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CONDITIONS OF PARAQUAT USE IN INDIA

PAN INDIA

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PAN INDIA

Frontpage **A farmer with a hand operated sprayer (West Bengal). Often paraquat and other pesticides are applied with this kind of sprayer.**

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FOREWORD BY THE EDITORS

Agriculture is the most important sector of the Indian economy providing employment and livelihood to nearly 70 % of the total population. The industrialization of agriculture has favoured the use of plenty of agrochemicals including fertilisers, pesticides, micro nutrients and plant growth regulators in the agricultural fields. According to recent data from the Central Insecticide Board and Registration Committee (CIBRC), 256 pesticides are registered for use in India (as of December 31, 2014). Among this, nearly half are insecticides, followed by fungicides and herbicides. According to the CIBRC list of registered pesticides in India (dated October 1, 2014), 54 herbicides and 13 combination herbicides are approved for use in the country.

Punjab, Haryana, Uttar Pradesh and Uttaranchal are the states where the herbicide consumption is high in India. Though herbicides were widely used in the plantation sector for a long time, now it is becoming widely accepted in most agricultural landscapes such as horticulture, cereals, vegetables and floriculture. About three fourths of the available herbicides in India are still used in plantation crops. At present herbicide use is common in major crops like sugarcane, wheat, rice, maize and vegetables. Data from a few studies on herbicide consumption shows that they are being used in approximately 20 million hectares, which constitutes about 10 per cent of the total cropped area. In general, herbicides are being used where the economic stakes for farmers are high, and/or where choices are limited. In 2013–14 (as on December 18, 2014), the volume of herbicides consumed in India was 5000 metric tonne technical grade.

The implications of using pesticides, including herbicides, are increasingly being experienced in the form of hazardous health effects. Several studies across the globe reveal that pesticides can cause severe health hazards including infertility and sub-fertility, abnormal development, birth defects, hormonal disorders, immune suppression, diminished intelligence and cancers.

Herbicides are extremely toxic to other organisms and soil life. Persistence in soil, pollution of environment and ground water, toxic residues in food, feed, fodder, development of herbicide resistant weeds and adverse effect on non-target organisms and biodiversity, etc. are other negative impacts of herbicide use. The potential of herbicides contaminating ground water has gained considerable attention in recent years.

Butachlor, 2,4-D, isoproturon, glyphosate, anilophos, paraquat dichloride, pretilachlor, and atrazin are the most commonly used herbicides in India. Among these, paraquat dichloride has received global attention over the past couple of years due to its high acute toxicity and ability to cause severe short term and long term health effects among users.

For many years, International Union of Food and Allied Workers (IUF), Pesticide Action Network and the Berne Declaration have been asking governments for a global ban on paraquat and also calling on industry to stop production and sale of this highly hazardous pesticide. The product is already banned in many countries all over the world, including African and Asian nations, the European Union and Switzerland, the home country of Syngenta, the main producer of paraquat. In countries like the United States and China the use of paraquat is restricted. Nevertheless, paraquat is still one of the most used herbicides globally, especially in developing countries, where its use leads to countless poisoning episodes of workers and farmers.

This led us to do a study on Conditions of Paraquat Use in India. We did the study across six states where paraquat use is high. The objective was to understand and document the use of paraquat, the reasons thereof, the knowledge about its impacts among farmers and workers, the use of personal protective measures and the adherence to regulations by the users. The study has established that the use of paraquat in India clearly violates the International Code of Conduct on Pesticide Management of the World Health Organisation (WHO) and the Food and Agriculture Organisation (FAO). The manufacturers and the state have a responsibility to change this untenable situation. The Government of India also needs to act and ensure that the use of herbicides and pesticides is within the legal frame work of India and international commitments of India.

We believe that this report shows the need for national-level policy decisions on the regulation of pesticides and in this case on paraquat specifically. Regulations should be based on evaluation and assessment of impact of the intrinsic hazards of and anticipated exposure of users to these hazardous chemicals.

The editors would like to thank the main author, Dileep Kumar A D, the team of PAN India and all the others who have contributed to this study. The team has collected a lot of new information about the use of paraquat in India. We believe that this report will be helpful for the decision makers in India to align Indian regulations with international policies, so that harm to people and the planet can be minimized, if not removed completely.

C. Jayakumar and Dr. D. Narasimha Reddy
(Pesticide Action Network India)

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Dileep Kumar A D.

Collecting data from Pesticide retailer in Telagana state.

EXECUTIVE SUMMARY

The report presents the findings of a field study conducted to document the use of paraquat dichloride in India and its health impacts. Paraquat dichloride has high acute toxicity. Pesticide Action Network (PAN) International includes paraquat dichloride in its list of highly hazardous pesticides. Paraquat dichloride 24 % SL is the only formulation registered in India and is approved for weed control in nine crops.

The field study was carried out in eleven study areas across six States (Andhra Pradesh, Arunachal Pradesh, Assam, Madhya Pradesh, Telangana and West Bengal) in India, where paraquat use was observed in a preliminary exploration in 20 areas across 10 States. The field data was collected through purposive sampling with the help of questionnaires from farmers and farm workers including paraquat/pesticide applicators. In addition agriculture extension officers as well as pesticide retailers were also interviewed. Secondary data was collected through applications under the Right to Information (RTI) Act from State Agriculture Departments as well as from the web sites of respective departments or institutions.

Farmers use paraquat in their fields for controlling weeds. A total of 14 commercial names of paraquat dichloride have been found to be sold in the study sites. It is being used in about 25 crops (in the study area) including cereals, pulses, oil seeds, vegetables and cash crops while the Central Insecticide Board & Registration Committee (CIBRC) has approved its use in only nine crops. Significant variation was noted between the use approved by CIBRC and the recommendations by the various State agriculture departments and commodity boards such as the coffee board. Further, manufacturers of paraquat have recommended the use of paraquat in crops not approved by the CIBRC. Syngenta, for instance, has recommended the use of paraquat on 12 crops. Recommendations beyond what is approved by the CIBRC is a violation of the Indian Insecticides Act.

Farmers buy and use paraquat in an unsafe manner. It was found that paraquat is sold in plastic carry bags to farmers who demand 100ml or 200ml of the product. Neither the retailers recommend personal protective measures while handling paraquat nor do the farmers adopt them. Particularly, when it is sold in plastic carry bags the risk of exposure and poisoning is higher through spillage, inhalation as well as contact.

A considerable proportion of the respondents said that they neither read nor follow the instructions on the label of the paraquat containers, many of the respondents including farmers and agricultural workers reported that the font size of instructions given in the leaflet is too small to read or do not understand what is written. Ninety percent of the respondents reported that they get information and advice either from pesticide retailers or agents of distributors.

Awareness and training about how to use paraquat as well as other pesticides and taking personal protective measures is lacking among most of the respondents, which included farmers and agricultural workers.

Neither proper information nor training on the use of paraquat and personal protective equipment (PPE) are provided by agriculture offices or pesticide retailers. Therefore use of paraquat is occurring under unsafe conditions.

None of the respondents were using the recommended protective equipment. Seventy six percent of the respondents reported that they are not using any protective measures while handling paraquat, only 24 % of the respondents reported that they use some sort of protective measures among the following – cap, gloves, mask or face cover, full sleeved shirt, trousers and shoes. Eighty six percent of the respondents reported that the sprayers they used leaked sometimes, and most said that they did not get it repaired immediately. Paraquat is applied mostly before planting and for controlling weeds in standing crops. It is applied on weeds along the inter rows, ridges, furrows as well as field bunds and boundaries of crops. Twenty six percent of the respondents reported that they disperse paraquat mixed with fertilizers, sand and common salt in their fields. All the respondents spray paraquat on weeds and 18 % said they mix shampoo, salt, urea or kerosene, 2,4-D etc. to enhance the efficiency of the herbicide. Fifty four percent of the respondents reported that they continue to work in sprayed fields or enter a sprayed field immediately after spraying, for work, without wearing protective equipment. Most respondents reported that they dispose containers of paraquat by throwing them away, while some reported that they bury or burn them, some others reported selling them to scrap dealers and a few respondents said that they use the containers in toilets.

Farmers and workers were aware that paraquat is acutely toxic, but because of labour problems they felt compelled to use these chemicals. Lack of skilled labourers, non availability of labourers during critical periods of work, increased labour cost etc. were the major reasons reported for using paraquat. In addition, farmers claimed that paraquat is cheaper and weeds can be controlled with lesser effort. Some respondents reported that they occasionally do manual weeding.

The farmers and workers reported numerous adverse health effects caused by paraquat such as irritation, itching, headache, vomiting, burning sensation, breathing difficulty, muscle pain, abdominal discomfort, lethargy, skin allergy and colour change, tiredness, nausea, giddiness, fever, eye burn, dizziness, diarrhoea, throat drying, shivering, sneezing and change in heart beat rate. Some respon

dents reported that domestic animals were also adversely impacted by paraquat (death of a cow and a goat after grazing in paraquat sprayed fields; unconsciousness, stomach enlargement, diarrhoea and tiredness among goats and cows after grazing; hens and ducks not taking food for a couple of days after foraging in paraquat sprayed fields).

The actual practices at field level indicate the lack of an effective regulatory and monitoring system. And because of this, misuse, unsafe use and violations are happening in the country with regard to paraquat use.

THE STUDY FINDS,

- Significant variations between the crops on which the use of paraquat dichloride is approved by the Central Insecticide Board and Registration Committee (CIBRC) and the crops recommended by State Agriculture Departments or Agriculture Universities as well as commodity boards.
- Paraquat dichloride is being used for 25 crops in India, whereas it is approved for use in only nine crops by the Central Insecticide Board and Registration Committee. This is in violation of the Indian Insecticides Act.
- The manufacturers have recommended the use of paraquat for crops other than those approved by the CIBRC. This is clearly illegal and a violation of the Indian Insecticides Act by the manufacturers. CIBRC should take action against manufacturers and ensure immediate cessation of these illegal recommendations.
- Often farmers and workers do not read or understand the label on the paraquat container and instruction leaflet properly. They normally follow oral instructions of dealers and retailers and their field staff.
- In villages, retailers sell paraquat in plastic carry bags and refill bottles. Again this is a violation of the Insecticides Act and an illegal activity and a gross failure of regulation.
- Majority of the farmers and workers are not trained in the use of paraquat, do not have access to information about the use of paraquat dichloride, are not aware of appropriate safety instructions and do not use personal protective equipments. Paraquat is mixed with some other old dangerous herbicides, such as 2,4-D and additives such as kerosene, shampoo, salt and fertilizers.
- The use of paraquat dichloride is causing immense harm to farmers and agriculture workers, which are not documented as we do not have systems in place to do so. The data collected shows that farmers and farm workers are suffering adverse health impacts due to exposure to paraquat.
- In addition, secondary literature shows that paraquat has been used for suicides in various parts of the country and has a high mortality rate.
- The conditions of use of paraquat in India violate the International Code of Conduct on Pesticide Management. Also, other conventions are violated, such as the Chemicals Convention, 1990 and the Safety and Health in Agriculture Convention, 2001.

POLICY RECOMMENDATION

WE THEREFORE STRONGLY RECOMMEND THAT,

- The Government of India and State government authorities immediately stop the violations of the Indian Insecticides Act, and enforce the prohibition of paraquat use in crops where the use is not approved.
- The government urgently addresses the issues and take necessary steps towards a progressive ban of paraquat in India in a time bound manner.
- The government convenes a national working group for coming up with a package of practices for non chemical approaches, options and methods for weed management.

A farmworker on a tea garden prepares pesticide knapsack sprayers. The study found workers are usually not trained to handle pesticides nor are they provided with proper personal protective clothing.

1. INTRODUCTION

Paraquat dichloride (CAS No. 1910-42-5) is a widely used and highly toxic herbicide. It is a broad-spectrum (non-selective) contact herbicide and a powerful desiccant. Paraquat is the third most widely used herbicide in the world. It is used to control broad-leaved weeds and grasses, in a wide range of agricultural applications and for general weed control; it is less effective on deep rooted plants. Paraquat is increasingly used to destroy weeds in preparing land for planting in combination with no-till agricultural practices that minimize ploughing, thus the herbicide is widely promoted for no-till and minimum-till agriculture use. Paraquat is commercially produced and sold as dichloride salt and available as dimethyl sulphate as well. (FAO 2003; Watts M, 2011).

Chemically, it belongs to the group of bipyridilium herbicides. This chemical group is called quaternary ammonium salts and generally known as quats. It destroys plant tissue by disrupting photosynthesis and rupturing cell membranes, which allows water to escape leading to rapid desiccation of foliage. It is a fast-acting herbicide and generally affects all exposed green parts of plants and kills them in one to three days time (Neumeister L, Isenring R 2011).

The World Health Organisation (WHO) categorizes paraquat as a Class II-moderately hazardous pesticide. Although the WHO has listed it as *moderately hazardous*, it has been listed among most hazardous pesticides in wide use in the world today. Pesticide Action Network (PAN) International has categorized it as a highly hazardous pesticide and it shows high acute toxicity. Besides, paraquat has qualified as a PAN bad actor as well as a PAN dirty dozen pesticide. The Toxicological Data Network (ToxNet) and the Integrated Risk Information System (IRIS) of the Unites States Environmental Protection Agency (US EPA) have classified it as a probable human carcinogenic chemical (Class C). Paraquat is also reported to have links to reproductive problems and Parkinson's disease (FAO 2003; WHO 2009; Watts M, 2011; PAN Pesticide Database)

Paraquat is known to injure farmers, agricultural workers and community members as a result of occupational and accidental exposure. The skin can absorb it, especially if the skin has been damaged through exposure to the chemical. Acute poisoning may occur (through skin, eyes or when inhaled), but symptoms are often delayed. The outcome can be fatal and in these cases, death results from respiratory failure. Localized skin damage or dermatitis, eye injury and nosebleed occur frequently among paraquat users. Long-term exposure to low doses of paraquat is linked to changes in the lung and appears to be connected with chronic bronchitis and shortness of breath. Recent studies also link occupational and community exposure to paraquat to increased incidence of Parkinson's disease (Weinberg J, 2009).

Paraquat is used in more than 130 countries. However, paraquat is banned or its use is disallowed in at least 32 countries including members of the European Union due to its adverse health effects. In Switzerland, the home country of Syngenta, the main producer of paraquat, it is banned since 1989 due to its high acute toxicity for humans. In addition, many labelling organisations such as the Fair Trade International (FTI), the Forest Stewardship Council (FSC), the Rainforest Alliance, and food corporations like Dole, Chiquita and retailers like Marks & Spencer have voluntarily banned paraquat (Watts M, 2011; Neumeister L, Isenring R 2011).

Paraquat dichloride (24 % SL) is registered in India with the Central Insecticide Board and Registration Committee (CIBRC). This is the only formulation registered in India. CIBRC has categorised paraquat dichloride as highly toxic. Although CIBRC has not provided any recommendations, it has approved the use of this herbicide in nine crops. Another formulation, paraquat dimethyl sulfate was banned in India in 1993 (CIBRC 2014). Paraquat dichloride is one among the twenty most commonly used and recommended pesticides in the country (Chandra Bhushan *et al.*, 2013), although it is not the most used herbicide.

Paraquat is one of the pesticides most frequently used to commit suicide. There is no antidote for paraquat. The mortality rate for paraquat suicide attempts is comparatively high, at 42 to 80 %. The number of suicides using paraquat throughout the world is estimated to be several tens of thousands per year (Berne Declaration). Paraquat poisoning has been reported from various parts of India ranging from the northern States to the southern States and northeast States (Khosya S and Gothwal S V, 2012; Pavan M, 2013; Narendra S *et al.*, 2013; Raina S, 2008; Saravu K *et al.*, 2013; Sandhu JS *et al.*, 2003; Raghu K *et al.*, 2013; Banday T H *et al.*, 2014; Khan S U, 1975; Tayade S, 2013; Sarojini T, 2007). Paraquat distribution, sale and use was stoped in Kerala (a southern State in India) since 2011 along with 16 other pesticides including endosulfan, due to their being highly hazardous and having the potential to cause severe health implications (Kerala Government order, 2011); and currently, paraquat is not being used in Kerala as per the data obtained through the Right To information Act.

Although paraquat is known to cause severe health hazards and deaths among farmers, workers and community around the globe, only meagre data is available from India. Besides, there is no ground level data available on the application of paraquat in the fields, poisoning, etc. Therefore, the aim of this study was to document the actual practices of paraquat use and associated health and environmental impacts from India.

2. OBJECTIVES

The principal objective of the study was to document the use of paraquat dichloride in India and associated health and environmental impacts caused by its use. Thus the study was to learn and document the actual practices of use of paraquat in agricultural fields, the level of information and awareness among users, and the extent of use of protective measures among farmers and farm workers while handling or applying paraquat. The study was also intended to show the conditions that could lead to exposure to paraquat and consequent poisoning, and to highlight the health effects and symptoms manifested as a result of exposure. In addition, the study was also meant to record any environmental impacts that farmers themselves had identified as a result of the use of paraquat. An attempt was also made to collect information on the recommendations, safety instructions provided, training given on the use of personal protective measures and application of paraquat from agriculture extension officers and pesticide retailers. There were some unofficial reports stating that the use of paraquat has been stopped by farmers in some places in India. Therefore, as part of the study an attempt was also made to document information related to this. The recommended use of paraquat in India and national level consumption data were also collected as part of the study.

Workers in a tea garden spay pesticides without proper personal protective clothing.

3. METHODOLOGY

A preliminary exploration was done to identify the areas where paraquat is being widely used. Ten States were identified (Andhra Pradesh, Arunachal Pradesh, Assam, Chhattisgarh, Gujarat, Himachal Pradesh, Madhya Pradesh, Telangana, Uttar Pradesh, West Bengal) based on the crops for which paraquat is approved for use in the country. The States were selected considering the area under cultivation for the crops for which paraquat use is approved. Within these States 20 districts were identified for the study. In these districts, interactions were carried out with pesticide distributors, retailers and farmers to find out whether they use paraquat in the area. This preliminary exploration revealed that paraquat was in use in eight districts across six States. From the 12 districts across the remaining four States it was reported that farmers had not been using paraquat recently. Then it was decided to go with purposive sampling and the data was collected from the eight study sites (districts) across six States. The data was analysed both through quantitative and qualitative methods.

SAMPLING

Purposive sampling was done to identify the respondents. The data collection was especially focussed on farmers using paraquat in their farms. The farm workers were identified from the same areas. For the study, data was collected from 82 respondents comprising of 50 farmers, 23 workers (including eight paraquat/pesticide applicators), five pesticide retailers and four agriculture extension officers.

COLLECTION OF FIELD DATA

The field data for the study was collected from farmers, farm/plantation workers including paraquat applicators, pesticide retailers and agriculture extension officers with the help of survey questionnaires filled up through personal interviews. Separate questionnaires were developed for each category of respondents with an emphasis on paraquat use, safety measures used and recommendations, instructions provided, information and awareness on safety measures and trainings.

SECONDARY DATA

Secondary data on consumption of paraquat in India, poisoning cases reported and other relevant data was also collected as part of the study. The consumption data was collected from the office of the Directorate of Plant Protection, Quarantine and Storage under the Ministry of Agriculture, Government of India, and the web sites of the Ministry of Agriculture and Cooperation, Government of India, and the Central Insecticides Board and Registration Committee (CIBRC). Attempts were also made to collect data through the provisions of the Right to Information (RTI) Act and from various government (both Central and State government) agriculture departments and institutions. For this, RTI applications were filed addressed to agriculture departments in all the States in India as well as to the Department of Agriculture and Cooperation, Directorate of Plant Protection, Quarantine and Storage, CIBRC, and the Department of Chemicals & Petrochemicals. However, only limited data from a couple of States was received by the time the report was prepared.

LIMITATIONS OF THE STUDY

- Period of study: Data collection and field observations were carried out for only four months—December 2014 to March 2015. The period was not enough to cover a sizable number of plantation workers/farm workers/farmers due to the seasonal nature of their jobs.
- Due to the limited number of respondents, the study has not drawn generalizations about the pattern of use of paraquat all over India. Nevertheless, it does provide a realistic picture of how paraquat is used today in India as the interviews were done at various sites in different States, and a number of practices and problems observed were common in all the sites.
- Size of data: Availability of secondary data on paraquat use and poisoning in India is limited. State wise data on consumption of paraquat dichloride could not be obtained except for some States of India. Therefore, it was difficult to do a deeper analysis of the usage, health impacts and other problems.

4. STUDY AREA – STATE PROFILES

For the study, field data was collected from the eight identified districts in six States. The areas were selected based on selected crops such as tea, rice, potato, cotton, maize, wheat and vegetables (in which paraquat is reportedly being used). A short agricultural profile of the States from which the data was collected is given below.

● **Indicate Study area-States**
Source: http://d-maps.com/carte.php?num_car=24868&lang=en

The State of **Arunachal Pradesh** is located in the north-eastern region of India. The major crops grown in Arunachal Pradesh include rice, wheat, pulses, tea, cereals, maize, gram, oilseeds, sugarcane, vegetables, potatoes, apples, oranges pineapples, etc. More than half of the population in Arunachal Pradesh depends on agriculture and allied sectors for its livelihood.

Assam, located in north-eastern India, is predominantly rural and the economy is primarily agrarian in nature. Almost 70 % of the population is directly dependent on agriculture and another 15 % on allied activities for its living. The major crops cultivated in Assam include rice, tea, jute, sugarcane, fruits, pulses, coconut, cotton, areca nut, potatoes and other vegetables.

Andhra Pradesh is situated in the south eastern coast of India. The State's economy is mainly based on agriculture and livestock rearing. Farming is the main occupation of the people in the State and 60 % of the population is engaged in agriculture and related activities. The major crops are rice, cotton, wheat, sorghum, pearl millet, maize, many varieties of pulses, oil seeds, sugarcane, vegetables and oil crops such as peanuts and sunflower. (**Telangana** is a newly formed State, which was part of the Andhra Pradesh, therefore the profile for Andhra Pradesh is also applicable to Telangana.)

Madhya Pradesh is the second largest State in India, located in central India, and known as the heart of the nation. The economy of the State mainly depends on agriculture with more than 70 % of the population involved in agricultural activities. The major crops grown in Madhya Pradesh include cereals such as paddy, wheat, maize and sorghum, pulses such as green gram, black gram, horse gram, oilseeds such as soybean, groundnut and mustard. Cash crops like cotton and sugarcane are also grown in few districts of the State.

West Bengal is located in the eastern part of India and is the nation's fourth-most populous State. Agriculture is the leading occupation of the people in West Bengal. Rice is the principal food crop in the State and other major crops are potato, jute, sugarcane, wheat and oil seeds. Tea is also produced commercially in the northern districts.

5. RESULTS AND DISCUSSION

5.1. LEGAL FRAMEWORK

Various government agencies are involved in the regulation of pesticides in India. The Ministry of Agriculture regulates the manufacture, sale, transport and distribution, export, import and use of pesticides through the Insecticides Act, 1968 and the rules framed there under. The regulation of pesticides is governed by two different bodies: the Central Insecticides Board and Registration Committee (CIBRC) and the Food Safety and Standards Authority of India (FSSAI). CIBRC was established, in 1968, under the Department of Agriculture and Co-operation of the Ministry of Agriculture.

The CIBRC is responsible for advising the central and State governments on technical issues related to manufacture, use and safety of pesticides. Its responsibilities also include recommending uses of various types of pesticides depending on their toxicity and suitability, determining the shelf life of pesticides and recommending a minimum gap between the pesticide application and harvest of crops (waiting period).

The other part of the CIBRC, the Registration Committee (RC), is responsible for registering pesticides after verifying the claims of the manufacturers or importers related to the efficacy and safety of the pesticides concerned. The approval of the use of pesticides and new formulations to tackle pest problems in various crops is also given by the Registration Committee. It is the Food Safety and Standards Authority of India that is responsible for recommending tolerance limits of various pesticides in food commodities (Bhushan C *et al.*, 2013).

The State Agriculture Departments (SADs), State Agriculture Universities (SAUs) and other institutions such as the National Horticultural Board (NHB) and various commodity boards make recommendations for agricultural practices including use of pesticides. The SAUs, SADs, NHB and commodity boards have their own extension departments to reach out to farmers. The farmers of India have a conventional understanding of agriculture; they lack the technical understanding of pesticides, their uses and safety aspects. This makes them vulnerable to misguidance and increases the chances of unnecessary and inappropriate use of pesticides (Bhushan C *et al.*, 2013).

Approved use of paraquat as per CIBRC

The Central Insecticide Board and Registration Committee (CIBRC) has approved the use of paraquat dichloride to control weeds in nine crops–apple, cotton, grapes, maize, potato, tea, rice, rubber and wheat. The dosage approved for different crops varies widely from 800ml–2000ml to 4250ml, with an average 2072ml per hectare (around 830ml per acre). Along with the approved uses the waiting period between the last application and harvest are also given. Surprisingly, for food crops such as grapes, maize, potato and wheat, the waiting period is 90 days, 90–120 days, 100 days and 120–150 days respectively. But it can be observed that the waiting period has not been given for apple, tea and rice. The waiting period for cotton is given as 150–180 days.

Recommendation of paraquat dichloride by State Agriculture Departments or Agriculture Universities as well as commodity boards in India

The recommendation data for paraquat dichloride has been collected from the package of practices recommended by various State agriculture departments or agriculture universities (SAD/AU) as well as commodity boards like the coffee board, rubber board, tea board, etc. These have been collected from the websites of the respective departments or institutions. Through this method, data for only 12 States could be obtained. In addition, attempts were also made to collect the same data through the Right to Information (RTI) Act from all the 28 States in India, but again responses have been received only from a few States.

From the compilation of the above said data it has been observed that paraquat dichloride has been recommended for weed control in 17 crops. This is based on incomplete data as confirmation about the recommendation for use of paraquat is awaited from more States. The table below provides the details of the recommendations and the source. Again, this has to be compared against the CIBRC approval for use of paraquat in only nine crops.

TABLE 1: **DETAILS ON THE APPROVED USE OF PARAQUAT DICHLORIDE 24% SL IN INDIA** (as of October 2014)

SL NO	APPROVED CROPS	WEED SPECIES	DOSAGE/HA FORMULATION IN (ML/LITRE)	DILUTION IN WATER (LITRE)/HA	POST-HARVEST INTERVAL BETWEEN LAST APPLICATION & HARVEST (DAYS)
1	**Apple** (Post-emergence directed inter row application at 2–3 leaf stage of weeds)	*Rosa moschata, Rosa eglantaria, Rubus ellipticus*	3.25 L	700–1000	N.A.
2	**Cotton** (Post-emergence directed inter row application at 2–3 leaf stage of weeds)	*Digera arvensis, Cyperus iria, Trianthema monogyna, Corchorus spp., Leucas aspera, Euphorbia spp.*	1.25–2.0 L	500	150–180
3	**Grapes** (Post-emergence directed inter row application at 2–3 leaf stage of weeds)	*Cyperus rotundus, Cynodon dactylon, Convolvulus sp., Portulaca sp., Tridax sp.*	2.0 L	500	90
4	**Maize** (pre-plant [minimum tillage] before sowing)	*Cyperus rotundus, Commelina benghalensis, Trianthema monogyna, Amaranthus sp., Echinochloa sp*	0.8–2.0 L	500	90–120
	Maize (Post-emergence directed inter row application at 2–3 leaf stage of weeds)	*Cyperus iria, Cyperus rotundus, Commelina benghalensis, Amaranthus sp., Echinochloa sp, Trianthema monogyna*	0.8–2.0 L	500	90–120
5	**Potato** (Post-emergence overall/ inter-row application at 5–10% emergence)	*Chenopodium sp., Angallis arvensis, Trianthema monogyna, Cyperus rotundus, Fumeria parviflora*	2.0 L	500	100
6	**Tea** (Post-emergence directed inter row application at 2–3 leaf stage of weeds)	*Imperata setaria sp., Commelina benghalensis, Boerraria hispida, Paspalum conjugatum*	0.8–4.25 L (For season long weed control, use 2.5–5.0 litres for initial application. For subsequent repeat spot application use 1 litre)	200–400	Not Necessary (For season-long weed control, use 2.5 to 5 litres for initial application. For subsequent repeat spot application use 1 litre)
7	**Rice** (pre-plant [minimum tillage] before sowing/ transplanting for controlling standing weeds)	*Echinochloa crusgalli, Cyperus iria, Ageratum conyzides, Commelina benghalensis, Marsilea quadriofoliata, Brachiaria mutica*	1.25–3.5 L	500	N.A.
8	**Rubber** (Post-emergence directed inter row application at 2–3 leaf stage of weeds)	*Digitaria sp., Eragrostis sp., Fimbristylis sp.*	1.5-2.5 L	600	N.A.
9	**Wheat** (pre-plant [minimum tillage] before sowing)	*Grassy & Broad leaf weeds*	4.25 L	500	120–150

Source: CIBRC http://cibrc.nic.in/muph2012.doc

TABLE 2: **RECOMMENDATION OF PARAQUAT DICHLORIDE BY STATE AGRICULTURE DEPARTMENTS AND OTHER INSTITUTIONS**

SL NO	CROPS	DOSAGE PER HA	SAD/AU OR BOARDS, STATE	REMARKS
1	**Apple**	Gramoxone 1000 ml in 2000 L water	www.yspuniversity.ac.in, Himachal Pradesh State	
2	**Areca nut**		Department of Agriculture, Goa State	
3	**Banana**		Tamil Nadu Agriculture University, Kerala Agriculture University	
4	**Cane sugar**	–	Indian Council of Agriculture Research (ICAR)-Karnol, Agriculture Department of Assam, Uttarakhand and Goa States	Assam Agriculture Department recommended 2,4-D (amine-salt) 1.0 kg a.i/ha+ paraquat 0.5 kg a.i/ha in mixture
5	**Cashew**		Department of Agriculture, Goa State	
6	**Cherry**	Gramoxone 2000 ml/h	www.yspuniversity.ac.in, Himachal Pradesh State	
7	**Coffee**	–	Coffee board, Tamil Nadu Agriculture University (TNAU), Tamil Nadu	
8	**Cotton**		Agriculture Departments of Odisha, Punjab, Andhra Pradesh States	
9	**Jasmine**	–	ICAR-Goa	
10	**Jowar**	Paraquat 1500 ml/ha	Madhya Pradesh Agriculture Department	
11	**Maize**	Paraquat 0.5 kg with Atrazine 1.0 kg/ha	Agriculture Departments of Madhya Pradesh and Andhra Pradesh States	
12	**Oil Palm**		Tamil Nadu Agriculture University, Tamil Nadu	
13	**Pineapple**	–	Kerala Agriculture University*, Kerala	
14	**Potato**		Agriculture Departments of Uttarakhand and Punjab States	
15	**Rice**	–	Agriculture Departments of Kerala and Assam States	Assam: Pre-harvest treatment on standing crop for better grainquality.
16	**Rubber**	Paraquat 0.5 kg + 2,4–D 1.25 kg	Rubber board and Department of Agriculture, Kerala State	
17	**Tea**		TNAU, Tea Research Association and Tea Research Foundation	

Source: Compiled from package of practices published by agriculture departments, agriculture universities, commodity boards and their respective web sites as well as through the Right to Information Act.

* Paraquat dichloride is stopped in Kerala since 2011

Recommendation for use – manufacturer advice

In order to get a picture about the industry practice on the recommendation for use of paraquat, the instruction leaflet provided along with Gramoxone, a product of Syngenta and Kataar, a product of Canary Agrochemicals were analyzed. As per the leaflet provided with Gramoxone, Syngenta has recommended the product for weed control in 12 crops and for aquatic weed control as well. Canary Agrochemicals has recommended their product Kataar for 11 crops and aquatic weeds.

Variations in approved use and recommended use of paraquat dichloride in India

The data from CIBRC, State agriculture departments or agriculture universities (SAD/AU) and commodity boards, industry recommendation as well as use reported from the field shows plenty of variations and violations. The CIBRC has approved paraquat for use in nine crops, while the available data shows that the SADs/AUs and commodity boards have recommended paraquat for use in 17 crops. Over and above this, data from the six States covered in the study indicates that paraquat is being used in a total of 25 crops.

In the list of 17 crops proposed by the SAD/AU, paraquat is recommended for use by the CIBRC only in seven crops—apple, cotton, maize, potato, rice, rubber and tea. The CIBRC has not approved the use of paraquat for the remaining 10 crops. This shows that these bodies have recommended paraquat in violation of the directive by the CIBRC, demonstrating the lax approach towards national regulation. This is a problem which is also found with other pesticides as shown by Bhushan C *et al*., 2013.

A wide range of variation has been observed in the field data. As evident from the study, paraquat is being used for weed control in about 25 crops across six States. Among this 25, usage on only six crops (cotton, maize, potato, rice, tea and wheat) has been approved by the CIBRC. Thus, the use of paraquat for the remaining 19 crops is in violation of the directive of the CIBRC. Among these 19 crops that violate the CIBRC directive, one crop—banana—has been recommended by an agriculture university (again in violation of CIBRC directive).

The manufacturers have also violated the directive for approved use by the CIBRC, as evident from the Table 3. The recommendation by Syngenta includes all the nine crops approved by the CIBRC, three other crops (coffee, sugarcane, and sunflower) and for aquatic weed control, which are not approved by the CIBRC. In the same way, of the 11 crops recommended by Canary Agrochemicals, only seven were approved by CIBRC for paraquat use. The use of paraquat on the remaining four crops (coffee, sugarcane, tapioca, sunflower and for aquatic weeds) is not approved.

TABLE 3: VARIATIONS IN APPROVED USE AND RECOMMENDED USE OF PARAQUAT DICHLORIDE IN INDIA

1. CIBRC APPROVED USAGE	2. RECOMMENDATIONS BY SAD/AU/COMMODITY BOARDS	3. RECOMMENDATION BY MANUFACTURERS	4. DATA FROM THE FIELD ON CROPS FOR WHICH PARAQUAT IS USED
1. Apple	1. Apple*	1. Apple*	1. Banana
2. Cotton	2. Areca nut	2. Coffee	2. Bottle gourd
3. Grape	3. Banana	3. Cotton*	3. Brinjal
4. Maize	4. Cane sugar	4. Grapes*	4. Carrot
5. Potato	5. Cashew	5. Maize*	5. Chilly
6. Rice	6. Cherry	6. Potato*	6. Cotton*
7. Rubber	7. Coffee	7. Rice*	7. Ground nut
8. Tea	8. Cotton*	8. Rubber*	8. Jute
9. Wheat	9. Jasmine	9. Sugarcane	9. Kakrol
	10. Jower	10. Sunflower	10. Maize*
	11. Maize*	11. Tea*	11. Marigold
	12. Oil palm	12. Wheat*	12. Mustard
	13. Pineapple	13. Aquatic weed control	13. Okra
	14. Potato*		14. Onion
	15. Rice*		15. Orange
	16. Rubber*		16. Parble
	17. Tea*		17. Potato*
			18. Pumpkin
			19. Rice*
			20. Sesame
			21. Soybean
			22. Sunflower
			23. Tea*
			24. Tomato
			25. Wheat*

Source: Compiled from Tables 1 and 2, and recommendation given in the leaflet/label of commercial products of paraquat and field data.

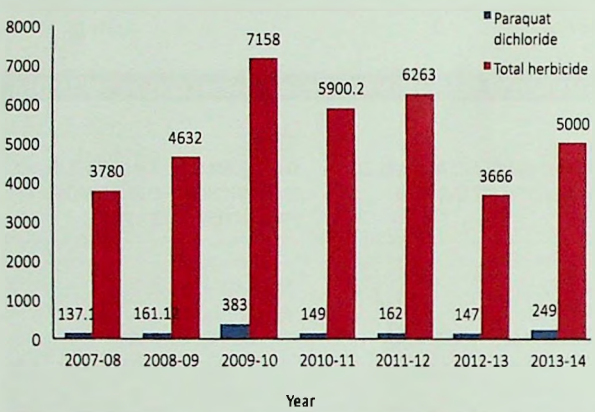
* Crops approved by the CIBRC

5.2. CONSUMPTION OF PARAQUAT DICHLORIDE IN INDIA

The chart given below shows the consumption data of paraquat dichloride and total herbicide consumption in India for the period between 2007–08 and 2013–14 (as on December 18, 2014). The data reveals that the volume of paraquat consumed is much less when compared to the total herbicide consumption in the country. However, in spite of paraquat not being the herbicide used in the largest quantities in comparison with other herbicides in India, its conditions of use are dangerous with many opportunities for serious exposure and risks to human health to farmers, agricultural workers, and others who handle paraquat, such as applicators and retailers.

CHART 1: CONSUMPTION OF PARAQUAT DICHLORIDE AND TOTAL HERBICIDE CONSUMPTION IN INDIA

in metric tonne (MT) technical grade



Source: Compiled using the data obtained from the Directorate of Plant Protection, Quarantine and Storage and CIBRC

Commercial names of paraquat dichloride reported from the study sites

From the study sites across six States 14 commercial products, manufactured by different firms, of paraquat dichloride were used for weed control.

TABLE 5: COMMERCIAL NAMES OF PARAQUAT DICHLORIDE REPORTED FROM FIELD

SL NO.	COMMERCIAL PRODUCTS	MANUFACTURER
1	All quit	Crystal
2	Finish	Total Agricare
3	Gramex	Crop Chemicals India
4	Gramo	Canary
5	Gramoxone	Syngenta
6	Herbucsone	Ankar Industries
7	Kapiq	Krishirasayan
8	Kataar	Canary
9	Milquat	Insecticides India
10	Paranex	Makhateshim-Agan India
11	Paraxzone	National Pesticides and chemicals
12	Uniquat	United Phosphorous
13	Parachlor 24	–
14	Ozone	Dhanuka Agritech limited

Source: Compiled from field data obtained through the study

TABLE 4: PERCENTAGE OF PARAQUAT DICHLORIDE TO THE TOTAL HERBICIDE CONSUMPTION

YEAR	2007–08	2008–09	2009–10	2010–11	2011–12	2012–13	2013–14
Percent of paraquat dichloride consumed	3.63	3.48	5.36	2.52	2.58	4.01	4.98

Source: Compiled using the data obtained from Directorate of Plant Protection Quarantine and Storage and CIBRC

Various Trademarks for paraquat sold in India: Gramo (manufacturer Canary), Gramoxone (Syngenta), Kataar (Canary), Milquat (Insecticides India)

State wise consumption of paraquat dichloride

The consumption data for paraquat dichloride was collected through the Right to Information (RTI) Act. Below are the responses received from four States. State wise consumption data of paraquat dichloride for the four States in India – Punjab, Goa, Maharashtra and Kerala – reveals that it continues to be used in fairly large volume in three of the States except Kerala, where paraquat was stopped since 2011, mainly because of health concerns.

TABLE 6: STATE WISE CONSUMPTION DATA FOR PARAQUAT DICHLORIDE OBTAINED THROUGH RTI ACT

Year	Punjab PARAQUAT DICHLORIDE 24 SL IN LITRES	Goa GRAMOXONE, PARACHLORE AND ALL QUIT; IN LITRES	Maharashtra PARAQUAT DICHLORIDE TECHNICAL GRADE IN MT	Kerala * PARAQUAT DICHLORIDE TECHNICAL GRADE IN MT
2004-05	–	–	12	–
2005-06	275532	2500	12	12.415
2006-07	276715	2500	11	13.629
2007-08	296379	2500	09	48.336
2008-09	299550	3000	10	61.817
2009-10	286111	3000	47	33.017
2010-11	305214	3200	156	37.2
2011-12	311450	3000	120	–
2012-13	319237	3000	96	–
2013-14	323952	4200	92	–
2014-15	231448	4000 (up to Jan 2015)	–	–

Source: Compiled using data obtained from the agriculture departments of respective States.
Note: State wise consumption data is incomplete as data from only four States was obtained.

* Paraquat is stopped (distribution, sale and use) in the State of Kerala since 2011, as per the Kerala Government order dated 07.05.2011

5.3. FINDINGS OF THE FIELD STUDY

Field data for the present study was collected from 82 respondents including farmers, farm and plantation workers (including pesticide applicators), pesticide retailers and agriculture extension officers from eight study sites in six States in India. The data was analysed separately for farmers, farm workers as well as applicators, and the survey results were compiled separately for agriculture extension officers and pesticide retailers.

Classification of respondents

The respondents included 59 men and 14 women, excluding retailers and agriculture extension officers. Their educational qualification ranges from secondary school to post graduation, except for a few who are illiterate. For most of these respondents, agriculture is the major source of livelihood.

TABLE 7: **CLASSIFICATION OF RESPONDENTS**

FARMERS	FARM WORKERS[1]	FARM WORKER-APPLICATORS[2]
50	15	5

PLANTATION WORKER-APPLICATORS[3]	AGRICULTURE EXTENSION OFFICERS	PESTICIDE RETAILERS	TOTAL
3	4	5	82

Demographic details of farmers

Sixty percent of the farmers included in the study have been using paraquat for up to five years; 24% have been using paraquat between five and ten years and the remaining 8% have been using paraquat for more than ten years, the remaining respondents have not furnished any details.

The respondents consist of marginal farmers, small-scale farmers as well as large-scale farmers. The land holding of the farmer respondents ranges from half an acre to a maximum of 56 acres. A few farmers have taken land on lease for cultivation in addition to farming on their own land. The number of respondents holding land between half an acre up to 15 acres is 40 (80%). The remaining 20% of the respondents hold land ranging from 15 acres to 56 acres.

The major crops grown by the respondents include paddy, wheat, mustard, jute, ground nut, sunflower, maize, cotton, tea, sesame, banana, sugarcane and vegetables such as chilly, onion, potato, tomato, okra, brinjal, pumpkin, kakrol and parble (both are cucurbitaceous vegetables), bottle gourd, bitter gourd, etc. All the farmers use chemical fertilizers and pesticides including herbicides. Some farmers also use farmyard manure, oil cakes and green manure in their farm.

All the farmers employ weed management practices such as manual hand weeding, mechanical weeding by cattle plough as well as by tractors and chemical weed control using herbicides. The herbicides commonly found in use in the study area include glyphosate, paraquat, pretilachlor, quizalofop ethyl, 2,4-D and butachlor.

Demographic details of workers

As part of the study, data on the use of paraquat, information and awareness about safety measures and health effects were collected from farm workers in addition to farmers. A total of 23 respondents were interviewed and included 15 workers from the States of Arunachal Pradesh and Andhra Pradesh. The respondents from Arunachal Pradesh are daily labourers working in small scale tea gardens in Namsai district. Most of the respondents from Andhra Pradesh are also daily labourers working in cotton, paddy, and vegetable farms. Ten of them are women workers and five of them are male workers. All the respondents are working in farms where paraquat is used. Almost all the workers are involved in all the activities in a farm, including fertilizer application, watering plants, weeding, harvesting, processing and also washing equipment used for application of paraquat and pesticides (40% of them claimed that they have occasionally been involved in either mixing or applying paraquat).

The remaining eight respondents are farm workers (referred to as applicators) mainly involved in applying pesticides including paraquat. Among them, five are farm worker-applicators from the study area in four States– Andhra Pradesh, Madhya Pradesh, Telangana, West Bengal and three are plantation worker–applicators from a commercial tea plantation in Assam. All of them are males and they have been involved in spraying paraquat and other herbicides, insecticides and fungicides. They also do other work in the farm apart from spraying. On an average they spend about 2–3 hours for one spraying and reported that in a year they spray paraquat 10–15 times. Two applicators said they have been spraying paraquat since two to four years, five applicators stated they have been applying paraquat for about six to eight years and one applicator said that he has been applying paraquat since 12 years.

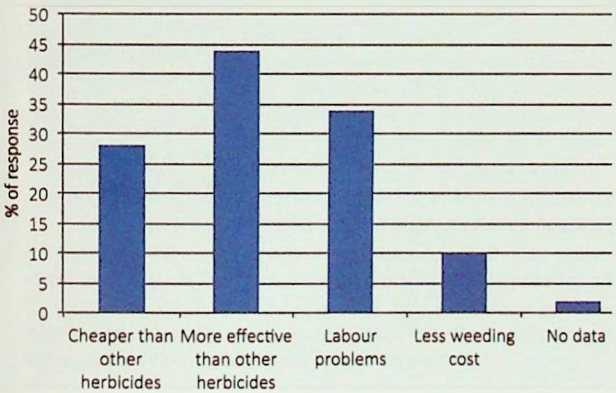
Reasons for using paraquat

Respondents reported that paraquat helps to kill weeds effectively within a short time period, therefore, they feel that using paraquat is an easy method to control weeds. In addition, weed control with paraquat and with other herbicides is less expensive compared to the cost incurred for

1 Farm worker: hired workers working in agricultural fields, they normally do not spray pesticides but are exposed while working in fields where these are used. They are sometimes involved in mixing these chemicals for spraying.
2 Farm worker-applicator: Workers hired by farmers specifically for application of pesticides and herbicides
3 Plantation worker-applicator: Daily wageworkers working in commercial tea plantations, who usually do the spraying of pesticides and herbicides in the plantation.

manual weeding. In addition, the spraying is comparatively a less labour intensive operation which takes less time as well. Sixty percent of the respondents reported that labour problem is the major reason for not doing manual weeding. Twenty eight percent of the respondents reported that paraquat is cheaper than other herbicides and 44 % of the respondents reported paraquat is effective and burns weeds quickly. Lack of availability of skilled labourers, non availability of labourers during critical periods, increased labour costs, are the major problems faced by farmers due to which they have moved to using herbicides. Lack of skilled workers to run and manage the cattle plough, lack of availability of sufficient number of cattle ploughs and increased cost of rental has reduced the use of cattle plough in weeding. Among all the respondents the chemical weed management method has become widely accepted.

CHART 2: **REASONS FOR USING PARAQUAT**



Source: Based on field data

Crops in which paraquat is used (Based on data collected from the field during the survey)

As per the data collected during the survey the crops for which paraquat is used includes cereals, pulses, oil seeds, vegetables and in horticulture. Farmers use paraquat for controlling weeds in 25 crops (the list is given in Table 3). As of now, there is no mechanism in India to monitor and ensure that paraquat (and other pesticides as well) is used only on crops for which it is legally approved. There is also no mechanism to prevent the illegal use (use in crops other than approved) of paraquat and other such chemicals.

Paraquat application in the field

Paraquat is applied in the field mainly during pre-planting, pre-sowing, seedling or vegetative stage as a pre-emergence measure as well as applied for post-emergent weed control. Pre-planting or pre-sowing application is reported by 70 % of the respondents. This is a common practice observed in all the study areas. The pre-sowing or pre-planting application was observed for crops such as cereals, pulses and vegetables. Paraquat is applied in the field about 15–20 days before the planting date, followed by field preparation once the weeds are burnt and then the crop is sown or planted. Paraquat is applied for weed control in standing crops as well. Fifty eight percent of the respondents reported that they apply paraquat for controlling weeds in spaces between the rows, ridges and furrows, as well as field bunds and boundaries of crops such as paddy, wheat and vegetables.

Paraquat is applied in two ways, one is by dispersion and the other is through spraying. The CIBRC data shows that paraquat is approved only for spraying. In addition, information obtained from the leaflet of Gramoxone, the manufacturer (Syngenta) only recommends use through spraying. But field data shows that farmers are using it by dispersion as well, ignoring the label, which is not recommended. Both the methods–dispersion and spraying–were observed in the study area and are described below.

Application of paraquat by dispersion

A few respondents especially from Andhra Pradesh and Telengana reported this type of application. Here paraquat is mixed with either sand, fertilisers or salt and the mixture is dispersed by hand. Twenty six percent of the farmers interviewed, reported this practice. Chilly, cotton, maize and paddy are the crops for which farmers disperse paraquat for weed control. Eighteen percent of the respondents (farmers) reported having applied paraquat in paddy, 6 % in chilly as well as cotton, and 4 % in maize. The articles used as carrier substances were sand (18 % respondents), fertilizer especially urea (16 % respondents) and salt (6 % respondents). The average volume of paraquat used per acre was about 1000 ml with a minimum of 100 ml to a maximum of 1500ml. The other materials added ranged from five kilograms to 75 kilograms. None of them reported the use of personal protective equipment while mixing or dispersing paraquat.

TABLE 8: **DISPERSAL OF PARAQUAT WITH OTHER MATERIALS**

CROPS	PARAQUAT DICHLORIDE	OTHER MATERIALS ADDED	% OF RESPONDENTS
Cotton **Maize** **Rice** **Chilly**	Average about 1000 ml per acre	Common salt Sand Fertilizers (urea)	26

Source: Compiled from field data

Application of paraquat by spraying

Spraying is the more widely practiced method of using paraquat observed in the study areas. All the respondents reported that they apply paraquat by spraying. For cotton, maize and potato, the dosage used was more than what is recommended. Eighteen percent of the respondents reported that while mixing paraquat for spraying they add 2,4-D (another herbicide) and other materials such as salt, kerosene, shampoo and adhesives. Farmers said that these materials are added to improve the effectiveness and to burn the weeds quickly. They added that such practices are recommended by the retailers or the agents of distributors. The practice of adding such substances has not been recommended by the CIBRC, agriculture departments, agriculture officers or the manufacturers. But field data shows that farmers are doing this under the advice from retailers or agents of distributors. It was observed that the retailers or the agents of distributors have more reach in the rural community than agriculture officers and are able to influence the practices. Also most of the farmers interviewed were not using personal protective equipment (PPE) to protect themselves.

TABLE 9: QUANTITY OF PARAQUAT USED AND THE ADDITION OF OTHER MATERIALS

CROPS	PARAQUAT DICHLORIDE (ML) USED PER ACRE (AVERAGE)	CIBRC APPROVED DOSE (ML/ACRE)	VOLUME WATER (IN LITRES) USED FOR DILUTION (AVERAGE)	% OF RESPONDENTS	OTHER MATERIALS ADDED
Cotton *	887	500–800	203	2	18% respondents reported that they add other materials such as common salt, shampoo, kerosene, 2,4-D as well as some adhesive while mixing
Jute	1000	–	200	4	
Maize*	1175	320–800	183	8	
Mustard	1100	–	160	2	
Rice*	905	500–1200	207	24	
Soybean	600	–	125	4	
Tea*	812	320–1700	200	8	
Wheat*	914	1700	143	14	
Vegetables and others	964	800 ml (only for potato*)	197	38	

Source: Compiled from field data and Table 1 | * Crops approved by CIBRC

Some respondents reported that they have had to increase the volume of paraquat used over the years. Fifty percent of the respondents reported having increased the volume of paraquat used, over what they used previously, to ensure that weeds are burnt as quickly as possible. A couple of farmers said that they mostly decide the volume of paraquat to be used without consulting any authority.

It was observed that paraquat application is mostly done by farmers themselves in their fields. Seventy six percent of the farmers interviewed reported that they apply paraquat in their fields and the remaining 24 % said that they hire workers to apply paraquat and other pesticides in their fields.

Application of paraquat by farm workers

The farm worker-applicators reported that generally paraquat is sprayed before sowing or planting as well as in the inter row spaces and ridges or boundaries of standing crops. The frequency of paraquat application varies among different crops depending on weed growth. In tea plantations paraquat is sprayed four to eight times a season, for cotton paraquat is applied three times, for vegetables one to two times and for paddy once in a season. Data obtained from farm worker applicators shows that the average volume of paraquat used is 955 ml per acre and is diluted on average with 220 litres of water. Plantation worker applicators reported that 750–800 ml of paraquat is used per acre and the volume of water used is 200 litres. In addition they also said that if weed intensity was severe, sometimes they added 500 gm of 2,4-D as well. Two farm worker-applicators reported that in the recent past they had been applying paraquat in higher doses compared to what they used earlier.

Frequency of paraquat usage

The frequency of application ranged from once in two weeks to once in a year. Those who apply paraquat once in a year or once in a season usually do the application before planting crops such as maize, cotton, paddy, wheat and vegetables. Other responses included twice a season/year, three to four times and five to eight times in a season/year, and once or twice a month. Farmers said that there is no spraying calendar, but whenever weed intensity is found

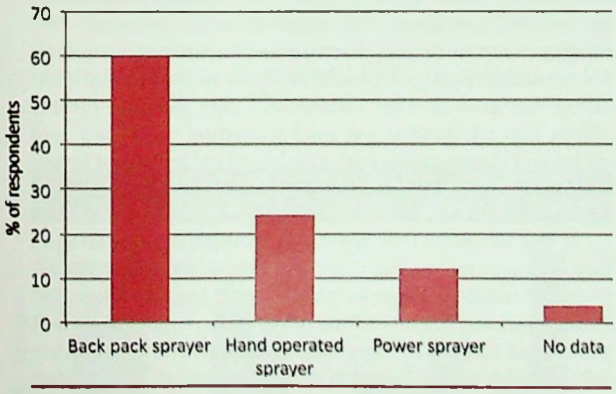
to reach problematic levels paraquat is applied. They added that during rainy season repeated applications are required. Usually spraying of paraquat kills weeds immediately but weeds regenerate in 10–15 days; therefore repeated application becomes essential especially for crops that require continuous management in terms of irrigation, fertilizer application, harvest, etc. Mostly such repeated applications were noted in vegetables and tea.

Type of sprayers used and problems

The study revealed that farmers use different types of sprayers for applying paraquat. The most popularly used one is a backpack or knapsack sprayer, which is used by 60 % of the respondents. Another type of sprayer used by 24 percent of the farmers interviewed is a simple hand operated sprayer popular among farmers especially in West Bengal. Most of the farmers in the region are marginal, and this type of hand sprayer is the only one they can afford as it costs around 250 rupees. These sprayers are not closed systems and therefore the risk of spillage is higher. A few respondents (12 % of the farmers interviewed) reported the use of power sprayers operated by diesel motors. Most respondents reported that they spray during the forenoon, especially during the morning and a few reported that spraying is done in the afternoon and evening.

All the applicators interviewed for the study were using backpack sprayers except one farm worker applicator, who was using a hand sprayer. All the applicators except one stated that the spraying was generally done during the forenoon. The remaining farm worker applicator said that he did spraying in the evening. All the applicators reported that they considered the direction of wind and always sprayed only along the direction of the wind.

CHART 3: **TYPE OF SPRAYERS USED – FARMERS**



Source: Based on field data

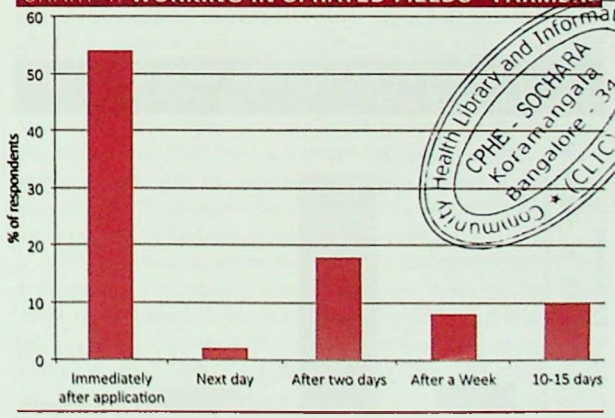
When asked about whether leaks occurred in the sprayer, majority of the respondents (86 %) reported that leaks had happened, the rest reported no leaks. From the responses provided it is evident that out of the total respondents only 56 % of the farmers knew to repair a leaking or damaged sprayer, and almost half of the respondents (44 %) were incapable of doing the repairs themselves.

The three plantation worker-applicators and three of the five farm worker-applicators reported that the sprayer leaks happened sometimes and the remaining one farm worker-applicator reported the sprayer had never leaked. Four applicators (three plantation workers and one farm worker applicator) reported that they could repair a leaking sprayer and they usually repair the sprayer immediately after noting the leak or after the spray or before the next spray.

Working in sprayed fields – farmers

Most of the respondents reported that they continue to work in the field (where paraquat is sprayed) immediately after the spray. They said that they work on the same day if some work is pending in the farm. Fifty four percent of the respondents said that they re-enter the field immediately after the spray. Two percent of the respondents said that they enter the field the next day after the spray. Eighteen percent of the respondents reported that they usually wait for two days after the spray, and eight percent of the respondents reported that they enter the field after one week of the spray. However, if there is some pending work or urgent work like harvesting or fertilizer application or pesticide spray, farmers generally enter the field without waiting for a gap after spraying.

CHART 4: **WORKING IN SPRAYED FIELDS – FARMERS**



Source: Based on field data

The plantation worker-applicators reported that workers were allowed to enter an area sprayed with paraquat only after 24 hours after the spray. Three of the five farm worker applicators and 10 out of the 15 agriculture workers reported that they enter the fields (where paraquat is sprayed) immediately after the spray for fertilizer application or harvesting. One farm worker-applicator stated that he works in a paraquat sprayed field only after two days; whereas another farm worker applicator and four agriculture workers said that they work in a sprayed field only after a week

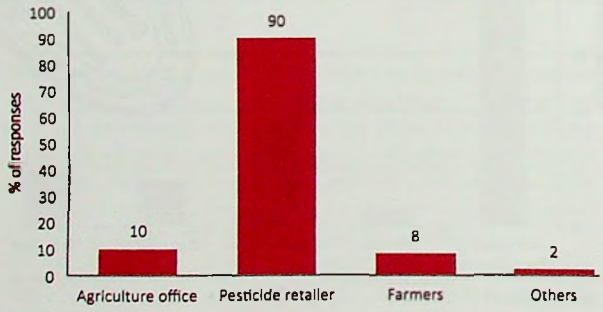
The available data shows that neither the CIBRC nor other government agencies or manufacturers have given instructions to farmers about the re-entry period while working in a sprayed field. However, the CIBRC has provided a waiting period (period between last application and harvest) for most of the crops for which the use of paraquat is approved. This waiting period for various crops ranges from 90 days to 180 days.

5.3.1. INFORMATION AND AWARENESS ON PARAQUAT USE AND SAFETY MEASURES

Information and advice on the use of paraquat dichloride among farmers

Agriculture extension officers, pesticide retailers, agents of pesticide distributors as well as neighbouring farmers are the major sources from where farmers get information on herbicides including paraquat and on insecticides and fungicides. In the present study, it was observed that 90% of the farmers interviewed got information and advice on paraquat dichloride from pesticide retailers. Some of the respondents also reported that they get information from neighbouring farmers as well. Among the respondents eight percent said that they have also sought information and details on paraquat and its use from agriculture officers. An exceptional case was noted from Arunachal Pradesh, where a farmer reported that he gets information on all plant protection chemicals from the tea factory, located in the neighbouring State of Assam, to which he supplies his harvest.

CHART 5: **SOURCE OF INFORMATION AND ADVICE ON PARAQUAT USE**



Source: Based on field data

Thus, it is evident that farmers are mainly dependent on pesticide retailers for information and advice on paraquat use. One of the major reasons for this is that in most cases the agriculture office or agriculture development office is quite far and therefore not always accessible to farmers in rural areas. The reality is also such that the pesticide distributors and retailers have roots in the villages or are from neighbouring areas, making them easily accessible to farmers in remote as well as rural areas. They also have a greater influence on farmers than agriculture officers. The farmers could only buy paraquat from pesticide retailers. Information obtained from agriculture offices in the study areas revealed that the agriculture department is not distributing or supplying paraquat dichloride.

The information from the field shows that retailers and agents of distributors, especially those in the study area in West Bengal, advise farmers to use 2,4-D (a herbicide) or kerosene or shampoo and or adhesives along with paraquat in order to increase the efficiency of weed control. This is totally against the conditions of approved use and use recommended by manufacturers. In addition, selling paraquat in repacked containers and in plastic carry bags, as evident from the field study area, can pass a wrong message to farmers that paraquat can be handled without taking much care. It is relevant to note that eight percent of the farmers interviewed were illiterate and most of them were from West Bengal.

In addition the possibility of stating more claims in favour of a product by retailers to increase sale cannot be ignored. The present study shows 90 percent of the farmers depend on retailers and or agents of distributors for information and advice on the use of paraquat. Thus, with the available data, it can be stated that retailers and the agents are not providing good advice. This promotes improper use and the consequent possibility of increased risk to the users cannot be ignored.

Awareness on instructions on the labels among farmers

It was noted that about half of the total number of respondents bought paraquat without label and instructions – either in bottles brought by the farmer or provided by the retailer or in plastic carry bags. Twenty four out of the total 50 farmer reported that they have bought paraquat without the product label (some of them have bought paraquat in its original container with label as well, but have also bought it without label) many times. Further investigation revealed that paraquat is sold not only in its original container but also in refill containers. This practice clearly shows that paraquat is not used according to the law laid down and the practices are in violation of the Indian Insecticides Act. In addition, such practices augment the risk of adverse health effects among users.

It was observed that especially in West Bengal, farmers buy paraquat in smaller volumes such as 100 ml or 200 ml from the retailers either in plastic carry bags or other bottles/containers. This handling of paraquat, especially when purchased in plastic carry bags, is dangerous for both retailers and farmers. It is also in clear violation of the International Code of Conduct on Pesticide Management, as is the lack of labels, and use of refill containers.

Information and awareness on use of paraquat among workers

All the three plantation worker-applicators and four of the five farm worker- applicators have reported that they have

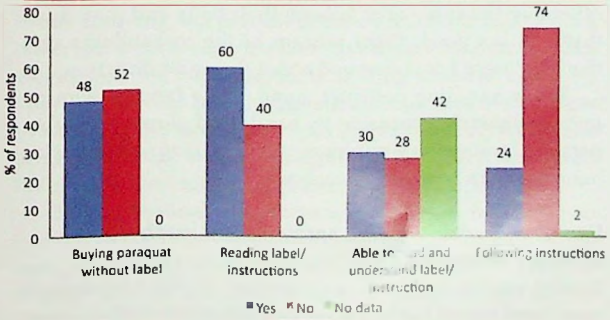
not read the instructions provided along with paraquat. The plantation worker-applicators reported that they are illiterate and have never seen the instructions or labels of any pesticides used in the plantation as they get paraquat and all other herbicides and pesticides in ready to mix condition or mixed in tanks and ready to spray. Mostly mixing is done by other workers.

Three of the five farm worker-applicators reported that they were aware that the instructions were on the product label and written in English, Hindi and some local languages and the remaining two farm worker-applicators said that they did not know in which language the instructions were given. Only two farm worker-applicators reported that they were able to read and understand the instructions. One of the remaining three farm worker-applicators reported that the text in the instruction leaflet was printed in too small a font for him to go through, the second person reported that he was illiterate. The remaining one did not give any response.

Use of information on product label and leaflets among farmers

When asked about whether they read the instructions or label given along with the product, 60% of the farmer respondents responded in the affirmative while the remaining 40% in the negative. It was observed that the label on the containers of some brands provides some instructions on usage and safety precautions. In most cases these instructions were written mainly in English and Hindi. In some cases it was observed that information was also written in other languages such as Kannada, Telugu, Bengali, etc. A bottle of paraquat, Allquit–a product of Crystal, sold in West Bengal, examined by the researcher, had information written on the product label only in English and Hindi. But the farmers in the study area were unable to read these two languages; obviously they could not understand what was written on the label on the container. In West Bengal, some other products such as Paranex and Gramo contained information in a few more languages (other than English and Hindi) including Bengali on the product label.

CHART 6: **RESPONSES TO QUESTIONS RELATED TO LABEL AND INSTRUCTIONS AMONG FARMERS**



Source: Based on field data

In addition to the product label pasted on the container, we observed that Syngenta had provided a leaflet along with its product, Gramoxone. This leaflet contained information in twelve Indian languages on use, dose, crops and weeds, safety instructions, symptoms of poisoning and first aid. These instructions are printed in a tiny font size and quite difficult to read and understand.

Fifteen farmers interviewed in the study (30%) reported that they were able to read the instructions provided along with various trademarks of paraquat dichloride, while 20% reported that they were unable to read the instructions due to the small font size. In addition, another eight percent were unable to read the label because they are illiterate.

Information on safety measures among farmers

The survey revealed that farmers were not at all concerned about their safety, and handle paraquat and other pesticides negligently. The survey revealed that none of the respondents were using complete personal protective measures while handling (mixing and spraying) paraquat dichloride. At least some sort of protective measures were being used by only 12 respondents (24%).

When asked about storage of paraquat, 78% of the respondents reported that they store paraquat inside their homes, mostly in the general store room and veranda or along the lower edges of the roofing of the house. Only 18% of farmers reported that they store paraquat in the farm shed and four percent responded that they store it in their cattle sheds. It was observed that at some level most of the respondents were aware that chemical pesticides including paraquat are not harmless. Ninety two percent of the 50 farmers said that they keep paraquat inaccessible to children. But the remaining 8% reported that they do not take this precaution. Seventy eight percent of the respondents reported that they are aware that these chemicals are not good and are poisonous, a couple of respondents reported that they know paraquat can cause problems such as vomiting, irritation, allergy, head ache, etc.

When asked whether they understand the toxicity/hazard level of a chemical from the colour code on the label most respondents from Arunachal Pradesh and West Bengal reported that they do not understand the meaning of colour code. There is no data on this from the other sites. Such a scenario from the ground reveals that the information provided to create awareness among the farmers or users is not reaching them effectively. Consequently, people on the ground are unable to decipher the labels properly and remain oblivious of safety information.

5.3.2. INFORMATION AND AWARENESS ON PERSONAL PROTECTIVE EQUIPMENTS (PPE)

Information and awareness on PPE among farmers

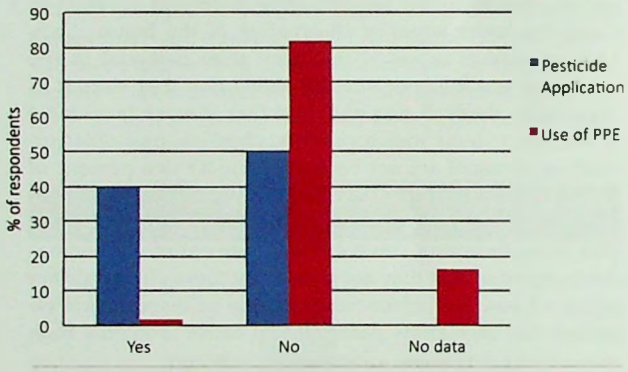
Awareness on the availability of PPE is lacking amongst majority of the respondents. Sixty eight percent of the respondents did not know from where they could buy PPE or

where it was available. And 32 % of the respondents reported that they knew where PPE was available in their village or district. Only 10 % of the respondents said that they have asked retailers or company representatives about the availability of PPEs. They reported that the retailer and company agents promised them that they will get PPE the next time they visit the village, but so far they have not received any kind of PPE from them. The remaining 90 % of the respondents said they have not asked for PPE to anybody.

Training on use of paraquat and PPE among farmers

It is also pertinent to note that only 40 % of the respondents have said that they received some sort of training on pesticide application. The trainings were organized or given by agriculture offices as well as pesticide retailers and agents. Regarding the use of PPE 82 % of the respondents said that they have not received any sort of training and only 2 % of the respondents reported that they attended training given by the agriculture extension officer on PPE use. Sixteen percent of the respondents have not given any response to this question.

CHART 7: **RESPONSES REGARDING TRAINING ON USE OF PPE AND PESTICIDE APPLICATION**



Source: Based on field data

Training on use of paraquat and PPE among farm workers

All the three plantation worker-applicators and two of the fifteen agriculture workers reported that they received training on pesticide and herbicide application as well as on how to use PPE. The remaining (all the five farm worker applicators and 13 farm workers) said that they have not received any training on working with pesticides including paraquat, working in sprayed fields or on the use of PPE. The respondents from tea plantations reported that they were instructed on the use of PPE and plantation officials frequently monitor them while they spray pesticides and herbicides to ensure that they are following the recommended practices. Seventy eight percent of all the 23 workers reported that they know paraquat and other pesticides are harmful and can cause illness.

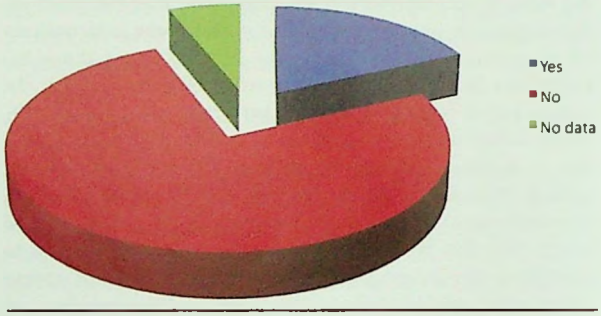
5.3.3. USE OF SAFETY MEASURES

Use of safety measures among farmers

Safety measures are an inevitable component that has to be considered in all the discussions on pesticide use. Unfortunately, adoption of required safety measures is not found at the field level. The data obtained in the current study is also not different. When asked about what they use to protect themselves while using paraquat, seventy six percent of the respondents reported that they did not use any additional personal protective equipment apart from their daily clothes to avoid exposure to paraquat or other pesticides. Among them a few respondents reported that they do not even use foot wear while spraying paraquat or working in paraquat sprayed fields.

Six percent of the respondents reported that they use plastic sheets like an apron. Eighteen percent of the respondents reported they either wash their hands after paraquat application, or occasionally use gloves, full sleeved shirts, or cover their mouth as well as nose with a cloth and wear long trousers and shoes to avoid contact with the paraquat spray.

CHART 8: **USE OF PERSONAL PROTECTIVE EQUIPMENT**



Source: Based on field data

As a safety measure to avoid exposure to spray mist most of the respondents claimed that they consider wind direction while spraying. Eighty six percent of the respondents reported that they consider the direction of the wind and always spray along the direction of the wind. They saidthat otherwise the spray mist falls on their body and they think that it is not good. Eight percent of the respondents said that they were not concerned about the wind direction.

While handling paraquat, none of the farmers who reported dispersing paraquat by hand used gloves and other personal protective equipment while mixing or dispersing paraquat with fertilizers, sand or salt.

Use of PPE while mixing, spraying and washing sprayers among farmers

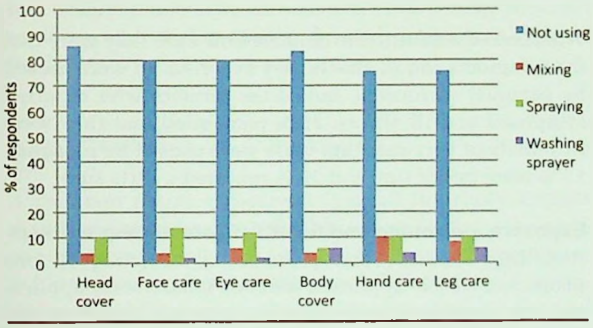
During mixing paraquat, four percent of the respondents used head covers such as a cap or cloth and a cloth to cover their mouth or nose, six percent used eye care equipment

Farmer showing paraquat bought in plastic carry bag.

such as spectacles, four percent used some body cover, either a full sleeved shirt or a plastic apron. Ten percent used gloves to protect their hands and eight percent used long trousers to protect their legs.

CHART 9: PERSONAL PROTECTIVE EQUIPMENT USED BY FARMERS

(those who apply paraquat themselves in their own fields)



Source: Based on field data

While spraying, ten percent of the respondents used a head cover such as a cap or cloth, hand care equipment like gloves and leg covering such as long trousers or shoes. Fourteen percent of the respondents took care of their face by covering the mouth and nose with a cloth, 12 % ensured protection of the eyes by using spectacles and 6 % covered their body with full sleeved shirt or plastic apron.

During washing the sprayers and containers, only two percent of the respondents used equipment for face or eye care, six percent of the respondents used body cover (full sleeved shirt or apron) and leg care (long trousers and or shoes), and only four percent used hand care (gloves). These results are more or less in line with industry figures where it was shown that, in India only around 20 % of pesticide users wear three protective items during spraying (Matthews 2008).

When the farmers were asked about the use of PPE by workers who spray in their fields, the former reported that they usually advice the workers to avoid exposure, touching and inhalation of spray. However, almost all the workers were found not to have used any type of PPE.

Use of personal protective measures by workers

Most of the applicators were handling paraquat without using any safety measures. All the five farm worker-applicators reported that they do not use personal protective equipment while spraying or mixing paraquat. Only the three plantation worker applicators reported that they use some sort of safety measures such as face care (cover mouth and nose with a cloth), eye care (glass), hand care (gloves) and leg care (long trousers and shoes). All the farm worker-applicators said that they did not know where they could get PPE in their village or district.

Six of the 15 agriculture workers (they do not usually apply herbicides or pesticides but work in farms where paraquat and other herbicides and pesticides are used) reported that occasionally they help to mix or spray paraquat and other pesticides in the farm and some of them use some personal protective equipment such as a face cover with cloth, gloves and spectacles on such occasions. Eleven of the 15 agriculture workers reported that they have not used any PPE when working in paraquat sprayed fields and the remaining four agriculture workers reported that they used some safety measures such as glass, face cover with cloth, and gloves while working in paraquat sprayed fields.

Recommended personal protective equipment (PPE)

Personal protective equipment means any clothes, materials or devices that provide protection from pesticide exposure during handling and application. In the context of

the International Code of Conduct on Pesticide Management, it includes both specifically designed protective equipment and clothing reserved for pesticide application and handling (FAO and WHO, 2014). For manual spraying, the most essential items are boots or covered shoes, a long-sleeved upper garment and garment that cover the legs, and a hat (if spraying high crops). Gloves and eye protection must be worn when pouring, mixing or loading pesticides. And there may be additional items required in certain circumstances (Whittle B, 2010).

PPE recommended by the manufacturers

Details of the recommended personal protective equipment were compiled from the leaflet provided along with Gramoxone (product of Syngenta) and labels of Paranex (product of Makhateshim-agan, India) and Kataar (product of Canary Agrochemicals). It showed that Syngenta recommended eye protection (wearing at least glasses) and wearing rubber gloves while mixing, whereas, for spraying they have recommended almost nothing. The statement on the leaflet says "avoid contact with the spray as much as you can". However, the two other manufacturers, Makhateshim-agan India and Canary Agrochemicals have respectively stated the following "wear full protective clothing while mixing and spraying" and "wear full protective clothing while broadcasting" on the label. Thus, the manufacturers have not specified what is "full protective clothing" required while using paraquat.

From the study, it can be observed that less than 15 % of the farmers and a few farm workers were using protective equipment. The PPE include some or all of the following: hat, gloves, eye glasses, plastic apron or long sleeved shirts, long pants or trousers, shoes etc. Some of the respondents claimed that they cover their mouth and nose with a cloth. It can be seen that none of the respondents use a face mask or respirator or overalls while mixing or applying paraquat. It can be concluded from the observations in the study area that majority of the farmers and farm workers use either partial or incomplete PPE or do not use PPE at all. It could also be that farmers and farm workers may not be aware of the complete PPE required to be worn while handling paraquat. In addition, it needs to be verified, whether, even the government authorities, industry and retailers are aware about the International Code of Conduct on Pesticide Management, on the use of PPE and the need to convey such information to the users.

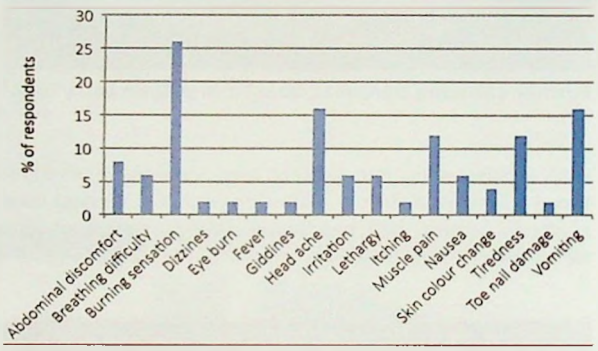
5.3.4. POISONING AND HEALTH EFFECTS

Exposure, poisoning and health effects among farmers

The study has also attempted to document the acute ill effects caused by the use of paraquat dichloride. Thirty four percent of the respondents reported that they were exposed to paraquat while handling it, whereas 54 % reported they were not exposed to paraquat. Four percent reported that they do not know whether they were exposed or not and eight percent have furnished no information.

Forty percent of the respondents (including people who claimed not having been exposed) reported that they experienced ill effects after working with paraquat. Numerous adverse health effects and symptoms were reported by the respondents. Those include the following: headache, burning sensation, itching and irritation, lethargy, breathing difficulty, toe nail damage, muscle pain, vomiting, nausea, tiredness and discomfort, abdominal discomfort, pain and stomach upset, giddiness, fever, eyes burning, dizziness and skin allergy. These ill effects, which show exposure, could also lead to chronic health effects.

CHART 10: **HEALTH EFFECTS REPORTED BY FARMERS (N=50)**



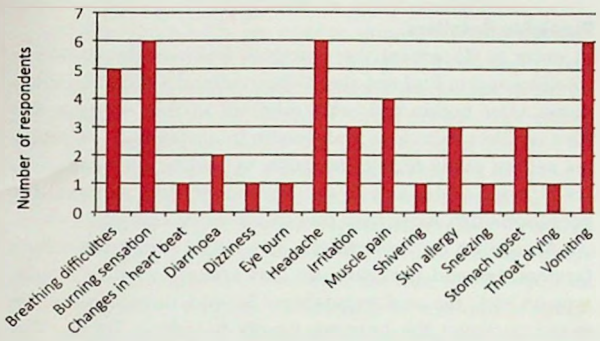
Source: Based on field data

When asked a question to confirm how sure they were that the symptoms and ill effects they experienced were caused by paraquat dichloride, out of the farmers who reported symptoms and ill effects, 25 % responded that they were extremely or very sure that these were caused by paraquat, 15 % were rather sure and 30 % reported a little sure.

Exposure, poisoning and health effects among workers

Regarding exposure and poisoning with paraquat, one plantation worker applicator and one farm worker applicator and a couple of agriculture workers said that they had not been exposed to paraquat while spraying or mixing or working in sprayed field. Two of the remaining plantation worker-applicators said that they did not know whether they had been exposed or not. Five of the 15 agriculture workers and four of the five farm worker-applicators stated that they were exposed to paraquat while mixing or spraying paraquat, or inhaled spray mist when working in the field where paraquat was being sprayed or in a nearby field. Six applicators (two plantation worker-applicators and four farm worker applicators) and all the 15 agriculture workers reported many symptoms they experienced after working with paraquat or after working in sprayed fields. Breathing difficulties, headache, vomiting, skin irritation, stomach upset, diarrhoea, muscle pain, irritation, skin burns and allergy, burning sensation on face and mouth and colour changes on fingers were the major symptoms reported.

CHART 11: **HEALTH EFFECTS REPORTED BY FARM WORKERS (N=23)**



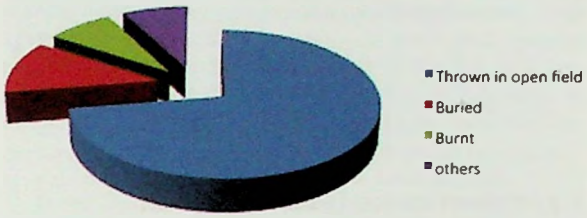
Source: Based on field data

Twenty one out of the 23 workers reported having experienced ill effects, one respondent said that he was very sure, another one said that he was rather sure, and eight respondents responded that they are a little sure that the symptoms were caused by paraquat. Whereas, nine respondents stated that they were not sure and two respondents said that they did not know whether the symptoms were caused due to exposure to paraquat. Only one respondent reported that a worker in the village became ill (vomiting and tiredness) after being exposed while mixing paraquat for spraying. Nine respondents claimed that they had observed domestic animals and birds getting poisoned or dying after they grazed or foraged in paraquat sprayed fields.

5.3.5. DISPOSAL OF CONTAINERS

A common practice observed from all the study areas is that it was quite common for the farmers to throw the empty containers and bottles into the fields in the neighbouring area. Among farmers, this type of disposal was reported by 74 % of the respondents. Other practices of disposal reported were burying (10 % respondents), burning (8 % respondents), and others (8 % respondents). Some of them said that they sold the containers to scrap dealers. Those who said that they disposed the containers by other methods explained some dangerous practices. Some of them reported that they used such bottles and containers in toilets as well as bath rooms as vessels. One respondent said that occasionally ice cream vendors who came to the villages collected the empty bottles. Some respondents said they used the containers for buying pesticides and herbicides from the retailers.

CHART 12: **CONTAINER DISPOSAL METHOD-FARMERS**



Source: Based on field data

Regarding the workers, it was observed that farm worker-applicators treated the empty containers carelessly. They reported that the containers were either thrown into the open fields (2 respondents), buried (1 respondent) or sold to scrap dealers (2 respondents). There is no data for the three plantation worker-applicators.

5.3.6. AGRICULTURAL AND ENVIRONMENTAL IMPACTS

The respondents were asked whether they have noted any effects on the crop, soil, biodiversity or other effects due to the application of paraquat. A considerable percentage (48 %) of the farmers interviewed reported that they noted positive effects such as growth enhancement and 44 % said they noted yield improvement, while negative effects such as growth retardation was reported by 24 % of the respondents and decreased yields were reported by 22 %. The remaining respondents did not furnish answer to the question.

Regarding pest infestations, 22 % of the respondents responded and the remaining respondents did not furnish answers. Thirteen percent of the respondents reported that pest and or disease infestation had decreased. Two percent of the respondents said that an increase in pest numbers was noted. In the same way, two percent respondents claimed that occurrences of some diseases were noted.

With regard to cost of cultivation, four percent of the respondents claimed the expenditure had increased while 54 % of the respondents claimed they experienced lower cultivation costs.

Thirty percent of the respondents reported that soil fertility diminished after they started using paraquat and other herbicides and more fertilizers had to be applied to get favourable yields. The remaining did not respond to this question.

About the impacts on biodiversity, most of the respondents did not answer except a few who claimed that some effects were noted, but they were unable to furnish further details.

Some respondents from West Bengal reported that they observed certain impacts on their domestic animals such as cows, goats and ducks due to paraquat exposure. Two respondents informed that a cow and a goat died in the villages after feeding on grass from a paraquat sprayed field.

Five respondents reported that diarrhoea, unconsciousness, stomach enlargement and tiredness were noted in their cow and goat, which accidently grazed on a paraquat sprayed field. Two respondents reported that their ducks and hens did not eat for a couple of days after they foraged in a paraquat sprayed field. Such incidents were not reported from other study areas.

5.4. REPORT BASED ON INFORMATION OBTAINED FROM AGRICULTURE EXTENSION OFFICERS AND RETAILERS

As part of the study an attempt was made to collect data on paraquat use and recommended safety measures from agriculture extension officers (AEOs) and retailers. We could interact with four agriculture extension officers and five pesticide retailers.

Agriculture Extension Officers:

All the four AEOs reported that manual, mechanical and chemical weed management are practiced in their respective areas. Weed control using herbicides has become widely accepted since the last eight to nine years. It is much easier and application of herbicides requires less labour costs compared to manual weeding. Two AEOs said that manual weeding could be a better option if resources were available–labourers as well as sound financial background, but herbicides are cheaper and so farmers are inclined to use herbicides.

The AEO from one study area said that they recommend paraquat for weed control in rice, but most farmers in the area follow manual weeding methods. In all other areas AEOs reported that agriculture department has not been recommending paraquat. AEOs from the study sites in North Eastern Indian States reported that paraquat is widely used in tea plantations. They also said paraquat use is a common practice in paddy fields as well as vegetable fields. All the AEOs claimed that they have given training to farmers on pesticide application, however, none of the trainings were specifically for paraquat dichloride. A few of them also claimed that they advice farmers to use personal protective equipment while handling pesticides to avoid exposure and poisoning. Three AEOs reported that they have neither provided training on the use of PPE nor helped farmers to get PPE. Only one AEO said that they gave training to farmers about the use of PPE and help farmers to get PPE on request All the AEOs informed that PPE is not available in their offices.

One AEO reported that there was a recent poisoning case with paraquat where a worker was exposed to the spray mist, and developed head ache and irritation.

Provision of safety equipment and awareness creation on the importance of using PPE has not happened in any of the study areas. The department of agriculture has to take a much more responsible role to create awareness among farmers as well as farm workers. In addition, information about the ill effects of paraquat should be shared and farmers should be encouraged to practice non chemical weed management.

Pesticide Retailers:

In order to document the practices followed by pesticide retailers and to find out about the availability of PPE, interviews were conducted with retailers in five study areas. Five retailers from four States were interviewed. The retailers selling many herbicides such as glyphosate, paraquat, 2,4-D, pretilachlor and so on. All the retailers were selling paraquat, often more than one commercial brand.

According to the retailers, the major crops for which farmers demand paraquat are okra, potato, paddy, onion, ground nut, tea and vegetables. In addition farmers demand paraquat for burning weeds in fallow lands. The dose recommended by retailers ranged from 400ml to 1000ml diluted with 100 L to 200 L water per acre, which is in line with the dose approved by the CIBRC.

The retailers stated that they get the products from distributors and usually PPE is not supplied. Two retailers claimed that PPE kits were available in their shop, which includes gloves, mask and spectacles; the cost per kit ranges from rupees 250 to 300. Three retailers said that they usually advise farmers to wear protective clothing while handling paraquat as well as other pesticides to avoid exposure from spillage or spray mist.

Some retailers said that they get some promotional gifts from distributors if they attain sales targets for paraquat. In which case, they sell those formulations for which promotional gifts are offered. Promotional gifts that encourage the use of pesticides are in violation of the International Code of Conduct of Pesticide Management.

Two retailers said that they attended trainings organised by agriculture development office or pesticide distributors in their region. The trainings were not specific to the paraquat dichloride, but generally focused on chemical pesticides.

An important observation from the State of West Bengal was that paraquat was sold in plastic carry bags as well as in empty bottles of other pesticides. Most marginal farmers buy paraquat in smaller volumes such as 100 ml or 200ml. Consequently retailers sell the highly hazardous paraquat dichloride in plastic carry bags and other bottles without following any safety measures. It was observed that paraquat smear had spread around the opening of the containers. Consequently, it is more than probable that the retailers and farmers have contact with and are inhaling paraquat increasing the risk of poisoning. Ironically none of the retailers use protective measures when refilling into containers or plastic carry bags.

5.5. PARAQUAT USE IN TEA PLANTATIONS

As part of the study to document the use and associated impacts of paraquat dichloride in India, we attempted to collect data from large-scale tea plantations in South India as well as in North East India. In south India we interacted with a member of *The United Planters' Association of Southern In-*

dia (UPASI) and an official of a tea plantation in the Nilgiris. According to them, the use of paraquat dichloride has largely been replaced by glyphosate in many plantations.

In North East India we tried to gather data with the help of officials of the International Union of Food and Allied Workers (IUF) India as well as from a tea garden in Dibrugarh district in Assam. The IUF India coordinator shared secondary data from larger tea plantations in Assam. We had an interaction with a senior official from a tea plantation in Dibrugarh. The details obtained are described below.

The senior official from a tea plantation in Dibrugargh explained that paraquat dichloride is in use in the estate since a long time and is used at the rate of 750–800 ml diluted in 200 litres of water. Usually 6–8 rounds of spraying is done in a year. Paraquat is normally not applied in younger tea gardens as it impacts growth adversely. If application becomes necessary in younger gardens, plant guards (a type of protective covering) are used to cover the plants to avoid contact with the spray.

When intensive growth of weeds or tough weeds are found 2,4-D is mixed at the rate of 250–500 gms along with 750–800 ml paraquat in 200 litres of water.Usually paraquat is sprayed on sunny or dry days, during the morning hours and is done by members in the spraying gangs who are trained on pesticide application and the use of PPE. According to the official, the pesticide/herbicide applicators are provided with safety equipments along with a small flag of cloth to find the direction of wind so that they can spray along the direction of wind.

The senior officer in the plantation said that though they ensure that workers are using the PPE given to them, it is not always followed. He informed that he himself found a few workers applying paraquat without wearing any PPE.

He said that so far neither poisoning incidents nor any symptoms have been reported. But two out of the three plantation worker-applicators interviewed reported that they experienced head ache and breathing difficulties. The secondary data obtained from the IUF India shows numerous adverse health effects that have been reported due to paraquat use from tea plantations in Assam such as skin burns, fever, and dizziness, loss of consciousness, breathing difficulties, vision trouble and vomiting.

Workers prepare to go to spray pesticides in a tea garden. They have no proper personal protective clothing.

OCCUPATIONAL HEALTH AND SAFETY LEGISLATION

The Plantations Labour (Amendment) Act, 2010 requires
18A. Safety.
(1) In every plantation, effective arrangements shall be made by the employer to provide for the safety of workers in connection with the use, handling, storage and transport of insecticides, chemicals and toxic substances.
(4) Every employer shall ensure that every worker in plantation employed for handling, mixing, blending and applying insecticides, chemicals and toxic substances, is trained about the hazards involved in different operations in which he is engaged, the various safety measures and safe work practices to be adopted in emergencies arising from spillage of such insecticides chemicals and toxic substances and such other matters as may be prescribed by the State Government.

The International Labour Organisation's Convention 184 on occupational health and safety in agriculture requires governments to ensure that there are preventive and protective measures for the use of chemicals and handling of chemical waste at the level of the undertaking covering:
- the preparation, handling, application, storage and transportation of chemicals;
- agricultural activities leading to the dispersion of chemicals;
- the maintenance, repair and cleaning of equipment and containers for chemicals; and
- the disposal of empty containers and the treatment and disposal of chemical waste and obsolete chemicals.

5.6. OTHER WEED MANAGEMENT METHODS

Farmers interviewed for the study reported that before herbicides became popular and available they practiced manual weeding and mechanical weeding employing cattle ploughs. These methods of weed management other than application of paraquat or herbicides are still being practiced in all the study areas–manual hand weeding and mechanical weeding using cattle plough. Cultural practices such as mulching is also reported to have helped farmers to prevent the growth of weeds. Sixty six percent of the farmers interviewed claimed that they do manual weeding (hand weeding) as well as with cattle plough at favourable occasions.

Another 22 % of the farmers, especially from Andhra Pradesh and Telangana said that they used cattle plough for weeding for some crops such as cotton, pulses and vegetables, mostly during earlier stages of the crop.

Seventy two percent of the farmers reported that they know other weed management practices apart from using chemical herbicides. From the responses, it seems like farmers are aware that manual weeding is a good option. However, due to labour problems and increased cost of labour, farmers are resorting to chemical methods.

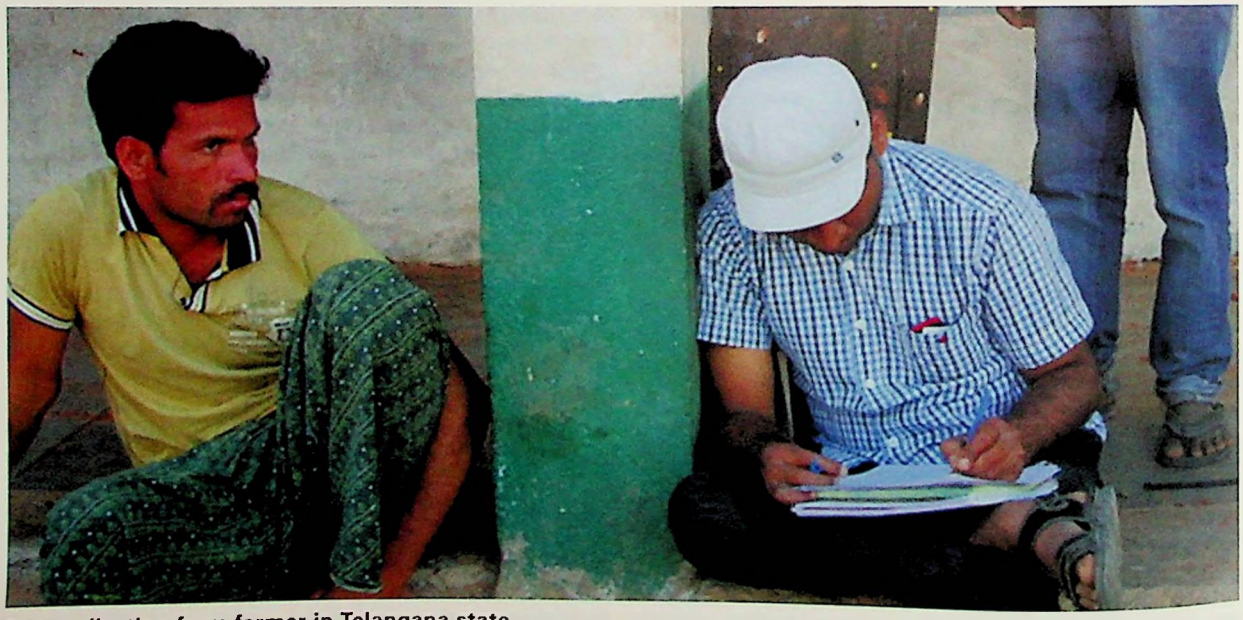
6. CONCLUSION

The study found that paraquat dichloride, a herbicide, is used for controlling weeds in at least 25 crops in India (as per information from the study areas) whereas the Central Insecticide Board and Registration Committee (CIBRC) has approved it only for nine crops. This means that many of the uses of paraquat are in violation of the laws in India regarding pesticides. The State Agriculture Departments and/or Agriculture Universities and the various commodity boards are in violation of the law as they have recommended paraquat for crops other than those approved by the CIBRC. Similarly, Syngenta, one of the major suppliers of paraquat, has recommended the use of its product Gramoxone in 12 crops and another manufacturer Canary has recommended the use of Kataar for 11 crops, again over riding the CIBRC.

It is evident from the interviews that farmers are not fully aware of the crops on which paraquat use is approved. Though farmers are aware that paraquat and other pesticides are poison, they lacked information about its proper use. Most of the workers interviewed were also not aware of the same and lacked the required PPE, thereby, increasing the risk of exposure and poisoning. This clearly indicates the failure of the agriculture departments and other concerned government agencies in providing adequate information about the use of paraquat and the PPE.

Interestingly farmers seek and get advice not from the concerned government departments but from the retailers or the agents of companies or distributors. This has contributed to insufficient information and improper use of the herbicide. In West Bengal paraquat was being sold in plastic carry bags, further increasing the risk of spillage, exposure, and poisoning.

The study found the use of paraquat dichloride is happening in violation of the Indian Insecticides Act. In addition to the violation of the International Code of Conduct on Pesticide Management, the conditions of use of paraquat in India also violate international conventions such as the Chemicals Convention of 1990 and the Safety and Health in Agriculture Convention of 2001. The actual practices in the field indicate the absence of an effective regulatory as well as monitoring system which in turn promotes misuse and illegal practices. Paraquat is being used in unsafe and dangerous conditions at the retailer, farmer and worker level. All this is happening while numerous adverse health effects have been reported from farmers and workers due to exposure to paraquat. All these demonstrate the need to take necessary steps towards a progressive ban of paraquat in India.



Data collection from farmer in Telangana state.

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