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Farmer's Awareness to the Impact of Aquatic Weeds in some Minor Canals, Gezira Scheme, Sudan (2018)

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Abstract: *Drastic growth of aquatic weeds makes such of water bodies unfit and take the shape of noxious aquatic vegetation in many countries around the world. In Sudan, many irrigation schemes have been greatly influenced by aquatic weeds such as Gezira Scheme. The objective of this study was to estimate farmer's awareness to the impact of aquatic weeds and their management in the Gezira Scheme in 2018. The study area covered number of the farmers around the area of the six minor canals at Centre Group at Gezira Scheme; namely: Barakat I, Barakat II, Barakat III, El sonni, El ibrahim and Haj elnour. A simple questionnaire was well designed and conducted to determine the seasonal growth of aquatic weeds, control measures and the most preferable method/s of control for aquatic weeds. Data were subjected to descriptive analysis, Statistical Package for Social Sciences (SPSS) was used to analyze the data. The results indicated that most of the responders were aware of aquatic weed species with vernacular names (52 -100%), their problems (very agree) and some control methods (very agree). Also, 71% of them considered aquatic weeds are harmful and detrimental, but, they need to know more about the seasonal growth of aquatic weeds to assist them in their control. Where, most of the responders considered that all aquatic weed species are available in both winter and summer seasons. These results are useful in the management of aquatic weeds in minor canals of the Gezira Scheme.*

Keywords: aquatic weeds; awareness, canals; farmers; Gezira Scheme; responders

1. INTRODUCTION

Aquatic plants play an essential role in the functioning of aquatic ecosystems [1]. However, excessive growth of aquatic plants makes it very noxious and have both ecological and economic impacts on aquatic ecosystems [2]. All aquatic weeds contribute to reduce the efficiency of waterways. Their appearance decreases water velocity and subsequently the conveyance capacity of the canals [3]. Dense macrophyte stands can increase the flood risk by impeding river flow [4]. In lakes and irrigation headworks, high evaporation rates of water are also a concern [3]. Aquatic vegetation growth can lead to water being lost from the reservoirs or channels through increased evapotranspiration and exacerbated seepage [5]. Aquatic weeds found in the intake channels may raise water levels resulting in additional seepage and spillage from the aqueducts. Floating weeds may cause many problems by partially or completely forming a thick blanket covering large and small water bodies and conflict with the normal access of water. They increase losses of water through the bilateral actions of evaporation and transpiration [6]. Submerged weeds decrease the carrying capacity of irrigation canals and main factors affecting the canal carrying capacity are vegetation density and the shape of submerged weeds along the canal cross-section [7]. In addition to these problems with efficiency of waterways, aquatic weeds also cause many problems in fish production, human health, electric production and generation and human activities.

The Gezira Scheme, Sudan, laying between the Blue and White Niles immediately south of Khartoum since 1925 when the Sennar dam on the Blue Nile came into operation. The minor canals are a key feature of the Gezira canal irrigation system. The total length of a minor canal can be as much as 20 km. Each minor is divided into reaches with a length varying from 1 to 4 km depending on the slope of the land. The reaches are separated by night-storage regulators consisting of brickwork well and sluice gate or, in the lower reaches, by a gated pipe [8]. The problem of aquatic weeds in minor canals is particularly serious because of their design, construction, nutrient rich sediments and low rate flow [9]. The presence of aquatic weeds was reported in the Gezira canals in 1929. The infestation progressively increased and particularly acute in the minor canals, *Abu* XXs and drains [3]. The presence of aquatic plants described since 1945, after that many surveys of aquatic weeds that were carried out in the Gezira irrigation system by [10, 11, 12] Desougi (1974), (1979), and Abdel Gadir (1986- 1987). These surveys showed the presence of many species in different groups belonging to different genera and families. In a review of aquatic weeds in the Gezira, Sudan [13] concluded that submerged weeds decrease the flow velocity by increasing friction, heavy infestation causes excessive water loss through evapotranspiration, silting and seepage.

The assessment of awareness of farmers to aquatic weed types, their effects on crop yield and the effectiveness of the adopted control measures is of great importance in planning effective and sustainable management strategy. There

were view studies regarding the awareness of farmers to aquatic weed problems and impact in the irrigated schemes in Sudan. Reference [14] carried out a survey in the Rahad scheme to assess the awareness of farmers to aquatic weeds and the current control measures adopted**.** It concluded that the awareness of farmers to aquatic weeds and their effect on crop yields need to be raised. Therefore, this study was carried to estimate farmer's awareness to the impact of aquatic weeds in some minor canals, Gezira Scheme, Sudan (2018).

2. MATERIALS AND METHODS

In general, the materials and methods of this study followed the protocol developed by [20]. To achieve the aim of this study, several field surveys were carried out during the rainy season in different endemic areas in Sudan in season 2013/2014 to collect *S. hermonthica* seeds. The study also comprised different laboratory experiments that were carried out at the Faculty of Agricultural Sciences (FAS), University of Gezira, Sudan.

2.1 Study Area

The study was carried out at the Centre Group at Gezira Scheme. The study area lies between latitudes 14° 15 N and 14° 20 N, and longitudes 33° 20 E and 33° 30 E. The climate of the region is semi-desert with a mean annual precipitation of 100-250 mm/year, with the rainy season from June to October and the dry season from March to June. The mean annual evapotranspiration is 2400 mm/year. The mean annual minimum and maximum temperatures are 12 °C in January and 42°C in May, respectively. The soil of the area is characterized by heavy soil (clay 60%), with pH 8-8.5, low organic matter and nitrogen, adequate potassium and low available phosphorous [15].

The study area covered a number of the farmers around the area of the six minor canals at Centre Group at Gezira Scheme; namely: *Barakat* I, *Barakat* II, *Barakat* III, *El sonni*, *El ibrahim* and *Haj elnour*. Each minor canal was divided into three sections (head, middle and tail), i.e. divided into 18 sites. The total population of farmers at the Center Group under the study is less than 10000 [16].

2.2 Awareness

To investigate farmer's awareness to the problems of aquatic weeds, a well-designed questionnaire was prepared. The questionnaire also determined the seasonal growth of aquatic weeds, control measures and the most preferable method/s of control for aquatic weeds in irrigation system in Gezira Scheme.

2.3 Sample size:

The sample size for the responders was estimated using the formula below.

$$n = \frac{z^2 p(1-p)}{d^2}$$

Where:

n = sample size
z = critical z value at significance level = 1.96
p = proportion of the population which has the attribute in question = 10%
d = absolute precision required around = 5%

Then the sample size estimation was:

z = 1.96
P = 0.5
q = (1-p) = 0.5
d = 0.05

$$n = \frac{(1.96)^2(0.1)(0.5)}{(0.05)^2} = 78$$

The total sample size was = 78

2.4 Statistical analysis

Data were subjected to descriptive analysis. Microsoft Excel and Statistical Packages for Social Sciences (SPSS) were used to analyze the data.

3. RESULTS AND DISCUSSIONS

The results of the questionnaire in the Gezira Scheme about farmer's awareness for aquatic weeds, their problems and management showed that most of the responders were males (95%), where, the percentage of females was (5%) only (Fig. 1). The age of the responders around (50 – 60) years old (24%) and (40 – 50) years old (21%) (Fig. 2), educated in secondary level (42%) (Fig. 3) and have long experience in agriculture (more than 25 years) (30%) (Fig. 4).

Aquatic weed species were known for most of the responders by their vernacular names. Where, (90%) of the responders known *Ipomoea aquatica*, (57%) known *Pistia stratiotes*, (72%) known *Vossia cuspidata*, (95%) known *Cyperus alopecuroides*, (52%) known *Polygonum glabrum*, (89%) known *Typha latifolia*, (71%) known *Najas pectinata*, (98%) known *Ipomoea hildibrandtti*, (99%) known *Echinochloa stagnina* and all of them known *Cynodon dactylon* (100%), but, (51%) of the responders didn't know *Azolla* sp. and (66%) don't known *Ludwigia palustris* (Table 1). Most of the responders observed that all of aquatic weed species available in both winter and summer seasons. Where, (24%) of the responders that known *Azolla* sp. observed that are available in both summer and winter seasons. Also, (30%) observed that in *Pistia statiotes*, (37%) in *Vossia cuspidata*, (48%) in *Cyperus alopecuroides*, (30%) in *Polygonum glabrum*, (48%) in *Typha latifolia*, (32%) in *Najas pectinata*, (68%) in *Cynodon dactylon*, (65%) in *Ipomoea hildebrandtii* and (60%) in *Echinochloa stagnina*, but, most of the responders (38%) that known *Ipomoea aquatica* observed that is more available in summer season and little of them believed that most of aquatic weeds are available in winter season (Table 2).

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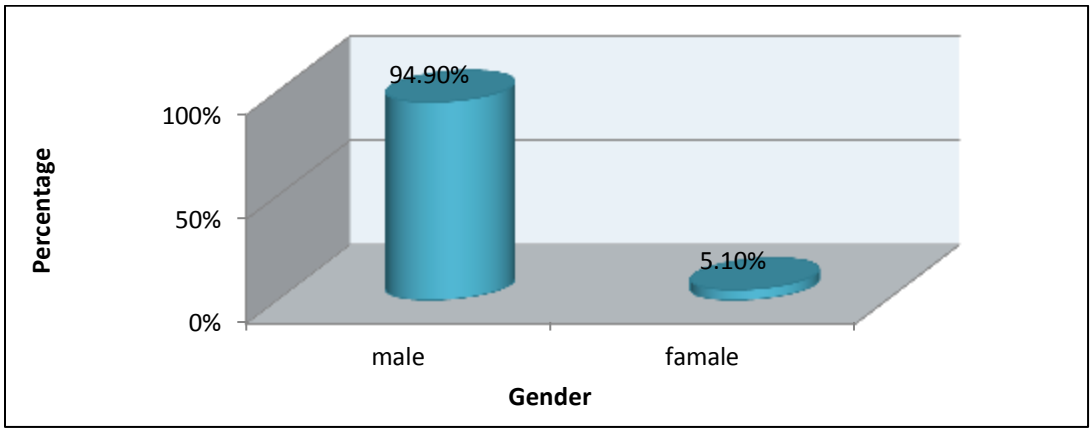

Fig. 1. Gender of the responders, Gezira Scheme, Sudan 2018

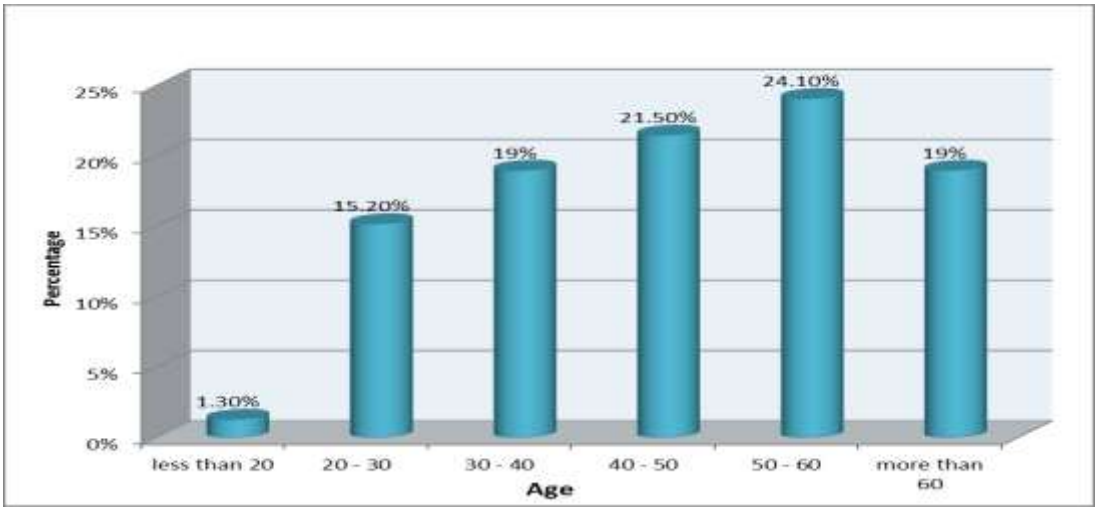

Fig. 2. Age of the responders, Gezira Scheme, Sudan 2018

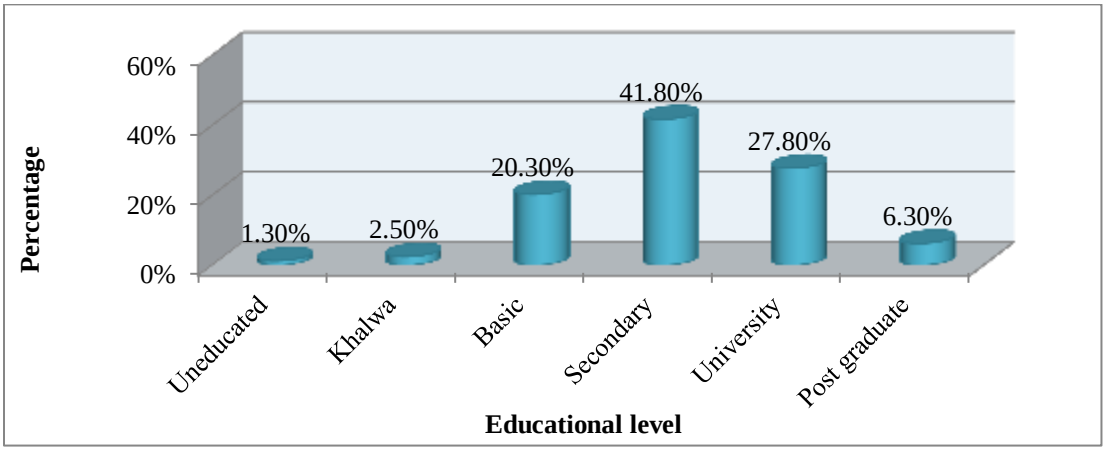

Fig. 3. Educational level of the responders, Gezira Scheme, Sudan 2018

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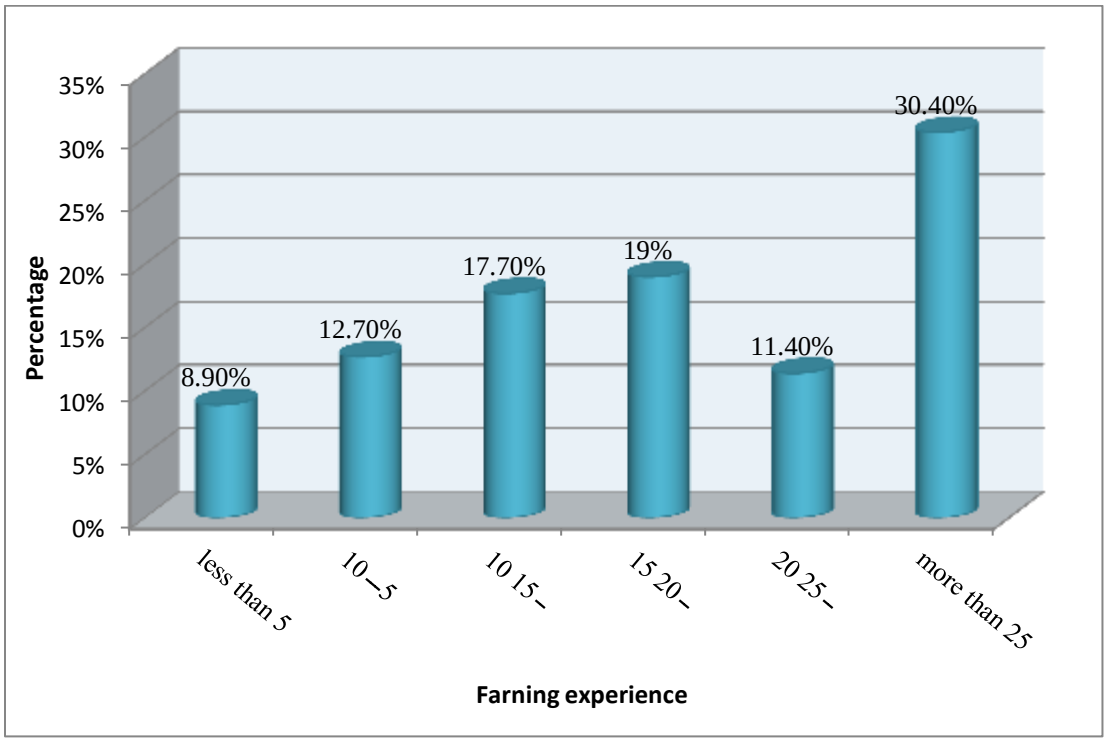

Fig. 4. Farming experience of the responders, Gezira Scheme, Sudan 2018

Regarding to the problems of aquatic weeds in irrigation system, (96%) of the responders very agree about the effect of aquatic weeds on the reduction of water velocity and the carrying capacity of canals, (44%) very agree about water losses cause by aquatic weeds through evapotranspiration, (49%) very agree about retards causes by aquatic weeds during raise of the water for irrigation, (28%) agree about the effects on fish production causes by the presence of aquatic weeds in water bodies, (48%) very agree about the role of aquatic weeds as a breeding areas for mosquitoes, worms and snails in aquatic environment, (52%) agree about the damage cause by aquatic weeds in pumps and turbines in irrigation system, (51%) agree about the effects of aquatic weeds on taste and odor of water and most of them (71%) considered that aquatic weeds are very noxious, harmful and detrimental (Table 3).

The responders indicated that mechanical control is the best control method (63%), followed by the use of herbicide (18%) and drying (15%), but, manual removal considered as un-preferable method (Table 4). Also, most of the responders considered that mechanical control is a very effective method for control of aquatic weeds (58%), followed by the use of herbicides (34%) and drying method (25%), but, manual removal was a very weak control method.

The results of the questionnaire in the Gezira irrigated scheme about aquatic weeds indicated that the responders have complete awareness about the problems and losses cause by aquatic weeds in irrigation system. They knew most of aquatic species and have enough information about some control methods like mechanical control and drying. This is due to the aged, long farming experience and comparatively educated (secondary level), but, some of aquatic species are not known to the responders, because these species are newly introduced into minor canals of Gezira scheme such as *Ludwigia palustris* and have no local name for it till now. Also, the responders need to know more about the seasonal growth of aquatic weeds to be able to select an adequate control method in optimum time. Where, most of the responders considered that aquatic weeds are available in both winter and summer seasons, and some of them believed that all weeds irrespective of habitats are growing in summer season (fall season). Few farmers have enough information about the wintering growth of aquatic weeds and the factors that govern the growth and reproduction of aquatic species, this because the farmers don't concern with the problems of aquatic weeds and depending only on the clearance of canals during the season for irrigating their crops.

The results are consistent with those reported by [13] who carried out a survey in Rahad scheme, Sudan to assess the awareness of farmers to aquatic weeds and the current control measures adopted. It was observed that almost 95% of the respondents do not aware of submerged weeds (*Najas pectinata*). About 79 % of farmers are aware of the emerged weeds (*Cyperus alopecuroides*, *Polygonum glabrum* and *Typha latifolia*). 64% of the farmers are aware of bank weeds (*Cynodon dactylon* and *Ipomoea hildebrandtii*). Around 62% of the respondents are not aware of floating weeds (*Azolla* sp., *Ipomoea aquatic*, *Ludwigia palustris*, *Pistia stratiotes* and *Vossia cuspidata*).

Table 1. Awareness of the farmers for aquatic weed species, Gezira Scheme, Sudan 2018

No.	Scientific name	Know	Don't know	Percentage
1	*Azolla* sp.	39	40	**79**
		49.4%	50.6%	**100%**
2	*Ipomoea aquatica*	71	8	**79**
		89.9%	10.1%	**100%**
3	*Ludwigia palustris*	27	52	**79**
		34.2%	65.8%	**100%**
4	*Pistia stratiotes*	45	34	**79**
		57%	43%	**100%**
5	*Vossia cuspidata*	57	22	**79**
		72.2%	27.8%	**100%**
6	*Cyperus alopecuroides*	75	4	**79**
		94.9%	5.1%	**100%**
7	*Polygonum glabrum*	41	38	**79**
		51.9%	48.1%	**100%**
8	*Typha latifolia*	70	9	**79**
		88.6%	11.4%	**100%**
9	*Najas pectinata*	56	23	**79**
		70.9	29.1	**100%**
10	*Cynodon dactylon*	79	0	**79**
		100%	0%	**100%**
11	*Ipomoea hildebrandtii*	77	2	**79**
		97.5%	2.5%	**100%**
12	*Echinochloa stagnina*	78	1	**79**
		98.7%	1.3%	**100%**

Table 2. Awareness of the farmers for the seasonal growth of aquatic weed species, Gezira Scheme, Sudan 2018

No.	Scientific name	Winter season	Summer season	Winter and summer seasons	Total
1	*Azolla* sp.	6	14	19	**39**
		7.6%	17.7%	24.1%	**49.4%**
2	*Ipomoea aquatica*	14	30	27	**71**
		17.7%	38%	34.2%	**89.9%**
3	*Ludwigia palustris*	4	9	14	**27**
		5.1%	11.4%	17.7%	**34.2%**
4	*Pistia stratiotes*	12	9	24	**45**
		15.2%	11.4%	30.4%	**57%**
5	*Vossia cuspidata*	10	18	29	**57**
		12.7%	22.8%	36.7%	**72.2%**
6	*Cyperus alopecuroides*	9	28	38	**75**
		11%	35.4%	48.1,%	**94.5%**
7	*Polygonum glabrum*	3	14	24	**41**
		3.8%	17.7%	30.4%	**51.9%**
8	*Typha latifolia*	15	16	38	**69**
		19%	20.3%	48.1%	**87.4%**

9	*Najas pectinata*	15	16	25	**56**
		19%	20.3%	31.5%	**70.8%**
10	*Cynodon dactylon*	10	15	54	**79**
		12.6%	19%	68.4%	**100%**
11	*Ipomoea hildebrandtii*	11	14	52	**77**
		13.9%	17.7%	65.8%	**97.4%**
12	*Echinochloa stagnina*	10	21	47	**78**
		12.7%	26.6%	59.5%	**98.8%**

Table 3. Awareness of the farmers for the problems of aquatic weeds, Gezira Scheme, Sudan 2018

No.	Question	Very agree	Agree	Neuter	Don't agree	Very don't agree	Total	Opinions
1	Aquatic weeds reduce the water velocity and carrying capacity of canals.	55	24	0	0	0	**79**	**V. agree**
		69.6%	30.4%	0.0%	0.0%	0.0%	**100%**	
2	Aquatic weeds cause water losses through evaporation.	35	34	8	2	0	**79**	**V. agree**
		44.3%	43%	10%	2.5%	0.0%	**100%**	
3	Aquatic weeds retard raise of water for irrigation.	39	33	2	4	1	**79**	**V. agree**
		49.4%	41.8%	2.5%	5.1%	1.3	**100%**	
4	Aquatic weeds reduce the effectiveness of water bodies for fish production.	20	23	14	22	1	**79**	**Agree**
		25.3%	28.3%	17%	27%	1.3%	**100%**	
5	Excessive growth of aquatic weeds consider as a breeding areas for mosquitoes, worms and snails.	38	34	4	3	0	**79**	**V. agree**
		48.1%	43%	5.1%	3.8%	0.0%	**100%**	
6	Aquatic weeds cause damage in pumps and turbines.	31	41	6	1	0	**79**	**Agree**
		39.2%	51.9%	7.6%	1.3%	0.0%	**100%**	
7	Aquatic weeds can affect the taste and odor of water.	31	40	5	3	0	**79**	**Agree**
		39.2%	50.6%	6.3%	3.8%	0.0%	**100%**	
8	Aquatic weeds consider as harmful.	56	14	5	4	0	**79**	**V. agree**
		70.9%	17.7%	6.3%	5.1%	0.0%	100%	

Table 4. The best control method adopted by the farmers, Gezira Scheme, Sudan 2018

No.	Control methods	Size	Percentage
1.	Drying	12	**15.2%**
2.	Mechanical control	50	**63.3%**
3.	Hand removal	3	**3.8%**
4.	Use of herbicides	14	**17.7%**
	Total	**79**	**100%**

Table 5. The effectiveness of control methods adopted by the farmers, Gezira Scheme, Sudan 2018

No.	Control methods	Very effective	Effective	Accepted	Very weak	Weak	Total
1.	Drying	20	29	17	11	2	**79**
		25.3%	36.7%	21.5%	13.9%	2.5%	**100%**

2.	Mechanical control	46	17	11	4	1	**79**
		58.2%	21.5%	13.9%	5.1%	1.3%	**100%**
3.	Hand removal	2	12	21	25	19	**79**
		2.5%	15.2%	26.6%	31.6%	24.1%	**100%**
4.	Use of herbicides	27	17	12	7	16	**79**
		34.2%	21.5%	15.2%	8.9%	20.3%	**100%**

Also, [13] reported that among the farmers questioned, 64% considered the emerged weeds had a high effect on crop yield. About 56% of farmers are not aware of floating or bank weeds effect and around 77% of the respondents are not aware of the effect of submerged weeds. The farmers follow basic three forms of control measures. These are dredging (mechanical control), cutting (manual removal) and herbicides. About 84% of farmers considered dredger (Karaka) effective in controlling aquatic weeds, 43% of farmers considered herbicides effective while only 10% of farmers considered cutting effect.

4. CONCLUSION

Investigation of farmer's awareness showed that farmers in the Gezira Scheme have enough information about aquatic species in minor canals, but, they need to know more about the prevalence of aquatic weeds during both summer and winter seasons for helping them to control aquatic species at the suitable time throughout the year. So, the researcher must supplement the farmers by gainful and proper information about aquatic weeds.

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