**Problems of Fresh Water Supply**

Public freshwater supply systems are crucial to properly functioning societies. The water supply ability of a city directly affects its development level. However, due to climate change and various factors, many cities which have already achieved stable water supply also have problems.

**Problems**

Here is a typical example of fresh water supply problems that are suffering people: San Diego’s severe drought conditions. San Diego’s rainfall is lower than Los Angeles and Fresno, even though these two cities have been dried enough. Additionally, this region has limited groundwater resources compared to other areas in the state. Furthermore, state officials have imposed water rationing on the water from the Sacramento River delta, located over 400 miles north. As a result, some farmers in California's Central Valley have been deprived of their primary irrigation source.

Due to climate change, environmental factors, and the increasing demand for urban water, the water supply issue is now more than just local, like San Diego. It is escalating into a global problem year by year.

**Solutions**

The conventional centralised water infrastructure cannot supply adequate water in many cities like San Diego nowadays. To address this issue, various approaches have been adopted by people. One prominent solution is the widespread implementation of desalination technology, particularly in coastal regions and countries with arid climates like Australia, America, and the Emirates. Another effective strategy has been decentralising water infrastructure, which includes practices such as rainwater harvesting and stormwater harvesting.

**The Desalination technology**

Desalination is an artificial process by which saline water (generally sea water) is converted to fresh water. The most common desalination processes are distillation and reverse osmosis.

Multi-stage flash distillation (MSF) is a water desalination process that distils sea water by flashing some water into steam in multiple stages of counter-current heat exchangers. Current MSF facilities may have as many as 30 steps. Usually, MSF distillation plants are often paired with power plants in a cogeneration configuration. Waste heat from the power plant is used to heat the seawater, simultaneously cooling the power plant. This reduces the energy needed by half to two-thirds, which drastically alters the economics of the plant since energy is by far the highest operating cost of MSF plants.

However, the leading process for desalination in terms of installed capacity and yearly growth is reverse osmosis (RO). RO membrane processes rely on semipermeable membranes and applied pressure to facilitate water permeation through the membrane while blocking salts. Compared to MSF, RO plant membrane systems consume less energy. Currently, the cost of desalinating seawater is higher than MSF. However, prices are anticipated to decrease over time due to technological advancements.

Still, RO must always be required for maintenance because ionic contamination can compromise efficiency. In severe cases, RO membranes may be destroyed. To prevent damage, pretreatment stages are implemented. Also, membrane cleaning is required periodically based on membrane contamination, seawater conditions, or monitoring processes. Flushing needs to use inhibitors in a freshwater solution. Still, this procedure poses environmental risks since contaminated water is discharged untreated into the ocean, potentially causing irreversible damage to sensitive marine habitats.

**Comparison**

MSF and RO both have their advantages and disadvantages. RO requires more pretreatment of seawater and more maintenance, which always has caused the environmental issue and need economic support. Furthermore, although RO needs lower power than MSF, it is still not cheaper than the waste heat which MSF uses. Still, with the development of the production process, the energy that RO needs could also be lower and lower, and one day it might be even lower than using the waste heat. In addition, MSF is always required to be paired with a power plant, or it will need much energy. Therefore, it can only be widely applied on a small scale. That might be one of the significant reasons why RO is the leading process for desalination in terms of installed capacity and yearly growth.

**Conclusion**

Overall, MSF and RO need to be improved to help solve the fresh water supply problems. However, from a longer-term perspective, RO may be the best solution for seawater desalination between these.