FACTORS THAT MILITATE AGAINST ADOPTION OF CHEMICAL WEEDING AMONGST FARMERS IN NORTH-CENTRAL NIGERIA: A CASE STUDY OF FARMERS IN IDOFIAN, KWARA STATE, NIGERIA

SALEH, A.* AND SULEIMAN, M.L.
Department of Agricultural and Bio-Resources Engineering, Ahmadu Bello University, Zaria, Nigeria

ABSTRACT

This study examined factors that hinder adoption of chemical weeding among farmers in Idofian area of Kwara state, Nigeria, with the aim of proffering appropriate solutions for increasing agricultural productivity, reducing drudgery and improving the standard of living of the rural populace. There has been a rising concern on public health hazards, water population and environmental degradation due to unguided use of agrochemicals. A structured questionnaire was administered to determine and generate relevant data on the socio-economic characteristics, farmers' sources of information and use of agrochemicals. Descriptive statistics was used to analyze the results obtained and determine their possible relationships with subject matter. The results indicate that 75% of the respondents were males with only 30% of them in their productive years, most of whom are small scale farmers with less than 5-acre farm lands. About 60% of the respondents were full-time farmers, while 64% had more than six (6) years of farming experience. Results identified high cost of herbicides as the main constraint of its adoption. Lack of awareness of either the weeding methods or its associated hazards were also observed. Other constraints include harmful effects on public health, environmental pollution and ground water contamination. The study suggests that the Government should double its effort in improving the level of awareness amongst farmers on the harmful effects of agrochemicals and the appropriate ways of their application with the view to minimizing the associated hazards.

Keywords: Adoption, Agro-Chemicals, Barriers, Hazards, Weed Control
***Correspondence:** salehaminu@gmail.com +234803 577 4780

INTRODUCTION

Agriculture is the most important economic activity in Nigeria which provides food, employment, foreign exchange and raw materials for industrial development. Agricultural production certainly occupies a prominent position in every economy that focuses on rural development, food sufficiency, fibre production and poverty alleviation. It is the mainstay of Nigeria's economy as it provides employment for about 70% of the country's population. It also contributes about 38% of the National Gross Domestic Product (GDP) and accounts for about 90% of the activities in the rural area [1]. Agriculture is, therefore, an important activity in every Nigerian society. However, agricultural production in Nigeria is highly predominated by traditional farming system where application of modern inputs and technology has been extremely inadequate. Farming is still widely carried out by human labour using mainly traditional tools resulting in high cost of production. Studies carried out on Nigerian agricultural crop production showed that labour accounted for 77% of the cost of maize production and about 60% of the total cost of sorghum production in Nigeria [1].

Weed and unwanted plants that grow and compete with crops for space, light, water and nutrients with the crops planted. Their ease of germination and rate of growth is very high. If not controlled, weeds tend to overshadow the crops that are planted resulting in low yields. Any attempt to eliminate them when they overgrow results in increase in cost of production [1]. Most farmers in Idofian are peasants and aged who cannot effectively control weeds manually. Thus, the need for appropriate weed control such as the application of agrochemicals to minimize drudgery, increase yield and improve standard of living of farmers, cannot be over stressed. Therefore, this study attempts to investigate factors that impede the adoption of chemical weeding as an alternative weeding system for a profitable crop production as well as reduce drudgery involved in manual weeding.

MATERIALS AND METHODS

Study area

The study area is Idofian town and its surrounding villages. Idofian is situated in Ifelodun Local Government Area of Kwara State in the North-Central Zone of Nigeria. Its geographical coordinates are 8° 23' 0" North and 4° 43' 0" East [2]. Climatic condition is humid tropic and is characterized by both wet and dry seasons with a mean annual temperature range of 25 – 28.9°C. Rainy season is between April and October with mean annual rainfall of 1,150 mm; while the dry season is from November to March. Agriculture is the main source of the economy in the study area. Majority of the people are subsistence farmers with as little as 5-acre farm holdings where primitive tools are still being used for farming. Crops produced include yam, cassava, maize, rice, okro, sorghum, locust-beans, groundnut and soybean [2].

Data collection and methodology
This study utilized the primary data obtained from the farmers in the study area. A total of 100 respondents were selected for a detailed study. Famers were reached through the distribution of a structured questionnaire containing both closed and open-ended questions administered randomly in thirteen (13) communities (Table 1) across the study area between March and May, 2019. Multistage random sampling procedure was employed in selecting the sample from where the data were collected [3].

Table 1: Distribution of sampled farmers involved in the survey

S/N	Ward	No. of Farmers
1	Idofian	28
2	Jimba-Oja	7
3	Kabba Owode	5
4	Gatta	8
5	Falokun	8
6	Ilota	5
7	Elerinjare	10
8	Okanle	3
9	Gaa Owonikoko	2
10	Igbo-Owu	4
11	Makolo	2
12	NCAM	10
13	ARMTI	8
Total		**100**

Statistical analysis
Data collected from this research were subjected to descriptive statistics to determine the militating factors that thwarts the respondents from using agro-chemical as a means of limiting weed infestation in the study area.

RESULTS AND DISCUSSION

Socio-economic characteristics of the respondents
The aim of this section was to reach an understanding of the factors inhabit farmers from adoption of use of agro-chemical in weeding their farms. In attempting to gauge how farmers' socio-economic characteristics affected adoption of the technology, a number of variables were considered. Such variables include gender, age, marital status, farm size, educational status, farming experience, etc. The importance of these characteristics in determining the barriers of the technology in relation to agricultural production was discussed in this section.

Gender
Table 2 shows the gender distribution of respondents in the study area. Seventy-five percent (75%) of the farmers were males while 25% were females. Men, therefore, constituted a good proportion of farmers in the study area. Studies on gender involvement in agricultural production earlier conducted indicate different roles men and women played in technology adoption. In their studies, Udensi *et al.* [4] agree with this finding on the roles played by both gender.

Table 2: Distribution of farmers according to socio-economic characteristics (%)

S/N	Variable	No. of Farmers (%)
1	Gender:	
	Male	75
	Female	25
2	Marital Status:	
	Single	12
	Married	73
	Divorced	2
	Widowed	13
3	Age:	
	< 30	11
	30 – 40	13
	40 – 50	23
	50 – 60	35
	> 60	18
4	Educational Status:	
	Non-Formal Education	43
	Primary Education	13
	Secondary Education	16
	Tertiary Institution	28
5	Occupational Status:	
	Part-time Farming	40
	Full-time Farming	60
6	Farming Experience (Years):	4
	0 – 2	14
	3 – 4	18
	5 – 6	64
	> 6	
7	Farm Size (acre):	
	<3	16
	3 – 5	55
	6 – 10	20
	11 – 15	7
	>15	2
8	Total Sample Farmers (N)	100

Marital status
Results obtained in this study showed that majority of the farmers (73%) were married, 12% were single, 2% were divorced and 13% widowed, (Table 2). This translates that married people dominate agricultural activities in study area. Analyzing this data further on gender basis revealed that 61% of the male respondents are married, 8% were single, 5% widowed and 1% divorced. With regards to the female farmers, the results indicated that 12% of them were married, 4% single, 8% widowed, and 1% divorced.

Age

Results obtained (Table 2) also showed that 11% of farmers in the study area were below the age of 30 years, 13% were between the ages of 30 – 40 years, 23% were aged between 40 – 50 years old. The 50 – 60 years age group was 35% while those above 60 years of age were 18%. This indicates that only 30% of the entire respondents are in their productive years [5]. Analyzing the age groups on gender perspective, it shows that 6% of the male farmers are below the age of 30, 10% between the ages of 30 and 40, 14% between 40 – 50 years, 30% between 50 – 60 years and 15% above 60 years. For their female counterparts, 5% are less than 30 years, 3% between 30 – 40 years, 9% between 40 – 50 years, 5% between 50 – 50 years and 3% above 60 years old. Age is said to be a primary latent characteristic in adoption decisions [4]. The study also agrees with Ogunsumi [6] that there were significant positive correlations between age and adoption pattern.

Educational status

The educational status of farmers in the study area shows that 43% of the farmers had no formal education while 57% had various forms of formal education. This translates that majority of the farmers in the study area are literate. While 14% of the farmers are partially literate, the results show that 13% of the farmers are graduates (Table 2). The studies further show that most of the farmers that practice chemical weeding are educated. This agrees with [8] that educated farmers were more receptive to new ideas and more willing to adopt. This was because they were more disposed to understand the new ideas provided by extension workers and thus, increasing a technology's adoption [9]. Waller *et al.* [10] also observed that education creates a favorable mental attitude for the acceptance of new practices.

Occupational status

The occupational status of the farmers in the study indicates that 60% of them were full-time farmers while 40% were farming on part-time basis (Table 2). Most of the part-time farmers were observed to have formal educational backgrounds and gainfully employed. Others are secondary schools drop-outs that depend on one trade or the other as means of livelihood but takes farming as alternate means of meeting two ends. Full-time farmers are expected to have a higher adoption rate of chemical weed control technologies than part-timers [4]. However, graduate part-time farmers are also expected to have high adoption rate due to their exposure and limited time they devoted to farming since other occupations takes most of their time.

Farming experience

Table 2 indicates that 64% of the respondents had more than six years of farming experience while 18% had between 5 – 6 years of farming experience. Most of the farmers in this category are 50 years of age and above. Udensi *et al.* [4] argued that farmers are antagonistic to risks involved in adopting a new technology with more experience thereby creating a positive or negative effect on farmer's decision to adopt chemical weed control technology.

Farm size

Results obtained from the study also showed that majority of the respondents (55%) had farm holdings of between 3 – 5 acres (Table 2). This implies that small-scale farmers have dominated agricultural production in the study area, supporting the findings of IFLGA [2] that majority of farmers in the study area are subsistence farmers. It also agrees with Nzomoi *et al.* [7] that most of the agricultural farms in Nigeria are on small-scale cultivation varying from 0.1 to 10 ha. The results also show that 16% of the farmers about 16% of the farmers cultivate less than 3 acres of farm land. Previous studies also found that positive relationship exists between farm size and adoption of technology. Udensi *et al.* [4] noted that farm size affects adoption costs, risk perceptions, human capital, credit constraints and labour requirements, among others. Abara and Singh [10] also argued that huge fixed costs become a constraint to technology adoption, especially if the technology is costly. Agunga [11] observed that for small scale operators, it is easier to adopt rather than larger farm operators who take more time to examine the risk involved.

Adoption status of chemical weed control

For a technology to be adopted, it must exist. Mahmood and Sheikh [12] stated that creation of awareness is the first step towards the adoption process. Then information about the technology motivates it usage. Results of this study identified the sources of information of chemical weeding in the study area as: government agencies (23%), Radio and TV (15%), friends and other farmers (5%) and cooperative societies (3%). There are some respondents who have more than one source as indicated in Figure 1. Results obtained with regards to sources of herbicides have been supported by some earlier discoveries. Yapa and Robert [13] opined that the adoption of an entrepreneurial innovation by an individual requires sufficient information on the innovation. Similarly, Hussain [14] also found that radio and TV was the major source of information in educating farmers regarding recommended agricultural practices. Fellow farmers were also regarded as source of agricultural information [14, 15].

Results of the survey conducted in the study area also indicated that 87% of the farmers are practicing both mechanical and chemical weeding methods (Figure 2). Combining the two methods was obviously due to the fact that most of the farmers use herbicides for pre-emergence only, thus necessitating supplementary mechanical weeding as only 7% of the

farmers were found to use post-emergence herbicides at the later stage of the crop growth. No farmer was identified to adopt the cultural and biological weeding methods while only 1% adopts integrated weeding system. Five percent (5%) of the respondents practice mechanical weeding only. This has been attributed to lack of knowledge/awareness on their part since they were found to be illiterates and aged (over 60 years). High cost of the herbicides and difficulty in application was also factors that deny them the benefit of using chemical weeding method.

Source of herbicides

There are three sources of procuring herbicides by the farmers in the study area. These are open market where 43% of the respondents purchase their herbicides, farmers' cooperative societies (1%) and others farmers and friends (2%). However, most of the farmers relied on more than one source to purchase their needed herbicides as indicated in Figure 3. Results obtained further showed that 62% of the respondents were experiencing some difficulties in procuring their requirements, perhaps due to non-availability of reputable Agro-chemical dealer within the study area. This makes most of them to rely on other farmers who have access to flourishing herbicides markets in Ilorin metropolis.

Method of chemical weeding adopted

The 95% respondents that were found to practice chemical weeding method, it was observed that most of them (81%) use the herbicides for pre-emergence only to suppress the initial weed growth. Later, they complement with mechanical weeding when the effect of the herbicides subsides to avoid unnecessary competition with crops planted. Only 14% of the farmers adopts both pre- and post-emergence weed control method in the study area thereby eliminating any form of mechanical weeding. These categories of farmers were all part-time farmers who have formal education at various levels and are gainfully employed. They, thus take farming either as hobbies or as source of income that will complement their main jobs/ trades.

Type of chemicals (herbicides) being used in the study area

Farmers in the study area had identified various types of agro-chemicals they use for weed control. Those that specialized in cereal production were associated with Primextra (a formulated mixture of Atrazine and Metolachlor as active ingredients) and Gramoxone (Paraquat). With economic meltdown, many respondents (78%) prefer to use Atrazine Power which is cheaper compared to Primextra solution. However, because of their low level of education, many of them could not differentiate between the brands of Paraquat and as such refer to them as Gramoxone (Table 3). Farmers producing broad leaves crops such as cowpea use Pendeline as their major herbicides while those that practice post-emergence weed control use Fusilade (33%). Farmers who use non selective broad spectrum herbicides to tackle stubborn weeds have preference in various forms of Glyphosates such as Round-up (12%), Touchdown (9%), Vinash (2%), Sarosate (4%) and Tackle (3%). The study also found 6% of the respondents as rice farmers using 2.4D to suppress weeds in their farms.

Table 3: Popularity of major herbicides used

S/N	Name of Herbicide	No. of Farmers (%)
1	Primextra/Atrazine	78
2	Paraquat:	
	Gramazone	52
	Weedkiller	24
	Bushfire	13
	Paraforce	6
3	Glyphosate:	
	Round-up	12
	Touchdown	9
	Vinash	2
	Sarosate	4
	Tackle	3
4	Post-Emergence:	
	Fusillade	33
	Pendeline	45
5	2.4D	6

Farmers' assessment of chemicals used in weed control

Farmers in the study area were observed to have been using various types of herbicides. It was discovered that as much as 8% of the respondents had adopted the weeding method for more than six years while 18% of them have a record usage of between 5 – 6 years. Most of those who adopt the technology (48%) have between 2 – 4 years' experience (Figure 4). Respondent's assessment of chemical weeding in the study area was very encouraging. This was because most of them (77%) rate the degree of weed infestation after applying various types of herbicides on their farms either as low or very low. However, 18% of the respondents were observed to experience some difficulties in weed management after applying the herbicides, (Figure 5). Similarly, most of the respondents (95%) attested to have noticed some forms of improvements in their farming activities as a result of adopting chemical weeding method. Such improvements include increase in overall yield where 55% of the farmers consented to a reduced production cost by 31%, keeping their various farms neat (77%) as well as providing them with time to attend to other jobs (42%) especially for those who took farming on part-time basis.

Interestingly, 28% of the respondents noticed other benefits such as scaring animals and other dangerous reptiles such as snakes from their farms after herbicides application (Figure 5). Yield increase agrees with previous studies [16], that herbicides are production tools that increase farm efficiency, productivity and reduce labour (Figure 6).

Hazards of adopting chemical weeding

Although farmers who adopted chemical weeding method derive so many benefits, this technology is not without some side effects as many respondents (57%) have encountered some hazards that were associated with its adoption. Perhaps this percentage may increase if those who did not encounter any side effect (38%) were not using hired labour in applying herbicides on their farms. This agrees with [17] that herbicide usage also carries risks that include environmental, ecological and human health effects. Some farmers in the study area revealed that 36% of them complained of poisoning after herbicide application, 20% have general body weakness while 18% had stained cloth and other containers used in mixing and application of the herbicides, (Figure 7). Other hazards identified include air and water pollution and bad odour associated with most agro-chemicals that cause nausea and vomiting to some respondents.

The hazards identified were in agreement with [18] who observed the major concerns about herbicides as their undeniable mammalian toxicity and other animal species. Hutchinson *et al.* [19] noted that most herbicides are often harmful to humans. Herbicides such as paraquat are also commonly used as a suicide agent in many developing countries [20, 21]. The enormity of poisoning caused by herbicides also leads to several hundred thousand cases of death every year worldwide [19, 22, 23]. The study also confirmed the concern about environmental degradation due to the use of herbicides for agricultural practices as it is associated health hazards and groundwater pollution as supported by Bouchard *et al*. [24].

Barriers of chemical weed control

Although the adoption of chemical weed control by farmers in the study area greatly contributed to raising their status by increasing their yield and ultimately their income, most respondents also encountered some constraints that militate against the sustainability of the technology. Results of the study conducted identify high cost of herbicides as the main constraint of its adoption (66%) among the respondents. It is closely followed by lack of information/awareness (61%) of either the weeding method or the existence of some herbicides by the respondents. Other constraints include problems associated with the application of the herbicides (44%), non-availability within the study area (39%), adulteration of the agro-chemicals (32%), continuous change of brand names (24%), ailments caused by poisoning (14%) and pollution of surface and ground water (4%). Figure 8 shows the main constraints militating against farmers' adoption of chemical weed control practices in the study area.

The study also shows that lack of awareness in the usage of the herbicides results in misuse thereby increasing cost of production. This ultimately discourages the farmer from sustaining the technology. Many respondents that complained about adulteration of the herbicides they used did not achieve the expected results. Adulteration, in most cases, could be traced to the source respondents procure their supplies. However, our investigations revealed that some herbicides may not actually be adulterated as claimed by the respondents but could be attributed to human errors. Chiefly among these errors was the lack of knowledge of formulating the mix. Respondents who used Attrazine powder, for example, were supposed to have 2 litres solution from 1 kg pack. However, many farmers either because of ignorance or poverty used excess water to dilute and may realize as much as 3 – 4 litres from the same pack. Some respondents were also unable to differentiate between nozzles used for herbicide application and those for insecticides. This was very important as it determines the amount of agro-chemical being sprayed at any particular time.

Rate of application was also found to determine the effectiveness of herbicides. To prove this, we considered the recommendation of the manufacturers of Fusilade Forte [25] that 2 – 3 litres/ha of the product be applied to normal weeds but recommend a higher dosage of 3.5 litres/ha for good control of noxious weeds such as spear grass (*Imperata cylindrical*) and Bermuda grass (*Cynodon dactylon*). However, most farmers claim ignorance of the specification. Instead they attributed non effectiveness to adulteration.

Another reason is lack of awareness of time of application. The manufactures of Fusilade Forte (a post-emergence herbicide) also recommends its application at 2 – 4 leaf stage of weed growth and not later [25]. Our interactions with some respondents who use this product shows non adherence of this instruction. Most farmers were found to apply it when weeds are fully grown, thus reducing its effectiveness. Cobb [26] agrees with this when he noted that timing of application was crucial for herbicides to be effective. Similarly, [27] noted that the most sensitive stage for many perennial weeds was when new shoots were still in younger stage. Application timing also concerns with the time of the day and the weather condition at the time of application. Respondents who complained application method as an impediment of use of herbicides as weed control methods were not knowledgeable on the use the spraying equipment and formulating the solution. Many of them do not have sprayers of their own but rely on other farmers. Many

farmers were also observed to use materials such as brooms and leaves as their spraying equipment.

There are several previous research findings that led credence to most of the constraints associated with chemical weeding observed in this study. Mwangi [28] explained the factors that influence adoption of agricultural innovations to include access to information, availability of inputs and distance to markets. Similarly, [29] and [30] identified lack of information about modern innovation often regarded as a barrier to adoption. Gamon and Scofield [31] also explained that low adoption of sustainable agriculture practices was related to lack of dissemination of clear and reliable information. Another reason for famer's unwillingness to adopt is the poor applicability and relevance of the information to the local conditions [32]. Lack of practical knowledge/awareness from extension agents to help farmers to implement practices has also identified as a barrier to adoption [29, 32].

With regards to cost of herbicides, [33] identified economic factors restricting farmers from adoption as the cost of adopting and the uncertainty of profitability. Nowak [32] and Barlas *et al.* [34] found frequent changes of brand names to an impediment to adoption. Since capital in any form is essential to finance a new technology, [34] also reasoned that credit constraint to access the technology is considered as one of the important factors that influence adoption of innovative technologies. This is because rural farmers are inevitably poor and are associated with traditional subsistence and low-yield food crops, poverty, lack of influence and the inability to adopt crop management innovations [35].

CONCLUSION

The study identified several factors that about 16% of the farmers cultivate less than 3 acres of farm land. These factors include: lack of financial support, risk and uncertainty, insufficient human capital, untimely and inadequate supply of inputs and complementary inputs and inappropriate transportation infrastructure. The degree of weed infestation after herbicide application could be attributed to either adulteration of the herbicides or lack of knowledge of its usage/formulation, use of improper nozzle also affects the effectiveness of herbicides, poisoning that causes nausea and vomiting whenever they come in contact with herbicides, high cost of agro-chemicals and inappropriate policies aimed at improving the level of awareness among farmers. The study recommends appropriate publicity on the safety measures, such as wearing of face, nostril and ear masks; and hand gloves. It also calls for awareness campaign through media and organizing seminar for farmers or through personal contacts to win the heart of the farmers on the benefits they stand to gain when they adopt the weeding method.

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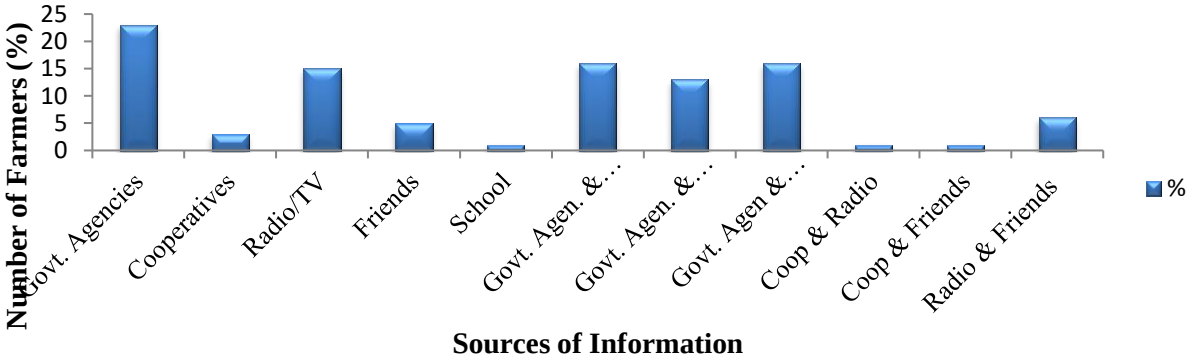

Figure 1: Source of information on chemical weeding

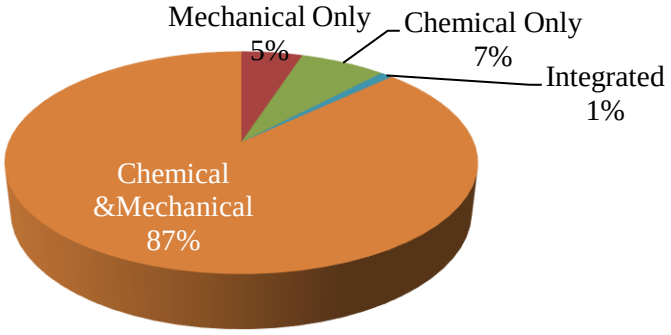

Figure 2: Adoption of weeding method (%)

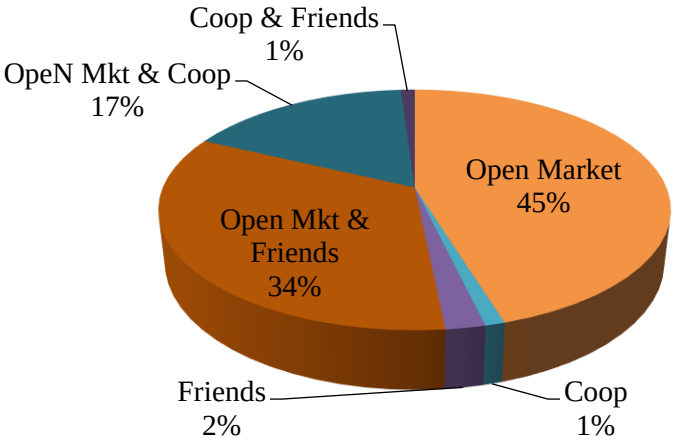

Figure 3: Respondent's sources of herbicides

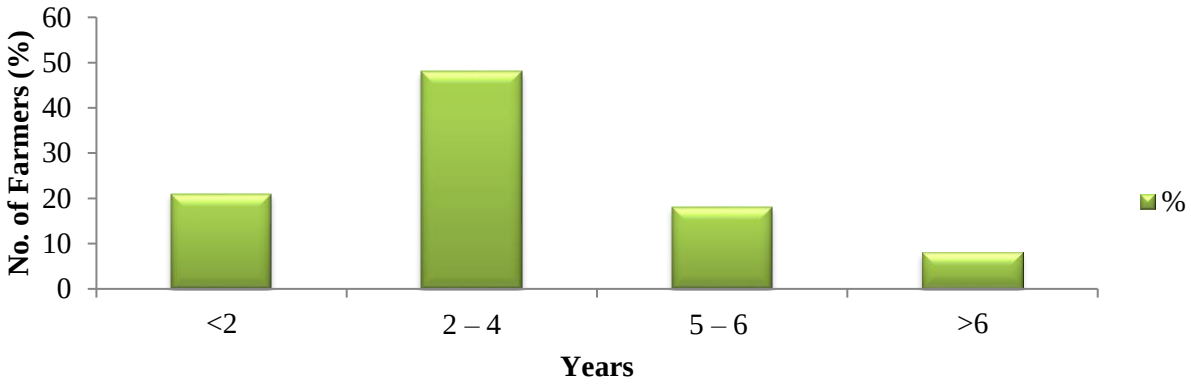

Figure 4: Farmers' experience on chemical weed control

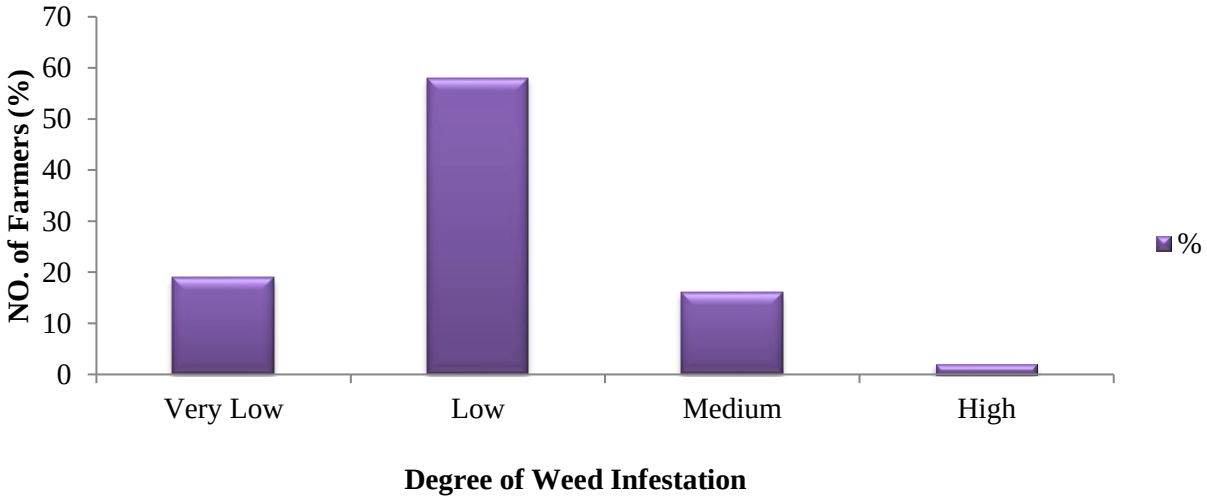

Figure 5: Famers' assessment of chemical weed control

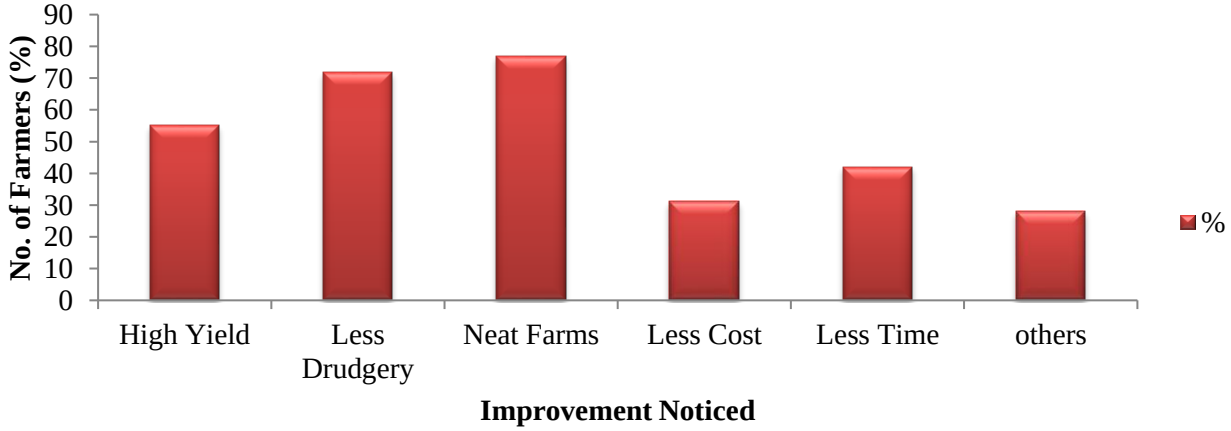

Figure 6: Improvements as a result of adopting chemical weed control

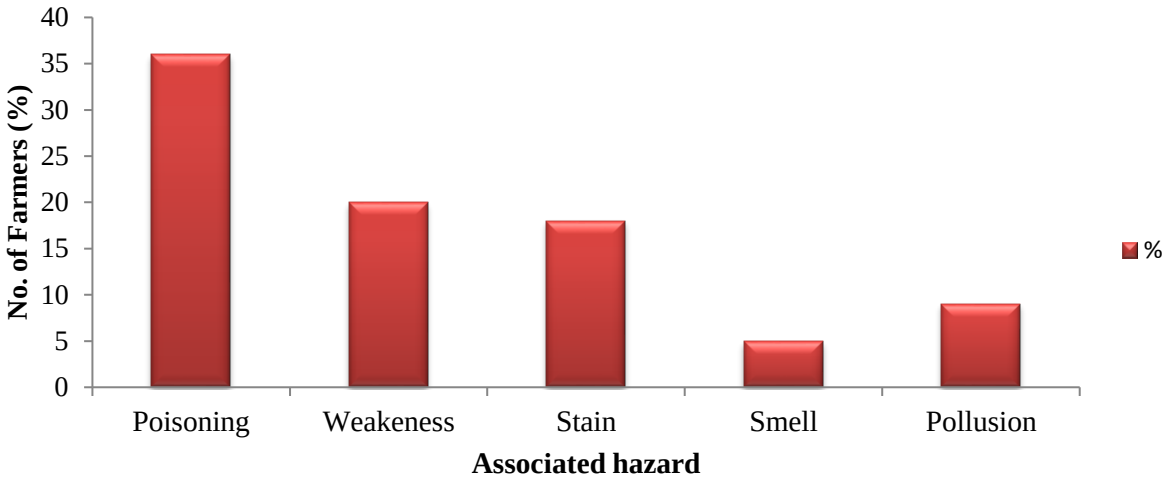

Figure 7: Hazards associated with herbicides application

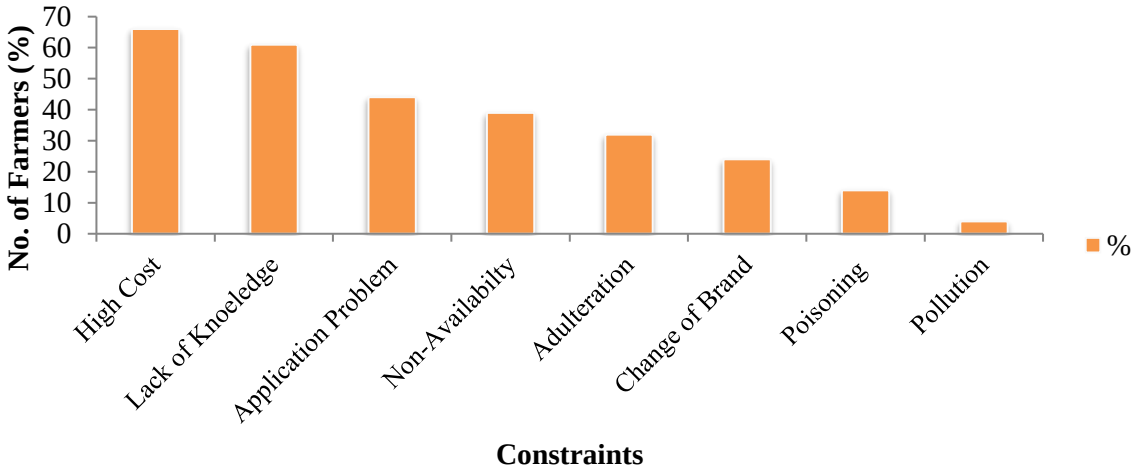

Figure 8: Constraints of chemical weed control