

FIELD SURVEY:

Pesticide Use and Impacts in Kerala, India





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PAN INDIA



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Pesticide Use and Impacts in Kerala, India

Introduction

For more than six decades, farmers have been constantly exposed to toxic pesticides, resulting in high levels of acute poisoning and serious chronic impacts that leave a legacy of ill health and suffering, including in successive generations. Pesticides are the leading cause of poisoning in India, with two in every three cases of poisoning happening because of pesticide consumption either intentionally or unintentionally, research on the prevalence of various types of poisoning in India has shown. The prevalence of pesticide poisoning in the adult population was 65 per cent and 22 per cent in children, according to the study published in the *British Medical Journal* (BMJ) May 24, 2021. Mittal, C. 2021.

Kerala, a south Indian state, often captures attention on the national and international level for its high Human Development Indices. The three districts in Kerala (Wayanad, Trivandrum and Kochi) were selected using purposive sampling and participants were selected randomly in this study. Community selected were closely connected with agriculture and those residing near to agricultural areas.

Wayanad district is located in the northern part of Kerala state. It is the home to the largest concentration of tribal communities or indigenous peoples (33.47 %) in the state and holds a prominent share of the state's green cover (KSTDD, Government of Kerala, 2013). Also labelled as the Ecologically Sensitive Zone as per the Gadgil report. Agriculture is the main economic activity in the district, with more than half of the population engaged in agriculture as their means of livelihood. The main crops produced are coffee, tea, cocoa, arecanut, pepper, plantain, vanilla, rice, cardamom, tea and ginger. Wayanad district is classified as an "industrially backward district" since it has a few small-scale industries and farms but no major industries yet. Since one of the major sources of the district is cattle raising, there is one dairy company, the Wayanad Dairy of Milma of the Kerala Cooperative Milk Marketing Federation,

which is located in Kalpetta, there are 62 industrial cooperatives registered in the district but only 19 of them are functional. According to Thanal, paddy was once a major crop in the district, covering almost the entirety of agricultural areas. Currently, paddies cover just 204 hectares with only a single crop harvested per year. Much of the paddy fields in the districts are being converted to banana and ginger cultivation.

Trivandrum is the capital city of Kerala and the most populous district. The agriculture area is low in Trivandrum compared to other districts in Kerala. Most of the population depends on local markets for their food needs. The district has approximately 28,000 hectares under cultivation including paddy, banana, coconut, vegetables and cassava, with a cropping intensity of 120.07 % (Government of Kerala, 2023). Urban and peri-urban farming practices in areas like Vattiyorkaavu, Kalliyur, Venganur and Nedumangad bring agricultural fields in close proximity to densely populated residential zones. This close interaction between agricultural and urban areas raises concerns about pesticide exposure for both farming as well as non-farming communities. Analysing pesticide usage in this context is crucial for understanding its impact on public health and developing sustainable agricultural practices in such mixed regions. Many urban residents have embraced small-scale terrace gardening and homestead kitchen gardening in their limited spaces for self-consumption, reflecting growing awareness about pesticide-contaminated foods in local markets. This positive trend is a result of many research, findings, campaigns, and publications.

Ernakulam serves as the central business hub of Kerala, bordered by the districts of Alappuzha, Thrissur, and Kottayam, with a coastal expanse of 3,068 square kilometres. Fisheries are the primary source of income for the local population. The Pokkali system of rice cultivation, a distinctive method, is practiced in this certain region of Ernakulam. Pokkali is a saline-tolerant rice variety with Geographical Indication (GI) status, cultivated organically through integrated aquaculture in the waterlogged coastal areas. This traditional farming technique spans approximately 5,000 hectares across the districts of Alappuzha, Kottayam, Thrissur, and Ernakulam in southern India (Anju sajan, 2021). Located along the Arabian Sea and crisscrossed by an extensive network of rivers, canals, and backwaters, Kochi's landscape supports diverse agricultural activities, including paddy fields, coconut groves, banana plantations, and spice cultivation in nearby areas like Aluva, Perumbavoor, and Edakochi. This low-lying terrain is highly susceptible to

pesticide runoff, which can contaminate water bodies and disrupt aquatic ecosystems. The humid tropical climate further influences pest proliferation, often necessitating higher pesticide usage contaminating aquatic life too.

Methodology

The data on pesticide use and effects was collected by Thanal utilizing the Community-based Pesticide Action Monitoring (CPAM) methodology developed by PAN Asia Pacific (PANAP). CPAM is a participatory action research framework designed to document and raise awareness about the hazards of pesticide use and its impacts on human health and the environment. This approach actively involves community members in the monitoring process, fostering collective organization and action. To enhance accessibility, the CPAM questionnaire was meticulously translated into the local language, Malayalam, for the interviewees, ensuring clear communication and accurate data capture. The research team employed the CPAM web-based application to systematically record and digitize the data. The information obtained through the interviews was subsequently submitted online via the CPAM application.

A total of 508 farmers participated and shared their experiences in this comprehensive survey. Thanal started CPAM survey in 2023 in Wayanad followed by Trivandrum and Kochi. In Wayanad, Panamaram, Cholappuram, Avayal and Kappikunnu panchayats, majority of them were Coffee, Arecanut and Rice farmers. In Trivandrum and Kochi, the major crops were rice, vegetables, tubers and banana. The use of pesticides was found very high in rice compared to other crops. The highest frequency of pesticide use was found for the weed control (herbicides) in agricultural lands. Venganoor, Kalliyoor, Karavaram, Vellayani etc. are the other panchayats in which the survey was conducted.

1. DEMOGRAPHIC PROFILE

The survey was conducted among 508 farmers. Of the respondents, 331 (65.16 %) are men farmers and 158 (31.10 %) are women farmers. 19 respondents (3.74 %) did not specify their gender. Most respondents fell under 50–59 (men: 103, women: 48). The pivot table containing age distribution and gender is given below.

Figure 1. Gender identity

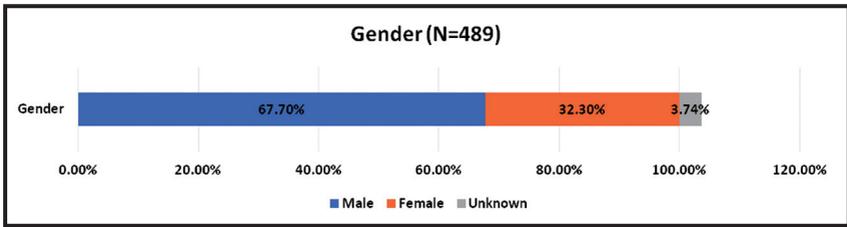


Table 1. Number of respondents, by gender, by age (N=485)

Respondents	20–29	30–39	40–49	50–59	60–69	70–79	Above 79	Total
	No./%	No./%	No./%	No./%	No./%	No./%	No./%	No./%
Men	1 (0.20 %)	49 (10.10 %)	63 (12.90 %)	103 (21.20 %)	76 (15.70 %)	34 (7.00 %)	2 (0.40 %)	328 (67.50 %)
Women	7 (1.40 %)	27 (5.60 %)	41 (8.60 %)	48 (9.90 %)	23 (4.70 %)	11 (2.30 %)	0	157 (32.50 %)

The majority of the respondents out of 494, [437, 88.46 %; 126 women (25.51 %), 308 men (62.34 %) and three unknown (0.61 %)] were married. 28 (5.66 %); 13 women (2.63 %), 13 men (2.63 %) are widowed, and seven (1.42 %): one man (0.20 %) and six women (1.22 %) are living separately. 14 (2.83 %); five women (1.01 %), nine men (1.82 %) of the respondents were single. Eight (1.63 %; women) respondents are cohabiting with their partner. No response was obtained from 14 participants. According to the responses obtained, only two respondents were pregnant and one was breastfeeding.

1.1. Household information: From the survey data of 467 respondents, three or more people live in the households of 403 (86.30 %); women 130 (27.84 %), men 267 (57.17 %), six unknown (1.29 %). 64 (13.70 %); women 23 (4.93 %), men 41 (8.77 %) respondents have less than three members in their household. No response was obtained from 41 participants. 177 respondents provided information regarding the children in the family less than 18 years old. The distribution is as follows:

- a. One child – 82 (46.33 %); 29 women (16.38 %), 52 men (29.38 %), one unknown (0.57 %);
- b. Two children – 72 (40.67 %); 28 women (15.82 %) and 44 men (24.85 %);
- c. Three children – 20 (11.30 %); nine women (5.08 %) and 11 men (6.22 %);
- d. Four children – three (1.70 %); one woman (0.57 %) and two men (1.13 %).

1.1.1. Spouse Occupation: The survey data of 371 respondents concerning the occupations of their spouses are provided below. No responses were obtained from 137 survey participants.

Table 2. Spouse occupation					
Spouse occupation	No. of respondents	Women	Men	Unknown	Percentage
Unemployed	15	1 (0.27 %)	13 (3.50 %)	1 (0.27 %)	4.04 %
Small business owner	21	12 (3.23 %)	9 (2.43 %)	0.00 %	5.66 %
Small scale farmer	64	35 (9.43 %)	27 (7.28 %)	2 (0.54 %)	17.25 %
Private sector worker	29	21 (5.66 %)	8 (2.16 %)	0.00 %	7.82 %
Other	31	13 (3.50 %)	17 (4.58 %)	1 (0.27 %)	8.35 %
MGNREGA	5	0.00 %	5 (1.35 %)	0.00 %	1.35 %
Homemaker	193	16 (4.31 %)	176 (47.44 %)	1 (0.27 %)	52.02 %
Commercial farmer	10	5 (1.35 %)	5 (1.35 %)	0.00 %	2.70 %
Government employee	3	3 (0.81 %)	0.00 %	0.00 %	0.81 %
Total	371	106	260	5	100.00 %

Note : MGNREGA is Mahatma Gandhi National Rural Employment Guarantee Scheme

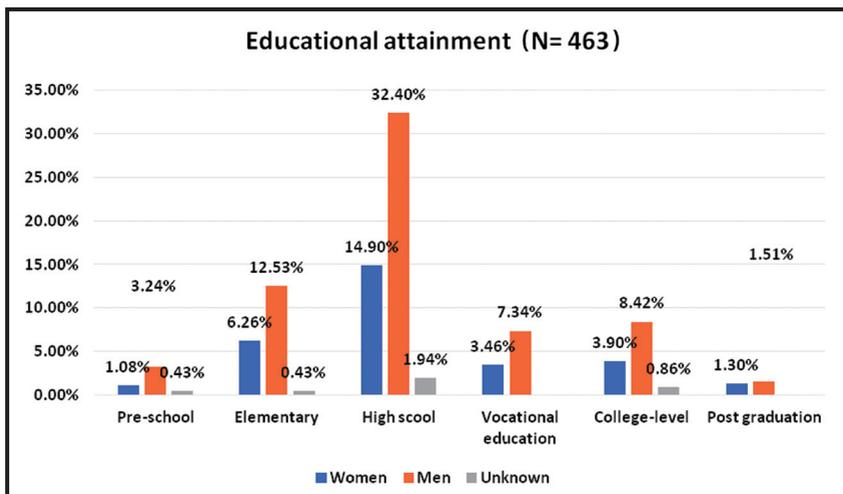
1.1.2. Household income (N= 414)

Table 3. Household income (N= 414)					
Income	No. of respondents	Women	Men	Unknown	Percentage
Less than \$500	229	53 (12.80 %)	172 (41.55 %)	4 (0.96 %)	55.31 %
\$1000–\$2000	76	27 (6.52 %)	49 (11.84 %)	0.00 %	18.35 %
\$2000–\$3000	39	21 (5.07 %)	16 (3.87 %)	2 (0.48 %)	9.42 %
\$3000–\$4000	28	11 (2.66 %)	12 (2.89 %)	5 (1.21 %)	6.76 %
\$4000–\$5000	13	1 (0.24 %)	12 (2.98 %)	0.00 %	3.15 %
More than \$5000	29	9 (2.17 %)	16 (3.87 %)	4 (10.96 %)	7.00 %
Total	414	122	277	15	100 %

1.2. Educational attainment-information (N=463): 228 respondents [(49.24 %); 69 women (14.90 %), 150 men (32.40 %) and nine unknown (1.94 %)] possess high-school-level education, while 89 [19.22 %; 29 women

(6.26 %), 58 men (12.53 %) and two unknown (0.43 %) farmers have elementary school-level education. Additionally, 61 [13.18 %; 18 women (3.90 %), 39 men (8.42 %) and four unknown (0.86 %)] farmers have college-level education, and 50 [10.80 %; 16 women (3.46 %) and 34 men (7.34 %) farmers have vocational education. 22 [4.75 %; five women (1.08 %), 15 men (3.24 %) and two unknown (0.43 %)] have studied up to pre-school. 13 [2.81 %; six women (1.30 %) and seven men (1.51 %)] of the respondents are post-graduates. No response was obtained from 46 participants.

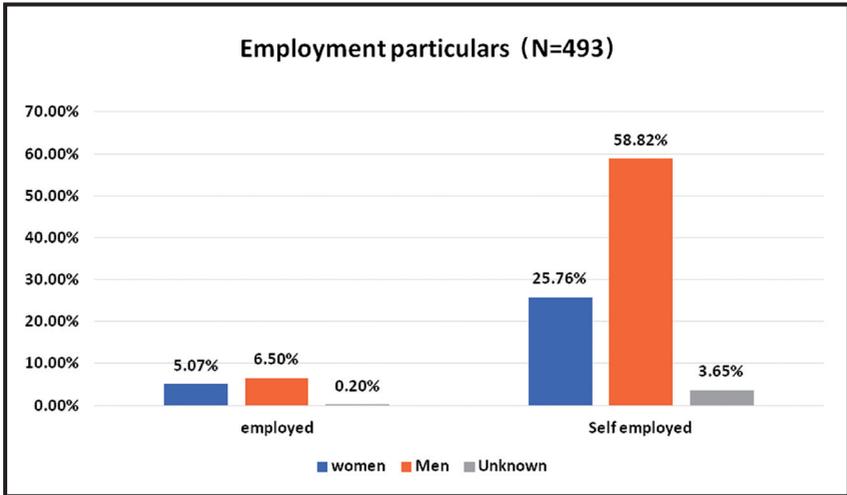
Figure 2. Educational attainment information



2. EMPLOYMENT PARTICULARS

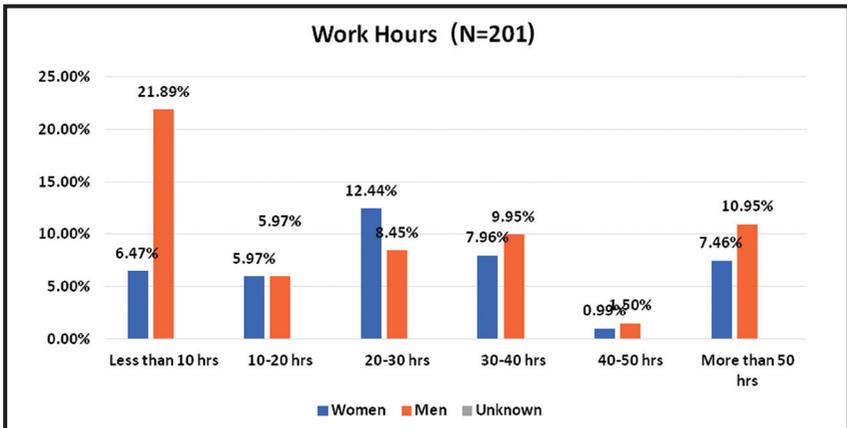
The survey data show that 88.23 % [435; 127 women (25.76 %), 290 men (58.82 %) and 18 unknown (3.65 %)] of respondents are self-employed, and 11.77 % [58; 25 women (5.07 %), 32 men (6.50 %) and one unknown (0.20 %)] are employed. No response was obtained from the rest 15 participants.

Figure 3. Employment particulars



2.1. Information-work hours per week (N=201). No response was obtained from 307 survey participants.

Figure 4: Work hours



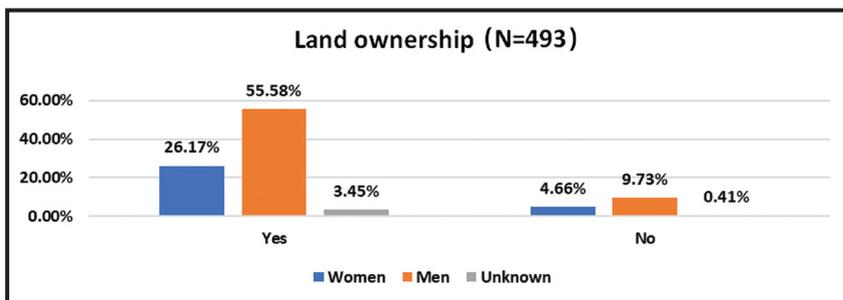
2.2. Salary particulars: From the responses from 173 respondents, 110 [63.58 %; 73 women (42.19 %) and 37 men (21.39 %)] revealed that their salary per hour does not comply with the minimum wage in India. For 63 [36.42 %;

37 women (21.39 %), 25 men (14.45 %) and one unknown (0.58 %) it does. No responses were obtained from 335 participants.

3. FARMING PARTICULARS

3.1. Land ownership: 420 [85.19 %; 129 women (26.17 %), 274 men (55.58 %) and 17 unknown (3.45 %)] out of 493 respondents own the land they are working on. 73 [14.81 %; 23 women (4.67 %), 48 men (9.73 %) and two unknown (0.41%)] are not. No responses were obtained from 15 participants.

Figure 5: Land ownership



3.2. Farming type: 473 [96.13 %; 146 women (29.67 %), 310 men (63.01 %) and 17 unknown (3.45 %)] respondents revealed farm-producing for their use, while 275 [55.89 %; 25 women (5.08 %), 242 men (49.19 %) and eight unknown (1.62 %)] are for commercial use. 17 [3.46 %; six women (1.22 %), 11 men (2.24 %)] farmers are involved in contract farming. 11 [2.23 %; three women (0.61 %), seven men (1.42 %) and one unknown (0.20 %)] are hiring workers to farm produce for commercial purposes. This is generated from the responses of 492 participants. Furthermore, the responses from survey data regarding the farming sector from 464 participants are depicted below.

3.3. Motive for farming: Diverse responses were reported from 436 participants. Most respondents were involved in farming because of their keen interest [204; 46.78 %; 70 women (16.05 %), 132 men (30.28 %), two unknown (0.45 %)]. A percentile of 162; [37.15 %; 29 women (6.65 %), 131 men (30.05 %) and two unknown (0.45 %)] are doing generational farming following their parents. 52 [11.92 %; 18 women (4.13 %), 32 men (7.34 %) and two unknown

(0.45 %) respondents are in this sector because of unemployment. Nine [2.06 %; two women (0.45 %) and seven men (1.61 %)] of them are subjected to farming to meet the daily needs of their lives.

Other than these, there are farmers following farming to:

- i) spend their time [2; 0.46 %; one women (0.23 %) and one men (0.23 %)];
- ii) due to income insufficiency [1; 0.23 %; one women (0.23%)];
- iii) as a side-business [2; 0.46 %; one women (0.23 %) and one men (0.23 %)];
- iv) and to produce chemical-free vegetables [3; 0.68 %; two women (0.45 %) and one men (0.23 %)].



Figure 6. Paddy field in Karavaram, Kerala

4. PESTICIDE USE

Among 508 survey participants, 495 responded regarding pesticide use. 313; [63.23 %; women 127 (25.66 %), 180 men (36.36 %) and six unknown (1.21 %)] of the respondents disclosed that they did not use pesticide products. However, 182; [36.77 %; 29 women (5.86 %), 140 men (28.29 %) and 13 unknown (2.62 %)] are. No response was obtained from the rest of the 13 participants.

Figure 7. Pesticide stored in households

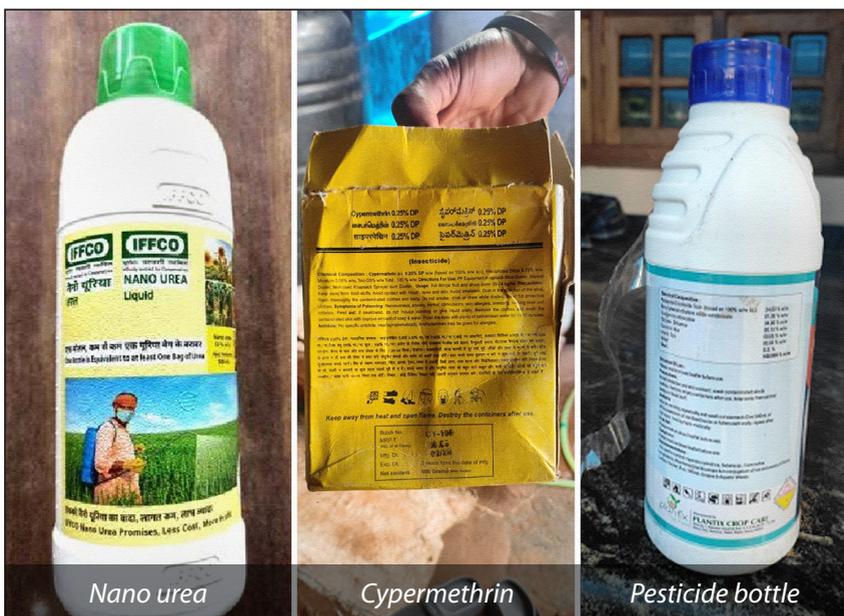
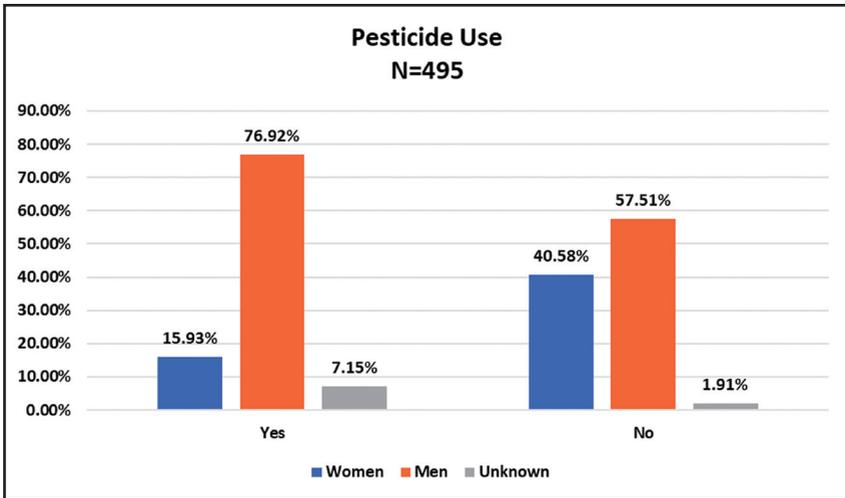


Figure 8: Pesticide use



The survey data of 242 respondents on where these pesticide products are applied show the following distribution of responses: 214 [88.42 %; 50 women (20.66 %) and 150 men (61.98 %)], 14 men (5.78 %) respondents are using them on farms, 34 [14.04 %; 17 women (7.02 %), 16 men (6.61 %) and one unknown (0.41 %)] in homes, and five [2.06 %; three women (1.24 %) and two men (0.82 %)]. No response was obtained from 266 survey participants.

History of pesticide use (N=199): The use of pesticides for more than ten years has been reported by 115 [57.79 %; 13 women (6.53 %), 93 men (46.74 %) and nine unknown (4.52 %)]; out of 199 respondents. Of those surveyed, 52 [26.13 %; 17 women (8.54 %), 31 men (15.58 %) and four unknown (2.01 %)] said they had been using it for no more than 10 years. Merely 32 [16.08 %; women 29 (14.57 %) and three men (1.51 %)] of the respondents indicated that they had been utilizing organic practices for several years. No responses were obtained from 309 participants.

4.1. Source of pesticides: Only 107 respondents provided details regarding the source of pesticides procured. The responses are provided below. No responses were obtained from 401 participants.

Table 4. Source of pesticides					
Source of pesticides	No. of respondents	Women	Men	Unknown	Percentage
Retail shops	88	6 (5.61 %)	80 (74.77 %)	2 (1.86 %)	82.24 %
Farm supply store	39	4 (3.73 %)	35 (32.71 %)	0.00 %	36.44 %
Market stall	23	2 (1.86 %)	21 (91.63 %)	0.00 %	21.49 %
Across the border	9	0.00 %	9 (8.41 %)	0.00 %	9 (8.41 %)
Provided by employer	12	0.00 %	12 (11.21 %)	0.00 %	12 (11.21 %)
Supermarket	25	0.00 %	25 (23.36 %)	0.00 %	25 (23.36 %)
Online	2	2 (1.86 %)	0.00 %	0.00 %	2 (1.86 %)

* N does not equal to 100 % due to multiple responses

When enquired, 129 respondents revealed their motives and reasons for choosing pesticides. A majority of 86 [66.66 %; nine women (6.98 %), 75 men (58.13 %) and two unknown (1.55 %)] are following the suggestions from pesticide sellers. 114 [88.37 %; women 18 (13.95 %), men 94 (72.87 %), and two unknown (1.55 %)] rely on their own experiences in selecting pesticide products. 60 [46.51 %; five women (3.88 %), 53 men (41.08 %) and two unknown (1.55 %)] consider the recommendation from others. Other than this 2 [1.55 %; one women (0.77 %) and one men (0.78 %)] of the farmers are acquiring information from training sessions and one from online sources.

4.2. Target pests noted (N=164): The following table shows the survey data regarding the target pests to which pesticides have been applied. From the data, weeds were the major concerns raised by a higher number of respondents (25.60 %) followed by plant diseases (21.95 %). No response was obtained from the rest of the 344 survey participants.

Table 5. Target pests noted (N=164)					
Target pests	Responses	Women	Men	Unknown	Percentage
Ants	6	1 (0.61 %)	5 (3.04 %)	0.00 %	3.65 %
Aphids	4	0.00 %	4 (2.43 %)	0.00 %	2.43 %
Beetles	2	0.00 %	2 (1.21 %)	0.00 %	1.21 %
Black bugs	2	0.00 %	2 (1.21 %)	0.00 %	1.21 %
Bollworms	6	0.00 %	6 (3.65 %)	0.00 %	3.65 %
Bugs	2	0.00 %	2 (1.21 %)	0.00 %	1.21 %

Caterpillars	5	0.00 %	5 (3.04 %)	0.00 %	3.04 %
Corn root worms	1	0.00 %	1 (0.60 %)	0.00 %	0.60 %
Cutworms	4	0.00 %	4 (2.43 %)	0.00 %	2.43 %
Diseases	36	3 (1.83 %)	33 (20.12 %)	0.00 %	21.95 %
Fleas	1	0.00 %	1 (0.60 %)	0.00 %	0.60 %
Foliar pests	9	1 (0.60 %)	8 (4.88 %)	0.00 %	5.48 %
Fruit borers	1	0.00 %	1 (0.60 %)	0.00 %	0.60 %
Fungal infections	14	5 (3.05 %)	9 (5.84 %)	0.00 %	8.53 %
Gall midges	1	0.00 %	1 (0.60 %)	0.00 %	0.60 %
Hispa	4	0.00 %	4 (2.43 %)	0.00 %	2.43 %
Hornets	1	1 (0.60 %)	0.00 %	0.00 %	0.60 %
Insects	30	5 (3.05 %)	25 (15.24 %)	0.00 %	18.29 %
Leaf curlers	1	0.00 %	1 (0.60 %)	0.00 %	0.60 %
Leaf hopper	3	1 (0.60 %)	2 (1.22 %)	0.00 %	1.82 %
Leaf roller	4	0.00 %	4 (2.43 %)	0.00 %	2.43 %
Mahali snails	1	0.00 %	1 (0.60 %)	0.00 %	0.60 %
Mealy bug	2	0.00 %	2 (1.21 %)	0.00 %	1.21 %
Mites	17	3 (1.82 %)	14 (8.45 %)	0.00 %	10.36 %
Mosquitoes	2	1 (0.60 %)	1 (0.61 %)	0.00 %	1.21 %
Nematodes	11	1 (0.60 %)	10 (6.10 %)	0.00 %	6.70 %
Phytophthora	1	0.00 %	1 (0.60 %)	0.00 %	0.60 %
Pod borer	3	0.00 %	3 (1.82 %)	0.00 %	1.82 %
Pyricularia	2	0.00 %	2 (1.21 %)	0.00 %	1.21 %
Pythium	2	0.00 %	2 (1.21 %)	0.00 %	1.21 %
Rat	1	0.00 %	1 (0.60 %)	0.00 %	0.60 %
Rhinoceros beetle	1	1 (0.60 %)	0.00 %	0.00 %	0.60 %
Rhizoctonia	2	0.00 %	2 (1.21 %)	0.00 %	1.21 %
Root grub	1	0.00 %	1 (0.60 %)	0.00 %	0.60 %
Sarocladium	2	0.00 %	2 (1.21 %)	0.00 %	1.21 %
Soil pests	9	1 (0.60 %)	8 (4.88 %)	0.00 %	5.48 %
Stemborer	7	1 (0.60 %)	6 (3.66 %)	0.00 %	4.26 %
Shoot borer	1	0.00 %	1 (0.60 %)	0.00 %	0.60 %
Sucking insects	2	0.00 %	2 (1.21 %)	0.00 %	1.21 %
Thrips	5	0.00 %	5 (3.04 %)	0.00 %	3.04 %

Wasps	1	1 (0.60 %)	0.00 %	0.00 %	0.60 %
Weeds	42	3 (1.82 %)	36 (21.95 %)	3 (1.83 %)	25.60 %
Weevil	5	1 (0.60 %)	4 (2.44 %)	0.00 %	3.04 %
Whorl maggot	2	0.00 %	2 (1.21 %)	0.00 %	1.21 %
Worms	3	0.00 %	3 (1.82 %)	0.00 %	1.82 %
Whitefly	1	0.00 %	100.00 %	0.00 %	0.60 %

4.3. Pesticide storage: The survey data generated from the responses of 153 respondents on pesticide storage shows the following distribution. No responses were obtained from 335 participants:

- a. Sheds: 131 [85.62 %; 17 women (11.11 %), men 102 (66.67 %) and 12 unknown (7.84 %)].
 - b. Fields: 91 [59.47 %; six women (3.92 %), 83 men (54.24 %) and two unknown (1.31 %)].
 - c. Garden: 59 [38.56 %; seven women (4.58 %), 51 men (33.33 %) and one unknown (0.65%)].
 - d. Homes: 9 [5.88 %; one women (0.65 %) and eight men (5.23 %)]: This is concerning as storing pesticides in households can lead to issues like accidental ingestion, inhalation, spills and leakages raising exposure risks in the family. Children and pets are especially vulnerable to exposure. Pesticides can spill or leak, contaminating surfaces, food items, or household products, which can lead to unintentional exposure over time.
- ▶ Furthermore, among 181 respondents, 154 [85.08 %; 25 women (13.81 %), 116 men (64.09 %) and 13 unknown (7.18 %)] are ensured keeping the pesticides locked up away from children to reduce exposure risks. However, 27 [14.92 %; five women (2.76 %), 22 men (12.16 %)] do not follow this. This is concerning and needs to be further addressed and must be given awareness. No responses were obtained from 326 participants.
 - ▶ Out of 169 respondents, 134 [79.29 %; 24 women (14.20 %), 108 men (63.91 %) and two unknown (1.18 %)] out of 167 have kept the pesticides separately from other items, whereas 35 [20.71 %; seven women (4.14 %) and 28 men (16.57 %)] have not.

4.4. Decantation of pesticides: Out of 150 respondents who provided information on this, 136 [90.67 %; 27 women (18.00 %), 108 men (72.00

%) and one unknown (0.67 %) are not involved in the practice of decantation, while 14 [9.33 %; three women (2.00 %), 10 men (6.67 %) and one unknown (0.66%)] are. This is a discouraged practice as transferring pesticides from their original containers is dangerous because of exposure and spillage risks.

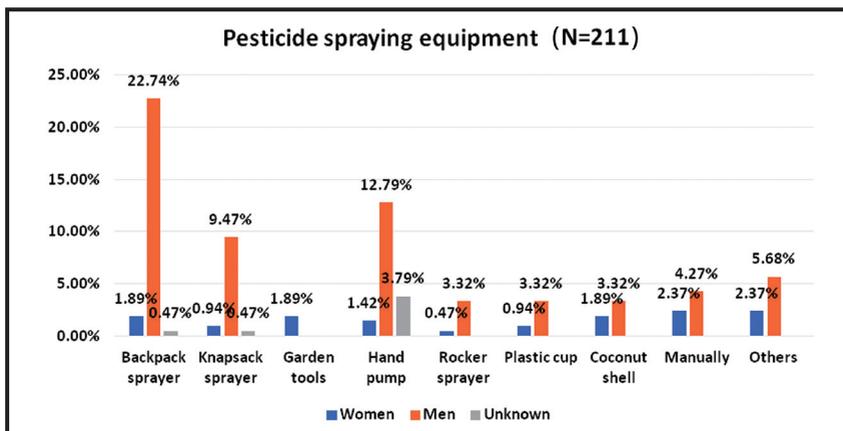
4.5. Recycling of pesticide containers: Shockingly, one respondent revealed recycling pesticide containers for water and food storage and other household items.

4.6. Pesticide disposal: The major disposal practices reported by 135 respondents include burning [94; 69.62 %; 13 women (9.63 %), 73 men (54.07 %) and eight unknown (5.92 %)], burying [82; 60.74 %; 10 women (7.41 %), 70 men (51.85 %) and two unknown (1.48 %)], putting in rubbish [74; 54.81 %; seven women (5.18 %), 64 men (47.41 %) and three unknown (2.22 %)], throwing in open fields [69; 51.10 %; four women (2.96 %), 59 men (43.70 %) and six unknown (4.44 %)], returning to the distributor [17; 12.59 %; seven women (5.18 %) and 10 men (7.41 %)] and reuse [1; 0.74 %; one men]. The data reveals a considerable dependence on disposal methods that may be harmful to both the environment and human health. Burning pesticide containers is a practice that poses significant risks by releasing toxic fumes and pollutants into the air, which can harm humans, animals, and the surrounding environment. This suggests a gap in awareness or a lack of access to safer disposal alternatives. The majority of respondents sell these containers to waste collectors, but it is unclear whether the containers are adequately cleaned beforehand. Additionally, disposal of used containers directly in the fields potentially leads to soil contamination and the leaching of chemicals into groundwater. These findings underscore the need for greater awareness within the farming community about safe pesticide container disposal methods.

4.7. Residential particulars: From the survey data of 357 respondents, 256 [71.71 %; 82 women (22.97 %), 169 men (47.34 %) and five unknown (1.40 %)] are residing at a distance of 1 km or less from the place where pesticide spraying takes place. 101 [28.29 %; 25 women (7.00 %), 75 men (21.01 %) and one unknown (0.28 %)] are living away from spraying places (more than 1 km).

4.8. Pesticide spraying equipment

Figure 9. Pesticide spraying equipment



* N does not equal to 100 % due to multiple responses

5. ALTERNATE PESTICIDE PRACTICES – SURVEY DATA

The following table shows the responses obtained regarding the alternate pesticide practices followed by the survey participants in farms, homes, and gardens. Cow dung application on the farms is one of the practices provided by a high number of respondents (N=45). Ash, Organic fertilizers and pesticides, neem-based remedies, factomfose, and potash are the other majorly noted alternate pesticide practices on the farm. In homes, most respondents use natural/home remedies for pest management (N=52). Other major practices include manual weeding and the application of organic fertilizers. As for the garden, the application of home remedies (N=35) is the major alternate pesticide practice reported by the respondents. Other major practices include the application of ash, neem-based remedies and organic fertilizers.

Table 6. Alternate pesticide practices

Alternate practices	Farm	Home	Garden
Ash	30	2	12
Banana peel	–	–	4
Bio-fertilizers	2	–	–
Bio-control agents	1	–	1
Bone Meal	18	–	1
Carbaryl	1	–	–
Camphor	–	3	–
Chambal	1	–	–
Charcoal	–	–	1
Chemical fertilizers	7	1	1
Chicken faeces	11	2	–
Cocopeat	1	–	–
Compost	17	1	6
Cow Dung	45	–	9
Cultural practices	1	–	–
Dish wash	1	3	–
Egg shells	3	–	10
Ekalux	1	–	–
Factmofose	30	3	–
Fish manure	2	–	–
Fungicides	2	–	1
Garlic/pepper spray	15	–	5
Ginger-based remedies	27	–	–
Goat manure	1	–	–
Green house nets	1	–	–
Gypsum	1	–	–
Hand picking	5	6	5
Home / natural remedies	33	52	35
Horticulture oil	1	–	–
HIT repellent	–	2	–
Lime stone powder	34	–	1
Lime water	2	–	–

Mechanical weeding	–	5	5
Manual weeding	19	12	7
Mosquito coil	–	2	–
Neem based remedies	38	8	12
No remedies	6	8	10
Onion peels	1	–	8
Onion water	2	–	–
Organic fertilizers	31	16	14
Organic pesticides	21	5	5
Organic methods	15	3	–
Paracetamol tablet	1	–	–
Peanut cake	1	–	–
Pesticides	6	–	2
Phorate	1	–	–
Potash	29	3	1
Repellents	–	–	1
Rice water	24	1	3
Soap water	15	1	10
Tea powder	4	1	8
Tobacco leaves	6	1	8
Traps	6	–	3
Turmeric water	3	2	5
Urea	29	3	1
Vegetable waste	9	1	11
Vermicompost	17	1	2
Weed mulching	1	4	3
Weedicide	1	–	–
Wheat straw	1	–	–

6. PESTICIDE PRACTICES AND EXPOSURE

The survey data on the pesticide practices followed by 161 respondents shows the following distribution. Higher responses (158; 98.13 %) are reported for applying and spraying pesticides. The other responses obtained are tabulated in the following table.

Table 7. Pesticide practices

Pesticide practices	No. of responses	Women	Men	Unknown	Percentage
Apply/spray in field	158	25 (14.88 %)	131 (77.98 %)	2 (1.19 %)	94.05 %
Household application	12	3 (1.78 %)	9 (5.36 %)	0.00 %	7.14 %
Human therapy	2	0.00 %	2 (1.19 %)	0.00 %	1.19 %
Mixing/loading/decanting/cleaning	105	15 (8.93 %)	88 (52.38 %)	2 (1.19 %)	62.50 %
Purchasing or transporting	73	5 (2.98 %)	67 (39.88 %)	1 (0.59 %)	43.45 %
Sprinkle in the pest spot	2	0.00 %	2 (1.19 %)	0.00 %	1.19 %
Vector control application	20	2 (1.19 %)	18 (10.71 %)	0.00 %	11.90 %
Veterinary therapy [for e.g., use for foot and mouth disease]	2	0.00 %	1 (0.59 %)	1 (0.59 %)	1.19 %
Washing the clothes used when spraying or mixing pesticides	80	8 (4.76 %)	70 (41.67 %)	2 (1.19 %)	47.62 %
Washing the equipment used in spraying or mixing pesticides	81	9 (5.36 %)	70 (41.66 %)	2 (1.19 %)	48.21 %
Working in fields where pesticides are being used or have been used	67	5 (2.98 %)	60 (35.71 %)	2 (1.19 %)	39.88 %

* N does not equal to 100 % due to multiple responses

6.1. Pesticide application schedule: Regarding the application time of pesticides, more than half of the 201 respondents [120; 59.70 %; 22 women (10.95 %), 85 men (42.28 %) and 13 unknown (6.47 %)], gave a response to the monthly application. Weekly applications were reported by 45 [22.38 %; eight women (3.98 %) and 37 men (18.40 %)] respondents. Concerningly, four respondents [1.99 %; men], were involved in the daily application of pesticides. 11 [5.47 %; six women (2.98 %) and five men (2.49 %)] of respondents reported yearly applications. Other responses included:

- a. Random applications – 13 respondents – [6.46 %; 12 women (5.97 %) and one men (0.49 %)];
- b. Rarely applications – four respondents – [1.99 %; four women];
- c. Seasonal applications – one respondents – [0.49 %; one men];
- d. Only when needed – four respondents – [1.99 %; four men].

6.2. Pesticide exposure – stage of exposure: When surveyed, out of 176 respondents, 150 respondents [20 women (11.36 %), 119 men (67.61 %) and 11 unknown (6.25 %)] revealed exposure to pesticides, during ground spraying

and two [1.14 %; two men] during sprinkling. 14 [7.95 %; one woman (0.56 %), 12 men (6.82 %) and one unknown (0.57 %)] respondents encountered contaminated water and food, and 6 [3.40 %; three women (1.70 %) and three men (1.70 %)] revealed pesticide exposure from neighborhood uses. Those from the spraying for vector control undertaken by the Government were also mentioned by seven [3.97 %; three women (1.70 %) and four men (2.27 %)] of the respondents. Shockingly, one of the respondents [0.56 %; one women] was randomly exposed to pesticides. The survey data regarding the exposure interval is provided below. No responses were obtained from 332 participants.

6.3. Re-entry to treated farms: From the responses of 198 respondents, 61; [30.81 %; 11 women (5.56 %), 49 men (24.74 %) and one unknown (0.51 %)] re-entered the treated area after one day. Shockingly, 63; [31.81 %; 24 women (12.12 %); 38 men (19.19 %) and one unknown (0.50%)] enter immediately after spraying. They are at high risk of exposure. This is something that needs to be addressed and given awareness. 74; [37.37 %; 10 women (5.05 %), 52 men (26.26 %) and 12 unknown (6.06 %)] enter into treated farms after two to three days. No responses were obtained from 310 participants.

6.4. The direction of application: Considering the direction of the wind while applying pesticides is crucial for minimizing pesticide drifts and exposure risks. The survey data of 245 respondents shows that 180; [73.47 %; 70 women (28.57 %), 108 men (44.08 %) and two unknown (0.82 %)] are randomly applying pesticides without considering the wind direction. This is concerning as this can cause the aforementioned issues among these respondents. 64; [26.12 %; 12 women (4.90 %), 51 men (20.82 %) and one unknown (0.40 %)] are applying along the wind direction and one respondent [0.41 %; one men] is spraying against the direction of the wind. No response was obtained from the rest of the 263 participants.

6.5. Pesticide spills: From the survey data of 322 respondents, 99 [30.75 %; Women 10 3.11 %), men 77(23.91 %) , unknown 12 (3.73 %)] have experienced pesticides being spilled on their bodies during the handling. A majority of 223 [69.25 %]; 93 women (28.88 %), 128 men (39.75 %) and two unknown (0.62 %) have not. No response was obtained from the rest of the 186 participants. 204 respondents provided further information regarding the stages of occurrence. The highest responses were obtained from respondents who experienced spills during the spraying of pesticides 88; [43.13 %; six women (2.94 %), 72 men (35.29 %) and 10 unknown (4.90 %)]. Other than this, respondents reported spills during the mixing 62 [30.39 %; six women

(2.94 %), 53 men (25.98 %) and three unknown (1.47 %) and loading 57 [27.94 %; three women (1.47 %) and 54 men (26.47 %)] of pesticides. No response was obtained from the rest of the 304 participants.

The responses obtained for the primary reason for the occurrence of pesticide spills from 81 respondents are tabulated below. No responses were obtained from 18 respondents who experienced pesticide spills.

Reason for spill	No. of responses	Women	Men	Unknown	Percentage
Spilled from hands	3	1 (1.23 %)	0.00 %	2 (2.47 %)	3.70 %
Spilled while spraying	33	1 (1.23 %)	32 (39.51 %)	0.00 %	40.74 %
Spilled while decanting/mixing	7	2 (2.47 %)	1 (1.23 %)	4 (4.94 %)	8.64 %
Faulty spray equipment	49	2 (2.47%)	47 (58.02 %)	0.00 %	60.49 %
Change in wind direction	48	2 (2.47 %)	44 (54.32 %)	2 (2.47 %)	59.26 %
Applied pesticide using coconut shells	4	1 (1.23 %)	1 (1.23 %)	2 (2.47 %)	4.93 %
Bottle cap is loose	13	3 (3.70%)	10 (12.35 %)	0.00 %	16.04 %
While sprinkling powder	4	1 (1.23 %)	1 (1.23 %)	2 (2.47 %)	4.93 %
Children playing with pesticide containers	2	1 (1.23 %)	1 (1.23 %)	0.00 %	2.46 %
Faulty packaging	7	1 (1.23 %)	6 (7.41 %)	0.00 %	8.64 %

* N does not equal to 100 % due to multiple responses

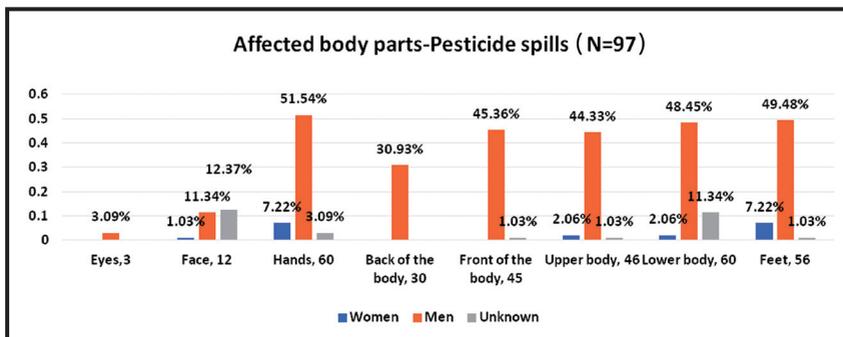
6.6. Management of pesticide spills (N=101)

Pesticide spill management	No. of respondents	Women	Men	Unknown	Percentage
Wiped off with clothes	32	2 (1.98 %)	29 (90.63 %)	1 (0.99 %)	31.68 %
Took a bath	52	4 (3.96 %)	43 (82.69 %)	5 (4.95 %)	51.48 %
Washed hands or affected area	76	6 (5.94 %)	64 (84.22 %)	6 (5.94 %)	75.24 %
Washed the clothes	38	1 (0.99 %)	36 (94.74 %)	1 (0.99 %)	37.62 %
Changed clothes	25	1 (0.99 %)	23 (92.00 %)	1 (0.99 %)	24.75 %
Sought medical attention	10	0.00 %	10 (9.90 %)	0.00 %	9.90 %
Applied home remedy	3	1 (0.99 %)	2 (1.98 %)	0.00 %	2.97 %
Did nothing	20	2 (1.98 %)	17 (16.83 %)	1 (0.99 %)	19.80 %

* N does not equal to 100 % due to multiple responses

6.7. Spill affected body parts: The distribution of survey data obtained from 97 respondents regarding the body parts affected by pesticide spills is depicted below. No response was obtained from two respondents who experienced pesticide spills.

Figure 10: Affected body parts – pesticide spill



6.8. Washing facilities: From the responses of 338 respondents, 259 [76.63 %; 68 women (20.12 %), 185 men (54.73 %) and six unknown (1.78 %)] have facilities where they apply pesticides for cleaning and washing. 79 respondents [23.37 %; 34 women (10.06 %), 41 men (12.13 %) and four unknown (1.18 %)] have not. No responses were obtained from 170 participants.

The distribution of data from 290 respondents regarding the washing facilities is provided in the table below.

Table 10. Washing facilities					
Washing facilities in body	No. of respondents	Women	Men	Unknown	Percentage
Ponds	78	8 (2.76 %)	70 (21.14 %)	0.00 %	26.90 %
River	86	13 (4.48 %)	70 (24.14 %)	3 (1.03 %)	29.65 %
Taps	224	64 (22.07 %)	153 (52.76 %)	7 (2.41 %)	77.24 %
Water containers	79	8 (2.76 %)	68 (23.45 %)	3 (1.03 %)	27.24 %
Water channels	113	14 (4.83 %)	97 (33.45 %)	2 (0.68 %)	38.96 %
Wells	116	22 (7.58 %)	94 (32.41 %)	0.00 %	40.00 %

* N does not equal to 100 % due to multiple responses

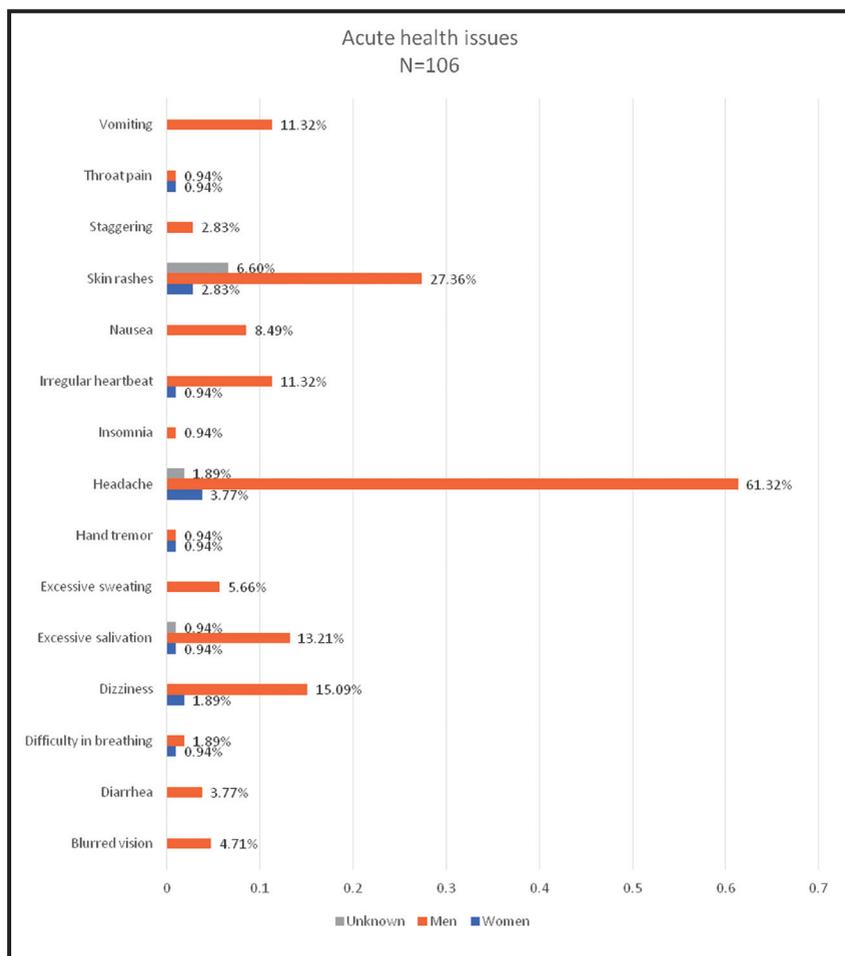
7. HEALTH ISSUES

7.1. Acute health issues: From the data, a high incidence among respondents was noted for health issues like headache (66.98 %) followed by skin rashes (36.79 %). However, further exploration is necessary. This data is generated from the responses of 106 respondents. No responses were obtained from the rest of the 401 participants.

Health issues reported	No. of responses	Women	Men	Unknown	Percentage
Blurred vision	5	0.00 %	5 (4.71 %)	0.00 %	4.71 %
Diarrhea	4	0.00 %	4 (3.77 %)	0.00 %	3.77 %
Difficulty in breathing	3	1 (0.94 %)	2 (1.89 %)	0.00 %	2.83 %
Dizziness	18	2 (1.89 %)	16 (15.09 %)	0.00 %	16.98 %
Excessive salivation	16	1 (0.94 %)	14 (13.21 %)	1 (0.94 %)	15.09 %
Excessive sweating	6	0.00 %	6 (5.66 %)	0.00 %	5.66 %
Hand tremor	2	1 (0.94 %)	1 (0.94 %)	0.00 %	1.88 %
Headache	71	4 (3.77 %)	65 (61.32 %)	2 (1.89 %)	66.98 %
Insomnia	1	0.00 %	1 (0.94 %)	0.00 %	0.94 %
Irregular heartbeat	13	1 (0.94 %)	12 (11.23 %)	0.00 %	12.26 %
Nausea	9	0.00 %	9 (8.49 %)	0.00 %	8.49 %
Skin rashes	39	3 (2.86 %)	29 (27.36 %)	7 (6.60 %)	36.79 %
Staggering	3	0.00 %	3 (2.83 %)	0.00 %	2.83 %
Throat pain	2	1 (0.94 %)	1 (0.94 %)	0.00 %	1.88 %
Vomiting	12	0.00 %	12 (11.32 %)	0.00 %	11.32 %

* N does not equal to 100 % due to multiple responses

Figure 11: Acute health issues



* N does not equal to 100% due to multiple responses

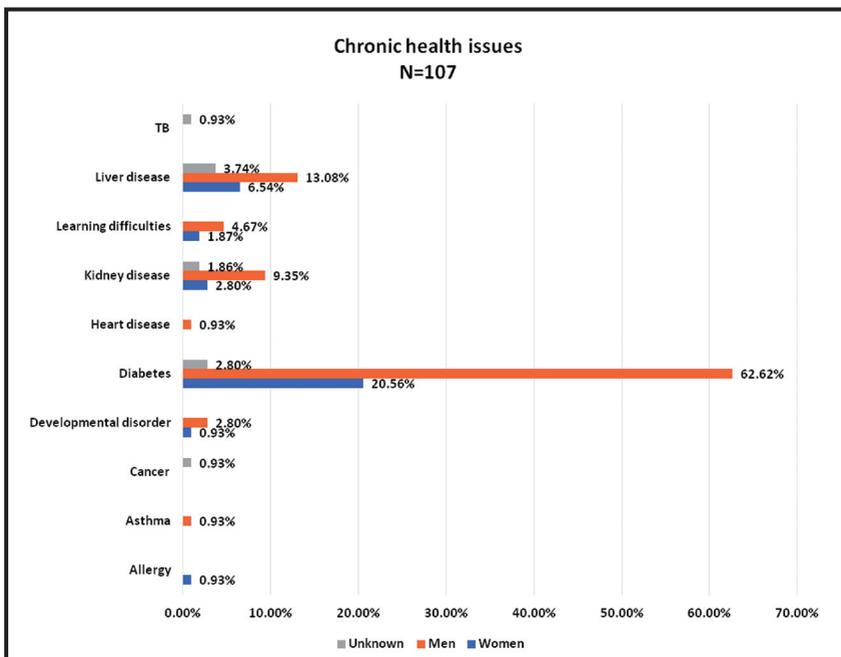
7.2. Chronic health issues: From the data, a high incidence among respondents was noted for health issues like diabetes (85.98 %) followed by liver disease (23.36 %). There is no empirical data to prove whether these are related to pesticide exposure or not. However, further exploration is necessary. This data is generated from the responses of 107 respondents. No responses were obtained from the rest of the 401 participants.

Table 12. Chronic health issues

Health issues reported	No. of responses	Women	Men	Unknown	Percentage
Allergy	1	1 (0.93 %)	0.00 %	0.00 %	0.93 %
Asthma	1	0.00 %	1 (0.93 %)	0.00 %	0.93 %
Cancer	1	0.00 %	0.00 %	1 (0.93 %)	0.93 %
Developmental disorder	4	1 (0.93 %)	3 (2.80 %)	0.00 %	3.73 %
Diabetes	92	22 (20.56 %)	67 (62.62 %)	3 (2.80 %)	85.98 %
Heart disease	1	0.00 %	1 (0.93 %)	0.00 %	0.93 %
Kidney disease	15	3 (2.80 %)	10 (9.35 %)	2 (1.87 %)	14.01 %
Learning difficulties	7	2 (1.87 %)	5 (4.67 %)	0.00 %	6.54 %
Liver disease	25	7 (6.54 %)	14 (13.08 %)	4 (3.74 %)	23.36 %
TB	1	0.00 %	0.00 %	1 (0.93 %)	0.93 %

* N does not equal to 100 % due to multiple responses

Figure 12. Chronic health issues



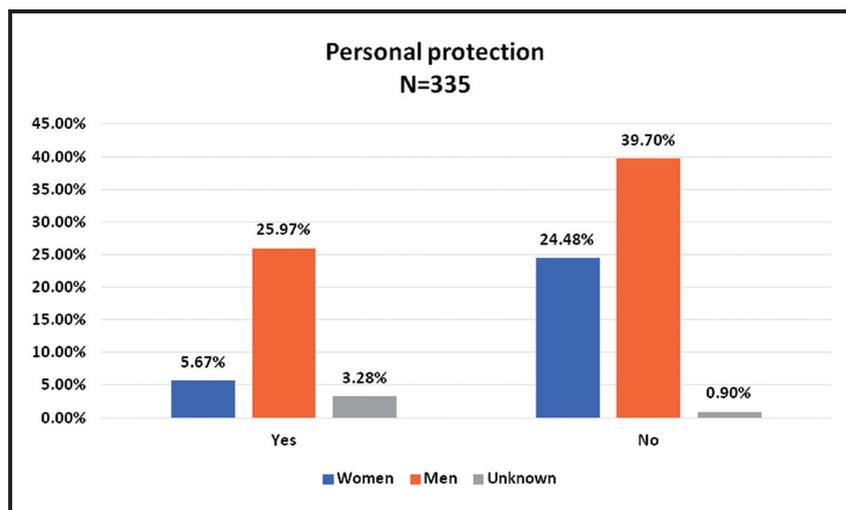
* N does not equal to 100 % due to multiple responses

8. PERSONAL PROTECTION PARTICULARS

The survey data of 335 respondents following protective clothing while handling pesticides is below. No responses were obtained from 173 participants.

Category	No. of respondents	Women	Men	Unknown	Percentage
Yes	117	19 (5.67 %)	87 (25.97 %)	11 (3.28 %)	34.92 %
No	218	82 (24.48 %)	133 (39.70 %)	3 (0.90 %)	65.08 %
Total	335	101	220	14	100.00 %

Figure 13. Personal protection



A high proportion (65.07 %) of respondents are not using PPE while handling pesticides, while only 34.93 % are. When exploring possible reasons for not using PPE, mixed responses were obtained from 68 respondents. For 33 [48.52 %; nine women (13.23 %), 23 men (33.82 %) and one unknown (0.47 %)] of the respondents, the PPE was not available. For 27 [39.70 %; seven women (10.29 %) and 20 men (29.41 %)], the major issue was comfortability. Some respondents revealed PPE is expensive [23; 33.82 %; five women (7.35 %) and

18 men (26.47 %)]. Very few reflected on not being aware of or concerned about PPE use [three; 4.41 %; three men].

185 participants responded regarding employer supervision of PPE use and personal protection. Except for four [2.16 %; all men, %], 181 [97.84 %; 78 women (42.16 %), 99 men (53.52 %) and four unknown (2.16 %)] ensured that their employer was unaware that they were not using PPE. Employers offered to supply PPE for just two [1.26 %; one woman (0.63 %) and one man (0.63 %)] out of 159 respondents, according to the survey outcomes. Additionally, 157 [98.74 % respondents; 74 women (47.13 %) and 83 men (52.87 %)] admitted that their job contracts did not mention PPE.

8.1. PPE issues: From the responses provided by 122 participants, 120 [98.36 %; 23 women (18.85 %), 95 men (77.87 %) and two unknown (1.64 %)] are not facing any PPE-related issues, except for 2 [1.64 %; one woman (0.82 %) and one man (0.82 %)]. However, out of 40 respondents, three [7.50 %; all men] have reported informing their employers of PPE-related difficulties, while 37 [92.50 %; 12 women (30.00 %), 25 men (65.50 %)] have not.

8.2. PPE training: From the responses of 230 respondents, it was noted that only 43 [18.70 %; eight women (3.48 %) and 35 men (15.22 %)] have received instructions or training on PPE use. 187 [81.30 %; 71 women (30.87 %), 105 men (45.65 %) and 11 unknown (4.78 %)] have not. No response was obtained from the rest of the participants. Only 39 respondents revealed the instruction sources, of which the distribution is provided below. No responses were obtained from 468 participants.

Table 14. PPE training					
Source of PPE instructions	No. of responses	Women	Men	Unknown	Percentage
Employer	4	2 (5.13 %)	2 (5.12 %)	0.00 %	10.25 %
Friend	12	3 (7.69 %)	9 (23.07 %)	0.00 %	30.76 %
Government	1	0.00 %	1 (2.56 %)	0.00 %	2.56 %
Krishi Bhavan	5	1 (2.56 %)	4 (10.26 %)	0.00 %	12.82 %
Leaflets	4	3 (7.69 %)	1 (2.56 %)	0.00 %	10.25 %
Manufacturer	15	2 (5.13 %)	13 (33.33 %)	0.00 %	38.46 %
Self-exploring	11	2 (5.12 %)	9 (23.08 %)	0.00 %	28.20 %

* N does not equal to 100 % due to multiple responses

8.3. PPE recommendations from training

Table 15. PPE recommendations from training					
Category	No. of responses	Women	Men	Unknown	Percentage
Eye protection	3	1 (1.07 %)	2 (2.15 %)	0.00 %	3.22 %
Face covers/mask	81	11 (11.82 %)	69 (74.2 %)	1 (1.07 %)	87.09 %
Long-sleeve shirt	85	13 (13.98 %)	71 (79.34 %)	1 (1.07 %)	91.39 %
Overalls	5	4 (4.30 %)	1 (1.07 %)	0.00 %	5.37 %
Hand cover/gloves	85	14 (15.05 %)	70 (75.27 %)	1 (1.07 %)	91.39 %
Long pants	72	7 (7.53 %)	64 (68.81 %)	1 (1.07 %)	77.41 %
Boots/Shoes	75	11 (11.83 %)	63 (67.74 %)	1 (1.07 %)	80.64 %

N=93, * N does not equal to 100 % due to multiple responses

8.4. PPE procurement: The responses obtained for the PPE items procured from 45 respondents are provided in the table below. No responses were obtained from 463 participants.

Table 16. PPE procurement					
Category	No. of responses	Women	Men	Unknown	Percentage
Facemask	36	5 (11.11 %)	23 (51.11 %)	8 (17.78 %)	80.00 %
Gloves	40	10 (22.22 %)	20 (44.44 %)	10 (22.22 %)	88.88 %
Long-sleeve shirt	13	2 (4.44 %)	11 (24.442 %)	0.00 %	28.88 %
Overalls	1	1 (2.22 %)	0.00 %	0.00 %	2.22 %
Boots/shoes	6	2 (4.44 %)	4 (8.89 %)	0.00 %	13.33 %
Long pants	10	1 (2.22 %)	9 (20.00 %)	0.00 %	22.22 %
Eyeglasses	1	1 (2.22 %)	0.00 %	0.00 %	2.22 %

PPE items procured: N=45; * N does not equal to 100 % due to multiple responses

9. LABEL/LEAFLETS

9.1. Access to the label/leaflet for the pesticides

Category	No. of respondents	Women	Men	unknown	Percentage
Yes	98	14 (9.79 %)	76 (53.15 %)	8 (5.59 %)	68.53 %
No	45	11 (7.70 %)	28 (19.58 %)	6 (4.19 %)	31.47 %
Total	143	25	104	14	100 %

All the necessary information regarding its toxicity, ingredients, type, and warning and precautionary statements are provided in a pesticide label and hence is crucial for avoiding risks. From the above responses, 68.53 % of respondents have access to pesticide labels. But 31.47 % do not. No responses were obtained from 365 participants.

From the survey data of 146 respondents on reading pesticide label information, positive responses were obtained only from 26 [17.81 %; five women (3.43 %), 17 men (11.64 %) and four unknown (2.74 %)]. 84; [57.53 %; 15 women (10.27 %), 65 men (44.52 %) and four unknown (2.74 %)] occasionally explore label information while a percentile of 36; [24.66 %; six women (4.11 %), 24 men (16.44 %) and six unknown (4.11 %)] do not.

Label language (141 respondents): Just 26; [18.44 %; six women (4.26 %), 15 men (10.63 %) and five unknown (3.55 %)] respondents to the survey acknowledged that the labels for pesticides are written in the local tongue. 31 [21.99 %; five women (3.55 %), 25 men (17.73 %) and one unknown (0.71 %)] say that it is not. For 84 [59.57 %; 14 women (9.92 %), 65 men (46.10 %) and five unknown (3.55 % of those surveyed, the languages vary. This is concerning as labels not being in the local language can produce difficulties in accessing information. This can lead to farmers avoiding leaflet information or label instructions.

9.1.1. Label font size: From the survey data of 130 respondents, it is clear that for 15 [11.54 %; three women (2.31 %), 12 men (9.23 %)], the information is not big enough to read. For more than half the proportion of 91; [70.00 %; 16 women (12.31 %), 73 men (56.15 %) and two unknown (1.54 %)],

the font sizes are sometimes larger, but not always. Only, 24 [18.46 %; six women (4.62 %) and 18 men (13.84 %)] confidently responded on labels having a readable font size.

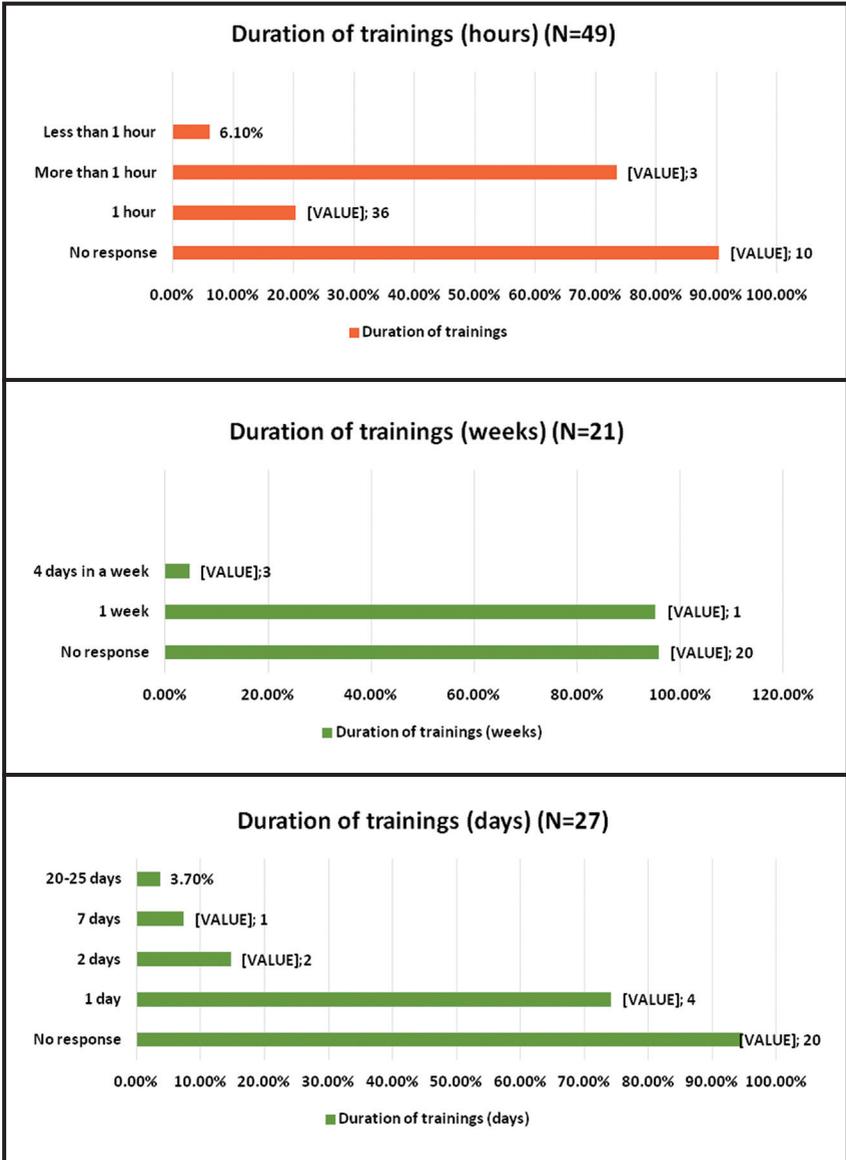
9.2. Leaflet information: 104 respondents among 507 survey participants provided information regarding access to pesticide leaflets. Among them, 64; [61.54 %; 11 women (10.58 %), 52 men (50.00 %) and one unknown (0.96 %)] have access, while 40; [38.46 %; four women (3.85 %), 35 men (33.65 %) and one unknown (0.96 %)] have not. 113 respondents shared their opinions on leaflet information. 53 [46.90 %; nine women (7.96 %), 40 men (35.40 %) and four unknown (3.54 %)] found the information provided useful. 60; [53.10 %; 10 women (8.85 %), 47 men (41.60 %) and three unknown (2.65 %)] do not. No responses were obtained from 404 participants.

10. PESTICIDE-RELATED TRAINING

1 94 respondents gave responses regarding the training received on pesticide use. Among them, 65 [33.50 %; 16 women (8.25 %), 48 men (24.74 %) and one unknown (0.51 %)] received training, while 129 [66.50 %; 20 women (10.31 %), 99 men (51.03 %) and 10 unknown (5.16 %)] have not. No responses were obtained from 313 participants. Furthermore, the distribution of the mode of training received from the responses of 67 respondents is provided below.

Mode of training	No. of responses	Women	Men	Unknown	Percentage
Courses	9	1 (1.49 %)	8 (11.94 %)	0.00 %	13.43 %
Field demonstrations	22	6 (8.96 %)	15 (22.38 %)	1 (1.49 %)	32.83 %
Learned from other professional farmers	1	0.00 %	1 (1.49 %)	0.00 %	1 (1.49 %)
Lessons from family	1	1 (1.49 %)	0.00 %	0.00 %	1 (1.49 %)
Research	1	1 (1.49 %)	0.00 %	0.00 %	1 (1.49 %)
Sales information	14	2 (2.98 %)	12 (17.91 %)	0.00 %	20.89 %
Seminar	52	11 (16.42 %)	40 (59.70 %)	1 (1.49 %)	77.61 %

Figure 14. Length of trainings: survey data



11. EMERGENCY SUPPORT

The responses obtained regarding the emergency medical support opted by 259 respondents are given. Higher responses were obtained from those consulting hospitals for emergencies. However, 14.67 % of respondents opt for local remedies in such scenarios. An in-depth analysis is required on this. Also, one respondent has reported drinking salt water when poisoned. This depicts the need for awareness regarding the impact of such practices among the respondents. No responses were obtained from 248 participants.

Emergency support	No. of respondents	Women	Men	Unknown	Percentage
Company	5	0.00 %	4 (1.54 %)	1 (0.39 %)	1.93 %
Family doctor	1	0.00 %	1 (0.39 %)	0.00 %	0.39 %
Family member	68	12 (4.63 %)	55 (21.23 %)	1 (0.39 %)	26.25 %
Friend	29	4 (1.54 %)	24 (9.26 %)	1 (0.39 %)	11.19 %
Hospital	223	50 (19.31 %)	159 (61.38 %)	14 (5.41 %)	86.10 %
Krishi bhavan	2	0.00 %	2 (0.77 %)	0.00 %	0.77 %
Local doctor	57	9 (3.47 %)	45 (17.37 %)	3 (1.16 %)	22.00 %
Local remedies	38	5 (1.93 %)	32 (12.35 %)	1 (0.39 %)	14.67 %
Local store	1	0.00 %	1 (0.39 %)	0.00 %	0.39 %
Poison centre	28	5 (1.93 %)	23 (82.14 %)	0.00 %	10.81 %
Saltwater drinking	1	0.00 %	1 (0.38 %)	0.00 %	0.39 %

* N does not equal to 100 % due to multiple responses

Notes: **Krishi Bhavan** is the government body in India undertaken by the Department of Agriculture in various states. Krishi Bhavan deals with the formulation and implementation of various state government programmes to augment the production of both food crops and cash crops in the state.

12. PESTICIDE MANUFACTURING COMPANIES

From the responses from 143 respondents, the data obtained regarding the manufacturing companies of the products they are using is provided here. 49 manufacturing companies were identified from the responses.

Table 20. Pesticide manufacturing companies			
	Pesticide manufacturing companies	No. of responses	Percentage
1.	Adama	2	1.39 %
2.	Agrotech	1	0.69 %
3.	Atul Ltd	1	0.69 %
4.	BASF	1	0.69 %
5.	Bayer	7	4.89 %
6.	Bio Garden	1	0.69 %
7.	Buracden	1	0.69 %
8.	Cheminova indofil	1	0.69 %
9.	Chipku	1	0.69 %
10.	Commando	1	0.69 %
11.	Currater	1	0.69 %
12.	Dhanuka	1	0.69 %
13.	Eco harvest	1	0.69 %
14.	Farm car solution	1	0.69 %
15.	FMC Corporation	17	11.88 %
16.	Generic	1	0.69 %
17.	Gharda chemicals	4	2.79 %
18.	Go garden	1	0.69 %
19.	Good night	1	0.69 %
20.	HIL	5	3.49 %
21.	Indian potash limited	2	1.39 %
22.	ITL	1	0.69 %
23.	JDF	1	0.69 %
24.	Jeevagro	3	2.09 %
25.	Kissan Organic	2	1.39 %
26.	Kripa organic	1	0.69 %

27.	Kulgudi	1	0.69 %
28.	Mangla	1	0.69 %
29.	Miller	1	0.69 %
30.	Monsanto	1	0.69 %
31.	Nashik	1	0.69 %
32.	NPK ltd	1	0.69 %
33.	ORMA	4	2.79 %
34.	Ortho	1	0.69 %
35.	PRAHAR	1	0.69 %
36.	Prakriti biotech	1	0.69 %
37.	Pura mate	1	0.69 %
38.	Rallis India	2	1.39 %
39.	Richfield	1	0.69 %
40.	Rocket products	2	1.39 %
41.	Safal	1	0.69 %
42.	Sanjeevani	1	0.69 %
43.	Siva pvt	1	0.69 %
44.	Sumicidin	5	3.49 %
45.	Sumitomo	4	2.79 %
46.	Syngenta	64	44.75 %
47.	Tata	22	15.38 %
48.	Tropical agro	8	5.59 %
49.	UPL	22	15.38 %

* N does not equal to 100 % due to multiple responses

13. PESTICIDES

296 respondents have provided the information regarding the pesticide products. Among them, 24 active ingredients [17 insecticides, three herbicides, one Plant Growth regulator, one molluscicide, one insect repellent, and one fungicide] and six active ingredients in combinations have been identified. 18 of the active ingredients are HHPs. Among the six combination products, three of them consist of HHPs. A pesticide product with a high frequency of use is Hilban (Chlorpyrifos 20%). 115 respondents are using this Insecticide.

13.1. Pesticide and active ingredients

Table 21. Pesticide and active ingredients					
	Type	Trade name	Frequency	Chemical name	Active ingredient
1.	Insecticide	Actara	6	Thiamethoxam	Thorin (Thiamethoxam 25 % WG)
2.	Insecticide	Ant killer	3	Indoxacarb	Indoxacarb, hydramethylnon, Boric acid
3.	Fungicide	Antracol	2	Propineb	Propineb 70 % WP
4.	Insecticide	Argo safe xl	1	Lambdacyhalothrin	Lambdacyhalothrin 2.5 %
5.	Insecticide	Chlorguard	5	Chlorpyrifos	Chlorpyrifos 20 % EC
6.	Insecticide	Carbaryl-copper spray	1	Carbaryl	Carbaryl
7.	Insecticide	Chlorphos	1	Chlorpyrifos	Chlorpyrifos
8.	Insecticide	Ddt	8	P,p'-ddt	P,p'-ddt 65-80 %
9.	Insecticide	Ecoguard	1	Chlorpyrifos	Chlorpyrifos 50 % EC
10.	Insecticide	Ekalux	85	Quinalphos	Quinalphos 25 % EC
11.	Insecticide	Fame	1	Flubendiamide,	Flubendiamide
12.	Insecticide	Fenval	9	Esfenvalerate	Esfenvalerate
13.	Insecticide	Furadan	72	Carbofuran	3% Granular formulation of Carbofuran
14.	Insecticide	G Snail kill	2	Metaldehyde	Metaldehyde 2.5 %
15.	Herbicide	Glyphosate	2	Glyphosate	Glyphosate
16.	Herbicide	Glytaf	5	Glyphosate	Glyphosate 71 % SL
17.	Herbicide	Harmony guard	5	Thifensulfuron methyl	0.0125 lb/a thifensulfuron methyl and 0.0063 lb/a tribenuron methyl
				Tribenuron methyl	
18.	Herbicide	Hornet and wasp killer	5	Flumetsulam	0.185 pound flumetsulam, 0.5 pound clopyralid acid, Lambda-Cyhalothrin
				Clopyralid	
				Lambda Cyhalothrin	

19.	Fungicide	Indofil	2	Mancozeb	Mancozeb and Metalaxyl
20.	Insecticide	Karate	10	Lambda Cyhalothrin	Lambda Cyhalothrin 5 % EC
21.	Insecticide	Malathion	5	Malathion	Diethyl 2- [[dimethoxyphosphorothioyl] sulfanyl] butanedioate
22.	Insecticide	Nagata	2	Ethion	Ethion (40 %) and Cypermethrin (5 %):
				Cypermethrin	
23.	Insecticide	Naphthalene balls	5	Naphthalene	Naphthalene
24.	Herbicide	Nominee gold	18	Bispyribac sodium	Bispyribac sodium 10 % SC
25.	Insecticide	Pestx	5	Imidacloprid	Imidacloprid, Cyfluthrin, Pymetrozine
				Cyfluthrin	
				Pymetrozine	
26.	Insecticide	Pianofix	2	Alpha naphthyl acetic acid	Alpha naphthyl acetic acid 4.5 % w/w
27.	Fungicide	Plantic kitosh	5	Azoxystrobin	Azoxystrobin 12.5 % + Tebuconazole 12.5 %
				Tebuconazole	
28.	Insecticide	Radar	16	Chlorpyrifos	Chlorpyrifos 20 EC
29.	Insecticide	Redar	1	Chlorpyrifos	Chlorpyrifos
30.	Insecticide	Rogor	5	Dimethoate	Dimethoate 30 % EC
31.	Herbicide	Roundup	94	Glyphosate	Glyphosate 41 % SL
32.	Fungicide	Saaf	83	Carbendazim	12% carbendazim and 63 % mancozeb
33.	Insecticide	Tafgor	2	Dimethoate	Dimethoate 30 %
34.	Herbicide	Tagmix	7	Metsulfuron Methyl	Metsulfuron Methyl 10 % and chlorimuron Ethyl 10 %
35.	Bio	Tagmonas	16	Pseudomonas	Pseudomonas fluorescens
36.	Insecticide	Tagban	9	Chlorpyrifos	Chlorpyrifos 20 % EC
37.	Insecticide	Takumi	2	Flubendiamide	Flubendiamide 20 % WG
38.	Insecticide	Tatamida	5	Imidacloprid	Imidacloprid 17.8 % SL
39.	Herbicide	Trikon	2	Trifluralin	480 g/L of Trifluralin

40.	Insecticide	18:18	1	Chlorantranilprole	Chlorantranilprole 18.5 % SC
41.	Insecticide	Action505	1	Chlorpyrifos	Chlorpyrifos and Cypermethrin
				Cypermethrin	
42.	Insecticide	Armour	2	Cyromazine	5% cyromazine, 20 % acetamiprid
				Acetamiprid	
43.	insecticide	Coragen	2	Chlorantranilprole	Chlorantranilprole 18.5 % w/w
44.	Insecticide	Fenvalerate	1	Fenvalerate	Fenvalerate
45.	Bio	Tagmonas	1	Pseudomonas	Pseudomonas fluorescens
46.	Insecticide	Cover	1	Chlorantranilprole	Chlorantranilprole
47.	Insecticide	Agadi	1	Fipronil	Fipronil
48.	Herbicide	Salix	1	Salicylic acid	Salicylic acid
49.	Insecticide	Good night	5	Permethrin	Premethrin
50.	Insecticide	Mangla ITL	2	Imidacloprid	Imidacloprid 17.8 % SL
51.	Insecticide	Mop	2	Disodium octaborate tetrahydrate	Disodium octaborate tetrahydrate

* N does not equal to 100 % due to multiple responses

13.2. List of pesticides used by the respondents (N=296)

Table 22. List of pesticides used by the respondents (N=296)							
	Chemical name	Frequency	Target crops	PAN HHP status	WHO classification	No. of banned countries	Type
1.	2,4-D	1 (0.33 %)	Paddy, vegetables	✓	II (Moderately hazardous)	10	H
2.	Alpha naphthyl acetic acid	2 (0.67 %)	Banana, vegetables	–	III (Slightly hazardous)	Not known to be banned	PGR
3.	Bispyribac sodium	18 (6.08 %)	Paddy	–	III (Slightly hazardous)	Not known to be banned	H
4.	Carbaryl	1 (0.33 %)	Cocounut	✓	II (Moderately hazardous)	48	I
5.	Carbofuran	72 (24.32 %)	Bitter gourd, peas, plantain, spinach, vegetables, betel	✓	Ib (Highly hazardous)	106	I

6.	Chlorantraniliprole	4 (1.35 %)	Banana, cauliflower, spinach, peas, cucumber, paddy	✓	U (Unlikely to present an acute hazard)	Not known to be banned	I
7.	Chlorpyrifos	148 (50.00 %)	Bananas, bitter gourds, tubers, cereals, coffee, arecanuts, ginger, cowpea, guava	✓	II (Moderately hazardous)	44	I
8.	Dimethoate	7 (2.36 %)	Paddy, vegetables	✓	II (Moderately hazardous)	38	I
9.	Disodium octaborate tetrahydrate	2 (0.67 %)	–	–	Not listed	Not known to be banned	I
10.	Esfenvalerate	9 (3.04 %)	Peas, banana, tapioca, spinach, vegetables	✓	II (Moderately hazardous)	Not known to be banned	I
11.	fenvalerate	1 (0.33 %)	Banana, tomatoes, spinach	✓	II (Moderately hazardous)	38	I
12.	Fipronil	1 (0.33 %)	Gua, banana, arecanut	✓	II (Moderately hazardous)	49	I
13.	Flubendiamide	3 (1.01 %)	Banana, cauliflower, spinach, peas, cucumber, paddy, vegetables	✓	III (Slightly hazardous)	1	I
14.	Glyphosate	101 (34.12 %)	Banana, coffee, vegetables, tapioca, paddy, ladies finger, cucumber, rubber	✓	III (Slightly hazardous)	12	H
15.	Imidacloprid,	7 (2.36 %)	Banana, coconut, rubber, gua gua, arecanut	✓	II (Moderately hazardous)	29	I
16.	Lambda Cyhalothrin	11 (3.71 %)	Vegetables, beans	✓	II (Moderately hazardous)	Not known to be banned	I
17.	Malathion	5 (1.68 %)	–	✓	III (Slightly hazardous)	40	I
18.	Metaldehyde	2 (0.67 %)	Gua gua, banana, arecanut	–	II (Moderately hazardous)	8	Molluscicide
19.	Naphthalene	5 (1.68 %)	Banana, elephant yam, Colocasia	–	II (Moderately hazardous)	36	Insect repellent
20.	DDT	8 (2.70 %)	Banana, green leaves, cabbage, peas, tapioca	✓	II (Moderately hazardous)	150	I
21.	Permethrin	5 (1.68 %)	–	–	II (Moderately hazardous)	39	I

22.	Propineb	2 (0.67 %)	Peas, cucumber, potato, tomato, chillies	✓	U (Unlikely to present an acute hazard)	31	F
23.	Quinalphos	85 (28.71 %)	Banana, peas, tapioca, spinach, paddy, coffee, ginger	✓	II (Moderately hazardous)	32	I
24.	Thiamethoxam	6 (2.02 %)	Vegetables	✓	II (Moderately hazardous)	Not known to be banned	I
25.	Trifluralin	2 (0.67 %)	Not mentioned	✓	U (Unlikely to present an acute hazard)	38	H
Active ingredients (formulations)							
1	Cyromazine	2 (0.67 %)	Green leaves, Banana	–	II (Moderately hazardous)	Not known to be banned	I
	Acetamidiprid			–	II (Moderately hazardous)		
2.	Metsulfuron Methyl	7 (2.36 %)	Paddy, ginger	–	U (Unlikely to present an acute hazard)	1	H
	Chlorimuron ethyl			–	III (Slightly haz- ardous)		
3.	Carbendazim	83 (28.04 %)	Banana, coffee, vegetables, arecanut	✓	U (Unlikely to present an acute hazard)	41	F
	Mancozeb			✓	U (Unlikely to present an acute hazard)		
4.	Azoxystrobin	5 (1.68 %)	Garden plants	–	U (Unlikely to present an acute hazard)	Not known to be banned	F
	Tebucon- azole			✓	II (Moderately hazardous)		
5.	Ethion	2 (0.67 %)	Gua gua, banana, arecanut	✓	II (Moderately hazardous)	35	I
	Cypermethrin			✓	II (Moderately hazardous)		
6.	Thifensulfu- ron methyl	5 (1.68 %)	Tapioca, sweet potato	–	U (Unlikely to present an acute hazard)	Not known to be banned	H
	Tribenuron methyl			–	U (Unlikely to present an acute hazard)		

* N does not equal to 100 % due to multiple responses

13.3. Pesticides and health issues

Table 23. Pesticides and health issues	
Chemical Name	Health issues
Acetamidrid	There is some evidence that acetamidrid is linked to human infertility
Alpha naphthyl acetic acid	Possible blood toxicant
Azoxystrobin	Minor effects on reproduction / development observed, liver toxicant, skin and eye irritant
Bifenthrin	May cause tremors and staggered gait; US EPA – possible human carcinogen; CLP data – suspected carcinogen and skin sensitizer
Bispyribac sodium	Possible liver toxicant
Butachlor	US EPA – likely to be human carcinogen
Carbaryl	Highly toxic, may be fatal if inhaled, swallowed or absorbed through skin, IARC Group 3 carcinogen – not classifiable; CLP data – suspected carcinogen; US EPA – likely to be human carcinogen, may be estrogenic and progesteronic; Endocrine issues – weak estrogen effect
Carbendazim	Evidence of liver enzyme induction; possible liver toxicant, Increase of estrogen production and aromatase activity, may cause genetic defects; US EPA – possible human carcinogen
Carbofuran	May cause testicular degeneration, may be fatal if swallowed, inhaled or absorbed through skin
Chlorantraniliprole	Possible liver toxicant
Chlorpyrifos	Highly toxic by ingestion, some studies indicate a link between chlorpyrifos metabolites and learning difficulties in children, suspected cardiovascular and blood toxicant, endocrine disruptor.
Clopyralid	Possible liver and kidney toxicant, skin and eye irritant
Copper Oxychloride	Potential heavy metal poisoning
Cyfluthrin	Highly toxic, possible liver or kidney toxicant, neurotoxicant and skin irritant
Cypermethrin	Endocrine issues – estrogenic effect, possible liver and kidney toxicant
Cyromazine	High dose can cause nausea, vomiting, abdominal distress and diarrhoea
Dimethoate	Highly toxic, harmful if swallowed; US EPA – possible human carcinogen; CLP data – no evidence of carcinogenicity; endocrine issues – disruption of thyroid hormones action and possible liver toxicant
fenvaterate	May cause abdominal pain, convulsions and vomiting if ingested, cardiovascular and blood toxicant, IARC Group 3 carcinogen – not classifiable; endocrine issues – inhibition of estrogen-sensitive cells proliferation, eye irritant, skin irritant, respiratory tract irritant, endocrine disruptor

Ethion	Bioaccumulate, acetyl cholinesterase inhibitor, neurotoxicant
esfenvalerate	Highly toxic, some studies point to endocrine effects; may cause nausea, vomiting and abdominal pain if ingested, reproductive development effects and skin sensitizer
Fipronil	Thyroid, kidney and liver toxicant
Flubendiamide	Possible liver, thyroid and kidney toxicant
Flumetsulam	Skin and eye irritant
Glyphosate	Possible bladder and liver toxicant; may cause serious eye damage; endocrine issues – disruption of aromatase activity; may cause gastrointestinal disturbances, carcinogen.
Imidacloprid	Moderately toxic, potential liver, kidney, thyroid, heart and spleen toxicant
Indoxacarb	Moderately toxic, possible kidney, liver, spleen and CNS toxicant
Lambda Cyhalothrin	Harmful if swallowed, inhaled or in contact with skin, possible immune system and thyroid toxicant in susceptible individuals, respiratory tract irritant, skin sensitizer and eye irritant
Malathion	Possible adrenal gland, thyroid and liver toxicant, acetylcholinesterase inhibition IARC group 2A carcinogen; US EPA – weak evidence to suggest possible human carcinogen; endocrine issues – inhibition of catecholamine secretion, neurotoxicant
Mancozeb	May cause ovarian hyperthropy, possible thyroid toxicant, respiratory tract irritant, skin sensitizer and eye irritant
Metaldehyde	Moderately toxic, kidney and liver toxicant, eye irritant
Metsulfuron Methyl	Respiratory tract irritant
Propineb	Primarily distributes via the thyroid gland, potentially thyroid toxicant; may damage lungs or cause muscular problems; US EPA – probable human carcinogen
Pymetrozine	May affect most major organs at high doses, highly toxic – harmful if swallowed; US EPA – likely to be human carcinogen, reproductive toxicant
Quinalphos	Acetyl cholinesterase inhibitor, neurotoxicant, respiratory tract irritant, skin irritant, eye irritant, highly toxic, may be fatal if inhaled, swallowed or absorbed through skin
Tebuconazole	Targets liver/blood system; US EPA – possible human carcinogen
Thiamethoxam	Increased incidence of liver cell adenoma and adenocarcinoma in mice; US EPA – likely to be human carcinogen
Thifensulfuron methyl	Neurotoxicant, respiratory irritant
Tribenuron methyl	US EPA – possible human carcinogen, possible liver and spleen toxicant; endocrine issues – weak estrogenic effect and skin sensitizer
Trifluralin	Blood, liver and kidney toxicant; may cause respiratory depression

Conclusion

In this report, on the conditions of the use of pesticides it was evident that farm workers including women and children are exposed to pesticides including highly hazardous pesticides (HHPs). Almost all the pesticides being used are HHPs and/or are widely banned in other countries.

Exposure of farmers was found to be widespread, beginning with the purchase and transport of pesticides, and then through decanting, mixing, application techniques, re-entry into sprayed fields, with additional risks generated by the washing of pesticide-contaminated clothes and equipment, and the storage of pesticides in the home and especially the kitchen areas. Drift into nearby homes is another exposure route, especially for children and other family members not involved in the actual spraying. None of them were wearing the correct PPE, for the usual reasons that it is not available, too expensive and/or too uncomfortable to wear. Apart from this, 69% of farmers burned the pesticide bottles after use due to lack of proper disposal methods. This poses a great risk by releasing toxic fumes and pollutants into the air, which can harm humans, animals and the environment.

Many of the pesticides being used are linked to several chronic health impacts including liver diseases, learning difficulties, kidney disease, heart disease, diabetes, development disorders, cancer, asthma and allergy. Pesticides like atrazine, chlorpyrifos, cypermethrin, mancozeb, malathion, Ekalux etc are known to be carcinogenic and cause disruption in the endocrine system, especially in children and acute health effects due to pesticides exposure could range from skin disorder, respiratory issues, circulatory issues and even death.

Recommendation

- ▶ Immediate action be taken by government to comply with Article 3.6 of the International Code of Conduct on Pesticide Management and ban pesticides that require PPE.
- ▶ That extension agents should strictly give proper trainings for farmers about the details of the pesticides (including waiting period, hazards, toxicity labels, dosage, equipment etc) that are commonly recommended by Krishi bhavans.
- ▶ Cease the export and import of pesticides that have been banned in their country of origin for health and/or environmental reasons.
- ▶ That government assist their small-scale farmers to move away from the use of hazardous pesticides by assisting them to implement agroecology.
- ▶ Proper labelling should be provided on the pesticide bottle in local languages. So, the farmers will be aware of the chemical nature and potential health risks of the chemical. (Article 3.5.4)
- ▶ Subsidizing agrochemicals have to be controlled. Instead, subsidies can be given for organic inputs.
- ▶ In case of implementation of Bharatiya Prakritik Krishi Paddhati (BPKP) scheme through Participatory Guarantee System (PGS) organic certification in Kerala, during the conversion period of three years, the farmers should be given required support to meet their yield loss when switching immediately from conventional to organic.



PAN Asia Pacific (PANAP) is one of the five regional centres of Pesticide Action Network (PAN). PANAP works for the elimination of harm caused by pesticides on human health and the environment. PANAP also promotes agroecology, helps strengthen people's movements in their assertion of rights to land and livelihood, and advances food sovereignty and gender justice.

Pesticide Action Network (PAN) India, established in 2013 as a non-profit organisation, and collaborates with the PAN International community to reduce the harmful impact of chemical pesticides on humans and the environment. The organisation promotes sustainable farming practices based on agroecology, advocating for alternatives to toxic chemicals and supporting farmers in conserving traditional knowledge and agro-biodiversity. PAN India focuses on research, capacity building, and awareness creation to encourage governments and farming communities to adopt ecological agriculture, sustainable food systems, and a toxic-free lifestyle, while ensuring social and environmental justice.

Thanal is a non-profit environmental organisation based in Kerala, dedicated to promoting sustainable living, ecological agriculture, and environmental justice. Since 1986, Thanal has been at the forefront of conservation efforts raising awareness and implementing community-based solutions for a greener, healthier future. Thanal works closely with diverse communities, including academicians, government institutions, and civil society organisations, to co-create sustainable solutions. As a regional council for PGS India, Thanal also serves as a supporting agency for the state governments of Kerala and Karnataka in facilitating PGS certifications.



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