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THE EFFECTS OF HERBICIDES ON CROP PRODUCTION AND ENVIRONMENT IN MAKURDI LOCAL GOVERNMENT AREA OF BENUE STATE, NIGERIA

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ABSTRACT

The study examined the effects of herbicides on crop production and environment in Makurdi Local Government Area of Benue State. Simple random sampling technique was adopted in collecting data. Data were collected through primary and secondary sources. Primary source was by survey using structured questionnaire administered on 80 respondents (farmers that used herbicides) selected randomly from four council wards; secondary data were collected from books, journals, proceedings and documents. Data collected were analyzed through descriptive statistics. Results revealed that 75.0% of the respondents applied herbicides in the morning, 110.0% used non-selective herbicides, 100% had fatigue while applying herbicides, 100% read the instruction rebel of the herbicides before applying it, 82.5% applied herbicides facing the direction of wind and 80% had problem of high cost of herbicides. It is recommended that Agricultural Development Project (ADP) should organize training for farmers on application of herbicides and farmers should form associations so as to pull resources together, buy herbicides directly from the distributors and disburse among their members.

Keywords: Effects of herbicides, Crop production, Agricultural Development, Makurdi, Environment and Agrochemicals.

INTRODUCTION

Food production started from time immemorial, with the geometric increase in population of human beings the need to increase food production to feed large number of people led to the advent of technologies like machines, herbicides among others. New production technologies designed to revamp the agricultural sector and boost agricultural production has led to marked increase in crop yields. The issue of providing adequate food supply to meet requisite demand in Nigeria has been topical for a number of years, problems of food production and distribution has been elaborately analyzed with a variety of policy recommendations, among which is the use of agrochemicals not only to increase food production but to reduce food waste and hopefully enhance food producers income. The conventional methods of raising farm productivity since the World War II has centered on employing the use of externally acquired inputs like fertilizers and protection chemicals among others (Avav and Oluwatayo, 2006).

Agrochemicals refer to substances used to help manage an agricultural ecosystem, or the community of organisms in a farming area. Agrochemicals are important agricultural inputs to protect crops from diseases, pests and weeds. The uses of agrochemicals contribute not only to healthy growth of crops and animals but also to improve farm work efficiency and stable supply of tasty agricultural produce. Agricultural chemicals include fertilizers, pesticides, herbicides, rodenticides to

mention but just a few used to eliminate the presence of living things that causes injury or diseases to crops and to improve production. Although many kinds of chemicals are used in agriculture, they can be categorized into simple groups according to the functions they performed. This includes insecticides, herbicides, fungicides, molluscides, and rodenticides, just to mention but a few (Ayoola, 1990).

Herbicides use is not limited to crop production alone, its use in animal production include antibiotics administered either by injection or combined with feed; to control infectious diseases and parasites that often arise when animals are raised under extremely crowded conditions. In similar way to tractors, ploughs and other implements, herbicides have now become an integral part of the complex word of technical inputs required for modern agricultural production and are accepted as a standard tool of the trade by farmers throughout the world (Lever, 1990). For several years humans have utilized herbicides to protect their crops. The first known agrochemical was sulfur-dusting used in ancient summer about 4,500 years ago in ancient Mesopotamia. By the 15^{th} century, toxic chemicals such as arsenic, mercury and lead were being applied to crops to kill insects. In the 17^{th} century, nicotine sulfate was extracted from tobacco leaves for use as an insecticide. The 19^{th} century saw the introduction of more natural agrochemicals; pesticides and pyrethrum, which are derived from chrysanthemums, and rotenone, which is derived from the roots of tropical vegetables (Miller, 2002).

In the 1940s manufacturers began to produce large amounts of synthetic herbicides and their use became widespread. Some sources consider the 1940s and 1950s to have been the start of the agrochemical era. According to Miller (2002), agrochemical use has increased 50 fold, since 1950 and 2.3 million tonnes (2.5 million short tonnes) of industrial pesticides are now used each year. Seventy-five percent (75%) of all herbicides in the world are used in developed countries however; its use in developing countries is increasing. Many herbicides can be grouped into chemical families. Prominent pesticide families include organocholrines, organophosphates and carbamates. Organochlorine hydrocarbons (DDT) could be separated into dichlorodiphenylethanes, cyclodiene compounds, and other related compounds. Prominent families of herbicides include pheoxy and benzoic acid herbicides (2, 4-D) tyriazines (atrazine), Ureas (diuron), and Chloroacetanilides (alachlor). Many commonly used herbicides are not included in these families, including glyphosate.

The primary objective of agriculture is to produce a reliable supply of food for the increasing world population. It plays an important role as a source of food, of foreign exchange for imports and of exports, employment and imports for other sectors in the economies of many industrialized as well as developing countries (Ayoola, 1990). Crop production has however, been threatened by various insects, weeds among others. The FAO has estimated pre-harvest crops losses due to weed infestation, plant diseases; arthropods (largely insects and termites) to be around 30 to 35%, and post-harvest losses (grain storage, etc.) amounted to an additional 10 – 20% (FAO, 1983).

In order to arrest these problems, chemical weed control has become an increasingly necessary operation in the consistent and economic production of crops. In addition to agricultural diversification and yield optimization, chemical weed control has formed an integral part of the policies of many governments world over. With benefits of herbicides control ranking high,

negative effects on the environment and human health generated mainly by lack of knowledge regarding safety parameters on the part of the user has made herbicides use in agriculture one of today's most controversial issues (Miller,2002).
Agricultural chemicals have significantly increase crop yield in the short term by limiting damage by pest, competition for water and nutrients from weeds and by providing large amounts of nutrients in a form that is easily available to plants. In the long run these processes can lead to serious depletion of soils because the natural processes of converting organic matter and the balance of microorganisms in the soils have been disrupted. Herbicides used against control of grasses can kill beneficial insects like lady bugs, aphids, among others. When the beneficial insects are gone, there is no natural control over the pest, so their populations can increase much more quickly after the initial application, requiring further applications of pesticides to control the original pest. Herbicides can kill butter flies, moths, spiders, and bees which play other roles in the environment such as pollinating plants.

Furthermore, some of the effects of herbicides on humans are damage to the reproductive and nervous systems and other organs, behavioural and developmental abnormalities, interference with hormone function as well as affecting the immunity system. Herbicides gather fat deposits in the body where they stay and cause a lot of damage. Most of the infants and young children drinking breast milk ingest herbicides as women who eat fruits and vegetables that have been sprayed with pesticides may pass the chemicals through their breast milk while pregnant women can pass the chemicals unto their foetus (Jurewicz and Hanke, 2008).

In most countries, herbicides must be approved for sale and use by a government agency. For example, in the United States, the Environmental Protection Agency (EPA) does so. Studies must be conducted to indicate whether the material is safe to use and effective against the intended herb. During the registration process, a label is created. The label contains directions for use of the material. Based on acute toxicity, herbicides are assigned to toxicity class. Some agrochemicals are considered too hazardous for sale to the general public and are designated restricted use agrochemical. Only certified applicators, which have passed an examination may purchase or supervise the application of restricted use chemicals (Wilson, 1996).
Alternatives to the use of pesticides are available and it include methods of cultivation, use of biological pest controls (such as pheromones and microbial pesticides), genetic engineering, and methods of interfering with insect breeding (Miller, 2004). Methods of alternative weed control are becoming increasingly popular and are often safer than traditional herbicides. Cultivation practices include polyculture (growing multiple types of plants), crop rotation, planting crops in areas where the pests that damage them do not live, timing planting according to when pests will be least problematic and use of crops that attract pests away from the real crop. In some developed countries, (USA in particular) farmers have had success controlling insects by spraying with hot water. Release of other organisms that fight the pest is another example of an alternative to pesticide use. These organisms can include natural predators or parasites of the pests (Miller, 2004).

With the increasing awareness concerning health hazards associated with herbicides on the part of consumers, environment and farming groups, there has been a consequent demand for more stringent regulatory measures in the development of environmentally safe agrochemical formulations. However, mankind will still continue to use chemicals to produce adequate supplies of food and feeds, while trying to minimize associated risks to human health and the environment. Risk is an

intrinsic part of life and must be weighed against the benefits likely to result from any particular action (Avav and Oluwatayo, 2006).

There is a lack of effective disposal methods; this depends on the package design and toxicity of herbicides. Widespread use of empty containers, lack of quantification and documentation of wastes, poor storage conditions for obsolete stocks, especially in developing countries. The package design should also discourage the widespread reuse of herbicide containers, which is a common practice in developing countries, and should encourage reductions in waste herbicides. It is therefore, desirable to ensure safe and effective use of herbicides by increasing awareness, training and the dissemination of relevant information, and by enacting legislation of control sales, distribution, use, production, formulation and disposal. There is further need for research into alternative herbicides and the deployment of herb – management strategies

The past decades have witnessed a dramatic change in agriculture with food production soaring due to the Green Revolution. The Green Revolution entailed the use of improved technologies; particularly the breeding of high yielding food crop varieties, the expansion of irrigation, mechanization, specialization and the use of chemical fertilizers and pesticides. However, the Green Revolution has been criticized for its adverse human health and environmental impacts. For example, agricultural intensification through excessive and inappropriate use of chemical fertilizers and pesticides, has polluted water bodies and degraded soils, led to biodiversity loss by killing beneficial plants, insects and other wildlife and in some cases poisoned farm workers, to mention but just a few. Sustainable agriculture has emerged as an alternative agricultural system that addresses the many constraints faced by poor-resource farmers and at the same time ensures environmental sustainability.

For agricultural production to be sustainable crop and livestock production must increase without an increase in the negative environmental impacts associated with agriculture, which means large increases in the efficiency of nitrogen, phosphorus and water use and integrated pest management that minimizes the need for toxic pesticides. Nutrient-use efficiency is increased by better matching temporal and spatial nutrient supply with plant demand. Applying fertilizers during periods of greatest crop demand, at or near plant roots, and in small and frequent applications all have the potential to reduce losses while maintaining or improving yield and quality (Matson *et al*, 1998; Matson *et al*, 1996; Cassman *et al*, 1993; Peng, 1996). Such precision of agriculture has typically been used in large-scale intensive farming, but is possible at any scale and under any conditions giving the use appropriate diagnostic tools. Strategies that synchronize nutrient release from organic sources with plant demand are also needed (Woomer and Swift, 1997; Roberston, 1997).

Multiple cropping systems using crop rotations or intercropping may improve pest control and increases nutrient and water use efficiency. Agroforestry, in which trees are included in a cropping system, may reduce erosion, provide firewood and store carbon. Landscape-scale management holds significant potential for reducing off-site consequences of agriculture. Individual farms, watersheds and regional planning can take advantage of services provided by adjacent natural, semi-natural or restored ecosystems. Trees and shrubs planted in buffer strips surrounding cultivated fields decrease soil erosion and take up nutrients that otherwise would enter surface or ground waters. Buffer zones along streams, rivers and lakeshores can decrease nutrient and loading from cultivated fields or pastures. Crop pollination can be provided by insects and other

animals living in nearby or buffer strips, whereas other organisms from these habitats, such as parasitoids, can provide effective control of many agricultural pests. Buffer strips can also manage to reduce inputs of weeds and other agricultural pests (Tilman *et al*, 2002).

Environmental sustainability is typically achieved through protecting, recycling, replacing and maintaining the natural resources base such as land, water and wildlife that contribute towards conservation of natural capital. While synthetic fertilizers can be used to supplement natural inputs, they are applied on needs basis. Under sustainable agriculture, synthetic chemicals known to harm soil organisms, soil structure and biodiversity should be avoided or reduced to minimum used (Kassie and Zikhali, 2009).

Kassie and Zikhali (2009) social sustainability relates to the quality of life those who work and live on the farm, as well as those in the surrounding communities. It includes ensuring equitable revenue or returns to different stakeholders of the agricultural production chain. In context of unemployment sustainable agriculture can promote sharing of agricultural value added by more members of the community through more extensive use of available labour, at least for some techniques, thus contributing to social justice and cultural cohesion. Fair treatment of workers and choosing to purchase supplies locally rather than more distant markets.

Economic sustainability should also be ensured, farms that are not economically viable are replaced by alternative uses of land that are more profitable. This can improve the economic viability of a farm in a number of ways. In the short term, improving soil management and crop rotation can increase yields, while in the medium and long term, improved soil quality and water availability as well as other environmental benefits from sustainable practices, may raise the value of the farm and provide for payment for environmental services. Economic viability can also be achieved through, for example, reducing machinery, chemical fertilizer and pesticide costs (for farmers who afford these inputs), depending on the specific characteristics of the production system. Of course, economic sustainability is also conditioned by many factors aside from crop production methods, for example household characteristics such as managerial ability, institutions, and infrastructure and market access among others (Kassie and Zikhali, 2009).

Nigeria government should adopt policies or strategies as it has been done in other countries including Australia, Canada, European Union countries, Japan, Norway, Switzerland and United States which instituted various forms of green payments, that is payment to farmers who adopt sustainable farming practices. Other policy options include taxes, removal of subsidies, a tax on fertilizers or pesticides, or removal of subsidies for these inputs would discourage excessive use (Tilman *et al*, 2002).

The pursuit of sustainable agriculture will also require substantial increase in knowledge-intensive technologies that enhance scientifically sound decision making at the field level (Byerlee, 1996). The earlier paradigm of science being developed at the international or perhaps national level and then disseminated to farmers should be replaced by an active exchange of information among scientists and farmers. Scientists in Nigeria who understand the ecosystems, human culture and demand on local agricultural systems must be actively trained, promoted and brought into the international scientific community.

METHODOLOGY

Makurdi the Benue State capital is one of the 23 Local Government Areas (LGAs) in the state. It is located within longitude 8° 20' N and 9° E and latitude 7° 20' N and 8' N of equator, it has a population of 2,661,980 people (NPC, 2006). Simple random sampling technique was adopted in collecting data. Data were collected through primary and secondary sources. Primary source was by survey using structured questionnaire administered on 80 respondents (farmers that used herbicides) selected randomly from four council wards; Agan, Fiidi, Mbalagh and Market ward II. Secondary data were collected from books, journals, proceedings and documents. Data collected were analyzed through descriptive statistics.

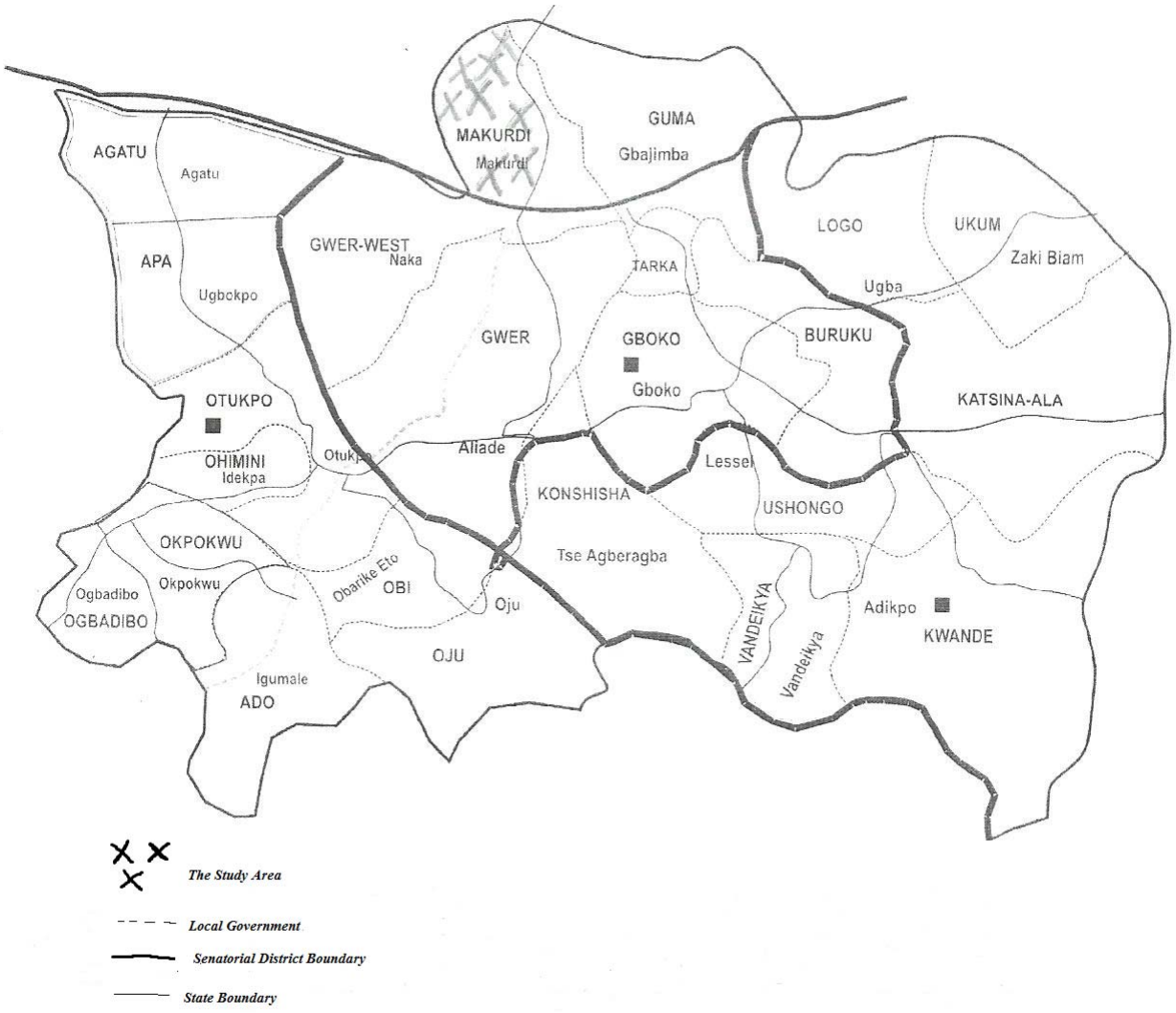

Table 1: Distribution of Respondents According to Time in a day when Herbicides are Applied

Time	Frequency	Percentage
Morning	60	75.0
Evening	14	17.5
Afternoon	6	7.5
Total	**80**	**100**

The results in Table 1 showed that 75.0% of the respondents applied herbicides in the morning. This could be attributed to the fact that most of the people used for application of herbicides in the villages do not wear any head mask before applying herbicides, because they do not wear head mask or boot, the best time to apply herbicides is in the morning. Apart from that, herbicides can easily evaporate leaving nothing to the farmer especially in tropics where the temperature in our environment is usually very high; its application in the afternoon allows a reasonable quantity of it to evaporate, therefore if applied in the afternoon the aim of the application is not achieved. To ensure proper utilization of herbicide it is better applied in the morning or evening when the temperature is low. The application of the herbicides in the morning make it to be absorbed easily by the herbs better than when it is applied at any other time of the day.

Table 2: Distribution of Respondents According to Types of Herbicides used

Types of Herbicides	Frequency	Percentage
Non-selective	88	110.00
Systemic	85	106.25
Selective	43	53.75
Contact	15	18.75
Insecticides	7	8.75

*** Multiple Responses * ***

Results in Table 2 showed that majority 110.0% used non-selective herbicides. Non-selective herbicides are used in non-crop situation; land clearing and industrial weed control, railway tracks, and forestry sites. Benue State belongs to vegetation belt that is characterized by high grasses (grassland area) therefore; farmers in their attempts to clear grasses/herbs for farming make use of non-selective herbicides. The use of herbicides for clearing herbs is faster, and energy conserving than the use of any other physical means especially hands. The use of herbicides for clearing herbs in preparation for farming is very common in Benue State especially in the last 8 years. Most farmers engage hired people who use herbicides and clear herbs which are very economical. If physical weeding is employed it may take farmers many months to clear preparatory to farming especially for those with large farm, however with the use of herbicides a few days are used to cover the same piece of land that could have taken the farmers many months to clear by weeding. The composition of herbicides when it is to be

applied among crops and grasses/herbs is also a major problem because most of the people involved in spraying do not undergo any form of training to make them understand herbicides composition and application.

Table 3: Distribution of Respondents According to Health Hazards Associated with the Use of Herbicides

Hazards	Frequency	Percentage
Fatigue	80	100
Eye problem	76	95.0
Skin problem	70	87.5
Dizziness	32	40.0
Vomiting	9	11.25

*** Multiple Responses * ***

Table 3 showed that 100% of the respondents stated that they had fatigue while applying herbicides. This could be attributed to attempts to cover large hectares of farmland within a short period of time and the use of faulty spraying equipment which cause linkages. Majority of the people hire spraying equipment for application of herbicides. Hiring of sprayers is time bound therefore, the farmers are eager to complete their job and returned the sprayers to the owners for fear of been sub charged. If it is a hired person, their attempts to cover large area of farmland often result to spraying fast which mostly results to fatigue, this also leads to haphazard application of herbicides which very often result to the poor death of the herbs. Furthermore, the poor death of the herbs after spraying herbicides on farmland could require a farmer to use other means in further clearing the herbs that were left over as a result of poor application of herbicides because most of the farm activities are done manually. The effective use of herbicides depends to a great extent on how they are applied. More so, much of the equipment used in developing countries is poor and some designs have proved unsuitable for use.

Table 4: Distribution of Respondents Based on Precautions Observed when Applying Herbicides

Precautions	Frequency	Percentage
Read label before use	80	100
Wear head mask	64	80.00
Wear overall or apron	39	45.00
Wear boot only	38	47.50

*** Multiple Responses * ***

Results in Table 4 showed that 100% of the respondents read the instruction rebel of the herbicides before applying it. This is an indication that most people that use herbicides can read and write. Majority of the farmers employ the services of commercial herbicide sprayers who sometimes go out from one house to another looking for farmers to hire them to do the job. Apart from farmers, schools (primary and secondary) and religious places make use of herbicides in clearing herbs in and around their premises. One thing with the commercial herbicide sprayers is that most of them are very familiar with the

herbicides commonly used in the area and they handle these herbicides as if they were not poisonous, a situation that will present a very dangerous future for them but most of them are not aware of the long time effect herbicides will have on their health.

Table 5: Distribution of Respondents According to Direction use when Applying Herbicides

Direction	Frequency	Percentage
Following the direction of wind	66	82.5
Wind direction not considered	13	16.25
Against the direction of wind	1	1.25
Total	**80**	**100**

Results in Table 5 indicated that 82.5% applied herbicides following the direction of wind. Direction of wind when applying herbicides is very important, at any time herbicides or agrochemicals are to be applied the direction of wind has to be considered. Herbicides are usually applied against the direction of wind. However most of the people in the rural area that apply herbicides are not trained. Majority of them saw others people making use of sprayers; they bought theirs and started using it either for personal or commercial purpose without knowing other requirements for application of herbicides. That is why most of the people involved in the application herbicide seem not very effective in carrying out the job. In addition to poor spraying, some of them cannot identify whether a sprayer is very good or bad at time of buying it and these constitute major problems in effective application of herbicides.

Table 6: Distribution of Respondents According to Factors Militating Against the Use of Herbicides

Factors	Frequency	Percentage
High cost	80	100
Contaminate water sources	10	12.5
Killing of non-targeted Organisms	2	2.5
Non-availability	2	2.5

*** Multiple Responses** ***** *****

Results in Table 6 depicted 80% high costs of herbicides. The high cost of herbicides is as a result of middle men's involvement in the sale and distribution of herbicides. The middle men in their attempt to maximize profit buy in large quantities and hike the price of herbicides almost beyond the average price making it difficult for the peasant farmers to buy. Apart from that most of the peasant farmers' farmland is not big enough to engage people outside their family as that will amount to waste of their little resources. So to those groups of farmers whose farmland is small it is not economical to use herbicides in any way on their farm as it will only amount to economic waste.

CONCLUSION AND RECOMMENDATIONS

The advent of herbicides has led to increase in crop yield and reduce drudgery among farmers; little time is now taken to clear herbs especially before farming. Most farmers applied herbicides in the morning the commonly used herbicide is non-selective. Furthermore, the common health hazard associated with application of herbicides is fatigue, though people employed for application of herbicides read instruction label before its application, they do not observe other instructions like wearing of mask and the right direction during herbicides application. High cost is one of the problems militating against the use of herbicides. Herbicides are good especially for clearing of weed around our environment; they cause a lot of damage by killing the non-targeted beneficial insects thereby creating more problems in the near future. It is recommended that Agricultural Development Project (ADP) should organize training for farmers on application of herbicides and farmers should form associations so as to pull resources together, buy herbicides directly from the distributors in large quantity and disburse the herbicides among themselves to prevent been exploited especially the hike in price by the middle men.

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