**Fuzzy logic implementation in Agriculture field**

**Introduction**

Fuzzy logic is an essential tool in precision agriculture, allowing for more efficient resource management by dealing with the inherent uncertainties and imprecise conditions of agricultural environments. This report outlines the implementation of a fuzzy logic system for controlling the amount of water used for irrigation based on key environmental factors such as soil moisture, temperature, and humidity.

**Objective**

The main objective of this fuzzy logic system is to determine the optimal amount of water to be used for irrigation based on the current conditions of the soil moisture, ambient temperature, and humidity. This approach ensures efficient water usage, which is critical in both conserving water resources and promoting healthy crop growth.

**Code:**

**Fuzzy Variables and Sets**

1. **Inputs:**
   * **Soil Moisture:** Represents the moisture level in the soil, with fuzzy sets defined as dry, optimal, and wet.
   * **Temperature:** Represents the ambient temperature, with fuzzy sets defined as cold, moderate, and hot.
   * **Humidity:** Represents the air humidity, with fuzzy sets defined as low, medium, and high.
2. **Output:**
   * **Water Amount:** Represents the amount of water to be applied for irrigation, with fuzzy sets defined as low, medium, and high.

**Fuzzy Rules**

The fuzzy logic system uses a set of rules to determine the output (water amount) based on the input conditions. The rules are as follows:

* **Rule 1:** If the soil moisture is dry, the temperature is hot, and the humidity is low, then the water amount should be high.
* **Rule 2:** If the soil moisture is dry, the temperature is moderate, and the humidity is medium, then the water amount should be medium.
* **Rule 3:** If the soil moisture is optimal, the temperature is moderate, and the humidity is medium, then the water amount should be low.
* **Rule 4:** If the soil moisture is wet or the temperature is cold, then the water amount should be low.

**Implementation and Simulation**

The system was implemented using Python and the skfuzzy library. The fuzzy logic control system was tested with specific input values to simulate real-world conditions:

* **Input Soil Moisture:** 40%
* **Input Temperature:** 25°C
* **Input Humidity:** 60%

The system computed the output water amount based on these inputs, resulting in an irrigation water amount that is finely tuned to the environmental conditions.

**Results**

For the given input conditions, the system determined the optimal water amount to be approximately **50.36%**. This indicates that the soil is not overly dry but still requires a moderate amount of water for optimal crop health.

**Conclusion**

The fuzzy logic system effectively balances the irrigation needs based on variable environmental conditions, providing a robust solution for optimizing water use in agriculture. This approach not only enhances crop yield but also promotes sustainable agricultural practices by conserving water resources.

Further enhancements to the system could include additional environmental factors such as wind speed, plant type, and time of day to increase the accuracy and effectiveness of the irrigation control system.