Analysis on determining the optimal site for a Convenience Store which has click and collect facility in Liverpool using GIS.

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Introduction

The determination of optimal locations for convenience stores has not been extensively researched, primarily due to the lower level of investment required per unit (Wood et al., 2007). This reduced financial commitment results in limited resources being allocated for in-depth research into location management strategies (Wood et al., 2007).

Historically, the competitive landscape for convenience stores has been shaped by major players like Tesco and Co-op. A significant milestone in this sector was marked by Tesco's strategic joint venture with Esso (Wood et al., 2007). This collaboration led to the establishment of convenience stores at Esso's forecourt locations, a move that bolstered Tesco's position in the market and infused a new level of confidence in their operational strategy (Wood et al., 2007). So, we need to consider All factors like working population, Household size and Online Grocery Shopping Prevalence etc., while estimating optimal site for convenience store.

Methodology

We need to locate optimal site for placing new c-store of Marks & Spencer Retailer (chosen). C-store should have a click & collect facility. We need to identify areas with High Online Grocery Shopping Prevalence. So, we re-coded IUC 2018 groups into four categories based on z-score for Buying Groceries in Online Shopping class. Four Categories are High Prevalence (1,2,3), Moderate Prevalence (5,6), Low Prevalence (8,9) and Very Low Prevalence (4,7,10).

We need to consider areas with High Working Population, Moderate or High affluence and small Households to have maximum profit for c-store and lowering the sunk cost. So, we considered Daytime Population data from Nomis Business Register and Employment Survey 2020, IMD 2019 and Household Size data from Census 2011.

We used latest Food stores 2023 Dataset from Geolytix Open Data, Supermarket Retail Points. To understand competition from other retailers and avoid revenue cannibalisation i.e. (to avoid placing two stores of same retailer near to each other, Which will increase revenue generated per unit), We plotted Fixed Distance and Drive Distance catchments for all c-stores in Liverpool and we also plotted catchments for supermarkets which have Click and Collect Facility.

By observing intersecting areas of High Online Grocery Shopping LSOA's with Chosen Retailer's catchments to avoid revenue cannibalisation, which leads to all potential locations for placing new c-store with click & collect facility for chosen retailer. Now, considering other factors such as Major Employers, Visibility, Road Connectivity etc. in and around all potential locations.

Finally, comparing above potential locations are compared with all other retailer's c-store and Supermarket with Click & Collect Facility catchments, we suggest a site for placing new C-Store for Chosen Retailer.

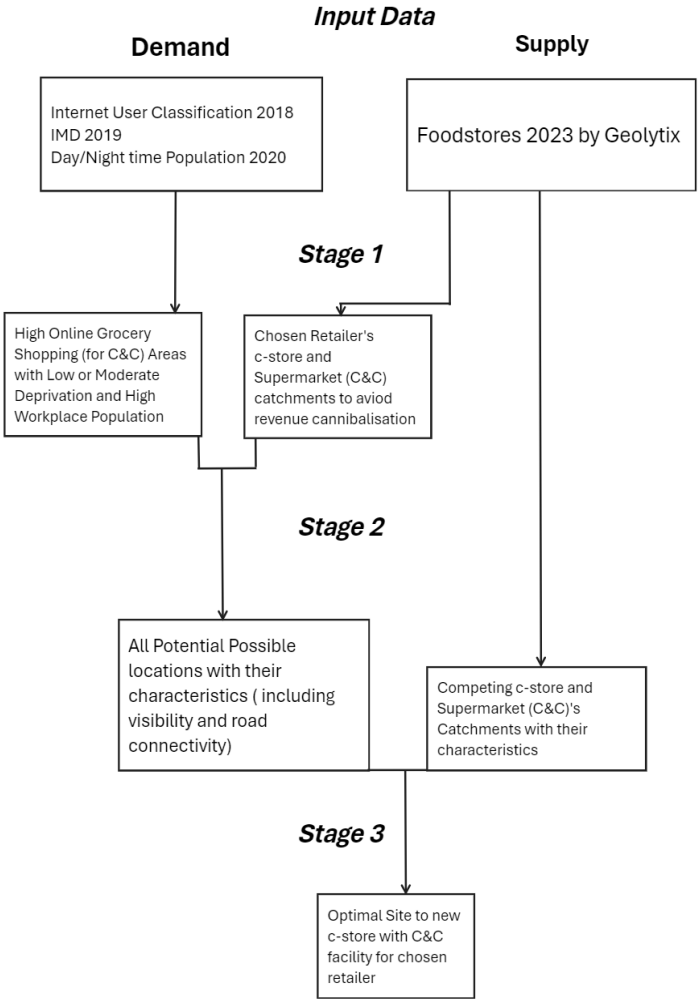

Fig.1. Flow Chart depicting how optimal site for c-store located.

Online Grocery Shopping Prevalence (IUC 2018)

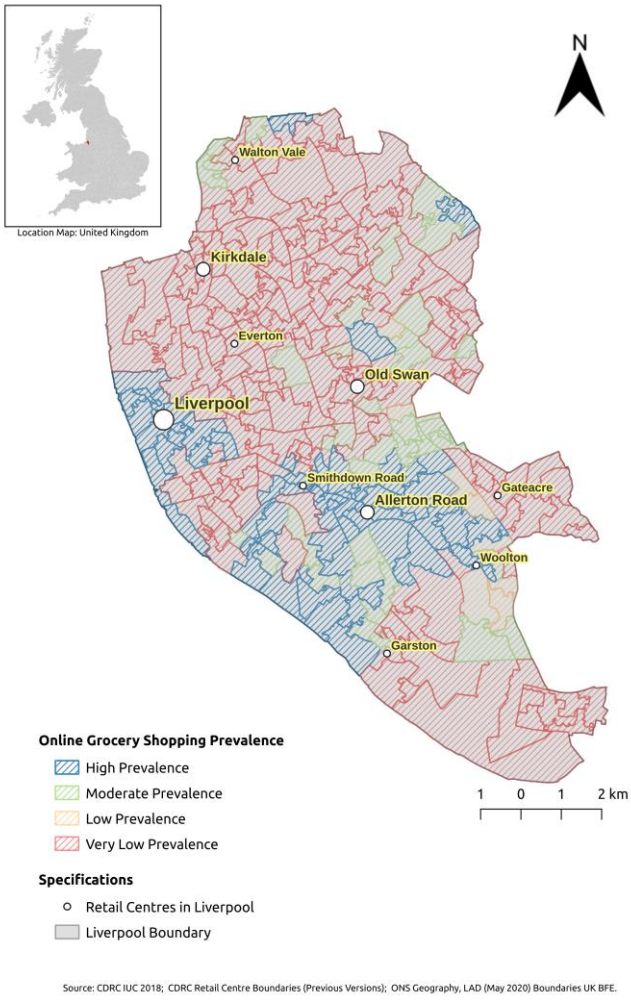

Fig. 2. Online Grocery Shopping Prevalence in Liverpool.

We re-coded Internet User Classification 2018 data into Four Categories based on z-score for Buying Grocery in Online Shopping Class. All the groups with z-score greater than zero are classified as High Prevalence and Groups with z-score near to zero, but positive are classified as Moderate Prevalence, and Groups with z-score near to zero, but negative are classified as Low Prevalence, and Groups with z-score less than zero are classified as Very Low Prevalence. We also overlayed Major Retailer Centres in Liverpool for regional identification.

IMD 2019 (by IMD Rank) with Online Grocery Shopping Prevalence

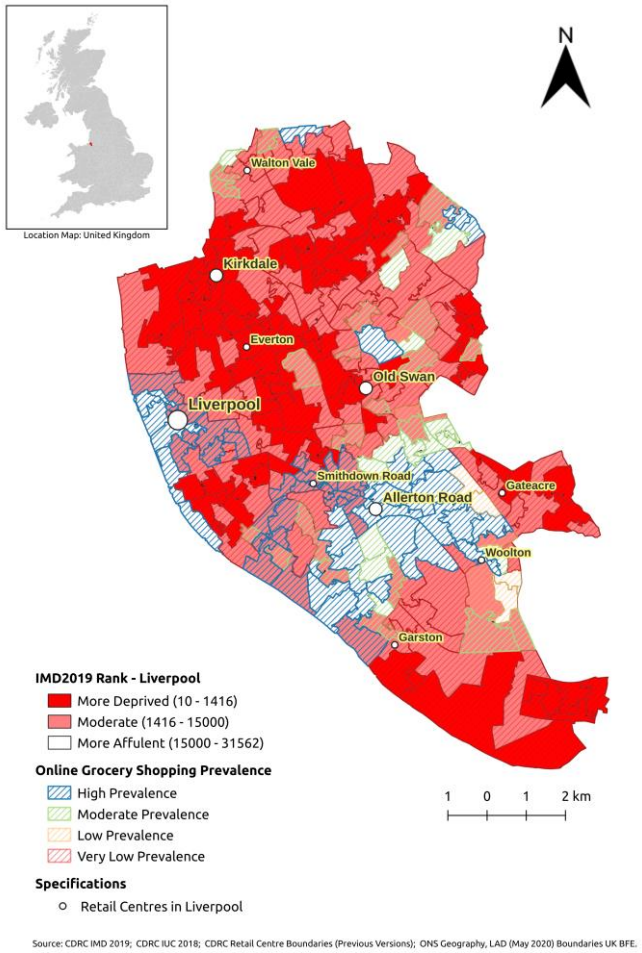

Fig. 3. Deprived areas within Liverpool.

We re-coded Index of Multiple Deprivation (IMD) 2019 data into Three Categories based on IMD Rank. All the LSOAs with IMD Rank greater than 15000 are classified as More Affluent, and LSOAs with IMD Rank greater than 10 and less than 1416 are classified as More Deprived. Regional Mean for IMD Rank is 7023 with standard deviation of 7915. So, Cutoff for More Affluent LSOA is kept at 15000.

The Most Interesting point in this map is that there is no LSOA which has High Deprivation and High Online Grocery Shopping Prevalence.

Foodstores 2023 Catchments

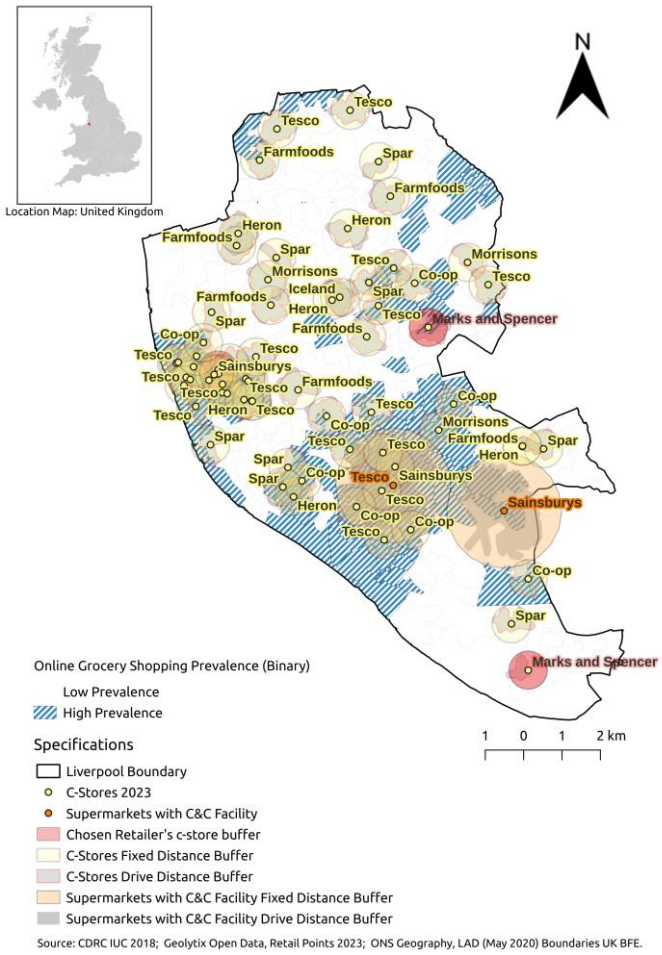

Fig. 4. Foodstores catchments in Liverpool.

Foodstores 2023 data from Geolytix Open Data, we filtered all c-stores and supermarkets with Click & Collect Facility. We plotted Fixed and Drive Distance Buffers for filtered retail points. To understand competition, we highlighted Chosen Retailer with red colour, and overlayed store's catchments with Online Grocery Shopping Prevalence map (Binary).

Daytime Population 2020

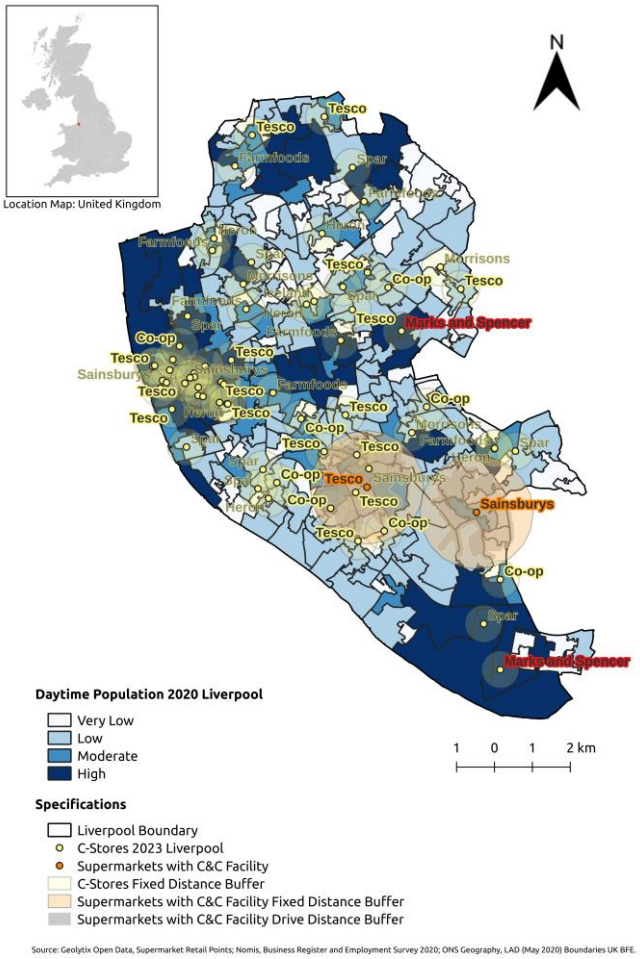

Fig. 5. Daytime Population 2020 in Liverpool.

We collected employment data from Business Register and Employment Survey 2020 and plotted daytime population for identifying LSOA's which have High Working Population. Regional Mean for Work Population is 861 with standard deviation of 2579. There is extremely high variation in the daytime population. So, Cutoff for High Daytime Population is kept at 900. We overlayed with foodstores fixed distance buffer to understand competition. Retailer who has more than 10 c-stores are only highlighted expect Chosen Retailer for ease of readability.

Density of Households (Census 2011)

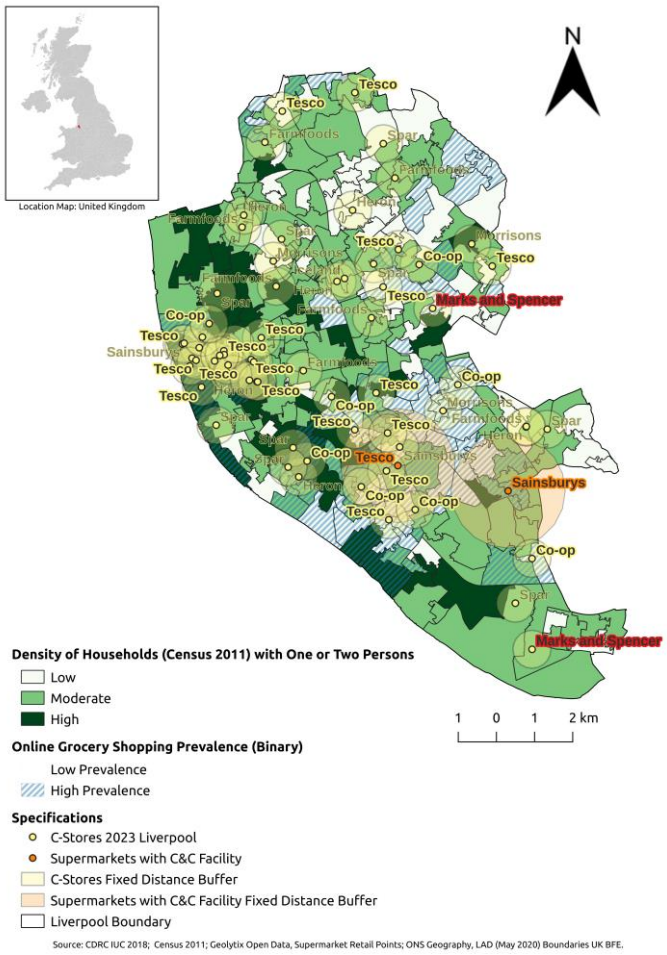

Fig. 6. Density of Households with 1 or 2 persons in Liverpool.

We collected Household Size data from CDRC Geodata Pack, Census Residential Data Pack 2011: Liverpool, and plotted density of households with one or two persons for identifying LSOA's which have small households. Regional Mean for Density is 474 with standard deviation of 157. There is some degree of variation in the Household Data. So, Cutoff for High Category is kept at 650. We overlayed with foodstores fixed distance buffer to understand competition. Retailer who has more than 10 c-stores are only highlighted expect Chosen Retailer for ease of readability.

Optimal Site for C-Store

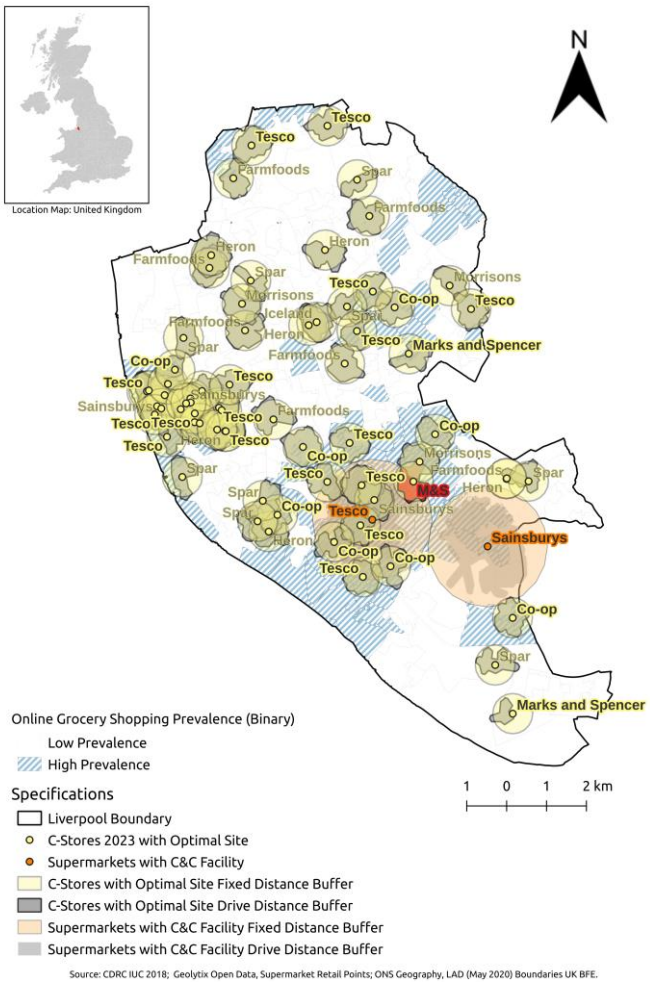

Fig. 7. Optimal Site for C-Store (Chosen Retailer) in Liverpool.

Finally, considering all factors into account, best site for new c-store proposed. It is near Liverpool Hope University, beside conference centre on Taggart Ave Rd. Coordinates in British National Grid format are 340645.96 E, 388487.65 N.

Results

1. From IMD 2019, There are 52 LSOA's which are more Affluent, 100 LSOA's which are more deprived and 146 LSOA's are Moderate out of 298 LSOA's of Liverpool, based on given classification.
2. From IUC 2018, There are 61 LSOA's which have High Online Grocery Shopping prevalence out of 298 LSOA's of Liverpool.
3. From IMD 2019, Food stores catchments have working population of 1054 people and residential population of 1622 people.
4. From Nomis Business Register and Employment Survey 2020, Food stores catchments have working population of 1005 people, but has standard deviation of 2869. So, there is extremely high variation in this dataset. This variation makes this dataset unreliable for consideration.
5. For New Site, Fixed Distance Catchment have working population of 900 people from IMD 2019 Data. Also, From Nomis Data, Work population in LSOA of New Site is 1230. This makes our new C-Store attract more customers.
6. Our New Site is located near Liverpool Hope University and there is a huge opportunity, because there is no c-store of any retailer near to university and in that LSOA.
7. In addition to that, there are 5684 student enrolments in this University as of November 2023 (Liverpool Hope University, 2023).
8. There is no LSOA with high online grocery prevalence has IMD rank less than 2628 (more deprived areas).

Table 1

Different Metrics with LSOA and Catchments Values

LSOA and Catchments Values					
Metrics	LSOA of New Site	New Site's Fixed Distance Catchment (Mean)	New Site's Drive Distance Catchment (Mean)	All c-stores and Supermarket with C&C facility (Mean)	Regional Mean (Liverpool)
IMD 2019 Rank	31562	26379.3±2738.4	26721.1±2669.9	7710.0±8258.5	7023.4±7914.6
IMD 2019 Inc Score	3.93	0.042±0.012	0.041±0.012	0.224±0.130	0.236±0.129
Daytime Population 2020	1230	445.8±414.2	450.0±383.6	1005.6±2869.0	860.5±2578.9
Work Population (IMD 2019)	1094	900.8±115.2	899.5±106.7	1054.4±442.3	1032.4±405.4
Residential Population (IMD 2019)	1702	1586.2±125.8	1595.3±118.6	1621.6±416.3	1609.8±393.4
Density of Households with One or Two Persons (Census 2011)	242	338.5±59.1	333.4±56.1	480.7±162.4	473.8±156.4

Source: Calculations based on Census 2011, IMD 2019, Nomis 2020

Note: All c-stores and supermarkets catchment's values are calculated based on Fixed Distance Buffer only, All Values: Mean ± Standard Deviation.

Picture of the Site

Fig. 8. Optimal Site for C-Store (Chosen Retailer) in Liverpool. (Google Maps, 2023)

Conclusions

There will always be uncertainty in any predicated model, for example, we considered datasets from different timelines, which introduces temporal inconsistencies. We calculated catchments characteristics on Fixed and Drive Distances, but average values are calculated solely count-based. It considered all queen neighbourhoods into average calculations. This will inherent another type of uncertainty. However, Site is Proposed by seeing huge opportunity in that LSOA, because there is no c-store of any retailer near to Liverpool Hope University. This can huge opportunity for new c-store of chosen Retailer.

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