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Review Article

Assessment of Local Pesticides Used by Farmers in Jorhat District

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Abstract— The indiscriminate use of chemical pesticides has raised concerns about environmental degradation, human health risks, and the sustainability of agricultural practices worldwide. In the context of Jorhat District, Assam, local farmers rely on both chemical and traditional pesticides to combat pests and ensure crop productivity. The aim of this research is to determine the types, usage patterns, and impacts of local pesticides applied by farmers in five selected villages: No.2 Sonari Gaon, Sotai Bhakat Gaon, Kakojan (Bonpithaguri village), Sokai Khongiya Gaon, and Garumora. Data were collected through field surveys, structured interviews, and questionnaires filled by 100 farmers across the study sites.

Keywords— Agriculture, pesticide, farmer, vegetable, productivity, Plants, Crops

1. Introduction

1.1 Background

Agriculture is the backbone of India's economy, providing livelihood to over 50% of the population and contributing significantly to national GDP. In Assam, a predominantly agrarian state in northeast India, the agricultural sector not only sustains rural livelihoods but also plays an important role in ensuring food security. The resulting pressure to increase crop yields had pesticide use increase in recent years, particularly with pesticides that are synthetic and quite harmful to the environment and also human health. Jorhat District, known for its highly fertile alluvial soils and diversification into many crops, summarizes the challenges and opportunities of pesticide use in Assam. Farmers in this area grow rice, tea, vegetables, and pulses, among many other crops that pose specific management challenges. Such farmers, on their part, use a combination of various pesticide formulations from the chemical and more traditional, indigenous methods. Although chemical pesticides have been widely applied for pest control, indiscriminate use has sparked various concerns; among them, the degradation of soil health and contamination of water sources are prominent along with the occurrence of pesticide-resistant pests. The primary aim of this research study is to gauge the kinds of pesticides applied by farmers in chosen villages of Jorhat District and analyze what determines their decision. The chosen villages are No.2 Sonari Gaon, Sotai Bhakat Gaon, Kakojan (Bonpithaguri village), Sokai Khongiya Gaon, and Garumora. This has been selected from villages representing a diverse spread of agriculture and ease of accessibility along with an assorted spread of socio-economic status. The use of chemical pesticides in Jorhat District, as in other parts of India, is often characterized by improper application, lack of protective measures, and limited knowledge of safe handling practices. Many farmers rely on advice from pesticide dealers rather than agricultural experts, leading to overuse or misuse. Moreover, traditional pest control practices, which are eco-friendly and cost-effective, are often overlooked or underutilized. This study aims to fill this knowledge gap by documenting current practices and evaluating their environmental, economic, and health implications.

1.2 Scope of Study

The most important part of this research is the analysis of farmers' knowledge and attitudes towards IPM practices. IPM is an environmentally friendly practice that uses biological, cultural, mechanical, and chemical methods for pest control without harming the environment. Despite the well-documented advantages of IPM, adoption in rural areas remains limited because of a lack of awareness, poor training, and a perception of the process as complicated. Focusing on the local context of Jorhat District, this study will contribute to the broader discourse on sustainable agriculture. Findings are expected to provide valuable insights into the dynamics of pesticide use in rural Assam, with challenges and opportunities for promoting safer agricultural practices. In addition, such a study will emphasize multi-stakeholder collaboration among farmers, policymakers, researchers, and extension workers in addressing the dual objectives of

productivity in agriculture and environmental sustainability. The paper is structured as follows: methodology shows the research design, sampling methods, and data collection techniques used in this study. The results and discussion section reports on the most crucial findings in this research work by pointing out types of pesticides, their usage patterns, and their impact on soil, water, and health conditions for farmers. Conclusion and recommendations for action for all the stakeholders have been put forth to help prevent adverse effects and promote sustainable alternatives.

1.3 Objectives

- To study and analysis of local pesticides
- To study the use and effectiveness of local pesticides
- To discover new environmentally free pesticides

2. Methodology

2.1 Village Selection:

The study was conducted in five villages within the Jorhat district, carefully selected based on their agricultural diversity, prevalent use of local pesticides, and ease of accessibility. These villages were chosen to represent a variety of agricultural practices and pesticide usage patterns. I selected the following villages because the farmers of these villages often use different types of pesticides for their crop improvement. They often try different types of pesticides that are available in their villages locally. The villages included in the study are:

a**) No.2 Sonari Gaon** – This place is known for rice and vegetable cultivation. Here, the farmer uses both chemical and local pesticides.

b**) Sotai Bhakat Gaon** – It is a fruit orchard major village and a pulse cultivator, where the organic pesticide methods are also applied.

c) **Kakojan (Bonpithaguri Village)** – The area is mainly known for its tea gardens, while vegetable farming occasionally takes place here. The percentage of local pesticide use is high in this region.

d) **Sokai Khongiya Gaon –** Chiefly engaged with paddy as well as mustard and the farmers do use a mixed bag of pesticide available in villages and in commercial markets.

e) **Garumora –** Agragricultural cultivation of rice and tea and the vegetables, whereby traditional and innovative pesticide practices tend to go simultaneously.

2.2 Field Observe & Discuss with Farmers

To gather comprehensive data on the use and impact of local pesticides, field observations were carried out in all five villages. The observations covered direct effects of the pesticides on crop plants such as changes in plant health and growth patterns as well as indirect environmental implications in terms of soil degradation, water contamination, and impact on non-target organisms.

On each visit to the crop fields, I closely examined areas where local pesticides have been applied. All obvious symptoms of pesticide toxicity on the crops were recorded, along with any obvious changes in soil quality or of surrounding ecosystems. Furthermore, the frequency and timing of application, method of application (e.g., spraying or soil application), and protective measures used by farmers during application were recorded.

Besides the field observations, I conducted in-depth interviews with a range of local stakeholders: farmers, agricultural workers, and traditional healers. The interviews were intended to gain particular, detailed information on which, specifically, are used pesticides, which methods of preparation are used (such as plant-based extracts or concoctions based on chemicals), and to which pest or disease they are thought to be applied.

The interviews had shed light upon the traditional knowledge pertaining to the pesticide usage along with the various apprehensions and difficulties the farmers might have had related to the efficiency and safety of pesticides. These were captured using structured interviews across the different villages.

2.3 Period & Number of Surveys taken along with number of village visits

The data collection process was conducted over five days, with each day allocated to visiting one of the selected villages. Each visit involved a combination of field observations, interactions with local farmers and agricultural workers, and interviews with key informants such as traditional healers, who often play a role in recommending or preparing local pesticides. This structured approach allowed for a detailed comparative analysis of pesticide practices across the different villages in Jorhat district.

3. Results and Discussion

Different types of local pesticides & their effects along with their making processes used by the farmers of visited villages are as follows:

a) Neem:

Process of making: The farmers first collect the matured leaves of neem plants and make a paste using morter or other local pesting tools (eg. Dheki). After making pest they add water to convert the pest into liquid form. The liquid is now ready to use in the crop fields.

Process of use: The neem liquid is sprayed in the leaves of crop plants by using hand sprayers.

Effects: According to the local farmers the neem pesticide repels different kind of pests and insects which help the crop plants to grow without any disturbance. This pesticide has no negative effect on the crop plants as well as the environment.

However, in heavy rain the pesticide gets flowed with rainwater. That is why after a heavy rain, farmers again need to spray it in their crop fields.

Scientific reason of using neem as pesticide

Neem (*Azadirachta indica*) is widely used as an organic pesticide due to presence of various compounds that have multiple effects on pests and pathogens. The primary scientific reasons for neem's effectiveness as a pesticide are rooted in its complex chemical composition, particularly the presence of azadirachtin, a powerful insecticidal compound. Here's a breakdown of the scientific reasons why neem is effective as a pesticide:

Insect Growth Regulator: Azadirachtin, the most active compound in neem, interferes with the normal growth and development of insects by disrupting their hormonal systems. It mimics the action of the insect hormone ecdysone, which is responsible for molting and metamorphosis. As a result, insects exposed to azadirachtin have difficulty molting, leading to death or incomplete development.

Feeding Deterrent: Azadirachtin acts as a potent antifeedant, making plants treated with neem unpalatable to many insects. It interferes with the insect's ability to taste and digest food, reducing feeding and eventually leading to starvation.

Reproductive Inhibition: Neem disrupts the reproductive systems of insects. It reduces egg-laying, fertility, and can cause sterilization in some insect species, thus lowering pest populations over time.

Biodegradability and Safety: Neem is biodegradable and breaks down rapidly, decreasing the risk of long-term contamination. It is generally safe for organisms that are not in target, including beneficial insects (like bees), birds, and mammals, making it an ecologically friendly alternative to synthetic pesticides. Neem-based pesticides are considered safe for humans when used according to recommended guidelines. The toxicity of neem compounds is significantly lower compared to many synthetic pesticides, which reduces the risk of adverse effects on human health.

b) Tobacco:

Process of making: It is made by drying the tobacco leaves. After drying, the leaves are crushed and converted into powder.

Process of use: The powder is either sprayed directly or mixed with water to make a liquid.

Effects: This pesticide contains high amount of nicotine content. Nicotine is a natural insecticide and is toxic to many insects. This pesticide can kill aphids, mites and other insects that are harmful for crop plants.

Scientific reason:

Mode of Action: Nicotine acts on the nervous system of insects. It acts on the acetylcholine receptors, neurotransmitter receptors critical for transmitting nerve impulses. When nicotine binds to these receptors, it disrupts normal nerve signalling, causing hyperexcitation, paralysis, and at last the death of the insect.

Broad spectrum: Nicotine is toxic to a wide range of insects including aphids, whiteflies, caterpillars etc. For this reason, tobacco is helpful in a variety of agricultural uses. Natural Insect Repellent: Nicotine does not kill pests alone but also acts as a repellent, inhibiting insects from feeding on the plants treated with tobacco extract. A double action-nicotine as a repellent and as toxin-is responsible for its high effectiveness as an insecticide.

Low persistence: Nicotine degrades relatively quickly, reducing the risk of harmful effects to non-target species, which is a concern with many synthetic pesticides. However, this does mean that frequent applications may be necessary to achieve sustained pest control.

History of Use: Traditionally, tobacco has been used as an organic pesticide in farming for decades. The fact that its efficiency against pests was recorded across different cultures has made its use extended well into modern times of organic farming.

Resistance Concerns: On the other hand, similar to synthetic insecticides, insects could develop resistance against nicotine-based pesticides. This therefore calls for judicious management and in some cases combinations with other methods of control.

c) Chilies:

Process of making & use: chilies are first crushed or grinded and after crushing, they are boiled and soaked overnight. After that, the solid particles are removed (filtrated) from the liquid by using nets. After filtration, the liquid is used in the crop fields. Some farmers also mix soap in the liquid. According to them, mixing soap increases the gummy property of the liquid which make the liquid more tolerant to heavy rain falls.

Effects: The capsaicin in chilies acts as a deterrent to many pests, including aphids, beetles, caterpillars.

Scientific reason of using as pesticide:

Irritation to Insects: The nervous system sensory parts of the insects are affected by capsaicin. It inflicts a burning sensation upon the contact of insects with capsaicin, which acts as a deterrent in feeding on plants.

Disruption in Feeding and Reproduction: The unpalatability of capsaicin for the pest makes the plant material unpalatable; hence, it disturbs the feeding habits of the pests. This interference in feeding may curtail the increase in the reproductive rates of the pests since they cannot obtain the nutrients they need from one source. Chili-based insecticides have wide-spectrum efficiency against a wide variety of pests, including aphids, whiteflies, beetles, and caterpillars. The wide-spectrum action of chili-based

pesticides makes this plant attractive to farmers as they continue their search for a natural and versatile pesticide.

Low Toxicity to Human beings and also to the Environment: Unlike pesticides containing chemicals, the biological nature of chili-based pesticides makes them biodegradable and less toxic to humans, animals, and the environment, hence a safer option in integrated pest management practices.

Synergistic Effects: Chili could be mixed with other organic materials, like garlic or neem oil, for better pesticidal action. This synergistic action may provide increased effectiveness of pesticide applications or a wider spectrum of action.

Advantages: Chili pesticide is biodegradable which makes it eco-friendly. Also, it doesn't have any negative effect on plants and human beings.

d) Tulsi
Tulsi (Basil) is used as pesticide in different ways as mentioned below:

Tulsi leaf Extract Spray: Here tulsi leaves are boiled in water for 10-15 minutes & after cooling, it is sprayed in crop fields using hand sprayers.

Tulsi leaf powder : The tulsi leaves are dried and grinded into fine powder. The powder can be sprinkled around the base of plants.

Companion planting : Tulsi plants are planted as a companion plant with other crops like brinjal, tomatoes etc.

Effects: Tulsi is highly insect & pest repellent due to its smell. It has no negative effects on crop plants according to local farmers.
The local farmers use this pesticide on their vegetable fields.
Scientific reason of using as pesticide :

Certain bioactive compounds present in Tulsi include eugenol, ursolic acid, and rosmarinic acid. These are strongly insecticidal in nature; they either repel or kill the pests that attack crops.

Insect Repellent Properties: Eugenol, one of the major components of Tulsi oil, may act as a natural repellent against insects. Its mode of action is interference with the nervous system, which eventually results in paralysis or death.

Antifungal Activity: The essential oils present in Tulsi exhibit antifungal activity by safeguarding the plants against fungal pathogens. Its constituents inhibit the growth of fungi that cause crop diseases.

Antibacterial Effects: There are reports that the extracts of Tulsi also exert antibacterial effects, thereby reducing the chances of bacterial infection in crops, which may otherwise be highly disastrous.

Safety to the Environment: Being of natural origin, the pesticides manufactured through Tulsi are bio-degradable and hence much safer for the environment compared to the synthetic chemicals by which the risk of contamination of soil and water may be minimized.

e) Cow urine:
Cow urine is sprayed directly on the crop fields by sprayers.
Effects: cow urine repels or kills different kinds of insects that are harmful for crop plants. Moreover, cow urine is a natural fertilizer that improves the soil health and plant growth.

Scientific reason of using as pesticide:
Bioactive Compounds Urea: Cow urine contains toxic urea for certain insects and pests. Urea disturbs the metabolic pathway of the pests which ultimately results in their death. Ammonia: Ammonia present in cow urine acts as a deterrent for pests. It disrupts the nervous system of the insects; hence it can work effectively as an insect repellent.

Phenols: The phenolic compounds in cow urine possess antimicrobial properties. These can inhibit the growth of bacteria, fungi, and other microorganisms that can be harmful to plants.

Minerals: Similarly, other minerals present in cow urine, such as sulfur, also contribute to repelling pests and improving the growth of plants.

Inhibition of Pathogens: Cow urine has been found to inhibit the growth of various plant pathogens, including fungi and bacteria that reduce the incidence of plant diseases.

Activity of Enzymes: Some of the enzymes present in cow urine are capable of degrading the cell wall of the pathogen, making it ineffective.

Odour: The sharp smell of the cow's urine itself may be an effective natural deterrent to a very wide range of insects and pests. This smell interferes with the pests' mechanisms of sensing, which, in turn, keeps them away from the crops.

Fermentation Products: Fermentation products of cow urine may present some by-products of the process which might be more effective in repelling pests.

Non-toxic to Environment: Cow urine, being biodegradable by nature, does not cause any harm to the environment on its application, unlike synthetic pesticides. It degrades naturally without leaving behind toxic residues.

Safe to Non-target Organisms: Cow's urine usually does not affect organisms that are not in target such as beneficial or useful insects, soil microbes, and humans and hence is an eco-friendly chemical pesticide substitute.

Combination with Other Substances: Cow urine, upon combination with other natural substances like neem or other herbal extracts, acts synergistically to enhance its pesticidal

effect due to the interactions that may exist between its various bioactive components.

f) Garlic:

Preparation method: The garlic cloves are crushed and steeped in water for several hours (overnight). The mixture is then strained and mixed with water to dilute. Some farmers also use liquid soap to increase its adhesive property.

The solution is directly sprayed in the leaves and stems of the plants.

Another method used by farmers is to plant garlic cloves around the base of crop plants. As the garlic decomposes, it releases insect repellent compounds.

Scientific reason of using Garlic as pesticide:

Production of Allicin: When garlic is broken by crushing or chopped, it produces a compound called allicin. Allicin is responsible for the strong odour of garlic and is toxic to many pests. Antimicrobial and antifungal properties have been elicited by allicin, which protects the plants from pathogens causing diseases.

Sulphur Compounds: Garlic contains sulphur compounds, like diallyl disulphide and diallyl trisulfide, which are toxic to insects. These can act as a repellent so that insects will keep away from feeding or laying eggs on treated plants.

Inhibition of Pest Reproduction: Several works also suggest that garlic extracts interfere with the reproduction cycle of some insects; thus, their population decreases with time.

Repellent Properties: The strong smell of garlic repels a number of insects, which may include aphids, mosquitoes, beetles, and many more. This masks the host plant smell, making it less attractive to the pest. Garlic is nontoxic to humans and pets and is safe to use for your pest management practices, especially in organic farming. Moreover, garlic works against a wide variety of insects and pests, including fungi, and bacteria, hence useful in integrated pest management system.

g) Wood ash:

Wood ash is directly sprinkled on crop the fields physically.

Effects: Wood ash makes a protective layer on the surface of leaves and stems due to which pests and insects cannot survive on it.

Wood ash contains essential nutrients like potassium, phosphorus & calcium which can improve plant health. Wood ash also can dehydrate insects and other pests, leading to their death.

Scientific reason for use:

High pH Levels: Wood ash is extremely alkaline, with pH levels commonly falling in the range of 9 to 13. Such a high pH, if directly applied to plants or soil, gets so unlivable for many pests; most soft-bodied insects like slugs and snails cannot survive under strong alkaline conditions.

Drying Effect: Wood ash is of a desiccating nature. On contact, it dries up insects or their homes, essentially by sucking the moisture from the insect body, hence killing them in that process. This will especially work effectively against pests such as slugs, snails, and some types of larvae.

Physical Barrier: Wood ash can work as a physical barrier. The fine ash may cause irritation on the body of crawling insects, hence increasingly discouraging them from being able to mobilize and feed on the plants.

Odour: The smell of wood ash may be repulsive to some pests, although this is rather anecdotal and varies depending on the type of wood burned.

Potassium and Micronutrients: Wood ash does contain potassium (K), calcium (Ca), and trace amounts of other micronutrients. Potassium is known to strengthen plant cell walls, making plants more resistant to pests and diseases. Calcium is also an important constituent for plant health, improving disease resistance such as blossom end rot in tomatoes.

Antifungal Action: It is assumed that the alkaline nature of wood ash could impede the growth of some fungi, hence reducing fungal diseases in plants. It further changes pH on the surface of the plant or in the soil, making the environmental conditions adverse for spore germination. **Soil**

Amendment: Although this is not pesticide action per se, wood ash can improve soil structure and fertility for better plant health over time; thus, plants better able to tolerate pests. This has been included below due to the added value it presents.

Silica Content: Wood ash may contain small amounts of silica that improve plant tissues by making them less palatable or difficult to damage by pests.

h) Black peeper powder:

Black peeper is used in crop fields by mixing it with water & forming a liquid. The liquid solution is directly sprayed with hand pumps. It is also mixed with soil in some of the villages. Another method used by local farmers is to make powder of the peepers and sprinkle it to the plants.

Effects: Black peeper can irritate the mouthparts as well as respiratory systems of the pests. Black peeper is not much effective to all types of pests. Its effectiveness depends on the species of pests.

Scientific reason of use:

Piperie: The major active principle of black pepper is piperine, which shows insecticidal and repellent action. This may disturb the nervous system of the pests and render them incapable of performing their normal functions, thus leading to death or repulsion.

Alkaloids: Black pepper contains some varieties of alkaloids, which tend to act as natural repellents to insects and pests.

Black pepper possesses anti-fungicidal properties, which are useful in restraining the fungal growth of crops. It may prevent plants from diseases caused by fungal infections.

Mode of Action: Nervous System Disruption: Compounds in black pepper disrupt neurotransmitters in pests, leading to paralytic or lethal outcomes.

Repellent Effect: The strong smell and bitter taste of black pepper act as a repellent to keep pests away from plants.

Environmental Impact: Unlike chemical pesticides, black pepper is biodegradable and nontoxic to both humans and animals, and the environment; hence, it is safer for use in agricultural practices.

i) Fish oil:

The preparation method used by local farmers is as follows :-

Preparation of Fish Waste:

- Collection of fish waste or small fish, typically those that are not suitable for consumption.
- Cleaning of the fish thoroughly to remove any dirt or impurities.

Fermentation :

- Fish waste is then put in a large container like a plastic drum or a clay pot.
- After that, an equal amount of molasses or jaggery is added to ferment the mass for the container to attract the beneficial microorganisms.
- Later, water should be added so that the fish waste and molasses can be covered by the stirred water, and then mix the mixture evenly to ensure a homogeneous distribution.
- The cover should be slightly loose so that the gases can escape from the container during the fermentation period. The fermentation process shall take 2 weeks up to a month depending on the temperature and other aspects.
- Every 3-4 days we have to mix the mixture so that each part of it can ferment equally**.**

Extraction:

- A layer of oil forms on top of the solution after the fermentation process. It is the fish oil.
- The fish oil is then extracted carefully and then stored separately. The rest of the liquid can be used as a natural fertilizer.

Pesticide preparation:

To be used as a pesticide, the extracted fish oil should be mixed with water in the ratio 1:20 (1 part fish oil in 20 parts water).

Within the framework of the procedure, we can also include juicing garlic, grating ginger, or adding hot chili to the previous choice to increase the properties of pest rejection of the mixture.

Application:

The solution can be directly sprayed to the crop fields.

Effects:

Physical Barrier: Spray fish oil in the form of a thin oily film to the plant surfaces which can sit on the small insects' respiratory spiracles causing their suffocation, thus aphids, mites, and whiteflies are killed.

Repellent Effect: The strong odour of fish oil acts as a natural repellent to many pests, deterring them from feeding on the plants.

Fish oil can help in controlling fungal diseases. The oil film can inhibit the growth of fungi by blocking the spores from penetrating the plant tissues and reducing the moisture needed for fungal growth.

Fish oil is rich in nutrients such as omega-3 fatty acids, vitamins, and proteins. When used as a pesticide, it can also provide a foliar feed, enhancing the health and resilience of the plants, which helps them resist pests and diseases more effectively.

Like the synthetic chemically produced pesticides, fish oil is also biodegradable and breaks down naturally reducing the risk of contamination of soil and water. This makes it a safer option for both the environment and the people who handle it.

Scientific reason of use :

Physical Barrier and Suffocation: Fish oil can physically protect plants and pests by forming a barrier on its surface. When applied to insects, it coats their bodies and blocks their spiracles-breathing pores-causing suffocation and death of the insect. Very effective against soft-bodied insects like aphids, mites, and larvae of certain beetles.

Repellence: Fish oil odours and tastes repel certain pests from feeding on the plant. This in turn is advantageous because it prevents infestation without harming the plant itself.

Improvement of Natural Defenses: These fish oils are usually made up of omega-3 fatty acids, which improve the health of plants. It will ensure good results on the stress and pathogen-resistive ability of the plant by enhancing the resistance of the attacked plant against disease and pest.

Synergic Action with Other Substances: Generally, the application of fish oil is combined with other substances that are either oils or natural pesticides, such as neem oil. That is how one substance may enhance the action of the other and give a broader effect regarding pest control through several modes of action.

Eco-friendly and biodegradable: Fish oil does not leave harmful chemical residues in the environment as many chemical pesticides do, making it a safer alternative for organic farming.

j) Sulphur:

Sulphur has been used as a pesticide for centuries, particularly as a fungicide and insecticide. It is applied by

local farmers in various forms, including dust, wettable powders, and liquid formulations.

Effects:

Fungicidal Properties:

Sulphur is highly effective against a variety of fungal pathogens. When applied to plants, it disrupts the cellular processes of fungi by interfering with their respiration and enzyme function. Sulphur vaporizes on the plant surface, which then forms sulphur dioxide, a substance that is toxic to fungi.

Targeted Diseases: Sulphur is effective against diseases like powdery mildew, rusts, scabs, and leaf spots. It's commonly used on crops such as grapes, apples, pears, and various vegetables to control these fungal infections.

2. Insecticidal Properties:

Sulphur acts as a contact insecticide. It affects insects by disrupting their metabolic processes, particularly through interference with their respiration. Sulphur can also have a repellent effect, discouraging pests from feeding on treated plants.

Targeted Pests: It is particularly effective against mites (such as spider mites) and thrips. Sulphur's fine particles can penetrate their exoskeletons and disrupt their metabolism, leading to their death.

3. Fumigant Action:

Soil Treatment: Sulphur can also be used as a soil fumigant to control soil-borne pests and pathogens. When sulphur is incorporated into the soil, it oxidizes to form sulfuric acid, lowering the soil pH, which can suppress harmful soil organisms.

4. Safety and Environmental Impact:

Low Mammalian Toxicity: Sulphur is considered to have low toxicity to humans and animals, making it a safer alternative to many synthetic pesticides. However, direct contact with sulphur can cause skin and eye irritation, and inhalation of sulphur dust or fumes can irritate the respiratory system.

Environmental Considerations: Sulphur is generally considered environmentally friendly because it is naturally occurring and breaks down in the environment without leaving harmful residues. However, excessive use can lead to soil acidification, which may negatively impact soil health and non-target organisms.

k) Bordeux mixture:

Bordeaux mixture is a traditional fungicide and bactericide that has been used for over a century in agriculture to reduce fungal diseases in crops like potatoes, grapes, brinjals, and tomatoes. It is made from copper sulphate (blue vitriol) and hydrated lime (slaked lime).

Farmers buy this pesticide from shop & apply to their crop fields.

Effects:

Fungal Protection: Bordeaux mixture is highly effective in controlling a broad range of fungal diseases like black spot, downy mildew, powdery mildew, and blight. It works by creating a protective barrier on the plant's surface that prevents fungal spores from germinating and spreading.

Bacterial Protection: In addition to fungi, Bordeaux mixture can also help control bacterial infections, making it a versatile tool in plant disease management.

Scientific reason of use:

Antifungal Properties: Copper ions from copper sulfate are fungotoxic. The action of Bordeaux mixture on plants involves interference with the enzymatic and proteinaceous aspects of fungal cells, inhibition of growth, and reproduction. Thus, the range from downy to powdery mildews and blights of fungal diseases become effectively controlled by Bordeaux mixture.

Bactericidal Effects: Besides antifungal activity, Bordeaux mixture can also show bactericidal effects. Copper ions may exert their lethal action on bacteria through cell wall damage, proteins, and enzymes. It is useful, particularly for the prevention of bacterial diseases in crops. The protective barrier arises when the Bordeaux mixture forms a layer over the plant surfaces, thereby preventing fungal spores and bacteria from reaching the plant tissues. This could prevent the incidence of diseases, more so under rainy conditions due to the fact that this is when most fungi grow.

Residual Activity: Bordeaux mixture is relatively long-acting, considering the duration it remains effective on the plant surface after application. This keeps the plant protected for some time from possible infection, hence reducing frequent application of the same.

Compatibility with Organic Farming: Bordeaux mixture is considered an acceptable treatment in organic farming practices since synthetic fungicides have no allowance. Therefore, it offers a good implement for farmers involved in organic farming and looking forward to managing the plant diseases through traditional methods.

Wide Spectrum of Activity: The Bordeaux mixture has a wide range of activity against fungal and bacterial pathogens, and its application consequently implies its flexibilities to farmers who deal with numerous plant diseases.

Sl no.	Village Name	Pesticide no.	Name of pesticide	Source of pesticide	Type of pesticide
1	No.2 Sonari Gaon	1	Neem	Neem plant	Plant based
		2	Tobacco	Tobacco plant	Plant based
		3	Ash of burned wood	Burned wood	Mineral Based
		4	Garlic	Garlic	Plant based
		5	cow urine	Cow	Animal Based
2	Sotai Bhakat Gaon	1	Tobacco	Tobacco plant	Plant based
		2	Chilies	Chilli plant	Plant based
		3	Tulsi	Tulsi plant	Plant based
		4	Ash of burned wood	Burned wood	Mineral Based
		5	Cow urine	Cow	Animal Based
3	Kakojan	1	Garlic	Garlic	Plant based
		2	Neem	Neem plant	Plant based
		3	Tobacco	Tobacco plant	Plant based
		4	Fish oil	Fish	Animal Based
4	Sokai Khangiya	1	Black peeper powder	Black peeper	Plant based
		2	Sulfur	Sulfur	Mineral Based
		3	Neem	Neem plant	Plant based
		4	Cow urine	Cow	Animal Based
5	Garumora	1	Tobacco	Tobacco plant	Plant based
		2	Chlilies	Chilli plant	Plant based
		3	Bordeaux mixture	Copper	Mineral Based
		4	Neem	Neem plant	Plant based
		5	Tulsi	Tulsi plant	Plant based
		6	Garlic	Garlic	Plant based

Table 1. Types of local pesticides used in some selected villages

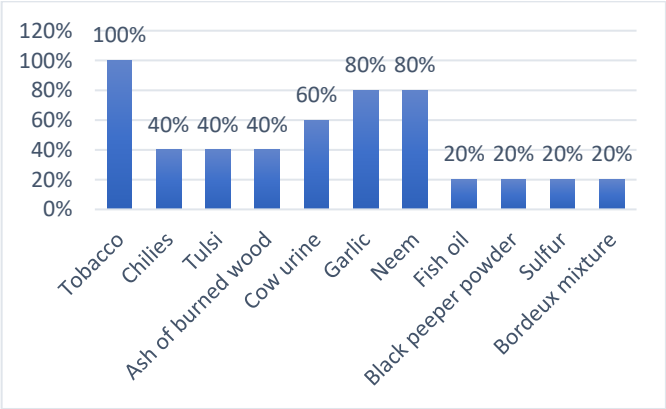

Fig 1. Popularity % of the pesticides among local farmers

4. Review of the result

From the given data (Table1 & Fig1), I can say that the farmers of the villages I selected often use plant based local pesticides in their crop fields.

In the Table1, I have given the data which I collected from the interviews with the farmers. I have included the village names, Pesticide names, Source of pesticides, and the type of pesticides for a better knowledge.

If we observe the Fig1 we see that Tobacco is the most popular (100%) among the villages followed by Garlic & Neem (80%); Cow urine (60%); Chilies, Tulsi, Wood ash (40%); And Fish oil, Black peeper, Sulfur, Bordeux mixture have lowest popularity (20%) because of their less effectiveness.

5. Conclusion and Future Scope

In this study, the main purpose was to review the local practices of pesticide in Jorhat district and its application among different farmers in a bid to explore the various pesticides, their preparation modes, and what effects these exhibit on crop plants and the surrounding environment.

5.1 Diversity of Pesticide Practices: Local pesticides are applied in very different ways in the chosen villages. While some of the villages are dependent on plant-based concoctions made from local plants, other villages use chemical pesticides. Most of these chemical pesticides are made using locally available materials such as neem leaves, garlic, and tobacco, mixed with water or oil. This variation reflects both the availability of resources and the cultural preferences for pesticide use in different communities.

5.2 Impact on Crop Health: The use of local pesticides has been somewhat successful in terms of pest control. In some cases, the local pesticides controlled specific pests such as aphids, caterpillars, and fungal infections.

5.3 Environmental and Health Issues: The study indicated several environmental concerns associated with local pesticides. For example, in some villages, inappropriate application methods like overuse or incorrect dilution led to degradation of soil and water contamination as well as harmful to some beneficial insects such as pollinators. Moreover, health issues of farmers and agricultural workers were a great concern, and there were reported cases of skin irritation and respiratory problems associated with exposure to certain pesticide ingredients.

5.4 Traditional Knowledge and Sustainable Practices: The interviews with traditional healers and older farmers emphasized the role of indigenous knowledge in managing pests through alternative, eco-friendly methods. In many cases, biological control agents and plant-based pesticides were found to be more sustainable. However, a combination of modern agricultural practices with traditional methods may provide a more balanced solution, reducing dependency on chemical pesticides while preserving local agricultural traditions.

In a nutshell, the local pesticides in Jorhat district are a potent force in managing pests. But their efficacy and environmental impact are a matter requiring much further research. It is important to educate farmers on safe pesticide usage, proper application, and the dangers of chemical pesticides over-

reliance. Further, the development of a better understanding of traditional, sustainable pest control methods may help to ensure more environmentally friendly farming practices and contribute to the long-term health of the environment and the agricultural community. Future research should focus on the development of safer and more efficient pesticide alternatives that can be easily adopted by local farmers without compromising crop yield or environmental integrity.

At last I can conclude that using local pesticides is very useful & cost effective for farmers through which they get relief from the cost of buying pesticides. Moreover local pesticides are ecologically friendly that we can use without any harmful effects.

5.5 Future Scope:

This study gives an initial insight into the trend of pesticide use by farmers of Jorhat District. However, subsequent studies can elaborate and broaden these results in a variety of ways:

- Other studies can also look into long-term impacts of the regional pesticides on water, soil, and species diversity within the region.
- More research can contribute to more effective policymaking and regulatory frameworks on pesticide use to facilitate more sustainable agriculture.
- A systematic review of the literature on pesticide exposure among consumers and farmers regarding the health impacts would be extremely useful to assess safety measures and mitigation.
- Exploring organic and bio-pesticides as alternatives to chemically produced pesticides would be an ideal move towards the encouragement of sustainable agriculture practices.
- AI, IoT, and remote sensing can be explored for application in the use of pesticides and monitoring for precision agriculture and minimum environmental impact.

By such research, future research can assist in supporting sustainable agriculture, better health for farmers, and environmental protection in the Jorhat District and other areas.

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