Mosquitofish

For Prelims: **Mosquitofish**, Gambusia affinis, Gambusia holbrooki, **Mosquito-borne diseases,** Invasive alien species, genetically modified OX5034 mosquito, **National Vector Borne Disease Control Programme**.

For Mains: Negative Impacts of Mosquitofish, Major Challenges Related to Mosquito and Related Disease Control.

Source: TH

Why in News?

Recently, various regions in **Andhra Pradesh, Odisha, and Punjab** have witnessed the release of mosquitofish **into local water bodies** as a measure to combat the increasing mosquito menace.

- However, a recent study highlights unexpected issues with this approach, bringing attention to potential drawbacks in the biological control method.

What is the Mosquitofish Approach and its Related Consequences?

- **Background- Rise of Mosquito-borne Diseases:**
  - Global climate and habitat changes in the last century have heightened the prevalence of **mosquito-borne diseases**, impacting over **500 million people in 150+ countries.**
  - In India, approximately **40 million individuals** annually suffer from these diseases, posing a persistent public health challenge for decades.
- **The Mosquitofish Approach:**
  - **Mosquitofish,** native to fresh waters of the southeastern **United States,** are known for their **appetite for mosquito larvae.**
    - They can consume up to **250 larvae per day**, making them a potential weapon against mosquito populations.
  - Two species of mosquitofish, ***Gambusia affinis and Gambusia holbrooki,*** were considered environmentally friendly and sustainable.
    - Yet, the unintended result was the worldwide dissemination of these fish from the U.S., causing ecological disturbances.
- **Introduction of Mosquitofish in India:**
  - **Gambusia** was first introduced in India in **1928 during British rule,** as a way to combat rapid mosquito spread.
  - Subsequently, government bodies and private organizations in India collectively joined efforts to combat malaria through this method.
    - The initial idea was for the fish to control mosquito larvae, but the strategy backfired, resulting in their transformation into **invasive alien species.**
- **Negative Impacts of Mosquitofish:**
  - **Invasive Nature:** Their adaptability and high tolerance to fluctuating environmental conditions contribute to their extensive dispersion, making them highly invasive.

        - Mosquitofish are now considered among the hundred **most detrimental** invasive alien species**.**
    - **Disruption of Native Fish Communities:** They are aggressive feeders, **consuming not only mosquito larvae but also eggs of native fish species.**
        - This can lead to the extinction of local species, particularly smaller, less competitive fishes.
    - **Loss of Unique Species:** Their introduction can threaten the existence of endemic and ecologically important fish species, potentially leading to a **loss of biodiversity and ecosystem resilience.**
        - Reports indicate a decline in **Microhyla tadpoles (rice frogs or narrow-mouthed frogs)** following the introduction of Gambusia in India.
- **Related Significant Steps**:
    - The World Health Organization **stopped recommending Gambusia as a mosquito control agent in 1982.**
    - In 2018, the **National Biodiversity Authority** of the Government of India designated **G. affinis and G. holbrooki** as invasive alien species.

Genetic Engineering Methods for Mosquito Control

- **Gene Drive Technology,** pioneered by **Austin Burt in 2003**, aims to control mosquito populations by altering their inheritance of specific genes.
    - This technique employs **proteins to modify mosquito** DNA, disrupting their ability to spread diseases like malaria.
- The genetically modified **OX5034 mosquito**, authorized by the **US Environmental Protection Agency,** was released in 2020. It is developed with a gene sensitive to an antibiotic, ***tetracycline.***
    - It **carries a self-limiting gene that prevents female offspring from surviving,** leading to a reduction in mosquito populations.

What are the Major Challenges Related to Mosquito and Related Disease Control?

- **Challenges in Mosquito Control:**
    - **Complex Environment:** Diverse **climates, geography, and socio-economic conditions** across India lead to varied breeding patterns of mosquitos.
    - **Insecticide Resistance:** Mosquitoes have developed resistance to commonly used insecticides and repellents, necessitating frequent rotation and development of new alternatives.
    - **Poor Sanitation:** Open drains, uncollected garbage, and stagnant water sources in urban and rural areas in India provide abundant breeding grounds.
- **Challenges in Disease Control:**
    - **Underreporting:** Many cases of mosquito-borne diseases, **especially in rural areas**, go unreported or misdiagnosed, hindering accurate data and targeted interventions.
        - Also, limited access to proper healthcare in remote areas delays treatment and increases complications.
    - **Vaccine Limitations:** Currently, no effective vaccines exist for all mosquito-borne diseases, making prevention mainly reliant on vector control and personal protection measures.

Way Forward

- **Improved Sanitation and Infrastructure:** Efficient waste collection and disposal can eliminate breeding grounds in urban areas.
    - Proper drainage systems can **prevent stagnant water accumulation**, a major breeding source for mosquitoes.

    - Providing communities with **clean water storage** solutions can reduce dependence on open containers, which attract mosquitoes.
- **Integrated Vector Management (IVM):** Implement a comprehensive approach that combines various strategies such as **biological control, insecticide use, and environmental management** to address mosquito-related challenges by accelerating the implementation of the **National Vector Borne Disease Control Programme.**
- **Community Engagement and Education:** Foster public awareness and involvement in mosquito control through **educational campaigns**, emphasizing preventive measures, and encouraging community participation.

UPSC Civil Services Examination, Previous Year Question

Q. Consider the following statements: (2017)

1. In tropical regions, Zika virus disease is transmitted by the same mosquito that transmits dengue.
2. Sexual transmission of Zika virus disease is possible.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

Ans: (c)

Q. 'Wolbachia method' is sometimes talked about with reference to which one of the following? (2023)

(a) Controlling the viral diseases spread by mosquitoes
(b) Converting crop residues into packing material
(c) Producing biodegradable plastics
(d) Producing biochar from thermo-chemical conversion of biomass

Ans: (a)

Mains:

Q. Identify the Millennium Development Goals (MDGs) that are related to health. Discuss the success of the actions taken by the Government for achieving the same. **(2013)**

Q. What do you understand by nanotechnology and how is it helping in health sector? **(2020)**