Journal of Agriculture and Rural Development in the Tropics and Subtropics
Vol. 114 No. 1 (2013) 59–67

urn:nbn:de:hebis:34-2013030542613 ISSN: 1612-9830 – journal online: www.jarts.info

Pesticide-handling practices of smallholder coffee farmers in Eastern Jamaica

Dwayne Henry [a], Giuseppe Feola [b,*]

[a] *University of the West Indies, Mona, Jamaica*
[b] *University of Reading, Whiteknights, Reading, UK*

Abstract

Pesticide use among smallholder coffee producers in Jamaica has been associated with significant occupational health effects. Research on pesticide handling practices, however, has been scarce, especially in eastern Jamaica. This explorative study aims at filling this gap and provides a first basis to develop effective interventions to promote a safer pesticide use. A random sample of 81 coffee farmers was surveyed. The majority of farmers reported to suffer from at least one health symptom associated with pesticide handling, but safety practices were scarcely adopted. There was also the risk that other household members and the wider local community are exposed to pesticides. The lack of training on pesticide management, the role of health services and the cost for protective equipment seemed to be the most significant factors that influence current pesticide handling practices in eastern Jamaica. Further research is recommended to develop a systemic understanding of farmer's behaviour to provide a more solid basis for the development of future intervention programmes.

Keywords: smallholding farmers, pesticide management, safety, personal protective equipment, coffee, Jamaica

1 Introduction

Coffee production is an important economic activity in Jamaica. Coffee is one of the island's highly valued export commodities (FAO, 2003), employing directly more than 50,000 people and contributing 7 % of the island's agricultural earnings (Waugh & Nelson, 2003). Coffee is produced both in the lowlands and in the hilly region of the Blue Mountains Jamaica, the latter region producing the highly priced Blue Mountain Coffee, whose high quality is internationally recognised and legally protected by a geographic indication of origin trademark (Teuber, 2010). Coffee production is also strongly intertwined with Jamaica's colonial and post-colonial history (Delle, 1998), and key to the island's rural development (Weis, 2000).

* Corresponding author
Email: g.feola@reading.ac.uk;
Phone: +44 118 378 7496
University of Reading, Whiteknights, RG66AB Reading, UK

Coffee production in Jamaica is vulnerable to several pests, such as the Coffee Leaf Miner (*Leucoptera cofeella*), and the most serious insect pest, the Coffee Berry Borer (*Hypothenemus hampei*) (Mansingh *et al.*, 2003; Waugh & Nelson, 2003). To control the latter, coffee farmers used to apply the organochlorine insecticide Endosulfan (Robinson & Mansingh, 1999). In order to comply with international regulations and with the requirements of coffee import countries on pesticide residues in food, the Jamaican Coffee Industry Board has progressively stressed the need for a safer use of pesticide and promoted the adoption of integrated pest management (Waugh & Nelson, 2003). However, even if Endosulfan has been recently phased-out, farmers apply several chemical pesticides, in particular organophosphates, that fall into the WHO toxicity categories 1a and 2 (Drive, 2006).

As in the wider region of the Americas (Choi *et al.*, 2001) and in many other developing countries (Garcia, 1998; Ecobichon, 2001), pesticide application in cof-

fee production in Jamaica has resulted in both environmental and human health negative effects. Robinson & Mansingh (1999) for example, detected pesticide residues in fourteen out of seventeen rivers, four out of seven natural springs, and eight out of thirteen wells in the three watersheds where Blue Mountain Coffee production in Jamaica is concentrated. High concentration of pesticide residues were also detected in other terrestrial and water ecosystems (Mansingh & Wilson, 1995; Mansingh *et al.*, 1997, 2003).

Occupational health issues have also been highlighted in empirical studies on Jamaican coffee farmers. Ncube *et al.* (2011) and Schlosser (1999) reported evidence of inadequate use of personal protective equipment (PPE), unsafe pesticide-handling practices, and pesticide poisoning among farmers. The symptoms observed mostly fall into the category of moderate pesticide poisoning (Thundiyil *et al.*, 2008). These results seem to confirm those of other studies carried out in the Caribbean (Andreatta, 1998), and Central America (Wesseling *et al.*, 2001), thus pointing out a regional pattern of health risk due to pesticide-handling practices. Nevertheless, as remarked by Mansingh *et al.* (2003) no reliable statistics about pesticide intoxications in Jamaica exists because farmers usually do not seek medical advice, and due to the lack of training among medical service operators the arising cases of pesticide intoxications are not recorded.

Some initiatives to promote the safe use of chemical pesticides such as Pesticide awareness week (Ncube *et al.*, 2011) and the Caribbean Agrochemicals Management Project (NRSP) (Mees *et al.*, 2003) have been launched in the Caribbean and in Jamaica . However, little evidence on the effects of such initiatives among Jamaican coffee farmers exists. In fact, in their study among 359 farmers in northwestern Jamaica, Ncube *et al.* (2011) found that 75 % of farmers reported that they never received training in pesticide handling or safety (see also Mansingh *et al.*, 2003). To the authors' knowledge, up to now no study on pesticide-handling practices has been carried out among coffee farmers in eastern Jamaica.

Socio-demographic and/or economic factors, contingent and external factors, values, beliefs and cultural orientations have been suggested to explain unsafe pesticide handling practices (Feola & Binder, 2010a). Given the variety of factors which potentially influence farmers, knowing which ones are relevant in a specific context is essential to develop effective intervention strategies to foster safer pesticide-handling practices (Feola & Binder, 2010b).

To provide a basis to develop effective intervention to promote safe pesticide use, the presented study aims to fill the gap in knowledge about pesticide-handling practices of smallholding coffee farmers in eastern Jamaica. With reference to the district of Brandon Hill, this study was carried out to explore (I) the health issues related to pesticide-handling (i.e. mixing and application); (II) the pesticide-handling practices, with particular focus on occupational safety measures and (III) the factors influencing occupational safety measures.

2 Materials and methods

2.1 Study area

The district of Brandon Hill is located in the parish of West Rural St. Andrew, in the eastern part of the island of Jamaica. The district is hilly, which makes it particularly suitable for the cultivation of the highly valued Blue Mountain quality coffee variety. The district is one of the largest contributors to coffee production within the parish of St. Andrew and accounts for the largest number of registered active coffee farmers in any of the parish´s districts. A total of 174 coffee farmers are based in the Brandon Hill district whereas the whole St. Andrew area harbours about 2,450 active farmers (ABIS, 2009; Gordon, 2009). Coffee production in the parish largely depends on smallholders, whereby 34 % of coffee farmers work less than 1 acre of land, and 44 % between 1 and 4 acres for a total of 787 acres (ABIS, 2009). Coffee farms are mainly intercropped with bananas and plantains to provide needed shade for coffee plants as well as additional produce. The coffee crop cycle lasts for one year. Pesticide application is carried out mainly outside of the coffee picking season, which lasts from August to March. Pesticides are usually applied by male workers using a knapsack sprayer (Mansingh *et al.*, 2003).

2.2 Study design

This study was conducted between January and August 2011 and constitutes a cross-sectional survey of coffee farmers in the district of Brandon Hill located in the parish of St. Andrew, Jamaica. A list of 174 active coffee farmers (i.e. study population) within the district of Brandon Hill was obtained from the Rural Agricultural Development Authority (RADA) in the Ministry of Agriculture and Fisheries through the Agricultural Business Information System (ABIS) database (ABIS, 2009). Coffee farmers with less than one crop cycle experience in coffee production and organic coffee farmers were excluded from this study. From the remaining sample size of 102 farmers, 81 farmers were selected who applied pesticides on a particular date during the study period. This sample selection covers 95 % confidence interval and was done by the researcher who was guided daily by a local Extension Officer.

Data were collected by means of a structured questionnaire and field observations. The structured questionnaire was used to gather data under four major headings (Table 1): i) basic sample characteristics; ii) health issues associated with pesticide-handling (i.e. mixing and application); iii) pesticide-handling and safety practices and iv) influencing factors such as knowledge, social, cultural, economic and contextual factors, broadly following (Feola & Binder, 2010a). The associations between pesticide-handling practices and factors potentially influencing them were explored by means of the Pearson Chi-square test. Data were analyzed using the statistical software SPSS 17.0. No laboratory or medical tests were conducted.

Table 1: *Overview of the collected data about pesticide handling gathered from 81 coffee farmers in eastern Jamaica.*

Data group	*Example of variables*
Basic sample characteristics	Gender; Age; Marital status; Household size; Education; Years worked as coffee farmer; Farm size.
Health	Symptoms; Medical counselling.
Pesticide-handling practices	Days worked per week; Hours/day worked on coffee farm; Use of pesticide on coffee farm; Mixing and application of pesticides; Smoking habits while handling pesticides; PPE use during pesticide mixing and application; Frequency of PPE use; Certification for pesticide use.
Influencing factors	
Knowledge and beliefs	Class of pesticides; Potential health effects of pesticide use; Routes of pesticide intake in human body; Recommended PPE; Recommended personal hygiene practices; Pesticide labels; Use, maintenance and storage of PPE; Signs of defective/non-functional PPE; Received training on pesticides management.
Social	Descriptive and prescriptive social norms; Peer pressure.
Cultural	Social roles (good farmer, good head of family); Traditional practices.
Economic	Cost of PPE; Affordability of PPE.

Four observations were done in order to triangulate self-reported information on pesticide-handling practices from the questionnaires. Farmers were selected for observation through snowball sampling. Observations of pesticide handling were carried out in a similar fashion as visits of Agricultural Extension Officers, to which farmers in Brandon Hill are accustomed. This was done in order to not interfere with the farmer´s activities and to minimize modifications to pesticide handling behaviours. The observations focussed on safety measures, e.g. types and conditions of personal protective equipment (PPE) and personal hygiene practices. Observations were noted on an observational guide and a digital camera was used to capture photographs. After each observation session, participants were asked to provide their rationale for any unsafe practice noted by the observer.

Prior to the interviews and observations, farmers were informed about the aim of the study, the risks and benefits of participation, confidential handling of data as well as the right of refusal to participate. All questionnaires were administered and observations conducted discretely.

3 Results

The sample is mainly composed of smallholding male farmers with primary education and full-time (or close to full-time) employment in coffee farming (Table 2). More than 73 % of the interviewed farmers reported working on the coffee farm for more than 5 hours a day. All interviewed farmers reported using chemical pesticides on farm.

3.1 Health issues related to pesticide-handling

Sixty-three farmers, corresponding to 77.8 % of the sample, reported having experienced at least one of the symptoms on occasion of pesticide-handling (Table 3). The most frequently reported symptom was skin irritation, which is due to the chemicals entering into contact with the farmer's bare skin. Dizziness, headaches, difficult breathing and tightness in the chest were also reported by more than a fifth of the interviewed farmers. Sixty-nine farmers (85.2 % of the sample) reported having never visited a doctor to be tested for traces of pesticide in the body.

3.2 Pesticide handling

No farmer reported having a certification for pest control. Thirty-one farmers (38.3 %) reported having received pesticide management training in the last 5 years, whereby the training had been most frequently provided by either RADA or Coffee Industry Board (CIB). The

Table 2: *Basic characteristics of the 81 coffee farmers in eastern Jamaica with information on number and percentage.*

Characteristic	*n*	*%*
Age		
Below 40	29	35.8
Between 40 and 50	29	35.8
Above 50	23	28.4
Gender		
Male	78	96.3
Female	3	3.7
Educational level		
Primary	58	71.6
Secondary or above	23	28.4
Household members		
4 or less	47	58
5 or more	34	42
Years of work as a coffee farmer		
Less than 10	25	30.9
More than 10	56	69.1
Farm size		
Less than 1 hectare	33	43.2
Between 1 and 3 hectares	24	29.6
More than 3 hectares	18	22.2
Days of work on coffee farm		
4 or less	28	34.6
5 or more	53	65.4

Table 3: *Self-reported health effects associated with pesticide-handling of 81 coffee farmers in eastern Jamaica.*

Symptom	*n*	*%*	*Severity* *
Skin irritations	35	43.2	Low
Dizziness	25	30.9	Low
Difficulty breathing	21	25.9	Moderate/Low
Headaches	19	23.5	Low
Tightness in the chest	18	22.2	Moderate
Cramps	12	14.8	Moderate
Blurred vision	12	14.8	Moderate
Diarrhea	8	9.9	Moderate
Loss of consciousness	3	3.7	Moderate
Vomiting	2	2.5	Moderate
Other symptoms	3	3.7	–

* According to Thundiyil *et al.* (2008)

majority of farmers worked with chemical pesticides for a limited number of days in the last year (i.e. less than 5 days) (Table 4), although for rather long periods of time (i.e. more than 2 hours and, for 44.4 % of farmers, more than 5 hours). Nevertheless, a non-negligible number of farmers reported having worked with pesticides on more days (up to more than 20 days). In some cases (40.5 %), the chemicals were borrowed from a peer. Most of the times (57.5 %) the pesticide borrowed was not received in the original package or container, which meant that the farmer had no access to the safety labels related to the borrowed pesticide.

Farmers reported washing hands after pesticide handling, but the majority of farmers reported not changing nor separating working clothes from other clothes, thus suggesting that contaminated clothes were likely to enter the households and reach family members who had been otherwise not be exposed to the chemicals. One farmer mentioned that he used to smoke during pesticide application.

Table 4: *Self-reported pesticide-handling practices of 81 coffee farmers in eastern Jamaica. The values in brackets indicate the cases of farmers who experienced pesticide poisoning symptoms, and the respective per cent, for each cell.*

Practice		*n*	*%*
The farmers personally mixes and applies pesticide			
	Yes	74 (59)	91.4 (79.7)
	No	7 (4)	8.6 (57.1)
Number of days the farmer worked with pesticide in the last 12 months			
	less than 5	63 (50)	77.8 (79.4)
	between 5 and 20	10 (8)	12.4 (80)
	more than 20	8 (5)	9.8 (62.5)
Number of hours per day the farmer worked with pesticide			
	less than 2	17 (11)	21 (64.7)
	between 2 and 5	28 (20)	34.6 (71.4)
	more than 5	36 (32)	44.4 (88.9)
The farmer borrowed pesticide from a peer			
	Yes	33 (31)	40.5 (93.9)
	No	49 (32)	59.5 (65.3)
The farmer did not received borrowed pesticide in original packaging			
	Yes	19 (19)	57.5 (100)
	No	14 (13)	42.5 (92.9)
The farmer always washes his/her hands with water and soap after pesticide handling			
	Yes	64 (48)	80 (75)
	No	16 (14)	20 (87.5)
The farmer always wears his/her working clothes also at home			
	Yes	40 (32)	49.4 (80)
	No	41 (30)	50.6 (73.2)

The pieces of PPE reportedly used by most farmers were rubber boots and rubber gloves (Table 5). Rubber boots was also the piece of PPE that most farmers (86.6 %) reported to use always, whereas for all other pieces of PPE this rate was below 40 %. No substantial difference was observed among the rankings of pieces of PPE used during pesticide mixing and application, although farmers reported a higher PPE use during pesticide application (Table 5).

Table 5: *Self-reported PPE use during pesticide handling, i.e. mixing and application (N=81). The values in brackets indicate the cases of farmers who experienced pesticide poisoning symptoms, and the respective per cent, for each cell.*

Piece of PPE	*Mixing*		*Application*	
	n	*%*	*n*	*%*
Rubber boots or boots cover				
Yes	69 (54)	85.2 (78.3)	77 (59)	95.1 (76.6)
No	11 (8)	14.8 (72.3)	3 (3)	4.9 (100.0)
Rubber gloves				
Yes	61 (39)	53.0 (76.5)	52 (38)	64.2 (73.1)
No	29 (23)	47.0 (79.3)	28 (24)	35.8 (85.7)
Respirator				
Yes	40 (28)	50.0 (70.0)	44 (30)	54.3 (68.2)
No	40 (34)	50.0 (85.0)	36 (32)	45.7 (88.9)
Coverall				
Yes	30 (24)	37.0 (80.0)	42 (31)	51.9 (73.8)
No	50 (38)	63.0 (76.0)	38 (31)	48.1 (81.6)
Long sleeves/pants				
Yes	25 (18)	30.9 (72.0)	29 (21)	35.8 (72.4)
No	55 (44)	69.1 (80.0)	51 (41)	64.2 (80.4)
Face mask				
Yes	23 (17)	28.4 (73.9)	24 (17)	29.6 (70.8)
No	57 (45)	71.6 (78.9)	56 (45)	70.4 (80.4)
Cap				
Yes	17 (15)	21.0 (88.2)	24 (18)	29.6 (75.0)
No	63 (47)	79.0 (74.5)	56 (44)	70.4 (78.6)
Goggles				
Yes	16 (11)	19.8 (68.8)	19 (13)	23.5 (68.4)
No	64 (51)	80.2 (79.7)	61 (49)	76.5 (80.3)

During the four observation sessions, no farmer used respiratory protection (respirator and face/dust mask), ocular protection (safety goggles), or rubber gloves. Moreover, most farmers wore rubber boots on the outside with the pants tucked into them rather than on the inside of their pants, which would effectively prevent pesticide runoffs from settling inside their boots. Short sleeved instead of long sleeved shirts were also worn by the majority of farmers, with the chest area sometimes left open, and thereby leaving large areas of the skin (hands, arms and chest) exposed to pesticides.

During the observation no use of coverall was recorded. Some farmers said that coveralls are not necessary during application of herbicides because these are applied close to the ground, as opposed to spraying coffee with other chemicals which are applied much higher above into wind currents. Some farmers who were observed not to use protective gloves, said that gloves obstruct the activation of the trigger on the spray equipment.

Finally, several practices were observed to be adopted by farmers to mitigate the risk of pesticide intoxication, among which drinking milk before and after pesticide application, consuming *bissy* (*cola nitida*) a nut of the kola tree, in form of a tea, and using mud to wash hands after pesticide handling. Mud is believed to act as a sorbent for pesticide residues on the skin. Farmers also reported to consume soil as an antidote to a suspected pesticide poisoning.

3.3 Factors influencing pesticide-handling practices

Farmers showed an overall satisfactory level of knowledge of pesticide characteristics and of the recommended safety measures. The rate of correct answers in the set of questions contained in the questionnaire was generally above 75 %, with the exception of knowledge about the routes of pesticide intake into the human body by ingestion and skin absorption (50 % and 69 % of correct answers respectively).

No coherent patterns of association between the potential influencing factors and PPE use were found. In particular, social (i.e. social pressure, social norms) and cultural (i.e. tradition, social roles) factors were not consistently associated with the use of any piece of PPE during either pesticide mixing or application. Nevertheless, some interesting associations could be identified.

Educational level was not associated with PPE use, but having attended specific training on pesticide management in the last 5 years was positively and significantly associated with the use of goggles and cap during both pesticide mixing ($\chi^2 = 4.753$, $p = 0.029$; and $\chi^2 = 12.941$, $p < 0.000$ respectively) and application ($\chi^2 = 3.848$, $p = 0.050$; and $\chi^2 = 18.982$, $p < 0.000$ respectively). Knowledge of the routes of pesticide intake (ingestion and inhalation) was significantly associated only with the use of gloves ($\chi^2 = 3.516$, $p = 0.061$; and $\chi^2 = 3.205$, $p = 0.073$ respectively). Surprisingly, the use of gloves was not significantly associated with the knowledge of skin absorption as route of pesticide intake. This result was reinforced by the fact that 32 farmers (39.5 %) mentioned specific training as a mean of assistance to increase the adoption of safety practices and PPE use.

Having visited the doctor for a health control related to pesticide-related health risks was significantly associated with wearing of gloves during pesticide mixing and application (χ^2 = 4.413, p = 0.036).

The number of days in which the farmer worked with pesticides in the last 12 months was positively associated with the use of coverall (χ^2 = 5.239, p = 0.022) and respirator (χ^2 = 6.809, p = 0.009) during pesticide application, and of goggles (χ^2 = 3.034, p = 0.082) and respirator (χ^2 = 6.366, p = 0.012) during pesticide mixing.

Affordability of PPE was not significantly associated with PPE use. A perception of PPE being expensive was found to be significantly associated with wearing two pieces of PPE during pesticide application, but not pesticide mixing, i.e. goggles (χ^2 = 4.413, p = 0.041), and cap (χ^2 = 8.595, p = 0.072).

Finally, that the cost of PPE might exert a significant influence on PPE use levels, whereby not all farmers have got all recommended pieces of PPE, was confirmed by the fact that 37 farmers (45.7 %) suggested the provision of PPE, e.g. by the RADA, as means of assistance to increase the adoption of safety practices and PPE use.

4 Discussion

This explorative study provides first insights into pesticide-handling practices and related health issues among smallholding coffee farmers in eastern Jamaica, a region in which this topic has been under-researched.

Firstly, this study showed that there were health problems associated with pesticide-handling practices among coffee farmers in eastern Jamaica. The majority of coffee farmers (about 78 %) in the studied region suffered forms of pesticide-related health symptoms. This figure is in line with recent studies carried out in other Jamaican districts (Ncube *et al.*, 2011; Schlosser, 1999). Moreover, more than 85 % of farmers did not rely on health services for pesticide-related health check-ups, which is a common issue in developing countries (Ecobichon, 2001). We showed that farmers who self-reported PPE use during pesticide handling tended to experience less pesticide poisoning symptoms. Future research might further look into the duration and severity of pesticide intoxication health effects and complement self reports with medical tests (e.g. Yanggen *et al.*, 2003).

Importantly, the results suggest that the population exposed to chemical pesticides might be broader than initially assumed and goes beyond the number of farmers directly working with chemicals in the fields. The lack of safety practices, such as wearing contaminated clothes in the household was a major source of exposure for other people in the household (Quandt *et al.*, 2006). The extent to which household members of Jamaican coffee farmers might intake pesticides and suffer negative health effects was not investigated in this study, but represents an important avenue for future research.

Secondly, this study showed that coffee farmers in the studied region adopted risky pesticide-handling practices, and in particular poor safety measures. The strong contrast between PPE use data gathered from the interviews and from observations might point out a limit of this study, i.e. a social desirability bias of survey data. Despite this potential bias, the PPE use figures are significantly far from what is recommended for a safe use of pesticide (ILO, 1991), and are consistent with previous studies carried out in Jamaica (Ncube *et al.*, 2011; Schlosser, 1999). Many of the practices adopted are common in other developing countries. For example, Feola & Binder (2010a) found that rubber boots were used by potato farmers in Colombia as normal footwear more than as a safety measure. In the same study, farmers were reported to use pieces of PPE incorrectly (i.e. facial protection), thus reducing the protective potential, similarly to what was observed in Brandon Hill (e.g. shirts open on the chest). In addition, farmers posed little attention to labels, also storing pesticide not in its original container, which makes it impossible for the farmer to read the related safety label. Farmers were also observed adopting what they meant as traditional intoxication mitigating measures such as drinking milk, *bissy*, or eating soil. Interestingly, evidence exists that drinking milk not only does not prevent poisoning, but that it may even be counterproductive in case of pesticide intoxication, as it may accelerate the take up of the chemical (NSA, 2011). Concerning the *bissy*, there is no evidence that it works to slow or prevent pesticide poisoning. Such traditional practices and beliefs are not uncommon in developing countries (Palis *et al.*, 2006).

Thirdly, the study provides a first insight into the factors influencing the adoption of safety pesticide-handling practices. Although the collected data did not allow for depicting a complete picture, they identified some factors that might be considered for future intervention programmes. Knowledge of pesticide characteristics and risks does not seem to be an issue among coffee farmers in the studied region, and is not significantly associated with PPE use. Instead, training on pesticide management seems to play a significant influence on the use of at least some pieces of PPE. This is confirmed by farmers suggesting the specific training as means of assistance to increase the adoption of safety practices and PPE use. In this respect, there seems to be room for improving the extent of actual training, whereby 62 % of farmers did not receive such training in the last 5 years. This figure roughly confirms the study of Ncube

et al. (2011) who found that about 75 % of coffee farmers in western Jamaica never attended training in pesticide handling and safety.

The results also suggest that the health services might play a role in influencing PPE use. Farmers who visited a doctor for a health control related to pesticide-related health risks were more likely to use rubber gloves. However, similarly to what observed in many developing countries (Garcia, 1998; Ecobichon, 2001) and by Mansingh *et al.* (2003) for Jamaica, farmer reported very limited access to such services in the district of Brandon Hill, which creates the scope for potentially another line of intervention programmes. In fact, health services might not only serve to mitigate pesticide intoxications once they occur, but to prevent them.

Finally, this study could also show that the cost of PPE might exert a significant influence on PPE use levels, whereby not all farmers have got all recommended pieces of PPE. This is confirmed by farmers suggesting the provision of PPE, e.g. by the RADA, as means of assistance to increase the adoption of safety practices and PPE use.

In sum, this study outlines some basic elements for an articulated strategy, i.e. one targeting education, economic incentives and the health system, to reduce unsafe pesticide-handling practices in eastern Jamaica. Its significance, however, extends beyond this region. While education is often proposed as the main strategy to overcome pesticide-related health problems but often achieves only limited or null effectiveness (Ospina *et al.*, 2009; Murray & Taylor, 2000), this study provides further support to the argument that a more articulated intervention strategy that combines different policy tools to target different influencing factors, could prove to be more effective in addressing unsafe pesticide-handling practices in rural areas in developing countries worldwide (Feola & Binder, 2010b; Feola *et al.*, 2012).

5 Conclusion

In conclusion, this explorative study showed that the pesticide handling practices of smallholder coffee farmers represent a relevant occupational health issue in eastern Jamaica. This not only involves the population of farmers active in the coffee plantations, but potentially other household members and therefore the wider local community, on account of the lack of safety practices that limit the contamination to the fields and farm workers. The study offered first insights into factors potentially influencing such practices, among which training on pesticide management, the role of health services and the cost of PPE seemed to be the most significant ones. However, further research is recommended as essential knowledge basis for future intervention programmes. Firstly, future research could extend the study scope to a wider population, in particular vulnerable household members potentially exposed to the chemicals and complement the analysis of farmer self-reported accounts with medical tests. Secondly, it is suggested that future research takes a stronger systemic approach by adopting theoretical frameworks and methods, including qualitative ones, to better understand the social and ecological dynamics that might be related to pesticide handling practices. Farmers are part of a social and ecological dynamic context in which social networks (including peers and other social actors), a changing environment, social norms, cultural beliefs and role models all interplay and potentially influence behavioural choices and the replication of social practices. Deepening the knowledge of such dynamics would represent a further significant step towards promoting more sustainable pesticide handling practices among smallholding coffee farmers in Jamaica.

References

ABIS (2009). Farmer Update. Agricultural Business Information System (ABIS) - Rural Agricultural Development Authority, Hope Gardens, Kingston 6, Jamaica W.I. URL `https://www.abisjamaica.com.jm/` last accessed 04.12.2010.

Andreatta, S. L. (1998). Agrochemical exposure and farm worker health in the Caribbean: a local/global perspective. *Human Organization*, 57 (3), 350–358.

Choi, B. C. K., Tennassee, L. M. & Eijkeman, G. J. M. (2001). Developing regional workplace health and hazard surveillance in the Americas. *Panamerican Journal of Public Health*, 10, 376–381.

Delle, J. A. (1998). *An archaeology of social space: Analyzing coffee plantations in Jamaica's blue mountains*. Plenum Press, New York and London.

Drive, D. H. (2006). Market requirements as it relates to pesticide residues. Coffee Industry Board of Jamaica. Available at:. URL `http://ciboj.org` last accessed 04.12.2010.

Ecobichon, D. J. (2001). Pesticide use in developing countries. *Toxicology*, 160, 27–33.

FAO (2003). WTO agreement on agriculture: The implementation experience - developing country case studies. Food and Agriculture Organization (FAO), Economic and Social Development Department, Geneva, Switzerland. URL `http://www.fao.org/docrep/005/y4632e/y4632e00.htm` last accessed 02.08.2013.

Feola, G. & Binder, C. R. (2010a). Towards an improved understanding of farmers' behaviour: the in-

tegrative agent-centred (IAC) framework. *Ecological Economics*, 69, 2323–2333.

Feola, G. & Binder, C. R. (2010b). Why don't pesticide applicators protect themselves? Exploring the use of personal protective equipment among Colombian smallholders. *International Journal of Occupational and Environmental Health*, 16, 11–23.

Feola, G., Gallati, J. A. & Binder, C. R. (2012). Exploring behavioural change through an agent-oriented system dynamics model: the use of personal protective equipment among pesticide applicators in Colombia. *System Dynamics Review*, 28, 69–93.

Garcia, J. E. (1998). Intoxicaciones agudas con plaguicidas: costos humanos y económicos. *Panamerican Journal of Public Health*, 4, 383–387.

Gordon, D. (2009). Coffee Industry Board (CIB), Kingston (Advisory Department). Personal communication (email).

ILO (1991). *Safety and health in the use of agrochemicals: A guide*. International Labour Organization (ILO), Geneva, Switzerland.

Mansingh, A., Robinson, D. & Dalip, K. M. (1997). Insecticide contamination of the Jamaican environment. *Trends in Analytical Chemistry*, 16, 115–123.

Mansingh, A., Robinson, D. & Dalip, K. M. (2003). Use, fate and ecotoxicity of pesticide in Jamaica and the Commonwealth Caribbean. In M. D. Taylor, S. J. Klaine, F. P. Carvalho, D. Barcelo, & J. Everaarts (Eds.), *Pesticide residues in tropical coastal ecosystems. Distribution, fate and effects* (pp. 425–463). Routledge, New York.

Mansingh, A. & Wilson, A. (1995). Insecticide contamination of Jamaican environment III. Baseline studies on the status of insecticidal pollution of Kingston Harbour. *Marine Pollution Bulletin*, 30, 640–645.

Mees, C., Esteban, N. & Seddon-Brown., S. (2003). Management of agro-chemicals for improved public and environmental health – A strategy for improved agro-chemical use and management for the wider Caribbean. Natural Resource System Program (NRSP); MRAG, London, UK. URL `http://natlaw.com/interam/jm/en/sp/spjmen00001.pdf` last accessed 02.08.2013.

Murray, D. L. & Taylor, T. L. (2000). Claim No Easy Victories: Evaluating the Pesticide Industry's Global Safe Use Campaign. *World Development*, 28, 1735–1749.

Ncube, N., Fogo, C., Bessler, P., Jolly, C. M. & Jolly, P. E. (2011). Factors associated with self-reported symptoms of acute pesticide poisoning among farmers in northwestern Jamaica. *Archives of Environmental & Occupational Health*, 66, 65–74.

NSA (2011). First aid treatment of pesticide poisoning. The Network for Sustainable Agriculture (NSA) - agLearn.net, Bangkok, Thailand. URL `http://www.aglearn.net/resources/resUse/fAidTreatment.pdf` last accessed 02.08.2013.

Ospina, J. M., Manrique-Abril, F. G. & Ariza, N. E. (2009). Intervención Educativa sobre los Conocimientos y Prácticas Referidas a los Riesgos Laborales en Cultivadores de Papa en Boyacá, Colombia. *Revista de Salud Publica*, 11, 182–190.

Palis, F. G., Flor, R., Warburton, H. & Hossain, M. (2006). Our farmers at risk: behaviour and belief system in pesticide safety. *Journal of Public Health*, 28, 43–48.

Quandt, S. A., Hernández-Valero, M. A., Grzywacz, J. G., Hovey, J. D., Gonzales, M. & Arcury, T. A. (2006). Workplace, household, and personal predictors of pesticide exposure for farmworkers. *Environmental Health Perspective*, 114, 943–952.

Robinson, D. E. & Mansingh, A. (1999). Insecticide contamination of Jamaican environment. IV. Transport of the residues coffee plantations in the blue mountains to coastal waters in eastern Jamaica. *Environmental Monitoring and Assessment*, 54, 125–142.

Schlosser, T. C. (1999). *Local realities and structural constraints of agricultural health: pesticide poisoning of Jamaican small-holders*. Master's thesis Virginia Polytechnic Institute and State University, Blacksburg, Virginia.

Teuber, R. (2010). Geographical Indications of Origin as a Tool of Product Differentiation: The Case of Coffee. *Journal of International Food and Agribusiness Marketing*, 22, 277–298.

Thundiyil, J. G., Stober, J., Besbelli, N. & Pronczuk, J. (2008). Acute pesticide poisoning: a proposed classification tool. *Bulletin of the World Health Organization*, 86, 205–209.

Waugh, T. & Nelson, G. (2003). Improving environmental performance in the coffee industry of Jamaica. Research & Environmental Department, Coffee Industry Board (Regulatory Division), Kingston, Jamaica. A research paper presented at the National Scientific Conference on the Environment: "Advancing Environmental Knowledge Towards Decision Making in Sustainable Development", April 9-10, 2003. URL `http://www.jiep.org/docs/T_Waugh__coffee.pdf` last accessed 02.08.2013.

Weis, T. (2000). The role and limitations of peasant co-operatives in rural Jamaica: the case of the St. Mary rural development project. *Canadian Journal of Development Studies/Revue canadienne d'études du développement*, 21 (3), 725–751.

Wesseling, C., Aragón, A., Castillo, L., Corriols, M., Chaverri, F., De La Cruz, E., Keifer, M., Monge, P.,

Partanen, T. J., Ruepert, C. & Van Wendel De Joode, B. (2001). Hazardous pesticides in central America. *International Journal of Occupational and Environmental Healt*, 7 (4), 287–294.

Yanggen, D., Crissman, C. & Espinosa, P. (2003). *Los Plaguicidas. Impactos en producción, salud y medio ambiente en Carchi, Ecuador*. Abya-Yala, Quito. Pp. 199.