



## Tilapia Lake Virus (TiLV): An Emerging Threat to Aquaculture

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Tilapia Lake Virus (TiLV) is an emerging viral pathogen that has become a major threat to global tilapia aquaculture. Since its first identification, the virus has spread to several countries, causing high mortality rates, substantial economic losses, and serious concerns for food security and rural livelihoods. TiLV primarily affects Nile tilapia and other cultured tilapia species, leading to clinical signs such as lethargy, loss of appetite, skin lesions, and organ damage. The virus spreads mainly through horizontal transmission via water, direct fish contact, and contaminated equipment, while vertical transmission remains under investigation. Effective disease management relies on early detection, strict biosecurity measures, disease-free seed production, quarantine protocols, and regular health monitoring. Recent advances in vaccine development, genomic studies, selective breeding, and artificial intelligence-based disease surveillance offer promising tools for future control strategies. In India, the detection of TiLV in farmed tilapia has highlighted the need for enhanced surveillance, improved diagnostic capabilities, and farmer awareness. Continued research, international cooperation, and sustainable disease management practices are essential to safeguard the future growth and resilience of the global tilapia aquaculture industry.

**Keywords:** Tilapia Lake Virus (TiLV), Aquaculture Biosecurity, Disease Surveillance, Sustainable Tilapia Farming.

### Introduction

Aquaculture is emerging as a fastest growing sector in the world and it plays an important role in ensuring global food security. As the world population is increasing day by day, the demand for affordable and nutritional protein food is also increasing. Fish and other aquatic products serve as the good source of high-quality protein, omega-3 fatty acid and vitamins which makes them important for healthy diet. According to the Food and Agriculture Organization (FAO), aquaculture now contributes more than half of the aquatic animal products consumed globally, highlighting its growing importance in meeting future food demands (FAO, 2017).

Among the numerous fish species cultured worldwide, tilapia has become one of the most important contributors to global aquaculture due to its rapid growth rate, adaptability to a wide range of environmental conditions, tolerance to handling stress, and relatively low production costs. Often referred to as the "aquatic chicken," tilapia plays a vital role in supporting food security, nutrition, employment, and economic development, particularly in developing countries across Asia, Africa, and Latin America.

However, despite the rapid growth of aquaculture, disease outbreaks continue to pose a major challenge to sustainable production. Factors such as intensified farming practices, increased movement of live fish and broodstock, environmental degradation, and climate-related stress have facilitated the emergence and spread of infectious diseases. These disease outbreaks can lead to significant economic losses through mass mortalities, reduced growth

rates, increased production costs, and trade restrictions, making aquatic animal health a critical concern for farmers, researchers, and policymakers worldwide (Jansen *et al.*, 2019).

### What is Tilapia Lake Virus?

Tilapia Lake Virus (TiLV) is an emerging viral pathogen that poses a serious threat to global tilapia aquaculture. The disease was first identified and reported in Israel in 2014. TiLV is a negative-sense, single-stranded RNA virus belonging to the family *Amnoonviridae* and is currently the only species classified under the genus *Tilapinevirus*. The viral genome consists of ten separate RNA segments that encode proteins involved in viral replication, assembly, and infection. The virus affects fish of different age groups, particularly fingerlings and juveniles, resulting in significant economic losses to farmers. TiLV is considered an emerging transboundary aquatic animal disease because it has rapidly spread across multiple continents through the movement of live fish, broodstock, and fingerlings associated with international aquaculture trade. Its increasing geographical distribution, high pathogenicity, and potential impact on food security have led organizations such as the Food and Agriculture Organization (FAO) and the World Organisation for Animal Health (WOAH) to recognize TiLV as a major concern for the sustainable development of the global tilapia industry (Aich *et al.*, 2022)

### Susceptible Species and Host Range

Tilapia Lake Virus (TiLV) primarily affects tilapia species, with Nile tilapia (*Oreochromis niloticus*), red tilapia, and hybrid tilapia being the most susceptible hosts. The virus has also been reported in other fish species, including Mozambique tilapia (*O. mossambicus*), blue tilapia (*O. aureus*), giant gourami (*Osphronemus goramy*), African catfish (*Clarias gariepinus*), and certain wild cichlids. However, severe disease outbreaks and high mortality rates have been consistently observed only in tilapia species. The presence of TiLV in non-tilapia fishes suggests a potential role in virus transmission and persistence, although their epidemiological significance remains unclear and requires further investigation (Mugimba *et al.*, 2023).

### Clinical Signs and Pathology

Tilapia infected with Tilapia Lake Virus (TiLV) exhibit a range of clinical signs that vary with the severity of infection and the age of the fish. Common external signs include loss of appetite, lethargy, skin erosion, scale protrusion, darkening of body coloration, abnormal swimming behavior, and exophthalmia (bulging eyes). Internally, the virus primarily targets vital organs, causing liver lesions, splenic enlargement, and extensive tissue damage. Histopathological studies have also revealed brain involvement, which may explain the neurological symptoms and erratic swimming often observed in infected fish. In severe cases, TiLV infection results in multi-organ damage, leading to high mortality rates and significant production losses in affected farms. These clinical and pathological manifestations make TiLV one of the most devastating viral diseases affecting tilapia aquaculture worldwide.

### Transmission of TiLV

Tilapia Lake Virus (TiLV) spreads primarily through horizontal transmission, where the virus is transmitted between infected and healthy fish through water, direct fish-to-fish contact, and contaminated equipment such as nets, tanks, and transport containers. The movement of infected broodstock and fingerlings can further facilitate the spread of the disease between farms and regions. Although horizontal transmission is well established, evidence from recent studies suggests the possibility of vertical transmission from infected broodstock to offspring, but this route remains under investigation. Several environmental and management-related factors, including high stocking densities, poor water quality, handling stress, and other unfavourable culture conditions, can increase fish susceptibility to infection and accelerate disease outbreaks. Understanding these transmission pathways is essential for implementing effective biosecurity measures and minimizing the spread of TiLV in aquaculture systems.

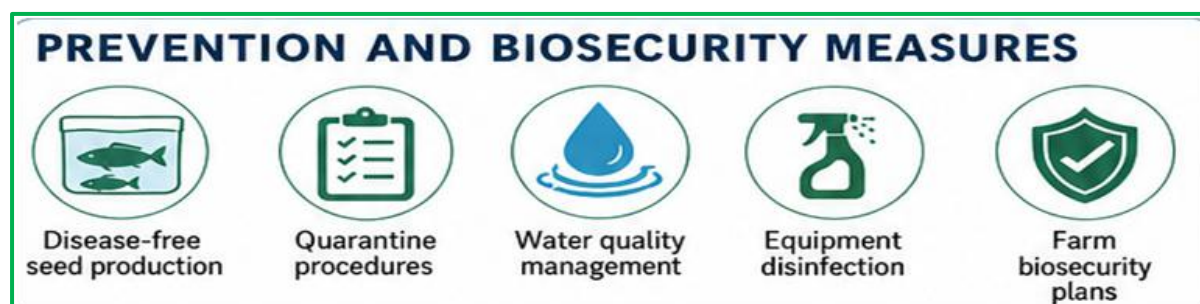
## Economic and Social Impact

Tilapia Lake Virus (TiLV) has significant economic and social consequences for the global aquaculture industry. Disease outbreaks can cause substantial production losses due to high mortality rates, reduced growth performance, and increased management costs, leading to considerable financial losses for fish farmers. Small-scale aquaculture producers are particularly vulnerable, as disease outbreaks can severely affect their livelihoods and household income. In regions where tilapia serves as an affordable and important source of animal protein, TiLV



outbreaks may also threaten food and nutritional security by reducing fish availability and increasing market prices. Consequently, the continued spread of TiLV poses a serious challenge not only to the sustainability of tilapia farming but also to the socioeconomic well-being of communities that depend on aquaculture for employment and food supply (FAO, 2017; Aich et al., 2022).

## Prevention and Biosecurity Measures



- Preventing the spread of Tilapia Lake Virus (TiLV) relies heavily on the implementation of effective biosecurity practices at all stages of aquaculture production.
- The use of disease-free seed and certified broodstock is essential to minimize the risk of introducing the virus into farming systems.
- Newly acquired fish should undergo quarantine procedures and health screening before being stocked to prevent the entry of infected individuals.
- Maintaining optimal water quality through regular monitoring of temperature, dissolved oxygen, pH, and waste levels helps reduce stress and improve fish resistance to disease.
- Routine cleaning and disinfection of nets, tanks, equipment, and vehicles further limit the transmission of pathogens between farms.
- In addition, comprehensive farm biosecurity plans, including controlled access, record keeping, health surveillance, and staff training, play a crucial role in preventing disease outbreaks and ensuring the sustainable growth of the tilapia aquaculture industry.

Guidance provided by the Food and Agriculture Organization and the World Organisation for Animal Health serves as an important resource for strengthening TiLV prevention and control measures worldwide.

## Recent Advances in TiLV Research

Recent advances in Tilapia Lake Virus (TiLV) research have provided promising opportunities for improving disease management in tilapia aquaculture.

- Scientists are actively developing various vaccine candidates, including inactivated, recombinant, and DNA vaccines, to enhance fish immunity and reduce disease-related losses.
- Genomic and phylogenetic studies have improved understanding of the virus's evolution, genetic diversity, and transmission patterns, helping researchers monitor the emergence and spread of new strains.
- Selective breeding programs are also being explored to develop tilapia stocks with greater resistance to TiLV, offering a sustainable long-term solution for disease control.
- In addition, emerging technologies such as artificial intelligence, machine learning, and sensor-based monitoring systems are being investigated for the early detection of disease outbreaks through continuous analysis of fish behaviour and environmental conditions.

Although many of these innovations are still in the research and development stage, they represent important advances toward safeguarding the future sustainability and productivity of the global tilapia farming industry.

### **Status of TiLV in India**

In India, Tilapia Lake Virus (TiLV) was first reported in 2016 from farmed Nile tilapia in Kerala and West Bengal, raising concerns about the potential spread of the disease in the country's expanding tilapia aquaculture sector. The detection of TiLV highlighted the need for enhanced disease surveillance, improved diagnostic capabilities, and stronger biosecurity measures. Indian tilapia farmers face several challenges, including the movement of infected seed, limited awareness of emerging diseases, inadequate diagnostic facilities, and the risk of rapid disease transmission among farms. To minimize the impact of TiLV, preventive measures such as the use of certified disease-free seed, quarantine of new fish stocks, regular health monitoring, water quality management, equipment disinfection, and implementation of farm biosecurity plans are essential. Strengthening surveillance programs, farmer training, and research on vaccines and disease-resistant strains will be critical for safeguarding the future of tilapia farming in India.

### **Future Perspectives**

The future management of Tilapia Lake Virus (TiLV) will depend on a combination of strengthened biosecurity measures, international collaboration, technological innovation, and sustainable farming practices. As global trade and movement of aquatic animals continue to increase, strict biosecurity protocols, including the use of disease-free seed, quarantine procedures, and regular health monitoring, will remain the first line of defense against disease outbreaks. International cooperation among governments, research institutions, and aquaculture organizations is essential for sharing surveillance data, diagnostic tools, and best management practices to prevent the transboundary spread of TiLV. Continued research is also expected to accelerate the development and commercialization of effective vaccines, which could provide long-term protection for farmed tilapia populations. In addition, sustainable disease management strategies that integrate biosecurity, improved husbandry practices, selective breeding for disease resistance, and early warning systems will be crucial for reducing disease risks while maintaining productivity. Through coordinated global efforts and scientific advancements, the aquaculture industry can enhance its resilience against TiLV and ensure the sustainable growth of tilapia farming in the years ahead.

### **Conclusion**

Tilapia Lake Virus (TiLV) has emerged as a major threat to global tilapia aquaculture, causing significant economic losses, affecting farmer livelihoods, and posing challenges to food security in regions that depend on tilapia as an important source of animal protein. The rapid spread of the virus highlights the critical importance of early detection, accurate diagnosis, and timely implementation of biosecurity measures to prevent disease outbreaks. Continued investment in research is essential for developing effective vaccines, improving diagnostic tools, and understanding the epidemiology of the virus. At the same time,

strengthened surveillance programs and increased farmer awareness are vital for ensuring rapid response and effective disease management. By integrating scientific innovation, robust biosecurity practices, and stakeholder collaboration, the aquaculture industry can enhance its resilience against TiLV and support the long-term sustainability and growth of tilapia farming worldwide.

## References

1. Jansen, M.D., Dong, H.T. and Mohan, C.V., 2019. Tilapia lake virus: a threat to the global tilapia industry? *Reviews in Aquaculture*, 11(3), pp.725-739.
2. Aich, N., Paul, A., Choudhury, T.G. and Saha, H., 2022. Tilapia lake virus (TiLV) disease: Current status of understanding. *Aquaculture and fisheries*, 7(1), pp.7-17.
3. Kembou-Ringert, J.E., Steinhagen, D., Thompson, K.D., Daly, J.M. and Adamek, M., 2023. Immune responses to Tilapia Lake virus infection: what we know and what we don't know. *Frontiers in immunology*, 14, p.1240094.