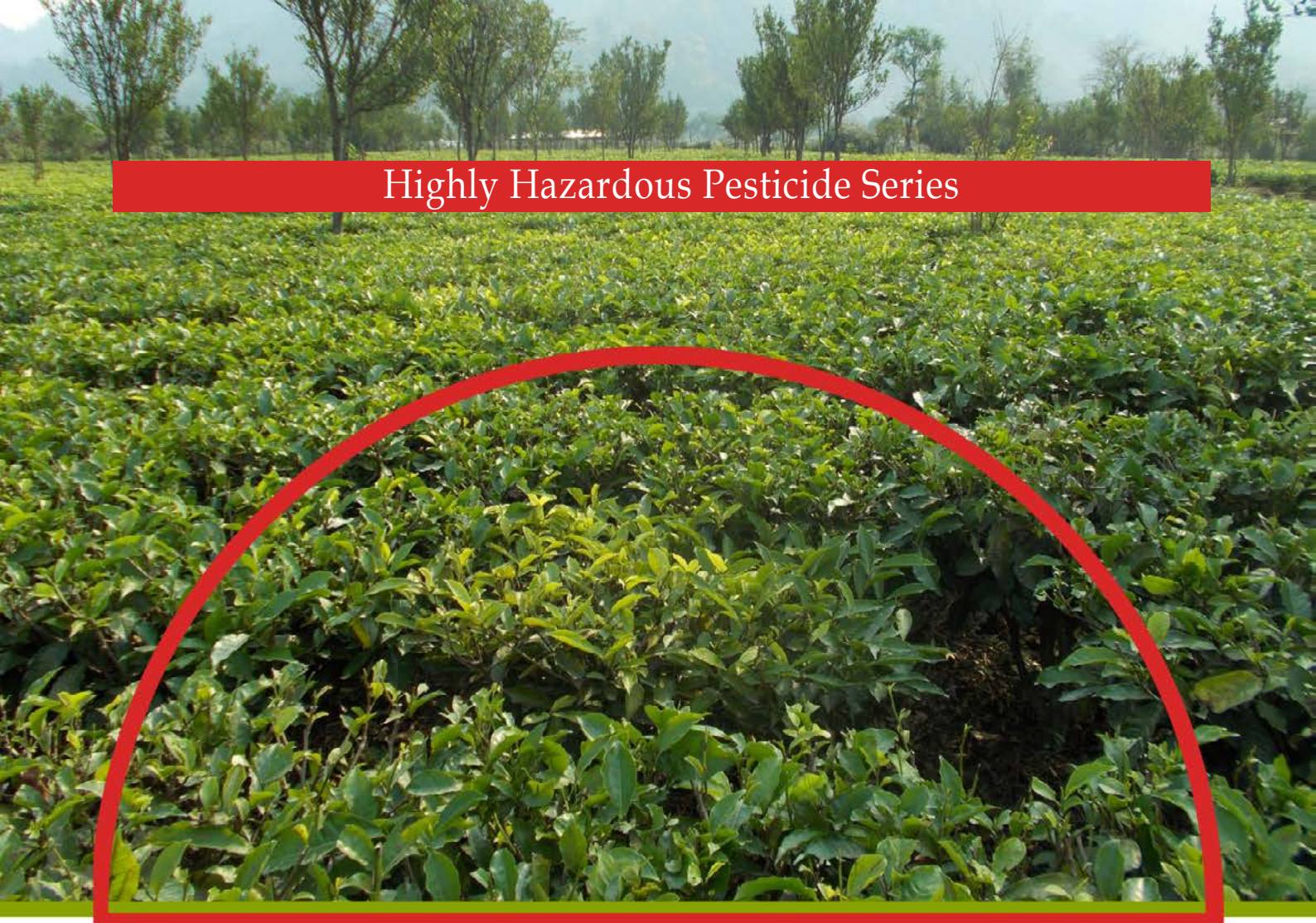
Highly Hazardous Pesticide Series



STATE OF GLYPHOSATE USE IN INDIA

Dileep Kumar A. D. MSc., PGDPRM

PAN INDIA

PAN ASIA PACIFIC
For a just and pesticide-free future

Highly Hazardous Pesticide Series

State of Glyphosate Use in India

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Author: **Dileep Kumar A. D. MSc., PGDPRM (UCT, South Africa)**

Design & Layout: **Anju Babu**

About PAN India

Pesticide Action Network India (PAN India) is a public interest research and advocacy non-profit organisation formed in 2013. PAN India is a national independent organization in India, working closely with the PAN Asia Pacific and PAN international community. PAN India's objective is to help communities and governments to reduce dependence on toxic chemicals for pest control in agriculture, household as well as public health and to increase the use of sustainable alternatives. PAN India is committed to safe farming, safe living, and a safe working place. PAN India is working to make India a world leader in Agroecology by empowering farming communities to keep away from toxic pesticides and agrochemicals, and to take up non-chemical methods of farming practices that champion traditional knowledge, biodiversity, and farmer participated research in attaining food sovereignty.

About PANAP

PAN Asia Pacific (PANAP) is one of five regional centers of Pesticide Action Network, a global network dedicated to the elimination of harm upon humans and the environment by pesticide use, and to the promotion of biodiversity-based ecological agriculture. PANAP's vision is a society that is truly democratic and culturally diverse, based on social and gender justice, fair distribution of productive resources and environmental safety and sustainability.

Contact

Pesticide Action Network (PAN) India
10/233/3, 1st Floor
Sarangi Complex
Chiyaram Post, Thrissur District
Kerala, India
PIN-680026
Phone: +91 487 2253737

www.pan-india.org
admin@pan-india.org

Contact

PAN Asia and the Pacific
P.O. Box 1170
10850 Penang, Malaysia
Phone 604-6570271 or 604-6560381
Fax 604-6583960

panap@panap.net
www.panap.net

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PREFACE

Glyphosate is one agrochemical that has been the focus of discussions and policy discourse worldwide, for a variety of reasons. Unlike other herbicides, this particular chemical has transcended boundaries of pesticide usage and application, with Roundup ready seeds getting traded on agricultural inputs markets. Glyphosate has become a combination product with herbicide-tolerant seeds. This mutually-dependent, non-exclusive use has made this product a money-spinner for the patent holder. Discussions at the international level, as usual, have been on its non-target life impacts. This herbicide's impact has been suppressed in the country of its origin, i.e, US, and never assessed completely in other countries. The European Union in the recent past raised a lot of hopes among groups working for its ban. But ultimately the decision was postponed effectively.

With the most liberal and reportedly science-based decision support systems failing to rein in glyphosate, its spread across the planet became easier. This is a major concern. India has become a destination because of the huge domestic market and also the condition of the regulatory system. And, now, India is emerging as a platform for launching this hazardous product in other countries.

Assessing the environmental and human health impacts of glyphosate in particular and pesticide use, in general, has not become a practice in India. To assess, it is essential to know how much glyphosate is being applied in a region on a given crop, collectively across all crops, and in other places (e.g., forests, schools, gardens, etc). Impact assessment is possible only when data are available on the area of application and crops treated; the timing and method of applications; rates and number of applications; the formulation applied and the total volume applied per acre. But, all these data are rarely available.

A depleted biodiversity is threatened by this herbicide, as farmers and gardeners are made to choose this method of de-weeding, over other sustainable methods including mechanical tools and physical energy. In fact, in India, especially in the cotton area, nutritious leafy vegetables that grow naturally between a row of cotton crop are the target of this herbicide. As a result, rural areas are killing nutritious food available on a platter to poor and disadvantages communities. It is also being used as an alternative method of human energy. Glyphosate has become a tool that leads to rural unemployment of the poorest of the communities. However, as this report is going to the press, the Government of India has issued a draft Glyphosate restriction order, on 7th July 2020, wherein it can be used only through Pest Control Operators.

PAN India has developed this report primarily to increase awareness of people about glyphosate, its toxicity, and the usage patterns. It will be our endeavour to keep updating this report, periodically, in order to present cogent and concise information for people in general. Farmers, farm labour and policymakers need to learn about this most hazardous and carcinogenic agrochemical.

Dr. D. Narasimha Reddy
Honorary Director, PAN India

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I express my deep sense of gratitude to all the respondents – farmers, farmworkers, pesticide retailers, and agriculture officers in the study area who spent their valuable time for interviews and sharing relevant data, which formed the basis of this report.

I would like to place special thanks to Team Thanal for their moral support and encouragement for taking up this important work. PAN India is grateful to Thanal for facilitating and supporting this research.

And finally, I gratefully remember the continuing support from my family members and friends for undertaking this work.

Dileep Kumar A. D.

EXECUTIVE SUMMARY

This report is part of the Studies on Highly Hazardous Pesticides undertaken by PAN India. Recently, a vast expansion of pesticide use, particularly herbicides, both in small-scale farms as well as small and large commercialized farms was noted throughout India. Herbicide usage has noted with a manifold increase in the last few years in the country, due to increased cultivation of genetically modified crops and labour shortages.

Glyphosate is a widely used weedicide, which is implicated in a number of severe short term and long term health outcomes. This study is aimed to assess the ground reality of this controversial and widely used herbicide in India. Glyphosate stands the second position in terms of production and consumption of herbicides in India.

Glyphosate has been approved for use in India for weed control in tea plantations and its non-cropped area. Though seven glyphosate formulations are approved in India, only three are reported by farmers. Glyphosate 41% SL is the widely used one, followed by 71%SG. A combination formulation, comprising of oxyflurofen 2.5% + Glyphosate (isopropylamime salt) 41% SC was also reported.

At least six state governments had attempted stringent regulation and/or a temporary ban of glyphosate-based herbicides in their jurisdiction in the past years.

Approved sources for import of glyphosate in India include six firms, whereas 35 firms are approved for indigenous manufacture. According to pesticide monitoring statistics of Ministry of Agriculture, India produced about 6684 metric tonnes of technical grade glyphosate during the year 2018-19, whereas the consumption of glyphosate during the same period was 765 metric tonnes. No data or information is available for the remaining quantity, which either could have been exported or used domestically but is unreported.

A field study was undertaken in 2017 in seven States - Andhra Pradesh Himachal Pradesh, Jharkhand, Karnataka, Tamilnadu, Telangana, and West Bengal. Field data was collected through a questionnaire survey from a total of 300 respondents that includes farmers (227), farmworkers (43), and retailers (30). The latest available secondary data on production and consumption of glyphosate in India, approved uses of glyphosate, food safety regulation for glyphosate, and other relevant information were also used for understanding the state of glyphosate use in India.

Varied uses of glyphosate have been noted in all the seven states in more than 20 crop fields and also for general weed control. Among the respondents, 77.97% of farmers and 41.12% of workers reported glyphosate use. A total of 24 different brands of glyphosate formulations were reported from the field study and were used for postemergence weed control in a wide variety of crops such as banana, beans, bitter gourd, brinjal, cauliflower, chilli, cotton, corn, maize, okra, onion, paddy, soybean, tomato, snake guard, leafy vegetables, wheat, paddy, maize, and groundnut.

More than 60 % of the respondents who used glyphosate reported that they are neither trained for glyphosate application nor on safety measures to be followed while handling it. Sources of information on glyphosate usage for farmers include retailers, agents of manufacturers and/or distributers, agriculture officers, and other farmers. Most of the respondents have had access to product labels and information leaflets; where as a small percentage of respondents were able to get glyphosate products without labels and information leaflets. A considerable percent of respondents were not able to read and understand the information provided on the label and instruction leaflets, mainly due to the following reasons: very small font size of the label/leaflet that is unable to be read or due to the language that they do not know, or unable to comprehend or illiterate.

Various practices that can lead to exposures and poisoning were noted regarding storage, spraying equipments, washing, use of personal protective equipment (PPE), application time, and working in sprayed fields. The location of glyphosate storage includes house premises (kitchen, wall shelf, veranda, near the window, store room, etc.), farmhouse and cattle shed. More than half of all the respondents reported that they store pesticides at places where children cannot reach them. Almost all of the respondents were

using manual and battery powered backpack sprayers for glyphosate application. About 37% of respondents were working with faulty sprayers that were leaking occasionally or frequently. Most of the respondents were washing the equipments used for glyphosate application in water sources – near to a well used for drinking, close to a well not used for drinking, close to a pond and other water resources.

None of the respondents reported use of a complete set of recommended PPE, whereas 66% reported use of at least one protective measure such as the use of hat, towel, cloth, gloves, mask, spectacles and goggles, raincoat, plastic sheet, full-sleeved shirts, full-length trousers, and shoes. Many of the respondents reported that they work in glyphosate sprayed fields without using any of the protective measures.

About 14.12% of respondents reported exposure to glyphosate while working in the field, due to a sudden change in wind direction while spraying, weedicide spilled when opening the lid of container, spilled on hands while mixing, and spilled on body while loading the sprayer. Symptoms of poisoning reported by the respondents who have exposed to glyphosate were nausea, vomiting, dysentery, headache, fever, skin fissures, increased heart rate, eye irritation, urinary infections, etc. About 15% of respondents reported any one or more of the above-mentioned ill effects.

No proper container disposal method was observed in this field study. Many respondents were using containers of glyphosate formulations for household uses. Throwing out the containers in open fields, burning and burying, selling to scrap dealers were the different practices of managing empty containers of glyphosate noted from the field.

Farm workers have reported the use of glyphosate in vegetables and cotton, which are non approved crops as per national approved use. None of the farm workers interviewed had undergone training on the use of pesticides including herbicides. 79% of workers reported that they did not have training on the use of personal protective equipment, safety measures, and precautionary measures. Nearly 40% of the workers reported that they are not aware of the health hazards of using glyphosate and other herbicides. None of the workers reported use of recommended PPE, whereas a very few reported use of cloths, gloves, goggles, and masks while spraying glyphosate, and none of them used protective measures apart from casual clothing while working in sprayed fields.

Exposure to glyphosate and health effects were noted for workers as well, due to spillage on leg, hand, and other body parts while mixing and spraying or using faulty spraying equipment. It had resulted in burning sensation and irritation. Body pain, eye irritation, general weakness, and vomiting are the other ill effects reported by workers on exposure to glyphosate.

Thirty retailers were interviewed as part of the study. The retail points were located in the village and semi-urban areas and were selling glyphosate-based herbicides along with other pesticides. All these retail points were noted in areas were the crops approved for glyphosate usage in India was not being grown. Various brands of single formulations, as well as combination formulations of glyphosate, were noted. None of the sales points had recommended PPE for sale or display; however, gloves, facemask, and goggles were noted from a few. About 66.67% of retailers said that they attended training programs on pesticides, mostly organised by pesticide companies or distributors, and also by agriculture departments. A few retailers were found to be practicing decanting of glyphosate.

Pesticide label analysis was done for one third of the total reported glyphosate brands. Reported container volumes for these brands are 100g, 250g/ml, 500ml, and one litre. Label information was provided in English, Hindi, and a few other languages, with required hazard classification details. None of the brands had information on how to use the product - application dosage - but it mentioned ‘read the leaflet’; however, none of the brands had an instruction leaflet attached to them. Some brands mentioned usage for weed control in tea and non-crop areas. A warning statement, some safety instructions, or precautionary statements with minimum information was noted on labels, whereas proper information on the use of PPE, as prescribed by the Insecticide Rules 1971, was not

seen on the label, except for gloves. The direction for proper disposal of used containers was also not seen on the label.

The lack of proper training on glyphosate use and safety measures, access to the right information to users, and the wider availability and easy accessibility to glyphosate products have been contributing to unintended as well as unsafe use of glyphosate in India, violating national laws as well as International Code of Conduct on Pesticide Management. Unintended uses of glyphosate were widely observed in the study, with more than 20 non-approved uses for food and non-food crops, which raise serious concerns over residues in food commodities, food safety, and environmental contamination as well as the consequent short and long term impacts.

The vast array of glyphosate use as noted in the study would have undesirable outcomes on soil health, farm productivity, food safety, the export of food and farm products, public health, as well as environmental wellbeing. The reality of glyphosate use, as mentioned above, necessitate the urgent need of eliminating glyphosate from India in order to protect its citizens from unintended and unpredictable health damages and environmental impacts.

MAJOR FINDINGS

- Glyphosate based herbicides are registered and approved in India for weed control in tea gardens and their non-crop areas. However, this study reports glyphosate use for weed control in more than 20 crop fields (16 of them are food crops) as well as non-crop areas.
- Statistical data on pesticides in India shows that glyphosate stands at the second position in production and consumption among herbicides, following 2,4-D. The data for production and consumption shows a huge difference and little information is available on its export.
- Six Indian states have brought in stringent restrictions or temporary bans or cancellation of licenses for glyphosate-based herbicides in their jurisdiction, considering indiscriminate use as well as health and environmental concerns.
- The field study conducted in seven states reports use of 24 different brands of three formulations based on glyphosate. Glyphosate-based herbicide products are also sold in areas where the crop for which it has been approved is not grown.
- About 77 % of farmers and 41 % of workers reported use of glyphosate in weed control for several crops, all of them are non-approved uses for this herbicide in India.
- The majority of farmers and workers interviewed in the study did not have training on glyphosate application, safety precautions, and use of PPE.
- None of the farmers or workers interviewed reported use of recommended PPE while working with glyphosate or working in fields sprayed with glyphosate; rather some of them reported use of a cloth, hat, mask, glove, goggles of poor quality as safety measures.
- Recommended PPE were not being sold in pesticide retail points where the field study was conducted.
- Product label analysis for glyphosate reveals the following: application dosage was not given, proper information on use of PPE was not given, direction on proper disposal of containers was lacking, minimum precautionary statement information, and instruction leaflet was not attached to containers.
- A number of practices that could lead to exposure to glyphosate were noted, including storage in house premises, working without adequate safety requirements, washing of spray equipments

near to drinking and household use water sources, reuse of glyphosate containers for household purposes, etc.

» Exposure to glyphosate was reported by a considerable percent of respondents due to spillage and wind drift. Burning sensation, eye irritation, nausea, vomiting, dysentery, headache, fever, skin fissures, increased heart rate, eye irritation, urinary infections, body pain, general weakness are the ill effects reported in this study by 15 % of farmers and 52.63% of workers.

» The unintended use of glyphosate reported in this study raises serious concerns over residues in food commodities, food safety, agriculture trade, and environmental contamination, as well as the consequent short and long-term health and environmental impacts.

» Monitoring of pesticide residues in India does not analyze for glyphosate residues in agriculture produce, hence the level and extend of contamination in food commodities remains unknown.

RECOMMENDATIONS

Glyphosate, which has severe health and environmental impacts, has been found with a number of unintended and unsafe usages, which are not approved uses in India. Hence this study recommends the following:

- Ministry of Agriculture and Farmers Welfare Government of India immediately take measures to phase out production and usage of glyphosate and glyphosate-based herbicides across India.
- Ministry of Agriculture and Cooperation, Government of India convene a working group with the National Center for Organic Farming to come up with a package of practices for non-chemical weed management approaches, options and methods that best suits agro-climatic and agro-ecological scenarios in India.
- The Central Sector Scheme, 'Monitoring of Pesticide Residues at National Level' undertakes to monitor glyphosate residues both in farm products and environmental samples across India to understand the level and extend of contamination.
- State agriculture departments take immediate measures to harmonize national approved use, and the use recommended by Agriculture Universities/Departments/Agencies as part of their extension mechanisms and stops all non-approved uses with immediate effect.
- State agriculture departments immediately take measures to stop sales and usage of glyphosate in States/Areas subject to the nationally approved uses of glyphosate.

1. INTRODUCTION

India is the fourth largest global producer of pesticides with an estimated market size of around $4.9 billion in 2017 financial year after United States, Japan and China[1]. The consumption of chemical pesticides in India in the year 2017-18 is 62183 metric tonnes technical grade, which is higher than that of previous years (Care Ratings, 2017). However, this dataset lacks consumption data from four Indian states and Union territories, therefore in reality the total consumption would be more than the above figure. In contrast to the increased pesticide consumption, the area under cultivation using pesticides in India has shown a drastic decline. During 2017-18, the area under cultivation with pesticide usage was reported to be 62,247 thousand hectares, while in the previous year (2016-17) it was 104,037 thousand hectares (PPQ&S, 2019).

In India, paddy accounts for the maximum share of pesticide consumption (26%-28%) followed by cotton (18%-20%). Insecticides have the major markey share (60%), whereas fungicides account for 18%, herbicides 16%, and the rest 6% by others. According to Credit Analysis & Research Limited (CARE Ratings), players across the industry have fairly steady credit profiles exhibiting steady revenue growth and profitability irrespective of the monsoon failures, mainly on account of a diversified revenue profile (Care Ratings, 2017). Approximately 50% of the demand comes from domestic consumers and the rest from exports. During the same period, domestic demand is expected to grow at 6.5% per annum and exports at 9% per annum. It is presumed that the Indian agrochemicals market will be driven by growth in herbicides and fungicides, increasing awareness towards judicious use of agrochemicals, contract manufacturing, and export opportunities (FICCI, 2016). According to TechSci Research report, "India Pesticides Market By Type, By Application, By Region, Competition Forecast & Opportunities, 2012-2026", the pesticide market in India is forecast to surpass $5 billion by 2026[2].

There has been a vast expansion of pesticide use, particularly herbicides, throughout India, both in small-scale farms as well as small and large commercialized productions in irrigated systems. The lack of appropriate regulatory capacity surrounding pesticides, including growth in imports and indiscriminate use of pesticides, is causing public and environmental health issues in rural areas, which largely remain unrecognised and un-documented in the current governance regime.

'State of glyphosate use in India' is part of a Highly Hazardous Pesticide study series undertaken by PAN India. This study is aimed to assess usage patterns of one of the controversial and widely used herbicides, glyphosate, in India. A major drawback is that State-wise consumption data of glyphosate is not available in India for all the States. However, herbicide usage has increased tremendously in the last few years due to labour shortage, higher wages, and changing lifestyles of farmers. Glyphosate usage has increased independently, especially after the introduction of illegal herbicide-tolerant genetically modified seeds. In the year 2017-18, 654 metric tonne technical grade glyphosate was used in India, which is higher than the figures in previous years (PPQ&S, 2019). Deviant market strategies could also be considered as a growth factor. Meanwhile, glyphosate has been declared as a probable carcinogen by the International Agency for Research on Cancer (IARC). Alarmingly, unrestricted access to glyphosate is probably leading to it becoming a self-poisoning agent in certain regions in India.

[1]Outlook of Indian Pesticide Industry, Ratings Department, Care Ratings, May 31, 2017.

[2] https://www.slideshare.net/TechSci_Research/india-pesticides-market-forecast-2026-brochure?qid=189691ee-cae5-48ca-a30d-9864421c0fa9&v=&b=&from_search=28

What are Herbicides?

Herbicides, popularly known as weedicides, are a group of pesticides or phytotoxic chemicals used to kill unwanted plants or inhibit their growth in agricultural fields and non-agricultural areas (Pretty, 2008). Based on the mode of action and chemical nature, different types of herbicides can be seen. Some herbicides would be specific in action, in that they inhibit growth or kill certain species of plants only (selective herbicides), whereas some others can kill different species (non-selective or broad-spectrum). After contact with plants, herbicides can get absorbed or moved through the plant tissues and exert their action (Fernandez & Brown, 2013). These chemicals kill or inhibit plants by interfering with key vital functions at the cellular level such as the synthesis of amino acids, lipids, photosynthesis, and cell division (Stephen, 1990). Many herbicides are also toxic to animals, including humans.

Herbicide use in India

For the first time in India, the use of herbicides for weed control was initiated in Punjab in 1937 using sodium arsenite. During 1946, the herbicide 2,4-D was first tested in the country. The Indian Council of Agricultural Research initiated field tests of herbicides in 1952 in crop fields such as rice, wheat, and sugarcane. The herbicide 2,4-D was introduced in Indian agriculture during the 1950s, and wider field use started during 1960 with its import, thereafter, herbicide use increased manifold in India. Curretnly, about 60 herbicide active ingredients including glyphosate are registered for use in India with several formulations and brands (Choudhary et al. 2016). Official figures of consumption of herbicides, both imdigenous and imported, for the year 2018-19 (provisional) in India amounts to 3434.35 metric tonne technical grade.

Glyphosate applied in vegetable field

2. MATERIALS AND METHODS

Study purpose

The principal objective of this study is to unravel the use and regulation of the controversial weedicide, glyphosate in India. This study analyses approved uses of this weedicide in India, recommended use by State Agriculture Departments, production and consumption, various formulations used, field level uses, and various implications of actual use in the field. Apart from use and regulation, this study attempts to gather details such as companies involved in importing and manufacturing of these pesticides including Indian firms and multinational players.

Scope of the study

This national level field study helps in understanding the ground reality of use of glyphosate in India. It can be used as a tool for informed decision-making processes by State governments, Central government, agriculture, and other departments as well as policymakers in achieving sustainable agriculture development without harming public health and environment.

Methodology

The study relies on primary and secondary data sources. Surveys were used to gather primary data from the study area. A structured questionnaire was administered to the Respondents. The participants in the survey included three categories of respondents: farmers (227), farm workers (43) and retailers (30). Surveys were conducted among farmers and farm workers to understand the use of glyphosate on farms. Additionally, surveys were conducted among retailers to understand their involvement in field level use of the pesticide and to know more about famers' decision-making.

The study area was finalized based on preliminary exploration and secondary data. States were identified based on glyphosate usage. Accordingly, seven among 28 States in India were randomly selected. Andhra Pradesh, Jharkhand, Himachal Pradesh, Karnataka, Tamilnadu, Telangana and West Bengal are the states where field survey was conducted.

Sampling

A purposive sampling method was used to select villages/blocks within the selected states. Field researchers/research partners in the respective states identified the blocks/villages based on perception of consumption which is related to cropping pattern were farmers are likely to encounter weed growth and decide on management with herbicides. The field researchers then identified farmers through purposive sampling. Farm workers involved in the application of glyphosate were also identified in the same way. Details of area from where the field data was collected are given in the study area section below. Apart from purposive sampling, snowball-sampling techniques were also used to identify study participants within each category of respondents.

Secondary data

Relevant secondary data was gathered from various official sources. The latest information available on the web sites of Central Government Institutions and Agencies such as Directorate of Plant Protection Quarantine and Storage, Ministry of Agriculture, Cooperation and Farmers Welfare, Government of India was gathered (https://eands.dacnet.nic.in, http://ppqs.gov.in/divisions/cib-rc/registered-products, and http://ppqs.gov.in/divisions/cib-rc/major-uses-of-pesticides) and Indian Council of Agricultural Research (https://icar.org.in).

Approved formulations and approved uses of pesticides in India were compiled from such datasets available in the web site of Directorate of Plant Protection Quarantine and Storage (PPQ&S), Ministry of Agriculture Cooperation, and Farmers Welfare, Government of India. Production and consumption data were gathered from latest information made available on the website, http://ppqs.gov.in.

Provisions of Right To Information (RTI) Act, 2005, were also used to gather important data. Through the provisions of this Act, applications were filed with all the State Agriculture departments in India to collect data on State level recommended use and consumption of pesticides. However, response came from a few States such as Andhra Pradesh, Delhi NCT, Haryana, Himachal Pradesh, Kerala, Madhya Pradesh, Mizoram, and Uttar Pradesh.

Study Area

A brief profile of the States where field study was conducted is given below.

Andhra Pradesh is the south-eastern State of India. The total population is around 53 million. Its economy is mainly based on agriculture and livestock rearing. Farming is the main occupation 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. From Andhra Pradesh, 13 farmers and five farm workers, from Padidempadu village and two pesticide retailers from Kurnool area were interviewed from Kurnool District (Kurnool block) for this study.

Jharkhand is an eastern Indian State, which accounts for 40% of the mineral resources of India. The total population is around 32 million. Nearly 30% of the total population belongs to tribal communities. Agriculture is the employment and primary income generating activity for 80% of the rural population of the state. The agricultural economy of the Jharkhand state is characterized by dependence on nature, low investment, low productivity, mono-cropping with paddy as the dominant crop. Other major crops are sugarcane, cotton, jute, tea, vegetables, etc. Twenty-four farmers and four farm workers and 11 pesticide retailers were interviewed from Bero Block (Bhauwardah, Kesa, Mukumda, Bhainsadon, Karanji, Tengariya and Punapani villages) in Ranchi District, and Bhitha village of Bhandra Block in Lohardaga District for this study.

Himachal Pradesh, the north Indian state, is a mountainous region that lies in the lap of Himalayas. The total population is around 7 million. Agriculture, including horticulture and animal husbandry, are the main occupation of people in this State. Wheat, barley, paddy, maize, potato, apple, ginger, and vegetables are the major crops in this state. Fifteen farmers and five farm workers were interviewed from Mandi District (Chalharg village in Jogindernager block; Suja, Baggi, Chauntra in Chauntra block; and Padher villages in Padher block) and Kangra District (Bhara Gra, Bir and Madher villages in Baijnath block; Khoti Khor village in Multhan block; and Bandia, Palmapur, and Kandbari vilages in Palampur block) in Himachal Pradesh for this study.

Karnataka is a state in southwest India with Arabian Sea coastlines. The population in Karnataka is around 65 million. For many rural residents of Karnataka, agriculture is the major occupation. A total of 123,100 km² of land is cultivated in Karnataka, 25.3% of the total geographical area of the state. The main crops grown here are rice, ragi, jowar, maize, and pulses (Tur and gram) besides oilseeds and a number of cash crops such as cashew, coconut, areca nut, cardamom, chillies, cotton, sugarcane, and tobacco. Karnataka is the largest producer of coarse cereals, coffee, raw silk, and tomatoes among the states in India. Fifty-one farmers and ten farm workers were interviewed from Shettahalli, Mikkere, H H Koppalu, Sujjaluru, Kyathanahalli, Shettahalli, Ragibommanahalli, Kyathanahalli, Nelamakanahalli, Nagegowdanadoddi, villages in Malavalli block; Annur, Byadarahalli, Bharathinagar villages in Maddur block; and Bhookanakere, Vitalapura, Alambadikaval, Vitalapura, Bellenahalli, villages in K. R Pete block from Mandya District.

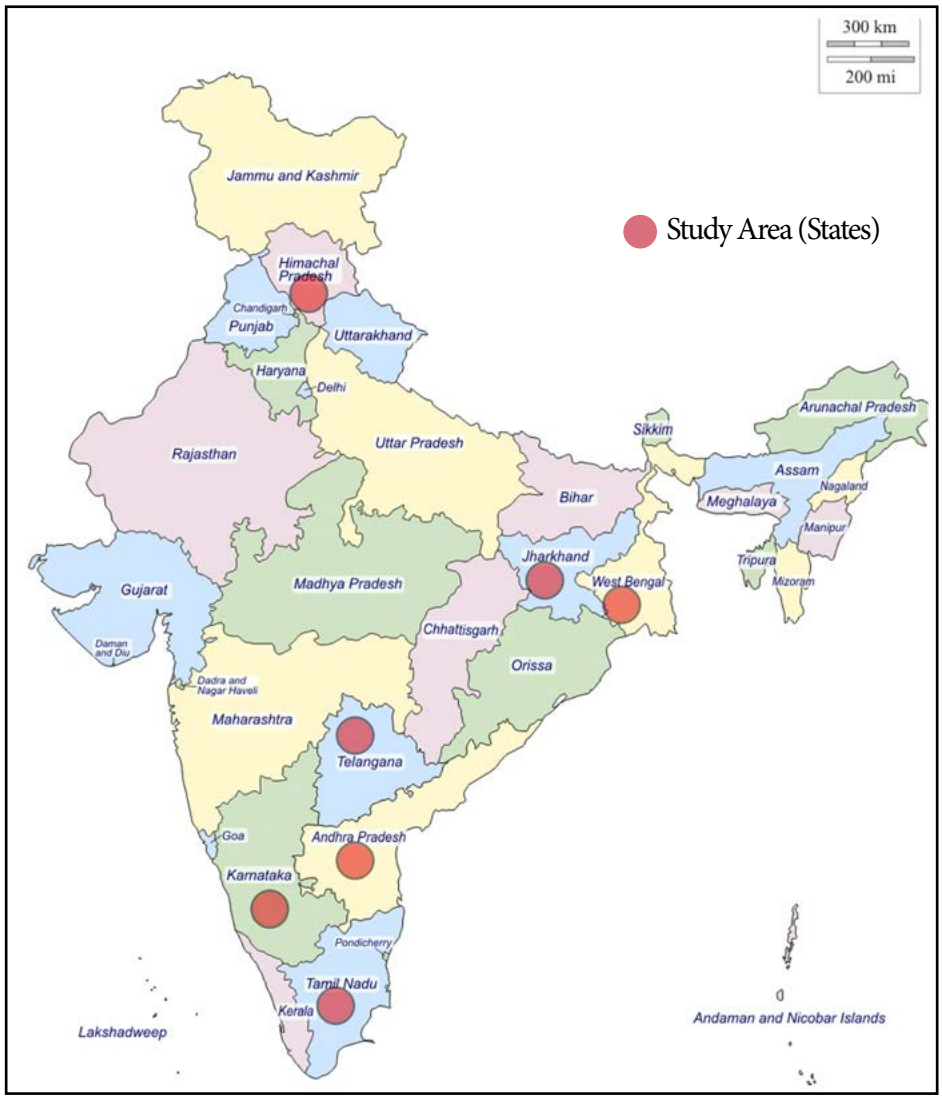
Tamilnadu is the southernmost part of peninsular India along the coast of Bay of Bengal. The population is around 68 million. Agriculture continues to be the most predominant sector of the State economy, as 70 percent of the population is engaged in agriculture and allied activities for their livelihood. Cereals, millets, pulses, vegetables, and fruits are the major crops grown in Tamilnadu. Fifty four farmers were interviewed from Karur District

(Nachalur, Inungur, Oonthampatti, Koilmedu, Akkad, Seplapatti villages in Kulithalai block; Kallai and Kavalkaranpatti villages in Thogamalai block) and Trichy District (Kalingankadu, Kalingapatti, and Sunnmbukaranpatti villages in Srirangam block) Tamil Nadu for this study.

Telangana is a south Indian State with a population of around 37 million. The majority of the population is dependent on agriculture and allied sectors for livelihood. Rice is the major food crop. Other important local crops are cotton, sugar cane, mango, and tobacco. Recently, crops used for vegetable oil production, such as sunflower and peanuts, have gained favour. Twenty farmers, four farm workers, and six pesticide retailers were interviewed for this study from Jangaon District (Basireddypalli, Laxmapur, Kesireddypalli, Kodavatoor villages in Bachnnapet block) and Rangareddy District (Kummari guda and Urella villages in Chevella block) in Telangana.

West Bengal is located in the eastern part of India and is the nation's fourth-most populous state. The total population is around 91 million. 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. Fifty farmers, 20 farm workers, and six pesticide retailers were interviewed from Bankura District (Belua, Basia, Iccharia, Bidyadhar Pur, and Rapat Gange villages in Sonamukhi block and Chanuya, Gouranga para, Merja pur, Tantulmuri, Uttar Ghos Para villages in Kotulpur block) in West Bengal for this study.

Map showing the States where field study was conducted



3. PROFILE OF GLYPHOSATE

Glyphosate (CAS number 1071-83-6) is one of the most widely used weed killer chemicals in the world. A Swiss chemist, Dr Henry Martin, discovered it in 1950 (Dill, et al., 2010). and later a Monsanto scientist identified its herbicidal property (Duke and Powles, 2008). Glyphosate was patented in 1971 in the United States as herbicide. It was made commercially available in 1974 and suddenly it became one of the leading agrochemicals in the market (Mesnage and Antoniou, 2017). Glyphosate is now widely available from many manufacturers under numerous trade names as its patent expired in 2000.

Chemically it is a phosphonoglycine compound, basically in acidic form, but commonly used in salt form. It is a non-selective, post-emergent herbicide, used for both agriculture and non-agriculture purposes. Around the world, glyphosate is used for the control of annual and perennial plants including grasses, sedges, broad-leaved plants, and woody plants.

Glyphosate has a systemic mode of activity. When applied to growing plants, it is absorbed by foliage and translocated to the roots. It is mobile in the phloem and is readily translocated throughout the plant (Franz et al.,1997). From the leaf surface, glyphosate molecules are absorbed into the plant cells were they are translocated to meristematic tissues (Laerke, 1995). It works by stopping the plant from producing an enzyme it needs to make protein for proper growth (disrupts the shikimic acid pathway through inhibition of enzyme); this results in wilting and death of plants within ~7-10 days (Deborah Smith-Fiola and Stanton Gill, 2017). Glyphosate's primary action is the inhibition of the enzyme 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS), a chloroplast-localized enzyme in the shikimic acid pathway of plants (DellaCioppa et al., 1986). This prevents the production of chorismate which is required for the biosynthesis of essential aromatic amino acids. These acids are used by plants in protein synthesis and to produce many secondary plant products such as growth promoters, growth inhibitors, phenolics, and lignin (Franz et al., 1997).

Glyphosate also affects soil microorganisms. After glyphosate is absorbed through the foliage, it is translocated within the plant, down to the roots, and released into the rhizosphere (soil surrounding the roots) (Kremer and Means, 2009), where it disrupts the soil and root microbial community. As much as 80% of glyphosate absorbed after foliar application is translocated to the shoot apex and root tips (Cakmak et al., 2009).

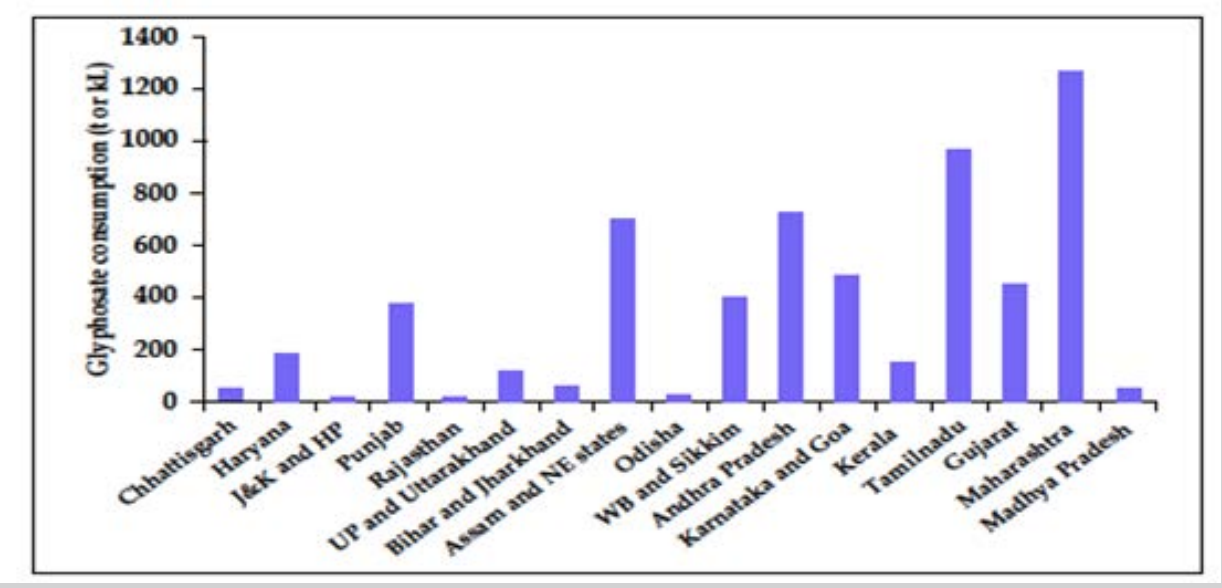
Studies have shown that glyphosate lowers photosynthesis ability of plants by reducing chlorophyll content and impairing carbon metabolism (Mateos-Naranjo and Perez-Martin, 2013; Kitchen et al., 1981; Pline et al., 1999; Eker et al., 2006; Kremer and Means, 2009). Decreased concentrations of calcium, magnesium, iron and manganese observed in non-glyphosate resistant soybean seeds which indicate glyphosate interference in nutrient dynamics in plants (Cakmak, et al., 2009). Glyphosate formulations may contain a number of so-called 'inert' ingredients, most of which are not publicly known. It has been reported that many of the inert ingredients and contaminants in glyphosate results in increased toxicity to non-target organisms (Watts et al., 2016).

Glyphosate by itself is still toxic, causing a wider range of effects on humans and the environment. Because of the inert ingredients, exposure to a glyphosate-based herbicide entails exposure to a wide range of other chemicals as well as the glyphosate, about which little information is available and the full health effects of which have not been established. Some, such as POEA (polyoxyethylene alkylamine;), are known to be more acutely toxic than glyphosate itself. Others are clearly capable of causing serious chronic effects (Watts et al., 2016).

Glyphosate Use in India

Generally, herbicide usage has increased in India. The rise in farm labour wages has contributed to increased consumption of herbicides (Manish and Saurabh, 2017). Meager literature is available about the use of glyphosate in India. Glyphosate has been approved for controlling weeds in tea and its non-crop areas. Glyphosate-based formulations are widely used in India in agriculture, forestry, urban areas, and aquatic bodies (Samanta, et al., 2019) in non-tea growing states/areas as well. An Indian Council of Agricultural Research's report reveals that two formulations of glyphosate, 41% SL and 71% SG are widely used in at least 22 Indian states for a number of cereals, pulses, oilseeds, fruits, vegetables, fiber crops, etc. About 52 brands of four glyphosate formulations have been reported (Choudhary et al. 2016). Moreover, glyphosate formulations have been used for removing unwanted plants in courtyards of houses and institutions such as schools and offices, roadsides, railway tracks[3], etc. This means that this herbicide is widely used in India not only for its approved uses but also for a range of other farm and non-farm uses. Thus the users are not only farmers but also other sectors in the society including non-farming households as well as offices and institutions. The widespread use of illegal herbicide tolerant (HT) cottonseeds is one reason for increasing the usage of glyphosate-based herbicides in India[4]. A study conducted by PAN India in 2017 noted the use of glyphosate in cotton fields in the Yavatmal district in Maharashtra (Narasimha Reddy. and Dileep Kumar, 2017). As illegal HT cotton has invaded many of the cottonseed markets and supply chains in India, farmers themselves may not be able to identify HT and non-HT varieties, and therefore, application of glyphosate on non-HT cotton leading to crop destruction could be a disaster. As glyphosate is not approved for cotton in India and considering its huge use and anticipating public health and environmental issues, some states such as Maharashtra, Telangana, Punjab, Andhra Pradesh, and Kerala states tried to temporarily restrict its usage but ended up with little effectiveness.

Glyphosate use in various states in India.



Source: Choudhary et al. 2016

The Safety and Hazards data provided in the PubChem database, based on Globally Harmonised System Hazard Statements, state that glyphosate causes serious eye damage (danger serious eye damage/eye irritation), may cause respiratory irritation (warning: specific target organ toxicity, single exposure; respiratory tract irritation), may cause drowsiness or dizziness (warning: specific

[3] https://www.downtoearth.org.in/coverage/agriculture/the-real-weed-61174
[4] https://timesofindia.indiatimes.com/city/nagpur/cancerous-glyphosate-sale-curbed-cos-licence-intact/articleshow/65445382.cms

target organ toxicity, single exposure; narcotic effects), very toxic to aquatic life (warning: hazardous to the aquatic environment, acute hazard), and very toxic to aquatic life with long-lasting effects (warning: hazardous to the aquatic environment, long-term hazard) (Pubchem 2004). However, according to the WHO classification of pesticides based on acute toxicity, glyphosate belongs to Class-III Slightly Hazardous category. But, according to Pesticide Action Network International's list of Highly Hazardous Pesticides, glyphosate is a highly hazardous pesticide, because of its classification as a carcinogen. In 2015, the International Agency for Research on Cancer has classified glyphosate as a probable human carcinogen. A PAN International monograph on glyphosate shows numerous research studies pointing to chronic toxic effects of glyphosate other than cancer, such as reproductive and developmental toxicity, neurotoxicity and immunotoxicity; and also the hormone disrupting properties of the glyphosate based product called 'Roundup'. (Watts et al., 2016). PANAP included it in their Terrible Twenty (T20) pesticides that can cause much harm to children.

According to the International Chemical Safety Card, glyphosate exposure can cause cough, redness in skin, redness and pain in eyes, burning sensation in throat, and chest (ICSC:0160). Ingestion of glyphosate can cause erosion of the gastrointestinal tract, dysphagia or difficulty swallowing, and gastrointestinal haemorrhage. Inhalation of spray mist may cause oral or nasal discomfort, as well as tingling and throat irritation. (Bradberry, et al. 2004; Talbot, et al. 1991). Signs and symptoms of exposure include irritation, swelling, tingling, itching or burning of the skin, photo-contact dermatitis, recurrent eczema, blisters, rashes; numbness in the face, swelling of the eye and lid, face, and joints; conjunctivitis, painful eyes, corneal injury, burning eyes, blurred vision, weeping eyes; oral and nasal discomfort, unpleasant taste, tingling and irritation of throat, sore throat; difficulty breathing, cough, coughing of blood, inflammation of lungs; nausea, vomiting, headache, fever, diarrhoea, weakness; rapid heartbeat, palpitations, raised blood pressure, dizziness, chest pains. Numerous occupational exposures and self poisoning with death have been reported for glyphosate (Watts et al 2016). A Beyond Pesticides fact sheet on glyphosate noted various health effects associated with glyphosate. They are; irritation to eye and skin, non-Hodgkin's lymphoma and spontaneous abortions; and reproductive and developmental anomalies are also reported for other ingredients in formulated products (Beyond Pesticides, 2017). Gastrointestinal effects, developmental effects, endocrine/hormonal effects, body eight effects, renal effects, hepatic effects, haematological effects, and reproductive effects are the various toxicity effects identified in animal studies (ASTDR, 2019).

Residues of glyphosate have been found in bread, flour, wheat, barley, bran, oats, breakfast cereals, cereal bars, polenta strawberries, lettuce, carrots, soy, wild berries, and drinking water (Watts et al 2016). Residues were also reported in human urine samples (Acquavella et al 2004; Brändli and Reinacher 2012).

Glyphosate is a wide spread environmental pollutant in both aquatic and terrestrial ecosystems. It pollutes water and soil and results in degraded soil quality. Glyphosate is toxic to soil microorganisms. Decreased earth worm and microbial population, as well as reduced soil dehydrogenase activity, are reported (Sebiomo, et al. 2011; Cycon, Piotrowska-Seget, 2007, Schreck et al., 2008). Weed resistance to glyphosate was reported in 35 species of weeds from 27 countries. (Watts et al., 2016).

Glyphosate has been severely restricted[5] in more than 35 countries, including them are Sri Lanka, Netherlands, France, Colombia, Canada, Israel, and Argentina. However, the Anupam Varma Committee constituted by Ministry of Agriculture, Government of India in 2013 with the mandate to review certain pesticides including those banned or restricted in other countries and still used in India did not include glyphosate for the review.

[5] https://www.baumhedlundlaw.com/toxic-tort-law/monsanto-roundup-lawsuit/where-is-glyphosate-banned/

Glyphosate Poisonings in India

Limited literature is available on glyphosate poisonings in India. Though attempts were also made to collect any official data on poisoning cases caused by Glyphosate from all the Indian states as well as Union Government through the provisions of RTI 2005, little data has been received. The use of glyphosate for self-poisonings in India was reported in a study as contributing about 10 percent of the herbicide poisonings cases reported in a medical college hospital in the Himachal Pradesh (Raina, et al., 2019). Two self-poisoning cases involving glyphosate were reported from Nagpur Medical College in 2014 (Thakur, et al., 2014) and 2018 (Khot, et al., 2018). The unrestricted assess and a wider availability of glyphosate-based herbicides in India, and poor pesticide poisoning monitoring might have been contributing to unreported or unrecognized occupational poisonings/ self poisonings in India.

Global risk assessments and regulatory developments on Glyphosate

Glyphosate has been extensively used as a non-selective herbicide in farm and non-farm areas globally both by farmers and non-farmer users[6] (Meftaul, et al., 2020). The topic of an association between glyphosate and cancer became a burning discussion globally after the International Agency for Research on Cancer classified it as probably carcinogenic to humans in 2015 (IARC, 2015). Though the EU's comprehensive scientific assessment of industry studies presents a different view and says 'glyphosate is unlikely to pose a carcinogenic hazard to humans', the European Commission brought in restrictions for its use in 2016 and a requirement to assess it again in 2023 (EC, 2015). While there are differing views on the carcinogenic potential of glyphosate from various global regulatory and health institutions, a 2019 report titled 'Toxicological Profile for Glyphosate' from the Agency for Toxic Substance and Disease Registry (ATSDR) of the United States Department of Health and Human Services supports the findings of IARC that there are links between glyphosate and cancer (ASTDR, 2019). So far, more than 42,000 lawsuits have been filed against Monsanto (now Bayer after it bought out Monsanto) alleging that the herbicide Roundup (which has glyphosate as a key ingredient) caused cancers, arguing that Monsanto suppressed such critical data. Studies linking glyphosate with fertility and reproductive concerns, and liver toxicity were also coming to light in the meantime, further raising questions on its safety (Stacy Malkan, 2020).]

[6] https://www.glyphosate.eu/useful-information/uses/

4. LEGAL FRAMEWORK OF GLYPHOSATE USE IN INDIA

In India, pesticides are regulated by various government agencies. The Central Agriculture Ministry regulates the registration, manufacture, sales, transport and distribution, export, import, and use of pesticides through the Insecticides Act, 1968, and the Insecticides Rules 1971. In effect, two different bodies, namely the Central Insecticides Board and Registration Committee (CIB & RC, under the Ministry of Agriculture) and the Food Safety and Standards Authority of India (FSSAI, under the Ministry of Family welfare), govern pesticide regulation. The Central Insecticides Board is responsible for advising the Central and State governments on technical issues related to the manufacture, use, and safety of pesticides. In addition, CIB&RC approves uses of various types of pesticides depending on their toxicity and suitability, the shelf life of pesticides, and a minimum gap between the pesticide application and harvest of crops (waiting period) as per label claims. The Registration Committee (RC) is responsible for registering pesticides after verifying the claims of the manufacturers or importers or formulators related to the efficacy and safety of relevant pesticides. The Registration Committee also gives approval for the use of pesticides for specific crop-pest combinations. Further, State Agriculture Departments, Commodity Boards, and agencies give recommendations for the use of pesticides through crop advisories and extension services.

Approval of glyphosate for 'non-crop area' is a tricky statement as it does give a notion to use it all places where crops are not grown or farming is not happening. An order issued by the Director of Agriculture, in the State of West Bengal, quoting the Secretary of Department of Agriculture, Cooperation and Farmers Welfare, Government of India states that glyphosate formulations are 'registered to be used in Tea Plantation Crop and non-plantation area accompanying the Tea crop and any use beyond this is illegal and in violation of the Insecticides Act, 1968 and Rules, 1971[7]' .

Table 1 Approved uses of glyphosate in India

Sl no	Formulations	Approved crops	Waiting period
1	Glyphosate 20.2% SL IPA (Isopropyl-amine) salt	Non Crop area	NA
2	Glyphosate 41% SL IPA Salt	Tea and Non crop area	21 days (for tea)
3	Glyphosate 54% SL (IPA Salt)	Non crop area	NA
4	Glyphosate Ammonium Salt 5% SL	Tea and Non crop area	7 days (for tea)
5	Glyphosate 71% SG (Ammonium Salt)	Tea and Non crop area	7 days (for tea)
6	Glyphosate 30.82% EW + Carfentrazone ethyl 0.43%	Tea and Non crop area	7 days (for tea)
7	Glyphosate (Isopropyl amine salt) 41% SC (w/w) + Oxyflurofen 2.5%	Tea	14 days

[7] Government of West Bengal, Order dated 14th June 2019, Memo No: 744/PSJ

Glyphosate formulations and approved use in India

Five individual formulations and two combination formulation of glyphosate have been approved for use in India. Among, two formulations (20.2%SL and 54%SL) are approved only for non-crop area weed control. Three individual formulations and one combination formulation have been approved for weed control in tea as well as non-crop area, and the remaining combination formulation is approved for weed control in tea. The CIB&RC has given a waiting period for pesticides with respect to different crops and formulations. It is the time interval to be observed in any crop between the last pesticide application and harvest. In the case of glyphosate, different waiting periods has been noted, ranging from 7 days to 21 days.

Use of pesticides as recommended by State Agriculture Departments (SAD)

Through the provisions of RTI act, uses of glyphosate as recommended by various State agriculture departments were gathered and are presented in the table given below.

Among the 14 States that provided information on RTI application, 10 States have given data on recommended uses of pesticides. The State Agriculture Departments (SAD) have recommended glyphosate for crops, which are not even approved by the Central Insecticide Board and Registration Committee.

Glyphosate has been recommended in states for control of perennial weeds in field crops, orchard crops, tea and non-crop areas, weed control in all crops before the cultivation of barren lands, controlling broadleaved and grassy weeds and for weed control in crop boundaries as well as used on cotton to bring fast maturing of bolls at the time of last picking, may be as a desicant. However, glyphosate formulations are approved in India only for weed control in tea plantations and for its non-crop areas.

Table 2 List of crops/uses recommended by SAD

Glyphosate
Control perennial weeds in field crops, orchard crops, tea, non crop area, weed control in all crops, before the cultivation of barren lands; used on cotton to bring maturity at the time of last picking, controlling broadleaved and grassy weeds, grassy and crop boundaries, etc.

Source: Compiled from responses obtained from SAD and through the provisions of RTI Act, 2005.

REGULATION OF GLYPHOSATE IN INDIA

Glyphosate is registered for use in India under the provisions of Insecticides Act, 1968. According to the approved uses of Registered Herbicides in India glyphosate is approved for weed control in the crop tea only, and for its non-crop area as well. The waiting period has been set for certain formulations and certain crops. The FSSAI has set MRLs for glyphosate for tea (1mg/kg), rice (0.01mg/kg) and meat and meat products (0.05mg/kg) (FSSAI, 2017). Though glyphosate has been restricted in a couple of countries, Anupam Varma committee constituted with the mandate to review such pesticides did not review glyphosate. Many states in India have come up with stringent measures to ban or restrict glyphosate over the concerns of public health, which are summarised below.

State level efforts towards Regulating Glyphosate Use

Andhra Pradesh

Realising there was injudicious use of glyphosate and related implications for cultivated crops and aquaculture, the Agriculture and Cooperation Department, Government of Andhra Pradesh issued an order on 9th February 2018 to comply with the approved use of glyphosate, that is for tea garden and its non-crop area (G.O. Rt. No. 69, dated 09.02.2018. Agriculture and Cooperation Department, Government of Andhra Pradesh).

Kerala

The Kerala Agriculture Department cancelled licenses for distribution and sales of glyphosate in the State (G.O.No. T.Q.(1)19361/2019, Department of Agriculture, Government of Kerala). The Department issued an order on 24th May 2019, in a bold move. Earlier in February 2019, Kerala had temporarily banned distribution, sales, and use of glyphosate in the State. The Agriculture Department responded to cancel the licenses in Kerala over concerns of public health and environmental pollution. The Agricultural University of Kerala had submitted a report to the Agriculture Department demanding immediate action to control and regulate the use of herbicides containing glyphosate as it can cause harmful effects to humans, animals, and soil organisms as well as the development of herbicide-resistant weeds. Following this, the Government of Kerala submitted a report to the Ministry of Agriculture demanding strict regulation of glyphosate-based herbicides. The Kerala government earlier, in 2015, restricted the use of glyphosate, making a prescription from an agriculture officer mandatory for its purchase.

Maharashtra

The Maharashtra government was trying to bring in strict regulation banning glyphosate sale and use in Maharashtra State in late 2017; however, the state was waiting for Central government's decision to move forward. The State could not implement a restriction as the Central government did not act upon their request.

Punjab

The Department of Agriculture and Farmers Welfare in Punjab issued an order to stop sales of glyphosate formulations and concentrated products and cancel licenses on glyphosate products on 23rd October 2018. The order noted, in acknowledgment of the approved use of glyphosate, that its use in the state is not relevant as the crop approved for glyphosate use is not grown in the state. Thus glyphosate is banned in order to comply with the national approved use (Memo No.15/5/16-Agri 2(6)/1670, Punjab Agriculture Department,).

Telangana

The Agriculture and Cooperation Department, Government of Telangana issued orders to not to sell glyphosate-based herbicides for any crops and directed to remove licenses for glyphosate sales. Dealers should not sell glyphosate for use in non-crop areas without a recommendation slip from the concerned agriculture officer (Memo No. 2689/Agri.I(1)/2018 dated 10.7.2018. Agriculture and Cooperation Department, Government of

Telangana). Further, during the last week of July 2019, the Telangana Agriculture Department again issued another order (G.O.Rt.No.273, dated 26th July 2019) for a six month restriction on glyphosate usage – for not using any of the glyphosate formulations in any of the crops until 30th of October, 2019. This order says, "farmers may use glyphosate formulations in non-cropped areas or during the months of November to May with specific recommendation by authorised personnel such as agriculture officer (ADA/ MOA)". A similar order was issued on 29th May 2020.

West Bengal

In order to comply with the approved use of glyphosate, that is weed control in tea plantations and non-cropping areas in tea plantations, the Directorate of Agriculture in West Bengal issued an order to strictly regulate glyphosate use in the State on 14th June 2019. Further, the order also states that glyphosate will not be used in any government research stations, farms, and for government schemes (Memo No. 744/PSJ dated 14.6.2019 Directorate of Agriculture, Government of West Bengal).

Though the above-mentioned steps are being taken, the Ministry of Agriculture and Farmers Welfare in India neither took measures to regulate this chemical nor on its unapproved usages. As glyphosate is widely available across India and indiscriminately used by both farmer and non-farmer users far beyond the approved uses, any restrictions without a comprehensive ban implementation would consequently lead to smuggling, black marketing and illegal uses which may have unprecedented and unacceptable health and environmental outcomes.

Glyphosate applied coffee -peper field in Wayanad, Kerala

5. STATISTICAL DATA ON GLYPHOSATE IN INDIA

The recent statistical data on production, import, consumption, and export made available in the web site of the Directorate of Plant Protection Quarantine and Storage, Ministry of Agriculture and Farmers Welfare was analyzed for glyphosate specific data. Though data on production, import, and consumption is available separately and specific for glyphosate, no data has been noted for export. However, some consolidated data is available for herbicides. The data shows that glyphosate stands at second position in production and consumption among herbicides in India, following 2, 4-D.

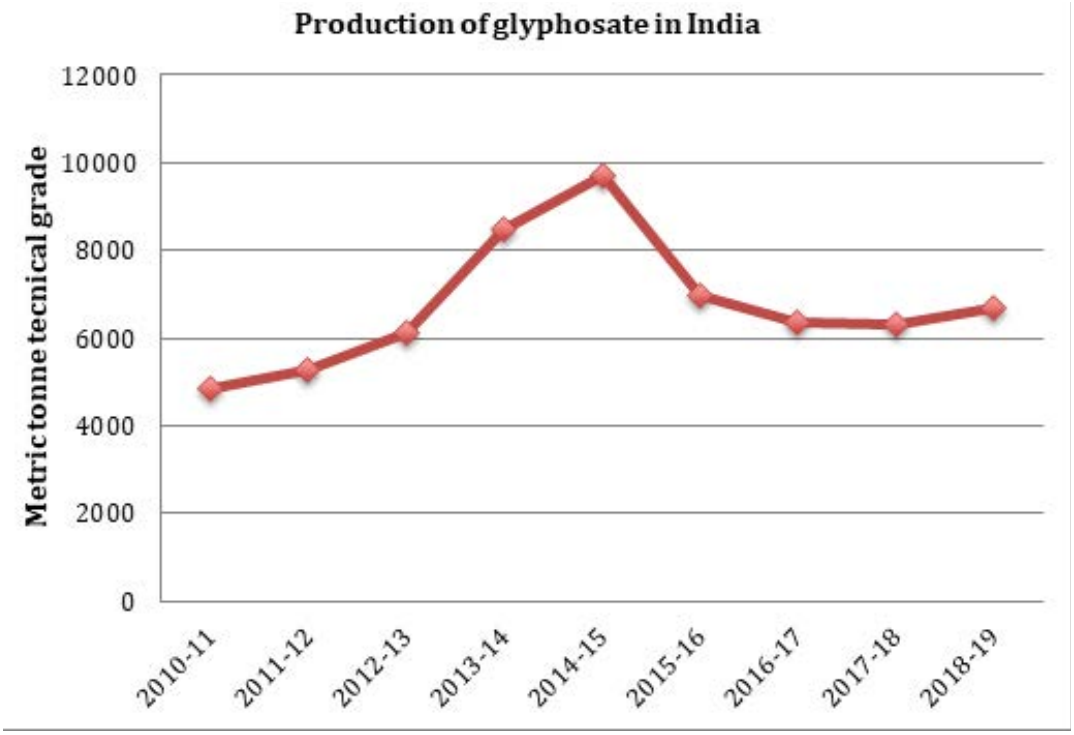
The production data for glyphosate is presented in the table below. Over the past nine years, production of glyphosate showed an increasing trend until 2014-15, but from 2015-16 a decrease in production is noted. However, a slight increase is observed in 2018-19. During 2017-18, glyphosate production was 48.72% of the total installed capacity[8] .

Table no. 3 Glyphosate Production in India, in Metric tonne Technical Grade, as on 18th July 2019

Year	2010 -11	2011-12	2012 -13	2013 -14	2014-15	2015-16	2016 -17	2017 -18	2018 -19
Production	4860	5253	6120	8478	9690	6960	6352	6294	6684

Source: Statistical Database, Pesticide Monitoring and Documentation Unit, PPQ&S, Ministry of Agriculture, Government of India.

Chart 1 Glyphosate production trend in India



Source: Compiled based on data provided in web site PPQ&S, production of key pesticides during 2010-11 to 2018-19.

[8]Chemical and Petrochemical Statistics at a Glance-2018, Government of India

Sources of Import and Indigenous Manufacturers of glyphosate in India

According to the approved sources of import and indigenous manufacturers of pesticides as obtained from the document Compendium of Registered pesticides, source of supply and list of manufacturers under Section 9(3) of the Insecticides Act, 1968 – dated 31st October 2019 – six companies including the multinational giant Monsanto are approved as sources of import for technical grade glyphosate of 95% minimum and glyphosate IPA salt technical 62% minimum. For the same chemicals, 35 companies are approved to manufacture indigenously.

Table 4 Sources of import and indigenous manufactures of pesticides for glyphosate

Common Name	Approved Source for Import	
Glyphosate Tech. 95% min.* Glyphosate IPA Salt Technical 62% min.	1. Monsanto Chemicals Co. Ltd., USA 2. Hebei Golhil Chemical, Co. Ltd, Tongda Road, Jinzhou city, 052260, Hebei, China Through supplier Hebei Bestar commerce and Tradel co. Ltd., 148, East Yuhua Road, Shejiazhuang, 050031, China (95% Min) 3. Cheminova A/s P.O Box 9, DK-7620, Lemvig, Denmark. 3. M/s Hubei Sanonda Co. Ltd., 93, East Beijing Road, Jingzhou, 4. Hubei, China 434001. Change to M/s ADAMA ltd, 93, East Beijing Road, Jingzhou, Hubei, China 434001. Through supplier: M/s ADAMA Fehrenheit B. V, Curacao Branch, (Valid upto-07/06/2022), (By M/s ADAMA India Pvt. Ltd. . 95% min. in 408th RC.) 5. M/s Jiangxi Jinlong Chemical Co. Ltd. Tashan Industrial Park of Leping City of Jiangxi Province, China with supplier name M/s Willowood (Hangzhou) Co. Ltd. Room No. 2003, Golden Plaza No. 118, Qingchun Road, Xiacheng, District, Hangzhou City, Zhejiang Province, China	1. Atul Ltd., Valsad 2. Excel Crop Care Ltd. Ltd., Mumbai 3. Gharda Chemicals Ltd., Mumbai. 4. Chemtura Chemicals India Pvt. Ltd 5. Ravi Organics Ltd. 6. Meghmani Industries Ltd. 7. Insecticide India Ltd. 8. Crystal Phosphates Ltd 9. Hyderabad Chemicals Products Ltd., Hyderabad 10. Krishi Rasayan Pvt. Ltd., Kolkata 11. United Phosphorus Ltd., Vapi 12. Punjab Chemicals & Crop Protection Ltd 13. Rotam India Ltd 14. G S P Crop Science Ltd 15. Siris Crop Science Ltd., New Delhi 16. Jai Shree Rasayan Udyog Ltd, Nathupur, Sonepat (Haryana) 17. Heranba Industries Ltd, Mumbai 18. Shivalik Rasayan Ltd, New Delhi 19. Sharda worldwide Exports Pvt Ltd, Mumbai 20. Cheminova India Ltd., Gujtrat 21. Sabero Organics Gujarat Ltd. 22. Bharat Rasayan Ltd., Delhi (95%) 23. Exel Industries Ltd., ROHA (Maharastra)

	6 Nantong Jiangshan Agrochemical & Chemicals Limited Liability Co., No. 998 Jiangshan Road, Nantong Economic & Technological Development Zone, Nantong, Jiangsu, China with supplier name M/s Sinochem International Corporation, 19/F, Jinmao Tower, No. 88 Century Boulevard Pudong New Area, Shanghai 200121, P.R. China. (By M/s Sinochem India Company Pvt. Ltd., New Delhi)	24. HPM Chemicals & Fertilizers Ltd., N. Delhi 25. Maheshwari Biochemical Pvt. Ltd., Sirsa 26. Best Crop Science LLP, Gajraula, UP 27. Sonachi Industries Ltd 95.0 % min. 9(4) 28. Samradhi Crop Chemicals, 95.0 % min. 9(4) 29. Sun Pesticides Pvt. Ltd 95.0 % min. 9(4) 30. Hemani Industries 95.0 % min. 9(4) 31. Agrisol (India) Pvt. Ltd., , 95.0 % min. 9(4) 32. Agrico Organics Ltd., New Delhi, 95.0 % min. 9(4) 33. Baroda Agrochemials Ltd., Gujarat, 95.0 % min. 9(4) 34. M/s Aristo Biotech Life Science Pvt. Ltd., 95.0 % min. 9(4), in 401st RC. 35. M/s Ichiban Crop Science Ltd., 95.0 % min. 9(4), in 405th RC.

Ref: Source of import and list of indigenous manufacturers of insecticides, as on 31st October 2019 Compendium of Registered pesticides, source of supply and list of manufacturers under Section 9(3) of the Insecticides Act, 1968
http://ppqs.gov.in/sites/default/files/source_of_import_31.10.2019.pdf

Consumption of glyphosate in India

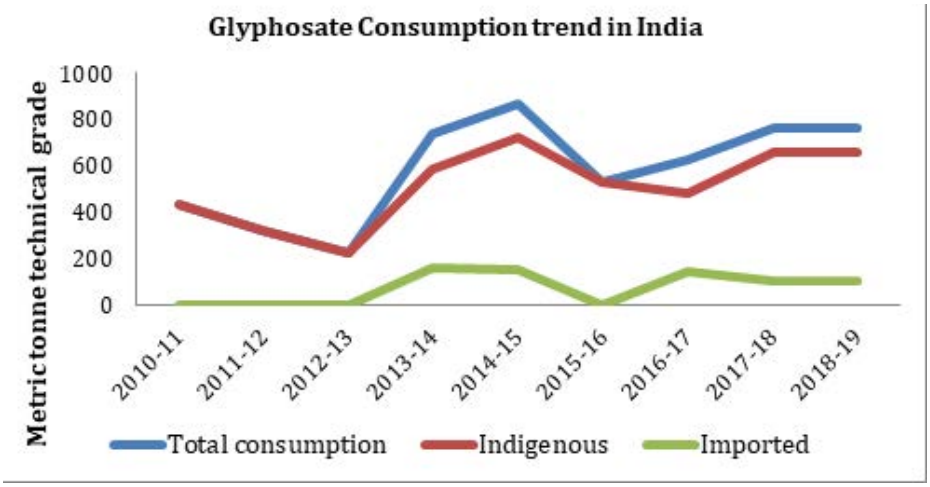
Consumption data over the past nine years shows that both indigenous and imported glyphosate is used in India. The major contribution to consumption is found to be from indigenous production.

Table 5 Consumption of glyphosate in India (in M.T. Tech. Grade) As on 10.05.2019

Year	2010-11	2011-12	2012-13	2013-14	2014 - 15	2015 -16	2016 - 17	2017 -18	2018-19 (Provisional)
Indigenous	433	320	220	582	718	529	479	654	661
Imported	2	-	-	157	148	-	146	104	104
Total	435	320	220	739	866	529	625	758	765

Source: Statistical Database, Pesticide Monitoring and Documentation Unit, PPQ&S, Ministry of Agriculture, Government of India.

Chart no. 2 Glyphosate consumption trend in India



The export data for glyphosate is not available in the public domain, though consolidated figures are available for weedicide/herbicide exports. A huge data gap is noted among the available data sets for production and consumption (see table 3, 5, and 6). As no export data is available in the public domain, it could be assumed that the quantity of glyphosate as noted as data gap, would have either been exported, or used for domestic consumption, but unreported or underreported.

State wise consumption data of Glyphosate for 2016-17 (obtained through RTI application)

RTI applications were sent to all the 29 States and National Capital Territory (NCT) in India; relevant data were obtained from 17 states only. Among, consumption data was given by 10 states and is provided in the table given below. Different states have given data in different units such as in metric tonne technical grade and kilogram or liter, and hence it is difficult to get a cumulative, and precise consumption figure.

Table 7 State wise consumption data of glyphosate

State	Glyphosate
Andhra Pradesh (Mt. tech grade)	32.793
Delhi NCT* (liters)	90,000
Haryana (kg)	1600
Himachal Pradesh (Mt tech grade)	3.71
Kerala (Mt tech grade)	86.259
Madhya Pradesh* (Mt tech grade)	42
Mizoram (Mt)	1.254
Nagaland* (liter)	45000
Uttar Pradesh (kg/liter)	32484
Haryana (kg/liter)	398384

*Data for the last 10 years

Table 6 Data gap noted for glyphosate statistics

Year	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Data gap (Production + import – total consumption=)	4427	4933	5900	7896	8972	6431	5873	5640	6023

Table 8 Different brands of glyphosate used in India

A total of 35 brands have been reported
Allkill, Azad, Bound off, Brake (Biostadt), Brake up (Plant Rem), Cedar, Clean-up (Indofil), Clean-up, Clinton, Dera, Everspread, Excel Mera71, Fausta, Gladiator (Devidayal), Globus, Glory, Glycare, Glycel (Excel), Glyfokil, Glyfos, Glyphogal SL, Glyphos, Glytaf, Glytech, Kill shot, Nippout, Noweed, Root-up, Round up, Roundup (Insecticide India), Safal (Tropical AS), Safal 71, Srigent (Jayasree Rasayan Udyog), Sweep, Weedoff.

Source: Compiled from Responses obtained SAD through the provisions of RTI Act.

Glyphosate applied vegetable field, From Himachal Pradesh. Photo by Budhi Singh for PAN India

6. OBSERVATIONS FROM FIELD STUDY ON GLYPHOSATE USE IN INDIA

Distribution and demographic details of respondents

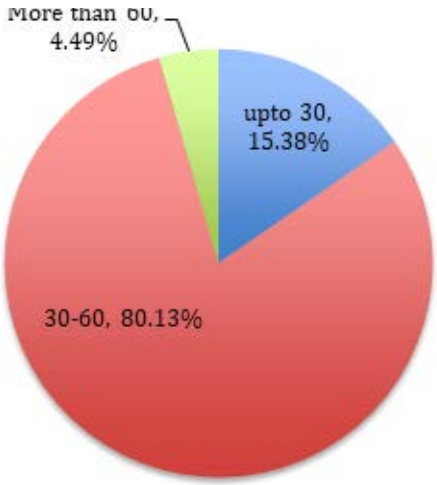
For this study, data has been collected from a total of 300 respondents – farmers, farm workers, and pesticide retailers - from eleven districts across the seven States selected, State-wise distribution of respondents is given in table 9.

Demographic details of farmers

For all of the 227 respondents, farming is the major source of income. More than a third (38.32%) of the respondents are marginal farmers, have landholding less than a hectare; about 43.65 % of the respondents are small scale farmers having a landholding between one and two hectares, and 14.98% of respondents have a landholding more than two hectares. In addition to growing crops in their own land, many of the small-scale farmers also cultivate crops in leased land as well.

Farmers were growing several crops such as paddy, maize, ginger, beans, black gram, tomato, cucumber, potato, mustard, corn, rajma, radish, beets, soybeans, cabbage, cauliflower, okra, vegetables, groundnut, jasmine, sugarcane, leafy vegetables, banana, red gram, cotton, jower, sunflower, marigold, onion, bitter gourd, chickpeas, broad beans, foxtail millet, pearl millet, etc.

Chart 3 Age wise distribution of farmers/ labourers



They have been using several pesticides for many years on their farm. Most of the farmers, except for those who have landholding more than two hectares, utilise family labour in many of their farming operations, with minimum hired workers. A quarter of the respondents have been using pesticides for about 10 years and the rest have been using them for more than 10 years.

Table 9 State wise distribution of respondents

Respondent categories	States							Total respondents
	Andhra Pradesh	Jharkhand	Himachal Pradesh	Karnataka	Tamil Nadu	Telangana	West Bengal	
Farmers	13	24	15	51	54	20	50	227
Farm Workers	5	4	-	10	-	4	20	43
Retailors	2	11	5	-	-	6	6	30

An analysis of the highest educational attainment in the farming households revealed that 12.77 % have family members completed up to matriculation; 25.55% have passed matriculation; 27.31 % have passed intermediate and 26.43% have completed graduation.

Demographic details of farm workers

As part of this study, a total of 43 farm workers from five states –Andhra Pradesh, Jharkhand, Karnataka, Telangana, and West Bengal - were interviewed to assess the practices followed by them. All of them were males and working as daily wage labourers for small and marginal farmers. 39.54% have been in agriculture work for about 10 years and the rest more than 10 or 20 years. They have been involved in pesticide/weedicide mixing and application in farm fields.

Brief profile of retailors

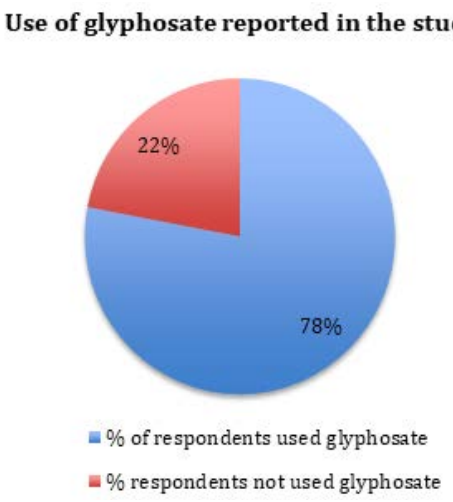
During this study, data were also collected from retailers noted from the Study area. A total of 30 retailers were interviewed from the study area. Except for two states-Karnataka and Tamilnadu - data from retailers was collected from all the remaining five states. All of them were males and their age ranges from 22 to more than 60. About 36.67% retailers were into the business of pesticide trade for about 10 years, 50% retailers for more than 10 years, and the rest did not respond to the questions. When asked about if they have a licence to sell pesticides, nearly 70% retailers said they have obtained a licence from the government, but they seemed to be hesitant to show the same. However, 6.67% retailers said they don't have licence and the rest 23.33% did not respond to the question related to licence.

USE OF GLYPHOSATE

Varied uses of glyphosate were noted in all the seven states in about 20 crop fields and also for general weed control. The use of glyphosate was reported by 77.97% of farmer respondents and 41 % workers respondents. In Karnataka and West Bengal, all the respondents interviewed were using glyphosate. In Andhra Pradesh and Himachal Pradesh, 92.31% and 93.33% respondents respectively were using glyphosate. While, in Telangana, 70% of the respondents were using this weedicide whereas, in Tamilnadu, 51.85% and in Jharkhand 33.33% respondents were using it. Most of the respondents who used glyphosate reported that they use glyphosate usually once a year, however, two to four times of post emergence use were also noted. Many of them reported that glyphosate is applied for pre-emergence weed control, mainly before ploughing. Usually, half to one and quarter kilograms of glyphosate are used per acre. Glyphosate SG is applied in mix with fertilizers such as urea or potash and broadcasted in the field or dissolved in water and sprayed. Glyphosate SL is generally sprayed and sometimes urea is mixed.

It has been found that glyphosate formulations are used for weed control in a wide variety of crops such as banana, beans, bitter guard, brinjal, cauliflower, chilli, cotton, corn, leafy vegetables, maize, okra, onion, paddy, soybean, tomato, snake guard, and wheat. Though seven formulations are approved in India, only three were noted in this study. Glyphosate 41% SL is the widely used one, followed by 71%SG. A couple of respondents have been using a combination formulation glyphosate with oxyflourofen (oxyflurofen 2.5% + Glyphosate (isopropylamime salt) 41% SC for weed control in vegetables, paddy, ground nut and maize. Respondents who use glyphosate for post emergence weed control in vegetables reported that less than two weeks of waiting period is followed between the last application and harvest.

Chart 4 Use of glyphosate reported in the study



Various brands of glyphosate reported from field study

A total of 24 different brands of glyphosate have been reported during the study. The most commonly used formulation, glyphosate 41% SL was noted with 19 different brands across the study area. The other commonly used formulation, glyphosate 71% SG was noted with five brands.

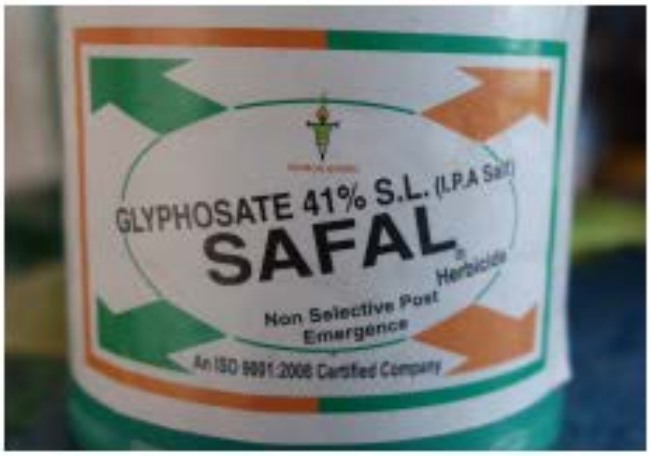
Table 10 Glyphosate brands, manufacturers and crops used for

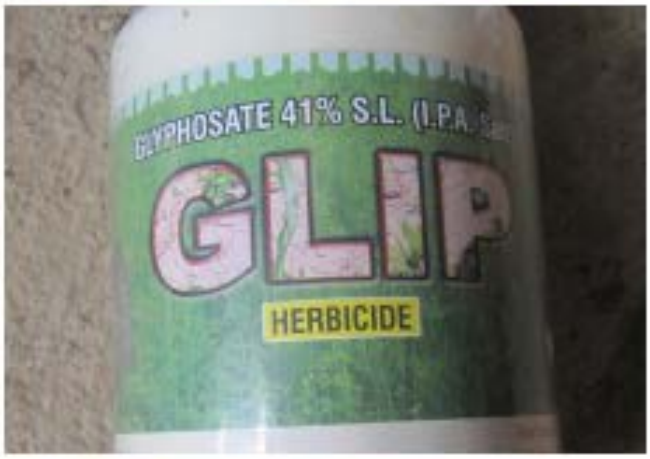
S. no	Brand name	Manufacturer	Crops used for
I. Glyphosate 41% SL IPA salt			Banana, beans, bitter guard, brinjal, cauliflower, chilli, cotton, corn, leafy vegetables, maize, okra, onion, paddy, soybean, tomato, snake guard, and wheat, as well as in floriculture (jasmine)
1	All Kill	Krishi Rasayan	
2	Brake-G	Biostadt	
3	Brake-up	Plant Remedies	
4	Glip	Krishirasayan	
5	Glycel	Excel crop care	
6	Glycid	Kingtech Bio chem	
7	Glycocin	Maharashtra Bio Fertiliser	
8	Glypho	Royal crop science	
9	Glyphogan	ADAMA India	
10	Glysan	Jai Kisan cropcare	
11	Glysate	Bhoocare Foodchem, Vijay Agro industries	
12	Glysil	Crop chemicals India	
13	Hijak	Insecticides India	
14	Noweed	Dhanuka	
15	Root up	Pioneer pesticides	
16	Root out	Bharat insecticides	
17	Roundup	Monsanto	
18	Safal	Tropical Agrosystems	
19	Vinash	Sulphur mils	

II. Glyphosate 71% SG (Ammonium salt)			Mainly used for pre emergence weed control applied before planting or sowing for most of the above-mentioned crops.
1	All Kill	Krishi Rasayan Exports	
2	Brake-G	Crystal Crop Protection	
3	Duster	Ram Sree chemicals	
4	Excel Mera	Excel Crop Care	
5	Star	Swal	

Glyphosate applied brinjal field, from West Bengal. Photo: Bhairab Saini for PAN India

Some brands noted from the study



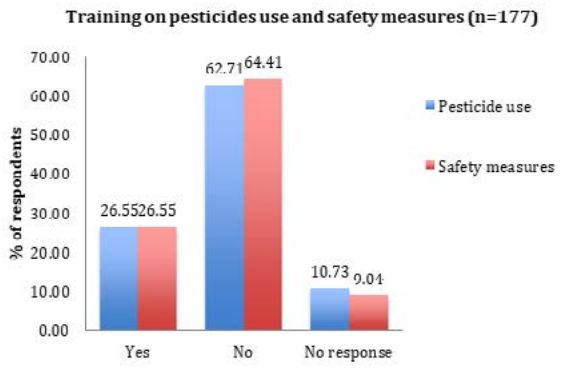


OBSERVATIONS FROM FARMERS

Training and awareness on pesticide use as well as safety measures

To a question asked of respondents on whether they have had received any training or instructions about handling and application of pesticides including glyphosate in the field as well as on the provision of safety measures and personal protective equipment, most of them said 'no'. Only 26.55% respondents reported that they were trained and instructed on glyphosate use and safety measures to some extend. This was mainly noted from the study areas in Himachal Pradesh and Karnataka where such awareness programs were reportedly organised by agriculture offices in the area. However, respondents did not provide further information on how long the training was given, what were the topics covered, etc. A considerable percent of respondents, 62.71% for pesticide use, and 64.41% for safety measures, reported that they are not trained or instructed.

Chart 5 Training obtained on pesticide use and safety measures among farmers

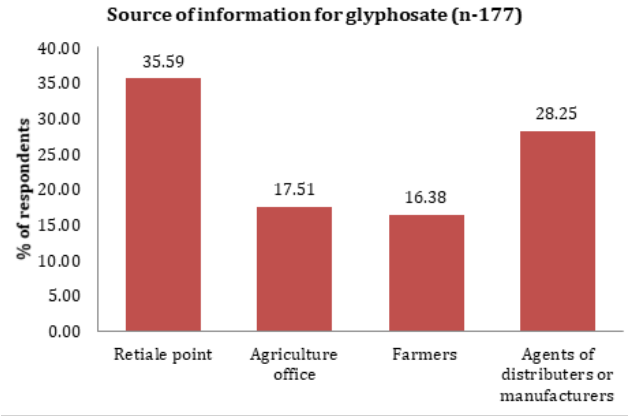


Source of information on glyphosate use

Different sources have been reported from the study area where the farming community is dependent for information and advice on pesticides and their use. They are retailers, agriculture offices, peer farmers, as well as agents of distributors and or manufacturers. This study has revealed that the majority of the respondents are depending upon the advice from retailers and agents of companies or distributors, though a small percentage is dependent on agriculture officers.

The majority of the respondents were depending on the advice of retailers (35.59%) and agents of manufacturers and or distributers (28.25%) for information on use of glyphosate. However, a considerable percentage of respondents were depending on instructions from agriculture officers (17.51%) and other farmers (16.38%). It was evident that the advice given by all these sources was not complying with the approved use. From the field study, it has become clear that these sources, including agriculture officers, have been recommending glyphosate to be used for general weed control in vegetables, other crop fields, and fallow lands as well as non-cropped areas and bushes.

Chart 6 Sources of information on glyphosate use

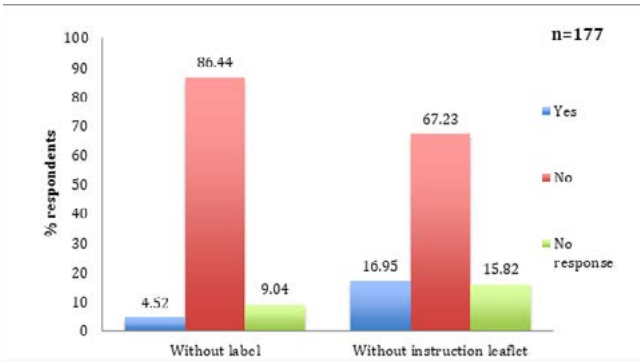


Access to information on labels and leaflets

Most of the respondents had access to product labels (86.44%) and information leaflets (67.23). However, it was noted that a small percentage of respondents were able to get glyphosate products without labels (4.52% respondents) and information leaflets (16.95% respondents). These respondents were mostly from West Bengal and the rest from Andhra Pradesh, Jharkhand, and

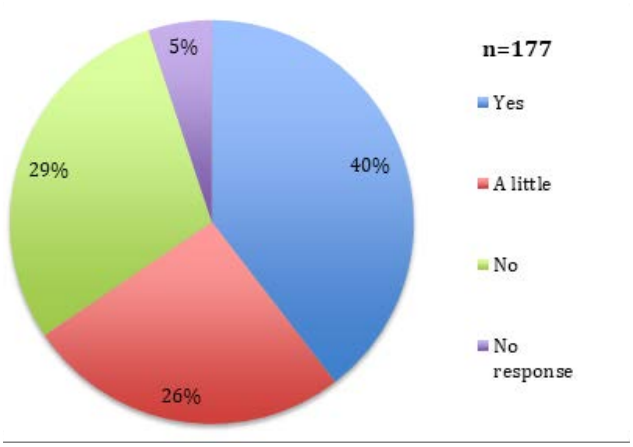
Karnataka. It is a usual practice in West Bengal that retailers sell decanted pesticides in quantities required by marginal farmers either in empty pesticide bottles of plastic carry bags. Many of the respondents did not remember brand names but a few of them said they asked for glyphosate.

Chart 7 Purchase of pesticides with/without product label and leaflet



About 40% of respondents reported that they are able to read and understand labels or instruction leaflets, and 26% reported that they are able to read and understand them 'a little' meaning not fully, the rest (34%) of respondents said 'no'. Respondents said that they try to follow instructions given on labels and leaflets such as keeping pesticides out of reach of children, crops specified, use of gloves and face mask, etc. Among the remaining respondents, 29% reported that they are not able to read and understand what was given in the label or leaflet, and 5% respondents did not respond. For those who were not able to read and understand these information resources, the major reason reported was that either the details are in a very small font size that is unable to be read or they do not know the language, or are unable to comprehend or are illiterate. From the study area, the majority of the respondents said labels and leaflets contained local language in addition to English. However, some respondents in Karnataka said some of the brands contained information only in English and Hindi, but they were unable to recall brand names.

Chart 8 Response to a question asked about whether they are able to read and understand labels/leaflets.

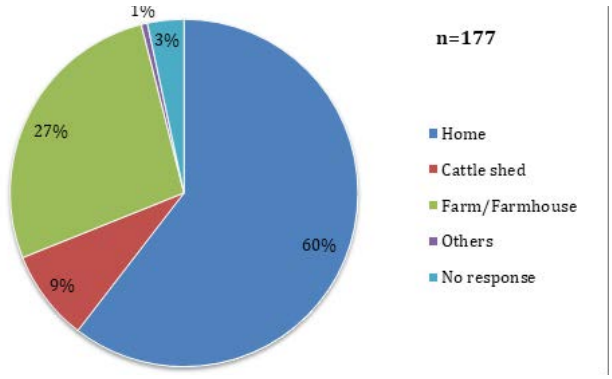


PRACTICES LEADING TO EXPOSURE AND POISONING

There are a number of factors that can lead to exposure to pesticides that result in poisoning. To avoid exposure and poisoning, the government and industry advise certain precautionary measures to be followed. However, field data shows that such precautionary measures are not followed in a proper way. This section of the report focuses on various practices by farmers that can lead to exposures and poisoning, regarding storage, spraying equipments, washing, use of PPE, application time, and working in sprayed fields.

Storage site of glyphosate based herbicides: farmers had to store pesticide containers - freshly bought, partly used, and empty containers - as per their convenience. Different storage sites such as homes, cattle sheds, and farmhouses were noted from the study, with majority of the respondents storing them in the home or home premises. Sixty percent of respondents stored pesticide containers within house premises (kitchen, wall shelf, veranda, near the window, store room, etc.), while 27% stored them in the farmhouse and 9% in the cattle shed. More than half of all the respondents reported that they store pesticides in places where children cannot reach them.

Chart 9 Location of storage



Type of spraying equipment and condition: the majority of the respondents were using backpack sprayers for glyphosate application. Manual backpack sprayers, battery powered backpack sprayers, as well as petrol-fuelled backpack sprayers, were noted from the study area. Less than two percent of respondents were using a manually operated sprayer. About 37% respondents were working with faulty sprayers that were leaking occasionally or frequently. Many of them were unable to repair the sprayers themselves, so continued to work with them. Only a few of them reported that they get their faulty sprayers repaired after the spray or just before the next spray schedule.

Location of washing equipments used for glyphosate application: respondents reported different locations used for washing of spraying equipment. 3.08% respondents reported washing the equipment near to wells used as the source of drinking water; 27.31 % respondents wash it at wells usually not used as sources of drinking water but for household purposes, 22.91% respondents wash it at ponds, 1.32% respondents wash equipment at their house premise, and the rest reported that they wash spraying equipment either in the farm itself, drainage streams, and/or in the river.

Chart 10 Types of spraying equipments

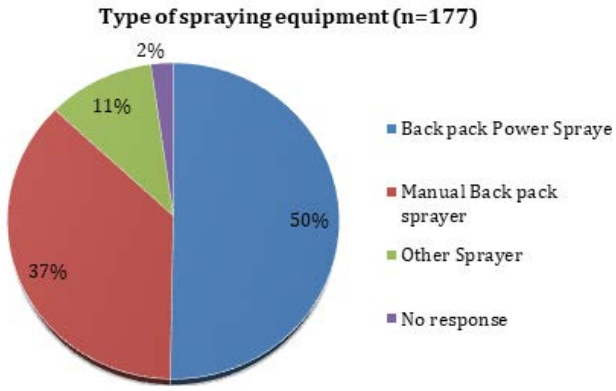


Table 11 Location of washing equipments used for pesticide application

#	Washing premises	% of respondents
1	Near to well used for drinking	1.13
2	Near to well not used for drinking	31.64
3	Near to pond	25.99
4	Other Water sources	36.72
5	Home premises	1.13
6	No response	3.39

Farmer washing sprayer in the canal. Photo: Bhariab Saini for PAN India

Activity roles: As the majority of the respondents are small scale and marginal farmers, various activities of pesticide use such as mixing, spraying, broadcasting/dispersing, and washing the equipments used are mostly done by farmers themselves or family members. However, about 12% of respondents hired workers for such activities. The age of those who are involved in various activities of glyphosate use (whether it is a farmer himself or herself, family member, or hired labourers) ranged from 23 to 66 years. About four percent of respondents reported women's participation in all these activities, with more participation for mixing and washing equipment used for spraying.

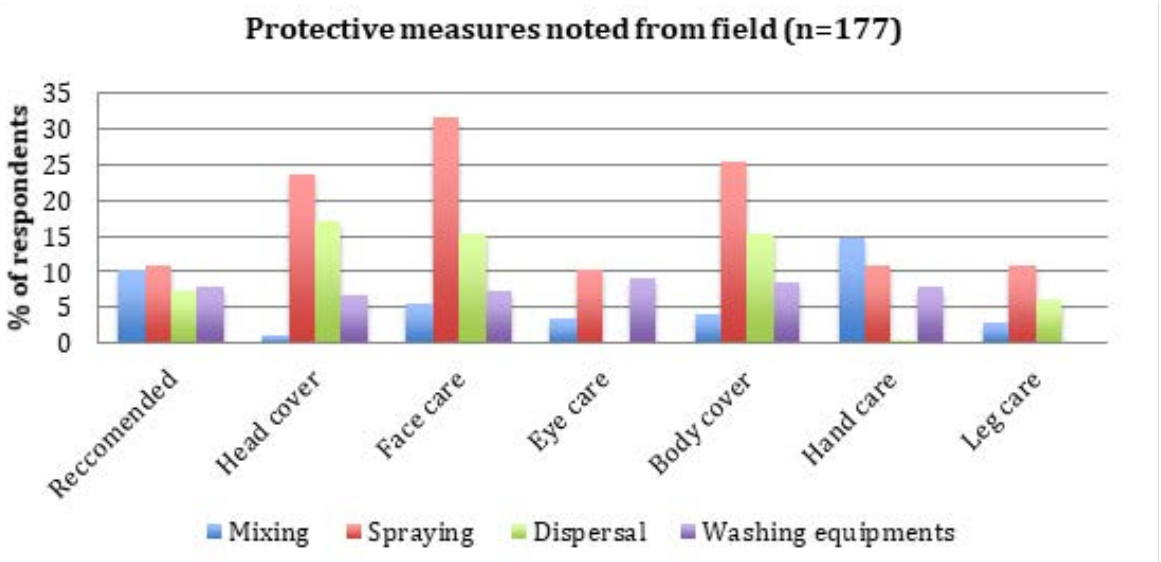
Use of Personal Protective Equipments (PPE)

When asked about the use of PPE while working with pesticides, about 66% respondents said "yes" and mentioned some kind of protective measures. A detailed further enquiry revealed that they were using some sort of protective measures, but not the actual recommended PPE. They used a hat, towel, cloth, etc. as head cover; mask and cloth wrapped around mouth and nose as face care; some sort of spectacles and goggles as eye care; raincoat and cloth as body cover; gloves, plastic sheet and full sleeved shirts as hand care; and full length trousers and shoes as leg care while mixing, spraying, broadcasting/dispersing and washing the equipment. However, least protection has been noted for eyes, hands and legs. Further, many respondents reported that wearing protective measures resulted in suffocation and difficulty for doing the work.

When asked about the availability of protective equipment in villages, 48.6% respondents mentioned that some sort of low quality gloves and goggles were available in some of the retail points, but not always, and for a great majority of the respondents, PPE was unaffordable, while only 28.91% reported that it was affordable. They further said that such items got damaged after being used a couple of times and did not last for even a year. On further enquiry about whether they asked for PPE from retailers, agriculture officers, agents of distributers and/or manufacturers, 35% of the respondents said yes, and these respondents mentioned 'it is good to use PPE and can avoid health implication'; however, they didn't say what were the PPE items required and where good quality equipments were available. A few respondents mentioned that they got some gloves and goggles when demanded of a retailer. More than half of the total respondents were not aware of the availability of PPE in their area.

Weedicide application time: field data shows that 80.23% of respondents were applying glyphosate mostly during the morning and evening, although some of them also reported that they had to spray during noon and afternoon to finish spraying the entire field. The rest of the respondents did not respond to questions on this aspect. The data also shows that 68.93% respondents considered wind direction while spraying, with 56.5% reporting

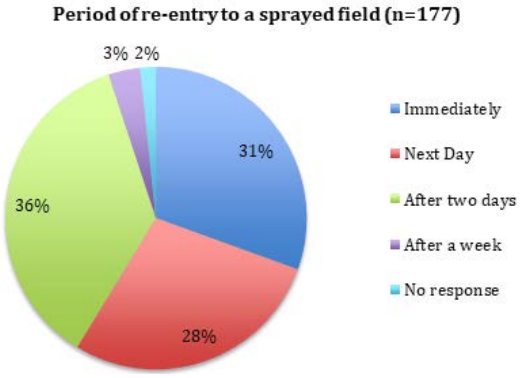
Chart 11 Various safety measures and protective measures noted from field



that they sprayed along the direction of wind to avoid spray blowing back onto their face, whereas the remaining respondents did not consider wind direction while spraying.

Re-entry to sprayed field: a varying period of re-entry to the sprayed field was noted among the respondents. Field data shows that 31% of respondents entered a sprayed field immediately after spraying for some work. Entering the sprayed field a short period after the spray and next day was reported by 28% of respondents; 36% of respondents reported that they entered a sprayed field after two days, 3% reported after a week, 2% did not respond.

Chart 12 Period of re-entry to sprayed fields



Increasing dose in successive applications: 27.2% of respondents reported to have used an increased dose of glyphosate in successive applications. They claimed that the dose of glyphosate was increased to get quick and better results, and during rainy season they always use higher doses to get the weeds killed.

Exposures and health effects noted

When asked about if they know the dangerous side effects of glyphosate use, 70.1% respondents responded 'yes'. Further interaction with them revealed that they are aware that some herbicides and pesticides can cause headache, asthma, body pain, breathing issues, nausea, abdominal discomfort, cancer and may even result in death. They further said that they continue to use these deadly chemicals, as no other options are available to save their crops.

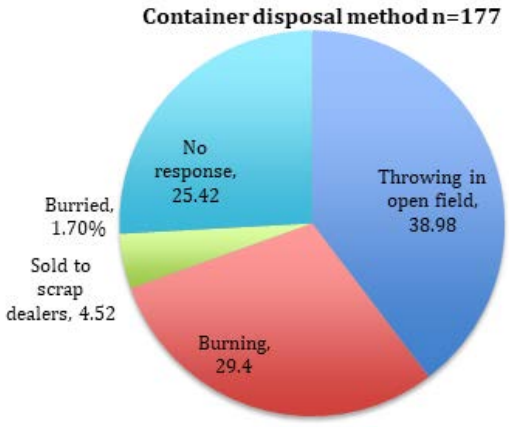
This study has observed exposures and poisoning due to glyphosate. About 14.12% respondents reported exposure to glyphosate while working in the field, while the rest of them reported no exposures and or did not respond. Most of the exposure happened because of a sudden change in wind direction while spraying in the field. The following are the other reasons for exposure noted from the field: weedicide spilled when opening the lid of container; spilled on hands while mixing; and spilled on body while loading the sprayer. Symptoms of poisoning reported by the respondents who were exposed to glyphosate while mixing, spraying, and cleaning sprayer after spray are nausea, vomiting, dysentery, headache, fever, skin fissures, increased heart rate, eye irritation, urinary infections, etc. and one respondent reported that he fell ill after sprayed for entire day with a newly bought power sprayer. About 15% of respondents reported any one or more of the above mentioned ill effects.

Use of containers and disposal

A proper container disposal method was not observed from this field study. About 14% of respondents were using empty containers of glyphosate formulations for household uses such as to store seeds, used as night lamp fuelled with kerosene, used as vessels in toilets and bathrooms, used to store kerosene and other oils.

The majority of the respondents (38.98%) reported throwing out the containers in open fields while 29.4% of respondents burned containers, 1.7% of respondents reported they bury the empty containers. However, 4.52% respondents sold such containers to scrap dealers. A quarter of the respondents did not respond to this question.

Chart 13 Container disposal methods



OBSERVATIONS FROM FARM WORKERS

For this study, field data were collected from 43 farm workers who work in small and marginal farm fields as daily wage labourers. 19 workers mainly from Jharkhand, Karnataka and Andhra Pradesh were reported to have been working with glyphosate-based herbicides.

Training on glyphosate application and use of safety measures

It was observed that none of the farm workers had received training on the use of glyphosate. Most of them were using backpack sprayers that operate either manually or powered by battery or petrol. Further, about 79% of workers reported that they did not have training on the use of PPE, safety measures and precautionary measures to be followed while working with glyphosate, whereas, the rest of the respondents said they were informed about using PPE while spraying. Nearly 40% of the workers said that they were not aware of the health hazards of using glyphosate and other herbicides, while the remaining workers reported that they know herbicides are poisons.

Crop specific use of glyphosate as reported by workers

Field data from farm workers show that they had used glyphosate for weed control in several crops as well as for general weed or vegetation control in open fields or non-cropping areas. The crops noted from the responses of workers include food crops and non-food crops. Glyphosate use was reported mainly in cotton, vegetables such as tomato, cucumber, chilli, etc, that are non-approved uses.

Use of PPE

Use of PPE is very important to minimise the intensity of pesticide exposure. However, field data reveals that apart from casual clothing, only a few (20.93%) of the workers were using certain safety measures. It was noted that the recommended PPE was not in use; however, a small percent of workers used certain kinds of equipment such as gloves, goggles, mask, or a cloth to wrap around the head and nose.

Respondents also reported that they have to work in glyphosate-sprayed fields as well, may be immediately after the spray, next day, or the following days. Fertilizer application, inter-crop cultivation, harvesting, watering, etc. are the general work undertaken in this way. About 46% of workers said that they usually entered and worked in a sprayed area immediately after spray or on the same day. They further reported that apart from casual clothing they do not use PPE while working in sprayed fields as well.

Exposure and health effects

There are multiple factors that contribute to exposure to pesticides. These include the time spent working with or applying pesticides, working in a sprayed area, absence of use of PPE and precautionary measures. The time spent working with glyphosate (mixing/application) varied considerably among the workers. Some of the workers (23.25%) reported that they work with glyphosate-based herbicides at least half a day, while others reported that sometimes they may have to work a full day for spraying, and sometimes continuously for three to four days during peak spraying seasons. They further reported that, on average, they spray about 5-20 days in a crop season, usually. As the workers do not have the habit of using recommended PPE, they have higher chances of getting exposed to glyphosate.

Spillage and exposure: Spillage and accidents are the other factors contributing to exposure to pesticides. Pesticide spillage, and inhalation and contact exposures were common among the farming community. In the case of workers, some of them reported that they were exposed to glyphosate while working in the field, mainly because of spillage or using faulty spraying equipment. A few workers reported pesticide spilt on leg, hand, etc. while mixing and spraying, and said they felt burning sensations and irritation.

Health effects: Farm workers complained about experiencing certain ill effects after being exposed to glyphosate. About 52.63% of the respondents who have been working with glyphosate reported ill effects such as body pain, eye irritation, muscle pain, general weakness, and vomiting.

Container disposal and reuse: Throwing out in an open field is the most common practice of container management noted among farm workers. However, a few workers reported that they use empty pesticide containers for household activities. Containers were used in toilets, used to store kerosene oil and cooking oil, used as kerosene lamps, etc.

OBSERVATION FROM RETAILERS

Location and type of sales points

Pesticide sales points recorded in this study were from both village and semi-urban areas. About 16.67% of them were from villages and the rest from semi-urban areas. Most of them were farm supply stores where they sell inputs such as seeds, fertilisers, and pesticides (insecticides, fungicides, herbicides, and plant growth regulators), while the rest were market stalls or roadside stalls. About 33.33% of the sales points were located near to a medical facility, 16.67% located near to schools, 20% located near to food item stores, 10% located near to an eatery, and the rest was close to agriculture fields. Vegetables, cotton, corn, paddy, sugarcane, soybean, wheat, mustard, garlic, etc. were the major crops grown in the area where pesticide sales points were recorded. An important fact to be noted is that glyphosate was sold in areas where the approved crop is not been grown.

Various brands of glyphosate formulations were reported from these sales points, with five single formulations (Glyphosate 20.2% SL IPA salt, Glyphosate 41% SL IPA sal, Glyphosate 54% SL (IPA salt), Glyphosate Ammonium Salt 5% SL, Glyphosate 71% SG Ammoniumsalt) and one combination formulation (Oxyflurofen 2.5% + Glyphosate (Isopropyl anime salt) 41% SC (w/w)). These retail points had a stock of several different brands ranging from 500ml to one litre, and some in five litre containers.

Availability of PPE in the sales points: almost all of the sales points lacked the recommended PPE. About 66.67% of sales points did not have any of the protective equipment, but the rest had some equipment such as gloves, face masks, goggles, etc. though they seemed to be of poor quality.

Training provided to retailers

It was noted that retailers provided some sort of training on pesticides and marketing. Retailers reported that agents of pesticide companies and distributors, as well as government agencies such as the Agriculture Department, organised training programs once or twice a year. Seminars and field demonstrations were the usual modes of training. About 66.67% of retailers said that they attended training programs on pesticides, mostly organised by pesticide companies or distributors, and also by Agriculture Departments. Some retailers reported that the training or seminars covered crops for which pesticides can be applied, precautions to be followed, storage and disposal, health, and environmental aspects.

Decanting and repackaging of pesticides

Almost all the retailers have responded ‘no’ to a question about whether they decant or repackage pesticides in the shops. However, it was noted that a few retailers were decanting glyphosate as per the requirement of farmers who requested smaller quantities such as 50 ml or 100 ml. Plastic carry bags and soft drink bottles were generally used. Further, it was noted that labels or instruction leaflets were not provided along with the decanted/ repacked products.

Advice given to buyers

Data collected from retailers showed that they ‘advised’ farmers as and when new products were made available. About 36% of retailers said ‘yes’ to a question asked on this. This advice is mainly on the crops for which the pesticides can be used and dosage, but usually as suggested by agents of companies or distributors. Further, when asked if any advice is given on disposal of pesticide packages and containers, many of them said that they tell the buyers to burn or bury them or to sell to scrap dealers. Little advice is given about safety measures and PPE.

PESTICIDE LABEL ANALYSIS FOR GLYPHOSATE BRANDS

As part of the study, the information provided in the labels pasted on various glyphosate brands were analyzed to get a sense of the labelling practices being followed by manufacturers. For this exercise, one third of total glyphosate brands reported were selected randomly. Thus, a total of eight brands of glyphosate were noted. Information provided on the product labels of all of them was assessed within the framework of the questionnaire developed as part of the Community Pesticide Action Monitoring (CPAM) of Pesticide Action Network Asia and Pacific (PAN AP). Observations on this exercise is given below.

Label languages and font size

All the eight brands were provided with a label pasted on the bottle/packet. The container volumes reported were 100g, 250g/ml, 500ml, and one litre. English and Hindi were the prominent languages in which information is presented on the labels. Besides these two languages, a few other languages were also noted on the labels.

Hazard classification

Hazard classification pictograms are important information with regard to pesticides. They were observed on the labels of all the glyphosate brands: the 'blue triangle' and the text 'Danger'.

Instructions and safety/precautionary measures

Instructions or directions on how to use the product and safety measure to be followed are the critical information needs to be given to the users to minimise the inherent risks of pesticide use. None of the brands provided information on how to use the product, but they mentioned 'read the leaflet'; however, none of the brands had an instruction leaflet attached to them. A precautionary statement with minimum information was noted in the label of all the eight brands.

Warning statements, some safety instructions, or precautionary statements were noted on labels of all the brands. All the brands had a warning statement: 'keep out of reach of children'. Keep away from foodstuffs, animals food, mouth, eyes, skin, avoid inhalation and skin contact, avoid mist,

Table 12 List of selected brands for label analysis

S. no	Brand name	Formulation	Manufacturer
1	Brake Up	Glyphosate 41% SL	Plant Remedies Pvt Ltd, Hazipur
2	Glycocin	Glyphosate 41% SL	Maharashtra Bio Fertilisers India, Latur
3	Noweed	Glyphosate 41% SL	Dhanuka Agritech Ltd, Jaipur, Rajasthan
4	Safal	Glyphosate 41% SL	Tropical Agrosystem (India), Chennai
5	All Kill 71	Glyphosate 71% SG	Krishi Rasayan Exports, Solan, HP
6	Brake-G	Glyphosate 71% SG	Crystal Crop Protection Ltd, Jammu or Haryana
7	Mera 71	Glyphosate 71% SG	Excel Crop Care Ltd, Bhavnagar, Gujarat
8	Roundup	Glyphosate IPA salt 41%SL	Monsanto

do not eat or drink while using, wash after using, not use utensils when mixing, use stick to stir, wear gloves, avoid skin contact, don't eat/drink, wash contaminated skin and cloth, do not store unused spray solution, etc. were the other precautionary statements noted on the labels of three brands.

Information on PPE use

None of the brands provided proper information on the use of PPE on their labels. Only one of the brands mentioned 'wear full protective clothing', but it did not give a detailed account of the required protective clothing. Further, two of the brands stated 'wear protective clothing', and two brands mentioned 'use rubber gloves and face mask'. The remaining three brands (of Monsanto, Plant Remedies, and Tropical Agrosystem) did not mention protective equipment.

Crop recommendation for use

The label analysis was also done for the advice or recommendations of crops for which glyphosate can be used as per the labels. None of the brands provided information with regard to application dosage on the label, but gave information about recommended crops or use. One brand each of the 41% SL and 71% SG (Brake up and Brake-G) mentioned recommended uses as weed control in tea and non-crop area. Three brands of 41% SL (Glycocin, Noweed and Safal) mentioned recommended use as weed control in tea. Two brands of 71% SG (All Kill 71 and Mera 71) generally mentioned 'weeds' as recommended use. In the label, Monsanto's Roundup was recommended for weed control in tea, in non-cropped area for monocot and dicot and in general weed control.

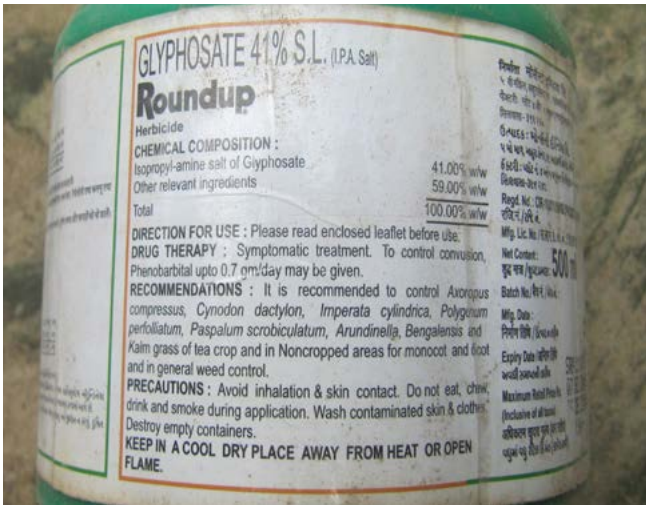
Information on container disposal

None of the brands contained instructions on the label for proper disposal of containers and left overs. Two of the eight brands simply stated 'destroy the containers' (Safal of Tropical Agrosystem) and 'destroy empty containers' (Roundup of Monsanto) after use, however they did not give any sense of how to dispose of containers and their left overs properly and safely. Additionally, none of the brands had provided information on how to decontaminate the containers.

Provision of instruction leaflets: None of the brands provided an instruction leaflet attached to the product from the retail points were the study has conducted. However, out of the seven brands, three of them mentioned 'read leaflet' for instructions on how to use the products.

Analysis of product Packaging: An analysis of the pesticide packaging was also done with the selected glyphosate brands. It shows that the packaging contained label information such as brand name, name of active ingredient and concentrations, name of the manufacturer, registration number, manufacturing license number among other details such as batch number, date of manufacturing and expiry, etc. The pesticide packaging was found to be bottles, packets, sachets, and cans. It was also noted that none of the brands were ready to use except for the granular formulations.

Labels of some popular glyphosate brands in India



Glyphosate 41% SL, Roundup, Monsanto

Glyphosate 41%, SL Safal, Tropical Agrosystems

Labels of some popular glyphosate brands in India

Glyphosate 71%, SG Mera 71 Excel Crop Care Ltd

Glyphosate 71%, SG All Kill 71, KrishiRasayanExports

Glyphosate 71% SG Mera 71 Excel Crop Care Ltd

Glyphosate 71%,GBrake-G, Crystal Crop Protection Ltd

Glyphosate 41%, SL Glycocin, Maharashtra Bio Fertilizers

Glyphosate 41%, SL Brake-Up, Plant Remedies

7. ANALYSIS AND DISCUSSION

Glyphosate use on non-approved crops

Use of pesticides on non-approved crops is a major problem in India, as highlighted in many studies. It has been confirmed with the presence of residues of non-approved pesticides in several food commodities as well. A comparative analysis between the use of glyphosate noted in the field and its approved uses[9] revealed several non-approved uses. Though seven different formulations of glyphosate are approved for use in India, only three of them are noted in this study from fields.

In India, glyphosate is approved only for weed control in tea plantation and non plantation area accompanying the tea crop, which is generally indicated as non-crop area. Glyphosate 41% SC is approved for weed control only in tea with a waiting period of 21 days. Glyphosate 71% SG is approved for weed control in tea (with 7 days waiting period) as well as in non-cropped areas. The combination formulation of oxyflurofen 2.5% + glyphosate (isopropylamime salt) 41% SC is also approved for use in tea. However, it was noted that these glyphosate formulations were being used for weed control in vegetables and other crops. Agriculture officers and retailers were recommending glyphosate to be used for weed control in several crops including vegetables, non-cropped areas, bushes, and general weed control. The State Agriculture Departments recommended about seven uses of glyphosate. However, actual field use was noted for more than 20 crops; usage in tea was not reported in this study. Therefore all the uses of glyphosate noted in this study are non-approved uses.

Data gathered from farm workers also showed that glyphosate was applied on non-approved crops. Several non-approved uses were observed from the response noted by workers. Thus unintended uses of glyphosate was noted from practices of workers as well, which, anyway would have been done as per the direction of farmers who hired these workers.

[9] Use approved by Central Insecticides Board and Registration committee, Directorate of Plant protection, Quarantine and Storage, Department of Agriculture and Cooperation, Government of India.

Non-approved use - concern over food safety

Uses of pesticides for crops not approved for them pose significant threat to food safety. This study noted numerous non-approved uses for glyphosate. There exists a significant risk when food crops fall under non-approved uses, and this study noted glyphosate use in more than 16 food crops, while it was approved for weed control only in tea gardens and non-crop areas. An ICMR bulletin in 2016 reported numerous uses for glyphosate formulations in at least 22 Indian states, which included tea and several non-approved crops such as cereals, pulses, fruits, vegetables, and fiber crops.

The dangers of a pesticide being applied for non-approved crops are many. For glyphosate, in the case of non-approved crops, waiting periods are not set. The waiting period denotes a time interval to be followed after the last pesticide spray before harvest. Generally, for many of the vegetable crops, farmers are not able to follow waiting periods between the last application and harvest because the crops are harvested either once or twice in a week. As per the approved uses of glyphosate, the minimum waiting period is seven days and maximum waiting period is 21 days for tea.

In addition to waiting periods, the maximum residue limits (MRL) are not set for such non-approved crops, and the national pesticide residue monitoring programme in India did not assess for residues of glyphosate in commodities. Therefore, the level and extend of contamination of glyphosate in food commodities remain unknown. A 2013 report showed that there are a number of pesticides in India for which MRLs are not fixed (Bhushan, C., et al., 2013). This report also revealed that MRLs have not been fixed for all the approved uses. Therefore such crops and pesticides usually do not come under the purview of residue tests and monitoring, leaving consumers at risk of exposure to such pesticides unknowingly. While glyphosate has been approved for use in weed control only in tea crops, the Food Safety and Standards Authority

of India has set MRLs of glyphosate for tea, rice, meat and meat products, (FSSAI, 2017), leaving many of the non-approved uses not monitored for health risks.

Lack of proper training and access to right information

Observations from this study, especially on training, awareness, and sources of information for pesticide use are a serious concern. This study has noted that retailers and agents are the sources of information for more than half of the sampled farmers. Similar observations were noted in the 2015 report, Conditions of Paraquat Use in India (Kumar, 2015). That report also revealed that retailers and agents have greater influence among the farming community than the agriculture extension services as they are located far away. The reality of nearly 70% of farmer respondents applying pesticides without getting proper training or awareness programs shows the appalling situation of what is actually happening in the field. Farm workers are also not provided with adequate information or proper training on pesticide use, safety measures to be employed and use of personal protective measures; similar observations were also noted by Kumar (2015).

The label analysis for glyphosate shows a further aggravating situation - that information on how to use the product, the required dose, proper information on required PPE, safe disposal methods, etc. are lacking. Further, it was noted that the font size in which some information is provided is too small and makes it difficult to read.

It is also an important fact that glyphosate is sold even without information leaflets; such practices often leave farmers and workers unaware of the inherent risks and precautions to be followed. Moreover, certain brands provide less information in Hindi language than English. The reality is that the majority of the farmers are unable to read and comprehend the information provided in the label and instruction leaflet. This needs to be addressed seriously and urgent action is required to resolve this issue. Further, selling pesticides without the mandatory information leaflet is a violation of national laws. This situation of multiple issues of not providing the right and proper information to the end users is further aggravated by wrong recommendations and advice from retailers as well as agents of distributors or pesticide manufacturers, as majority of the farmers depend on these sources for information on pesticide use. Studies showed that, even when labels and information leaflets are provided, they are often not read by the users and or understood (Waichman et al. 2002; Damalas et al. 2006). Additionally, in areas where the literacy rate is low, written instructions may be useless, even though, it is important to provide information meant for users in labels and instruction leaflets. A study conducted by Amar, D. et al. (2010) found a common complaint from the field is that the material written on the label is not readable because of the small font size.

Lack of proper training and awareness often leads to unintended uses of pesticides. 'Unintended use' comprises numerous actions, which violate laid down norms and safe practices, which also includes decision making for the selection of suitable pesticide, application methods and employing safety measures. Further, this leads to non-approved uses as well.

Kavitha and Sureshkumar (2016) observed in their study conducted in Tamilnadu that the knowledge of, not only farmers but also for the community in general, was limited regarding pesticide use and safety, as noted in this study. A study done by Singh and Gupta (2009) showed the majority of pesticides users were unaware of pesticide types, their mode of action, potential hazards and safety measures. The current study reveals similar results on pesticide purchase, application and safety. All the above mentioned facts, coupled with the lack of proper monitoring and regulation from the part of concerned authorities, results in unintended uses of toxic agrochemicals, thereby putting community, public health and the environment at high risk.

These observations would be true for other pesticides and herbicides as well. Kavitha and Sureshkumar (2016) noted pesticide users such as farmers in developing nations like India are at a much higher risk of pesticide exposure due to lack of adequate safety measures and awareness. Amar,

D. et al. (2010) found that a significant proportion of farmers have not received proper training and awareness on pesticide use. Similarly, this study also noted that farmworkers have less awareness about the handling of agrochemical and their toxicity.

Various practices noted in the study that leads to exposure to glyphosate can be seen as an indicator of poor awareness among the farming community, which in turn an indication of failure of pesticide governance and industry practices regarding training and awareness creation.

Recommended PPE is not used

It is interesting to note that none of the respondents had been using the recommended PPE. The safety measures used, as noted in the study, are not the proper ones recommended; however, some of the respondents were found to have used some kind of protective measures, mostly casual clothing. The majority of the respondents were not using even minimum protective measures. Further, the retail points did not have PPE for distribution. These results are more or less in line with observations of some studies that noted only a small fraction of pesticide users wear three protective items during spraying in India (Kumar 2015). Another study has noted that a very high proportion of farmers interviewed in Asia, especially in Bangladesh, India, Philippines and Sri Lanka, do not wear the minimum protective clothing consisting of long-sleeved shirts and long trousers and shoes or boots while spraying (Matthews 2008).

The Indian Insecticide Rules, 1971 clearly state the protective clothing, equipments and respiratory devises required to be used while working with pesticides. Rule 39 says 'the protective clothing shall be made of materials, which prevent or resist the penetration of any form of insecticides formulations. The materials shall also be washable so that the toxic elements may be removed after each use'. However, the various articles used by respondents to protect their body parts, in reality, do not seem to be providing the required protection. And none of the respondents reported the use of a respiratory device. A complete suite of protective clothing shall consist of the following dresses, namely protective outer garment/overalls/ hood/hat, rubber gloves or such other protective gloves extending half-way up to the fore-arm, made of materials impermeable to liquids; dust-proof goggles and boots. The right complete set of PPE of good quality needs to be available to the farming community who want to use pesticides. If the authorities are unable to provide it, then the government needs to step in to ban such pesticides that require the use of PPE, as put forth by the Article 3.6 of the International Code of Conduct on Pesticide Management.

Glyphosate use results in exposure and poisoning

Several practises have been noted from the study that increase the risk of glyphosate exposure. Storing pesticide containers within house premises, use of leaking faulty spraying equipment, washing equipments near to water sources used by villages, lack of proper PPE, spraying practices in fields, etc, increase the risk of exposure. Further, entering tino glyphosate sprayed fields can be dangerous, as there is a considerable chance of exposure if farmers or workers enter too soon after the application, and often, they do not use PPE for working in sprayed fields. However, farming communities are not properly trained or rightly informed about such precautionary measures to be followed while working in a sprayed field to minimize the risk of exposure. Similar observations have been noted in the literature, that storage of pesticides in reach of children is a major cause of poisoning incidents involving children (Balme et al. 2010; UNEP 2004). Amar, D. et al. (2010) noted an overwhelming majority of farmers did not keep the pesticides in safe locations. This current study has documented exposure and poisoning as well. Matthews (2008) reported that farmers and workers in developing countries use backpack/knapsack sprayers that are frequently leaking, and were not using required PPE. Further, the practice of not taking a bath or wash after pesticide application may lead to continuous exposure. Ntow (2006) reported a lack of proper disposal of containers could also lead to exposures. Use of containers for food and beverages is a major cause of exposures. Empty

Provisions regarding protective measures as put forth by the Indian Insecticide Rules 1971*

Rule 39. Protective clothing

1. Persons handling insecticides during its manufacture, formulation, transport, distribution or application, shall be adequately protected with appropriate clothing.
2. The protective clothing shall be used wherever necessary, in conjunction with respiratory devices as laid down in rule 40.
3. The protective clothing shall be made of materials, which prevent or resist the penetration of any form of insecticides formulations. The materials shall also be washable so that the toxic elements may be removed after each use.
4. A complete suit of protective clothing shall consist of the following dresses, namely:
   - (a) Protective outer garment / overalls / hood / hat;
   - (b) Rubber gloves or such other protective gloves extending half way up to the fore-arm, made of materials impermeable to liquids;
   - (c) Dust-proof goggles
   - (d) Boots

Rule 40. Respiratory devices:

For preventing inhalation of toxic dusts, vapours or gases the workers shall use any of the following types of respirators or gas-masks suitable for the purpose, namely:

- (a) Chemical cartridge respirator
- (b) Supplied air respirator
- (c) Demand flow, type respirator
- (d) Full face or half face gas masks with canister

In no case shall the concentrates of insecticides in the air where the insecticides are mixed exceed the maximum permissible values.

Rule 42. Training of Workers:

The manufacturers and distributors of insecticides and operators shall arrange for suitable training in observing safety precautions and handling safety equipment provided to them.

*Source: http://cibrc.nic.in/insecticides_rules.htm;

pesticide containers if not properly disposed of, not only pose a threat to the environment but also to people, for example, children who may use them for play. A 2010 study conducted in Kolhapur district in Maharashtra found unsafe disposal of containers. It also observed that 33% of the respondents washed the used pesticide containers and re-used them for various purposes (Amar, D. et al. 2010).

Shah, et al (1897) reported that there are different pathways through which children and people can be exposed to atrazine and other herbicides. Those who live downstream from fields where the pesticide is applied to crops may be exposed through contaminated water, as well as farm workers and applicators being exposed. Children may be exposed by playing in dirt that contains pesticide drift, and also through contaminated water.

Inadequate retailers practices

It was noted that all the retailers have been selling pesticides without obtaining proper training. Moreover, it was noted that pesticide sales points are located very close to schools, medical facilities, food item stores and eateries, which would pose risks to customers of such facilities. Another important factor noted in this study is the non-availability of recommended PPE at pesticide sale points. Similar observations were made by Kumar (2015 and 2017) that retail points do not sell the required PPE in India.

Environmental contamination of glyphosate use in India

Pesticide consumption data for the year 2018-19 reveals that 765 metric tonne technical grade glyphosate was used in India, which is more than 40% higher than that of the 2015-16 consumption. Over the past few years, glyphosate usage has increased alarmingly that its use has been noted for a range of agriculture fields, despite the fact that it was approved for weed control only in tea crop and for non-crop area. Over the past decades, a number of studies and reports have raised concerns over the environmental impacts of pesticides. Studies have shown that not all applied pesticides may actually reach targeted pests and the remaining pesticide has the potential to get into the soil, water and the atmosphere (Jeyanthi and Kombairaju, 2005). A 2016 bulletin of the Indian Society of Soil Science reported that only one percent of the applied pesticide strikes the target (Katyal, et al 2016). The rest, 99 percent, is wasted and contributes to polluting the ecosystem. Pimentel and Levitan (1986), stated in their paper an estimate indicating that less than a 0.1% of the pesticides applied to crops actually reach the target pest, with the rest finding its way to soil, air and water.

Herbicides have differing persistence in soil (Janaki et al, 2015). Glyphosate has low to very high persistence with half life ranges from less than a week to more than one and half years depending on soil binding and microbial breakdown. In warmer climate, its half life ranges from four days to 180 days (Watts et al., 2016). Though they may undergo biotic, abiotic or chemical degradation, the unaltered herbicides and their metabolites may reach and contaminate ecosystems and food chain. The presence of herbicide in water, food, feeds, terrestrial and aquatic systems may pose toxicity to and undesirable impacts on human beings, domestic and wildlife (Choudhary et al. 2016). Though it is believed that glyphosate is bound onto soil particles, but now it is known that it can easily become unbound again and available to plant uptake and/or leach out (Watts et al., 2016).

Increased as well as indiscriminate usage of glyphosate would have been contributing to contamination of both agriculture and non-agriculture ecosystems in aquatic and non-aquatic terrain across India, putting both aquatic and terrestrial life forms at risk of exposure and consequent undesirable effects. However, further detailed and more focused studies are required to elaborate these problems.

VIOLATION OF NATIONAL REGULATION

The actual use of glyphosate in India is found to have violated national laws and rules. First of all, the violation is noted in the use of glyphosate for non-approved crops. The use registered/approved by CIB&RC is violated, as a number uses on non-approved crops are noted in the study. It is also noted that the State Agriculture Department has been recommending crops that are not approved by CIB&RC for glyphosate.

Secondly, the Insecticide Rules 16, 17, 18 and 19 are found to have been violated, as the sale of pesticide without instruction leaflets was recorded.

Thirdly, Insecticide Rules 39 sub-rules 1, 2, 3 and 4 are found to have been violated, as the protective equipment as laid down by these Rules is not available either in the villages, retail points or agriculture offices, and none of the farmers surveyed reported use of such protective equipment. Further, such details are not provided in the product labels.

Fourth, the Insecticide Rules 42 is found to have been violated, as majority of the farmers have been using glyphosate without getting proper training. Rule 42 states that 'training of workers: manufacturers and distributors of insecticides and operators shall arrange for suitable training in observing safety precautions and handling safety equipment provided to them'.

Fifth, Rule 44 sub-rule 1 is found to have violated. This rule states that 'it shall be the duty of manufacturers, formulators of insecticides and operators to dispose packages or surplus materials and washing in a safe manner so as to prevent Environmental or water pollution'. However, such disposal mechanism is not reported in the field.

VIOLATION OF INTERNATIONAL CODE OF CONDUCT ON PESTICIDES MANAGEMENT

The International Code of Conduct on Pesticides Management (the Code) is a set of guidelines established by the Food and Agriculture Organization of the United Nations and the World Health Organziation, to ensure sound management of pesticides. The Code provides a framework for regulation and management of pesticides throughout their lifecycle and applies to govnerment,s the pesticides industry and distributors, and all sectors of society involved in pesticide management and use.

This study has noted that glyphosate use is happening in India without adhering to various articles of the Code, which was ratified by the Indian government and pesticide industry. Non-adherence to a number of article provisions was found, and this includes:

Article 3.6, which states that pesticides whose handling and application require the use of personal protective equipment that is uncomfortable, expensive or not readily available should be avoided, especially in the case of small-scale users and farm workers in hot climates. As India generally enjoys a tropical climate with humidity and maximum temperature above 30 degree Celsius, the use of pesticides for which PPE is recommended violates this Article of the Code. Using recommended PPE in such climate conditions, is unsuitable, uncomfortable, and results in heat stress.

Article 5.2.5: Halt sale and recall products as soon as possible when handling or use pose an unacceptable risk under any use directions or restrictions and notify the government. As a number of non-approved uses have been reported, unacceptable residual risk for such farm products occurs. Recognizing this, as well as the conditions of use that do not favor the use of recommended PPE, it can be seen that Article 5.2.5 is in violation regarding the use of glyphosate in India.

Article 5.3 states Government and industry should cooperate in further reducing risks by, 5.3.1 promoting the use of personal protective equipment which is suitable for the tasks to be carried out, appropriate to the prevailing climatic conditions and affordable. 5.3.3 Establishing services to collect and safely dispose of used containers and small quantities of leftover pesticides. This study has noted that recommended PPE is not available or accessible to farmers, and there are

no mechanisms established for the collection and disposal of used containers.

Article 7.4 : Governments and industry should ensure that all pesticides made available to the general public are packaged and labelled in a manner, which is consistent with FAO/WHO or other relevant guidelines on packaging and labelling and with appropriate national or regional regulations. This study has noted decanting of glyphosate into low volume bottles or plastic carry bags without label or instruction leaflets as reported by a very small percent of respondents.

Article 10.4: Governments should take the neccessary regulatory measures to prohibit the repackaging or decanting of any pesticide into food, beverage, animal feed or other inappropriate containers and rigidly enforce punitive measures that effectively deter such practices.

Children park sprayed with glyphosate in West Bengal, Photo credit- Bhariab Saini for PAN India

8. CONCLUSION

A vast expansion of herbicide usage has been noted in India due to increased cultivation of genetically modified crops, as well as labour shortage and or increased wages. Glyphosate holds the second position in production and consumption among the herbicides used in the country. This study was an attempt to unravel the ground reality of the widely used highly debated weedicide, glyphosate, in India. Results of this study reveal the fact that glyphosate, being approved for tea and non-crop areas only, has been extensively used by the farming community for weed control across a range of food and non-food crops as well as non-farming areas. The recommendations by State Agriculture Departments and/or Universities for glyphosate use are not in compliance with the national approved use. Thus the recommended, as well as actual use of glyphosate seen in field, often results in illegal and unintended uses in India. Apparently, monitoring of pesticide residues in India does not have assessments for the presence of glyphosate in commodities.

Responses from farmers and workers, as noted in the study, reveal the alarming reality of unsafe practices. It is important to note that the majority of the farmers and farm workers interviewed in this study never received training with regard to the use of this herbicide, as well as the required personal protective equipments and safety measures. They often had limited access to information on labels and instruction leaflets, making the end-users unable to do informed decision making about the use and adopting adequate protective measures. Analysis of pesticide labels on selected glyphosate brands indicates that information is provided mainly in English and Hindi, and not in the local languages where the end use is happening. Minimum and vague information on critical aspects of usage, precautionary and safety measures are noted on the labels. None of the brands analysed provided information on how to use the products and safe disposal of the used containers, and proper use of personal protective equipment. Similarly, minimum information was noted on safety and precautionary measures in the label of some brands.

The practices of storage, spraying, washing spray equipment, re-entry into sprayed fields, etc. are happening in a way that results in high chances of exposure and poisoning. Observations from retailers reveal that glyphosate formulations are also sold in areas where the only approved crop is not grown, and recommended personal protective equipment is not available at the retail points. Non-availability and lack of access to recommended protective equipment, coupled with unintended usages in the given climatic conditions in the country, would end up in undesirable occupational as well as environmental exposures, including contaminating natural resources both in aquatic and terrestrial ecosystems.

Thus it is evident that glyphosate use is happening in India in violaton of the national regulations as well as the International Code of Conduct on Pesticides Management. In the light of mounting evidence on the intrinsic properties of glyphosate for a number of acute and chronic health and environmental outcomes, the ground reality of its use in India is seen as an ‘anarchic’ scenario. This would have undesirable impacts on soil health, farm productivity, food safety, food and agriculture trade, public health, as well as environmental wellbeing. Such usage over a period would consequently result in unacceptable public health and environmental impacts that the farming community, regulatory system or the public would not be able to manage properly. Ignoring the ground reality of illegal usages and unsafe practices definitely would have profound damages to the socio-economic system. While, farmers and agriculture workers are often blamed for indiscriminate, injudicious and unsafe use of pesticides, it needs to be realized that the fault also lies primarily with the regulatory system, industry and the agriculture extension services because they recommend pesticides beyond the approved usages set by the regulatory authority and the International Code of Conduct on Pesticide Management.

At least six Indian states have come up with strict restrictions and temporary bans for glyphosate-based herbicides in their jurisdiction,

considering the indiscriminate use as well as its health and environmental safety. The conditions of use, including the diverse and biodiversity rich agro-ecological regimes in India, a tropical climate that does not favour the use of recommended personal protective equipment, illiterate and uneducated farming communities, a vast array of non-approved uses, poor regulatory as well as monitoring systems, necessitate the urgent need of eliminating glyphosate from India in order to protect its citizens from unintended and unpredictable health damage as well as environmental impacts.

Glyphosate applied to kill vegetation close to a house in West Bengal

REFERENCES

Acquavella JF, Alexander BH, Mandel JS, Gustin C, Baker B, Chapman P, Bleeke M. 2004. Glyphosate biomonitoring for farmers and their families: results from the farm family exposure study. Environ Health Perspectives. 112(3): 321-6.

ASTDR, 2019. Toxicological Profile for Glyphosate (Draft for public comment), Agency for Toxic substances and Disease Registry. US Department of Health and Human Services.

Balme KH, Roberts JC, Glasstone M, Curling L, Rother HA, London L, Zar H & Mann MD. 2010: Pesticide poisonings at a tertiary children's hospital in South Africa: an increasing problem. Clinicical Toxicology 48(9):928-34.

Beyond Pesticides, 2017. Glyphosate (Roundup) Fact Sheet, 2017 Beyond Pesticides.

Bradberry, S. M.; Proudfoot, A. T.; Vale, J. A. Glyphosate poisoning. Toxicol. Rev. 2004, 23 (3), 159-167

Brändli D, Reinacher S. 2012. Herbicides found in human urine. Ithaka Journal Jan 270-272.

Care Ratings, 2017. Outlook of Indian Pesticide Industry, Ratings Department, Care Ratings, May 31, 2017.

Chandra Bhushan, Avimuktesh Bhardwaj and Savvy Soumya Misra. 2013. State of Pesticide Regulations in India, Centre for Science and Environment, New Delhi.

Choudhury PP, Singh R, Ghosh D and Sharma AR. 2016. Herbicide Use in Indian Agriculture. ICAR - Directorate of Weed Research, Jabalpur, Madhya Pradesh, 110 p.

CIB&RC. 2015. Minutes of 361st special meeting of Registration Committee (RC) held on 22.12.2015 (Downloaded from http://www.cibrc.nic.in/361rc2015.pdf , on 13th January 2016)

CIB&RC, 2017. Insecticides / Pesticides Registered under section 9(3) of the Insecticides Act 1968 for use in the India. Central Insecticide Board and Registration Committee, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India. As on 30th June 2017 (downloaded from http://www.cibrc.nic.in/reg_products.doc on 18th September 2017)

CIB&RC, 2019. Insecticides / Pesticides Registered under section 9(3) of the Insecticides Act 1968 for use in the India. Central Insecticide Board and Registration Committee, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India. As on 31st October 2019. (Downloaded form http://ppqs.gov.in/sites/default/files/list_of_pesticides_registered_upto_31.10.2019.pdf on 12th December 2019)

Cycon, M. Piotrowska-Seget, Z. Effect of selected pesticides on soil microflora involved in organic matter and nitrogen transformations: pot experiment. Pol J Ecol 55(2007):207–220

Damalas CA, Georgiou EB & Theodorou MG. 2006. Pesticide use and safety practices among Greek tobacco farmers: A survey. International Journal of Environmental Health Research. 16 (5):339 - 348.

Deborah Smith-Fiola and Stanton Gill. 2017. Vinegar: An Alternative To Glyphosate?. University of Maryland Extension, Central Maryland Research and Education Center https://extension.umd.edu//sites/extension.umd.edu/files/_docs/programs/ipmnet/Vinegar-AnAlternativeToGlyphosate-UMD-Smith-Fiola-and-Gill.pdf

Dhere Amar, Javadekar Prahcee, Jagtap Mahesh. 2010. Modern Agricultural Practices: a Dilemma of Farmers and Farm Workers' Health in the Cash Crop Zone in the Maharashtra State. Bhatter College Journal of Multidisciplinary Studies, Vol. 1, No. 1. pp80-88

Dileep Kumar. 2015. Conditions of Paraquat use in India. http://www.pan-india.org/wp-content/uploads/2017/03/BD_paraquat_4-15_def-WEB.pdf

Dileep Kumar. 2017. Paraquat dichloride retailing in India : a case study from west Bengal. A sequel to 'Conditions of paraquat use in India' 2015. PAN India. http://www.pan-india.org/wp-content/uploads/2017/04/Paraquat-retainiling-in-India_PAN-India-04.2017.pdf

Dill GM, Sammons RD, Feng PCC, Kohn F, Kretzmer K, Mehrsheikh A, Bleeke M, Honegger JL, Farmer D, Wright D, Haupfear EA, 2010. Glyphosate: discovery, development, applications, and properties. Chapter 1. In: Nandula VK (ed) Glyphosate resistance in crops and weeds: history, development, and management. Wiley, New York, pp 1–33. ISBN 978-0470410318

Dinham ,B. 2007: Pesticide users at risk. Survey of availability of personal protective clothing when purchasing paraquat in China, Indonesia and Pakistan and failures to meet the standards of the Code of Conduct.

Berne Declaration (BD), Pesticide Action Network Asia and the Pacific (PANAP), Pesticide Eco-Alternatives Center (PEAC), Gita Pertiwi, Lok Sanjh. http://www.evb.ch/cm_data/Paraquat-Code_Survey_FINAL_rev1.pdf

Dinham, B. 2003. Growing vegetables in developing countries for local urban populations and export markets: problems confronting small-scale producer. Pest Management Science 59:575–582. DOI: 10.1002/ps.654.

Duke SO, Powles SB. 2008. Glyphosate: a once-in-a-century herbicide. Pest Manag Sci 64:319–325.

European Commission https://efsa.onlinelibrary.wiley.com/doi/epdf/10.2903/j.efsa.2015.4302

FAO and WHO. 2014. The International Code of Conduct on Pesticide Management. World Health Organization and Food and Agriculture Organization of the United Nations.

www.fao.org/fileadmin/templates/agphome/documents/Pests_Pesticides/Code/CODE_2014Sep_ENG.pdf

FICCI, 2016. Next Generation Indian Agriculture - Role of Crop Protection Solutions, A report on Indian Agrochemical Industry July 2016, Federation of Indian Chambers of Commerce and Industry (FICCI)

Franz et al., 1997 - Franz, J.E., M.K. Mao and J.A. Sikorski. 1997. Glyphosate: A Unique Global Herbicide. American Chemical Society. Chap. 4 pp. 65-97

FSSAI, 2017. Notification on Draft Regulations, Food Safety and Standards Authority of India, Ministry of Health and Family Welfare, Government of India.

Glyphosate Technical Factsheet, National Pesticide Information Centre http://npic.orst.edu/factsheets/archive/glyphotech.html (accessed Sept. 30, 2017)

IARC, 2015. Monograph Vol.112. The International Agency for Research on Cancer (IARC) https://www.iarc.fr/wp-content/uploads/2018/07/MonographVolume112-1.pdf

Janaki, P., Sharma, N., Chinnusamy, C., Sakthivel, N. and Nithya, C. 2015. Herbicide residues and their management strategies. Indian Journal of Weed Science 47 (3): 329–344.

Jeyanthi H and Kombairaju S. 2005. Pesticide Use in Vegetable Crops: Frequency, Intensity and Determinant Factors Agricultural Economics Research Review.Vol. 18. 209-221

Katyal, JC, Chaudhari, SK, Dwivedi, BS, Biswas, DR,Rattan, RK and Majumdar, K (Editors). 2016: Soil Health: Concept, Status and Monitoring. Bulletin of the Indian Society of Soil Science 30, 1-98

Kavitha D And Sureshkumar M. 2016. Use Of Pesticides In North Tamil Nadu (Namakkal)-Impacts On Human Health And Persistence In Environment. IOSR Journal of Pharmacy and Biological Sciences (IOSR-JPBS). Volume 11, Issue 5 Ver. I (Sep. - Oct.2016), PP 131-137

Khot, R., Bhise, A., Joshi, R., Patil Ambade, N. 2018. Glyphosate Poisoning with Acute Fulminant Hepatic Failure. Asia Pacific Journal of Medical Toxicology, 7(3), 86-88. doi: 10.22038/apjmt.2018.11984

Laerke, P.E., 1995. Foliar Absorption of Some Glyphosate Formulation and their Efficacy on Plants. Pesticide Science. Vol. 44. pp. 107-116

Leverton K, Cox V, Battershill J & Coggon D. 2007. Hospital admission for accidental pesticide poisoning among adults of working age in England, 1998–2003. Clinical Toxicology (45) 5: 594-597

Major uses of herbicides (approved under the insecticides act, 1968) as on 30th June 2016. Central Insecticide board and Registration Committee. Directorate of Plant Protection Quarantine & Storage; Department of Agriculture & Cooperation, Ministry of Agriculture government of India. (Downloaded from http://cibrc.nic.in/mupi2012.doc 3rd October 2017)

Major uses of herbicides (approved under the insecticides act, 1968) as on 31th October 2019. Central Insecticide board and Registration Committee. Directorate of Plant Protection Quarantine & Storage; Department of Agriculture & Cooperation, Ministry of Agriculture government of India. (Downloaded from http://ppqs.gov.in/sites/default/files/mup_herbicide_.pdf on 12th December 2019)

Manish M and Saurabh R. 2017. India Agrochemicals on Fertile ground. Religare Institutional Research. https://www.dsij.in/productAttachment/premarketreports/Market_Agrochemicals_Religare_10.01.17.pdf

Matthews G A. 2008. Attitudes and behaviours regarding use of crop protection products – A survey of more than 8500 smallholders in 26 countries. Crop Protection (27):834 – 846.

Meftaul, I. M., Venkateswarlu, K., Dharmarajan, R., Annamalai, P., Asaduzzaman, M., Parven, A., & Megharaj, M. 2020. Controversies over human health and ecological impacts of glyphosate: Is it to be banned in modern agriculture?. Environmental pollution (Barking, Essex : 1987), 263(Pt A), 114372.

Meriel Watts, 2012. Glyphosate Factsheet-Special release. PANAP factsheet series. http://archive.panap.net/sites/default/files/pesticides-factsheet-specialrelease-glyphosate.pdf (accessed Sept. 30, 2017)

Meriel Watts, 2016. Glyphosate Monograph. PAN International. http://pan-international.org/wp-content/uploads/Glyphosate-monograph.pdf (accessed Sept. 30, 2017)

Mesnage, R., & Antoniou, M. N. 2017. Facts and Fallacies in the Debate on Glyphosate Toxicity. Frontiers in public health, 5, 316. doi:10.3389/fpubh.2017.00316

Narasimha Reddy and Dileep Kumar. 2017. Pesticide Poisonings in Yavatmal District in Maharashtra: Untold Realities. PAN India. http://www.pan-india.org/wp-content/uploads/2017/10/Yavatmal-Report_PAN-India_Oct-2017_web.pdf (accessed Sept. 30, 2017)

Ngowi AVF, Mbise TJ, Ijani ASM, London L & Ajayic OC. 2007. Smallholder vegetable farmers in Northern Tanzania: Pesticides use practices, perceptions, cost and health effects. Crop Protection 26:1617–1624.

Ntow WJ, Gijzen HJ, Kelderman P & Drechsel P. 2006. Farmer perceptions and pesticide use practices in vegetable production in Ghana. Pest Management Science 62 (4): 356–365.

PAN India 2017. The decision to ban 18 pesticides in India brings hope, but it should be extended to include all the pesticides banned/restricted elsewhere and still used in India. Press Release. 10th January 2017. http://www.pan-india.org/pan-india-welcomes-pesticide-ban-order-demands-extension-to-include-all-66-bannedrestricted-elsewhere/

(accessed Sept. 30, 2017)

Glyphosate Pesticide Information Profile. Extension Toxicology Network http://extoxnet.orst.edu/pips/glyphosa.htm (accessed Sept. 30, 2017)

Pimentel D, Levitan L. 1986. Pesticides: amounts applied and amounts and amounts reaching pest. Bioscience 27:178-185.

PPQ&S, 2019. Area under cultivation and under use of chemical & bio- pesticides during 2014-15 to 2018-19. Pesticide Monitoring and Documentation Unit. Directorate of Plant Protection and Quarantine and Storage, Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture, Government of India.

PPQ&S, 2019. Consumption of chemical pesticides in various States/UTs during 2014-15 to 2018-19. Pesticide Monitoring and Documentation Unit. Directorate of Plant Protection and Quarantine and Storage, Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture, Government of India.

PPQ&S, 2019. Pesticide wise consumption of indigenous pesticides during 2014-15 to 2018-19, Pesticide Monitoring and Documentation Unit. Directorate of Plant Protection and Quarantine and Storage, Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture, Government of India.

Pretty J. 2008. Agricultural sustainability: concepts, principles and evidence. Philosophical Transactions of the Royal Society B: Biological Sciences. Vol. 363:447–465. DOI:10.1098/rstb.2007.2163.

Pubchem 2004. Glyphosate Compound Summary.National Center for Biotechnology Information. PubChem Compound Database; CID=3496, https://pubchem.ncbi.nlm.nih.gov/compound/3496 (accessed Oct. 2, 2017)

Raina S, Sood V, Shah B, Thakur M, Sharma R. 2019. Acute herbicide poisoning: an emerging phenomenon in Himachal Pradesh, India. Recent Adv Biol Med. Vol. 5, Article ID 881092, 5 pages. https://doi.org/10.18639/RABM.2019.881092

Ratra, G. S.; Casida, J. E. 2001. GABA receptor subunit composition relative to insecticide potency and selectivity. Toxicol. Lett. 122, 215-222.

Reigart, J. R.; Roberts, J. R. 1999. Organophosphate Insecticides. Recognition and Management of Pesticide Poisonings, 5th ed.; U.S Environmental Protection Agency, Office of Prevention, Pesticides and Toxic Substances, Office of Pesticide Programs, U.S. Government Printing Office: Washington, DC.

Samanta, P., Pal, S., Mukherjee, A.K. 2019. Effects of Glyphosate-Based Herbicide (Excel Mera 71) on Digestive Enzymes and Recovery Pattern in Teleostean Fishes. Proc Zool Soc 72, 54–60. https://doi-org.ezproxy.uct.ac.za/10.1007/s12595-017-0255-6

Schreck, E. Geret, F. Gontier, L. Treilhou, M. Neurotoxic effect and metabolic responses induced by a mixture of six pesticides on the earthworm Aporrectodea caliginosa nocturna. Chemosphere 71(10) 2008:1832-1839.

Sebiomo A, Ogundero VW, Bankole. Effect of four herbicides on microbial population, soil organic matter and dehydrogenase activity. Afr J Biotechnol. 10 SA (2011):770–778

Shah, P. V., Fisher, H. L., Sumler, M. R., Monroe, R. J., Chernoff, N., and Hall, L. L. 1987. Comparison of the penetration of 14 pesticides through the skin of young and adult rats, J. Toxicol. Environ. Health, (21), 353

Stacy Malkan. 2020. Glyphosate Factsheet: Cancer and Other Health Concerns. www.usrtk.org

Stephen O. D. 1990. Overview of Herbicide Mechanisms of Action. Environmental Health Perspectives. Vol. 87, pp. 263-271.

Talbot, A. R.; Shiaw, M. H.; Huang, J. S.; Yang, S. F.; Goo, T. S.; Wang, S. H.; Chen, C. L.; Sanford, T. R. 1991. Acute poisoning with a glyphosate surfactant herbicide ('Roundup'): A review of 93 cases. Hum. Exp. Toxicol. 10 (1), 1-8.

Thakur, D. S., Khot, R., Joshi, P. P., Pandharipande, M., & Nagpure, K. 2014. Glyphosate poisoning with acute pulmonary edema. Toxicology international, 21(3), 328–330. https://doi.org/10.4103/0971-6580.155389

Tomlin, C. D. S. 2006. The Pesticide Manual, A World Compendium, 14th ed.; British Crop Protection Council: Alton, Hampshire, UK. p 186-187

UNEP 2004. Childhood pesticide poisoning: information for advocacy and action. Geneva, Chemicals Programme of the United Nations Environment Programme (UNEP), Food and Agriculture Organisation, World Health Organisation. http://www.who.int/entity/ceh/publications/pestpoisoning.pdf. (accessed Oct. 2, 2017).

Waichman AV, Römbke J, Ribeiro MOA & Nailson CSN. 2002. Review Articles Use and fate of pesticides in the Amazon State, Brazil Risk to human health and the environment. Environmental Science and Pollution Research 9 (6): 423-428, DOI: 10.1007/BF02987596

WHO. 2009. The WHO recommended classification of pesticides by hazard and guidelines to classification. WHO Library Cataloguing-in-Publication Data. World Health Organization, pp: 19-38. (Downloaded from http://www.inchem.org/documents/pds/pdsother/class_2009.pdf on 13th June 2017)

"Acquavella JF, Alexander BH, Mandel JS, Gustin C, Baker B, Chapman P, Bleeke M. 2004. Glyphosate biomonitoring for farmers and their families: results from the farm family exposure study. Environ Health Perspectives. 112(3): 321-6." on page 53

Report in Brief

This study presents the fact that glyphosate use is happening in India violating the national regulations as well as the International Code of Conduct on Pesticides Management. An order issued by the West Bengal Agriculture Department in 2019, quoting the Secretary of Department of Agriculture, Cooperation and Farmers Welfare, Government of India states that glyphosate formulations are 'registered to be used in Tea Plantation Crop and non plantation area accompanying the Tea crop and any use beyond this is illegal and in violation of the insecticides Act, 1968 and Rules, 1971'. Ironically, this field study has noted at least 20 non-approved uses with 16 of them in food crops. In the light of mounting evidences on the unacceptable health and environmental outcomes of glyphosate, the ground reality of its use in India is seen as an 'anarchic' scenario. This would have undesirable impacts on soil health, farm productivity, food safety, agriculture trade, public health, as well as environmental wellbeing in the country. The scenario of glyphosate use thus necessitates the urgent need of eliminating it from India.

About the Author

Dileep Kumar A. D. has completed his post graduation in Zoology in 2011 from the Kannur University in Kerala, India. Following, he joined the public interest environmental research group named Thanal in Kerala, and since 2013, he became part of Pesticide Action Network (PAN) India as well. He has been into research and studies to understand ground reality of pesticide use in India and its public health and environmental impacts and published couple of studies. He has completed a two year Post Graduate Diploma in Pesticide Risk Management from the University of Cape Town, South Africa in 2019.

About PAN India

Pesticide Action Network India (PAN India) is a public interest research and advocacy non-profit organisation formed in 2013. PAN India is a national independent organization in India, working closely with the PAN Asia Pacific and PAN international community. PAN India's objective is to help communities and governments to reduce dependence on toxic chemicals for pest control in agriculture, household as well as public health and to increase the use of sustainable alternatives. PAN India is committed to safe farming, safe living and safe working place. PAN India is working to make India a world leader in Agroecology by empowering farming communities to keep away from toxic pesticides and agrochemicals, and to take up non-chemical methods of farming practices that champion traditional knowledge, biodiversity, and farmer participated research in attaining food sovereignty.

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For a just and pesticide-free future