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ORIGINAL ARTICLE

Gorgon Cultivation - A Serious Threat To Wetland Bio-diversity

Jahanara Khatun[1] and A.K. M. Anwaruzzaman[2]

[1]Assistant Teacher (Geography), Chaltia Sreeguru Pathsala High School, PO Berhampore, Dist. Murshidabad
[2]Assistant Professor of Geography, Malda College, Malda -732101,
Email: zmn_anwar@yahoo.co.in

Abstract:

Wetlands are gifts of nature. These perform multifaceted functions that have importance at local, national and international perspectives. The economic and aesthetic importance of wetland is well known all over the world. Among the versatile roles, the environmental roles are so appreciated that it is often termed as 'lungs and kidneys' of nature. This precious component of nature is severely threatened all over the world. Malda, being no exception, is also witnessing various types of threats in this treasure of bio-diversity. Apart from many natural threats, a number of anthropogenic threats are obvious in this region. The newly introduced aquatic plant named Gorgon has been threatening it unto death. There have been efforts to make an assessment of threats also making effort in the direction of saving these natural wealth is the aim of the paper.

KEYWORDS:

Gorgon, Wetland, Makhana, Marsh, Fen, Peatland, Bio-diverstiy, Eutrophication, Makhana, Nitrification, Gasification, Insecticides and Pesticides.

INTRODUCTION:

The very name of the district "Malda" or "Maldah" suggests that it full of Dahas i.e. Hrads (lakes) or water bodies. Historically it used to be a region of lakes and water bodies. Even today the district has a number of wetlands. Wetlands are one of the richest bio-diversity reserves and ecosystems. Unfortunately these 'gifts of nature' are suffering from numerous problems of variety of nature all over the world. Malda wetlands are also threatened by natural as well as anthropogenic process. Among others the introduction of Gorgon plant (Euryale Ferox) locally known as Makhana in the water bodies of Malda district is a very severe one. Being vulnerable to insects and pastes Makhana fields require heavy doses of insecticides and pesticides that pollutes the water bodies to such an extent that they become inhabitable for most of the aquatic plants and animals.

THE STUDY AREA:

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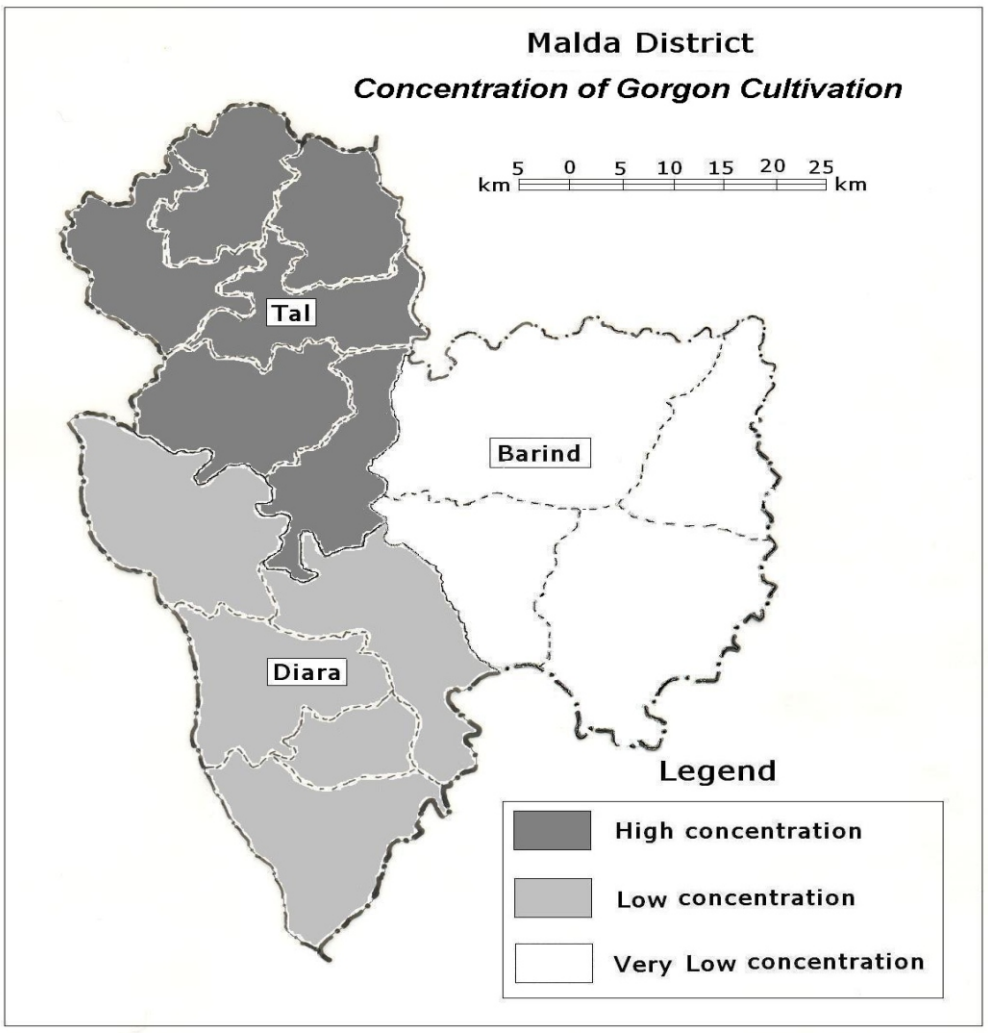
The district is extended from 244020 North Latitudes to 253008 North Latitudes and from 874550 East Longitudes to 882810 East Longitudes. The study area



incorporates the district of Malda covering 3,733 km2 in the state of West Bengal. Bihar and Jharkhand border the district in the west; by Bangladesh in the East, North and South Dinajpur in the North and Murshidabad in the South. The mighty Ganges forms the South and West (partially) and Punarbhaba River forms the Indo-Bangla border. Apart from these two rivers the district has a number of other rivers such as Mahananda, Pagla, Tangon, Fulahar and Kalindri etc. Most of the rivers have shifted their courses, for some times, several kilometers that has curved out numerous ox-bow-lakes and cut-off channels. The Tal region has been formed by siltation and hence quite a few remnants of Tal (lake) are still visible. The district has a number of man-made water bodies too.

TABLE 1: DISTRIBUTION OF WETLANDS BY NATURE, SIZE AND CLASS IN MALDA (2000)

Nature	Class	Number	Area (ha)	Average size (ha)	Percent to total area
Natural	Ponds/Lakes	22	2760.79	125.49	9.39
	River cut-off/Ox-Bow-Lake	190	2986.80	15.7	10.15
	Seasonal waterlogged	235	20956.49	89.19	71.24
	Marsh/Swamp	20	2047.09	102.35	6.96
Man-made	Reservoir	4	34.86	8.71	0.12
	Tank	90	613.07	6.81	2.08
	Waterlogged	1	17.85	17.85	0.06
Total	**All classes**	**562**	**2941.95**	**52.34**	**100.00**

Source: Bhatteacharya and others (2000): Wetlands in W.B., p. 59, IWMED (Kolkata) and SAC (Ahmedabad)

Aim of the study: The paper is aimed at assessing different threats to the wetlands with special reference to threat perceived by the cultivation of Gorgon plant. The process and economy of Gorgon cultivation will be evaluated. The paper will also try to suggest some steps to combat menace by some scientific approach.

Database and Methodology: Both primary and secondary data have been used for the purpose. Extensive fieldwork has been conducted to assess the economy involved in it and also to ascertain the ecological threats due to cultivation of Gorgon plant. Visit to wetlands and interviewing cultivators as well as suppliers of insecticides and pesticides have given rise to lot of primary data. The data have been statistically analyzed and cartographically represented.

Significance of wetland with special reference to bio-diversity: Human survival primarily depends on biological wealth i.e. on plants and animals. Wetlands offer one of the richest bio-diversity. Nobody can deny the fact that a local community directly or indirectly depends on immediate environment for their food, fodder, fibre, fuel etc. Thus, wetlands are source of livelihood for local people. By the advancement of biological sciences, bio-diversity is being increasingly harnessed for pharmaceutical, food and other industries (IGIDR, 2001, p.6).

Wetlands are among one of the most productive and biologically rich ecosystem. To quote Gopal (2000, p. 57) “Tropical wetlands are more productive than tropical savannahs. It can produce 300 g/m2 in submerged Macrophytes and 10 kg/m2 in emergent Macrophytes. Wetlands host a vast and varied repository of biodiversity, rich in fish, mammals, birds, amphibians, reptiles and other plant and animals species.

Kundu and others (1997, p. 110-112) while working on wetlands of Gangetic West Bengal on behalf of the Kolkata based Institute of Wetland Management and Ecological Design enumerated 212 vascular plant species of 56 families. The team detected 4 classes of algae of which chlorphyceae is found to be the most dominant one with 20 genera. They identified 9 types of insects, among them 5 types of flies namely the May fly, the Dragon fly, the Damsel fly, the Lepidopteron (water-strides) and the Gerris are very common. Among the others, Backswimmer (Notonecia-Notonectidal), Waterboatman (Corexia-Corixide), Whirling beetle (Gurinide, Nepride), Gesonula punctiformis (Grasshoper) Leaf insect (Phyllium scethe) and Spiders (Nephilia sp.) and Crab (Gelacimus) are found by the researchers. Apart form that fresh water crab, several types of mollusca, (7 nos), 23 types of piscifauna, 5 types of zooplnktons, 2 annelids and 60 varieties of birds are enumerated. Among the birds 27 are migratory and the remaining are resident and

common birds.

Apart from these, some of the restoration methods like desiltation, aeration, harvesting of macrophytes and prevention of pollution by waste water treatment (methods like screening, aerated lagoon and constructed wetlands) are also suggested to improve the catchment conditions and the quality of water (Chatrath, 1992, p. 28)

During the field visit the author found most of the enlisted species of plants and animals in the wetlands of Malda district. The wetlands of this region are particularly known for being host of number of migratory birds. They use these sanctuaries for grazing, breeding, lying of eggs and also hatching. Before introduction of Gorgon plants wetland were used to be nesting and resting grounds for several migratory birds, which have almost disappeared.

Threatened wetlands of Maldah :

Wetlands of Malda district are under all round threats. Neglected over years and anthropogenic pressure is posing very serious threats to the existence of these precious ecosystems. Unfortunately, these invaluable 'wetlands are amongst endangered'. A study carried out by the Wild Life Institute of India reveals that some 70-80 percent of individual fresh water marshes and lakes in Gangetic flood plain have been lost in the past 50 years.

Threats to the wetlands of Malda district may be grouped into two – natural and anthropogenic. Among the natural threats Siltation and Eutrophication are common in the area. Though the eutrophication is very common and of higher magnitude, the siltation is not that much common phenomenon. The anthropogenic sources threatening wetlands in this region are:

1.Cultivation of Gorgon plant.
2.Reclamation by alteration of wetlands for agricultural use;
3.Draining out of water and encroachment for construction of railway, roads, bus stand, human settlement and industry;
4.Grabbing by real estate promoter/developer;
5.Coming up of slums and subsequent encroachment by slum dwellers;
6.Dumping of solid waste garbage from municipal as well as industrial sources;
7.Pollution from untreated domestic sewage, industrial effluent and also insecticides, pesticides, herbicides and roddenticides from agricultural field; and finally
8.Poisoning of water bodies by applying pesticides etc.

Gorgon cultivation - growth and distribution:

It has already been mentioned above that the wetlands of Malda district are threatened by number of anthropogenic process. Gorgon cultivation is one of the most important among them. The Gorgon was introduced as a crop in the later half of 1990s which posses a various serious threat today.

The Gorgon plant is popularly and locally known as 'Makhana' is an aquatic plant and also known as 'Fox Nut'. Its scientific name is Euryale Ferox. It is a monotypic genus of Nymphaceae family and a native of South-East Asia. In China it is cultivated for centuries. In India, it is cultivated in the wetlands of Bihar, Assam and West Bengal (mainly Tal region of Malda district), Tripura, Manipur and Kashmir. The state of Bihar (Darbhanga, Motihari, Madhubani, Saharsah, and Purnea produces almost 80 percent of all Makhana produced in the country. Makahna produces edible fruits/seeds. Popped seeds are eaten parched or made into flour. Gorgon flour is considered to be rich in protein and contains low fat. Presently a considerable quantity of Gorgon seeds is exported to middle-east countries. Recently an export order at the tune of Rs. 4.5 crore has been signed with the government of Saudi Arabia. Cultivation of gorgon may be identified as the single most important and highly dangerous threat to the bio-diversity of the wetlands of the area under consideration. It's advent may be traced from the east ward march of the crop from the neighbouring state of Bihar. This crop was reported from the Harishchandrapur Block II for the first time in the district during late 1990s. By the beginning of year 2000 it occupied around 150 hectare of wetland in the mentioned block and subsequently it started spreading in the neighbouring blocks too. During last two years of 1990s, land devoted to Gorgon increased three folds. Block-wise area under gorgon cultivation is given in the table-2.

It is obvious that approximately 58 percent of the area under Gorgon cultivation in the sub-division is concentrated within Harishchandrapur block II area. It has already recorded a considerable spread in the neighbouring blocks of this sub-division. Eve other blocks of Diara and some parts of Barind region is also witnessing advent of this plant. Harishchandrapur being the heart of Tal offer excellent environment for this practice. Roughly 50 percent area of this region is low lying and therefore, suitable for Gorgon cultivation.

TABLE 2:
Block-wise distribution of Gorgon cultivation in Chanchal Sub-division (2000-2001) & 2008-09

Serial No.	Block	Area (ha) under Gorgon (2000-01)	Percent to total	Area (ha) under Gorgon, (2008-09)	Percent to total	Growth rate (%) (2000-01 to 2008-09
1	Harishchandrapur I	50	19.23	130	17.15	160
2	Harishchandrapur II	150	57.69	448	59.10	165
3	Chanchal I	15	5.77	60	07.92	400
4	Chanchal II	Reported	N.A.	50	06.60	CG
5	Ratua I	25	9.61	45	05.94	80
6	Ratua II	20	7.70	25	03.30	25
Total	Chanchal Sub-division	260	100.00	758	100.00	498

Source: Crop Coverage Register, Sub-divisional agriculture office, Chanchal, Malda.

Though there is a problem of systematic records related to land devoted to Makhana cultivation, yet growth is noticeable. The department of agriculture dose not recognizes it to be one of the agricultural crops. Now it has been decided that department of horticulture will supervise the cultivation of this crop. If one considers only Harishchandrapur block II, one can notice that it has increased to 150 ha in the year 2000-2001 from merely 50 ha in the year 1989-99. By the year 2003-04 the area under Gorgon cultivation in this block increased further and reached to 180 ha and then there is a continuous growth. The area devoted to Gorgon reached to a high of 448 ha in the current cropping year i.e. 2008-09, which shows that the demand for the produce is ever increasing. It is certain from the trend even that from the point of view of cultivator too it profitable and hence it is quite clear that it is gaining popularity. The annual fluctuation in the area devoted to Gorgon (table-3) is mainly due to price instability.

TABLE 3:
Trend of Gorgon cultivation in Harishchandrapur Block II (2000-01 to 2008-09)

Cropping season	Area under Gorgon cultivation (ha)	Annual change (ha)
2000-01	150	N. A.
2001-02	80	(-) 70
2002-03	110	(+) 30
2003-04	180	(+) 70
2004-05	216	(+) 36
2005-06	259	(+) 33
2006-07	311	(+) 52
2007-08	373	(+) 52
2008-09	448	(+) 75

Source: Crop Coverage Register, Sub-divisional agriculture office, Chanchal, Malda.

GORGON CULTIVATION- PROCESS AND ECONOMY:

Cultivation of Gorgon involves a complicated process. A low lying area with shallow water, 2-5 feet dip is suitable for the crop. Wetland with plenty of sediments and humus is essential for the crop. Field

preparation for plantation sowing or plantation of Gorgon involves the water body to be completely cleared of all weeds etc. then insecticides and pesticides are applied to sterilize the water so that insects and fishes can not it up the shoots once they come out after germination of seeds. Sowing of seeds takes place in the month of December and January. Plantation of saplings (nursery) takes place during February, if a cultivator chooses to go for plantation instead of sowing. Saplings are collected from the old fields where there was cultivation of this crop during last cropping season. After the harvest of crop in the last year, the left over seeds are germinated very thick for the next year. The thinning out process produces sapling for other fields.

Harvest of the crop starts by the last week of June and it continue till end of July. Three rounds of harvests are generally practiced. The first round of harvest or collection of seeds where maximum quantity of seeds are easily available is locally known as 'Sharkat'. During the second round of collection is little less and more time consuming and locally known as 'Markat'. The third and last round has least harvest with longest duration; locally known as 'Chharkat'. The payment to the labour is made in kind i.e. a part of the production is shared with the labour on piece rate basis. During 'Sharkat' 10 kg for every quintal of collection, during 'Markat' 25 kg per quintal and during 'Chharkat' 50-60 kg per quintal of collection is paid to the labour.

The produced seeds are taken to the factories to make perched seed (locally known as 'Khoi' or 'Lava') which is used as an ingredient to prepare sweet dishes, vegetable items and also used as a mixture of condensed milk and baby foods. Since the product is rich in protein and fact contain is very low, it is a very popular item to the people who have crossed 50 years of age. The cultivators seldom have their factory of their own. They sell their produces to the factory owners who are mostly entrepreneurs/traders from Bihar and Uttar Pradesh. The labour working in the factories do not get payment on daily wage basis but they have a contact of getting payment in kind instead of cash. While the Gorgon seed delivered to the labour 5.5 kg is treated as 5 kg that means 110 kg is given and counted as one quintal. After the processing the labour is supposed to deliver four standard sack (measuring 18"×44"and holding 10 kg of finished product) full of finished product locally known as 'Labha' or 'Lava'. There are three qualities of final products namely the grade-I or the best quality is known as 'Labha' or 'Lava' (soft and best quality), the second grade-II or the moderate grade is known as 'Thurri' (hard) and the grade-III or the inferior one is known as 'Murra' (very hard and half perched). The 'Murra' is used to make flour for preparation of inferior quality food items. After the processing for which entire cost (labour, fuel and rent etc) is born by the labour, 40 kg of processed 'Lava' has to be handed over to the owner and the remaining part will be with labour as labour charge.

TABLE 4:
Calculation for income and expenditure for cultivation of one bigha (1\3 of an acre) of Gorgon in a season

SL	Area of expenditure	Quantity required	Expenditure		Income (Rs)	Profit (Rs)
			Rate (Rs.)	Amount (Rest)		
1.	Field preparation	As per requirement	Not specified	1500.00	-----	-----
2.	Seeding/plantation	50 kg	70	3500.00	-----	-----
3.	Labour (sowing/plantation)	10 Man days	250	2500.00	-----	-----
4.	Insecticides and pesticides etc.	As per requirement	As per market rate	3000.00	-----	-----
Total expenditure		-----	-----	-----	10500.00	-----
Production		4.5 quintal	4.5 quintal @ Rs. = Rs.24750.00	5500.00 quintal	14250	
Income		Income = Production - Expenditure = Rs. (24750.00-10500.00) = Rs. 14250.00				14250.00

Source: Calculated by the researcher on the basis of data/information collected from the field during July, 2009.

Economy of Gorgon is equally complicated and planned such way that the owner of the land or the owner of the factory will seldom run in loss. The cultivators and entrepreneurs have evolved their own innovative system and method of payment to labour and workers. The payment for harvest during first round (Sharkat) is at the ratio 1:10 that means for collection of every quintal of Gorgon seed the labour will get 10 kg, during second round (Markat) it is 1:4 i.e for every quintal the labour charge is 25 kg and for the third round (Chharkat) it is 1:2 i.e. 50 kg is the labour charge for every quintal of collection. As the duration for collection goes on increasing from round one to the third round and hence labour charge also goes on increasing. The collection by the labour will be weighing in wet condition and hence 7 kg is treated equivalent to 5 kg and sometimes 6 kg equivalent to 5 kg. For processing the trader will give 110 kg of Gorgon seed to the labour and will receive back 40 kg of perched (lava). But it is not weight but 4 sacks full of lava are assured to be delivered to the trader. The standard sack used is measured 18"×44"and contains about 10 kg of finished product. The entire ancillary costs such as fuel and rent for the shed etc. is born by the labour. With 110 kg of seed whatever they produce, after delivering 40 kg of processed seed, remaining part is with the labour as their wage (charge).

Processing of Gorgon is not that profitable as compared to the cultivation. The trader hands over 110 kg of Gorgon seed to the labour which cost Rs. 6050.00 @ Rs. 55.00 per kg. In return the trader will get around 40 kg of finished product which will fetch him around Rs. 7600.00 as the 'Lava' is sold @ around Rs. 190.00 per kg. This offers a profit of Rs. (7600-6050) Rs. 550.00 per quintals of processing of Gorgon.

Threat form Gorgon cultivation – impact on environment:

It is true that Gorgon cultivation is spreading very fast but the question remains why one should worry so much. Certainly there is a point of great concern regarding this. This crop cultivation takes place under such an ecological condition, which is naturally very rich in bio-diversity. A good quality wetland is considered to be ideal for this culture too. Mishra (1998, p. 20) a scientist associated with Division of Floriculture and Landscaping of Indian Agricultural Research Institute, New Delhi, observes, "Clay with plenty of humus is ideal". He further notes "depth of water in no case should be below 0.6 m during May-June and above 1.5 m during October-November". From Mishra's observation it is clear that in areas lying as interface between Terrestrial and aquatic ecosystems with plenty of aquatic plants to supply plenty of humus is suitable for Gorgon cultivation. While describing field preparation he added, "Before sowing, the ponds should be cleared of weeds and etc." Mishra (1998, p. 20). During field visits it was noticed that wetland is cleared of all weeds (undesirable aquatic plants) and other aquatic lives such as fishes etc. The cultivators apprehended crop damage incase the fishes and other zoo and Phytoplanktons are left. It was further noticed that water is completely sterilized by application of insecticides/pesticides of endosulfan group, so that once shoots come out of Gorgon seed may not be eaten up or damaged by fishes and other aquatic lives.

Cultivators of this region, for better yield, apply number of chemicals. Particularly after a few years of Gorgon culture, when natural nutrients are exhausted, high doses of urea is applied. A mixture of NPK 30:20:10 is being used at a rate of 20 kg/bigha (one third of an acre). Nitrogen through Urea 65-70 kg/ha, Potash 5 kg/bigha, Calcium Ammonium Nitrate 150 kg/ha is applied for better yield. In order to get a higher yield Linden dust is applied in two forms i.e. dusting (1.3%) and spraying (6.5%). APSA 80 of Amway, Miraculan/Phylocol, Planofix/(α-NAA)are also applied for better response. In very recent times Vitamins (Ankavite-L, Miracle and Heera 303) are in use in the areas where soil fertility is low.

During stages of growth, when leaves are exposed on the surface of water, they are susceptible to different insects, pastes and also to fungal attack. To protect crop from fungus or leaf scaring/cutting/sucking blight and cater pillar application of different insecticides, pesticides and fungicides are common which directly go into the water and kill remaining aquatic lives. It is obvious from the table-5 that so much of concentration of dangerous chemicals in the form of insecticides/pesticides/fungicides and fertilizers, aquatic lives find it very difficult to survive. The sad story does not end here. Wetlands are generally located amongst the extensive agricultural land. Thanks to heavy use of chemical fertilizer as well as insecticides and pesticides in the agricultural field. Remains of all these fertilizers and pesticides find their way in to theses low lying areas (wetlands) with surface run-off generated during rains. These chemical remnants along with chemicals used for Gorgon cultivation make aquatic lives impossible.

TABLE 5:
Insecticides/Pesticides/Fungicides used in Gorgon Cultivation

SL	Insecticide/Pesticide	Compound	Application method	Ratio/Concentration (ml/l) or g/l	No. of times applied	Quantity applied per bigha in a cropping season
1	Blitox (50 WP)	Copper Oxichloride	Spray	4g/l	1	175g
2	Cypermethrin(10% WP) (Ostad/Cypercel)	Cypermethrin	Spray	1.0-1.5	4	50-100ml
3	Contaf (5%EC)	Hexaconazole	Spray	1.0-1.5	3	50ml
4	Derosal (50%WP)	Carbendazim	Spray	2g/l	3	35g
5	Kundan/Folidal dust (2%)	Methylparathion	Broad casting	NA	3	5kg
6	Metacid (5%)	Methylparathion	Spray	1.0-1.5	3-4	120ml
7	Paratap (2%)	Methylparathion	Broad casting	NA	3	10kg
8	Tataphen (20%)	Phenvelarate	Spray	1.0-1.5	3	50-100ml
9	Tata Master/Unilax/Ridonil (8%+64%)	Mancozeb + Metaloxyl	Spray	1.0-1.5g/l	2	100g
10	Thioden (35 EC)	Endosulfan	Spray	1.0	3	50ml
11	Kinadon (40% SL)	Phosphamidon	Spray	2ml/l	8	100ml
12	Josh/Kargil (40% SL)	Triozophos	Spray	1.5ml/l	8	60-70ml
13	Saff/Stuff (63% WP + 12% WP)	Manchozeb +Carbendizine	Spray	2.0-2.5ml/l	3-5	100ml

Source: Collected by the author form the field during March- August, 2008.

Gorgon itself is armed with spines and denies survival of others. The thick growth of leaves cover water surface all the way. It does not allow sunlight to reach to the surface of water, which is necessary for growth and survival of algae and other weeds. Mishra (1998, p. 20) observes, “Euryale Ferox is an annual plant having flat circular, through out spiny and floating leaves which have prominent veins on the purple undersides, densely pitted with spines.” Each part of the plant is armed with spines, which make survival of other aquatic lives difficult. He further opines “The Petioles of leaves, flower stalks and sepals are also armed with spines” (Mishra, 1998, p. 21).

Under such a situation we are destroying very rich bio-diversity reserves, which are habitats for a wide variety of plants and animals. Shallow water of wetland is ideal for water birds, particularly, water-fowls. From the point of view of physico-chemical and bio-chemical processes, which occur in wetland, it's very important to conserve these precious 'gifts of nature'. According to Prof. N. Balakrishnan Nair importance of wetlands includes, “sedimentation, storage, ion exchange, nutrients uptake, absorption, bacterial and fungal assimilation, solubilization, gasification, immobilization, nitrification, de-nitrification, bio-conversion and so on” (Nair, 1989).

Remedies: In order to arrest unlimited conversion of wetland into other use a stringent law should be brought banning all types of alteration of wetland. Cultivation of Gorgon plant in the wetland should be banned immediately. Pisciculture may be encouraged in order to healthy survival of wetlands. The owner may be convinced logically (economic) that Pisciculture is more profitable as compared to Gorgon cultivation. Filling up of wetland and draining out of water from them should be prohibited. An exclusive authority may be created to monitor use of them and the authority will be responsible for preservation of the same. Local people may be encouraged to preserve this wealth in its original form. People from the riparian villages should/may be sensitized regarding beneficial role of wetland and harmful effect of it if converted into another use or if the wetlands are degraded. “Because Wetlands are common property with multi-purpose utility, their protection and management also need to be a common responsibility. An appropriate forum for resolving the conflict on wetland issues has to be set up. It is important for all the relevant ministries to allocate sufficient funds towards the conservation of these ecosystems” (Prasad and others, accessed form
http://wgbis.ces.iisc.ernet.in/energy/water/paper/wetlands/impacts.html#9http://wgbis.ces.iisc.ernet.in/e

nergy/water/paper/wetlands/impacts.html#9 on 07.01.2011). Choking of the supply line of the excessive nutrients may arrest the eutrophication/aging of water bodies.

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