Agricultural Activities, Pesticide Use and Occupational Hazards among Women Working in Small Scale Farming in Northern KwaZulu-Natal, South Africa

SALOSHNI NAIDOO, MBCHB, FCPHM, MMED, LESLIE LONDON, MBCHB, MD, ALEX BURDORF, PHD, RAJEN N. NAIDOO, MBCHB, PHD, HANS KROMHOUT, PHD

South Africa's land policies have increased women's participation in agriculture, but limited information exists about their agricultural activities. We surveyed 911 women working on the Makhatini Flats in Northern KwaZulu-Natal in 2006, gathering data on demographics, agricultural activities, crop production and pesticide use in both irrigated and Dryland areas. Average age of participants was 41.9, with Drylands women slightly older. Education levels were low among both groups, but lowest in the Drylands. Drylands women were more likely to engage in reported agricultural activities, including pesticide spraying. Use of World Health Organization class I and II pesticides was reported in both areas. Farm ownership, age <30 years, and being a sprayer were associated with knowledge of the names of pesticides utilized. This analysis suggests that women on the Drylands face greater risk of adverse ergonomic health outcomes and women from both areas are equally at risk for adverse pesticide-related health outcomes. *Key words*: South Africa, women, occupational health, pesticides.

INT J OCCUP ENVIRON HEALTH 2008;14:218–224

In agriculture, researchers have distinguished certain activities as "men's" and "women's" tasks. "Men's" tasks require greater physical effort such as clearing the land for planting and ploughing. "Women's" tasks, such as weeding and harvesting, are more easily arranged around household chores and require less physical effort.[1] Similarly, a distinction has been drawn between crops planted by men and women. Historical perspectives suggest that men tended to plant cash crops such as maize and other cereals; women, on the other hand, tended to plant subsistence crops, such as vegetables, which contributed toward family food security and local sale.[2,3]

However, with agricultural intensification, accompanied by migration of men toward the industrial sectors and growing female empowerment, clear distinctions between "men's" and "women's" work and crops are no longer easily made in agriculture. While women continue with domestic responsibilities, their agricultural activities and responsibilities have increased.[4,5] This change in women's roles in agriculture is evident in most of Africa, where there has been an increase in the number of female-headed households with women owning their own farms and planting crops which have traditionally been labeled "men's" crops.[6] Women may even participate in agricultural activities such as pesticide mixing and application.[7,8] Women with lower literacy levels[9] and financial income[2,5,10] as compared to their male counterparts may be unable to read pesticide information leaflets or purchase protective equipment, putting them at risk for pesticide exposure and the resultant adverse health effects. Furthermore, women working in agriculture in developing countries tend to participate in repetitive activities, work long hours, and have low incomes, all of which increase their risk for adverse occupational health outcomes.[5,11]

Following the advent of democracy in South Africa in 1994, the National Agricultural and Land Restitution Policy, encouraged the restitution of land to black South Africans whose land was expropriated under the apartheid regime, and encouraged gender equity promoting the return of land to women as independent landowners.[12] Between 1997 and 2000, 94,160 hectares of farmland in the province of KwaZulu-Natal (KZN) was redistributed to historically disadvantaged people. Women as owners and married co-owners were recipients of 46% of these land redistribution transactions.[13] This, combined with the long history of migration of men to

Received from the Department of Occupational and Environmental Health, School of Family and Public Health Medicine, Nelson R Mandela, School of Medicine, University of KwaZulu-Natal, South Africa (SN, RNN); Occupational and Environmental Health Research Unit, School of Public Health and Family Medicine, University of Cape Town, South Africa (LL); Department of Public Health, Erasmus MC, University Medical Center, Rotterdam, Netherlands (AB); and Institute for Risk Assessment Sciences, Environmental Epidemiology Division, Utrecht University, Netherlands (HK).

Funding for this research was provided by the South African Netherlands Research Programme on Alternatives in Development (SANPAD) and the South African Medical Research Council (SAMRC), Grant Number: 04/15.

Address correspondence and requests for reprints to: Saloshni Naidoo, Department for Occupational and Environmental Health, School of Family and Public Health Medicine, Nelson R Mandela School of Medicine, University of KwaZulu-Natal, Private Bag 7 Congella, 4013; email: <naidoos71@ukzn.ac.za>.

Disclosures: The authors report no conflict of interest.

urban areas for employment, has resulted in an increase in the number of women involved in small scale farming activities in rural communities in South Africa. There is, however, limited information available on the agricultural practices of, or occupational health hazards for, women involved in small scale farming in South Africa.

Located in Umkhanyakude District in the north-eastern part of KZN, the Makhatini Flats is the site of extensive small scale farming activity. Umkhanyakude District, bordered by Swaziland to the east and Mozambique to the north, has a scattered rural population of approximately 500,000 people.[14] More than 75% of the economically active age group is unemployed. This is a malaria-endemic area with an estimated HIV/AIDS prevalence of 31.8% in antenatal clinic attendees.[15] All homes are sprayed with DDT annually to control for Malaria.[16] The Makhatini Flats has a temperate climate making year-round cultivation of cash crops possible.

The Makhatini Flats includes farms on an artificial irrigation scheme and farms on unirrigated dry-lands. The irrigation scheme, developed under apartheid rule in South Africa and initially intended for the use of white farmers, was subsequently allocated to black farmers to support development in KZN. The Irrigation Scheme received considerable resources from the state, and has remained the focus of government support in the post-apartheid era.[17,18] The approximately 276 farms on the irrigation scheme vary from 1 to 10 hectares in size. On the Dryland, there are 1200 farms, ranging from 1 to 5 hectares in size. Almost all farmers practice mixed cropping with maize, vegetables, cotton and sugar cane being common crops on both the Irrigation Scheme and the Drylands.[17,19,20] Over the years the Dryland farmers have received less government support than their Irrigation Scheme counterparts. Drylands levels of productivity are dependent on the presence of natural rainfall.

Female agricultural worker applying pesticide to cotton crop with a backpack sprayer, KwaZulu-Natal, South Africa.

Female agricultural worker carrying recently-harvested cotton, KwaZulu-Natal, South Africa.

The aim of this study was to describe the agricultural activities and pesticide use among women working on small scale farms on the Makhatini Flats in Northern KZN, South Africa. The specific objectives of the study were to (1) establish a demographic profile of women working in agriculture on the Makhatini Flats; (2) describe agricultural activities, crop production and pesticide use by women; (3) to draw comparisons between women working on the Irrigation Scheme and the Drylands of the Makhatini Flats with respect to agricultural activities, crop production and pesticides used, as a means of investigating whether state developmental policies and gendered labor practices have created different risk profiles for these two groups of women farmers.

METHODOLOGY

A questionnaire survey of women involved in small scale farming on the Makhatini Flats was conducted June–August 2006, following ethical approval by the Ethics Committee of the University of KwaZulu-Natal.

Study Population and Recruitment of Study Participants

A preliminary informal census of the area indicated that there were on average 2–3 women working per farm, varying by size of farm, with smaller farms having fewer women working. We estimated that there were approximately 4400 women working on farms in the Makhatini Flats.

Prior to the questionnaire survey, the research team briefed the farmer unions and the community through community workshops on the project. Women in the community were invited directly and through the farmer unions to voluntarily participate in the ques-

Female agricultural worker transferring pesticide into a backpack sprayer, KwaZulu-Natal, South Africa.

tionnaire survey. Specific meeting points regularly used by the farmers were identified, and thirteen were randomly chosen as sites at which the questionnaire survey would be held on different days over the three month data collection period. Each site was visited more than once to ensure that women wanting to participate in the survey were able to do so.

All women above the age of 18 years who were present at these sites on the days of the interview were included in the survey, and in total 913 women volunteered to participate in the survey. This represented approximately twenty percent of the estimated number of women working on farms in the Makhatini Flats. There were no refusals.

Data Instrument and Data Collection

A questionnaire covering demographic details, crop production, agricultural activities, pesticide use and safety, and health outcomes, and consisting of a mixture of open and closed ended questions, was developed by the research team. The questionnaire was translated into Zulu and back-translated to ensure correctness of translation. Two research assistants piloted the questionnaire on the Makhatini Flats two months prior to the actual survey and the necessary corrections were made. A team of six experienced (4 female and 2 male) field workers, all fully conversant in Zulu, were trained to administer the questionnaire by the research team.

Data collection at the different sites took place from 11 A.M. onwards, because most women started their agricultural activities by 6 A.M.and were completed by midday. By scheduling the interviews in the middle of the day, we were able to ensure greater participation in the survey. Prior to data collection, the field workers solicited informed consent from participants. The questionnaires took approximately 30 minutes to administer.

Participants were requested to answer questions on crop production, agricultural activities and pesticides used, according to their activities over the past year. Participants provided trade names for pesticides used which were transformed to their active principles during analysis.

Data Analysis

The data collected was coded and captured by trained data capturers using EPIDATA. The SPSS version 15 statistical package was used to analyze the data. Means and 95% confidence intervals (95%CI) were calculated for continuous data, and frequencies were established for categorical data. The Independent Samples t-test and chi square were used to test for significant differences for continuous and categorical variables among women from the Irrigation Scheme and the Drylands, respectively.

Chi square was used to test for significant differences in pesticide knowledge between women from the two areas. A binary logistic regression model was developed to test if age, educational level, farm ownership, location and being responsible for spraying pesticides impacted on the knowledge of pesticides among women who sprayed in the two areas. The control variables chosen for inclusion in the regression model were selected because they were significantly related to the outcome under study on univariate analysis. The accepted level of significance was 0.05.

RESULTS

Questionnaires for two study subjects were spoilt and these were discarded. The results reported below are based on the data available for 911 women. In total 376 (41%) women from the Irrigation Scheme and 535 (59%) from the Drylands were interviewed.

Demographic Details

Average age of all participants was 41.9 years (95% CI: 41.0–42.7). Women working on the Irrigation Scheme were found to be and average of 2.2 years younger than those working on the Dry-lands. Forty-four percent (n=401) of the women participating in the survey had never attended school, while 56% (n=510) had some form of education. Women working on the irrigation scheme had received on average 1.1 years more education than women working on the Drylands (Table 1). Women on the Drylands were significantly more likely to work on farms owned by themselves or their families (n=502; 68.5%) compared to those from the Irrigation Scheme (n=231; 31.5%). Of the women interviewed, 113 (12.4%) lived in a house on their farm while 798 (87.6%) lived in a house that was a distance away from their farms.

TABLE 1 Demographic Profile of Female Agricultural Workers on the Makhatini Flats, by Location

	Irrigation scheme		Drylands	
	N	Mean (95% CI)	N	Mean (95% CI)
Age (in years)*	370	40.6 (39.3–41.9)	515	42.8 (41.7-43.8)
Educational level (years)*	233	7.3 (6.8–7.7)	277	6.6 (6.2–6.9)
Duration of residence (years)**	358	18.8 (17.5–20.2)	492	27.9 (26.5–29.5)
Distance residing away from farm (kilometers)**	347	13.4 (12.4–14.3)	450	9.4 (8.8–10.1)
Duration of employment (years)	294	7.1 (6.2–7.9)	286	8.2 (7.4–9.1)

Independent t-test α=0.05
*p<0.05
**p<0.001

Crop Production and Agricultural Activities

In agriculture the types and size of crops produced may influence the nature and intensity of agricultural exposures. Study participants planted 1–7 crops, with an average of 2 crops. Maize was the crop most frequently planted (n=517; 56.8%), followed by cotton (n=402; 44.1%). The mean hectarage cultivated per crop ranged from 0.5 for tomatoes to 4.3 for sugar cane. Women on the Irrigation Scheme cultivated a significantly larger mean hectarage (3.7 hectares) than women on the Drylands (2.9 hectares). Drylands women were significantly more likely to conduct all agricultural activities than women working on the Irrigation Scheme (p<0.05) (see Table 2).

Pesticides: Type, Frequency and Duration of Spraying

Of the 911 women interviewed, 45.6% (n=415) indicated that they themselves usually did most of the pesticide spraying on their farms. The mean number of times that women sprayed pesticides on each crop over the course of its cycle ranged from a low of 5.5 (95% CI: 4.9–6.2) for cabbages to a high of 18.3 (95% CI: 8.6–27.9) for mangoes. Some women reported spraying their crops as frequently as twice a week during a single growth cycle. The mean duration of spraying per crop cycle ranged from 0.7 hours for peppers to 8.9 hours for sugar cane.

Only 30.6% (n=279) of women in the study population knew the name of the pesticide they were using on their crops. Ten (3.5%) of the 279 women recalled more than one pesticide name. Cypermethrin (n=80; 28.7%), followed by glyphosate (n=75; 26.9%) and monocroptophos (n=38; 13.6%) were the most commonly recalled pesticide names. Farm ownership (OR=4.5, CI 2.3–8.9) was most significantly associated with having knowledge about the names of pesticides sprayed, followed by being less than thirty years of age (OR=2.3, CI 1.3–4.1), and being a sprayer (OR=2.0, CI 1.3–3.1) (Table 3).

Completion of more than 4 years of education was weakly associated with better knowledge of pesticide names (OR=1.6, CI 0.9–2.5) while location (Drylands v. Irrigation Scheme) was not (p=0.5).

Of those who could recall the names of the pesticides they used, several reported use of pesticides classified by the World Health Organization (WHO) as highly hazardous (Class Ib) or moderately hazardous (Class II) (Table 4).[21] A combination of glyphosate and cypermethrin was most frequently used on tomatoes (17.2%), cabbages (14.9%) and peppers (15.6%). Cypermethrin was reported as most frequently used on maize (10.9%) and cotton (9.8%). Paraquat, a herbicide, was most frequently reported as being used on sugar cane crops (3.5%). Combinations of pesticides such as monocrotophos and cypermethrin, monocrotophos and lambda-cyhalothrin, diuron and paraquat and metribuzin were also used by a small number of women.

A total of 415 out of 911 women (45.6%) sprayed pesticides, with significantly (p<0.001) more women from the Drylands (n=281; 52.5%) responsible for spraying of pesticides than those from the irrigation scheme (n=134; 35.6%).

DISCUSSION

This study of working patterns and exposures to agricultural hazards of rural women in KwaZulu-Natal, South Africa has described some of the risks faced by

Female agricultural workers tilling the land, KwaZulu-Natal, South Africa.

TABLE 2 Comparisons of Women's Agricultural Activities on the Makhatini Flats, by Location

	Location	
	Irrigation Scheme N=376	Dry-lands N=535
Women's Agricultural Activities	Yes n (%)	Yes n (%)
Animal assisted ploughing**	9 (2.4)	201 (37.6)
Tractor assisted ploughing*	236 (62.8)	372 (69.5)
Manual ploughing**	150 (39.9)	365 (68.2)
Planting**	298 (79.3)	509 (95.1)
Manual irrigation**	69 (18.4)	185 (34.6)
Spraying**	199 (52.9)	374 (69.9)
Weeding*	347 (92.3)	512 (95.7)
Harvesting**	297 (79.0)	484 (90.5)

Chi squared test: α=0.05
*p<0.05
**p<0.001

TABLE 3 Factors Influencing Knowledge of Pesticide Names

Variable#	Odds Ratio	95% CI
Farm ownership*	4.5	2.3–8.9
Age (<30 years)**	2.3	1.3–4.1
Age (30-39)	1.6	0.8–2.9
Age (40-49)	1.1	0.5–2.2
Age (50-60)	1.7	0.5–5.2
Years of education***	1.6	0.9–2.5
Responsible for spraying	2.0	1.3–3.1
Location	1.1	0.7–1.7

#Variables included in the logistic regression model
*Farm ownership = woman and/or family owned.
**Reference age group = <30 years.
***Reference group = >9 years education
****Irrigation Scheme vs. Drylands.

TABLE 4 Pesticides Used on Crops as Reported by Women on the Makhatini Flats, by WHO Class

Name	WHO Class[a]	Chemical Class[b]	Main Use[c]
methamidophos	Ib	OP	I
monocrotophos	Ib	OP	I
methyl carbamate	Ib	C	I
cypermethrin	II	PY	I
deltamethrin	II	PY	I
dimethoate	II	OP	I
lambda-cyhalothrin	II	PY	I
paraquat	II	BP	H
metribuzin	II	T	H
malathion	III	OP	I
glyphosate	U	NA	H
diuron	U	SU	H
mancozeb	U	TC	F

[a]1a = Extremely hazardous; Ib = Highly Hazardous; II = Moderately hazardous; III = Slightly hazardous; U = Unlikely to present acute hazard in normal use; O = Obsolete as pesticide, not classified.
[b]OP = Organophosphate, PY = Pyrethroid, BP = Bipyri-dylium derivative, C = Carbamate. T = Triazine, TC= Thiocarbamate, SU = Substituted Urea, NA = Chemical class not available.
[c]F = Fungicide, H = Herbicide, I = Insecticide.

this marginalized sub-population. Women were found to be working with moderate to highly hazardous pesticides, and the majority of these women had no knowledge of their exposures. While substantial differences in working patterns exist between women in the two areas, this exposure pattern remains constant.

This study found that a large number of women were responsible for spraying pesticides, which has been traditionally regarded as a male activity. Traditionally, women have had much less occupational contact with pesticides than their male counterparts; however, female involvement with pesticides has varied over time and place. For example, Mancini et al. report women laborers mixing and filling spray tanks with pesticides while male coworkers sprayed.[7] The potential for adverse pesticide-related health effects among women in this study increases with the assumption of pesticide spraying duties. Study participants reported use of a wide variety of pesticides, several of which belong to the WHO pesticide classes I and II, which are known to be hazardous to humans.[21] In previously described studies conducted in the developing world, similar findings have been reported. Mancini et al.,[7] Ohayo-Mitoko et al.,[22] and Ngowi et al.,[23,24] studying female cotton farmers in India, pesticide applicators in Kenya, flower farmers and smallholder vegetable farmers in Tanzania, all found that class I and II pesticides were extensively used.

While the farms on the Irrigation Scheme tend to be larger than those on the Drylands, the study found that women on the Drylands were more often involved in agricultural activities as compared to the women on the Irrigation Scheme. Women on the Irrigation Scheme were less likely to be working on family owned farms. Instead, they formed part of an employed labor force including men, who performed more agricultural activities as compared to the women. Women on the Drylands were more likely to own their farms or work on family-owned farms, and so may have limited male assistance and as a result be more involved in agricultural activities. It has also been shown that female-headed households experience greater financial constraints and thus may have difficulty in hiring labor.[3] The agricultural activities reported by the women in this study may require frequent bending, twisting, carrying of loads, working in awkward postures and exposure to vibration. Such exposures have been associated with a high prevalence of musculoskeletal symptoms among farmers and have the potential to produce similar symptoms in this study population.[25,26]

The age and education profile of women on both the Drylands and the Irrigation Scheme is typical of most rural communities in South Africa.[27] Research in South Africa has shown that unmarried women age 26–35 with a secondary school education are more likely to migrate to urban areas than married females with a primary school education.[28] Thus, the poorly educated female is more likely to remain in the rural areas working in agri-

culture. Interestingly, our study showed younger women had better knowledge of the names of the pesticides compared to older women. This finding likely reflects the low literacy levels among older women in this community, which puts them at greater risk for known adverse pesticide-related health outcomes.

In South Africa, the Occupational Health and Safety Act requires that all employers train employees exposed to workplace hazards on the nature of their exposures, safety procedures, and related adverse health effects.[29] The Hazardous Chemical Substances regulation places a further obligation on employers to protect the health of workers from exposures to dangerous chemicals. Unfortunately, in South Africa the implementation of health and safety legislation in agriculture is poor. In our study, women showed a considerable lack of knowledge about the pesticides with which they had contact. This lack of knowledge may be attributed to the absence of formal training on pesticide application, which has been shown to be the case in rural communities elsewhere.[22,24] In most rural communities in South Africa, there are low literacy levels, which are compounded with limited or absent training on pesticides, which increases the risk for exposure and adverse health effects in agricultural populations. In Ethiopia, Mekonnen and Agonafir found that most of the sprayers in their study could not read or understand the information provided in pesticide packages.[30] As a result, workers were unable to adopt appropriate safety practices with respect to pesticide applications, putting them at risk for adverse health effects. Similarly, Salameh et al. found in a study of Lebanese farmers that the lower the pesticide knowledge, the fewer protective measure they took.[31] The significant association between education and knowledge of pesticide names found in our study suggests that education and training would serve to improve knowledge among women working in agriculture. This education and training could be extended to all aspects of pesticide management and occupational health and safety in agriculture in general.

CONCLUSION

In conclusion, this study found that there was a general lack of knowledge about pesticides in both groups of women, leaving both groups at risk for adverse pesticide-related health outcomes. The findings of this study suggest that women on the Drylands are more likely to be involved in agricultural activities as compared to their counterparts on the Irrigation Scheme, and are thus at greater risk for adverse ergonomic health outcomes.

Based on the study findings, it is recommended that further research in this study population should examine the physical and chemical hazards associated with the documented agricultural activities. In addition, the presence of adverse ergonomic and pesticide related health outcomes such as musculoskeletal pain, pesticide poisonings and reproductive abnormalities should be investigated.

Female agricultural workers harvesting cabbages, KwaZulu-Natal, South Africa.

References

1. Burton ML, White DR. Sexual Division of Labor in Agriculture. American Anthropologist. 1984;86(3):568-83.
2. Stone MP, Stone GD, Netting RM. The Sexual Division of Labor in Kofyar Agriculture. American Ethnologist. 1995;22(1):165-86.
3. Doss CR. Designing Agricultural Technology for African Women Farmers: Lessons from 25 Years of Experience. World Development. 2001;29(12):2075-92.
4. Doss CR. Men's Crops? Women's Crops? The Gender Patterns of Cropping in Ghana. World Development. 2002;30(11):1987-2000.
5. London L, de Grosbois S, Wesseling C, Kisting S, Rother HA, Mergler D. Pesticide usage and health consequences for women in developing countries: out of sight, out of mind? Int J Occup Environ Health. 2002;8(1):46-59.
6. Ezumah NN, Di Domenico CM. Enhancing the role of women in crop production: A case study of Igbo women in Nigeria. World Development. 1995;23(10):1731-44.
7. Mancini F, Van Bruggen AH, Jiggins JL, Ambatipudi AC, Murphy H. Acute pesticide poisoning among female and male cotton growers in India. Int J Occup Environ Health. 2005; 11(3):221-32.
8. J Erbaugh MA, S Kyamanywa, E Adipala The role of women in pest management decision making in Eastern Uganda. J Intl Agric and Ext Educ. 2003 10(3):71-80.
9. Atreya K. Pesticide use knowledge and practices: A gender differences in Nepal. Environmental Research. 2007;104(2):305-11.
10. Rahman S. Women's employment in Bangladesh agriculture: Composition, determinants and scope. Journal of Rural Studies. 2000;16(4):497-507.
11. Singh S. Contracting Out Solutions: Political Economy of Contract Farming in the Indian Punjab. World Development. 2002; 30(9):1621-38.
12. Hall R. A Political economy of land reform in South Africa. Review of African Political Economy. 2004;31(100):213-27.
13. Lyne M, Darroch M. Land Redistribution in KwaZulu-Natal, South Africa: Four Census Surveys of Farmland Transactions, 1997-2000. [Internet]. Wisconsin. 2001. [cited 2008 April 20]. 32p. Available from: http://www.ies.wisc.edu/ltc/live/bassaf0108g.pdf.

14. Umkhanyakude [Online report]. Pietermaritzburg: Government of KwaZulu-Natal; 2003 [cited 2008 Apr 27]. 9p. Available from: http://devplan.kzntl.gov.za/General/Documents/2003Aug27_4/Umkhanyakude_Lekgotla_report_July_2003_Version3.pdf.
15. Day C, Gray A. Chapter 22. In Ijumba P, Padarath A eds. South African Health Review. Durban, South Africa: Health Systems Trust; 2006:369-506.
16. Day C, Gray A. Chapter 17. In Ijumba P, Day C, Ntuli A eds. South African Health Review. Durban, South Africa: Health Systems Trust; 2005:249-366.
17. Pschorn-Strauss E. Bt cotton in South Africa. The case of the Makhatini Farmers. Seedling. 2005:13-24.
18. Witt H, Patel R, Schnurr M. Can the Poor Help GM Crops? Technology, representation cotton in the Makhathini flats, South Africa. Review of African Political Economy. 2006; 33(109):497-513.
19. Bennet R, Buthelezi T J, Ismael Y, Morse S. M. Bt cotton, pesticides, labour and health. A case study of smallholder farmers in the Makhatini Flats, Republic of South Africa. Outlook on Agriculture 2003; 32:123-8.
20. Hofs J-L, Fok M, Vaissayre M. Impact of Bt cotton adoption on pesticide use by smallholders: A 2-year survey in Makhatini Flats (South Africa). Crop Protection. 2006;25(9):984-8.
21. World Health Organization. The WHO Recommended Classification of Pesticides by Hazard and Guidelines to Classification [Internet].Geneva; 2004. [cited 2008 Feb 10th]. 60p. Available from: http://www.who.int/ipcs/publications/pesticides_hazard_rev_3.pdf.
22. Ohayo-Mitoko GJA, Kromhout H, Karumba PN, Boleij JSM. Identification of Determinants of Pesticide Exposure Among Kenyan Agricultural Workers Using Empirical Modelling. Ann Occup Hyg. 1999;43(8):519 -25.
23. Ngowi AVF. Occupational exposure to pesticides at flower farms in Northern Tanzania. Afr Newsletter Occup Health Saf. 2003; 13(1):16-8.
24. Ngowi AVF, Mbise TJ, Ijani ASM, London L, Ajayi OC. Smallholder vegetable farmers in Northern Tanzania: Pesticides use practices, perceptions, cost and health effects. Crop Protection. 2007;26(11):1617-24.
25. Holmberg S, Thelin A, Stierstrom E, Svardsudd K. The Impact of Physical Work Exposure on Musculoskeletal Symptoms among Farmers and Rural Non-Farmers: A population-based study. Ann Agric Environ Med. 2003;10:179-84.
26. Walker-Bone K, Palmer KT. Musculoskeletal disorders in farmers and farm workers. Occup Med. 2002;52(8):441-50.
27. Curtis B, Bradshaw D, Nojilana B. Socio-Demographic Profile of the Magisterial District of Hlabisa—1996 Census. [Internet]. Durban. South African Medical Research Council (SA); 2002. [cited 2008 Feb 10th]. 22p. Available from: http://www.mrc.ac.za/bod/hlabisafinal.pdf.
28. Van der Berg S, Burger R, Leibbrandt M, Mlatsheni C. Migration and the changing rural-urban interface in South Africa: What can we learn from census and survey data? Unpublished paper. 2002.
29. South African Department of Labour. Regulations for Hazardous Chemical Substances Occupational Health and Safety Act (Act No. 85 of 1993). Pretoria. 1993.
30. Mekonnen Y, Agonafir T. Pesticide sprayers' knowledge, attitude and practice of pesticide use on agricultural farms of Ethiopia. Occup Med. 2002;52(6):311-5.
31. Salameh PR, Baldi I, Brochard P, Abi Saleh B. Pesticides in Lebanon: a knowledge, attitude, and practice study. Environ Res. 2004;94(1):1-6.