

# Causal Loop Diagram (CLD)

## Answers to exercise

Full resource, see: <https://www.ncrm.ac.uk/resources/online/all/?id=20845>

### QUESTION

- i) Following image shows these 17 variables placed in a random order. Using the information provided above and your own intuition, connect those variables using arrows. Mark the nature of the causality of each arrow with (+) or (-).

### ANSWER

Please check whether your CLD is similar to the one provided below (Diagram 1). If it does, great! If not, try to rationalize our interpretations and see whether you agree with it or not. Perhaps you have identified some connection we have not.

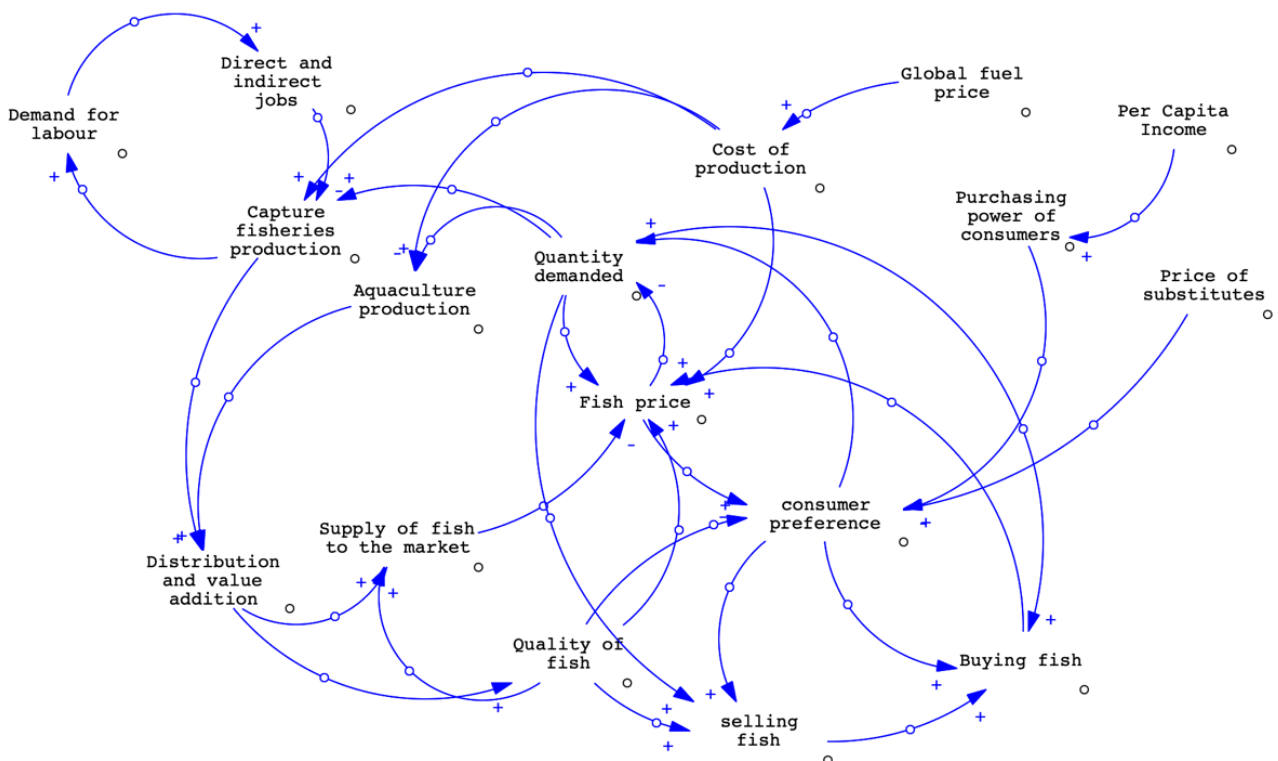


Diagram 1: CLD of a system of fish production-supply and consumption.

## QUESTION

- ii) Once you have completed the CLD, identify all the feedback loops present and specify whether each feedback loop is reinforcing or balancing.

## ANSWER

Please refer to the polarity of the arrows and draw the circular loops.

## QUESTION

- iii) For each identified feedback loop, provide a detailed explanation of how it functions. Describe the relationships between the variables in the loop and how changes in one variable affect the others over time.

## ANSWER

Here we have showed two feedback loops, a **reinforcing loop** (image 2) and a **balancing loop** (image 3).

- a) The reinforcing loop among capture fisheries production, distribution and value addition, supply of fish to the market, fish price and quantity demanded.

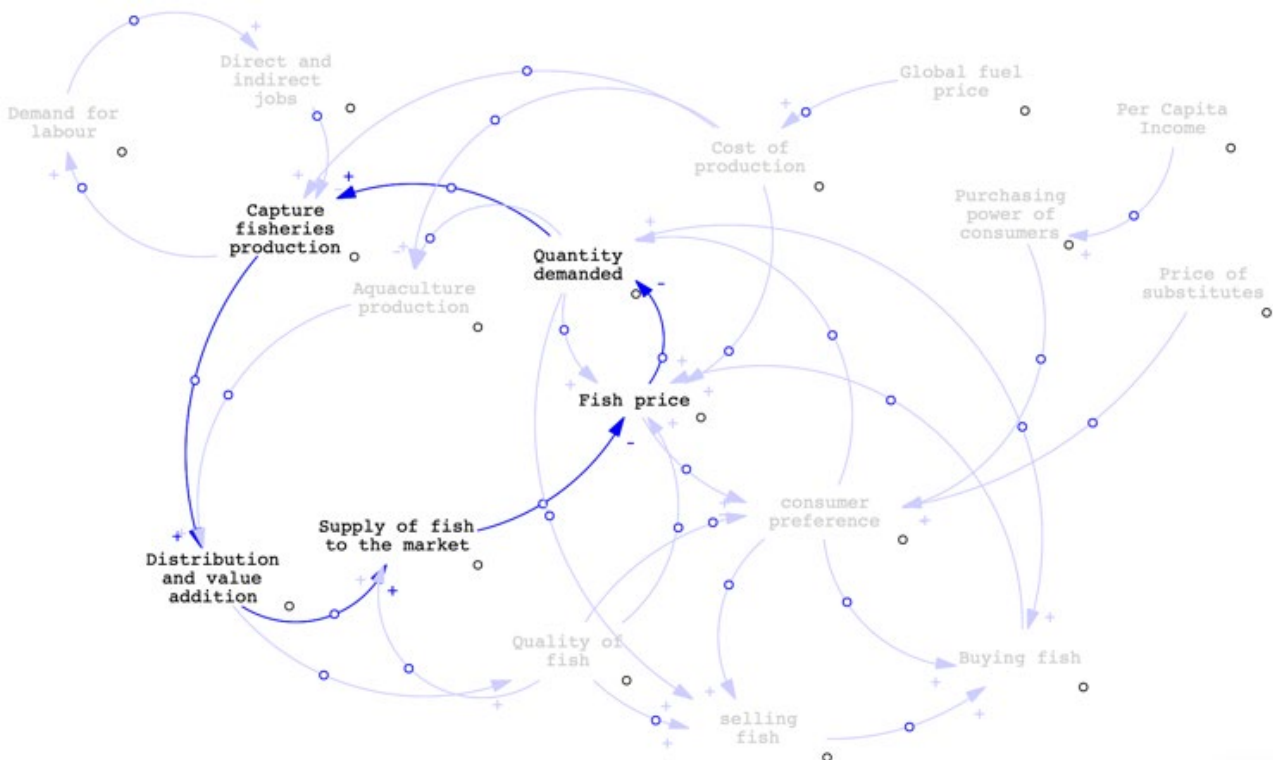


Diagram 2: A reinforcing feedback loop.

A positive feedback loop is formed here among these variables. Higher demand requires more fish to be produced from capture fisheries. More production results more distributions and value addition which enhances the quantities supplied to the markets. When the supply increases while the demand remains constant, it creates a surplus. This means that there are more products in the market than the number of consumers who wish to buy them. In this instance, the sellers try to lower the price of fish to sell it before they get perished. The reduced prices once again attract more consumers, further increasing the demand. This loop repeats requiring more investments to enhance fish production.

b) The balancing loop among demand for labour, direct and indirect jobs and capture fisheries practices.

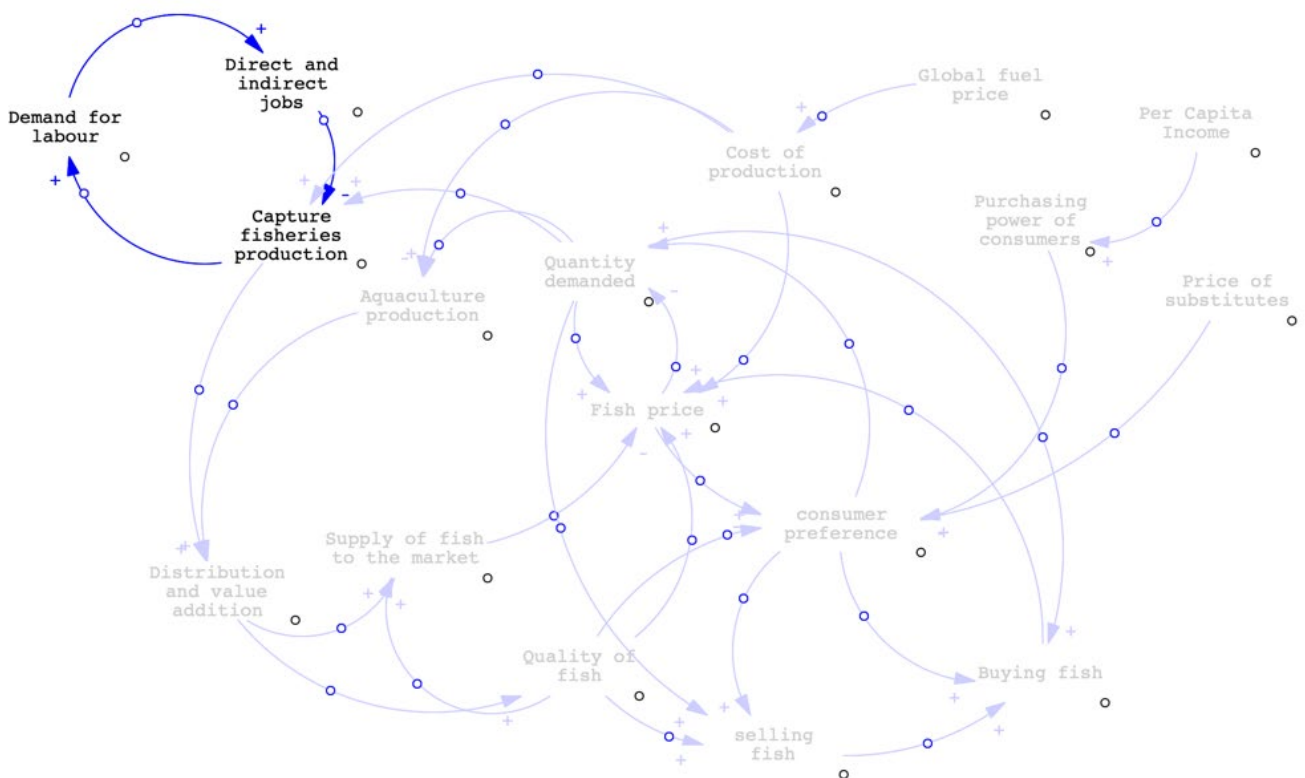


Diagram 3: A balancing feedback loop.

A negative feedback loop is formed when increased capture production create higher demands for labour, which enhances number of direct and indirect jobs. When the market demands for more fish products, the labour force needs to be expanded. It generates lots of job opportunities in direct fishing jobs and many indirect jobs in landing, postharvest,

processing and gear manufacturing sectors. This scenario is equally valid in the development of aquaculture production as both physical and intellectual labour is in demand for farm practices. In capture fisheries when more people engage in fishing jobs, they occupy more vessels, more fishing gear and spend more fishing hours at sea. This creates enormous pressure on fisheries resources and can even boost the fish production in the short run. However, natural replenishment of wild stocks cannot keep up with the continuously high fishing pressure and heavily exploited wild stocks can easily become overexploited, declining their production in the long run.

\*\* There can be many other feedback loops beyond these two. Feel free to explore your own CLD and identify them.

## QUESTION

iv) Choose one **reinforcing feedback loop** and one **balancing feedback loop**. Discuss the potential long-term impacts of each loop on the overall system.

## ANSWER

Considering the above identified **reinforcing feedback loop**, it is a self-amplifying process, which drives more fish production to meet the demand. There are both positive and negative long-term impacts of this loop that we need to carefully identify and analyse.

Here are some positive impacts;

- More production means more economic growth in the fishing sector, improving sales, infrastructure, and international trade relationships.
- More production requires more labour, creating more job opportunities.
- Fish is an inexpensive alternative to meat, therefore it enhances the food security and nutritional status of people living in rural areas.
- More opportunities for technological advances are created that allows automation and energy efficient techniques in packaging and distribution.
- More production reduces the risks of market fluctuations and keeps the price stable to a certain point.

In the meantime, this same loop can create negative impacts;

- When the wild capture fish production operates under a heavy fishing pressure with more gear, labour, equipment and more fishing hours, there is a good chance that the wild stock can decline and end up being over exploited.
- When more gears are in operation, it negatively influences the environment by generating marine debris, destructing habitats, harming biodiversity and burning fossil fuel.
- If more fish products are saturated in the markets and their price drops, it can reduce the sales of small-scale fishers' daily catches.
- Enhanced fish production needs a strong regulatory system to manage its sustainability. Failures and loopholes in the regulatory system could jeopardize the economic, environmental and social integrity of the fishing sector.

Identifying these positive and negative impacts created by this loop is very important. To balance the net impact and deliver the expected outcomes, prioritization of activities is the key while considering the long-term sustainability of the larger system.

Let's analyse the impacts of the identified **balancing feedback loop**. It stabilizes the system by reducing the fish production, signalling the fishing pressure and efforts generated by excessive labour force to slow down. There are both positive and negative sides to this loop.

Positive impacts:

- When the system signals that it has room to expand the fishing sector, it creates opportunities for economic growth, job creation, and societal growth of coastal communities.
- When the market demands for more production, it opens ventures for adopting sustainable fishing practices. At this level it is important to recognize the role of science in stock assessment and allocate funding for scientific research. This will make sure that the status of exploited fish stocks is known and monitored.
- Adopting sustainable fishing practices can minimize the negative impacts on environment and biodiversity. This ensures that the same ecosystem can support other marine sectors such as tourism, enhancing further benefits to the communities.

If we disregard the early signals to slow down and step back and now the system starts to generate declined fish production, it can result following negative impacts.

- When the fish production drops, it is followed by reductions in market and trade opportunities. This can be challenging for coastal nations whose economies heavily depend on fishing industry.
- Declined fish production means declined fish supplies to the market. This can increase fish price and make them unavailable for families of lower income.
- When the production declines it reduces the revenues. Vessel owners will have to go into debt to cover the cost. They will stop hiring more fishers onboard, hence decline the previously available job opportunities, drawing them to poverty.
- Collapsing of fish stocks signals unstable ecosystems, which are unable to deliver their ecosystem services. The resilience of such ecosystems is very low, making them easily vulnerable to stressors like climate change.

Early identification of the signals of this feedback loop is crucial to take proactive measures to avoid these negative impacts and keep the production at sustainable levels. This ensures the economical and societal benefits of sustainable fisheries in the long run.

## QUESTION

- v) Consider a scenario where there is a sudden decrease in capture fisheries production due to a moratorium as a fishery management measure. Using the identified feedback loops, explain the potential short-term and long-term effects on the system. How might this change propagate through the loops?

## ANSWER

A moratorium is a temporary banning of fishing practices as a measure to reduce the fishing pressure in a certain area to prevent collapsing of fish stocks and allowing time to regenerate. when a moratorium is declared, it creates a scenario where the production of the target stock is temporarily ceased. This means that all the direct fishing activities and associated industries will stop operating. This scenario is quite similar to the situation of the balancing feedback loop that we discussed. There we discussed the potential positive and negative impacts. In this situation, it is important to take it as an opportunity to rejuvenate the fishing sector with more sustainable

practices and profound regulatory system. With the time and further scientific interventions, the collapsed stocks might be replenished, and the moratorium can be lifted if the production can be resumed. However, this needs to be done after careful observation of the system to return positive impacts. Once the production starts to increase again, it will boost the reinforcing loop that we discussed earlier by supplying more fish products to the market. More fish supplies could reduce the fish prices and drive the consumer demand, requiring more production. Therefore, a moratorium can be a scenario which can balance the system and take it back to its normal state, however paving the way for a reinforcing loop in the long run.

As you can realize now, feedback loops are vicious circles that a system cannot escape from. What is important is we understand the nature of these feedback loops, when they start signalling and how to minimize their detrimental impacts and amplify their constructive responses to the overall system.

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