2022-10-06

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Bourlakis, M

2022 DSI Annual Conference Proceedings: resiliency and adaptability for a better global future

DECISION SCIENCES INSTITUTE

Mapping Food Supply Chains for UK Disadvantaged Communities: A focus on Plymouth

Michael Bourlakis
Cranfield University
Email: m.bourlakis@cranfield.ac.uk

Emmanuel Sawyerr
Cranfield University
Email: emmanuel.sawyerr@cranfield.ac.uk

Clare Pettinger
University of Plymouth
Email: clare.pettinger@plymouth.ac.uk

ABSTRACT

Regardless of many efforts by the government and people of the United Kingdom to address food insecurity and poverty, food inequalities in the country continue to worsen. Having identified the limited research on the role logistics and supply chain management could play in addressing this challenge, this study coproduces a food product for disadvantaged communities using Plymouth as a case study and maps the supply chain for it to identify the processes and key challenges therein. Accessibility is not a major challenge in Plymouth, but limited demand, affordability and inconvenience are.

KEYWORDS: Fish supply chain; Disadvantaged communities; supply chain mapping; UK food redistribution; Distribution Logistics.

INTRODUCTION

Food is of absolute importance for the survival of humans on the planet as it is fundamental to good health and well-being. It is one of the pillars upon which society is built (M. Bourlakis & Weightman, 2004); so that, tampering with food supplies or food sources could instigate serious political instabilities and even wars. Many conflicts have resulted over lands that were deemed arable for food production (Telesetsky, 2011). Not surprisingly, the distribution and sale of agricultural and horticultural products have been going on for centuries (Walley & Custance, 2010). Logistics and supply chain management play a crucial role in this as it is food supply chains that facilitate the provision of safe, healthy, and nutritious food, right from farm to fork (Burlingame & Pineiro, 2007; Septiani et al., 2016).

In recent times, the volatility and vulnerability of supply chains have been increasingly recognised (Ali et al., 2017; Christopher & Holweg, 2011; Sawyerr & Harrison, 2020; Vlajic et al., 2012). Food supply chains face the same challenges, in addition to unique vulnerabilities due to the types of products using these supply chains (Stone & Rahimifard, 2018; Vlajic et al., 2013). As the incidence of extreme weather conditions is rising, it may be anticipated that these challenges will get more pronounced (Allison et al., 2009). Additionally, issues around inadequacies in food safety and quality pose significant risks to food integrity, particularly considering the perishability of some of the products in food supply chains (Fox et al., 2018; Septiani et al., 2016). With increased globalisation, the distances between the points of food production and places of consumption have also increased, thereby impairing traceability and

exponentially heightening food integrity risks and food losses and waste (M. Bourlakis et al., 2014; Dania et al., 2018; Facchini et al., 2018).

All of these have resulted in increasing concerns by governments about resilience in food supply chains, food security and the long-term sustainability of the food industry (Accorsi et al., 2018; Leat & Revoredo-Giha, 2013). The United Kingdom (UK) government is insisting on the high resilience of its food supply chain and the country has a food industry that is experienced in dealing with food supply disruptions and firms which try to establish alternative supply routes and suppliers, among other measures, to help minimise disruptions (The Environment Food and Rural Affairs Committee, 2020). Food losses and waste are, by the government's admission, a problem that needs addressing, while many citizens in the country live in food poverty or are food insecure.

This paper discusses food inequalities in developed countries, focusing on the UK's southwestern port city, Plymouth. Even though it is located in a rich and diverse agricultural hinterland with direct access to seafood, the city, like many others in the UK, has an increasing population of persons suffering from food poverty and poor diet-related health. The city thus presents a representative case for which the findings can be generalisable not only across the UK, but in other developed countries as well. The paper begins by providing a literature review of food poverty in the UK and then in Plymouth. It then discusses the utility of supply chain mapping in helping to understand the processes and challenges in food supply chains after which the methodology section presents how data from 40 total interviewees (both national and local) and 4 focus groups in Plymouth were used to map the national supply chain map that serves disadvantaged communities in the UK, identify fish as an aspirational food product that consumption could increase among these groups in Plymouth and map the fish supply chain map in Plymouth. The findings and discussions are presented, and the paper concludes by highlighting opportunities for practical and research interventions.

LITERATURE REVIEW

Food Poverty in the UK

Global food insecurity continues to worsen. Many developed countries – including the UK – have reported increased reliance among their populations on emergency redistributed food offers. In the UK, there is increasing pressure on the government to incorporate "the right to food" into the nation's law (May et al., 2018). As food poverty levels continue to escalate, exemplified by increasing numbers of citizens reliant on food banks (Greener, 2019; May et al., 2018), the insistence on ratifying the right to food into law has been amplified (Westwater, 2021). The Food Foundation (2019) reports that the poorest 10% of UK households need to spend about 74% of their disposable income on food to meet the costs of the Eatwell guide. Additionally, about 80% of adults and 95% of children eat fewer than 3.5 portions of vegetables a day and around 16% of adults skip meals for financial reasons. Indeed, a quarter of the UK's population thinks healthy and nutritious food is unaffordable (Corfe, 2018). Children living in households where a healthy diet is unaffordable are identified to have a higher likelihood of suffering adverse consequences on their education (Adolphus et al., 2013, 2016; Gooseman et al., 2020). The most vulnerable households to such food poverty and insecurity include single-parent households, those living in temporary accommodation, poorer families, households with no recourse to public funds and families where at least one member suffers physical, dietary or mental health conditions (Lovell & Eatwell-Roberts, 2019; May et al., 2018). Other vulnerable groups include adults who live alone, homeless people, individuals without a car or public

transport monies, and some pensioners. As they are usually socially and economically disadvantaged, persons within these groups tend to make poor choices on food due to a variety of complex and imposing conditions (Pettinger et al., 2017). The acute rise in food poverty and insecurity in the UK in recent years is corroborated by the 284% (pre-COVID) increase in reliance on food banks since 2012 (Lovell & Eatwell-Roberts, 2019). The Coronavirus pandemic worsened the plight of the most vulnerable, especially as nationally imposed lockdowns disrupted agri-food chains (Dimbleby, 2021). As this research presents the peculiarities of food insecurity and poverty in Plymouth, the next section discusses the food system in the city.

The Food System in Plymouth

Plymouth has high levels of deprivation which is evidenced by the existence of food deserts, where access to fresh and affordable food is restricted (Lewis et al., 2014; PCC, 2020; Pettinger & Bonney, 2016; Williamson et al., 2017). A strong correlation between class, affluence, location within the city and access to fresh food has been identified. This has provided an insight into the diet-related health patterns as observed in these parameters within the city (Lewis et al., 2014) where the lowest income households disproportionately suffer from poor nutrition and related health issues (Kinra et al., 2000; Pettinger et al., 2017; Pettinger & Ellwood, 2019).

The city is favourably located in the rich agricultural hinterland of the south-western English coast with access to rich marine resources. Notwithstanding, not much of the locally consumed food is sourced from the surrounding areas or city's ports where some of the biggest fish-landings are made in the UK (Lewis et al., 2014). This has been attributed to a departure from the city's conventional dependence on outlets that retail locally produced food to shopping from supermarkets that usually source nationally and internationally (Miller, 2013) – a situation that is common in many developed countries. Over time, the capacity to meet the demand for locally produced food has become inadequate and unsustainable despite lingering significant demand (Lewis et al., 2014).

Food inequalities, inadequate food production capacity and easy access to unhealthy foods increase the exposure of the city's residents, especially children to obesogenic food environments. This aggravates the already dire health conditions of children living in food poverty. Seeking to explore the provision of healthier and sustainable food product options for the disadvantaged, this study maps the supply chain for locally landed fish to identify the challenges and opportunities to increase local consumption.

Supply Chain Mapping

There are a variety of risks (for food businesses and consumers alike) within food supply chains that require mitigation. Supply chain mapping is useful for improving visibility in food chains. It, therefore, provides a useful means, not only for risk mitigation but also for resilience, efficiency and sustainability (Donaldson et al., 2020; Mubarik et al., 2021; Sawyerr & Harrison, 2020; Thompson, 2015). This became significantly evident across the globe with the COVID-19 pandemic as about 70% of organisations did not have a clear sense of the parts of their supplier networks that were adversely affected (Choi et al., 2020). The organisations that had mapped out their supply chains at a multi-tier supplier level on the other hand were able to pre-emptively protect their supply by analysing their maps and identifying alternate sources to mitigate the supply lines that were disrupted (Vakil, 2021).

Supply chain mapping involves the process of documenting information across companies, suppliers and individuals who are involved in the company's supply chain, to create a global map of their supply network. The resulting map is "*a representation of the linkages and members of a supply chain along with some information about the overall nature of the entire map*" (Gardner & Cooper, 2003, p. 46). Supply chain maps represent the supply network relationships, flows and dynamics in a simplified yet realistic manner by capturing the essence of the environment in which the supply chain operates. This thereby allows for the visualisation of the upstream and downstream of their supply networks to allow for the identification of problematic areas and to support process decisions (Anastasiadis et al., 2020; Mubarik et al., 2021). It provides supply chain managers with insights to understand the areas of cost savings and offers companies much flexibility because it facilitates the identification of opportunities, monitoring of threats and risks, and avoidance or mitigation of the possible effects in case of disruption (Fragapane et al., 2020; Mubarik et al., 2021). Primarily, a supply chain map may cover all facets of the supply chain structure, showing the firms, facilities, processes and materials, information and financial flows (Craighead et al., 2007; Mubarik et al., 2021). A supply chain map that is useful for strategy execution should typically include the focal firm, its suppliers, the technologies used in the supply chain process and also the capabilities, such as Just-In-Time deliveries (Lambert & Cooper, 2000; Mubarik et al., 2021; Soto-viruet et al., 2013; Suarez-Barraza et al., 2016).

A variety of methods have been employed in mapping food supply chains. In the UK, the food value chain analysis (FCVA) method has been one of the utilised methods. Multiple authors (including Donaldson et al., 2020; Francis et al., 2008; Simons et al., 2003, 2005; Taylor, 2005, 2006) have used the method or a variation of it in different agri-food sectors. One of such modified versions is Kumar et al.'s (2013) relationship-based method where a basic map is developed using data from literature and secondary documentary sources. Data collected from semi-structured interviews with actors in the basic map are analysed and used to understand the processes within the chain, linkages between interfaces, the nature of relationships between actors and the potential opportunities for integration. A similar methodological approach is adopted for mapping the supply chains in this study.

METHODOLOGY

First, a national supply chain mapping for food supply chains that support disadvantaged communities was conducted. After this, an exemplar product was selected through coproduction activities with the local community for which mapping was to be done. Additional data was then collected through interviews to map out this supply chain in Plymouth to identify its challenges and the opportunities to increase local consumption, especially among the communities vulnerable to food insecurity and poverty. The questionnaire for collecting data for the local fish supply chain is provided in the appendix.

For the national mapping of the food supply chain that serves disadvantaged communities, a relationship-based supply chain mapping approach was adopted (Kumar et al., 2013). Having examined the relevant literature and government documents, the "basic" map showing the structure of the UK's commercial food supply chain was developed. With this map, 32 participants consisting of primary producers, manufacturers, retailers, wholesalers and logistics companies were interviewed. In addition, some experienced academic professionals, industry experts, government officials and food charities were also interviewed. The collected data were analysed using an abductive thematic analysis method to map out the infrastructure, and processes involved at the various stages of the supply chain to supply food to disadvantaged

communities in the UK. This map was then the template for which the local data collection was going to be done for the food product identified within the Plymouth community.

Based on the national statistics from Kantar, Living Costs and Food Survey (LCFS) and Family Food dataset (FFD), data on spend as a percentage of shopping basket were used to identify the food products consumed by the lowest socioeconomic status (SES) groups within the UK. A variety of the eligible food products identified from the national data were verified through 4 different focus groups, each consisting of 6 individuals from the disadvantaged groups in Plymouth both to ascertain correspondence at the local level, as well as to identify the aspirational food products that would be healthy, sustainable and affordable for them. Fish was identified as one such food product that could be consumed more.

Having identified the product, 8 additional interviews were conducted using the schematic derived from the national supply chain mapping and the data was analyzed and used to map out the fish supply chain. The results of the data collected and analyzed are presented below.

FINDINGS AND DISCUSSION

From the data collected nationally, our findings indicate that the supply chain that serves disadvantaged communities is a merger between the commercial food supply chain (which consists of primary producers, manufacturers, wholesalers, retailers, the hospitality and catering industry and logistics companies) and the food aid supply chain (FASC). Actors in the commercial food supply chain serve as the suppliers (donors) of food (usually considered surplus) to food redistributors from whom the disadvantaged access supplementary food to what they afford through the commercial chains. Food redistributors are either food aid wholesale distributors or food aid service organisations. The former collect food (either surplus or planned donations) in high volumes from the large actors within the commercial food supply chains and supplies these to the latter from which the disadvantaged directly access the food. The findings from the data collected locally were as follows.

Processes within the local fish supply chain

There are well over 50 different species of fish caught in Plymouth including herring, whiting, pollock, haddock, ling, sardine, mackerel, pouting, John Dory, monkfish, wrangler fish, octopus and shellfish (scallops, crabs, lobsters etc.). Most fish landed at the Plymouth ports by fishermen are auctioned by the Plymouth Trawler Agents to buyers through a hybrid system where purchases may either be made online or in person. Buyers include local fish mongers, local wholesalers, wholesalers from other parts of England (such as London) and international wholesalers. A few wholesalers work with small-scale fishermen to purchase their fish directly and sell them off to retailers and the hospitality and catering industry. For most fishermen, selling through the trawling agency provides them better prices, along with convenience, as it helps them avoid any legal and regulatory requirements for selling directly to consumers. It also relieves them of any additional burden of having to market their fish and manage sales. An interviewed fisherman explained: "*it's too much fish and too much variety of fish to be able to sell directly to anybody. It's too large an amount…obviously they connect me with 200 buyers, so I get the top price for my fish*".

Local fish consumers therefore primarily access local fresh fish through fish mongers, the local hospitality and catering organisations and sometimes directly from the local wholesalers. They may also get access to fish products from supermarkets but the fish that goes through this route

tends to be bought and shipped to the distribution centers of the major retailers from fish products from other parts of England, as well as international imports are assembled and redistributed across the country. It thus becomes relatively difficult to trace fish landed in Plymouth through the supermarket supply chain back to the city. Figure 1 below provides a schematic overview of the fish supply chain in Plymouth.

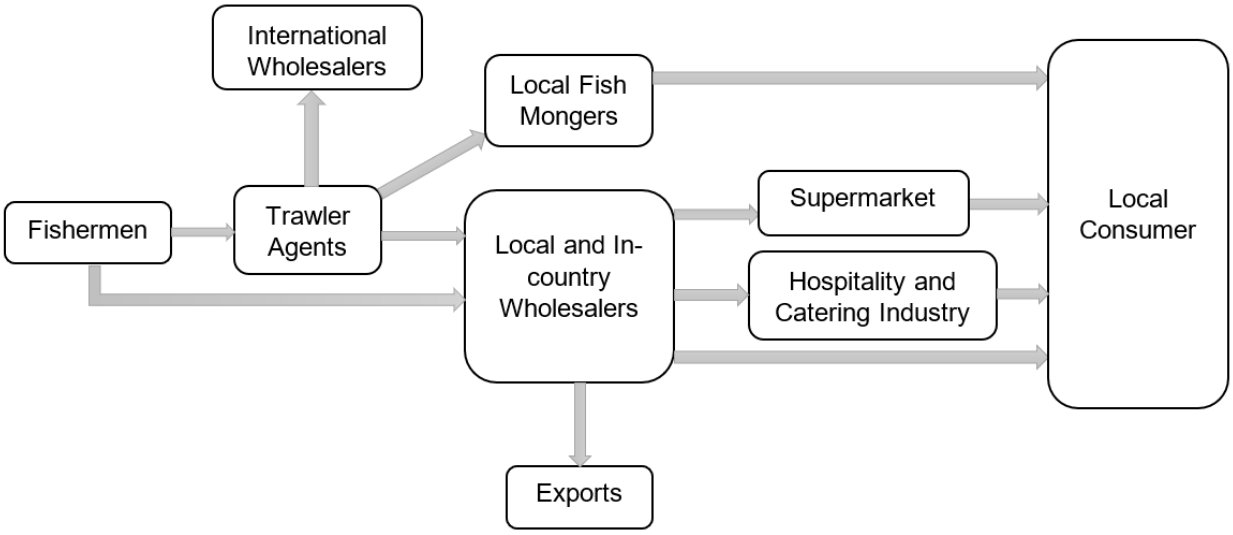

Figure 1 Fish Supply Chain in Plymouth

As is inferable from Figure 1, local fish mongers compete with large local and in-country wholesalers, as well as international merchants for the fish that is landed. As it is an auction, larger players are able to make higher bids which thus means that most of the fish caught in the city's waters get shipped outside of it. Nevertheless, accessibility to fresh fish landed in Plymouth ports is not a problem within the city even though the fishmonger tends to be the primary source for consumers.

Challenges

Even though accessibility is not a major challenge, affordability is. Unlike the supply chains that provide food aid through the redistribution of surplus food, there is very little to no waste in the fish supply chain in Plymouth. Most of the landed fish are sold, those which are not sold in good time get frozen while the remaining are then used locally or exported as bait. This therefore makes it very difficult to have any surplus fish available for redistribution like is done for some ambient food products or even fresh fruits and vegetables. This is consistent with what is observed in the rest of Europe since most of the waste in the fish supply chain occurs at the processing and manufacturing stage of the supply chain involving inedible parts (Caldeira et al., 2019) which are, thus, not surplus and are not available for redistribution. Additionally, local demand for locally landed fish in the UK is relatively low. Compared to Norway, the leading exporter of fish in Europe (Eurostat, 2022) where 57.27% of its landed fish are consumed within country (The Directorate of Health, 2022), most of the UK's landed fish (such as mackerel and herring) are exported, while most of its domestically consumed fish (such as tuna, haddock, cod, shrimps and prawns) are imported (DEFRA, 2021). Consequently, the few stocks of preferred locally landed fish that are sold locally tend to be pricy and less likely to be redistributed.

Limited skill in fish processing (descaling, filleting, skinning, gutting, etc.) was identified as a hindrance for donating or subsiding fish for food charities. One of the interviewed local wholesalers pointed out concerning some of the fish they used to give out, that:
"*They were brought in, as a gift, everything but cut and they would say "But it's still got the skin on it". Fish comes with skin. That's just the way it is. So, in the end, the amount of time that it would have taken me to get it all prepared the way they wanted it, I was losing money by not working to do my actual job.*"
Thus, even when the organisations within the fish supply chain were willing to donate to food charities, there was very little incentive to do it because of the difficulties in handling and processing the fish for the charities.

The lack of skill was also identified as a major hindrance to the consumption of local fish. Convenience was highlighted as high-ranking on consumers requirements of the fish products. A local fish monger said, "…*if you come in and you have a look, most of the products on our counter are actually whole fish. So they (customers) come in and have a look at it,…they're not sure whether they're expected just to pick it up and walk away with it, and do it themselves…. They come in not just for convenience food, but convenience shopping as well.*" Because many people are not adequately skilled to process, prepare and cook the fish (Neale et al., 2012), there was relatively little desire to buy fish directly from fishermen, even if it were at a cheaper price (Carlucci et al., 2015). Fishermen and wholesalers pointed out the need to come to the fish landing sites and the smell of freshly caught fish were also deterrents. Consequently, owing to the declined demand for locally landed fish within the city over time, there were very few fish mongers remaining in the city.

Another challenge towards local consumption, particularly among the disadvantaged, was the cost. Interviewees highlighted facts such as fuel prices, low local demand, government-assigned quotas and the high level of consolidation in the corporations that manage fishing boats and quotas as contributing factors to the prices at which fish gets sold. The processing required to get fish in the state that customers were comfortable with, along with other convenience requirements also pushed the price of fish in the city up.

Opportunities for affordable local fish

Limited data on the fish consumption in Plymouth is a challenge that opens up opportunities to explore solutions. There is an opportunity for the Plymouth City Council to collect data on the consumption of fish food products and compare them with available extant data on the city's fish landings to help facilitate the exploring of viable local solutions. The scarcity of relevant data makes most propositions speculative and difficult to justify implementation. Arguments have been made for the potential of using locally landed sardines and other small-sized fishes in the production of fish pies, fish tacos, canned fish products, among others, to drive up local consumption in line with dietary recommendations on fish (SACN, 2004).

There is optimism with the production of products like fish pies and tacos as they do not require high levels of industrial machinery for processing. Concerns were raised on canned or tinned fish due to the capital and operational expenditure that may be required to operate factories that would produce these products. Worries were expressed about these things causing prices to be high compared to the relatively low-quality tinned fish products that are imported into the UK.

CONCLUSION

Increasing food inequalities in the UK has highlighted the urgent need to deliver affordable, healthy and sustainable food options for the various disadvantaged groups in the country who struggle to get these. As the role of logistics and supply chain management has scantly been explored in addressing these concerns (Wang, 2017), this research sought to investigate the nature of the fish supply chain in Plymouth, compare it to the generic supply chains through which disadvantaged communities access food and identify the challenges to accessibility and affordability of fish in the city. A schematic map of the local fish supply chain is presented.

Our findings indicate that, unlike food products such as fresh fruits and vegetables where surplus from commercial supply chains is redistributed through food aid supply chains to supplement the quantities accessed by disadvantaged communities via traditional routes (Spring et al., 2019), there is little to no surplus in the fish supply chain for redistribution. Thus, despite the variety and quantities of fish landed in Plymouth, there is little overall consumption in the city, and this becomes worse among the disadvantaged. Accessibility was not a challenge but affordability and convenience (in terms of the fish being in a state that was easy to consume) were identified as major obstacles. Unlike Weymes and Davies (2018) who suggested that the reason for the low quantities of fish (and meat) redistributed was due to food safety concerns around the handling of raw materials, our findings show that in Plymouth, the limited redistribution of fresh fish is mainly due to the limited quantities of surplus fish and the inconvenience of processing it. Indeed, some organisations in the fish supply chain which were donating to food charities discontinued their provision of fish due to an extra requirement for processing the fish – an additional cost the donors deemed too high to concede.

Considering the uniqueness and complexity of the challenges identified in the fish supply chain in Plymouth, there are opportunities for interventions through practice and research. This paper has highlighted the need for more data to understand the nature of local fish provisioning and consumption in order to allow for good, sustainable solutions to be developed. It has highlighted how unlike other types of fresh food, fish requires innovative and sustainable solutions. Thus, there are opportunities for further research into making such food products more accessible and affordable for disadvantaged consumers. With food redistribution not being a viable short to medium-term solution to inadequate consumption of fish by disenfranchised groups (Garthwaite et al., 2015; Papargyropoulou et al., 2022; Spring et al., 2019; Vlaholias et al., 2015), researchers and policy makers alike have to seek out long-term solutions that address the demand, affordability and convenience challenges that plague fish supply chains in the UK.

ACKNOWLEDGEMENT

This paper is part of the Food Systems Equality project titled “Co-production of healthy, sustainable food systems for disadvantaged communities” funded by the BBSRC under UKRI’s Strategic Priorities Funds.

APPENDIX

Participant Details

Name:
Role:
Experience:
Organisation:

Interview Questions

1. Kindly elaborate on what you (and your organisation) do.

2. Kindly give an overview of the fish supply chain in Plymouth. How much of the fish would you estimate are sold locally in Plymouth?

3. Is fish popular among people who struggle to access food in this community? Why do you think so?

4. Do actors in the supply chain ever end up with fish that does not get sold? If yes, what do they do with those?

    a. Are any of these sent to any local charities (such as food banks)? Who are they? If not, who do they give them to?

    b. What equipment (e.g., freezers, chilled vans) and processes are used to preserve, handle and transport any extra fish within the supply chain and within the community?

    c. Why are the fish sent to these organisations? What resources or capabilities do you think they have that are complementary to each other to help deliver to consumers?

    d. Do you think these organisations learn anything from their work with each other based on what information or knowledge they share with each other? How? Do you think the learning is mutual?

    e. Are you aware of processes, methods or personnel for the redistributing of surplus fish? What processes are these? What is the title of their role and how do they work?

5. What are the key internal barriers within companies that are faced in supplying surplus fish to the charities? What are the external barriers, in terms of the law, regulation, other persons or organisations (fish mongers, other wholesalers, manufacturers) they work with?

    a. Are you aware of any areas within the city that do not have access to fish? What are the causes of these or what hinders accessibility in these areas?

    b. What about the delivery of fish to local communities that may not be able to afford or access food?

6. What plans, if any, do you think organisations could have in addressing these internal and external barriers that you have identified?

7. What are the enablers within companies (internally) that encourages or facilitates the supply of fish to consumers (especially those with limited affordability or access) in the city? What are the external enablers?

8. How do you think that the City Council, along with the other stakeholders in the community can address the supply of fish to everyone, including those with limited affordability or access in the city?

9. Any final thoughts or issues that we have not discussed but you deem relevant?

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