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Research Paper

Awareness of Health and Ecological Impacts of Pesticide Usage Among the Farm Workers of Cardamom Plantations, Southern Western Ghats, Kerala

Environment

KEYWORDS : Cardamom plantation, Pesticides, Farm workers, Health, Awareness.

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ABSTRACT

The uncontrolled exercise of pesticides in agriculture segment causes a severe environmental degradation problem also, being closely associated with public and workers health hazard. Even though the utilization of pesticides helps to manage diseases thus reduce crop losses and result in improved yield of the crops. The present study aimed at determining the farm workers awareness of the human health problems and environment impacts associated with pesticides. Six hundred and ninety seven farm workers were interviewed among the farm workers in Cardamom Hill Reserve (CHR) area in Udumbanchola Taluk, Idukki District, Kerala, South India. Data was obtained by structured questionnaire together with personal interviews. Results of the present study revealed that general awareness of pesticide and awareness about physical problems caused due to pesticide were comparatively high in farm workers. Ecological impacts of pesticide and the awareness of pesticide handling practices were relatively low in farmers. There was no significant difference in gender wise studies about the different levels of health and environment awareness. The farm workers of the selected study area are both from Kerala and Tamil Nadu and the nativity related survey showed that Keralites had significant level of general awareness (t-value, -3.962), awareness of pesticide handling practices (t-value, -2.507), physical problems (t-value, - 4.648) and psychological problems (t-value, -5.581) compared to Tamils. On the basis of income, farm workers are divided in to two groups; average and below average group and there was no significant difference in income wise studies about the different levels of health and environment awareness. In the case of education status, farm workers are categorized in to four groups, they are illiterate, primary level, secondary level and graduate level and there was a significant variation (F value, 5.479) in the awareness of physical problems caused due to the pesticide regarding education status. To check the awareness of the pesticide problems on the basis of age groups, farm workers are divided in to four groups. They are; below 20, 21-40, 41-60 and above 60 and the age related survey showed that there was significant level of variation about general awareness (F value, 25.408), awareness pesticide handling practices (F value, 7.906), awareness about physiological problems (F value, 8.544) and awareness of ecological impacts (F value, 13.013).

INTRODUCTION

Pests and diseases are principal hazards in crop production which require intensive pest management. Each year these pests destroy almost half of the world's food crops. Besides, indiscriminate use of pesticides in agriculture sector poses serious environmental issues including public/workers health related problems. Worldwide usage of pesticide has increased manifold since the 1960s. Since the green revolution in the early 1970s, pesticides have been a major component in food production. Although the green revolution has doubled crop production in Asia (Maclean et al., 2002), the use of pesticides had adverse effects on the environment (Tejada et al., 1995) and human health making it an important concern in public health. The use of pesticides has helped considerably to reduce crop losses and to get better yield of the crops. On other side, their unfavorable effects in the form of environmental degradation and human health have also been well documented. The main issue of pesticides mismanagement starts at the local area where it causes severe damage to land, soil water, farmer's/ worker's health and the environment as whole including pollution of atmosphere but is also reflected globally from region to region and continent to continent (Huber et al., 2000; Kidd et al., 2001; Ntow, 2001; Cerejeira et al., 2003).

In many developing countries like India most pesticides are associated with adverse effects on human health and the environment; these adverse effects have arisen as a result of inappropriate use and handling of pesticides by inadequately trained farm workers (Ngowi and London, 2006; Naidoo et al., 2010). Farm workers can be exposed to pesticides through different routes, such as inhalation, ingestion and skin contact (Chitra et al., 2006; Ngowi et al., 2007). Exposure to pesticides can result in acute and chronic health problems which include eye irritation, immune system disturbances, chromosomal damage, respiratory distress, hormone disruption, male genital abnormalities, diminished intelligence and cancer (McCauley et al., 2006; Hoppin et al., 2007). An estimated 1.3 billion workers are active in agricultural production worldwide, 80 per cent of these are found in Asia. The International Labour Organization (ILO) estimates that as much as 14 per cent of all occupational injuries are due to exposure to pesticides and other agrochemical constituents, and 10 per cent of these – around 17,000 per year – are fatal. The World Health Organization (WHO) and the United Nations Environmental Programme estimated that one to five million cases of pesticide poisoning occur among agricultural workers each year with about 20, 000 fatalities.

Pesticides not only pollute the soils and water but also persist in the vegetables and then enter the food chain, and enter the body system, blood and organs. In addition, pesticides also contribute to environmental pollution, biodiversity losses and deterioration of natural habitats (Cerejeira et al., 2003). There have also been reported instances of pest resurgence, development of resistance to pesticides, secondary pest outbreaks and destruction of non target species. Despite the fact that pesticides are also used in other sectors, agriculture is being perceived as the most important source of adverse effects (Sattler et al., 2007). Farmers mostly use pesticides belonging to organochlorine, carbamate, pyrethroid and neo-nicotinoid groups for the control of these pests. The use of pesticides in Asia, Africa, Center and South America is increasing due to high demand for food quality products and urgent need for self sufficiency in food production in various regions (Mansour, 2004). Besides, cost effectiveness and easy availability of the above chemicals also lures farmers to use them. Although much is known about the short-term effects of pesticides exposure, the long-term effects of human exposure to these compounds is less clear. Research continues to explore associations between chronic pesticides exposure and diseases such as cancer and Parkinson's disease. The potential genotoxic, immunotoxic and reproductive effects of pesticide

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are also being examined. The results of such research may have important implications for end-users and policy makers.

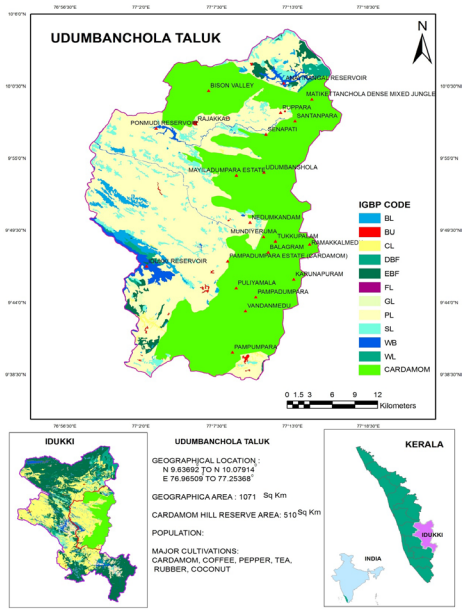
Over the last 40 years pesticide use has increased in all the states of India. The situation in Kerala is also not much different. In the year 2002-2003, farmers in Kerala bought about 72 varieties of pesticides and the maximum demand is for insecticides like carbofuran (furadan), chlorpyriphos, fenvalerate, methyl parathion, phorate and quinalphos (Usha and Harikrishnan, 2004). Recently the application of endosulfan in cardamom and cashew plantations and associated toxic effect on human population has been received considerable attention in Kerala. Technical grade endosulfan is generally composed of α- and β- isomers of endosulfan in the ratio 7:3 (Sutherland et al., 2002) and both isomers are extremely toxic to living organisms. In Padre Village, Kasargod district, Kerala, sustained exposure to endosulfan resulted in congenital, reproductive, long term neurological damage and other symptoms. Reports on the pesticide usage and its further implications in Idukki have already come. A study conducted by the National Institute of Advanced Studies (NIAS, 2009) showed pesticide use in cardamom plantations in Idukki was one of the worlds highest. On an average, farmers used 27 kg of pesticides in a hectare (ha) of cardamom plantations and 9 kg in a ha of tea garden, and they found residues of seven pesticides in cardamoms collected from the Cardamom Hill Reserve and the levels of highly toxic pesticides like triazophos, quinalphos and endosulfan were high (Down to Earth, 2011).

Only a few studies have been undertaken on pest management in Kerala, with none investigating the health effects of exposure of farm workers to pesticides. More studies on the agricultural practices of farm workers and the use of pesticides as well as the consequent health and environmental impacts of pesticide usage are needed to make informed policy decisions to promote safer and sustainable agricultural practices and to reduce the exposure of vulnerable farm workers in Kerala to potentially hazardous pesticides. The present study aimed at determining the farm workers awareness of the human health problems and environment impacts associated with pesticides.

MATERIALS AND METHODS

Study area: Idukki district, the spicy valley of Kerala, South India is highly endowed with tea and cardamom plantations. At present as a part of high input agriculture, the intensive use of pesticides and chemicals have reached in situation where, it finds different implications in human and environmental health and well being. For the present study we select Cardamom Hill Reserve (CHR) area in Udumbanchola taluk is located between 90 8'55"N to 10^0 4'52"N latitudes and $76^0$58'00"E to $77^0$16' 27"E longitudes and is known for the cardamom plantations. Map of the study area is presented in figure 1. In cardamom Hill Reserve, Small Cardamom (*Elettaria cardamomum* Maton) is cultivated as an under storey crop in the tropical ever green forests in the altitude ranging from 500-1500m above MSL with an average annual rainfall between 1500 to 6000mm. A large quantity of various pesticides like Quinalphos, Chlorpyriphos, Monocrotophos, Acephate, Methylparathion, Profenophos, Endosulfan, DDT, Phorate, Carbofuran etc. were sprayed by the farmers in these cardamom plantations.

Figure 1. Map of the study area



Interview Questionnaire:

The questionnaires were prepared in the form of Likert method of summated ratings. The questionnaire is based on United States Environmental Protection Agency questions and on that used in the similar World Bank studies in Bangladesh and Vietnam. The items meant to express their state of mind, knowledge or attitude regarding the pesticide handling and effects caused due it. The statements of the scale were selected after thorough review of available related literature on the subject. The investigator also consults many experts in this field. The investigator primarily constructed an attitude scale consisting of 120 items and after sample study; item analysis was done by using independent sample t-test. In the present study item analysis of attitude scale was done by using Likert method. For this purpose, a pilot study was conducted to representative sample of 100 respondents. The subjects were rank ordered on the basis of the total scores in the draft scale. The t-values of the items of the high and low scoring groups were computed and ranked. Those items showed significant difference between high and low scoring groups were retained in the final form of scale and the scale was constructed by listing the retained items. The preliminary scale consisted of 120 items; item analysis was done for each item separately. Thus by using item analysis, from the 120 items of draft scale, 90 items were selected in the final form of scale.

In order to facilitate the item analysis, statements were grouped based on the objectives of the study. The first section which accesses the general awareness about pesticides and their impact consisted of 20 items. Section two has 15 items which are aimed to under the handling practices followed by workers while using pesticides. Third section consists of 20 items, which are intended to reveal the physical problems faced by workers/ inhabitants of the locality. The fourth section consists of 20 items which is aimed to gather information regarding the psychological problems felt by the workers and inhabitants in the locality. The fifth section consists of 15 items showing the knowledge of workers and inhabitants about the ecological impacts caused by pesticides.

Sample for the study:

The study area is CHR, Idukki district in Kerala. The study population is composed of workers and inhabitants of CHR in Idukki. The sample of the study consists of 697 workers and inhabitants of CHR. In order to select the sample, the investigator gone through thorough literature regarding the CHR in Idukki and consulted a number of people who have already done research in the area and persons who are working CHR. Simple random sampling procedure was adopted to select the sample so that the representations of all the groups are ensured.

Data collection:
The present study is mainly based on the primary data obtained from sample farmers through Questionnaire survey method. The method of interview was used for filling in the questionnaire and all the interviews were conducted face to face. Six hundred and ninety seven farm workers were interviewed from amongst farm workers in Cardamom Hill Reserve (CHR) area in Udumbanchola Taluk, Idukki District, Kerala, South India. Survey was conducted on the basis of gender, nativity, income, age and education status of the farm workers. An investigation visit was carried out for general familiarization with the research area and the key players in pest management in the area. The familiarization process was assisted by the use of some informant interviews to obtain information about the general set-up. The questionnaire was then modified using the background knowledge from the reconnaissance visit. Final version of the questionnaire was used to collect information on pesticide use and practices, applicator precautions/ averting behavior and health/ environmental effects. The technique of stratified random sampling was used to obtain cross-sectional data.

Data analysis:
The collected data were analyzed with respect to a number of background variables, the following statistical techniques were used for this purpose. Measures of central tendency, standard Deviation, Karl Pearson's product moment coefficient of correlation was used for computing the relationship between different domains, computation of t-value to test the significance of difference between the means of two groups of data, one way analysis of variance to test the significance of difference between the means of more than two groups of data.

RESULTS
Gender wise Awareness about pesticide problems:
Out of the 697 individuals interviewed 359 were males and the remaining were females. Gender wise awareness regarding the pesticide problems are presented in figure 1. The mean obtained for male sample is 55. 05 and of the female sample is 55.15 for the general awareness about the pesticide problems. There is no significant difference in gender wise general awareness among the farm workers of cardamom plantation since the obtained t-value (-0.124) is not significant. Regarding the awareness of handling practices, gender wise studies revealed that the mean value of male population is 48.08 and of females are 47.73. The calculated t-value (0.563) reveals that there is no significant difference in gender vise awareness levels about pesticide handling practices. About the physical problems, 57.61 is the mean value of the male population and 47.73 is the mean value for female population and there is no significant difference (t value, -1.433) in gender wise variation about the awareness of physical problems caused due to pesticide.

Male populations of the cardamom plantations had the mean value of 52.25 about the awareness of psychological problems and 51.30 is the mean value obtained for female population and there is no significant difference (t-value: 1.267) in gender wise awareness for the psychological problems felt by the workers and inhabitants. Regarding the awareness of ecological impacts of pesticide, gender wise studies showed the mean value of 41.09 for male population and 40.62 for female population. There was no significant difference between gender vise awareness levels about the ecological impacts of pesticide since the t-value obtained is 0.909.

Nativity wise Awareness of pesticide problems:
The farm workers of the selected study area are both from Kerala and Tamil Nadu. Out of the total individuals interviewed 552 were Tamil peoples and others (145) were Keralites. Nativity wise awareness of the pesticide impacts are presented in figure 2. 54.36 is the mean value obtained for the Tamil people and 57.94 is the mean of Keralites for the general awareness about the impacts of pesticides and there was a significant difference (t-value, -3.962) between Tamil people and Keralites about the general awareness. Regarding the awareness of handling practices, nativity associated survey showed that 47.52 is the mean for the Tamil people and 49.39 is the mean of Keralites and there was a significant difference (t-value, -2.507) between Tamil people and Keralites. 57.18 and 62.27 are the mean values obtained for Tamil people and of Keralites respectively about the awareness of physical problems caused due to pesticide and there is a significant difference (t-value, -4.648) between Tamil people and Keralites. 50.74 is the mean value for the Tamil people and 55.81 is the mean value for Keralites about the awareness of psychological problems of farm workers and there was a significant difference (t-value, -5.581) between Tamil people and Keralites. About the awareness of ecological impacts, 40.56 is the mean of the Tamil people and 42.06 is the mean of the Keralites and there is a significant difference (t-value, -2.345) between Tamil people and Keralites.

Income wise Awareness of pesticide problems:
On the basis of income, farm workers are divided in to two groups; average and below average groups. Income wise awareness of pesticide problems are presented in figure 3. Out of the total population interviewed, 617 peoples were considered as below average group and 80 were measured as average group. 56.81is the mean value of the average income group about the general awareness and 54.88 is the mean value of the below average income group. There was no significant difference between income groups on general awareness of pesticide problems since the obtained t-value is 1.664. Regarding the awareness of pesticide handling practices, the mean value for the average income group is 47.18 and 48.04 is the mean value of the below average income group and there is no significant difference (t-value: -0.873) between income groups. 57.013 is the mean value of the average income group about the awareness of physical problems caused due to pesticides and 58.40 is the mean value of the below average income group and there was no significant difference (t-value: -0.977) between income groups about the awareness of physical problems caused due to pesticides. 51.17 is the mean value of the average income group about the awareness of psychological problems of workers and inhabitants and 51.87 is the mean value of the below average income group. There was no significant difference (t-value: -0.528) between income groups within the farm workers of cardamom plantation about the awareness of psychological problems. Concerning the awareness of ecological impacts of pesticides, income wise studies revealed that 42.46 is the mean value of the average income group and 40.65 is the mean value of the below average income group. There was significant difference (t-value, - 2.225) between income group about the awareness on ecological impacts of pesticides.

Education wise Awareness of pesticide problems:
In the case of education status, farm workers are categorized in to four groups, they are illiterate, primary level, secondary level and graduate level. Education wise Awareness of pesticide problems are presented in figure 4. Illiterate, primary level, secondary level and graduate groups showed the mean values for general awareness of 55.71 (SD, 10.63), 54.45, (SD, 10.10) 55.02 (SD, 7.70) and 57.46 (SD, 8.50) respectively. There was no significant variation (F value, 1.988) between the education groups about the general awareness of the pesticides. 47.33 (SD, 6.37), 46.84, (SD, 7.04) 44.62 (SD, 7.12) and 45.14 (SD, 6.34) are the mean value of illiterate, primary level, secondary level and graduate groups respectively regarding the awareness of pesticide handling practices. There was no significant variation (F value, 1.403) among the education groups related to the awareness of pesticide handling practices. Illiterate, primary level, secondary level and graduate groups had the mean values of 60.58 (SD, 11.95), 58.44 (SD, 11.92), 54.80 (SD, 10.82) and 56.75 (SD, 12.25) respectively about the awareness of physical problems caused due to pesticide and there was significant variation (F value, 5.479) between the education groups within the farm workers of cardamom plantations. 53.64 (SD, 9.71), 51.67 (SD, 10.07) 50.84 (SD, 9.25) and 49.32 (SD, 10.34) are the mean values of illiterate, primary level, secondary level and graduate groups respectively regarding the awareness of psychological impacts and there was no significant variation (F value, 3.551) between the education groups. Regarding the awareness of ecological impacts, education based studies showed that illiterate, primary level, secondary level and graduate groups had the mean values of 41.14 (SD, 7.076), 40.21 (SD, 6.916) 41.92 (SD, 6.341) and 42.13 (SD, 7.122) respectively and there is a significant variation (F value, 2.711) between the education groups within the farm workers of

cardamom plantations.

Age wise Awareness of pesticide problems:
For the age wise survey intended for the awareness of pesticide problem, farm workers are divided in to four groups. They are; below 20, 21-40, 41-60 and above 60. Age wise Awareness of pesticide problems are presented in figure 5. Below 20, 21-40, 41-60 and above 60 groups had the mean values of general awareness of 47.95 (SD, 11.50), 55.70 (SD, 9.34), 57.46 (SD, 8.13) and 52.18 (SD, 10.58) respectively. There was significant variation (F value, 25.408) between the age groups about the general awareness of pesticide problems. Age vise survey within the farm workers of cardamom plantation showed that below 20, 21-40, 41-60 and above 60 groups had the mean values of pesticide handling practices of 44.12 (SD, 8.78), 46.53 (SD, 6.86), 48.03 (SD, 5.91) and 46.22 (SD, 6.56) respectively. There was significant variation (F value, 7.906) between the age groups related to the awareness of pesticide handling practices. Below 20, 21-40, 41-60 and above 60 groups had the obtained mean value of physical problems are 57.20 (SD, 11.67), 57.63 (SD, 12.58), 59.38 (SD, 11.55) and 57.28 (SD, 10.79) correspondingly. There was no significant variation (F value, 1.449) between the age groups related to awareness of physical problems caused due to pesticide. Regarding the psychological problems, below 20, 21-40, 41-60 and above 60 groups had the mean values of 47.45 (SD, 10.325), 51.37 (SD, 10.390), 53.48 (SD, 9.385) and 52.04 (SD, 8.119) respectively and there was significant variation (F value, 8.544) between the age groups about the awareness of psychological problems of pesticide. In age wise survey, below 20, 21-40, 41-60 and above 60 groups had the mean values of ecological impacts of 36.73 (SD, 7.38), 41.85 (SD, 6.81), 41.26 (SD, 6.57) and 40.59 (SD, 6.04) correspondingly and there was a significant variation (F value, 13.013) between the age groups related to the awareness of ecological impacts caused due to pesticides.

DISCUSSION
The present work was carried out in the Cardamom Hill Reserve (CHR) area in Udumbanchola Taluk, Idukki District, Kerala, South India, which has several environmental problems, including concern about the effects of pesticide related activities in the agricultural sector. Pesticide problems have been identified as a major environmental health problem in the Cardamom Hill Reserve (CHR) area in Udumbanchola Taluk. The present study aimed at determining the farm workers awareness of the human health problems and environment impacts associated with pesticides and their use on the field. The total response of farm workers to the questionnaire interview was relatively high, indicating good intentions to participate in the present study. A high level of illiteracy was recorded among the respondent farm workers, reflecting a low educated community.

Results of the present study revealed that general awareness of pesticide problem and awareness about physical problems caused due to pesticide were comparatively high in farm workers. This may attributed to problems of farm workers due to the inhalational and dermal absorption during pesticides usage and agrees with other studies which have found that most occupational exposure to pesticides occur from skin absorption and through inhalation (Iorizzo et al., 1996; WHO, 1993). Awareness of ecological impacts and handling practices were comparatively low in farmers. The majority of the interviewed farm workers not aware about the handling practices of pesticides, thus no one took precautions. Some of the farm workers are aware about the handling practices but not following, could be attributed to carelessness, discomfort, cost, or unavailability of protective devices. The present finding is inconsistent with the study from Sri Lanka and the USA (Sivayoganathan et al., 1995; Perry et al., 2000).

Pesticides have created the environmental issues due to their excessive use and the farm workers had the lowest level of knowledge on the impacts of pesticides on environment. This may be attributed to the low education status of the farm workers and the absence of awareness and study classes about the ecological impacts of the pesticides among the farm workers. Elzimaity (1998) reports that change in one or more of the physical, chemical properties, or all or some of the vita components of the environment would lead to adverse effects to humans, plants and animals. Researchers like Alam, (1996); Cornwall et al. (1995), also reported the risk of pesticides on the environment and public health in the developing countries. Jeyaratnam et al. (1987) and Sivayoganathan et al. (1995) have also reported similar situations in the case of Sri Lanka and Yassin et al. (2002) in Palestine. The findings of some other studies conducted in the developing countries also supported this aspect (Salameh et al., 2004; Atreya, 2007).

In the present work, there was no significant difference in gender wise studies about the different levels of health and environment awareness. This could be attributed to the education status of the males and females of the farm workers, there was no gender wise education status difference among the farm workers of cardamom plantations. The nativity related survey showed that Keralites had significant level of general awareness (t-value, -3.962), awareness of pesticide handling practices (t-value, -2.507), awareness about physical problems (t-value, -4.648) and awareness of psychological problems (t-value, -5.581) compared to Tamils. This could be also due to the education status difference between Tamils and Keralites. Comparatively Keralite farm workers had high education status than Tamil peoples. Higher education was significantly related to higher percent of correct answers in all aspects of knowledge. These results confirmed the findings of the earlier studies indicating that there are a significant relation between farmers' educational level and their level of knowledge (Yassin et al., 2002, Nazaril et al., 2011). There was no significant difference in income wise studies about the different levels of health and environment awareness.

Age related survey showed that there was significant level of variation about general awareness (F value, 25.408), awareness pesticide handling practices (F value, 7.906), about psychological problems (F value, 8.544) awareness of ecological impacts (F value, 13.013). Generally 21-40 and 41-60 groups showed higher awareness compared to below 20 and above 60 groups. This may be attributed to high experiences and moderately education status of 21-40 and 41-60 groups. Low awareness in below 20 and above 60 groups could be due to less experience and less education respectively.

CONCLUSION
Present study concluded that farm workers in Cardamom Hill Reserve (CHR) area had deprived awareness about the health and ecological impacts of pesticides. There is a need of health education programs and outreach extension programs on the safe use of chemical pesticides among the farm workers to provide them with the awareness about the major problems caused due to pesticide and detailed instructions about precautions during pesticide usage. Knowledge levels on the significance of periodic health check-ups of workers on the farms, especially those dealing directly with pesticides require to be improved. Regular programs in the media, written and audiovisuals are needed for the farmers to make them aware of the dangers of pesticides and the safety measures to adopt. The study has highlighted the requirement of targeted trainings to farm labourers on scientific management of pesticides and conduct massive awareness creation programmes.

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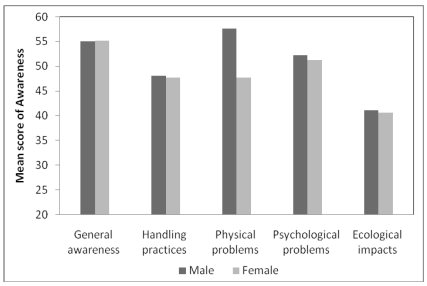

Figure 1 Gender wise awareness about handling practices, health problems and ecological impacts of pesticides

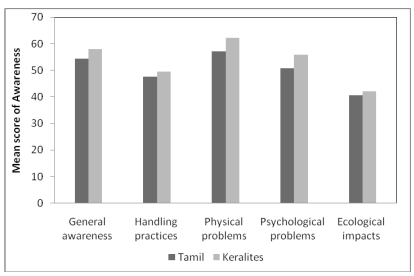

Figure 2 Nativity wise awareness about handling practices, health problems and ecological impacts of pesticides

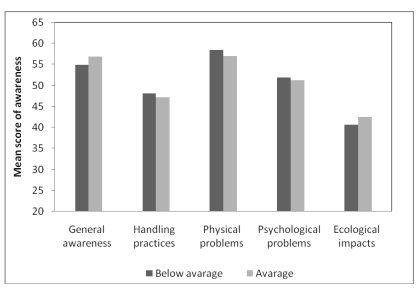

Figure 3 Income wise awareness about handling practices, health problems and ecological impacts of pesticides

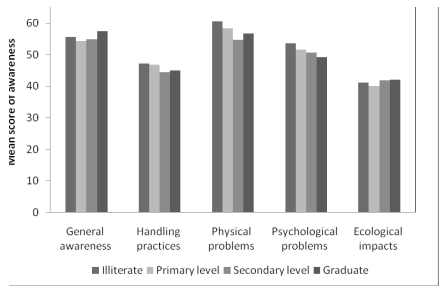

Figure 4 Education wise awareness about handling practices, health problems and ecological impacts of pesticides

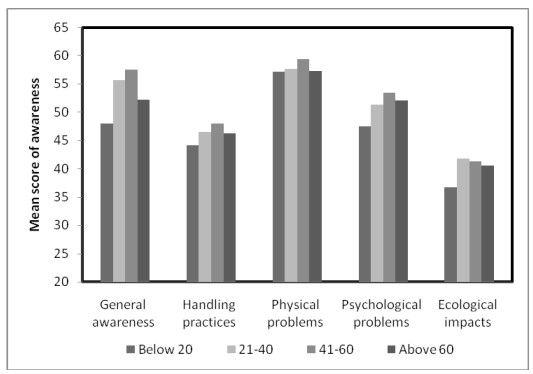

Figure 5 Age wise awareness about handling practices, health problems and ecological impacts of pesticides

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