Introduction

What is aquaculture?

Aquaculture is the process of cultivating fish, shellfish, algae, and other aquatic organisms in tanks so that they can be processed into food for human consumption. These organisms can be used in a variety of ways.

Importance

As the global population grows and our oceans and other natural resources deplete, people will need new ways to eat seafood. Ocean resources are no longer enough to feed everyone on Earth. Wild fish consumption is ancient. Some believe the annual catch of edible marine proteins has peaked. Daily seafood consumption exceeds ocean capacity. Aquaculture will replace scarce seafood. Fish farming may be a way to provide future generations with protein sources that are good for the environment and rich in nutrients.

Aquaculture is more sustainable and humane than other protein-producing farming methods. Eating seafood is an excellent way to get enough protein because it retains more than chicken, pork, or beef. It contains a minor protein per unit of food compared to other types. Aquaculture reduces greenhouse gas emissions compared to conventional farming.

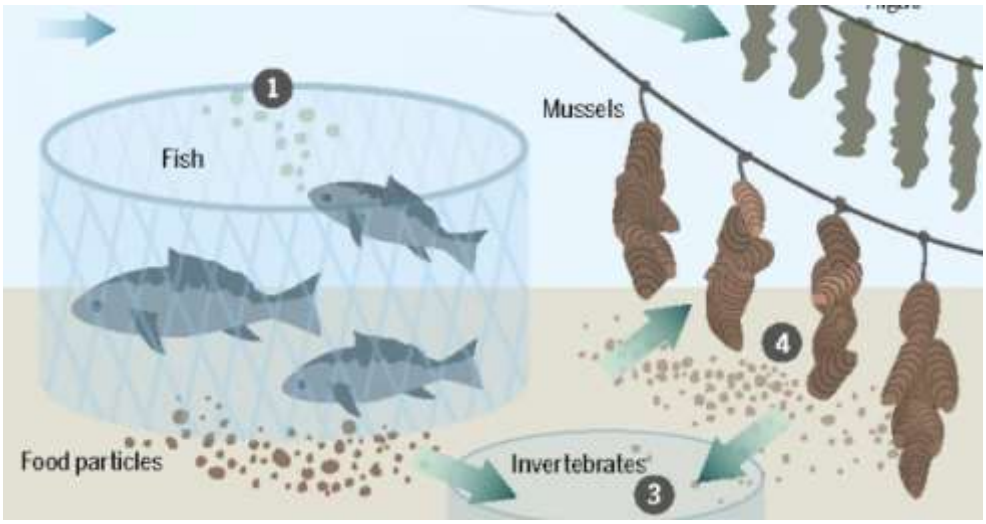

Figure 1 Aquaculture

Many predict 10 billion people on Earth by 2050. It will increase animal protein consumption by 52%. The global food crisis is worsening, so finding long-term solutions is crucial. Aquaculture is needed to feed the world's growing population. Aquaculture helps harvest more seafood from its natural habitat. It means consumers worldwide will have more seafood options.

If done socially and environmentally responsible, aquaculture can improve the health of our planet and its inhabitants. Aquaculture improves animal health.

Methodology:

Water is essential to the survival of marine life, but unfortunately, it can carry a wide variety of pathogens. Alterations in dissolved calcium, oxygen, nitrogen, pH, carbon dioxide, ozone, hydrogen, sulfide, or ammonia may cause these diseases. These rapid shifts in these parameters pollute the water supply, which is harmful to the aquatic life that lives in it. We must emphasize productivity and longevity to ensure the species' continued viability. To provide conditions ideal for aquatic life, parameters must be kept within their typical ranges. If we had a trustworthy method of quantifying the pressures that marine species are up against, we would better understand the factors affecting the well-being and development of marine species. These automated systems were developed with the help of some cutting-edge methods. Additionally, FLC has produced fully automated systems with clearly defined inputs. Automatic systems built on the fuzzy method can potentially be used to fight against the spread of disease.

Fuzzy Control:

In terms of system management, the fuzzy controller is responsible for defining, modifying, and utilizing the heuristic knowledge of individuals. You can see the fuzzy controller's block diagram in the figure located to the right. The picture appears to depict a controller with a hazy level of control. The fuzzy controller is composed of four primary parts, all working together. After that, rules are applied to evaluate an expert's explanation of how fuzzy logic could be used to improve company operations as a rule foundation, and the evaluation results are reported. Based on their extensive knowledge and experience in the relevant field, an expert will provide recommendations regarding the most effective procedures for the upkeep of a plant. By utilizing a fuzzification interface, the inputs from the controller can be converted into data that the inference process can use. When translating inference findings into real-world inputs, this process stage is referred to as the "defuzzification interface," It is referred to as such by its name.

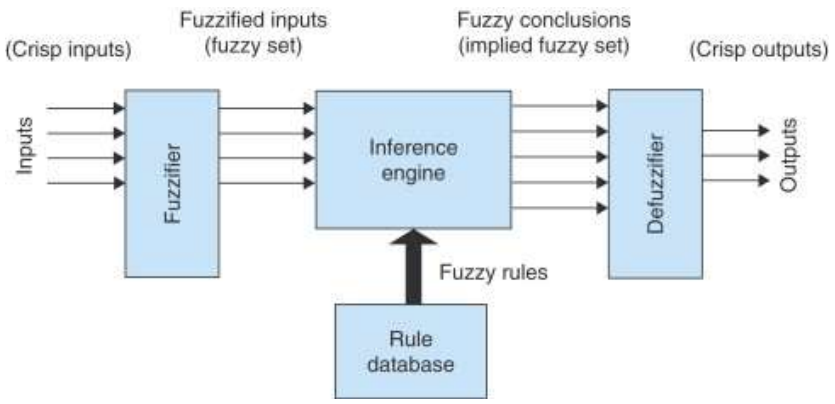

Figure 2 Fuzzy Control [3]

Simulation of Aquaculture system

A fuzzy inference system (FIS) is one of the most popular applications of fuzzy logic and fuzzy sets theory. FIS can be constructed by two methods, i.e., Mamdani and Sugeno method. Both ways differ only in how to determine the price of output FIS. Here we are using the Mamdani method. The Mamdani approximator is unquestionably superior to the Takai Sugeno (TS) approximator since it is the only one of the two that can use words in addition to numbers and is founded on human knowledge and experience [4]. As a result, it is superior to the TS approximator in every conceivable way. For the Simulation of the Aquaculture system in MATLAB, the following procedure is followed

- Launch MATLAB and enter the Fuzzy command to bring up the fuzzy interface.
- The three inputs—temperature, pH, and dissolved oxygen (DO)— and output can be entered in the fuzzy interface's edit section, located in the upper left corner.
- Select the trimf membership function as the default for the three inputs and a single output with the corresponding low, medium, and high names.
- Input and output parameters are set, and the rules are established by clicking the edit bar in the top left corner.
- Set the defuzzification method to the centroid. Although it is a little bit slow, it gives better output results.

- If you want to see the output results in the rules section after setting the rules, click the view button in the top left—where the sliding bar can be adjusted to reveal the water's quality.
- In the top left of the fuzzy interface, select the surface in view button to observe the outcome in 2D and 3D graphs.

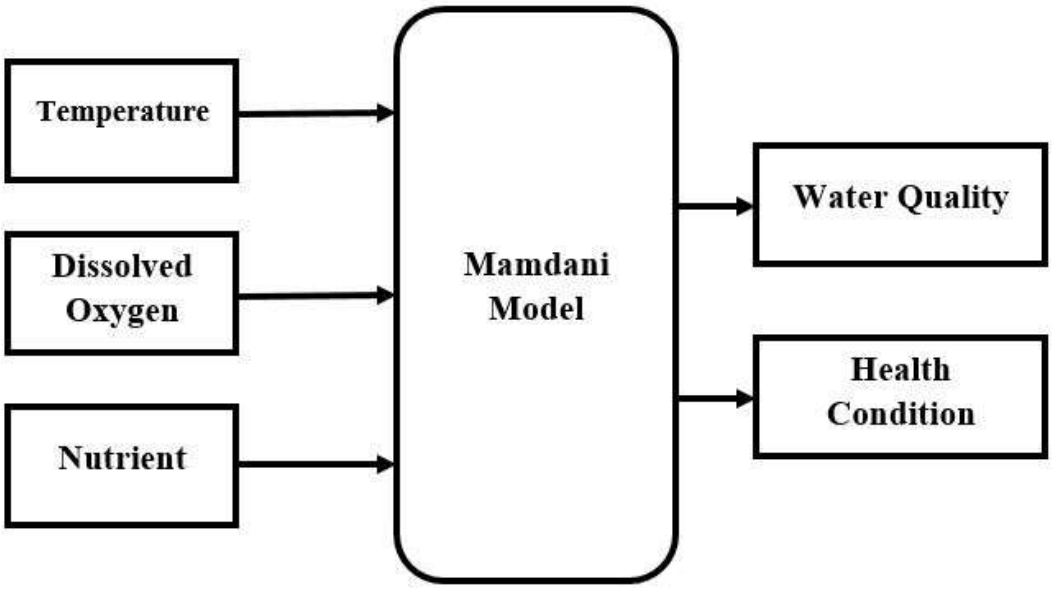

Figure 3 Block diagram of Aquarium system