Region. The purpose of this workshop was to introduce gender in agriculture and participatory research methodologies to agricultural scientists, extension agents, and representatives from the Ministry of Agriculture working with the IPM CRSP in Ghana (Christie & Zselezky, 2011). Techiman is approximately 10 km from Tuobodom, the research site for this study; fieldwork during the workshop was conducted in Tuobodom and contributed to this research. Workshop participants facilitated eight FGDs (four men's groups and four women's groups) with 48 farmers—36 men and 12 women. Activities in the FGDs included a timeline generation exercise, participatory mapping, and creation of an activity profile. Workshop participants also conducted household visits with eight farmers from the FGDs. The household visits consisted of a photo interpretation activity, participatory mapping, semi-structured interview and household observation. My role during the workshop was to help facilitate, observe the FGDs and household visits, and take detailed notes during fieldwork and workshop activities.

I stayed in Techiman for three weeks after the workshop to conduct field research and build on the initial findings generated in the workshop. I conducted 22 household visits, seven visits to farmers' fields, six visits to agrochemical stores, unstructured interviews with fourteen key informants, and participant observation of various agricultural and household activities. The socioeconomic team of CSIR-CRI implemented a survey developed by the Gender Global Theme in coordination with the Impact Assessment Global Theme of the IPM CRSP to supplement the fieldwork conducted during July and August 2011. They conducted the survey in seven IPM CRSP sites throughout Ghana, including Tuobodom, during January and February of 2012. The mixed-method approach of this study helped to explore the same questions in different

ways, triangulating the data. It also served to reveal the ways in which different methods can produce contradictory findings or gaps in the data (Nightingale, 2003).

I worked with a Ghanaian research assistant who is a native speaker of the local language, Twi, to improve my understanding of participant responses if they did not speak English, the official national language. Most respondents spoke in Twi, so my understanding is based on the interpretation provided by the research assistant. She was trained in the research approach during the Gender and Participatory Methodologies Workshop and holds a bachelor's degree in Economics with a minor in the Twi language from the Kwame Nkrumah University of Science and Technology in Kumasi, Ghana. However, responses are still subject to the challenges of lost meaning through interpretation and the inability to translate some words from Twi to English. In an effort to compensate for these challenges, three CSIR-CRI scientists—all of whom were native Twi speakers—collaboratively translated the household interview prompt to Twi during the workshop. This translation ensured that the same questions were asked to each respondent in the same way. The research assistant and I also took extensive field notes throughout the research activities to supplement the data collected.

3.4.1 Focus Group Discussions (FGDs)

The eight focus group discussions (FGDs) were comprised of tomato farmers from Tuobodom. The local Agricultural Extension Agent (AEA) selected participants and was instructed to invite 20 men and 20 women tomato farmers. The AEA assigned to Tuobodom was out of town attending school but provided a list of farmers for the interim AEA to contact. Some of the selected women chose to leave before the activities started because they did not produce tomatoes anymore or because they did not have the time to participate. A few farmers joined the focus groups mid-way through the exercises. These numbers were recorded and incorporated in the total count. In the end, 48 farmers participated in the FGDs: 36 men and 12 women (Figure

4). Although this meant that there were not equal numbers of men and women, there were still enough farmers to separate into four large groups of men and four small groups of women. Participants represented a range of ages. Women facilitated the women's FGDs and vice versa for men. Each FGD included a timeline generation exercise (FAO, 2011a; Thomas-Slayter, Esser, & Shields, 1993; Thomas-Slayter, Polestico, Esser, Taylor, & Mutua, 1995), the creation of an activity profile (Moser, 1993; Thomas-Slayter et al., 1993; Thomas-Slayter et al., 1995), and a participatory mapping exercise (Byrne, 2011; Christie, Kyamureku, & Kaaya, 2010; Kindon, Pain, & Kesby, 2007; Rocheleau, 1995).

During the timeline generation, farmers were asked to talk about trends in tomato production and pest management in their community. They answered three questions: 1) Has tomato production always been this way? 2) Have pests and diseases changed? 3) Have these changes impacted men and women differently? If so, how? The activity profile illustrated who was responsible (men, women, children, or some combination) for major activities in tomato production, as well as reproductive and community work. The inclusion of activities was determined during pretesting, though FGD participants had the opportunity to add activities as they saw fit. During the participatory mapping activity, farmers were asked to draw the "path of the pesticide," from its point of purchase to its final destination. This exercise was modeled after similar participatory mapping exercises that ask farmers to identify the full course of a particular agricultural product or input (Byrne, 2011; Christie et al., 2010). It also aimed to reveal perceptions of pesticide residues and impacts of pesticides beyond the field.

After the eight focus groups had completed all the activities, they came together in one large group for the farmers to present their findings to one another. These activities provided an opportunity to facilitate discussion about tomato production, pest management, and gender

relations. The presentations and following discussion provided a better understanding of the knowledge, perceptions, practices, and access to resources of individuals as well as the community. These insights also helped identify key issues to explore further in the fieldwork that would follow.

FGDs (Berg, 2009; FAO, 2011a; Flora, 1994; Longhurst, 2003; Thomas-Slayter et al., 1993; Thomas-Slayter et al., 1995; Trauger et al., 2008) are an important participatory method because they allow sensitive issues to emerge “that would have been unlikely to surface using more structured methods, which do not allow for the voice of the marginalized to be heard” (Kindon et al., 2007, p. 84). However, FGDs can also be constrained by power relations within a group (particularly between men and women) therefore the researcher must be aware of this impact on findings and use other methods to triangulate data (Kindon et al., 2007). This is why groups were initially sex-disaggregated to complete the activities and why farmer participants presented their work to each other.

3.4.2 Household Visits

A total of 30 household visits were conducted in Tuobodom, eight during the workshop and 22 during the following three weeks of fieldwork. Household visits were conducted with equal numbers of men (15) and women (15). Four men and four women farmers were selected from the FGDs to participate in household visits conducted during the Gender and Participatory Methodologies Workshop. This subset of the sample was selected for logistical reasons (i.e., it was more feasible to have workshop participants interview farmers that were already identified rather than trying to select a separate set of farmers in the middle of the day—a time when most farmers are out in their fields).

The remaining 22 farmers selected for household visits were not participants in the FGDs (Figure 4). There was no adequate sampling frame that included the target population of all

smallholder tomato farmers in Tuobodom. To establish a sample of the population, a map was created to divide the town into six sections. The research assistant and I walked throughout the town and approached households in each section. If the residents were present, we asked if they were tomato farmers. If they were tomato farmers, the purpose of the research and time requirements were explained, and verbal consent was obtained or denied. If the residents were not tomato farmers or denied consent, we continued walking. A similar “random walk technique” was used in a survey of the tomato sector in the Brong Ahafo Region in the late 1990s (Lyon, 2000). The location and gender of respondents were recorded on the map to ensure that a uniform spatial distribution of farmers, equal parts men and women, were selected (Appendix A). Farmers’ ages were also recorded to confirm inclusion of a range of men and women of various ages. We tried to approach farmers in the morning or evening as farmers were more likely to have left their homes to farm in the fields during the day. However, this was not always possible and there were generally some farmers home during the day for various reasons (plans to go to the market, attending funerals, etc.). In three cases, snowball sampling was used because farmers’ spouses or neighbors were available and willing to participate, and we did not want to miss the opportunity to talk with more farmers.

Household visit respondents⁸ ranged in age from 18 to 57 years, though the majority of respondents, men and women, were between 30 and 49 years of age (Table 1).

Table 1: Ages of household visit respondents

	18-29 years	30-49 years	50+ years	Total
Women	2	10	3	15
Men	1	9	5	15
Total	3	19	8	30

⁸ Participants in the household visits will be referred to as “household visit respondents” throughout this paper.

There were clear differences in the levels of education of the men and women who participated in the household visits. While no women had more than 11 years of formal education, half of them had only attended school for up to five years. The vast majority of men respondents had between six and ten years of formal education, and three of them had more than 11 years (Table 2).

Table 2: Years of formal education of household visit respondents

	0-5 years	6-10 years	11+ years
Women	8	7	-
Men	-	12	3

Most of the household visit respondents were not members of a farmer association of any kind, though there were gender differences among those who were association members. Six men were part of a farmer association in comparison to two women.

While efforts were taken to ensure equal numbers of men and women respondents for household visits as part of a gender-sensitive approach, it became clear as the research progressed that more men grow tomatoes in Tuobodom than women. Although this sampling approach distorts the proportions of men and women tomato farmers, it provides information on the perspective of women who have not been accounted for in previous studies of tomato farmers in the Brong Ahafo Region (Ntow et al., 2006).

These visits to individual farmers in their homes were an opportunity to conduct many of the same activities as the FGDs but in a more intimate setting. A more conversational tone helped elicit information from farmers that the researchers had not yet considered. Activities in the household visits included photo interpretation, participatory mapping, semi-structured interviews (Longhurst, 2003), and household observations (Thomas-Slayter et al., 1993).

The photo interpretation involved farmers describing a series of pictures: 1) tomatoes with pest and disease problems; 2) a man with a pesticide container tied to his bicycle; and 3) children in a field (Appendix B). The facilitator asked the farmers three questions for each picture: 1) What do you see in this picture? 2) What do you think about it? 3) Do you see any problem(s) in this picture? The participatory mapping exercise was the same activity used in the FGDs to map the “path of the pesticide.” The third component of the household visits was a semi-structured interview comprised of 16 questions (Appendix C). These questions represented a subset of questions from the larger farmer survey that were identified during pretesting as requiring further exploration. The questions were compiled to explore farmers’ knowledge, access, perceptions, and practices of pesticides and pest management, specifically in relation to tomato production. Finally, household observations helped to determine where pesticides were stored, particularly in relation to food, clothing, children, livestock, and crops.

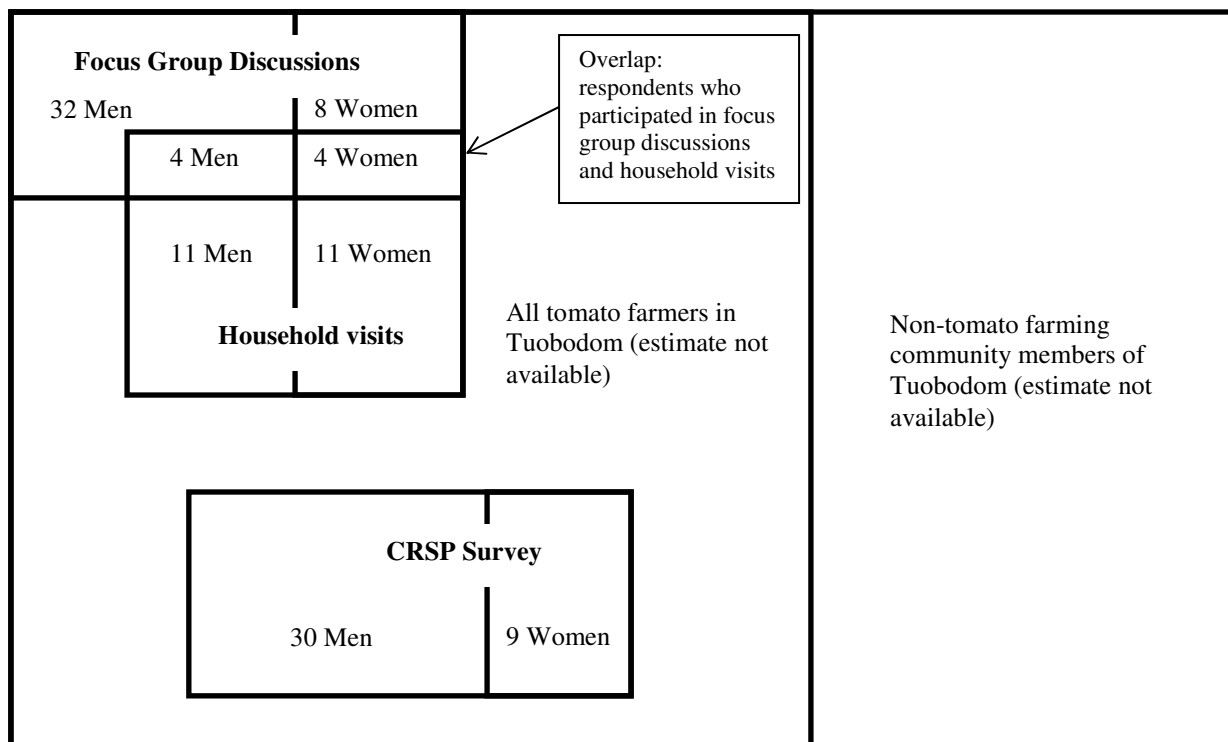


Figure 4: Sampling framework within Tuobodom (population: approx. 11,000)

3.4.3 Observations and key informant interviews

At the end of the household visits, farmers were asked about their tomato fields and, when possible, I made arrangements to visit the fields with the farmers. In particular, observations focused on where men and women grow tomatoes, where pesticides are stored (if outside the home), if there were sources of water close to the fields, and the location of other important points that emerged through the other methodologies.

Over the course of the three weeks of fieldwork, I also conducted participant observation (Laurier, 2003) with farmers in their fields and homes for a total of approximately 25 hours. This included walking to the fields with farmers, preparing the nursery beds, planting seeds, transplanting seedlings, harvesting tomatoes, shelling groundnuts, and preparing local foods. These activities provided the opportunity to get a better sense of life in the community, observe practices and access to resources, and ask questions about knowledge and perceptions of tomato production and pest management.

Unstructured interviews with fourteen key informants were also used to gain a fuller understanding of the context of tomato production and pest management in Tuobodom. These informants included six pesticide vendors, the local agricultural extension agent, three health workers, the secretary of the local tomato growers' association, the manager of a local rural bank, a representative of the municipal statistics office, and a scientist from CSIR-CRI. Questions were developed based on issues that emerged during household visits, field visits, and observations. These questions provided starting points for conversation, but other issues were explored as they arose even if they were not identified prior to the interview.

Visits to agrochemical stores were a key element of this research. These visits provided the opportunity to observe farmers coming to the store to purchase agrochemicals, as well as the opportunity to talk with the agrochemical vendors and farmers about their preferences, access to

information, and safety precautions. These observations also helped to determine what containers are used for pesticides, if the containers have labels, in what language the labels are written, and if the labels included safety information.

3.4.4 Survey

The Gender Global Theme and Impact Assessment Global Theme of the IPM CRSP worked together with CSIR-CRI to conduct a survey in all regions of the country where the IPM CRSP is working with tomato farmers. This survey included questions on gender relations, tomato production, and pest management, as well as questions that will provide baseline data for later impact assessment (Appendix D). A total of 293 farmers were surveyed in the seven sites; 40 farmers were from Tuobodom in the Brong Ahafo Region (Figure 4). Tomato farmers were selected to participate in the survey using a similar sampling method to that of the household visits. Numbers of men and women were selected to be proportional to estimates of men and women growing tomatoes in each site. The surveyors determined these proportions by asking three men and three women in each site how many men and women grow tomatoes there. These estimates were averaged and the mean proportion was then applied to the number of respondents in each site. I provided the lead researcher for the survey with a list of the farmers included in the household visits in Tuobodom to avoid duplication.

Overall, the sample of 293 farmers was 73.7% male and 26.3% female, with eight cases where the gender of the informant was not recorded. Forty respondents were surveyed in Tuobodom, 76.9% male and 23.1% female with one case missing gender information (Appendix E). The average age of CRSP survey respondents⁹ was 40.9. Farmers had an average of 7.8 years

⁹ Participants in this country-wide IPM CRSP survey will be referred to as “CRSP survey respondents” and the survey will be referred to as the “CRSP survey” throughout this paper to clarify the delineation between respondents from this large-scale survey and the smaller set of respondents from the 30 household visits.

of schooling and a household size of 8.1 people. The mean number of children under 18 years old in each household was 3.6 (Table 3).

Using a one sample t-test, there were no significant differences in age or education between all men and women CRSP survey respondents though there were significant differences in household size and number of children (Table 3). There were also significant differences in all demographic categories between CRSP survey respondents in Tuobodom in comparison to all farmers surveyed. On average, respondents in Tuobodom were younger, slightly more educated, and had slightly smaller households with fewer children in them than farmers in the other sites. Additionally, there were significant differences in all demographic categories between male CRSP survey respondents in Tuobodom and all men surveyed. There were significant differences in all categories except for household size between female CRSP survey respondents in Tuobodom and all women surveyed. With the exception of the number of children, there were significant differences between male and female CRSP survey respondents in Tuobodom in each of the demographic categories. Women farmers surveyed in Tuobodom were older than their male counterparts with slightly less education and larger average household sizes.

Table 3: Mean values of demographic characteristics among CRSP survey respondents

	Age	Years of formal schooling	Household size	No. of children (<18 yrs)
All sites				
All farmers	40.9	7.8	8.1	3.6
Males	40.8	7.7	7.9 ^a	3.7 ^a
Females	41.8	7.3	8.7	3.2
Tuobodom				
All farmers	35.2 ^b	9.9 ^b	6.3 ^b	3.2 ^b
Males	34.2 ^{c d}	10.2 ^{c d}	5.7 ^{c d}	3.3 ^c
Females	38.6 ^a	9.0 ^a	8.3	3.1 ^a

^a Different than all females surveyed at the 0.05 level of significance

^b Different than all farmers surveyed at the 0.05 level of significance

^c Different than all males surveyed at the 0.05 level of significance

^d Different than females surveyed in Tuobodom at the 0.05 level of significance

Household visit respondents in Tuobodom were significantly different from CRSP survey respondents in Tuobodom in age and years of education (Table 4). Male household visit respondents were significantly older and from larger households than male CRSP survey respondents in Tuobodom. Among women in Tuobodom, there were only significant differences between household visit and CRSP survey respondents in years of education. Eight farmers from Tuobodom participated in both focus group discussions and household visits. There were significant differences between these farmers and CRSP survey respondents in Tuobodom in the categories of age, education, and household size. Men who participated in both activities were significantly different from male CRSP survey respondents in Tuobodom by age and household size, while women who participated in both activities were significantly different than female CRSP survey respondents in Tuobodom by household size and number of children.

Table 4: Mean values of demographic characteristics among household visit and duplicate respondents

	Age	Years of formal schooling	Household size	No. of children (<18 yrs)
Household visits (Tuobodom)				
All farmers	41.5 ^a	7.6 ^a	6.9	2.6
All males	42.4 ^b	10.3	8.2 ^b	2.7
All females	40.6	5 ^c	5.6	2.6
Farmers participating in both focus groups and household visits				
All	46.3 ^a	7.6 ^a	8.9 ^a	2.8
Males	50.3 ^b	10.8	13.5 ^b	3.5
Females	42.3	4.5	4.3 ^c	2 ^c

^a Different than all farmers surveyed in Tuobodom at the 0.05 level of significance

^b Different than males surveyed in Tuobodom at the 0.05 level of significance

^c Different than females surveyed in Tuobodom at the 0.05 level of significance

These demographic characteristics reveal some differences between household visit respondents and CRSP survey respondents overall and between Tuobodom and other IPM CRSP research sites that could contribute to different experiences, and therefore different responses, between groups of respondents. However, as discussed in the following results section, data from the CRSP survey generally supported the findings from household visits.

3.4.5 Qualitative and quantitative analysis

The qualitative data analysis software NVivo 9 was used to organize and analyze the qualitative data collected during this research. This process involved compiling all research notes and data, reading through this data to develop a set of emergent themes, “coding” the data by these themes, and conducting the analysis of findings within each theme (Berg, 2009; Cope, 2003). Basic descriptive statistics and frequencies were used to analyze quantitative data in SPSS software, specifically in terms of gender differences. The Chi-square test of association was applied to categorical variables and one sample t-tests were used with numerical data to identify significant differences at the 0.05 level of significance.

3.5 Results

The following sections detail the results of this study. Findings are organized according to the Gender Dimensions Framework in the following categories: practices and participation; access to assets; beliefs and perceptions; and laws, policies, legal rights, and institutions. The implications of these findings in terms of gender-based constraints and opportunities to IPM among tomato farmers are explored in the discussion section.

3.5.1 Practices and participation

The process of tomato production in Tuobodom consists of several steps. Farmers plant tomato seeds in nursery beds near the farmers’ fields. The farmers typically distribute the seeds by scattering them haphazardly over the beds, using the “broadcasting” method, though the agricultural extension agent (AEA) working with farmers in Tuobodom recommended that farmers create small, indented rows in the nursery bed (“drills”) to help the seedlings grow stronger and more upright. The farmers cover the seeds with large palm fronds for a few weeks and apply a mixture of water and fertilizer. Then they lift the palm fronds and arrange them in a protective barrier around the beds and the farmers apply the diluted fertilizer. After a few more

weeks the farmers transplant the seedlings in rows in the field. These fields are generally monocropped, containing only tomatoes. Each seedling is transplanted individually into a small mound with a crater to direct water toward the plant and fertilized with the diluted mixture. Observation revealed that the process takes at least full day for a whole plot, even when as small as one-half to one acre. The work of transplanting is also tedious and can be quite fatiguing, requiring the farmers to bend over and stand upright repeatedly for as many hours as the transplanting requires. My own experience transplanting seedlings during a day of participant observation confirmed this. A week after the seedlings have been transplanted, the farmers apply undiluted fertilizer. One week after that, they apply pesticides. They continue a weekly routine of spraying and every two weeks they reinforce the mounds in which the plants are grown (“mounding up”) until the fruits are ready for harvest (Appendix F, Photos 1-2).

During the time of this fieldwork, most farmers in Tuobodom were in the nursery stage of tomato production. Among the farmers whose fields were visited, one woman had not yet finished harvesting and one man had already planted and started spraying pesticides (because he said he wanted to beat the flood into the market during the major growing season) but these cases seemed to be exceptions to the general production trends in the community.

While many farmers in Tuobodom cultivate tomato, the AEA estimated that about 70% of them are men and only around 30% are women. During the focus group discussions one woman said, “Mostly men cultivate tomatoes. Women don’t get anything from it” (Focus Group, July 20, 2011). Another women said,

“I think there are more men in tomato cultivation than women. Making mounds is difficult so men are into it. Women have a hard time getting money. Both men and women have trouble getting loans but men can do the work themselves whereas women have to hire labor to do it” (Tomato farmer, personal communication, August 9, 2011).

This statement suggests that women’s lack of participation in tomato cultivation may be related to the labor required for production, labor that men can provide themselves but that women have to hire or find through some other means. However, one of the women’s focus groups reported that men and women cultivate tomato equally (Focus Group, 20 Jul. 2011).

CRSP survey data shows a significant difference between the sizes of men’s and women’s tomato plots in Tuobodom. On average, men’s plots are 1.9 acres while women’s plots are 1.5 acres. This data also reveals that men and women in Tuobodom are involved in growing different crops. While men grow larger plots of tomato, maize, and cassava, women grow significantly larger plots of pepper and yam (Table 5).

Table 5: Plot size (acres) by crop

Variable/description	All farmers	All males	All females	Tuobodom (All farmers)	Tuobodom Males	Tuobodom Females
Tomato	2.01 [292]*	2.15 [210]	1.59 [74]	1.81 [39]	1.89 [30]	1.48 ^a [8]
Plantain	1.43 [112]	1.45 [68]	1.40 [44]	0.35 [4]	0.20 [2]	0.50 [2]
Cocoyam	0.13 [91]	0.16 [62]	0.08 [29]	0.51 [7]	0.51 [6]	0.50 [1]
Pepper	0.73 [167]	0.69 [117]	0.76 [46]	0.67 [15]	0.56 [12]	1.10 ^a [3]
Okra	0.22 [120]	0.23 [84]	0.13 [34]	0.50 [4]	0.50 [3]	0.50 [1]
Eggplant	0.14 [97]	0.12 [66]	0.18 [31]	0.72 [6]	0.20 [2]	0.98 [4]
Cocoa	0.27 [80]	0.38 [57]	0 [23]	0.40 [1]	0.40 [1]	0 [0]
Oil palm	0.23 [77]	0.29 [53]	0.08 [24]	0 [0]	0 [0]	0 [0]
Maize	2.19 [181]	2.25 [128]	1.87 [48]	1.57 [21]	1.60 [16]	1.48 [5]
Yam	0.33 [101]	0.28 [71]	0.38 [29]	1.11 [18]	0.88 [12]	1.48 ^a [5]
Cowpea	0.42 [111]	0.43 [76]	0.22 [30]	0.80 [3]	0.80 [3]	0 [0]
Cassava	1.08 [119]	1.02 [78]	1.18 [40]	1.08 [14]	1.03 [11]	0.90 [2]

* Numbers in brackets represent N for each category

^a Different than Tuobodom males at the 0.05 level of significance

During the household visits, both men and women reported extensive damage from pests and diseases to their tomato crops (Appendix F, Photos 3-4). Eight men and eight women reported that more than 50% of their tomatoes were affected by or lost to pests and diseases. Six men and five women reported an amount affected or lost between 10% and 50%. Two women said that if they sprayed their tomatoes with pesticides, pests would not destroy any of the crops.

All household visit respondents reported using pesticides on their tomatoes in response to these pests and diseases. Most of these farmers did not report using any other non-pesticide control methods for their tomatoes, though a few did. Additionally, two of the farmers who said they did not use any non-pesticide control methods had heard of alternative pest control methods such as neem (Table 6). CRSP survey data revealed that 90.1% of farmers in all sites and 85% of farmers in Tuobodom use agrochemicals for pest control. Other methods used by some farmers include handpicking insects, removing diseased parts of plants and crop rotation (Appendix E).

Table 6: Use of non-pesticide control methods for pests and diseases on tomatoes

	None	Handpicking insects	Weeding	Ash
Women	14	-	-	1
Men	11	2	1	1

The activity profile exercise during the focus group discussions revealed gender differences in some tomato production activities. Men prepare the land for tomatoes. This includes clearing brush and debris, tilling the soil, and creating the ridges and mounds in which the tomato seedlings will be transplanted. It also includes preparing the nursery bed. Activities in nursery management were not clearly identified as either men's or women's work, which is likely because activities in the nursery are carried out by the plot holder, whether woman or man. However, almost every group listed weeding, in both the nursery and the field, as the responsibility of men. The majority of groups identified watering and carrying the water to be used in mixing herbicides, pesticides, or fertilizer as women's work. Nearly all groups reported mixing and applying herbicides and pesticides as the responsibility of men. The groups identified applying fertilizer, however, as the work of men and women. There were mixed responses regarding who buys agrochemicals. This may be similar to nursery management in the sense that the plot holder is responsible for purchasing the agrochemicals for his or her field. Similarly,

groups identified harvesting as the responsibility of men and women, or mostly women. While the groups reported carrying the produce to the road and selling at the road as work of men and women, selling produce at the market was unanimously identified as women's work. All groups identified a majority of reproductive tasks as women's work. However, men and women originally identified caring for children, elderly, and the sick as the work of men and women. Upon further discussion, we determined that this perception was because men contribute money to pay for the expenses of these tasks. As a result, we created a separate category for providing monetary support for domestic activities. This finding emphasized the need for thorough discussion when identifying men's and women's roles and reiterated the fact that these roles are often more complex than the researcher assumes (Appendix G).

The activity profile during the focus group discussions revealed that men are primarily responsible for mixing and applying pesticides. However, because women who own their tomato plots may have a role in the selection, purchase, or application of pesticides, both men and women were asked questions pertaining to pesticide use. In household visits, all farmers reported purchasing pesticides from agrochemical shops in Tuobodom or the nearby city of Techiman. During the participatory mapping, most men and women said they bring their purchased pesticides straight to the field from the shop, though some farmers reported bringing their pesticides home before taking them to the field. However, when asked directly, several farmers reported storing their pesticides. This discrepancy (between reporting bringing pesticides straight to the field and then reporting storing pesticides) may be because farmers bring new pesticides straight to the fields but store leftovers or because farmers were hesitant to report storing their pesticides at home early in the interview (during the mapping activity, as opposed to later during the interview). Most household visit respondents said they stored their pesticides in the field or

farm; a few reported storing chemicals in or near the home or not storing them at all. A few farmers also said they store unused chemicals in the house (Table 7). CRSP survey data shows that most farmers, in all sites and Tuobodom, store pesticides and that the most common location for storage is in the field. There was no significant difference between men and women in these categories (Appendix E).

Table 7: Storage of pesticides

	Field	In house	Near house	In house if unused	Do not store
Women	11	-	1	1	3
Men	11	3	-	3	1

* Note: multiple responses permitted.

Two-thirds of men in household visits reported disposing of empty pesticide containers by throwing/leaving them on the field. The remaining third said they burned or buried the containers. Equal proportions of women gave these answers. Three women and two men made reference to selecting a particular disposal method (burning, burying, or throwing away in the field) in order to keep the empty containers away from children or people. CRSP survey data also reveals that 39.5% of farmers in all sites dispose of empty pesticide containers by leaving them in the field, while 27.7% of farmers report burning containers and the same number report burying. In Tuobodom, there is a significant difference between men's and women's disposal methods; men are more likely than women to burn empty containers while more women than men are likely to leave containers in the field (Appendix E).

For the most part, household visit respondents said they do not reuse their pesticide containers. Observation confirmed this.¹⁰ However, one man did report reusing pesticide containers to drink water. More farmers, although not a majority, reported reusing the containers

¹⁰ The research assistant said she thought she saw one container in a household visit and suspected it was used to store salt, though this was not confirmed.

used to mix pesticides for other purposes. Two men said they reused the small buckets used to mix pesticides to bathe and one man reported having used the bucket used to mix pesticides to prepare food.¹¹ During household observations, two men pointed to small buckets in their kitchens when talking about the buckets used to mix pesticides.¹² Two women noted that after the tomato season was finished, they would bring the large drums used for mixing pesticides home, wash them, and reuse them to store water. Farmers also pointed out that they stored their backpack sprayers used to apply pesticides in various parts of their homes; one man stored his sprayer in his bedroom, one woman stored her sprayer in her kitchen, and one man and one woman stored their sprayers in their storage rooms (Appendix F, Photos 5-7).

When asked in household visits how they determine whether the pesticide mixture is the correct strength, the most common answers from men were seeking advice from an agrochemical dealer, reading the pesticide container label, and using the scent of the mixture as a gauge. Other methods included feeling the heat of the mixture with their hands, experience, advice from the radio, advice from the agricultural extension agent, and one man reported mixing it “however I feel.” Most women reported getting advice from agrochemical dealers, using past experience, or using scent. Other responses included advice from other farmers, examining the color of the mixture and reading the pesticide container label. Two women said their husbands or hired labor mixed the pesticides and were therefore the ones who determined the correct strength of the pesticide mixture (Table 8).

¹¹ This man reported falling ill immediately and having to be taken to the hospital.

¹² It was unclear whether these were the buckets used to mix pesticides and clearly being reused in the kitchen or if they were just buckets of similar size pointed out to illustrate the type of container used.

Table 8: Methods of determining when pesticide mixture is correct

	Agro-chemical dealer	Pesticide container label	Scent	Other farmers	Experience	Color	Spouse or hired labor	Other
Women	6	1	3	2	3	2	2	-
Men	4	4	3	-	1	1	-	4

* Note: multiple responses permitted.

All respondents in household visits said that they do not taste pesticides to determine the strength of the mixture.¹³ Four men and four women made reference to knowing pesticides are dangerous or poisonous when asked this question. However, two men and seven women reported tasting fertilizer to determine the correct mixture. While fertilizers are not necessarily as toxic as pesticides, they are agrochemicals and tasting them could pose risks to farmers. The original interview question did not address tasting fertilizer. It was added to the question about tasting pesticides after a respondent voluntarily added that while she did not taste pesticides, she did taste fertilizer. The disproportionate number of women who reported tasting fertilizer is likely because most of the men were interviewed before we realized it was important to ask about tasting fertilizer. CRSP survey data revealed that most farmers do not taste pesticides, however 7.5% of farmers in all sites and 10.8% of farmers in Tuobodom did report tasting pesticides. There were no significant differences in tasting between men and women (Appendix E).

A field observation of one male respondent mixing and applying pesticides revealed that he did not wear gloves, boots, long sleeves or long pants, or other protective clothing when mixing the chemicals. He prepared a mixture of powdered fungicide, a small amount of water, and liquid fertilizer in a small bucket. Then he poured two capfuls of insecticide in a large drum of water. He proceeded to pour the fungicide/fertilizer mixture into the drum with insecticide and

¹³ We asked this question because IPM CRSP researchers in Ghana had observed a farmer tasting a pesticide mixture to determine the correct dosage.

mix all three agrochemicals using the bucket and his hands to stir the water around. Throughout this process, his hands were getting wet with the mixture and the liquid was dripping on his legs and feet. Afterwards, he changed into a long-sleeved shirt, long pants, and closed-toe shoes. I could smell the mixture from a few feet away or if the wind picked it up, and when that happened I started sneezing. He and his friend who was helping him that day poured the mixture into their knapsack sprayers using the small bucket. They proceeded to spray the field by walking up and down the rows and spraying the row immediately next to them (Appendix F, Photos 8-11).

In general, children do not accompany their parents to tomato fields. The only exception may be during harvest, which could pose health risks if the farmers have recently sprayed before harvesting. However, since most tomato farmers were not harvesting at the time of this research, I did not observe any children in the fields except for a 13-year-old girl who accompanied a woman harvesting.

3.5.2 Access to assets

The level of access that farmers have to key productive assets such as inputs, financial resources, or information can impact their production methods and pest management decisions. This dimension overlaps with the other dimensions in many ways. For example, while the use of protective clothing is a significant aspect of farmer practices, it is also a matter of whether or not farmers have access to protective clothing or the resources necessary to obtain such gear.

3.5.2.1 Access to inputs

Protective clothing to prevent harm from pesticides is available to some extent in agrochemical shops in Tuobodom, though farmers rarely use it at all or as recommended. Officially recommended protective clothing includes long sleeves and long pants, gloves, boots, and masks or barriers for the face (Appendix F, Photo 12). In household visits, two women and

one man noted the dangers of pesticides and that farmers could be affected if they do not wear protective clothing. During the photo interpretation exercise, six men noted the lack of protective clothing in the picture of the man farmer. However, neither of the two farmers we observed spraying pesticides wore all of the recommended protective clothing. One man said that farmers don't wear protective clothing like gloves because they cannot afford to purchase replacements when the old ones get worn out. However, visits to agrochemical stores revealed that protective clothing and equipment can be inexpensive. Masks, albeit not the kind recommended to protect farmers from pesticides, cost about one Ghana Cedi (approximately U.S. \$0.60). All agrochemical vendors recommended that farmers use protective clothing but none of their stores carried all the recommended items (gloves, boots, and masks). Three of these vendors noted that farmers do not use protective clothing because it is uncomfortable or they have farmed for a very long time and do not think they need things like masks. One of these vendors explained that this is why he does not sell protective clothing. Observation also revealed that men often wear shoes or boots to the field while women and children are more likely to wear flip flops or no shoes at all.¹⁴

All respondents in household visits reported obtaining their tomato seeds by saving seeds from the fruits of previous harvests or getting them from other farmers. Two men noted that they would occasionally purchase seeds from the agrochemical store. CRSP survey data shows that 63.8% of farmers in all sites report getting seeds from private dealers compared to 15% of farmers in Tuobodom. Seventy-five percent of farmers in Tuobodom get seeds by saving them from previous harvests while 31.1% of farmers in all sites report themselves as their source of seeds. Moreover, no women in Tuobodom reported getting seeds from private dealers and 100%

¹⁴ Differences in clothing between men and women may be a factor of culture in addition to access to resources.

of them reported saving their own seeds. Family, neighbors, and other farmers are also a major source of seeds for farmers in Tuobodom, both men and women (Appendix E). The source of seeds is notable since reusing seeds can result in increased risk of inbreeding or disease transmission between crops.

3.5.2.2 Access to information

Research on access to information as an asset revealed household visit respondents primarily obtain information about pest management from other farmers and agrochemical vendors, corroborating previous research on this topic (Danquah et al., 2009). Other sources of information include agricultural extension agents, radio, pesticide container labels, and experience. Notably, radio may overlap with other categories. One woman said an agricultural extension agent came on the radio and provided information about pest management while the man who reported radio as his source of information said an agrochemical vendor spoke about pest management on the air (Table 9).

Table 9: Source of information about pest management

	Other farmers	Agro-chemical vendors	Agricultural extension agents	Radio	Pesticide container label	Experience
Women	8	8	-	1	-	-
Men	7	3	2	1	2	1

* Note: multiple responses permitted.

CRSP survey data reveals that 41.3% of farmers in all sites get information about pesticides from extension agents while 38.6% get information from private dealers and 34.5% get information from neighbors or other farmers. In contrast, 72.5% of survey respondents in Tuobodom reported getting information from private dealers while only 10% get information from extension agents. Sixty-five percent of farmers in Tuobodom also go to neighbors or other farmers for information (Appendix E). The low number of farmers who reported obtaining

information from an agricultural extension agent may be due to the lack of an extension agent who lives year-round in the community. The current extension agent for Tuobodom is pursuing a degree in agriculture from the Kwame Nkrumah University of Science and Technology in Kumasi and is only in Tuobodom during school breaks.

Access to information on alternative methods of pest control, particularly IPM, is also limited among tomato farmers.¹⁵ In household visits, more men than women reported having heard of IPM. Additionally, two men reported having tried IPM practices and one man said he is currently practicing IPM methods. Of the two men who had tried IPM practices, one discontinued because of poor results while the other discontinued his IPM practices because of a perception that non-pesticide methods imply a lack of money to purchase pesticides. Three of the women who said they had never heard of IPM did mention knowledge of non-pesticide control methods, specifically the use of ash (Table 10). CRSP survey data corroborate these findings. Overall, only 17.1% of farmers in all sites had heard of IPM and 17.5% of farmers in Tuobodom had heard of it. In Tuobodom, there are significant gender differences in knowledge of IPM; men are more likely than women to have heard of IPM (Appendix E).

Table 10: Familiarity with IPM and non-pesticide control methods

	Heard of IPM	Know of other non-pesticide control methods	Never heard of IPM
Women	3	3	9
Men	9	-	6

¹⁵ The exact wording for this interview question was “Have you ever heard of Integrated Pest Management? (ex. staking, mulching, different non-chemical methods of pest control) If yes, what do you know about it?” Because of this wording it is unclear whether farmers who said yes were indicating their familiarity with the term “Integrated Pest Management” or the methods of IPM provided as examples.

An additional potential constraint to accessing information may be access to trainings. The local agricultural extension agent said that even if women are invited to trainings they do not attend. This was confirmed by the lower ratio of women to men farmers who attended the focus group discussions. Additionally, one of the women's focus groups reported that women farmers need training in tomato production, specifically in chemical application and disease control.

3.5.2.3 Access to financial resources

More than half of the farmers in household visits reported making decisions regarding the money earned from the sale of tomatoes jointly with their spouses or another family member. One woman noted that she makes decisions on her own when she “fully owns the farm” (Tomato farmer, personal communication, July 20, 2011). Most of the remaining household visit respondents said they make decisions on their own, though one woman said her husband advises her on how to spend the money earned from her tomatoes. One of the men who reported making decisions on his own said he did so because “I’m the man so I have to make decisions on my own” (Tomato farmer, personal communication, August 2, 2011). Another man and two women said they made decisions on their own because they owned the farm, and one woman said she made decisions on her own and her father owned the farm (Table 11). CRSP survey data shows that most farmers report having decision-making power over the income from their farm products. Overall, 92.9% of farmers in all sites say they have decision-making power, while 84.6% of farmers in Tuobodom report making such decisions (Appendix E). According to the CRSP survey, there is no significant gender difference in decision-making power among men and women in Tuobodom.

Table 11: Decision making over money earned from sale of tomatoes

	Joint decision with spouse	Joint decision with other family member	Spouse advises	Makes decision on own
Women	7	1	1	6
Men	9	1	-	5

Tomato farmers also face challenges in terms of limited access to financial resources, such as credit and loans, and labor. As discussed earlier, women reported particular challenges in tomato production because they have to hire male labor to do work that men farmers can do themselves. Some women reported that men and women face equal challenges obtaining loans. The local agricultural extension agent also reported that men and women both have problems paying off loans, which they usually get through local savings and loans schemes or rural banks in Tuobodom, but noted that women do not have financial support from their husbands and often have difficulty paying off loans they have taken out on their own. One women's focus group reported that the high incidence of pests and diseases has increased the cost of tomato production, causing most women to withdraw from tomato cultivation and weakening some men financially. During the activity profile exercise, no group listed women as the primary providers of money for domestic activities, illustrating that women have limited access to financial resources and control over household finances despite being responsible for the majority of domestic work.

The manager of a local rural bank in Tuobodom said that the bank helps both men and women farmers. The bank requires applicants for loans to have collateral (like a house), an account with the bank, or someone to sign for them in order to be approved. The bank manager also noted that the bank is trying to encourage farmers to increase the level of mechanization of their farming enterprises, specifically with regards to irrigation so that farmers are less dependent

on environmental fluctuations like rainfall. Given women's limited access to financial resources, these bank policies may affect men and women differently.

3.5.2.4 Access to transportation and issues of distance

Gender differences also appeared in terms of access to transportation. During the participatory mapping exercise of the focus groups, one women's group illustrated a woman carrying pesticides from the store to her field on her head. A men's group map showed a man transporting pesticides by truck from the store to the house to the farm. Observation revealed that men have access to bicycles and motorcycles, which they often use to get to their fields, while women primarily walk. When asked about this difference, women said they do not know how to ride bicycles and do not have money to purchase them. Men and women seemed to have equal access to the large trucks, or "kias," that take farmers to their fields, though this is only an option for farmers whose fields are accessible by vehicle, which is not the case for all farmers, particularly women. Observation revealed that many women's fields were farther from vehicle-accessible roads than men's fields. Both men and women take taxis for longer trips, such as to go to the market in Techiman.

3.5.2.5 Market access

Most tomato farmers in Tuobodom produce primarily for sale rather than consumption. Therefore access to markets is an important issue for these farmers. During the major tomato-growing season, the market becomes flooded with tomatoes and farmers may experience difficulty finding buyers or a price they perceive to be reasonable. A large part of market access is dependent upon farmer relationships with the market women who control the tomato markets. As previous studies have found (Robinson & Kolavalli, 2010b), many farmers, politicians, and agricultural officers and researchers perceive the market women to offer unfairly low prices to

farmers during the major tomato-growing season. The agricultural extension agent for

Tuobodom echoed this sentiment when he said:

“During the major tomato-growing season market women cheat the farmers because the farmers have no way of storing their tomatoes. They need to sell them so they take whatever price they can get. There are a lot of tomatoes in the market and the buyers know the farmers are desperate to sell so they can offer very low prices” (Agricultural Extension Agent of Tuobodom, personal communication, August 9, 2011).

Farmers also commented on the power market women have in relation to tomato growers. One farmer described his strategy for accessing better prices for his tomatoes:

“You need to be smart about when you plant because if you wait until everyone plants, there will be too many tomatoes in the system and you will not get a good price. This is why I planted early” (Tomato farmer, personal communication, August 2, 2011).

Another farmer explained that if farmers do not have a buyer they will let the tomato plants rot on the field because it is not worth the risk of getting injured or losing resources when tending plants that will not be sold. He said that most farmers have a buyer lined up before they start cultivating, but when farmers are unable to produce the amount they planned, buyers will reach out to other farmers who did not have an arrangement with a buyer from the start (Secretary of Tuobodom tomato growers’ association, personal communication, August 6, 2011). Four farmers mentioned that in an effort to appeal to market women and consumers, some farmers spray their tomatoes with pesticides right before or after harvesting to make them look “fresh.”

A processing plant for tomatoes is due to be constructed in Techiman to provide an additional market for tomatoes. However, the secretary of the local tomato growers’ association explained that processing plants do not accept the variety of tomato grown in Tuobodom because it has too much water in the fruit and is not good for processing. He also said that the varieties desired by the processing plant do not grow well in the environment of Tuobodom.

3.5.3 Beliefs and perceptions

Farmers beliefs and perceptions influence, and are influenced by, their practices as well as their access to resources. It is important for an IPM program to understand and account for farmers perceptions so that the project is appropriate to the farmers' particular context.

During the "path of the pesticide" participatory mapping activity, all focus group and household visit respondents reported that the path of the pesticide ends in the field. However, when asked if they believe pesticide residues exist on their tomatoes, most farmers responded in the affirmative. Thirteen men and twelve women in household visits reported that pesticide residues exist on their tomatoes or have the potential to exist if a farmer harvests too soon after spraying or there is no rain. Eight of these men and eight of these women added that they know residues exist because they can see the color of the pesticide on the tomatoes or they can feel the residues with their hands when they touch the fruits. CRSP survey data shows that farmers are more evenly divided over whether or not there are pesticide residues on their tomatoes. Fifty-two percent of farmers in all sites said they thought residues exist while 41.8% thought there were no residues. In Tuobodom, 65.8% of farmers believed there are pesticide residues on their tomatoes while 28.9% believed there are none (Appendix E). There were no significant gender differences among farmers in Tuobodom in terms of perceptions of pesticide residues.

Farmers in Tuobodom distinguish between pesticides, revealing their perceptions of the hazards of insecticides. While fungicides and herbicides are referred to by their brand name or as "agrochemicals," insecticides are called "poison." This perceived distinction became clear when all farmers in the household visits reported that they do not taste pesticide mixtures, eight of whom noting this is because pesticides are poisonous. Farmers' perceptions of the danger of pesticides were further revealed during the photo interpretation activity when five men and one

woman pointed out the potential danger of a pesticide container hanging on a farmer’s bicycle in one picture.

There also seems to be awareness among farmers of the dangers to children present in tomato fields, though this is not necessarily always in relation to the presence of agrochemicals. During the photo interpretation activity of the household visits, the third picture of children in a field elicited several comments about dangers to or of children in the field. Half of the respondents said that children could become sick or be in danger because of the presence of chemicals in the fields. Thirteen respondents made note of the dangers of insects or animals in the fields to the children. Additionally, twelve respondents commented on the potential for children to damage the crops if the field was a tomato field. In each of these cases, more men than women made these observations (Table 12). CRSP survey data revealed that only 21.9% of farmers in all sites and 25.6% of farmers in Tuobodom believe that the application of pesticides affects the health of children in the household. While 72.4% of farmers in all sites do not think pesticides affect their children, 59% of farmers in Tuobodom hold this belief and 15.4% have no opinion (Appendix E). There was not a significant gender difference in the perception of pesticide risks to children among farmers in Tuobodom.

Table 12: Farmers' perception of dangers to or of children in the field

	Chemicals harming children	Insects or animals harming children	Children damaging crop
Women	6	5	5
Men	10	8	7

* Note: multiple responses permitted.

Many farmers are aware of the negative health effects of pesticides. In household visits, 14 men and 12 women thought there are possible dangers of pesticides. They reported dangers including: collapsing, skin irritation (itching, burning, or rashes), general weakness, body pains,

congestion, upset stomach, eye irritation, negative effects for the consumer, and death if tasted. Among CRSP survey respondents, 88% of farmers in all sites said they believed there are dangers associated with pesticides. In Tuobodom, 100% of men and women farmers reported believing pesticides can be dangerous (Appendix E). However, in household visits, eight men reported experiencing or knowing other people who have experienced health problems due to pesticides, while only one woman reported experiencing negative health effects and two women reported knowing someone who had experienced health problems due to pesticides (Table 13). CRSP survey data also shows a significant gender difference in experiencing health problems from pesticides; 80% of men in Tuobodom have experienced health problems compared to 66.7% of women (Appendix E).

Table 13: Perceptions of health problems due to pesticides

	Experienced health problems	Know someone who has experienced health problems	Unsure	Have not experienced or know anyone with health problems
Women	1	2	1	11
Men	3	8	2	5

The lower number of women reporting health effects from pesticides may be due to the fact that women do not generally spray pesticides. Workers at the local health clinic in Tuobodom said that they had never received any patients reporting or exhibiting health problems due to pesticides. The doctor at the hospital in nearby Techiman said they do see patients with pesticide poisoning, but there are usually only one or two of these cases per month.

One woman reported smelling chemicals when she washes her husband's clothes after he returns from spraying pesticides. She said the smell gave her headaches. Another woman also reported smelling chemicals on the clothes she washed, and said that she uses the scent as a

gauge for how clean the clothes are (i.e., if she cannot smell chemicals, the clothes are clean but if she can still smell chemicals the clothes are not clean) (Tomato farmer, personal communication, August 9, 2011).¹⁶

Farmers' perceptions of the dangers of pesticides extended to the concept of consumption. In the photo interpretation exercise of household visits, one farmer noted that the children (in the picture of children in a field) could consume peanuts if they were hungry but if it were a tomato field, pesticides would have been sprayed and the children could not consume the tomatoes. Another man noted that he and his brothers do not eat the tomatoes they spray with pesticides. Instead, they leave the tomatoes they plan to eat unsprayed. Additionally, as discussed earlier, one man said he re-used the bucket used to mix pesticides to make his lunch and immediately collapsed and had to be taken to the hospital. However, four men and one woman noted that they eat in or near their farms but did not mention any perception of danger associated with this. Also as noted earlier, some farmers talked about spraying tomatoes with pesticides right before or after harvest to appeal to market women and customers; this has obvious health implications for anyone harvesting, transporting, or consuming those tomatoes.

Some household visit respondents also perceived pesticides to cause problems for tomatoes. Seven men and two women made reference to application of incorrect pesticides or excessive application of pesticides killing or damaging plants or being ineffective and allowing pests and diseases to continue affecting the plants. Two men's focus groups noted that pests have become resistant to chemicals over time.

¹⁶ The topic of washing clothes came up later in the research process, so most farmers were not asked whether they can smell chemicals when washing their farm clothes. It is likely that this is a common experience and inadequately reflected in this research where only two women reported smelling chemicals on their husbands' farm clothes. Other studies (Garcia, 2003) have found health problems associated with pesticide residues on clothing.

While many farmers are not familiar with IPM practices, one man reported that he had practiced the technique of applying neem to plants but had now stopped. When asked why, he explained that alternative methods of pest control are associated with lower status because they imply that the farmer does not have enough money to purchase pesticides. A second man confirmed this perception. However, two women farmers disagreed and did not think alternative pest control techniques are associated with low status.¹⁷

Conversations with respondents revealed a perception that insecticides are sometimes used by farmers to commit suicide. Five farmers and one agrochemical vendor made comments about drinking “poison” to commit suicide, in some cases for specific reasons (e.g., if the farmers are depressed, do not have a good crop, or cannot find a buyer for their crop). Three of these comments were specifically about women. Two of these referred to agrochemical vendors not selling pesticides to women because of the perception that women will drink the chemicals to kill themselves. Respondents did not clearly state why women would be more likely than men to use pesticides to commit suicide.

3.5.4 Laws, policies, legal rights, and institutions

The legal and institutional dimension of the Gender Dimensions Framework provides an opportunity to examine the structural and policy issues that may affect gender relations or agricultural practices and resources. In this study, the main legal and institutional issues that impact gender, tomato production, and pest management are the laws surrounding pesticide use and distribution and the status of farmer organizations in Tuobodom.

The Pesticides Control and Management Act of 1996 details the registration requirements for pesticides and pesticide distributors as well as classifications and restrictions of pesticides.

¹⁷ This perception was not expressed until late in the research process so we were unable to ask all farmers what they thought about it. As a result, there are few responses here on this topic.

Agrochemical vendors must be certified to distribute pesticides by the Environmental Protection Agency of Ghana (EPA). The EPA has the authority to check stores after certification to ensure they are not selling any banned or expired chemicals. At least four of the nine agrochemical stores visited reported being certified to sell chemicals, though not all vendors attend trainings. While the owner of the store may attend trainings, the owners' siblings, children, or spouses may work in the store and sell chemicals to farmers but not attend trainings. In five out of the nine agrochemical stores visited in Tuobodom, women relatives were overseeing the store at the time of the interview, though all nine stores were owned by men.

While there is a farmers' association for tomato growers in Tuobodom (the "Tuobodom 'Unity' Co-Operative Tomato Growers & Marketing Society Ltd."), few tomato farmers are members. During household visits, five men and one woman reported being members of the tomato growers' association. Two men and two women reported that there was no tomato farmers' association in Tuobodom or were unsure if one existed. The secretary of the tomato growers' association explained that in 2008, membership in the association was around 2,000 farmers. However, after a new variety of tomato was introduced through the association and farmers did not get good results, most members dropped out. This deterioration of trust in the tomato growers' association has resulted in little organization among tomato farmers in Tuobodom. The secretary said the last meeting was held in April or May of 2011 and at the time there were 42 members, 11 women and 31 men. Another farmer estimated membership to be 45 tomato farmers, 40 men and 5 women (Tomato farmer, personal communication, August 3, 2011). Topics of discussion at the last meeting included production methods and issues of pests, diseases, and inputs. Additionally, representatives from major agrochemical distributors in

Techiman were invited to come speak. Women said there are no women's organizations in Tuobodom but that there are women's groups in churches.

3.6 Discussion

Three issues emerged throughout this research as key areas of importance to examine in terms of gender relations and pest management: health and safety; markets and the value chain; and information and training. These issues are important to gain a better understanding of the current context of tomato farmers and also present opportunities and constraints to the introduction of an IPM program.

3.6.1 Current context of tomato farmers

One of the objectives of this research was to explore the existing context of tomato production and pest management in Tuobodom to serve as baseline information for the IPM CRSP as scientists work with farmers to develop a package of IPM technologies for tomato that is appropriate to the context in Ghana. In doing so, the IPM CRSP should consider the following health, market, and information issues that tomato farmers in Tuobodom experience.

3.6.1.2 Health and safety

Tomato farmers are exposed to pesticides in a variety of ways, some of which are related to their gendered activities in tomato production. The hypothesis of this research was that gendered activities in productive and reproductive spheres are linked to farmers' knowledge, access to, and perceptions of pesticides and pest management. This research revealed that men's and women's roles in tomato production and household maintenance are related to their knowledge, experiences with, and perceptions of pesticides. Women carry water and pesticides to the fields on their heads, increasing their risk of exposure should the chemicals spill. Men are more likely to mix and apply pesticides and, since most farmers lack adequate protective clothing, are at increased risk of exposure to pesticides through those activities. While women

described smelling pesticides when washing clothes, their roles in food preparation and caring for the sick did not seem to influence their perceptions of the risks of pesticides.

Men may be more aware than women of the risks of pesticides because the mixing and application of these chemicals are primarily men's activities. Men also have higher education levels than women and may have more access to information from agrochemical sellers or extension agents, as observation revealed that primarily men purchased agrochemicals and disproportionate numbers of men attend trainings. Women's involvement in reproductive activities may be linked to a lower awareness of pesticide risks in the sense that women are often busy with, or expected to manage, domestic and household activities and therefore do not have time for or access to education or trainings. Additionally, because women are generally not responsible for the mixing and application of pesticides, their experience with pesticides may be limited in comparison to men.

Men and women reported physical effects from pesticides, though more men than women said they had experienced these negative health effects. The number of men reporting health problems from pesticides was similar to a previous study (Ntow et al., 2006). The local hospital's report of only a few cases of pesticide poisoning per month indicates that farmers do not seek medical attention when experiencing related health problems. It also suggests that doctors may not recognize non-acute symptoms of pesticide exposure, such as persistent headaches, and therefore do not have adequate records of a higher number of pesticide-related issues among patients. Lack of availability and use of protective clothing also increases farmers' risks of pesticide exposure. Narratives of drinking insecticides, or "poison," to commit suicide reveal important perceptions of pesticides within the community. Intentional pesticide poisoning is a problem in many countries and, in some areas, the most common method of suicide (Garcia,

2003). These narratives demonstrate that farmers generally recognize the poisonous nature of insecticides, though their continued use of pesticides on their tomatoes contradicts this perception and/or reveals the lack of alternative options for pest management. That many of these narratives in Tuobodom were specifically about women also reveals deeper cultural perceptions of women as more emotionally unstable than men or facing difficult conditions in their agricultural production.

Additionally, men and women reported using the scent of the pesticide mixture to determine when it was the correct strength. One man said he used his hands to feel the warmth coming from the pesticide mixture to know the dosage was right. While none of the household visit respondents reported tasting the pesticide mixture, they did report tasting fertilizer mixtures. Survey data revealed that a small number of farmers in Tuobodom do taste pesticides. In household interviews, more than half of the respondents reported feeling or seeing pesticide residues on their tomatoes. Four farmers raised the issue of spraying tomatoes right before or after harvest to make them look fresh, though few farmers said anything about dangers of pesticides to consumers. Moreover, all household members, including children, are exposed to pesticides when the buckets and drums used to mix the chemicals are reused for water storage, food preparation, or bathing. These experiences of pesticide usage reveal the risks tomato farmers, their families, and consumers face using their current methods of pest management.

Farmers are also aware of the dangers of pesticides to children. Keeping pesticides away from children was a recurring theme in the photo interpretation activity, participatory mapping exercise, focus groups, and key informant interviews. Some farmers also raised the issue of the dangers to children of insects and animals in tomato fields. More than half of the household visit respondents noted the dangers of pesticides to children. Greater numbers of men than women

raised this issue, which could be associated with men's familiarity with pesticides because of the gendered nature of activities like mixing and applying pesticides. This would contradict one of this study's original assumptions that women's reproductive roles increase their awareness of the risks of pesticides. However, survey data did not reveal a significant difference between men and women in terms of perceptions of pesticide risks to children.

Studies have demonstrated the health risks of indirect exposure to pesticide residues such as when pesticide application equipment, contaminated clothing, or containers are brought home or family members apply pesticides (Loewenherz, Fenske, Simcox, Bellamy, & Kalman, 1997; London et al., 2002; Garcia, 2003). This research revealed that while reuse of pesticide containers is reportedly rare in Tuobodom, reuse of containers for mixing pesticides is more common, and equipment and clothing used in pesticide application are often brought home. Observations of backpack sprayers stored in a kitchen, bedroom, and storerooms with food and animals suggest that tomato farmers are at high risk of exposure to pesticide residues beyond the field.

3.6.1.3 Markets and the value chain

In Tuobodom, farmers produce tomatoes primarily for sale. Not surprisingly then, their perceptions of and concerns with tomatoes are largely market oriented. Comments during the photo interpretation activity revealed this when farmers noted that rotten tomatoes or fruits without "heads" (the tips of stems still attached) are not marketable, as did reports of spraying tomatoes with pesticides to appeal to customers or market women.

Farmers in Tuobodom reported clear changes in tomato production over the past 50 years. Both men and women said more pests and diseases affect their tomatoes now than in the past, and tomato production requires more inputs, such as fertilizer and pesticides, than it did in the past. More than half of the respondents reported that over 50% of their tomatoes were

affected by or lost to pests and diseases. Farmers seem to perceive tomatoes as vulnerable and valuable, as reflected in comments about children potentially harming the plants if brought to the field. These findings illustrate the challenges tomato farmers face, yet they continue to produce tomatoes. One woman said “I continue to cultivate tomato in the next season because that is the only job I do and also with the hope that there will be a good harvest in the next season and less disease” (Tomato farmer, personal communication, July 20, 2011). The costs and problems associated with tomato production must be perceived as worth the risk because of the high market value of tomatoes.

In Tuobodom, men’s greater participation in tomato production may be linked to gender differences in access to resources, though women do produce tomatoes. Women have less access to assets and resources including land, money, and transportation. Moreover, women have to hire male labor or utilize kinship networks to find labor for many of the tasks involved in tomato production. Previous research has determined that hired labor comprises a particularly large proportion of costs for tomato farmers in the Brong Ahafo Region relative to other tomato growing areas in Ghana (Robinson & Kolavalli, 2010a). While this study found that there is no significant gender difference in decision-making power over the revenue from tomatoes, this is likely because the women that have access to the resources necessary to produce tomatoes (a small proportion of all women) also have the power to make decisions over the use of the money they earn from that production.

Requirements for loan applicants at the local rural bank seem likely to exclude women or disproportionately favor men since women are less likely to own land, a house, or have bank accounts (which are required for collateral). While having someone co-sign on a loan may be an option for women, it could potentially limit their independence by creating unequal power

relations (e.g., if the co-signer requested information about, or exerted control over, the use of the loan because s/he provided the collateral for the loan). Additionally, the rural bank's explicit support of farmers working in mechanized, large-scale production could exclude many smallholder farmers, of whom a disproportionate amount is women. Moreover, the manager of the rural bank noted irrigation systems as a particular area of emphasis, though a recent study of tomato production in Ghana found that "average yields under irrigation are not significantly greater than those under rainfed conditions" (Robinson & Kolavalli, 2010a). While men and women may both face challenges obtaining and repaying loans, if women have to take out more loans to pay for hired labor, they could be at a distinct disadvantage in producing tomatoes. The extent to which men also hire labor, and differences in costs to men and women of hiring labor, requires further exploration.

This research revealed the importance of examining the entire tomato value chain in Ghana in order to gain a better understanding of gender-based constraints and opportunities with regards to IPM adoption. Starting at the beginning of the value chain with inputs, this study found that men and women in Tuobodom generally get tomato seeds from their own harvests or other farmers but that they go to agrochemical vendors for pesticides. While men go to agrochemical vendors for information on pesticides, women are more likely to get this kind of information from other farmers or family. Farmers also report a lack of availability of protective clothing in agrochemical stores and observations confirmed this, but vendors say they do not stock protective clothing because of a lack of consumer demand. This kind of information will help an IPM program understand the context of tomato production and areas where an IPM intervention could improve access to or the quality of inputs. Additionally, the power of market women to set prices and control the flow of tomatoes into markets makes them key players in the

value chain. Relationships and trust networks between market women and tomato producers, and whether these differ between men and women, are also an important aspect of the value chain for an IPM program to consider. If market women do influence farmers' pesticide use as respondents reported, they could be critical actors in promoting the use of IPM. Consumers also need information on the benefits of IPM practices, and efforts to increase the transmission of consumer demands back to farmers could provide further incentive for farmers to reduce pesticide use.

While dominant narratives throughout Ghana suggest that tomato processing plants are an ideal way to increase farmers' market access, particularly during periods when the market is flooded with tomatoes, and because market women are perceived to cheat farmers, research through the Ghana Strategy Support Program (GSSP) found that this is not necessarily the case (Robinson & Kolavalli, 2010c). Increased tomato processing would increase demand for tomatoes and raise prices, which would benefit farmers, but the cost of fresh tomatoes would be too high for domestic tomato processors to compete with inexpensive imported tomato paste (Robinson & Kolavalli, 2010c). Additionally, most tomato processors do not accept the local varieties of tomatoes, which are typically the varieties that flood the market during the major season (Robinson & Kolavalli, 2010c; Secretary of the Tuobodom tomato growers' association, personal communication, August 6, 2011). Farmers have greater bargaining power with traders when they are organized, which is not the case in Tuobodom or in general (Robinson & Kolavalli, 2010c). This highlights the need to revitalize the existing tomato growers' association in Tuobodom.

3.6.1.4 Information and training

Many of the market issues and health and safety problems tomato farmers in Tuobodom face are linked to lack of access to education, information, and training. Farmers who cannot

read are unable to understand the labels on pesticide containers and rely primarily on advice from other farmers or agrochemical vendors on correct usage. Even farmers who can read may have limited understanding of the directions on a label, particularly if they are written in a language other than the native tongue. In this case, most agrochemical labels are in English, but farmers primarily speak the local language Twi. While most agrochemical vendors in Tuobodom are certified to sell pesticides, the individuals who conduct transactions with farmers are not always trained and could provide incorrect information. Furthermore, agrochemical vendors providing information to farmers can be problematic as the vendors may have a greater interest in making a sale rather than providing accurate information to the farmer.

The lack of widespread participation of tomato farmers in the local tomato growers' association also contributes to a lack of information about tomato production, safe pesticide use, and alternatives to pesticides among farmers. The association provides an opportunity for farmers to share information and learn new information from agrochemical representatives and agricultural extension agents invited to attend meetings. However, the low membership of the organization relative to the number of tomato farmers in the community and the distrust of the association reported by some farmers represent challenges that need to be addressed in order to increase tomato farmers' access to information. Many farmers reported that they currently get information about tomato production and pest management from other farmers who are not members of the tomato farmers' association. A better functioning organization would provide opportunities to access information from outside the community and increase farmers' bargaining power with traders.

Farmers in Tuobodom are generally unaware of IPM and have limited knowledge of non-pesticide methods of pest management. This may be linked to the fact that agrochemical vendors

are a primary source of information for tomato farmers, yet have little interest in promoting methods of pest management that would decrease business at their stores. Additionally, the inconsistency of the local agricultural extension agent's presence in the community may limit the extent to which tomato farmers are exposed to new ideas and information. Furthermore, the association of IPM practices, such as the use of neem, with low status requires further research. While it is unclear how commonly this perception is held, it could have important implications for how IPM should be introduced in the community. IPM trainings that represent IPM practices as part of "modern," scientific agriculture may be more appealing to the community, or particular community members, than an approach that emphasizes other aspects of IPM. However, an IPM program would need to ensure that any proposed techniques or inputs are thoroughly tested and will be successful in the Tuobodom context, given the lack of trust in the existing farmer association and the potential for an unsuccessful IPM program to further erode that trust.

3.6.2 Opportunities and constraints for an IPM project

The findings of this study reveal several opportunities and some constraints to the introduction of an IPM program for tomato in Ghana. Based on the issues that tomato farmers in Tuobodom face in terms of health, markets, and access to information, this section explores key areas that the IPM CRSP should address in developing an effective and sustainable IPM program in Ghana.

3.6.2.1 Health and safety

Despite general awareness that pesticides can be dangerous, tomato farmers continue to use these chemicals and engage in unsafe practices. Whether this can be attributed to lack of information or lack of alternatives, these health and safety issues highlight the need for training farmers on safe pesticide use and alternative methods of pest management such as IPM.

Trainings could be tailored to the particular roles men and women play in tomato production,

such as land preparation or the application of agrochemicals, as well as domestic and community work. Care must be taken not to generalize these roles or assume that the categories of men and women are static, homogenous, or even the most important aspect of identity in determining practices, knowledge, access, or perceptions of tomato production and pest management. Other key factors to take into account include class, age, education, etc.

3.6.2.2 Markets and the value chain

The need or expectation for women to hire men for labor-intensive tasks in tomato production represents a major constraint to women's participation in tomato cultivation. Consequently, women may be less likely than men to adopt IPM technologies that require more labor, particularly for tasks considered appropriate for men. However, women's lack of access to financial resources may mean they would be particularly interested in IPM technologies that are labor-saving or that reduce the amount of money spent on expensive agrochemicals.

Beyond these possible gender-based constraints and opportunities, IPM projects should consider the whole tomato value chain when building an IPM approach in Tuobodom and Ghana more broadly. Many points in the value chain before and after production could influence the suitability of an IPM program. For example, the source of tomato seeds and information about the varieties of tomato that work well in the environment or are desired by processing plants could help scientists determine if a certain resistant variety should be incorporated in an IPM package. The influences of market women and consumer demands on farmers' use of pesticides are also important considerations for an IPM program.

3.6.2.3 Information and training

Many men and women are aware of the negative effects of pesticides and expressed an interest in improving their tomato production. This represents a key opportunity for IPM programs because tomato farmers are interested in and willing to try new approaches to tomato

production and pest management. This study revealed a need for training and information on IPM as well as safety and application information for agrochemicals. Several previous studies have made similar recommendations (Danquah et al., 2009; Eshun et al., 2011; Essumang et al., 2008; Marfo, 2006; Ntow et al., 2006; Obiri-Danso et al., 2011). While the IPM CRSP is focused on research for development of IPM packages and not pesticide safety training, any IPM program working in Ghana must recognize the current state of widespread and unsafe use of pesticides on tomatoes. Full adoption of IPM practices is unlikely to happen immediately or by all farmers, and IPM programs can help farmers protect themselves and their tomato plants by integrating trainings on safe pesticide use as part of the transition to farmers' adoption of IPM methods. IPM programs should also consider presenting the scientific value of IPM to prevent or challenge perceptions that non-pesticide methods of pest management are low status. Additionally, there is a need for more comprehensive trainings for agrochemical vendors, particularly for employees or relatives of storeowners who participate in transactions with farmers.

As previous research suggests, an IPM program should consider different strategies of information and technology dissemination depending on the complexity of the proposed IPM technologies (Harris, 2011). The existing tomato growers' association could be an entry point for an IPM program to introduce trainings and technologies, though the lack of community membership, and the history of this situation, should be noted. Alternative methods that provide opportunities for information dissemination include radio and women's church organizations. The reported lack of women's participation in trainings suggests that women may need to be specifically targeted, though further study is required to determine the underlying causes of women's underrepresentation. For example, how are women invited to these kinds of events?

Who invites women to trainings? Is their lack of attendance due to lack of time or lack of topics relevant to women's interests?

3.6.3 Reflections, Recommendations, and Further Research

This research revealed key opportunities for the IPM CRSP to develop and introduce an effective IPM program for tomatoes in Tuobodom. Farmers reported major pest and disease problems with their tomatoes, yet continue to produce this crop because of its high value. While most farmers do not currently use IPM practices, they are interested in new solutions to their pest management problems. The IPM CRSP should recognize this opportunity to involve farmers in the development and trials of IPM technologies and dissemination of information about IPM. Furthermore, the IPM CRSP could play a key role in building institutions which will support the adoption of IPM practices among tomato farmers. For example, provision of IPM training or dissemination of resistant varieties of seeds through the local tomato growers' association could strengthen the organization and make it a more viable institution in the community. It would also help to build social capital among tomato farmers to increase knowledge exchange and bargaining power with traders. However, because the association has a history of failed projects and loss of trust within the community, interventions by the IPM CRSP to help rebuild the organization must be well planned and tested or they could result in further erosion of trust of this potentially vital community institution. Provision of training on IPM and safe pest management practices could also be valuable for—and build a stronger network for IPM through—agrochemical vendors, tomato traders, and consumers.

The findings of this study also demonstrate that gender and gender relations are site-specific and may be contradictory to, or more complex than, the assumptions of a researcher or the assumptions on which research is based. For example, there are many different women involved in the tomato sector including farmers, agrochemical vendors, and tomato traders.

These women have different access to, practices, knowledge, and perceptions of pesticides and pest management because of their different situations and roles within the tomato value chain among other factors. This illustrates the need to recognize the heterogeneity of women and to be sure not to assume all men and all women are similar or representative of other men or women simply because of their gender.

Moreover, these findings challenged the assumptions on which this study was based about the role gender plays in men's and women's use and knowledge of pesticides. As this research revealed, women are not necessarily more likely to perceive the dangers or negative health effects of pesticides despite their responsibilities for preparing food, washing clothes, and caring for children and the sick. Additionally, men consider themselves responsible for reproductive activities because of their provision of financial support for domestic expenses. This research was based on the hypothesis that gendered activities are linked to men's and women's practices and perceptions of pesticides and pest management. Findings revealed that access to information and education, which is also gendered, might actually be more important to the safe use and perceptions of risks of pesticides than gender roles and practices. This has implications for the factors that the IPM CRSP should take into account when developing a gender-sensitive IPM package for tomato in Ghana. It also illustrates the shortcomings of the categories of "productive" and "reproductive" work as a frame through which to examine gender roles. A more comprehensive framework including men's and women's access to, practices, knowledge, and perceptions of pesticides and pest management permits a better understanding of the complexities inherent in a given context.

Gender analysis illuminates gender relations and differences in practices, access to resources, and perceptions. It does not necessarily confirm assumed stereotypes or dichotomies

about men and women in agriculture such as men producing cash crops and women producing subsistence crops (Boserup, 1970); women having a “natural” connection to the environment or extensive agroecological knowledges because of their responsibilities (Padmanabhan, 2007); or clear lines between productive and reproductive work (Moser, 1993). However, some of these assumptions may be true in certain situations. Rather, gender analysis helps development projects gain a better understanding of the specificities of a particular context and the gender relations in that context. These findings may challenge assumptions (i.e., this study revealed that women do not have more perceptions of health risks of pesticides due to their reproductive roles) and ultimately serve to help a development project more sensitively account for context-based factors that could affect the success and sustainability of the project.

This research also revealed the strengths and weaknesses of many of the methodologies. For example, the initial concept for the participatory mapping exercise was to give as little direction as possible to respondents so that their maps could be a true reflection of their perception of the “path of the pesticide.” However, most respondents were initially quite uncomfortable with the exercise because it was unfamiliar, so we made the decision to provide examples of the types of things they may want to draw on their map (e.g., Where do you buy it? Where do you store it? Where do you use it? Where does it end up?). This resulted in many of them maps looking similar. As opposed to providing unique insights into how farmers perceived the path of the pesticide by what they drew, the mapping activity served more effectively as a prompt for unstructured conversation about tomato production, pest management, and farmers perceptions surrounding these activities. Additionally, the use of participatory methods such as mapping and photo interpretation were engaging and interesting for farmers, as opposed to the questionnaires and surveys they have been exposed to through the Ministry of Agriculture

(which the agricultural extension agent reported were unsuccessful and which farmers avoid).

The agricultural extension agent noted that this may have increased farmers' willingness to talk to us and answer our questions.

We also learned that pretesting was a critical step in determining parts of or questions in the methodologies that were not culturally appropriate or relevant to the context. For example, we determined that the inclusion of the activity profile in the survey was too complicated and time-intensive so it was eliminated but addressed in the focus groups discussions. In the photo interpretation exercise, we learned that people in the Brong Ahafo and Ashanti regions of Ghana do not apply pesticides to their groundnut fields, so the picture of children in a groundnut field was unlikely to elicit discussion about the hazards of pesticides. Since a better photo was not available once we were in the field, we determined that after the respondent replied with his or her initial thoughts, we would ask "what if this were a tomato field?" This second question did tend to prompt responses about the risks of pesticides. We also learned that "risk" did not translate well in an interview question about risks of pesticides, so we changed the wording to "danger."

This study raised several issues that require further research. First, the issue of women hiring male labor and having limited access to financial resources to do so requires further exploration; more specifically, have increased costs of production caused women to drop out of tomato cultivation at higher rates than men? Is tomato production more expensive for women because of the costs of hiring labor? If so, is this because women hire more labor than men or because female labor is inexpensive so men spend less money hiring women than women spend hiring men? Have women developed strategies to adapt to these costs (i.e., credit from family members, friends, or informal lenders)? This research also revealed the need for studies to

explore the spatial distributions of men's and women's fields, particularly with reference to distance from vehicle-accessible roads, and if or how this impacts agricultural production and marketing. Another interesting issue raised by this research is the perception that using IPM practices represents low status. Further research into the prevalence of this perception and how factors like gender or class affect it would be critical information for an IPM program. Further research should also address the elements and inputs in the tomato value chain that may affect successful implementation of IPM. For example, what is the role of processing plants in influencing farmers' selection of tomato varieties? How much influence do market women have over farmers' use of pesticides or other methods of pest control? Finally, while this study focused on gender differences in practices, perceptions, knowledge, and access to pesticides and pest management, the data collected through this research should also be analyzed from the perspective of how other factors (i.e., age or education level) affect these dimensions of pest management among tomato farmers in Tuobodom and Ghana more broadly.

3.7 Conclusion

This research sought to explore the context of gender relations and pest management among tomato farmers in the town of Tuobodom, Brong Ahafo Region, Ghana. It aimed to determine gender-based constraints to and opportunities for the introduction of IPM among these farmers. The initial hypotheses were that there are gender-based constraints and opportunities that stem from gender differences in access to, knowledge, perceptions, and practices of pesticides and pest management and that these gender differences are largely the result of gendered activities in productive and reproductive spheres.

Findings revealed that constraints to and opportunities for the introduction of IPM do exist for tomato farmers in Tuobodom; some of these are general while others are gender-based. For example, most farmers, both men and women, face major losses from pests and diseases and

recognize the dangers of pesticides. These farmers are interested in alternative solutions to their pest management problems, presenting a significant opportunity for the introduction of an IPM program. At the same time, men and women are exposed to pesticides in different ways because of their different roles in tomato production. While men are more likely than women to be exposed to pesticides during the mixing and application processes, women are at risk of exposure to the chemicals when they wash the clothes worn to spray pesticides. Findings also revealed that gender differences in access to, knowledge, perceptions, and practices of pesticides and pest management are related to gendered activities in productive and reproductive spheres in some cases (e.g., men's and women's differential exposure to pesticides based on their activities in tomato production) but may be more closely linked to gendered access to resources. For example, women are not necessarily more likely than men to perceive the risks of pesticides because of their roles in food preparation, washing clothes, and caring for the sick. In contrast, men are more likely than women to report having experienced, or knowing someone who has experienced, negative health effects due to pesticides and to have heard of IPM. Men are also more likely to attend trainings according to focus group participants and, among household visit respondents, more men than women get information about pest management from sources other than agrochemical vendors. Knowledge and perceptions of the risks of pesticides is likely linked to access to education and information.

These findings demonstrate key areas (health and safety; markets and the tomato value chain; and information and training) where an IPM program could provide support and issues that such a program should consider when working with farmers to develop an effective and sustainable IPM package for this area. In terms of health and safety, this research revealed the need for training on safe pesticide use and alternative methods of pest management. These

trainings should be tailored to men's and women's different roles in tomato production and exposure to pesticides. There is also a need for training on safe pesticide use for agrochemical vendors. Examining tomato production and pest management from the viewpoint of markets and the tomato value chain demonstrates that women's lack of access to financial resources may make them less likely to adopt IPM technologies that are labor intensive or require hiring male labor. However, women may be particularly interested in IPM technologies that save labor or reduce the amount of money spent on expensive agrochemicals. Finally, from the perspective of information and training, different methods of information dissemination should be used for different IPM technologies (e.g., the local tomato growers' association, radio, or women's church organization) and specific action should be taken to increase women's representation in trainings, particularly by increasing the spatial and temporal accessibility of trainings.

This study demonstrates the need for gender analysis in agricultural development programs such as IPM to identify issues that may affect the implementation or sustainability of a particular project in a given context. This research sought to provide insight into the key issues of gender and pest management in Ghana relevant to the IPM CRSP program. It aims to contribute to the areas of gender and agricultural development, gender and agriculture in Ghana, and pesticides and IPM by illuminating how gender relations intersect with pest management in ways that may affect or be affected by the introduction of an IPM program for tomato.

3.8 References

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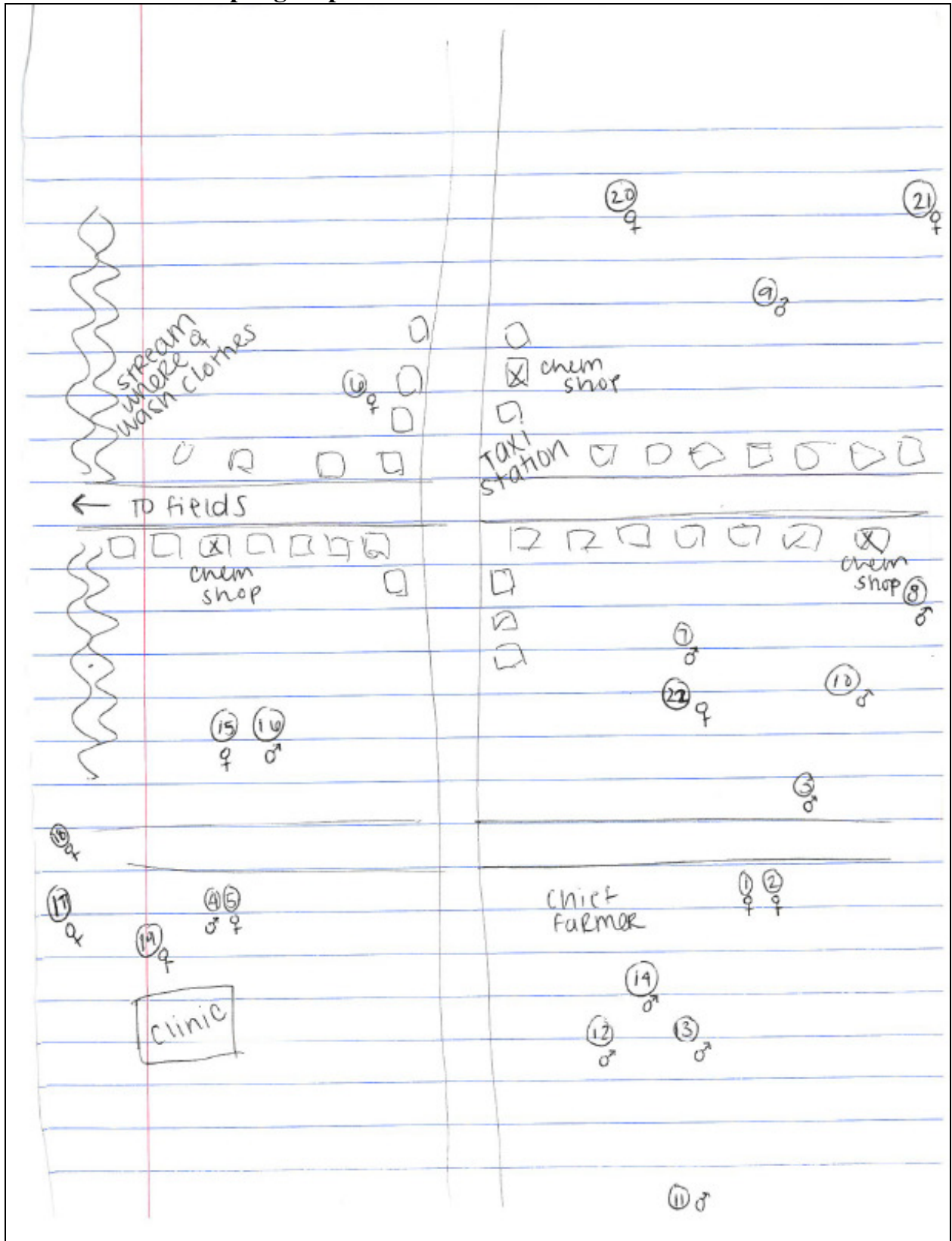
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APPENDIX A: Sampling map used in household visits



APPENDIX B: Photo interpretation exercise

<p>Photo 1: Tomatoes</p> 	<p>Expected responses:</p> <ul style="list-style-type: none">• Disease and insect damage to tomatoes
<p>Photo 2: Farmer with pesticide container on bicycle</p> 	<p>Expected responses:</p> <ul style="list-style-type: none">• Dangers of reusing pesticide container
<p>Photo 3: Children in a field</p> 	<p>Expected responses:</p> <ul style="list-style-type: none">• Dangers of pesticides in field to children

APPENDIX C: Household interview prompt

1. What is your source of tomato seeds?
2. What are the main pests affecting your tomato crops and what problems do they cause?
3. What percentage of your crop do you lose to these different pests?
4. What control methods do you use for these pests?
5. Are there insects that do not cause damage to your tomato crop? If yes, what are they?
6. If you use any pesticide on tomato, where did you learn about it (them)?
7. Do you use any non-pesticide control method for tomato pests? If so, where did you learn about that method?
8. Is there any danger associated with using pesticides? If yes, what?
9. Do you think there are pesticide residues on the tomatoes you eat from your fields?
10. Have pesticides caused any health problems for you or your family? If so, what?
11. What do you do with empty pesticide containers? Why?
12. What do you do to find out if the pesticide mixture is the right strength?
13. Have you ever tasted the pesticide mixture before spraying to know that it is the right strength?
14. Who decides how to spend the money that comes from the sale of your tomatoes?
15. Have you heard of Integrated Pest Management? (ex. staking, mulching, different non-chemical methods of pest control) If yes, what do you know about it?
16. Do you store your pesticides? If so, where?

Demographic Information

1. Age: _____
2. How many years of formal education do you have? _____
3. How many people are in your household? _____
4. How many children (less than 18 years) are in your household? _____
5. Are you (yourself, not your spouse) a member of any farmers' association?
____ YES ____ NO

Thank you for your time!

APPENDIX D: Survey Instrument



IPM CRSP Ghana Survey
Interview No. _____

Name of the Enumerator _____

Gender of Enumerator M F

Region _____ Town _____ District _____

Interview date _____

Name of respondent _____

Gender of respondent M F

6. How far is your tomato field from the nearest market (miles)? _____
7. How far is your village/community from the nearest major road (miles)? _____
8. How far is your house from the nearest extension agent (miles)? _____
9. List the number of acres (total for both seasons) of all crops you grew last year. Also list the number of acres of crops that other household members grew.

Crop	1. Tomato	2. Plantain	3. Cocoyam	4. Pepper	5. Okra	6. Garden eggs	7. Cocoa	8. Oil palm	9. Maize	10. Yam	11. Cowpea	12. Cassava
Farmer												
Other household members												

Write any additional crops below:

10. How many times did you plant tomato last year?

- _____ a) Once
- _____ b) Twice
- _____ c) Three times
- _____ d) More than three times

11. What months did you plant tomato last year? [Enumerator: this refers to the months in which the tomato crops were planted, not the period of time throughout which they were grown]

12. How much of the land (acres) that you use for tomato do you own, rent, share crop, common field or control by other means?

	Farmer	Other household members
a. Own		
b. Rent		
c. Share crop		
d. Other (specify)		

13. How many years have you cultivated tomatoes? _____

14. Is your tomato crop primarily for sale or for household consumption?

- a) Primarily for sale
 b) Primarily for household consumption
 c) Both

15. In your tomato plot, how many times did you harvest last rainy season? _____

16. How many baskets/crates (circle one) did you harvest each time? _____

17. In your tomato plot, how many times did you harvest last dry season? _____

18. How many baskets/crates (circle one) did you harvest each time? _____

19. How many baskets/crates of tomato did you produce last year? [Enumerator: Circle whether baskets or crates]

Rainy season _____ Basket/Crate size _____ kg

Dry season _____ Basket/Crate size _____ kg

20. What is your source of tomato seeds? (Check all that apply)

- Private dealers
 Extension service
 Family
 Neighbor/Friend/Other farmers
 Self
 Others (specify) _____

21. Assuming that your Total Variable Costs is 100, what costs will the following inputs contribute to it?

Input	Costs		
Plowing/tractor services			
Seeds			
Pesticides (insecticides, fungicides, herbicides etc.)			
Fertilizer			
Organic manure			
Water			
Rent for land			
Hired labor	Number of days	Number of workers	Daily wage
a. Preparing land			
b. Nursery operation			
c. Transplanting			
d. Applying pesticides			
e. Fertilizing (chemical and non-chemical)			
f. Weeding			
g. Irrigation/watering			
h. Other non-chemical methods of pest control			
Other (specify)			

22. What are the main pests (insects, diseases, weeds) that affected your tomato crop last year?

		Insects				Diseases				Weeds		
Name →												
% of tomato crop affected	In your plots											
	In the community											
Severity of effects on yield and/or quality of tomato crop	Some effects											
	Large effect											

23. Did you use agrochemicals for these pests (insects, diseases, weeds) on your tomatoes last year? [Enumerator: list the same insects, diseases, and weeds from above.]

		Insects				Diseases				Weeds		
Name →												
Do you use agrochemicals for these problems? (Y = yes; N = no)												
Agrochemical used												

24. If you used agrochemicals for the pests (insects, diseases, weeds) on your tomatoes last year, indicate how often you applied the chemicals and the quantity of each application.

Agrochemicals used	Total number of applications per season	Quantity per application

25. Do you use any of the following methods to control pests and diseases for your tomatoes? (Check all that apply)

- Agrochemical application
- Use of resistant variety
- Plant extracts
- Host free period
- Time of planting
- Crop rotation
- Nets for seedlings in nursery
- Traps
- Handpicking insects
- Removal of diseased parts
- Other (specify): _____

26. Are there insects that **DO NOT** cause damage to your tomato crop?

- ___ a) Yes
- ___ b) No
- ___ c) Don't know

27. If yes, what are they? Name as many as you can.

28. If you use any pesticide on tomato, where did you learn about it (them)? (Check all that apply)

- Private dealers
- Farmer Field School
- Field days/demonstrations
- Extension agents/Researchers
- Family
- Neighbor/Friend/Other farmers
- NGO
- Media (television, radio, newspapers, pamphlets, etc.)
- Other (specify) _____

29. If you used any non-pesticide control method for tomato pests, where did you learn about that method? (Check all that apply)

- € Private dealers
- € Farmer Field School
- € Field days/demonstrations
- € Extension agents/Researchers
- € Family
- € Neighbor/Friend
- € NGO
- € Media (television, radio, newspapers, pamphlets, etc.)
- € Other (specify) _____
- € Not applicable

30. With how many farmers did you share information that you learned about pest management practices?

31. Is there any danger associated with using pesticides?

- _____ a) Yes
- _____ b) No
- _____ c) Don't know

32. If yes, what is the danger? _____

33. What can people do to reduce the danger? _____

34. Do you think there are pesticide residues on the tomatoes you eat from your fields?

- _____ a) Yes
- _____ b) No
- _____ c) Don't know

35. Indicate your opinion on the following statement: Using pesticides to control pests can harm water quality on the farm if the farm is near a water body.

- _____ a) Agree
- _____ b) Disagree (**Go to Q. 32**)
- _____ c) Don't know

36. If you agree, do you think your farm's water supply has been negatively affected by pesticide use?

- _____ a) Yes
- _____ b) No
- _____ c) Don't know

37. Have pesticides caused any health problems for you or your family?

- a) Yes
- b) No
- c) Don't know

38. If so, what health problems have pesticides caused? _____

Indicate your opinion on the following statements.

You find that the application of pesticides affects the health of:	Agree	Disagree	No opinion
39. People regularly applying pesticides			
40. People working in gardens treated with pesticides			
41. People harvesting the crop			
42. Children in the household			
43. Pregnant women in the household			
44. Consumers			

45. Have you or any member of your family ever participated in a Farmer Field School (FFS) training for **NON-PESTICIDE** control methods for crop pests?

- a) Yes
- b) No
- c) Don't know

46. If yes, for which crop(s)?

- (a) _____
- (b) _____

47. Have you ever been visited by an agricultural extension agent or researcher who discussed **NON-PESTICIDE** means of controlling crop pests? YES NO

48. If so, where did the visit occur?

- a) In your field
- b) In your house
- c) Other (specify) _____

49. Have you ever attended a field demonstration for **NON-PESTICIDE** means of controlling crop pests?

- YES NO

50. If yes, for which crop(s)?

- (a) _____
- (b) _____

51. Have you ever heard of Integrated Pest Management (IPM)? YES NO (If no, go to Q. 51)

52. If yes, where did you learn about it? (Check all that apply)

- Private dealers
- Farmer field school
- Field days/demonstrations
- Extension agents/Researchers
- Family
- Neighbor/Friend
- NGO
- Media (television, radio, newspapers, pamphlets, etc.)
- Other (specify) _____

53. If you have heard of IPM, do you use IPM practices or technologies? YES NO

54. If yes, which IPM practices or technologies do you use? (Check all that apply)

- Staking
- Mulching
- Host-free period
- Grafting
- Improved varieties
- Other (Specify) _____

55. If you do not use IPM practices or technologies, why not?

- a) Too time-intensive
- b) Too costly
- c) Lack of access to resources
- d) Distance from inputs (including information)
- e) Other (Please specify) _____

56. Can you use the money from the sale of the products of your farm any time you wish?

YES NO

57. Do you have decision-making power over the money from the sale of products on your farm?

- a) Yes
- b) No
- c) Sometimes

58. Did you or your spouse apply pesticides on your tomatoes last season? YES NO (If no, go to Q. 99 for demographic information)

59. Did you (yourself) apply pesticides on your tomatoes last season? ____ YES ____ NO

How important to you are the following attributes in your choice of pesticides (insecticides, fungicides, herbicides, etc.):

[Enumerator: be sure to give the farmer all the options (important, somewhat important, not important, don't know) after each question.]

	Important	Somewhat important	Not important	Don't know
60. Pesticide cost				
61. Safety				
62. Efficacy (How well they work)				
63. Availability of pesticides				
64. Availability of information about pesticides				
65. Other (specify):				

How important to you are the following sources of information in your choice of pesticides (insecticides, fungicides, herbicides, etc.):

[Enumerator: be sure to give the farmer all the options (important, somewhat important, not important, don't know) after each question.]

	Important	Somewhat important	Not important	Don't know
66. Extension agents/ Researchers				
67. Pesticide dealer's advice				
68. Relatives' advice				
69. Fellow farmers' advice				
70. Local media (television, radio, newspapers, pamphlets, etc.)				
71. NGOs				
72. Other (specify):				

73. Do pesticides reduce the time you (yourself) spend working in your tomato fields in one season?

a) Yes

b) No

c) Don't know

74. Do pesticides reduce the amount of money you spend on paid labor for working in your tomato fields?

a) Yes

b) No

c) Don't know

75. Who buys the pesticides in your household? (Check all that apply)

You

Spouse

Son

Daughter

Other (Please specify _____)

76. Do you apply pesticides before you see pest damage or afterwards? (Check all that apply)

Before

After

77. Who mixes the pesticides for your tomatoes? (Check all that apply)

You

Spouse

Son

Daughter

Other (Please specify _____)

78. Who applies the pesticides on your tomatoes? (Check all that apply)

You

Spouse

Son

Daughter

Other (Please specify _____)

79. What protective measures do you use when preparing or applying pesticides? (Check all that apply)

Clothing

Mask

€Gloves

€Boots

€Nothing

€Other (Please specify _____)

Indicate how often you do the following:

[Enumerator: be sure to give the farmer all the options (never, rarely, sometimes, often, always) after each question.]

	Never	Rarely	Sometimes	Often	Always	Not applicable
80. Read the labels on the containers of pesticides before using them.						
81. Wear protective clothing and other accessories such as a nasal mask, goggles, or boots for the application of pesticides.						
82. Mix pesticides with your hands.						
83. Observe the preharvest timeouts after the application of pesticides.						
84. Wait 12 hours before entering a field that has been sprayed with pesticides.						
85. Store pesticides out of reach of children.						
86. Store pesticides away from food.						
87. Keep pesticides in a well-ventilated location.						
88. Wash your hands with soap after spraying pesticides.						
89. Take a bath as soon as you get home from spraying pesticides.						
90. Wash the clothing used for spraying pesticides before wearing them again.						

91. What do you do with empty pesticide containers?

___ a) Re-use (Specify how) _____ (**Go to Q. 78**)

___ b) Sell (**Go to Q. 78**)

___ c) Disposal (Specify how) _____

92. If you dispose of empty pesticide containers, how do you dispose of them?

___ a) Burn

___ b) Bury

___ c) Leave in field

___ d) Other (specify) _____

93. Why do you use this method of disposal?

94. What do you do with leftover pesticides?

_____ a) Use at a later time

_____ b) Sell

_____ c) Dispose (Specify where) _____

95. Do you store your pesticides? _____ YES _____ NO

96. If yes, where do you store your pesticides?

_____ a) In the field

_____ b) In the granary

_____ c) In the kitchen

_____ d) In the bedroom

_____ e) Other (Specify) _____

97. What equipment do you use to apply pesticides on your tomatoes?

_____ a) Knapsack sprayer

_____ b) Other sprayer (Specify) _____

_____ d) Other (Specify) _____

98. Do you have access to a knapsack sprayer for use on your tomatoes? _____ YES _____ NO

99. If yes, is it:

_____ a) Owned

_____ b) Rented

100. Can you use it when you wish?

_____ a) Yes

_____ b) No

_____ c) Sometimes

101. Have you ever tasted the pesticide mixture before spraying to know that it is the right strength?

_____ YES _____ NO

102. What do you do to find out if the pesticide mixture is the right strength?

103. How many days or weeks after spraying pesticides do you harvest your tomatoes?

_____ days

_____ weeks

Demographic Information

104. Age: _____
105. How many years of formal education do you have? _____
106. How many people are in your household? _____
107. How many children (less than 18 years) are in your household? _____
108. Are you (yourself, not your spouse) a member of any farmers' association? _____ YES _____ NO
104. Have you participated in any research-based farm activities before? _____ YES _____ NO

105. INTENDED NEW TECHNOLOGIES FOR TOMATOES

Do you:	Technology	Response: (1 =Yes, 2 = No)	Acreage under this practice, if Yes
	Raise nursery bed first, and then burn the thrash (Sterilization)?		Not Applicable
	Practice germination test?		Not Applicable
	Drill seeds at Nursery (instead of broadcasting)?		Not Applicable
	Practice sanitation such that all old plantings of solanaceous crops like pepper, garden eggs, old tomato plants etc are removed before planting?		
	Monitor pests or diseases (instead of calendar spraying) before spraying?		
	Remove and Bury virus infected plants if observed early in development?		
	Destroy old tomato plants promptly after harvest (first two weeks)?		
	Use botanicals for spraying?		
	Use Soapy water for spraying aphids?		
	Grow disease tolerant/resistant varieties?		

106. Name of main tomato variety planted last year? -----
107. What are the reasons for growing it? -----
- 1 = High Yield, 2 = Marketable, 3 = Disease tolerance/resistance, 4 = Seed availability, 5 = Early maturity, 6 = Taste, 7 = Other (Specify) _____

Enumerator: Thank the farmer for their time.

FOR THE ENUMERATOR:

Write down any observations or conclusions about the interviewee and their environment:

APPENDIX E: Frequencies of key survey questions

Variable	All Sites	All Sites Male	All Sites Female	Tuobodom	Tuobodom Male	Tuobodom Female
Gender of respondent						
Male	73.7*			76.9		
Female	26.3			23.1		
[N]**	[285]			[39]		
Source of seeds						
Private dealers	63.8	65.7	56	15	20	0
Extension service	4.4	5.2	1.3	5	6.7	0
Family Neighbor/Friend/Other farmer	4.8	5.2	4	27.5	26.7	33.3
Self	15.7	15.7	17.3	47.5	53.3	33.3
	31.1	27.1	44	75	66.7	100
[N]	[293]	[210]	[75]	[40]	[30]	[9]
Methods of pest control						
Agrochemical application	90.1	88.1	97.3	85	80	100
Use of resistant variety	6.8	6.7	8	20	20	22.2
Plant extracts	8.2	10	2.7	0	0	0
Host free period	4.4	3.3	4	0	0	0
Time of planting	8.5	9.5	5.3	12.5	13.3	11.1
Crop rotation	12.3	13.3	5.3	20	20	22.2
Nets for seedlings in nursery	3.1	3.3	1.3	0	0	0
Traps	3.4	3.3	2.7	17.5	16.7	22.2
Handpicking insects	27.6	27.6	28	60	60	66.7
Removal of diseased parts	33.8	36.2	25.3	27.5	26.7	33.3
[N]	[293]	[210]	[75]	[40]	[30]	[9]
Beneficial Insects						
Yes	46.7	52.1	32	44.4	46.2	33.3
No	33.3	27.3	50.7	41.7	34.6	66.7
Don't Know	19.9	20.6	17.3	13.9	19.2	0
[N]	[276]	[194]	[75]	[36]	[26]	[9]
Source of info: Pesticides						
Private dealers	38.6	35.7	46.7	72.5	73.3	66.7
Farmer Field School	5.1	4.8	4	0	0	0
Field days/demonstrations	4.4	3.3	5.3	2.5	3.3	0
Extension agents/Researchers	41.3	47.1	25.3	10	13.3	66.7
Family Neighbor/Friend/Other farmer	16	14.8	20	55	53.3	66.7
	34.5	31.4	41.3	65	60	88.9
NGO	3.4	2.4	4	2.5	3.3	66.7
Media	6.8	6.7	5.3	7.5	6.7	11.1
[N]	[293]	[210]	[75]	[40]	[30]	[9]

Variable	All Sites	All Sites Male	All Sites Female	Tuobodom	Tuobodom Male	Tuobodom Female
Source of info: Non-pesticide						
Private dealers	4.1	4.3	4	15	13.3	22.2
Farmer Field School	2.7	2.4	2.7	2.5	3.3	0
Field days/demonstrations	0.7	0.5	1.3	0	0	0
Extension agents/Researchers	21.5	24.8	12	5	6.7	0
Family Neighbor/Friend/Other farmer	1.4	1	2.7	0	0	0
NGO	10.2	11	9.3	15	13.3	22.2
Media	1.4	0.5	2.7	0	0	0
[N]	2.7	2.9	1.3	0	0	0
[N]	[293]	[210]	[75]	[40]	[30]	[9]
Danger assoc. with pesticides						
Yes	88	89.1	83.8	100	100	100
No	8.8	9.4	8.1	0	0	0
Don't Know	3.2	1.5	8.1	0	0	0
[N]	[283]	[202]	[74]	[35]	[26]	[8]
Pesticides affect health of children						
Agree	21.9	20.2	25.7	25.6	17.2	55.6
Disagree	72.4	75.4	64.9	59	65.5	33.3
No opinion	4.9	3.9	8.1	15.4	17.2	11.1
[N]	281	202	73	39	29	9
Pesticide residues on tomatoes						
Yes	51.9	52.2	53.3	65.8	67.9	66.7
No	41.8	42.9	36	28.9	28.6	22.2
Don't Know	6.3	4.9	10.7	5.3	3.6	11.1
[N]	[287]	[205]	[75]	[38]	[28]	[9]
Health problems caused by pesticides						
Yes	33.6	39.5	19.4	74.3	80	66.7 ^a
No	60.9	57.9	66.7	22.9	16	33.3 ^a
Don't Know	5.5	2.6	13.9	2.9	4	0 ^a
[N]	[274]	[195]	[72]	[35]	[25]	[9]
What do you do with empty pesticide containers?						
Re-use	4	4	3	13.5	10.7	25
Sell	0	0	0	0	0	0
Disposal	96	96	97	86.5	89.3	75
[N]	[247]	[175]	[66]	[37]	[28]	[8]
Method of disposal of empty containers						
Burn	27.7	31.9	12.1	25.7	25.9	14.3 ^a
Bury	27.7	33.5	12.1	11.4	11.1	14.3 ^a
Leave in field	39.5	29.7	69.7	57.1	55.6	71.4 ^a
Other	5.1	4.9	6.1	5.7	7.4	0 ^a

Variable	All Sites	All Sites Male	All Sites Female	Tuobodom	Tuobodom Male	Tuobodom Female
[N]	[253]	[182]	[66]	[35]	[27]	[7]
Tasting of pesticide mixture						
Yes	7.5	6.7	10.4	10.8	10.3	14.3
No	92.5	93.3	89.6	89.2	89.7	85.7
[N]	[267]	[194]	[67]	[37]	[29]	[7]
Decision-making power over money from the sale of farm products						
Yes	92.9	92.5	94.6	84.6	86.2	77.8
No	5	5	4.1	12.8	13.8	11.1
Sometimes	2.1	2.5	1.4	2.6	0	11.1
[N]	[281]	[201]	[74]	[39]	[29]	[9]
Heard of IPM						
Yes	17.1	21.4	6.7	17.5	20	11.1 ^a
No	83	78.6	93.3	82.5	80	88.9 ^a
[N]	[293]	[210]	[75]	[40]	[30]	[9]
Storage of pesticides						
Yes	88	88.4	85.9	74.3	70.4	85.7
No	12	11.7	14.1	25.7	29.6	14.3
[N]	[250]	[180]	[64]	[35]	[27]	[7]
Location of stored pesticides (if respondent stores pesticides)						
Field	88.8	91.5	83.1	86.2	90.5	71.4
Granary	1.2	1.1	0	0	0	0
Kitchen	1.2	0.6	3.4	6.9	4.8	14.3
Bedroom	2.1	1.7	3.4	3.4	4.8	0
Other	6.6	5.1	10.2	3.4	0	14.3
[N]	[242]	[177]	[59]	[29]	[21]	[7]

Note: one sample t-tests used to identify significant differences between Tuobodom males and females when possible (excludes "select all that apply" questions: source of seeds, methods of pest control, and source of info (pesticide and non-pesticide))

* All numbers represent percentages

** Numbers in brackets represent sample size for each category

^a Different than Tuobodom males at the 0.05 level of significance

APPENDIX F: Photos



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Photo 1: Nursery beds of tomato seedlings protected by palm fronds



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Photo 2: Men preparing tomato field



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Photo 3: Tomato damaged by *esa* (fruit borer)



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Photo 4: Diseased tomato plants



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Photo 5: Pesticide sprayer stored in bedroom



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Photo 6: Pesticide sprayer stored in kitchen



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Photo 7: Pesticide sprayer stored in storage room with sheep and cookware



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Photo 8: Tomato farmer preparing to mix agrochemicals



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Photo 9: Adding insecticides to mixture of water, fungicide, and fertilizer



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Photo 10: Stirring the agrochemical mixture with a bucket and hands



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Photo 11: Applying agrochemical mixture to tomato plants



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Photo 12: Poster in agrochemical shop with recommendations for pesticide container disposal and protective clothing.

**APPENDIX G: Combined activity profile responses of men's (X) and women's (O)
focus groups**

Socio-economic Activities	Only men	Men with the help of women	Both men and women equally	Women with the help of men	Only women	Children	Observations
Productive Activities							
Nursery management							
a. Bed preparation	XXXO OO						
b. Watering	XXX	XO	O		OO		
c. Weeding	XXXX OOO		O				
d. Mixing and applying pesticides	XXXX OO		O		O		
Mounding and ridging	XXXX OOOO						
Buying agrochemicals	XXX		XOOO		O		
Herbicides							
a. Carrying water			X		XXXO OOO		
b. Mixing	XXXX OO		O		O		
c. Applying	XXXX OO	OO					
Transplanting		XXO	XXOO O				
Watering			XXO	XX	OOO		
Pesticides							
a. Carrying water			XO		XXXO OO		
b. Mixing	XXXX OOO		O				
c. Applying	XXXX OOO		O				
Non-chemical pest control							
Fertilizer		XO	XXO		O		
a. Carrying water			X	X	XXOO OO		
b. Mixing	XXXX OO		O		O		
c. Applying	OX		XXXO OO				
Weeding	XXXX		O				

Socio-economic Activities	Only men	Men with the help of women	Both men and women equally	Women with the help of men	Only women	Children	Observations
	000						
Harvesting			X000 0	XX	X		
Selling	XO		0				
a. Carrying to road	X	0	X000	XX			
b. Selling at the road	XXXO		0		XOO		
c. Selling at market					XXXX 000		
Reproductive activities							
<i>Domestic non-paid work</i>							
Gathering water					XXXX 0000		
Preparing food for the family					XXXX 0000		
Providing monetary support for domestic activities	XXXX 00	00					
Caring for children			00	X	XXXO 0		
Caring for elderly				XX	XX00 00		
Caring for sick	X			0	XXXO 00		
Cleaning and arranging the house					XXXX 0000		
Washing clothes					XXXX 0000		
Growing food for home consumption		XO	XXXO 0		0		
Community non-paid work							
Participate in assemblies and meetings	XXXX		0000				
Cleaning community			XXXX 00	0	0		

Socio-economic Activities	Only men	Men with the help of women	Both men and women equally	Women with the help of men	Only women	Children	Observations
Leisure and Education							
Participate in trainings	XXXX OOO				O		
Attend church or mosque			XO	XXOO	XO		