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# Safety use of Pesticides in Southern Zone of Andhra Pradesh – KAP Analysis

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***Abstract:*** *In the present scenario of modern agriculture, the use of pesticides is observed as the most convenient method followed by the farming community to control pests and diseases. The application of chemical fertilisers and pesticides became inevitable due to several factors in which climate change is the most influencing one. Many health organizations and Government authorities are cautioning the farmers to follow the protective measures while applying pesticides. But most of the farmers are neglecting them due to lack of vision on how they are harmful to health and also having over confidence on their health. Many training programmes have been conducting to aware the farmers regarding negative impact of pesticide exposure for a long time. In this connection, a survey is planned to measure the knowledge, attitude and practice of the farmers on safety use of pesticides in three districts of Andhra Pradesh viz., Chittoor, YSR and Nellore to know the most influenced factor that made the farmers to neglect the safety measures. Survey discloses that the average knowledge, attitude and practice scores along with standard deviations as 17.5 ± 4.8, 49.9 ± 3.1 and 20 ±3.1 respectively and the average scores in terms of percentages are 60%, 83% and 67% respectively. Statistical analysis has been done using appropriate statistical tools on direct scores of knowledge, attitude and practice and also on their categories. Results reveal that the education and age of the farmers have significantly influenced the knowledge whereas the practice is influenced only by age but not by education. Further, knowledge has inculcated the positive attitude in the farmers but attitude could influence the practice of the farmers at certain level only. Moreover, the knowledge failed to enhance the practice to an expected level which shows the negligence of farmers in practicing safety measures despite their sound knowledge on them. Self reported health symptoms are also noted in terms of prevalence rate due to over exposure to the pesticides. Hence, the present study recommends the structured motivational programmes for the farming community rather than further awareness programme on safety use of pesticides.*

***Keywords:*** *Pesticide use, Safety measures, Knowledge, Attitude, Practice and health symptoms.*

## I. Introduction

Burgeoning world population is expected to reach 9 billion people by 2050. This population growth, combined with the diet demands of a wealthier populace, is expected to double world food demand by 2050 [30]. Assuming production, regulation and innovation trends of the past several decades continue, global pesticide production will be 2.7 times higher in 2050 than in 2000, exposing humans and the environment to considerably higher levels of pesticides. The demand for greater agricultural production poses a challenge perhaps as great as global warming.

In addition to their agricultural use in crop protection, pesticides are important public health tools that are used to prevent vector-borne disease and to increase food supplies. However, recent research has shown that pesticides may also have negative impacts on public health. Alavanja et al (2004) demonstrated acutely toxic effects at high doses, as well as chronic effects at low levels of exposure [1].

All over the world, the use of pesticides is considered the most attractive method of controlling pests which involves less labour and characterizes higher output per hectare of land. However, extensive use of such pesticides results in substantial health and environmental threats. Being the principle polluters and victims of pollution, farmers are at the top of this risk. The World Health Organization (WHO) and the United Nations Environment Program estimate pesticide poisoning rates of 2-3 per minute, with approximately 20,000 workers dying from exposure every year, the majority in developing countries [5,30].

Researchers had concluded that farm workers in developing countries will continue to use pesticides in increasing quantities because of the lack of alternatives to pesticides, ignorance of the sustainability of pesticide use, and the weak enforcement of regulations and laws on pesticide use [27,32,33]. Farm workers' knowledge of hazards, which must be corrected, is important for the prevention of acute and chronic poisoning: erroneous beliefs can seriously impair farm workers' capacity to protect themselves against the risks of pesticides [14].

Various policies have been designed to protect workers and minimize exposure to pesticide residues. These policies regulate the time of re-entry into fields after the application of certain chemicals and rely

extensively on workers to engage in self-protective behavior such as wearing protective clothing to minimize their risk of exposure.

Most of the results showed that farm workers have reasonably good knowledge but, to what extent that knowledge is being practically used. It could possibly be the useful study in order to make them not to handle pesticides with improper method of exposure.

### 1.1 Objectives

The present study is planned based on the below mentioned objectives

1. To measure the Knowledge, Attitude and Practice of the farmers on the safety measures during pesticide application.
2. To investigate the determinants of poor or good knowledge on the safety measures during pesticide application.
3. To evaluate the field practices with pesticides in relation to the farmers' knowledge on safety measures.
4. To evaluate the field practice with pesticides in relation to the farmer's attitude on safety measures.
5. To determine the prevalence of self-reported health symptoms related to pesticide exposure.

### 1.2 Hypotheses

1. Good knowledge is positively associated with the safe use of pesticides among farmers.
2. Positive attitude is positively related with the safe practices of pesticides among farmers.
3. Education will be the major factor to practice the correct method while using pesticides.
4. Age will influence positively the knowledge on safety use of pesticides.

## II. Review of Literature

Several studies have recognized that pesticide safety education does not prevent much of the serious exposure that causes illness or death; such exposure usually results from working conditions, which are not likely to be under laborers' control [4]. In a context where workers have very limited economic resources, the effectiveness of the policies in reducing environmental risks is questionable. Poverty and unstable economic situations are conditions that may predict increased exposures to various environmental hazards [12,31]. These conditions may be associated with, or influence, personal and group processes that directly modify health or risk behavior.

Stenzel (1991) reported that education programs and safe work practices have been emphasized as key components in the regulatory strategy towards pesticide protection for workers [26]. Sadly few, if any, migrant health clinics are capable, in terms of technology, diagnostic protocols, and logistics, of diagnosing pesticide-related illness [4].

Most of the reported symptoms of pesticide use are considered to be common manifestations of acetyl cholinesterase-inhibiting insecticides [13,20,25]. These findings require urgent intervention, and protection to prevent the risk of these symptoms. The organophosphate and carbamate insecticides such as methamidophos and methomyl were commonly used and these are classified as highly hazardous [29]. Restriction in the use of highly toxic pesticides has been considered by some scientists in order to decrease intoxication events [11,15].

It was observed that more than 75 percent women are involved in farm activities like winnowing, weeding, grading, threshing and cleaning of field operations. There are various ill effects and masculo- skeletal problems of such postures and in order to minimize the adverse effects of these postural discomfort and hazards, an ergonomic evaluation of occupational and farm activities need to be conducted. Opinion of the women must be considered when designing tools and technologies of agricultural and allied implements and also focus on education and extension activities on women [23].

In 1987, with 1,700 worker-related deaths (52 per 100,000 workers), agriculture became the most hazardous occupation in the U.S.[6]. In terms of injury and illness, the Bureau of Labor Statistics estimates that there are 12.7 cases per 100 full-time workers per year. Common hazards include: acute injuries (e.g., falling from heights, farm machinery accidents); chronic low-grade back and joint trauma; lack of toilets and safe drinking water; chronic, acute and occasional pesticide exposures; and occupational dermatomes. In particular, the EPA has ranked chemical exposures of agricultural workers as one of the most significant environmental hazards affecting human health in the U.S. [7].

As per the Environmental Protection Agency reports exposure to pesticide residues can be substantial during an agricultural season; as many as 3,00,000 seasonal workers may experience pesticide-related illnesses during a given year [8]. The few studies that are available on chronic or low-level pesticide exposure suggest that limb-reduction birth defects [23], childhood leukemia [17], brain tumors [9], sterility, spontaneous abortion, and adult lymphomas and lymph sarcomas [2] may be linked to occupational exposure to pesticides. Prolonged low-

level exposure to pesticide residues has been associated with an increased risk of various negative health outcomes, including anemia and asthma.

A KAP analysis conducted at Pondicherry, India discloses that, while 70% of respondent's perceived pesticide spraying affects a person's health, only 40% were aware that it affects the environment. Two thirds of the respondents (62%) were aware that pesticide enters the body through nose and affects lungs. Awareness on other modes of entry was less. Majority (76%) of them were aware of training programs conducted by government agriculture department on pest management. About 42% of farmers had good knowledge regarding pesticide. Between 40% and 70% of respondents was not using any protective equipment during pesticide spraying. Around 68% of farmers indiscriminately disposed empty containers while 48% buried the leftover pesticides. Significant association ($p<0.05$) was observed between knowledge of the farmers and their practices related to pesticides [18].

A pesticide safety knowledge test was developed to assess farmer's knowledge related to pesticide safety at two districts of southern Punjab and Pakistan. More educated and adult respondents performed better than younger and illiterate. Similarly large land holder scored higher than small landholders, indicating their more access to information and extension [19].

Another study carried out in Chittoor district of Andhra Pradesh revealed that certain level of education and experience has contributed significant knowledge on safety use of pesticides which further has to motivate the farmers to practice correct methods while applying pesticides. But no such practice has been identified whereas age and gender have not influenced their knowledge and practice on safety use of pesticides. Farm workers are practicing the safety measures only at moderate level even they know them[16].

## III. Methodology

Methodology section explains the research approach, research design, the size of the sample, the sampling technique adopted , tools used, data collection procedure and statistical tools of data analysis.

### 3.1 Research approach

Survey method is adopted to determine the Knowledge, Attitude and Practice of the farmers pertaining to safety measures taken while applying the pesticides based on proposed objectives.

### 3.2 Study area and Population

The area under study is the Southern Zone of the Andhra Pradesh contains three Districts viz., Chittoor, YSR and Nellore, 163 revenue mandals representing nearly 3706 revenue villages.

The zone is primarily agrarian in character with 77.84% rural population.Major soil group that dominates the zone was red soils with 53% area which includes red loams (57%), red sandy (24%) and red clay (3%) of Chittoor and YSR districts. In Nellore district soils are sandy clay loams (36%), clay loams (29%) and sandy loam (19%). In YSR district black soils constitutes 20% of area. Summer is rather hot during the months of April to June and winter is mild and short. The highest temperature of $41.3^0$C was recorded during the month of April in the zone and the lowest of $12.65^0$C was recorded in December. The average rainfall ranges from 693 mm in YSR to 1044 mm in Nellore district. The North-East monsoon contributes more rainfall in Nellore district contributing 59.65% of total rainfall received. However, in YSR and Chittoor districts, south west monsoon contributes 54.14% and 46.14% of total rainfall respectively . The only major river is Pennar which passes through YSR and Nellore districts and the other minor river is Swarnamukhi which passes through parts of Chittoor and Nellore districts. This zone has an area of 6.62 lakh hectares under irrigation which is about 59.26% of the total net area sown. Majority of this irrigated area is under tanks, wells and filter points which accounts for 45.85% of total irrigated area of the zone. Irrigation under canals is 21.95 per cent, tanks is 17.39 percent and under wells accounts for 9.50 per cent of total irrigated area. The other sources and lift irrigation accounts for 1.59 per cent of total irrigated area. Average size of land holding of the zone is 1.05 ha. In YSR it is 1.37 ha while in Nellore and Chittoor, it is 1.00 and 0.95 ha, respectively. Holdings with less than 1 ha in size predominate in the zone accounting for about 61.50% of total number of holdings, but occupies only 25.79% of the operational area. The large holdings more than 2ha occupy 48.69% of the operational area. Out of the total geographical area of 43.58 lakh ha in the zone, the net area sown is 11.08 lakh ha which accounts for 25.44% of the geographical area. The remaining 56.42 lakh ha is occupied by forests (27.87%), barren and uncultivable land (12.08%), land put to non- agricultural use (13.0%) cultivable waste (4.64%), permanent pasture other grazing lands (2.69%), miscellaneous tree crops (1.47%), current fallows (6.96%) and other fallow lands (5.82%). The gross cropped area is 12.90 lakh ha against the net area of 11.08 lakh ha with an average cropping intensity of 116.40% in the zone. The highest cropping intensity (120.63%) is in YSR and the lowest cropping intensity (111.98%) is in Chittoor district. The most important field crops in the zone are paddy, groundnut, sunflower, sugarcane, cotton, red gram, bengal gram, black gram, jowar, ragi, bajra, sesamum, tobacco and onion. Among horticultural crops mango, citrus, banana, turmeric, betel vine, vegetables, flowers are important.

Out of the total cropped area in the zone, rice occupies major share of 3.47 lakh ha accounting for 26.89% of the area followed by groundnut with 2.56 lakh ha accounting 19.81% of area [27].

**3.3 Sampling frame**

This is a cross-sectional study that involved farmers or farm workers who apply pesticides in open fields or closed fields (greenhouses) or both.

**3.4 Sampling technique and sample size**

One hundred farmers from each district are fixed to maintain the equal sensitivity in the study. So the total sample size will be 300 from three districts. Stratified Random Sampling was used to collect the data from the farmers of three districts by treating each district as a stratum.

**3.5 Study tool**

Interview Schedule was developed for this study which contained four sections. The first section deals with the personal information of the farmers which contains questions regarding age, gender, education level, and type of agricultural field (open or closed fields) and financial status.

The second section is designed to assess the farmers' knowledge on safety measures to be followed while using pesticides. This section contains 10 questions viz., Wearing of protective clothes and gloves, Wearing of special face mask, Wearing of special shoe (fully covered), Not eating, drinking and smoking during the application of pesticides, Reading and following label instructions, Using leftover pesticide solution in the same day, Washing hands after pesticide application, Not keeping the leftover pesticide in drinking container, Taking bath after spraying pesticides (at least the end of the day) and Washing contaminated clothes separately that could be answered as *well known* or *known* or *don't know*. These responses are ranked as 3, 2 and 1 respectively.

The third section contains 15 statements related to the attitude of the farmers and are assessed by point Likert scale viz., *strongly agree*, *agree*, *disagree* and *strongly disagree* with ranks 4, 3, 2 and 1 respectively.

The fourth section of the schedule consists of 10 questions pertaining to their practice on safety measures with responses *always*, *sometimes* and *never*. The responses are quantified by assigning weights as 3, 2 and 1 respectively. Finally self reported health symptoms are listed in terms of prevalence rate..

**3.6 Statistical analysis**

Appropriate statistical tools viz., frequencies (both one-way and two-way) and percentages are used to describe the data; Chi-square tests have been conducted to identify the contributing factors for good knowledge, attitude and practice towards safety measures while using pesticides. For the data of scores Karl Pearson coefficient of correlations (bivariate) have been computed to know the significant relations among knowledge attitude and practice and the results are concluded at the respective levels of significance using p-value. Finally, the major findings are represented graphically.

## IV. Results and Discussion

**4.1 Demographics of the farmers who participated in the study**

In this study, most of the respondents said that they are engaged in the farming activities since their childhood. The results showed that 221 (76%) participants were using pesticides in open fields, 79 (26%) in closed fields. Gender wise distribution of respondents in three districts is shown in table-4.1.1.

**4.1.1. Gender wise distribution of farmers in three districts**

**Table-4.1.1: Distribution of farmers according to gender in three districts**

| | | District | | | Total |
|---|---|---|---|---|---|
| | | YSR | Nellore | Chittoor | |
| Gender | Male | 93 | 87 | 90 | 270 |
| | | 93.0% | 87.0% | 90.0% | 90.0% |
| | Female | 7 | 13 | 10 | 30 |
| | | 7.0% | 13.0% | 10.0% | 10.0% |
| Total | | 100 | 100 | 100 | 300 |
| | | 100.0% | 100.0% | 100.0% | 100.0% |

From table-4.1.1 it can be identified that the majority (90%) of the participants were male. The percentage of male farmers is almost similar in three districts ranged. The female participants are ranged from 7% to 13% where as their total participation is only 10%.

### 4.1.2. Age wise distribution of farmers in three districts

**Table-4.1.2:Agerwise distribution of farmers in three districts**

| | | District | | | Total |
|---|---|---|---|---|---|
| | | YSR | Nellore | Chittoor | |
| Age of the farmer | 20 - 35 years | 26 | 17 | 17 | 60 |
| | | 26.0% | 17.0% | 17.0% | 20.0% |
| | 36 - 50 years | 54 | 43 | 57 | 154 |
| | | 54.0% | 43.0% | 57.0% | 51.3% |
| | above 50 years | 20 | 40 | 26 | 86 |
| | | 20.0% | 40.0% | 26.0% | 28.7% |
| Total | | 100 | 100 | 100 | 300 |
| | | 100.0% | 100.0% | 100.0% | 100.0% |

In the present study, large percentage (51.3%) of the participants was aged between 36 and 50 years. Similar results were reported by Lavanya K.P.et.al (2013) in India [16] and other researchers in other countries [3, 22].

### 4.1.3. Education wise distribution of farmers in three districts

**Table-4.1.3: Distribution of farmers according to education in three districts**

| | | District | | | Total |
|---|---|---|---|---|---|
| | | YSR | Nellore | Chittoor | |
| Education of the farmers | Illiterate | 5 | 7 | 8 | 20 |
| | | 5.0% | 7.0% | 8.0% | 6.7% |
| | Primary | 15 | 12 | 15 | 42 |
| | | 15.0% | 12.0% | 15.0% | 14.0% |
| | Secondary | 32 | 27 | 25 | 84 |
| | | 32.0% | 27.0% | 25.0% | 28.0% |
| | Inter & above | 48 | 54 | 52 | 154 |
| | | 48.0% | 54.0% | 52.0% | 51.3% |
| Total | | 100 | 100 | 100 | 300 |
| | | 100.0% | 100.0% | 100.0% | 100.0% |

In three districts, the educational levels of the farmers showed that 20 (6.7%) had no education and 42 (14%) possessed the Primary education, whereas 84(28%) studied 6$^{th}$ class to 10$^{th}$ class while the majority of the famers 154(51.3%) have studied Intermediate or graduation. From these observations it can be known that the education level of farmers was improved over the decade.

### 4.1.4. Economic status wise distribution of farmers in three districts

**Table-4.1.4: Distribution of farmers according to economic status in three districts**

| | | District | | | Total |
|---|---|---|---|---|---|
| | | YSR | Nellore | Chittoor | |
| Economic status of the family | Good | 14 | 23 | 19 | 56 |
| | | 14.0% | 23.0% | 19.0% | 18.7% |
| | Average | 60 | 55 | 61 | 176 |
| | | 60.0% | 55.0% | 61.0% | 58.7% |
| | Poor | 26 | 22 | 20 | 68 |
| | | 26.0% | 22.0% | 20.0% | 22.7% |
| Total | | 100 | 100 | 100 | 300 |
| | | 100.0% | 100.0% | 100.0% | 100.0% |

While studying the economic status of the farmers, it was observed that majority (58.7%) of the farmers are in moderate status and nearly 23% of the farmers are still living in poor economic status whereas only 18.7% of farmers are sufficient enough with good economic status indicates the capability in savings.

### 4.2 Comparisons based on actual scores among the southern zone farmers

The scores of the Knowledge, Attitude and Practice are computed as the total score of responses as per the weights assigned for each response as explained in the methodology section. Knowledge scores are ranged between 10 to 25 for the maximum score of 30, attitude scores are obtained between 45 to 55 out of 60, whereas practice scores are varied between 15 to 25 for maximum of 30. The average and standard deviations of the knowledge, attitude and practice scores will be 17.5 ± 4.8, 49.9 ± 3.1 and 20 ±3.1 respectively. The obtained scores have been tested for its normality using one-sample Kolmogorov Smirnov test but they failed (table-4.2(a). Hence the non parametric approach was taken up for comparisions and results are summarized in tables-4.2(b) to (d).

**Table-4.2(a):Test for Normality**

| | Null Hypothesis | Test | Sig. | Decision |
|---|---|---|---|---|
| 1 | The distribution of Knowledge is normal with mean 17.53 and standard deviation 4.83. | One-Sample Kolmogorov-Smirnov Test | .001 | Reject the null hypothesis. |
| 2 | The distribution of Attitude is normal with mean 49.93 and standard deviation 3.14. | One-Sample Kolmogorov-Smirnov Test | .001 | Reject the null hypothesis. |
| 3 | The distribution of Practice is normal with mean 20.01 and standard deviation 3.11. | One-Sample Kolmogorov-Smirnov Test | .001 | Reject the null hypothesis. |

**Table-4.2(c):Comparisions among age groups**

| | Null Hypothesis | Test | Sig. | Decision |
|---|---|---|---|---|
| 1 | The distribution of Knowledge is the same across categories of Age of the farmer. | Independent-Samples Kruskal-Wallis Test | .028 | Reject the null hypothesis. |
| 2 | The distribution of Attitude is the same across categories of Age of the farmer. | Independent-Samples Kruskal-Wallis Test | .324 | Retain the null hypothesis. |
| 3 | The distribution of Practice is the same across categories of Age of the farmer. | Independent-Samples Kruskal-Wallis Test | .015 | Reject the null hypothesis. |

**Table-4.2(b):Comparisions among districts**

| | Null Hypothesis | Test | Sig. | Decision |
|---|---|---|---|---|
| 1 | The distribution of Knowledge is the same across categories of District. | Independent-Samples Kruskal-Wallis Test | .251 | Retain the null hypothesis. |
| 2 | The distribution of Attitude is the same across categories of District. | Independent-Samples Kruskal-Wallis Test | .775 | Retain the null hypothesis. |
| 3 | The distribution of Practice is the same across categories of District. | Independent-Samples Kruskal-Wallis Test | .708 | Retain the null hypothesis. |

**Table-4.2(d): Comparisions among education levels**

| | Null Hypothesis | Test | Sig. | Decision |
|---|---|---|---|---|
| 1 | The distribution of Knowledge is the same across categories of Education of respondent. | Independent-Samples Kruskal-Wallis Test | .117 | Retain the null hypothesis. |
| 2 | The distribution of Attitude is the same across categories of Education of respondent. | Independent-Samples Kruskal-Wallis Test | .448 | Retain the null hypothesis. |
| 3 | The distribution of Practice is the same across categories of Education of respondent. | Independent-Samples Kruskal-Wallis Test | .669 | Retain the null hypothesis. |

According to the obtained results, it is identified that the knowledge and practice are influenced by age significantly at 5% level (refer table-4.2(c)) but not by education (refer table-4.2(d). From table-4.2(b), it is observed that the level of knowledge, attitude and practice of the famers towards safety measure in three districts are same. The average percentage of knowledge, attitude and practice among the farmers is computed as 60%, 83% and 67% respectively.

### 4.3 Correlation analysis

**Table-4.3:Correlation among Knowledge, Attitude and Practice of south zone farmers**

| | | Knowledge | Attitude | Practice |
|---|---|---|---|---|
| Knowledge | Correlation | | .788(**) | .540(*) |
| | p-value | | 0.000 | 0.042 |
| | R-square | | 0.62 | 0.29 |
| Attitude | Correlation | .788(**) | | .631(**) |
| | p-value | 0.000 | | 0.002 |
| | R-square | 0.62 | | 0.398 |
| Practice | Correlation | .540(*) | .631(**) | |
| | p-value | 0.042 | 0.002 | |
| | R-square | 0.29 | 0.398 | |

Spearman rank correlations are computed among knowledge, attitude and practice scores (pair wise) and the results are furnished in table-4.3. Results reveal that there is significant correlation ($r = 0.788$; $p < 0.01$) between knowledge and attitude on protective measures at 1% level where as the correlation ($r = 0.540$; $p < 0.05$) between the knowledge and practice is significant at 5% level. That means knowledge is influencing the attitude better than practice. Further, attitude is positively correlated with practice ($r = 0.631$; $p < 0.01$) at moderate level, hence the hypothesis framed regarding the effect of the attitude is proved. From this study one can understand that the knowledge of the farmers on protective measures failed in putting the same into practice and contradicts the fact that the farmers with good knowledge on protective measures might show good practice while spraying pesticides.

But farmers who used pesticides without protective measures could be exposed to pesticides at various levels to be caused acute health symptoms. This might be due to lack of seriousness and motivation; hence the farmers need a structured motivational programme which explains the severe health hazards.

### 4.4 Comparisions based on categories-Demographic versus Knowledge

Further these scores are divided into three mutually exclusive categories based on *quartiles* such that the scores less than the first quartile is treated as the first group (low), the scores between the first quartile and the third quartile values is treated as the second group (moderate) and the scores more than third quartile is treated as the third group (high). Using chi-square test the relations are verified once again by means of categorical analysis to have clear understanding.

### 4.4.1 Influence of age on level of knowledge of farmers

**Table-4.4.1: Influence of age on level of knowledge of farmers**

| Chi-square value | p-value | Level of Knowledge | | | Total |
|---|---|---|---|---|---|
| 2.149 | 0.708 | Low | Moderate | High | |
| Age of the farmer | 20 - 35 years | 19 | 29 | 12 | 60 |
| | | 31.7% | 48.3% | 20.0% | 100.0% |
| | 36 - 50 years | 37 | 75 | 42 | 154 |
| | | 24.0% | 48.7% | 27.3% | 100.0% |
| | above 50 years | 23 | 39 | 24 | 86 |
| | | 26.7% | 45.3% | 27.9% | 100.0% |
| Total | | 79 | 143 | 78 | 300 |
| | | 26.3% | 47.7% | 26.0% | 100.0% |

The knowledge of the farmers in relation with their age is presented in table-4.4.1. Results depict that the age has no influence on having knowledge on safety use of pesticides. The knowledge levels of the farmers are equally distributed over the age groups in terms of categories which is evidently proved by the p-value (>0.05) of chi-square test. However, the significant impact of age is observed on knowledge when we consider the actual scores as explained in the section 4.2. This may be due the fact that the knowledge scores are stagnated at the quartiles where cut offs of grouping are decided.

### 4.4.2 Influence of education on level of knowledge

**Table-4.4.2: Influence of education on level of knowledge of farmers**

| Chi-square value | p-value | Level of Knowledge | | | Total |
|---|---|---|---|---|---|
| 11.897* | 0.044 | Low | Moderate | High | |
| Education of the farmer | Illiterate | 4 | 7 | 9 | 20 |
| | | 20.0% | 35.0% | 45.0% | 100.0% |
| | Primary | 6 | 25 | 11 | 42 |
| | | 14.3% | 59.5% | 26.2% | 100.0% |
| | Secondary | 29 | 40 | 15 | 84 |
| | | 34.5% | 47.6% | 17.9% | 100.0% |
| | Inter & above | 40 | 71 | 43 | 154 |
| | | 26.0% | 46.1% | 27.9% | 100.0% |
| Total | | 79 | 143 | 78 | 300 |
| | | 26.3% | 47.7% | 26.0% | 100.0% |

*significant at 5% level

Table-4.4.2 reveals the farmers' knowledge in relation with their education. From the results one can understand that the percentage of farmers with various education levels have different levels of knowledge on safety use of pesticides. Chi-square test results supports the fact that the knowledge of the farmers is significantly influenced by their education level at 5% level (p-value <0.05). Interestingly the illiterates had high level of knowledge when compared to other educational groups since this group might be tried to know the information regarding safety measures eagerly due to their innocence.

## 4.5 Association between demographic variables and Attitude of farmers on safety measures

### 4.5.1 Influence of age on the attitude of farmers

**Table-4.5.1: Influence of age on the attitude of farmers**

| Chi-square value | p-value | Type of attitude | | | Total |
|---|---|---|---|---|---|
| 4.088 | 0.394 | Negative | Neutral | Positive | |
| Age of the farmer | 20 - 35 years | 18 | 32 | 10 | 60 |
| | | 30.0% | 53.3% | 16.7% | 100.0% |
| | 36 - 50 years | 42 | 66 | 46 | 154 |
| | | 27.3% | 42.9% | 29.9% | 100.0% |
| | above 50 years | 24 | 38 | 24 | 86 |
| | | 27.9% | 44.2% | 27.9% | 100.0% |
| Total | | 84 | 136 | 80 | 300 |
| | | 28.0% | 45.3% | 26.7% | 100.0% |

The attitude of the farmers in relation with their age is presented in table-4.5.1. From the results it can be identified that the attitude has also not been influenced by the age as in case of knowledge. Attitudes of the farmers regarding safety measures are uniformly distributed in three age groups which means the differences

observed in percentage of farmers are due to random but not due to their age. Further, the chi-square test has also revealed the same fact since the p-value (>0.05).

### 4.5.2 Influence of education on the attitude of farmers

**Table-4.5.2: Influence of education on the attitude of farmers**

| Chi-square value | p-value | Type of attitude | | | Total |
|---|---|---|---|---|---|
| 5.191 | 0.520 | Negative | Neutral | Positive | |
| Education of the farmer | Illiterate | 6 | 10 | 4 | 20 |
| | | 30.0% | 50.0% | 20.0% | 100.0% |
| | Primary | 15 | 17 | 10 | 42 |
| | | 35.7% | 40.5% | 23.8% | 100.0% |
| | Secondary | 19 | 36 | 29 | 84 |
| | | 22.6% | 42.9% | 34.5% | 100.0% |
| | Inter & above | 44 | 73 | 37 | 154 |
| | | 28.6% | 47.4% | 24.0% | 100.0% |
| Total | | 84 | 136 | 80 | 300 |
| | | 28.0% | 45.3% | 26.7% | 100.0% |

Similarly, the influence of education on the attitude of the famers has been checked with the help of another chi-square test and results are exhibited in table-4.5.2. From the results it is identified that irrespective of their education farmers has the same type of attitude towards safety measures. Out of 300 farmers only 80 (26.7%) have positive attitude whereas 84 (28%) farmers have showed negligence towards safety measures while 136(45.3%) farmers responded neutrally.

## 4.6 Association between demographic variables and the practice of farmers on safety measures

### 4.6.1 Influence of age on the practice of farmers

**Table-4.6.1: Influence of age on the practice of farmers**

| Chi-square value | p-value | Level of Practice | | | Total |
|---|---|---|---|---|---|
| 17.464** | 0.002 | Low | Moderate | High | |
| Age of the farmer | 20 - 35 years | 27 | 21 | 12 | 60 |
| | | 45.0% | 35.0% | 20.0% | 100.0% |
| | 36 - 50 years | 34 | 79 | 41 | 154 |
| | | 22.1% | 51.3% | 26.6% | 100.0% |
| | above 50 years | 14 | 44 | 28 | 86 |
| | | 16.3% | 51.2% | 32.6% | 100.0% |
| Total | | 75 | 144 | 81 | 300 |
| | | 25.0% | 48.0% | 27.0% | 100.0% |

** significant at 1% level

Table-4.6.1 explains the practice level of the farmers as per their age in terms of frequencies and percentages. From the results it can be observed that majority (32.6%) of old age farmers (>50 years) are following safety measures strictly whereas these percentages in younger (20-35 years) and middle aged farmers (36-50 years) will be 20% and 26.6% respectively. The huge variation among these percentages elicits that there is significant variation among age groups with regard to practice levels of the farmers. The chi-square test with p-value of 0.002(<0.01) emphasizes the same. Hence it can be concluded that the practice level of the famers is improving as long as their age is enhancing.

### 4.6.2 Influence of education on the practice of farmers

**Table-4.6.2: Influence of education on the practice of farmers**

| Chi-square value | p-value | Level of Practice | | | Total |
|---|---|---|---|---|---|
| 5.469 | 0.485 | Low | Moderate | High | |
| Education of the farmer | Illiterate | 5 | 8 | 7 | 20 |
| | | 25.0% | 40.0% | 35.0% | 100.0% |
| | Primary | 10 | 26 | 6 | 42 |
| | | 23.8% | 61.9% | 14.3% | 100.0% |
| | Secondary | 22 | 39 | 23 | 84 |
| | | 26.2% | 46.4% | 27.4% | 100.0% |
| | Inter & above | 38 | 71 | 45 | 154 |
| | | 24.7% | 46.1% | 29.2% | 100.0% |
| Total | | 75 | 144 | 81 | 300 |
| | | 25.0% | 48.0% | 27.0% | 100.0% |

Table-4.6.2 interprets the level of farmers' practice as per their education from which one can understand that the figures indicated in the table-4.6.2 are failed to support the influence of education on the practice levels of the farmers regarding safety use of pesticides since p-value(0.485) is greater than 0.05. Education could not influence the practice as it influences the knowledge level which is explained in section-4.4.2.

### 4.7 Comparisons among three districts

Finally, the knowledge, attitude and practice score of the farmers regarding safety use of fertilisers have been compared among three districts.

#### 4.7.1 Comparison of farmer's knowledge among three districts

**Table-4.7.1: Influence of district on the farmers' knowledge**

| Chi-square value | p-value | Level of Knowledge | | | Total |
|---|---|---|---|---|---|
| 1.737 | 0.784 | Low | Moderate | High | |
| District | YSR | 27 | 48 | 25 | 100 |
| | | 27.0% | 48.0% | 25.0% | 100.0% |
| | Nellore | 30 | 45 | 25 | 100 |
| | | 30.0% | 45.0% | 25.0% | 100.0% |
| | Chittoor | 22 | 50 | 28 | 100 |
| | | 22.0% | 50.0% | 28.0% | 100.0% |
| Total | | 79 | 143 | 78 | 300 |
| | | 26.3% | 47.7% | 26.0% | 100.0% |

Table-4.7.1 explains the distribution of farmers with low, moderate and high level of knowledge on safety measures among three districts and the chi-square test reveals the fact that this distribution is similar in three districts. That means irrespective of the district, the farmers have same level of knowledge on safety measures because these districts belong to the southern zone, hence the same level of training and care is offering for three districts uniformly.

#### 4.7.2 Comparison of farmer's attitude among three districts

**Table-4.7.2: Influence of district on the farmers' attitude**

| Chi-square value | p-value | Type of attitude | | | Total |
|---|---|---|---|---|---|
| 2.759 | 0.599 | Negative | Neutral | Positive | |
| District | YSR | 26 | 47 | 27 | 100 |
| | | 26.0% | 47.0% | 27.0% | 100.0% |
| | Nellore | 32 | 39 | 29 | 100 |
| | | 32.0% | 39.0% | 29.0% | 100.0% |
| | Chittoor | 26 | 50 | 24 | 100 |
| | | 26.0% | 50.0% | 24.0% | 100.0% |
| Total | | 84 | 136 | 80 | 300 |
| | | 28.0% | 45.3% | 26.7% | 100.0% |

From the table-4.7.2 the farmers' attitude among three districts will be known in such a way that the difference in attitudes of the farmers in three districts have no much variation as in the case of knowledge. Chi-square test also revealed the same with the p-value (>0.05).

#### 4.7.3 Comparison of farmer's practice among three districts

**Table-4.7.3: Influence of district on the farmers' practice**

| Chi-square value | p-value | Level of Practice | | | Total |
|---|---|---|---|---|---|
| 0.686 | 0.953 | Low | Moderate | High | |
| District | YSR | 23 | 51 | 26 | 100 |
| | | 23.0% | 51.0% | 26.0% | 100.0% |
| | Nellore | 27 | 46 | 27 | 100 |
| | | 27.0% | 46.0% | 27.0% | 100.0% |
| | Chittoor | 25 | 47 | 28 | 100 |
| | | 25.0% | 47.0% | 28.0% | 100.0% |
| Total | | 75 | 144 | 81 | 300 |
| | | 25.0% | 48.0% | 27.0% | 100.0% |

Further practice level of the farmers on safety use of pesticides among three districts has been indicated in table-4.7.3. From the table it can be identified that as similar to knowledge and attitude, the practice levels of the farmers are also same among three districts. It was proved statistically using a chi-square test.

### 4.8 Safety practices in relation to pesticide knowledge

**Table-4.8: Safety practices in relation to pesticide knowledge**

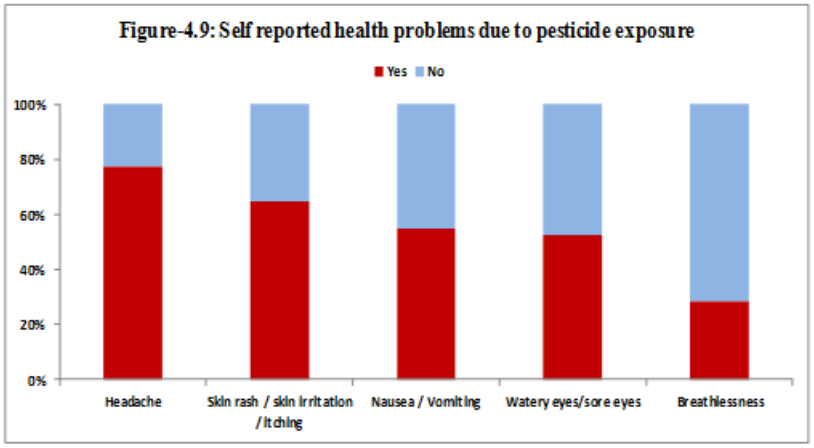
| Safety Practice | Practicing safety measures | | | Total |
|---|---|---|---|---|
| | Never | Sometimes | Always | |
| Wearing of protective clothes and gloves | 135 (45%) | 85 (28.3%) | 80 (26.7%) | 300(100%) |
| Wearing of special face mask | 85(28.3%) | 130 (43.3%) | 85 (28.3%) | 300(100%) |
| Wearing of special shoe (fully covered) | 140 (46.7%) | 95(31.7%) | 65(21.7%) | 300(100%) |
| Not eating, drinking and smoking during the application of pesticides **(3)** | **152(50.7%)** | 78 (26.0%) | 70 (23.3%) | 300(100%) |
| Reading and following label instructions **(2)** | **165 (55.0%)** | 110 (36.7%) | 25 (8.3%) | 300(100%) |
| Using leftover pesticide solution in the same day | 128(42.7%) | 65(21.7%) | 107 (35.7%) | 300(100%) |
| Washing hands after pesticide application | 65 (21.7%) | 125(41.7%) | 110(36.7%) | 300(100%) |
| Not keeping the leftover pesticide in drinking container **(1)** | **185(61.7%)** | 40 (13.3%) | 75(25%) | 300(100%) |
| Taking bath after spraying pesticides (at least the end of the day) | 46(15.3%) | 95(31.7%) | 159(53%) | 300(100%) |
| Washing contaminated clothes separately | 145(48.3%) | 90 (30%) | 65 (21.7%) | 300(100%) |

Table-4.8 shows that only 55% of farmers are wearing protective clothes and special gloves; among them only 26.7% are using them always and the rest is using sometimes, 72% reported wearing of special face mask; among them only 28.3% are always and the are sometimes wearing the special face mark, 53.3% reported wearing of special shoe while applying the pesticides in which only 22% are following always, 49.3% reported not eating , drinking and smoking during application of pesticides but only 23.3% are practicing always, out of 45% who reported reading and following label instructions, only 8% are implementing that practice always before spraying pesticides, 57% of the participants indicated that they used leftover pesticide solutions on the same day but only least percentage 33% are really doing it always , out of out of 38% of the farmers who knew to not keep the leftover pesticide in a drinking container for later use only 25% are following strictly, a majority (85%)of the farmers stated taking bath after spraying pesticides; among them 53% are practicing every time after spraying and 52% of the farmers indicated that they used to wash contaminated clothes separately but only 22% are following every time which indicates the thorough gap between knowledge and practice. A majority (50% to 62%) of the farmers are still keeping the leftover pesticide in drinking containers which is very harmful to their entire family, not reading and following the label instructions and eating, drinking and smoking during the application of pesticides which directly affect the lungs and intestine.

### 4.9 Self-reported toxicity symptoms among farmers

This section discloses regarding the self-reported toxicity symptoms associated with pesticide use. The outcome of survey showed that the common symptoms among the farmers are headache, skin rash, nausea, watery eyes and breathlessness only. Present study reports that the most frequent self-reported toxicity symptoms associated with pesticide use were headache (78%), skin rash (65%), nausea (55%), watery eyes or sore eyes (53%) and breathlessness (28%). These are represented in figure-4.9.

The WHO has recommended the use of pesticides only by trained people [30]. The level of exposure to pesticides will be decreased when the safety measures are followed strictly. According to [14] it has been proved empirically that the farmers who using gloves may be differed from those not using gloves with regard to health symptoms. Hence, the use of protective measures could contribute to decreasing the health effects of pesticides. Basic objective of the proper training or education on proper use of pesticides is to ensure that farmers understand the health hazards of relevant pesticides, use protective equipment properly, practice personal hygiene measures, become familiar with and adopt proper work practices, recognize early symptoms of overexposure to pesticides, and obtain first aid at the earliest time possible.




## V. Conclusions and Recommendations

Most of the farmers in the study area had sufficient level of knowledge (60%) regarding protective measures while spraying pesticides. But, the farmers seriously unaware of real pesticide risks and they require safety education in that direction. Further, age of farmers has showed significant influence on having good knowledge on safety use of pesticides, which might avoid intoxication risks but they have poor practice of safety measures. And education of the farmers is identified as one of the significant factors that positively influenced the good practice. Certain efforts must be placed not only to provide additional knowledge on risks of pesticide use but on the execution of Personal Protective Measures (PPM) which also necessary to decrease the pesticide exposure of farm workers irrespective of their experience in this field of agriculture. Therefore, it is strongly recommended to initiate special educational programs for the all farmers prior to engage them for pesticide application. Farmers who had sufficient knowledge on the protective measures must follow them strictly and further they need to share their knowledge among peer farmers since these practices will improve the quality of work and will prevent the health disorders due to over exposure of the pesticides.

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