Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

Journal of Entomology and Zoology Studies

E-ISSN: 2320-7078
P-ISSN: 2349-6800
www.entomoljournal.com
JEZS 2020; 8(2): 844-851

Received: 10-01-2020
Accepted: 12-02-2020

Pawan Kumar Sharma
Ph.D. Research Scholar, Dept. of Aquaculture, FC & RI Ponneri, TNJFU, Tamil Nadu, India

J Stephan Sampath Kumar
Director, Directorate for Sustainable Aquaculture, Thanjavur, TNJFU, Tamil Nadu, India

GK Shiv Raman
Principle Scientist ICAR-CIFT, Cochin Kerala, India

V Senthil Kumar
Assistant Professor& Head i/c TCeSA, Thanjavur, TNJFU, Tamil Nadu, India

S Anand
Assistant Professor& Head i/c EBCeSA, Bhavani Sagar, TNJFU, Tamil Nadu, India

Chandana BL
M.F.Sc Research Scholar, Dept. of Aquaculture, KUFOS, Kerala, India

Gayatri Pandey
Ph.D. Research Scholar, Dept. of FPT., FC & RI Thoothukudi, TNJFU, Tamil Nadu, India

Corresponding Author:
Pawan Kumar Sharma
Ph.D. Research Scholar, Dept. of Aquaculture, FC & RI Ponneri, TNJFU, Tamil Nadu, India

A case study on therapeutic use of chemicals and antibiotics in aquaculture practices in selected places of Kerala and Tamil Nadu states of India

Pawan Kumar Sharma, J Stephan Sampath Kumar, GK Shiv Raman, V Senthil Kumar, S Anand, Chandana BL and Gayatri Pandey

Abstract
The commercialization and intensification of aquaculture demand use of drugs. This study was carried out in two districts of Kerala (Ernakulum and Kottayam) and Tamil Nadu (Thanjavur and Trichy) from October 2018 to March 2019 through interaction with the farmers. Structured questionnaire was prepared and used. The calculations were done in MS excel and the data processed. Farmers of Kottayam District of Kerala were found to consult the fisheries officials but only 56.25% farmer's analysed water and soil quality regularly. The use of medicines and chemicals was 6.25% higher in Ernakulum than Kottayam District. Only 20% farmers of Ernakulum and 12.50% of farmers in Kottayam invested less than Rs 1, 000 towards chemical or medicines. Compared to Kottayam, 01 to 04% more farmers had a 1-ha fish farm in Ernakulum district. In these districts, the farmers stock their ponds with Indian and exotic carps, tilapia, pearl spot besides shrimps. In Ernakulum district, the use of KMnO4, bleaching powder and salt is common as a medicine or chemical for fish diseases while in Kottayam district the use of NUAN, KMnO4, CuSO4, FeSO4 and bleaching powder is common. The frequency of regular monitoring the water quality was 16.25% higher with the farmers of Kottayam district than those of Ernakulum district. The farm ponds of Thanjavur district were managed under the Irrigated Agriculture Modernization Project while those in Trichy were managed under the Multi-purpose Farm Pond Scheme (2017-18) where occurrence of diseased fish was negligible as these farmers are getting quality seed from the Fisheries Department that is healthy and fingerling size (>5cm). Finally It is thus obvious that better management practices (BMP) under monitoring of aquaculture units by fisheries departments and research and academic institutions may minimize disease occurrence and thereby improve the production also.

Keywords: Therapeutic use, chemicals and aqua drugs, intensification, better management practices, awareness

Introduction
Aquaculture is a fast-growing industry in India which besides providing livelihood security to more than 1.4 crore people is also one of the major foreign exchange earners, being as high as Rs 10,048 crores in 2010-11 (Ayyappan S., 2011) [1]. The drug which is being used by the farmers to protect their culture systems from diseases is a compound that works in or on the fish, whereas a pesticide works in the water. The "drug" is an articles intended for use in the diagnosis, cure, mitigation, treatment, or prevention of disease in man or other animals; articles (other than food) intended to affect the structure or any function of the body of man or other animals. The usage of antibiotics provides selective pressure that can accelerate arg development and spread. However, as water provides a constant and facile mechanism for dispersal of drug residues, microbial pathogens, and resistance genes, aquaculture will continue to pose a threat that may increase as the demand for seafood increases (Done *et al*. 2015) [9].

Misuse of antimicrobials or use of manure as a fertilizer in aquaculture may not only introduce and disseminate some pathogenic food borne or zoonotic bacteria in the pond environment but could also be transmi-ttedto human beings during culture operations, marketing, processing or consumption causing a health hazard besides developing multidrug-resistant strains and, possibly, leading to production of low quality fish and shorter shelf-life (Aly SM and Albutti A, 2014) [3]. Although improvement of water quality, nutrition, and other general husbandry factors may be enough to improve the health of a population, chemotherapeutics are often

required to ameliorate disease outbreaks. Management of fish diseases is challenging because of basic logistics, including the aquatic environment, numbers of fish, and routes of administration, and also because of the pharmacologic and regulatory complexities of chemotherapeutic usage in fish (Roy P. E. Yanong, YEAR).

Based on his Banerjee (2014) [22] concluded that there is a huge perspective of research in the field of aquaculture drug resistance remediation. The various uses of Biocides, Antibiotics use in aquaculture and tried to give a prospective on the treatment of these drug resistances by the various target organisms of the drugs, It is also important to evaluate the effects of these compounds through continuous monitoring of concentration profiles in water, sediment and biota to provide information that could lead to concerted action to ban or regulate their use. During the last five years the tremendous upsurge in the use of chemicals and medicines is primarily due to the phenomenal growth in shrimp grow-out culture and hatchery operations and to the expansion of the carp industry. Lack of awareness regarding the nature of a disease and its etiology makes the farmers an prey to errant advisers and leads to indiscriminate use of hazardous chemicals, which may prove dangerous (Pathak *et al*., YEAR).

Due to commercialization and intensification the use of aquaculture drugs is increasing day by day and studies reveal that farmers of the selected areas got good results in disease treatments by applying single or combinations of various aqua-drugs and chemicals resulting in about 95% recoveries within a very short period of time that led the farmers to use more and more commercial aqua-drugs (Kawsar *et al*., 2019) [14]. The private entrepreneurs, local sellers and company promotional officers often interact with the farmers and the latter rely on them more rather than the government officials and researchers, maybe due to lack of communication and not an easy approach in rural areas. Often they take suggestions from local sellers and company promotional officers for using these products, as such indiscriminate application of chemicals and drugs is found in some studies (SM Shahin Hossain *et al*., 2018) [23].

Due to increasing interest in intensive aquaculture, probability of disease occurrence certainly increases and this provides an opportunity to a lot of pharmaceutical companies to present their products. The finding of Alam and Rashid (2014) [17] in Bangladesh were also supported by Spanggaard *et al* (1993) [24], Anderson and Levin (1999) [5] and Tendencia and De La Pena (2001) [25] who stated that massive use of all these aqua-medicines may cause a great harm to the aquaculture environment of Bangladesh within a short period. Due to the use of malachite green the presence of residues of leucomalachite green (LMG) compounds represents a risk to human health due to their toxicity as well as a potential impact on the environment and could also raise barriers for commercialization in the country and for export (Hashimoto, 2011) [11]. Adequate supply of good-quality water with minimum contamination by organic substances and the use of good-quality feeds will keep fish in the best health condition and increase their resistance to infections (Sudova *et al*., 2007) [6]. The present study was done with the objective to identify the problem of aqua farmers regarding diseases, production status and communication gap, research thrusts in the field of therapeutics and medicine and to find the production gap in selected areas of Kerala and Tamil Nadu.

Materials and Methodology

A six month study was carried out in two district of Kerala (Ernakulum and Kottayam) and Tamil Nadu (Thanjavur and Trichy) since October 2018 to march 2019. Total 20 fish ponds of Ernakulum and 16 fish ponds of Kottayam district were visited in Kerala state while 25 farm ponds of Thanjavur and 17 farm ponds of Trichy district were visited in Tamil nadu state. A certain questionnaire was prepared to discuss in detail (Md. Zillur Rahman *et al*., 2017) [15]. In this study the data's were collected through questionnaire interview, personal contact, market survey and participatory rural appraisal like focus group discussion with fish farmers, retailers of animal medicine and representatives from and pharmaceutical companies. In the present study after a thorough discussion with farmer entrepreneurs and fisheries officials of concern district of Kerala and Tamil Nadu states, data's were arranged in the form of table. The calculation was done in excel and finally data's were arranged in the form of percentage.

The questionnaire was

1. Area of fish production unit and ownership?
2. Variety of fish cultured?
3. Stocking density and stocking size?
4. Prevention measures are being adopted?
5. Medicines/ chemicals are being used during disease?
6. Strategy is being used to diagnose the disease?
7. How to apply the medicines or chemicals & Quantity?
8. Monitoring of water quality parameters?
9. Investment on medicines/chemicals?
10. Suggestions.

Results

The 100 percentage of farmers of Kottayam district of Kerala consult with the fisheries officials but only 56.25 percentage farmers monitor the water and soil quality regularly. The use of medicines and chemicals is found 6.25 percent higher in Ernakulum than Kottayam district (Table-1). Most of the farmers of both districts of Kerala do not use any medicines while only 20 percentage farmers of Ernakulum and 12.50 percentage of Kottayam are being invested less than 1000 Rs. as a chemical or medicine expanses. Here in both districts no farmer has reported any side effect of the medicine in their farms (Table- 2).

The water source of the farms is natural and mostly the land is owned by the farmers self. The farmers use to make the fish farm in less than one hectare land in both the district but in Ernakulum district some farmers have more than one hectare land as a fish farm that is approx. 4 percentages higher than Kottayam (Table- 3). Hundred percentage farmers of both districts use to stock their culture unit with more than 10000 seeds per hectare and most of seed size is less than 5 cm. Here in these districts the farmers stock their pond with a variety of fishes including IMC, exotic carps, tilapia, pearl spot and shrimps etc. (Table- 4)

In Ernakulum district the use of KMnO4, bleaching powder and salt is common as a medicine or chemical for fish diseases while in Kottayam district the use of NUAN, KMnO4, CuSO4, FeSO4 and bleaching powder is common as a chemical and therapeutics (Table-). The tendency of regular monitoring of the water quality was found more in farmers of Kottayam district and it is 16.25 percentages higher than Ernakulum district farmers (Table- 1).

The farm ponds visited in Thanjavur district were managed under irrigated agriculture modernization project and in the Trichy these were managed under multi-purpose farm pond scheme 2017-18, so here the farm ponds were equally sized, depth, feed, stocked in a proper ratio and well managed where the observation of disease fish was negligible. These farmers are getting seed from the fisheries departments that is healthy and good size (>5cm).

Table 1: summarised the collected information regarding consult with fisheries officials, chemicals or medicines used, regularly check water and soil quality in Ernakulum and Kottayam district.

S. No.	District Name	CWFO	DCWFO	UCM	DUCM	RWSQ	DRWSQ
1.	Ernakulum	95%	5%	25%	75%	40%	60%
2.	Kottayam	100%	0%	18.75%	81.25%	56.25%	43.25%

(Abbreviations- CWFO- consult with fisheries officials, DCWFO- do not consult with fisheries officials, UCM- chemicals or medicines used, DUCM- do not used chemicals or medicines, RWSQ- regularly check water and soil quality, DRWSQ- DO NOT regularly check water and soil quality**).**

Table 2: summarised the collected information regarding method of medicine use, investment on medicine, and side effects of chemicals in pond water in Ernakulum and Kottayam district.

S. No.	District Name	MSTWS	DBT	NAM	ICPCMC<1000 RS.	ICPCM>1000	ICPCM=0	SECO
1.	Ernakulum	15%	15%	85%	20%	0%	80%	0%
2.	Kottayam	6.25%	18.25	81.50	12.50	6.25	81.50	0%

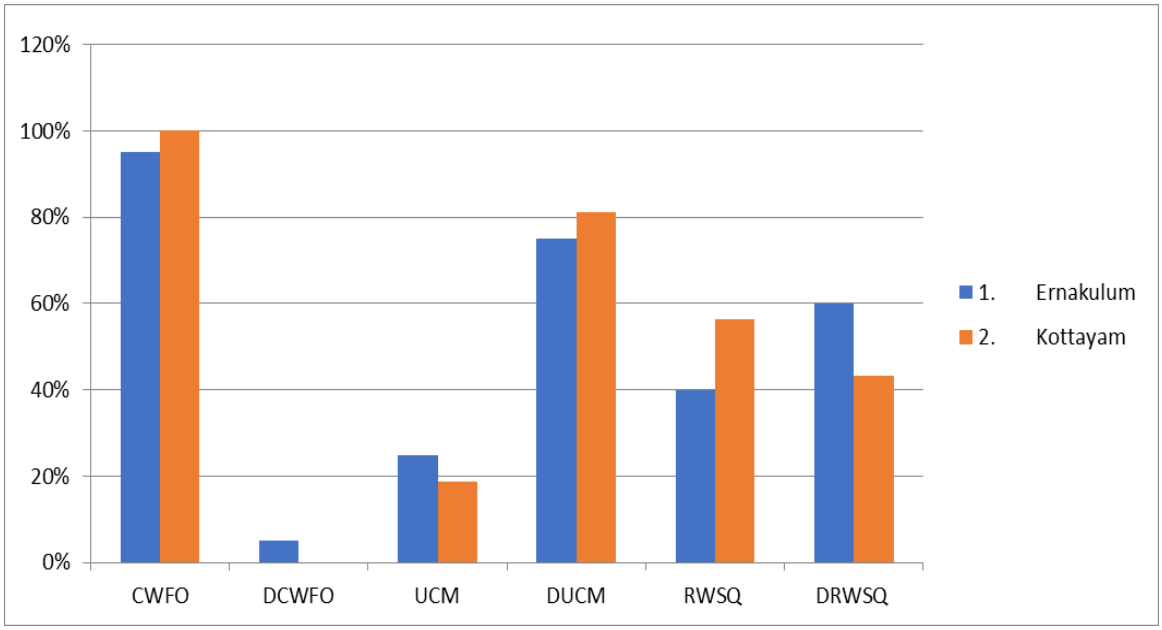
(Abbreviations- MSTWS- Medicines simply throwing on the water surface, DBT- dip or bath treatment, NAM- Not Applied Any MEDICINE, ICPCMC- Investment cost per crop on medicines or chemicals is less than 1000 rs. SECO- side effect of chemicals observed**).**

Table 3: summarised the collected information regarding pond area, water source and land ownership in Ernakulum and Kottayam district

S. No.	District Name	having less than one hectare land	having more than one hectare land	having natural water source	having artificial water source	Land is owned by self	Land on lease
1.	Ernakulum	65%	35%	100%	0%	100%	0%
2.	Kottayam	68.75%	31.25%	100%	0%	93.75%	6.25%

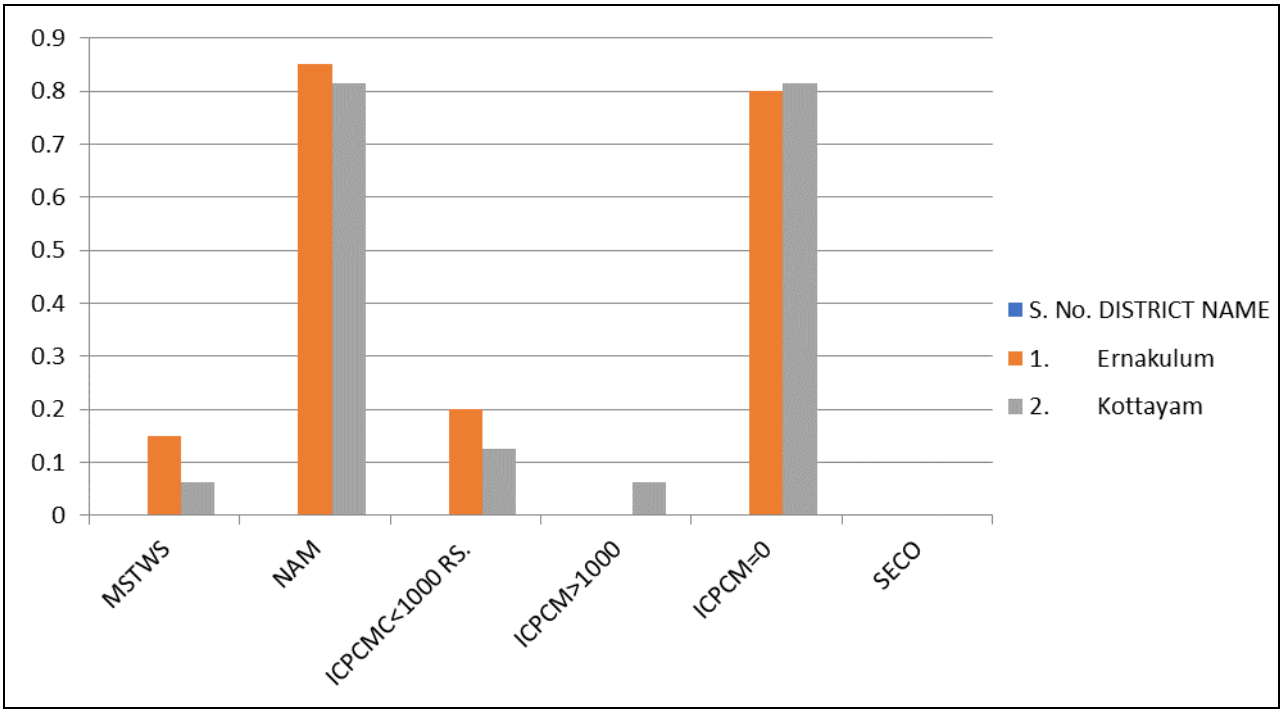
Table 4: summarised the collected information regarding species cultured, stocking density, and stocking size in Ernakulum and Kottayam district

S. No.	District Name	Only Imc Cultured	Imc+ Exotic	Imc+Exotic+Others	Stocking Density<10000/Hect.	Stocking Density >10000 / Hectare	Stocking Size > 5 Cm	Stocking Size < 5 Cm
1.	Ernakulum	25%	20%	55%	0%	100%	20%	80%
2.	Kottayam	43.75%	25%	62.5%	0%	100%	18.75%	81.25%



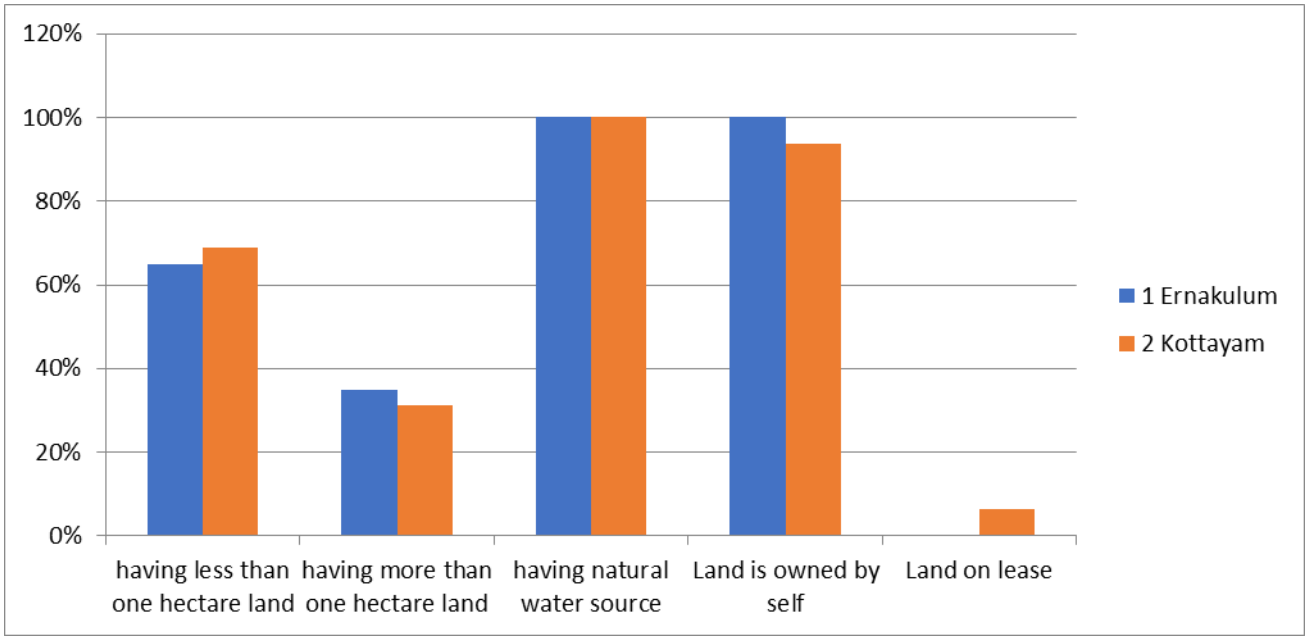
Graphs 1: Graphical representation of summarised information regarding consult with fisheries officials, chemicals or medicines used, regularly check water and soil quality in Ernakulum and Kottayam district

Abbreviations- CWFO- consult with fisheries officials, DCWFO- do not consult with fisheries officials, UCM- chemicals or medicines used, DUCM- do not used chemicals or medicines, RWSQ- regularly check water and soil quality, DRWSQ- DO NOT regularly check water and soil quality.

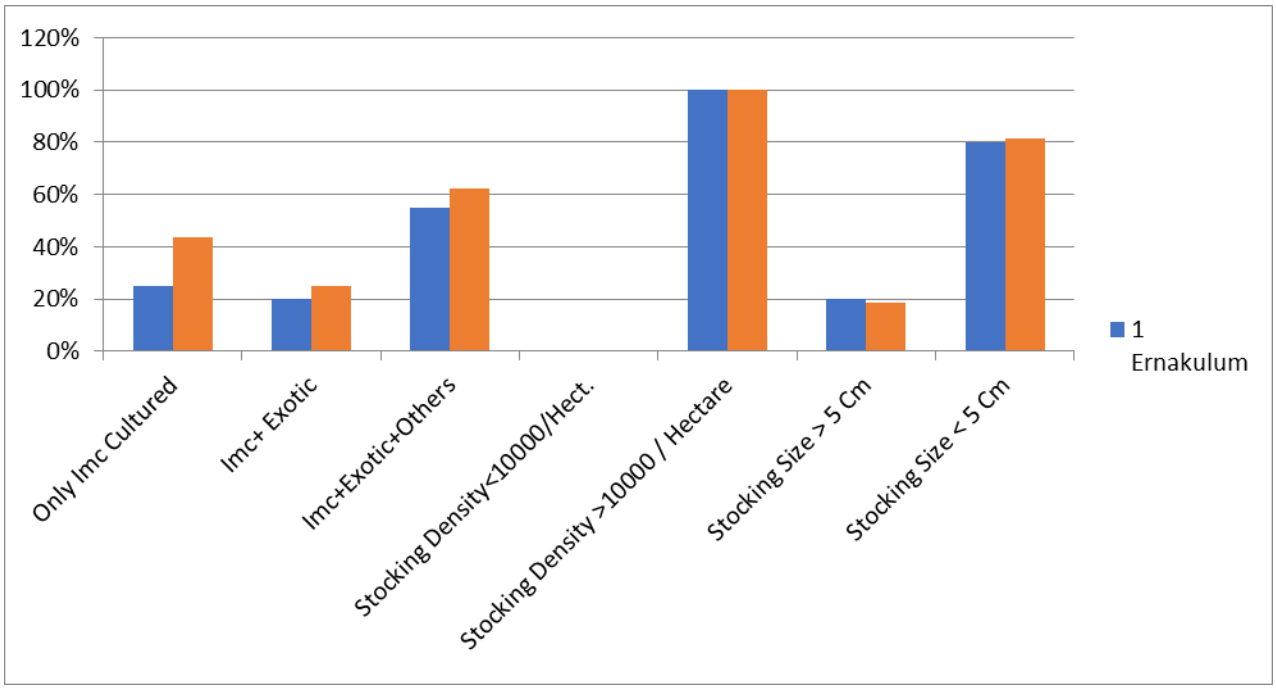


Graph 2: Graphical representation of summarised information regarding method of medicine use, investment on medicine, and side effects of chemicals in pond water in Ernakulum and Kottayam district

Abbreviations- MSTWS- Medicines simply throwing on the water surface, DBT- dip or bath treatment, NAM- Not Applied Any MEDICINE, ICPCMC- Investment cost per crop on medicines or chemicals is less than 1000 rs. SECO- side effect of chemicals observed.



Graph 3: Graphical representation of summarised information regarding pond area, water source and land ownership in Ernakulum and Kottayam district.



Graph 4: Summarised the collected information regarding species cultured, stocking density, and stocking size in Ernakulum and kottayam district.

Plates

Discussion

Less occurrence of disease and the need of medicine to the farmers of Kottayam is the result of regular consultancy by the fisheries department to the 100% farmers of Kottayam district while the lake of communication between farmers and officials or researchers promoted the irrespective use of medicines in Ernakulum district (M. Belal Hossain, 2013) [13]. The consumer safety is an important part of aquaculture

sector sowhile applying drugs and chemicals in fisheries to observe the withdrawal periods is important for all aquaculturists and operators because the following proper withdrawal times helps to ensure that products reaching consumers are safe and wholesome (www.asean.org Jakarta, 2014).

Proactive and reactive programmes has become a primary requirement for sustainable aquaculture production (Idowu TA *et al*., 2017) [10]. the marketing of Similar products in different trade names and the use of traditional chemicals in health management included lime, salt, potassium permanganate, sumithion, malathion, formalin, bleaching powder, etc. was more or less similar in freshwater (Md. Zillur Rahman *et al*., 2017) [15].

In the present study the use of lime, salt, potassium permanganate is common but farmers are not aware about the use of probiotics, bioremediation and vaccination while in comilla, Rahman *et al*., observed that the use of probiotic products is common to control mainly bacterial diseases and few alternatives to minimize the adverse effects of aquaculture chemical were noted like bioremediation and immunostimulants vaccination and alternative therapeutic.

Lack of knowledge of the chemicals, doses and methods of application of these chemicals, the alternatives to minimize the adverse effects of aquaculture chemical are simply use less of them (*Zakigonjupa zilla*). Efforts to reduce the negative impacts of chemicals in aquaculture should be the important objective of policy makers, researchers and scientists (Afnan Alam Chowdhury *et al*., 2015) [2].

A common thought of farmers rearding the application drugs found in which they use lime, potassium permengnate and salt while a study by Agnieszka Pękala-Safińska, 2018 in Poland, found the occurrence of two gram positive bacteria frequently these are *Lactococcus garviae* and *Streptococcus iniae* and Nowadays, *Acinetobacter* spp. *Plesiomonas shigelloides*, *Sphingomonas paucimobilis*, and *Stenotrophomonas maltophilia* are the most frequently isolated from fish exhibiting clinical signs of disease. In addition, infections caused by the Gram-positive bacterium Kocuriarhizophila have appeared in recent years. This bacterium has not been known until now to be pathogenic to fish. Therefore, this infection could be called an emergent disease

The irrespective doses of chemicals and medicines are not only harmful for the fish as well as consumers but also it is a threat to the aquatic environment. To determine the safe dose before treating all fish infected with external parasites (*Trichodina* protozoa), a simple test can be run with a few diseased fish in formalin solutions ranging from 50 ppm to 100 ppm (for example 50, 60, 70, 80, 90 and 100 ppm solutions made from the 5 000 ppm stock solution) and find the lowest safe concentration that eliminates the parasites in a 30-minute bath. According to the FAO the maximum safe dosage for a 30-minute bath is 100 ppm formalin for 10- to 20 g juveniles of the new fish species, in the conditions of the test, in particular water temperature ranging from 21 ^{0}C to 22 ^{0}C (www.fao.org).

The need of combined work by the policy makers, researchers and scientists in addressing the issues of drugs used in aquaculture with the view to decrease the negative impacts. Same efforts from the government and nongovernment organizations are expected for better understanding of chemical uses in aquaculture management (Md. Rajib Sharker *et al*., 2014, SM Shahin Hossain *et al*., 2018 and Md. Abu Kawsar *et al*., 2019) [16, 23, 14].

The chemicals and their concentrations must be planned carefully to suit the conditions on each farm (Rintamäki-Kinnunen P *et al*., 2005) [21]. The malachite green is a better medicine as no truly adequate substitute for it has been found, but malachite green will persist in the aquatic environment for a long time and may pass via the food chain from there to untreated fish intended for human consumption, If enough attention is not paid to the problem, malachite green contained in baths or industrial waste water might penetrate to the aquatic environment and cause serious problems there (E. Sudova *et al*., 2007) [6].

The negligible occurrence of diseases and better production in Thanjavur and Trichy district is due to culture practices monitored and controlled under TN-IAMP scheme while Pawan kumar sharma *et al*., 2019, observed huge occurrence of diseases and low production during his study in Rajasthan that might be the result of poor management practices and lack of awareness.

Conclusion

It is concluded to solve out the problem of diseases that there is a need of mobile diagnostic laboratories at the district level and man those with adequately trained personnel who is available in the field whenever required. Empowerment of the diagnostic laboratories, together with pollution control agencies in the states to monitor the use of chemicals by the aquaculture industry, as well as to maintain information databases is strongly recommended. Extension services and evaluate our expertise are needed to be strengthened to strengthen our capabilities. To grow without endangering our aquatic habitat and human health it is also needed to share information with other countries in the region that have acquired expertise in the field, these steps may enable us (Pathak, S. C. *et al*.). Some important concerns such as human health, product quality and environmental issues are there, Therefore, those items practice should be taken under scrutiny by the governmental level to get better product through good aquaculture practice (SM Shahin Hossain *et al*., 2018) [23]. The actively participation of government bodies is needed to protect the fresh water sources from the contaminated sources because due to this the pathogens increases rapidly, that affects to the fish health and production as well (KoustavSen and Rimpa Mandal, 2018) [12]. Finally it is suggested that the better management practices under monitoring of aquaculture units by government bodies like fisheries departments, research stations and academic institutions may minimize the occurrence of the disease and improve the production also.

Acknowledgement

I acknowledge all the publications, journals, researchers and websites which I have used their valuable research findings for the preparation of this paper. I am highly thankful to the fisheries officials Mr. Senthil Kumar (Assistant Director Fisheries Trichy District), Mr. Chinnacoupan (Assistant Director Fisheries Thanjavur District), Mr. Durai (Fisheries Inspector Thanjavur). I am also grateful for the Maharaj Kumar Sahib Shri Lakshay Raj Singh Mevad (LRSM Udaipur, Rajasthan) for encouraging me during my research work and publications. This paper is a contribution of knowledge in therapeutics and disease management in aquaculture practices and it will be helpful to minimize the occurrence of diseases so the production and benefit/cost ratio will be certainly enhanced.

References

1. Ayyappan S. Handbook of Aquaculture, Directorate of Knowledge Management in Agriculture, Indian Council Agricultural Research, 2011, www.iasri.res.in/agridata.
2. Afnan Alam Chowdhury, Md. Shahab Uddin, Suvashis Vaumik, Abdulla-Al-Asif. Aqua drugs and chemicals used in aquaculture of Zakigonjupazilla, Sylhet, Asian J. Med. Biol. Res. 2015; 1(2):336-349; doi: 10.3329/ajmbr.v1i2.25628, Asian Journal of Medical and Biological Research ISSN 2411-4472 (Print) 2412-5571 (Online) www.ebupress.com/journal/ajmbr
3. Aly SM, Albutti A. Antimicrobials Use in Aquaculture and their Public Health Impact. J Aquac Res Development 2014; 5:247. doi:http://dx.doi.org/10.4172/2155-9546.1000247.
4. Agnieszka Pękala-Safińska. Contemporary threats of bacterial infections in freshwater fish, J Vet Res. 2018; 62:261-267. DOI:10.2478/jvetres-2018-0037, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6295991/pdf/jvetres-62-261.pdf
5. Andersson DI, Levin BR. The biological cost of antibiotic resistance. Current Opinion in Microbiology. 1999; 2:489-493.
6. Sudova E, Machova J, Svobodova Z, Vesely T. Negative effects of malachite green and possibilities of its replacement in the treatment of fish eggs and fish: a review, Veterinarni Medicina, 2007; 52(12):527-539. http://www.vri.cz/docs/vetmed/52-12 527.pdf
7. Fish Disease Prevention and Treatment, http://www.fao.org/fishery/static/FAO_Training/FAO_Training/General/x6709e/x6709e15.htm.
8. Guidelines for the Use of Chemicals in Aquaculture and Measures to Eliminate the Use of Harmful Chemicals. Jakarta: ASEAN Secretariat, December 2013, www.asean.org, https://www.asean.org/storage/images/Community/AEC/AMAF/UpdateApr2014/ASEAN%20Guideliness%20for%20Chemicals%20Final%20Draft%20Malaysia%20OK.pdf
9. Hansa Y Done, Arjun K Venkatesan, Rolf U Halden. Does the Recent Growth of Aquaculture Create Antibiotic Resistance Threats Different from those Associated with Land Animal Production in Agriculture?, American Association of Pharmaceutical Scientists, The AAPS Journal. 2015; 17(3).
10. Idowu TA, Adedeji HA, Sogbesan OA. Fish Disease and Health Management in Aquaculture Production. Int J Environ & Agri Sci 1: 002, 2017.
11. Juliana Campos Hashimoto, Jonas Augusto Rizzato Paschoal, Júlio Ferraz de Queiroz, Felix Guillermo Reyes Reyes. Considerations on the Use of Malachite Green in Aquaculture and Analytical Aspects of Determining the Residues in Fish: A Review, Journal of Aquatic Food Product Technology. 2011; 20(3):273-294, DOI: 10.1080/10498850.2011.569643
12. Koustav Sen, Rimpa Mandal. Fresh-water fish diseases in west Bengal, India, International Journal of Fisheries and Aquatic Studies 2018; 6(5):356-362 http://www.fisheriesjournal.com/archives/2018/vol6issue5/PartE/6-5-29-107.pdf
13. Belal Hossain M, Amin SMN, Shamsuddin M, Minar MH. Use of Aqua-chemicals in the Hatcheries and Fish Farms of Greater Noakhali, Bangladesh. Asian Journal of Animal and Veterinary Advances, 2013; 8:401-408. https://scialert.net/abstract/?doi=ajava.2013.401.408
14. Md. Abu Kawsar, Md. Tariqul Alam, Saokat Ahamed, Maliha Hossain Mou. Aqua drugs and antibiotics used in freshwater aquaculture of North Chittagong, Bangladesh, International Journal of Fisheries and Aquatic Studies 2019; 7(1):28-34, http://www.fisheriesjournal.com/archives/2019/vol7issue1/PartA/6-6-46-223.pdf
15. Md. Zillur Rahman, Aisha Khatun, Md. Ibrahim Kholil Md. Mer Mosharraf Hossain. Aqua drugs and chemicals used in fish farms of Comilla regions, Journal of Entomology and Zoology Studies. 2017; 5(6):2462-2473, http://www.entomoljournal.com/archives/2017/vol5issue6/PartAH/5-6-227-213.pdf.
16. Md. Rajib Sharker, Kanij Rukshana Sumi, Md. Jahangir Alam, Md. Mokhlasur Rahman Zannatul Ferdous, Mir Mohammad Ali *et al*. Drugs And Chemicals Used In Aquaculture Activities For Fish Health Management In The Coastal Region Of Bangladesh, Int. J Life Sc. Bt & Pharm. Res. 2014, http://www.ijlbpr.com/currentissue.php
17. Ashraful Alam M, Mamnur Rashid M. Use of Aqua-Medicines and Chemicals in Aquaculture in Shatkhira District, Bangladesh, IOSR Journal of Pharmacy and Biological Sciences (IOSR-JPBS) e-ISSN: 2278-3008, p-ISSN:2319-7676. 2014; 9(6):05-09 www.iosrjournals.org, http://iosrjournals.org/iosr-jpbs/papers/Vol9-issue6/Version-5/B09650509.pdf
18. Pathak SC, Ghosh SK, Palanisamy K. The use of chemicals in aquaculture in India. In: J. R. Arthur, C. R. Lavilla-Pitogo, & R. P. Subasinghe (Eds.) Use of Chemicals in Aquaculture in Asia : Proceedings of the Meeting on the Use of Chemicals in Aquaculture in Asia 20-22 May 1996, Tigbauan, Iloilo, Philippines (pp. 87-112). Tigbauan, Iloilo, Philippines: Aquaculture Department, Southeast Asian Fisheries Development Center, 2000.
19. Pawan Kumar Sharma, Dr. J Stephan Sampath Kumar, Dr. CP Juyal, Dr. V Senthil Kumar Dr. S Anand. Aquaculture medicine and therapeutics in Alwar and Udaipur district of Rajasthan: A field study, Journal of Entomology and Zoology Studies. 2019; 7(2):748-751, http://www.entomoljournal.com/archives/2019/vol7issue2/PartM/6-6-211-538.pdf
20. Roy PE Yanong. (YEAR),*VMD*, University of Florida; therapeutic considerations in aquaculture, pages from 000 to xxx or total number of pageshttps://www.msdvetmanual.com/exotic-and laboratoryanimals/aquaculture/therapeutic-considerations-in-aquaculture#
21. Rintamäki-Kinnunen P, Rahkonen M, Mannermaa-Keränen AL, Suomalainen LR, Mykrä H, Valtonen ET. Treatment of ichthyophthiriasis after malachite green. I. Concrete tanks at salmonid farms, Dis Aquat Organ. 2005; 64(1):69-76. https://www.ncbi.nlm.nih.gov/pubmed/15900690
22. Soumik Banerjee, Dr. Vikram Kumar, Pathak AN. Drug Effects on Aquaculture and IT'S Remediation, Journal of Drug Delivery & Therapeutics; 2014; 4(1):117-122. http://jddtonline.info.
23. Shahin Hossain SM, Shamima Sultana, Manash Kabiraj Sathi Rani Dey. Recent Scenario of Application of Aqua Drugs and Chemicals in Fish and Shell Fish Health

Management in Southwestern Region of Bangladesh, International Journal of Fisheries and Aquatic Studies 2018; 6(4):203-210, http://www.fisheriesjournal.com/archives/2018/vol6issue4/PartC/6-4-2-476.pdf.
24. Spanggaard B, Jorgensen F, Gram L, Huss HH. Antibiotic resistance in bacteria isolated from three freshwater fish farms and an unpolluted stream in Denmark. Aquaculture. 1993; 115:195-207.
25. Tendencia EA, De La Pena LD. Antibiotic resistance of bacteria from shrimp ponds. Aquaculture. 2001; 195:193-204.