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PROPOSED MODEL FOR HANDLING PESTICIDE CONTAINERS BY AGRICULTURE TEACHERS IN ESWATINI

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Abstract

Pesticides are toxic, even in very small quantities can have an adverse impact on organisms. Consequently, improper disposal of pesticides or their containers can lead to health hazards and environmental contamination. From the Draft Policy on Pesticides Management of 1992, Eswatini drafted a Pesticides Management Bill of 2010. At the moment there is no legal document that enforces the management of pesticides in Eswatini. This study aims at proposing a model by which agriculture teachers in Eswatini can use in managing pesticide containers. The study used a qualitative approach, transformative paradigm employing action research design. Content analysis was employed at data collection and analysis. The content analysis involves the review of documents such as policies, bills and related documents. Findings revealed that the model of handling pesticide containers by pesticide users: firstly users should read the container label, triple rinse pesticide containers, properly store the containers, sort containers by pesticide material, recycle the container, send it back to manufacturer, incineration, and land filling. Conclusion drawn is that anyone using agricultural chemicals is equally responsible for the safe disposal of the pesticide container. The model is recommended for the handling of pesticide containers by agriculture teachers in Eswatini.

Keywords: action research, model, pesticides containers, pesticides disposal, waste management

INTRODUCTION

Pesticide containers can be a nuisance: sometimes they are not easy to dispose of and they clutter workshops and storage areas (Pesticide Disposal Program, 2014). According to Brown (1999) pesticides are toxic, even in very small quantities and can have an adverse impact on organisms. A pesticide container can be as hazardous as a full one because of residues left inside (Buhler, n.d.). Consequently, improper disposal (waste management) of pesticides or their containers can lead to environmental contamination and may incur both civil and criminal penalties. Improper disposal of these pesticide containers can lead to environmental problems such as contamination of groundwater, soils, plants, and animals (Pesticide Disposal Program, 2014). Waste management is the collection, transportation, processing or disposal, managing and monitoring of waste materials. The term usually relates to materials produced by human activity and the process is generally undertaken to reduce their effect on health, the environment or aesthetic. Waste management is a distinct practice from resource recovery which focuses on delaying the rate of consumption of natural resources. All waste materials, whether solid, liquid, gaseous or radioactive fall within the remit of waste management (Rao, 1991). Johnson (2010) asserts that there are three types of pesticide wastes that require proper disposal. These types of pesticide wastes are the unused pesticides that remain in the original containers; pesticide mixtures that are left unused after an application, and pesticide containers. This paper focuses on the management of pesticide containers.

According to the Basel Convention (1992) without proper waste management, we are not only harming the beauty and health of our environment but, we are also increasing negative effects that waste can have on our own health. Rao (1991) pointed out that landfill becomes the most popular method of disposing waste (such as pesticide containers) and often established in abandoned or unused quarries. More than half of the waste produced end up in landfill and therefore consuming huge amount of land. Incineration is another mode of managing waste (including pesticide containers). It is a controversial method of waste disposal due to issues

such as emission of gaseous pollutants (Rao, 1991). In incineration, organic wastes are subjected to combustion such as to convert them to residue and gaseous products. This method is useful for the disposal of residue of both solid waste management and solid residue from waste water management. This process reduces the volume of solid waste to 20 to 30 percent of original volume. Scottish Environment Protection Agency [SEPA] (2006) suggested recycling as another waste management strategy. In recycling, waste materials such as empty beverages containers are collected and reuse. The materials from which an item is made from can be reprocessed into new products (SEPA, 2006).

From the Draft Policy on Pesticides Management 1992, Eswatini drafted the Pesticides Management Bill of 2010 which is still waiting to be passed by the parliament. In a nutshell, the Pesticides Management Bill (2010) in Part IV, Article Number 34, Section 2 and 3 respectively states that "*A person shall not sell or reuse containers which had previously contained pesticides*" and "*A person shall not dispose of any pesticide or pesticide waste in a manner that may harm human or animal health or environment ... and unless the person has a valid permit*".

Section 4 requires that a committee should be set up by the Minister of Agriculture in collaboration with the Minister responsible for environment to manage the accumulation of obsolete pesticides and pesticide containers (Ministry of Agriculture, 2010).

In March 6, 2012, the Minister of Agriculture speaking during a seminar on '*Empty Pesticide Containers Management*' held at the Veterinary Offices in Manzini confessed that his Ministry was not effective enough in the management of pesticide containers, which at times becomes a threat to both livestock and human health. The minister further highlighted that the agricultural sector was not only expected to use pesticides responsibly but also make sure that pesticide containers were properly managed. Consequently, the stakeholder meeting was convened to start developing regulations on the Bill (Shaw, 2012).

At the moment there is no legal document that enforces the management of pesticide or pesticide containers in Eswatini (Dlamini, 2000). This literally means the selling and use of pesticides is unregulated. Pesticide containers are either lying around in the environment or used as food containers. Therefore, this paper seeks to present a model in which pesticide containers can be handled.

This study aimed at proposing a model which agriculture teachers in Eswatini can use in managing pesticide containers. The objectives of the paper were to:

(i) present the different ways of handling pesticides containers by agriculture teachers in Eswatini
(ii) develop a model that can be used to handle pesticides containers by agriculture teachers in Eswatini

METHODOLOGY

The study used a qualitative approach, transformative paradigm employing action research design. Action research is a type of qualitative research that seeks action to improve practice and study the effects of the action that was taken (Creswell, 2014; Streubert & Carpenter, 2002). It is regarded as a means of social change (Schratz & Walker, 1995) and for improving practice (Koshy, 2010).

There has also been a need to address validity and reliability in this study. Validity is the degree of congruence between the explanations made and the realities observed (Straits & Singleton, 2011). In this study validity was enhanced by thick description of the handling of pesticide containers as suggested by Guba (1981). Reliability is the fit between what researcher's record as data and what really occurs in the natural setting being researched (Straits & Singleton, 2011). Reliability was addressed by a describing in detail the research design and its implementation – and design choices made as postulated by Lincoln and Guba (1985). The author provided a full detail of data generation (content analysis) and a reflective evaluation of the study. In order to improve trustworthiness the researcher ensured that there was a linkage between the methods (content analysis) used and the research instruments developed to guide the researcher during data collection.

Content analysis was employed in data collection. This involved soliciting information from various sources: internet; books, bills and policies (e.g. Draft Policy on Pesticides Management, 1992) and the Pesticides Management Bill, 2010) in Eswatini such as the Ministry of Agriculture (Crop Production Section), Malkerns Research Station, Municipalities (Mbabane and Manzini) and Swaziland Environmental Authority. The data were analysed inductively using thematic analysis. The research findings emerged from frequent dominant and significant events in the raw data (Nieuwenhuis, 2007). Thereafter, analysis involved identifying broad categories of constructs across the data related to the key research question of the study. This required a line by line reading of the different data set. The analysis involved identifying theoretically and conceptually informed themes across the identical categories (Cresswell, 2013). This allowed the researcher to critically link explicit themes emerging from the empirical data and to discuss this in light of the current debates and theories in the field to which the study wishes to contribute knowledge.

FINDINGS AND DISCUSSION

The presentation of the findings was guided by the objectives of the study.

Ways of managing pesticide containers

Pesticides containers can be handled in many ways. These involve reading the container label, cleaning chemical

containers; proper container storage; sorting containers by material; recycle; sending it back to manufacturer; incineration, and land fill.

Never use pesticide containers for food or drink stuff

A pesticide container can be as hazardous as a full one because of residues left inside. Therefore, never reuse pesticide containers to carry or store other items, especially food or drinks. Never puncture or burn a pressurized or aerosol container - it could explode (Buhler, n.d). Agriculture teachers should not reuse the pesticide container for any purpose unless: it is specifically designed to be returned and refilled, and the teacher should do so in line with the label instructions or filling it with an identical pesticide product transferred from a damaged container (Code of practice for using plant protection products, 2006)

Read the pesticide container label

Before disposing of a non-returnable container, make sure it is completely empty (Code of practice for using plant protection products, 2006). Most pesticides containers have labels on disposal instructions. James (2006) asserted that it is important that the user of the pesticide read the label and understand the disposal requirements before getting rid of the pesticide container. The product label will state whether the pesticide user should rinse the container after emptying it (Code of practice for using plant protection products, 2006).

Clean the pesticide container

Generally, all containers should be thoroughly cleaned and drained before disposal. Cleaning containers is considered less hazardous and attracts lower disposal charges than dirty packaging (SEPA, 2006). However, Schoubroeck, Herens, de Louw, Louwen, and Overtoom (1992) pointed out that even though the content is less dangerous as it is diluted, it should be emptied in drain, not on the soil surface or water sources.

Containers of liquid formulations should be triple rinsed or pressure rinsed immediately after emptying into the spray tank (James, 2006). According to Buhler (n.d.) the following steps should be followed for triple-rinsing pesticide containers: (i) **w**hile still wearing protective equipment, pour any excess pesticide into the sprayer; (ii) fill pesticide container ¼ full of clean water, replace cap and shake container for 30 seconds. Pour rinse water into sprayer; (iii) repeat two additional times, shaking container in different directions; (iv) carefully rinse the outside of the container and the cap over the sprayer (or bucket to catch rinse water); (v) dispose of the cap as regular household waste, and dispose of or recycle containers according to local regulations; and (vi) apply the diluted rinse material according to label directions.

If there are no instructions, the pesticide user should: use purpose-made container-rinsing equipment in line with the manufacturer's instructions or rinse containers by hand (using gloves) at least three times (or until the container is visibly clean) with clean water. Add the rinsings to the spray solution. The pesticide user may also be able to rinse some types of flexible packaging designed for solid pesticides which are applied as a solution, depending on the material and design of these packs. The pesticide user should always rinse containers immediately after emptying them, once the pesticide user has allowed the product to drain fully into the equipment that is applying it. The pesticide user should also rinse contaminated closures (caps and seals) and any contamination on the outside of containers. All rinsing should be added to the spray solution (Code of practice for using plant protection products, 2006).

Firmly replace caps on containers immediately after rinsing and draining them into the equipment used for applying pesticide. Put the rinsed foil seal inside the container. Store the rinsed and drained containers upright in a secure, weather-proof area away from stored pesticides (either in a separate store or a separate part of the chemical store), until one can dispose them (Code of practice for using plant protection products, 2006).

Containers that have been thoroughly rinsed and drained will generally be accepted at licensed waste-disposal sites as long as the conditions of the site operator's licence allow this. The local Environment Agency office can give the pesticide user details of these sites. Do not use empty pesticide containers or contaminated pallets for transporting food or animal feed (Code of practice for using plant protection products, 2006).

According to the Code of practice for using plant protection products (2006) one must not rinse or clean pesticide containers which hydrogen cyanide gassing powders or aluminium, magnesium or zinc phosphides have been supplied in or kept in because of the dangerous gases they give off when they come into contact with moisture. The pesticide user should handle and store these pesticide containers as if they still contained the pesticide and should dispose of them through a licensed waste-disposal contractor.

Proper storage of pesticide container

Containers which are not suitable for rinsing (for example, paper sacks and cardboard cartons) and those containing products which are either ready-to-use or not applied as a solution, are normally emptied completely but not rinsed. These will have the phrase '*Empty container completely and dispose of safely*' on the label. The pesticide user should handle and store these pesticide containers as if they still contained the pesticide, and should dispose of them through a licensed waste-disposal contractor (Code of practice for using plant protection products, 2006). The containers of dry formulations after empting the contents into the tank should be shaken to remove as much residue as possible. One should also be careful not to inhale any dust from the pesticide container. Similarly, with containers of aerosol formulations, one should spray out as much as possible -

on the proper site, relieving the pressure (Brown, 1999). The cleaned containers should then be allowed to dry properly before disposal (SEPA, 2006).

Sort pesticide containers

Check with a waste disposal/recycling contractor how and if materials need to be sorted in to different packaging types e.g. cardboard, plastics, metals, foil seals. Return unopened pesticide containers to the dealer (SEPA, 2006). Properly rinsed containers can be taken to a container collection centre to be recycled (Buhler, 2004). Containers must be free of any pesticide residue inside and outside before they are recycled (Johnson, 2010). The good news is that Container Management Program (CMP) Phase (1) has now commenced in Eswatini with the recycler now collecting pesticide containers from all the sugar estates and the two major forestry companies **(**Empty pesticide container management, 2012). Some communities have programmes to recycle household waste such as empty bottles and cans. Do not recycle any pesticide containers, unless the recycling programme specifically accepts pesticide containers and follow the programme's instructions for preparing the empty containers for collection (Buhler, n.d).

Recycling of pesticide

Properly rinsed pesticide containers can be chipped and used to make such things as plastic fence posts, palates and various other industrial supplies (Pesticide Disposal Program, 2014). Paper-fibre materials can be recycled to produce such products as tissue, newspaper, cardboard, etc (Department of Water Affairs and Forestry, 1998). Recycled waste plastic materials can be recycled into either plastic sheets to be used as wallboards; fence posts (Buhler, n.d.) or could also be used to generate electricity at Waste Energy Plants (Brown, 1999). Metal recycling such as tin, steel and aluminium cans, used for aerosols are sold to metal recyclers (Department of Water Affairs and Forestry, 1998).

Incinerate pesticide containers

According to Rao (1991) incineration is the preferred means of disposal for most organic and selected inorganic pesticide container. It is simply the controlled combustion of waste materials to reduce these to a non-combustible residue or ash and exhaust gases i.e. carbon dioxide and water. All remains from incineration or any pesticide container that cannot be incinerated is taken to a landfill (Rao, 1991).

Take pesticide containers to a landfill

Pesticide containers that cannot be recycled and incinerated should be taken to a landfill. Some landfills can accept all forms of waste while others are specific e.g. designed for hazardous waste (Loehr, 1974). Generally, landfills are owned by municipalities. In Eswatini there are only three landfills: Manzini Municipality, Mbabane Municipality and Matsapha Municipality. Specifically, the Manzini and Mbabane municipalities work with the Ministry of Agriculture and the Swaziland Environmental Authority (SEA) to dispose pesticide containers which need the incineration or landfill.

Integrated pesticide container management

The pesticide user can dispose rinsed pesticide containers in the following ways: (i) pass them on to a licensed waste-disposal contractor; (ii) take them to a licensed waste-disposal or waste-recovery site, after checking whether the site will accept rinsed containers; (iii) burn them only in an incinerator licensed by the local authority or the Environment Agency. Contact the local Environment Agency office for more information (Code of practice for using plant protection products, 2006). It is worth noting that some containers need to be returned to the manufacturer for proper disposal (Johnson, 2010).

Proposed model for handling pesticide containers

The handling of containers could vary with the type of material used to make containers or type of pesticide that was contained. This section presents the proposed model of handling pesticide containers as depicted in Figure 1. Agriculture teachers should start by reading the container label before any attempt to dispose the pesticide container is made. This will help the teacher to decide whether the pesticide container should be sent directly back to pesticide manufacturer or should be cleaned and triple rinsed. Generally, all containers should be thoroughly cleaned or triple rinsed and drained before disposal to render them less hazardous. The pesticide containers are then sorted out according to pesticide and material. Thereafter, the pesticide containers are stored in a temporary storage area. One should

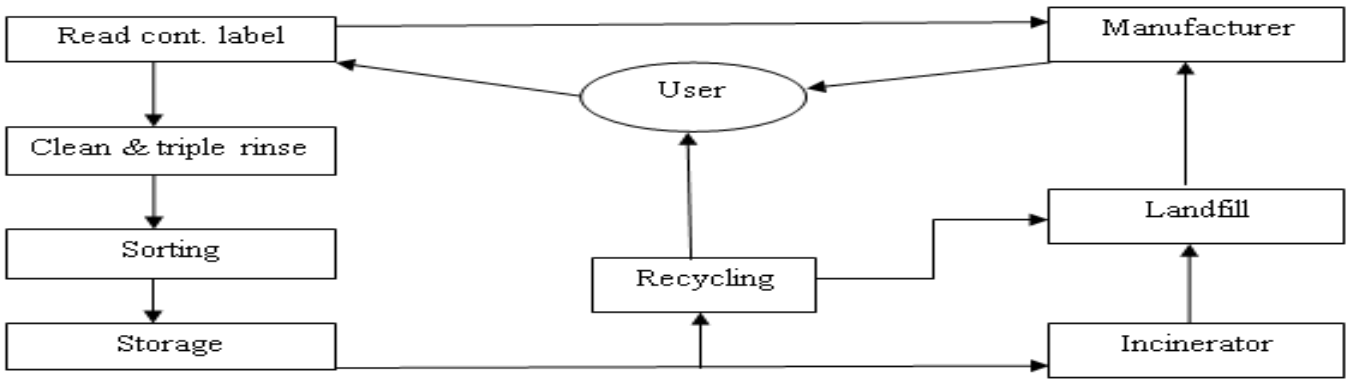

Figure 1 Proposed Model for Pesticide Container Disposal

decide whether these containers can be taken to a recycling firm or for combustion in an incinerator. Recycling could be the best alternative since the material become reusable. Other options are to take the triple rinsed pesticides container from storage to the landfill or straight back to the pesticide manufacturer. Remains from the incineration are taken to the landfill.

CONCLUSION AND RECOMMENDATIONS

Every one using agricultural chemicals is also responsible for the safe disposal of the pesticide container. This can be ensured through following disposal instructions and triple rinsing before any other waste management strategy such as recycling, incineration or land filling is considered. Land filling should be the last resort. Conclusion drawn is that agriculture teachers as users of agricultural chemicals are equally responsible for the safe disposal of the pesticide container. The model is recommended for the handling of pesticide containers by agriculture teachers in Eswatini.

LITERATURE CITED

Basel Convention (1992). *The Basel convention technical guidelines on hazardous waste from the production and use of organic solvents.* Retrieved from http: www.basel.int/.../Technical-guidelines-on-the-environmentally-sound-co- processing-of-hazardous-wastes-in-cement-kilns.aspx

Brown, A. M. (1999). *Disposal of pesticide containers.* U.S.A, Maryland: Department of Entomology. University of Maryland, U.S.A.

Buhler, W. (2004). College of Agriculture and Life Sciences, NC State University. *Recycling plastic pesticide containers.* Retrieved from www.acrecycle.org.

Buhler W. (n.d). *Pesticide and container disposal.* http://pesticidestewardship.org

Code of practice for using plant protection products (2006). *Disposing of pesticide waste.* Retrieved from http://www.pesticides.gov.uk

Creswell, J. W. (Ed.). (2014). *Research design international student edition: qualitative, quantitative and mixed methods approaches*. United Kingdom. London: Sage Publications, Inc.,

Department of Water Affairs and Forestry (1998). *Minimum requirements for the handling, classification and disposal of hazardous waste.* Republic of South Africa, Pretoria: Author.

Dlamini, M. (2000). *Pesticides management in Swaziland.* The OECD-FAO-UNEP workshop on obsolete pesticides. Retrieved from http://www.gov.sz

Empty pesticide container management (2012). *Empty pesticide container management project – Swaziland. Crop Life Africa Middle East Newsletter Number 77.* Retrieved from http://www.croplifeafrica.com

Guba, E. G. (1981). Criteria for assessing the trustworthiness of naturalistic inquiries, *Educational Communication and Technology Journal* 29: 75–91.

James, L. (2006). *Safe disposal of empty pesticide containers.* Australia, Sandra Hardy: Crop Life.

Johnson, R.H. (2010). *What you need to know... about disposing pesticide.* Agricultural Research and Cooperative Extension. Pennsylvania State University. Retrieved from www.pested.psu.edu

Koshy, E., Koshy, V., & Waterman, H. (2010). *Action research in healthcare.* U.S.A California: SAGE Publications.

Loehr, R. C. (1974). *Environmental Science - Agricultural Waste Management: Interdisciplinary Monograph Series.* United Kingdom, London: Academic Press INC,.

Lincoln, Y. S. & G. Guba, E. G. (1985). *Naturalistic inquiry*. USA, Newbury Park, CA: Sage Publications.

Ministry of Agriculture (2010). *Swaziland Pesticide Management Bill.* Government of Swaziland, Mbabane, Swaziland.

Nieuwenhuis, J. (2007). Analysing qualitative data. In Maree K. (ed*).First step in research.* South Africa, Pretoria: Van Schaik Publications.

Pesticide Disposal Program (n.d.). Pesticide container recycling & pesticide waste disposal. *Retrieved from http://agr.georgia.gov/pesticides.aspx*

Pesticide Disposal Program (2014). Pesticide container recycling & pesticide waste disposal. *Retrieved from http://www.epa.gov*

Rao, C. S. (1991). *Environmental pollution control engineering.* United Kingdom, London: Wiley Eastern Limited New Age International.

Riffer W. F and Shirmohammadi A (2001). *Agricultural non-point source pollution: watershed management and hydrology.* USA, New York: Lewis publisher.

Schratz, M., & Walker, R. (1995). *Research social change: new opportunities for qualitative research.* United Kingdom, London: Routledge.

Scottish Environment Protection Agency [SEPA]. (2006). *Pesticide containers disposal: after spraying.* Scotland. Retrieved from www.wasterecycling.org.uk

Schoubroeck, F. H .J. V., Herens M., de Louw W., Louwen J. M., and Overtoom T. (1992). *Managing pests in small scale agriculture.* Netherlands, Netherlands: In Zet, Association.

Shaw, C. (2012, March 7). Ministry has not been effective enough in the management of pesticide containers**.** *Times of Swaziland,* Mbabane, Swaziland.

Straits, B.C. & Singleton, R. J. (2011*). Social research approaches and fundamentals*. USA, New York: Oxford University Press.

Streubert, H., & Carpenter, D. (2002). *Qualitative research in nursing: Advancing the humanistic imperative (3rd ed).* USA, Philadelphia: Lippincott Williams & Wilkins,.

