# Evaluating the impact a restaurant aggregator might have on a UK National Restaurant Chain and with that impact in mind consider whether prevailing retail theories apply in the online world.

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Supervisor: Nick Bearman

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## DEPARTMENT OF GEOGRAPHY

**MSc in Geospatial Analysis**

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## ABSTRACT

The UK restaurant industry is estimated to be worth £21.3bn. In recent years it has benefited hugely from changing eating habits and in particular has experienced an enormous expansion of food deliveries. This has led to the rise in ordering food for home delivery by way of smartphone apps. In 2013 Deliveroo launched its app through which it is now possible to order food from around 22,000 restaurants.

This dissertation seeks to examine what impact Deliveroo might have on the industry through the activities of one particular UK national restaurant chain. Its focus is twofold; a) identify whether this impact will be an increase or loss of sales, and b) examine whether it is possible to develop a spatial model to use as the basis of allocating to restaurants any additional revenue derived from sales through the Deliveroo app. Deliveroo and its competitors (commonly known as Aggregators) have the potential to disrupt the UK restaurant market. With this in mind it is necessary to examine whether prevailing retail theories are relevant to the online world and how, if at all, there are any differences when compared to the real world.

Academic literature is explored to better understand prevailing retail theories. These focus on the relationships between the time and cost of travel over distance. The paper concludes that these factors remain important in the online world, but the relationship between them is different to the real world. It also demonstrates how behavioural economics is at the heart of Deliveroo's algorithm.

The dissertation concludes that Deliveroo has the potential to disrupt sales substantially. There are two impacts; a) the risk of sales cannibalisation (i.e. causing existing sales to be channeled in future through apps), and b) the risk that existing customers may choose to order food from competing restaurants. It also demonstrates that the risk of loss is mitigated by the possibility of increased sales. The dissertation demonstrates that GIS algorithms, such as polygon-to-points and nearest neighbour analysis, can be used to create financial models for allocating revenue.

This dissertation is essentially seeking to identify some of the dynamics at play between the physical and online worlds. It is an area of study that has not yet attracted much academic attention and in the conclusion a number of suggestions for further study are identified.

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| | |
|---|---|
| “DSA” | Means Deliveroo’s Service Area |
| “GIS” | Means Geographical Information Systems |
| “LSOA” | Means Lower Layer Super Output Area |
| “NRC” | Means National Restaurant Chain |
| “QSR” | Means Quick Service Restaurant |
| “TZ” or “TZs | Means Trading Zone or Trading Zones |

# 1. INTRODUCTION

The UK restaurant market is, by the end of 2019, estimated to be worth £21.3bn (Full-Service Restaurants - UK Market Research Report 2019). It employs 614,100 people in around 72,500 restaurants, (Ibisworld 2019). It is an industry that is characterised by a large number of single site operators, but many of the restaurants are branded regional and national chains organised on a franchise model.

The industry has benefited hugely from recent changes in eating habits; PwC's research estimates that "*People now eat out more often and for a wider range of occasions*" (Picewaterhousecoopers, 2019), and according to Office for National Statistics ("ONS"), in 2018 the average weekly household expenditure on restaurants (and hotels) was £49.60, representing 9% of total household expenditure (ONS 2019).

Along with market growth as a whole has been the expansion of the food takeaway market and within that the food delivery sector. According to the 2018 Food Service Delivery Report, the food takeaway and food delivery sector was worth £8.1 billion in 2018. Sixty percent of UK adults are active delivery users who, on average, order two times per month and spend £9.47 per head per order (Malley, 2019).

Until recently consumers wishing to order a delivery will have had to have phoned the restaurant of their choice, placed their order and the restaurant would then have delivered it; some more sophisticated restaurants might have had the capability to accept orders placed via their website. This began to change with the launch of the non-restaurant branded apps offering takeaway ordering service (Just EAT, founded in 2005). At the time the restaurant delivered the meal; this service was therefore limited to restaurants who already were able to deliver.

After 2013 a new generation of operators launched their apps (Deliveroo in 2013 and UberEATS 2014). These new generation of operators, known as Aggregators, have a different business model; they provide an ordering and delivery logistics service to restaurants who do not have their own. Through the use of algorithms Aggregators have the potential to overturn the current dynamics of the home delivery service as

well as to exert a major influence in the way consumers purchase takeaway meals.

The question that this paper seeks to address is what impact Aggregators might have on one particular national restaurant chain (which for confidentiality reasons will be referred to as “NRC”), will this impact result in increased or lost sales and is it possible to develop a financial model that allocates income from increase sales proportionally to restaurant operating in overlapping Trading Zones (“TZ” or “TZs”). It will aim to answer the question by looking at the food delivery service area (i.e. the physical area in which food deliveries take place) of one particular Aggregator (i.e. Deliveroo) and model this using spatial data provided by NRC. It also aims to put Deliveroo’s activities into the context of prevailing academic theories on retailing in order to examine whether Aggregators have the potential to overturn or to merely require theories to be updated.

The structure of this dissertation is as follows: the introduction outlines retail theories as well as relevant economic theories; the methodology section describes the approach adopted through which the results were obtained. The discussion section revisits the results in the light of potential limitations with the study, and areas for suggested further work are identified. Final observations are presented in the conclusion.

# 2. LITERATURE REVIEW

## 2.1. Introduction.

As outlined in the Introduction, changes in the way the food delivery market works have the potential to disrupt the UK restaurant market. With this in mind it is necessary to examine whether prevailing retail theories will still apply to the market once this wave of disruption is completed. It is also worth reflecting on what academic literature says about how GIS techniques have been used to help business managers identify the optimum locations for restaurants. These ideas are explored through the following sections; sections 2.2 and 2.3 covers retail, economic, behavioural and location theories through the broad language of economics, namely supply and demand side theories; section 2.4 identifies examples of papers that focus on how GIS has been specifically applied to address location issues; and section 2.5 looks at how GIS is at the heart of the activities of Aggregators.

## 2.2. Supply Side Theories.

### 2.2.1. Retail Theories.

General theories on retailing were first postulated by Christaller (1933), subsequent to which developed into four, now widely accepted concepts, namely, i) Central Place Theory (Christaller, 1933), ii) Principle of Minimum Differentiation (Hotelling, 1929), iii) Spatial Interaction Theory (Reilly, 1929 & 1931) and iv) Bid Rent Theory (Haig, 1927). As the last of these, (Bid Rent) is less about retailing and more on land values as a whole this is best explored in the section on Economic Theories.

All these theories have a very similar moral and socio-political grounding, namely they assume that "*people are rational, utility-maximising decision makers and that economic activity takes place in freely competitive, equilibrium-seeking contexts or settings*" (Brown, 1993: 186). This underlining presumption has been proved time and again not to be the case and as such there are two factors to consider. The first is that in UK retailing decisions are constrained by planning law that "*ensures that*

*the right development happens in the right place at the right time, benefitting communities and the economy*" (Department for Communities and Local Government, 2015: 3) and the second is that behaviour, particularly in the restaurant market is as much influenced by emotion, "r*estaurants attract customers on factors such as price, cleanliness, service, cuisine type, and food quality*" (Prayag et al., 2012: 4) as it is by rational decisions. Notwithstanding their weaknesses the four original theories continue to have some validity, and therefore they need to be examined in more detail.

Central Place Theory works on the presumption that all consumers have the same demand, have the same level of purchasing power and are all fully informed. Christaller (1933) postulated that a) there must be a minimum level of demand for a service to be made available, b) demand decreases as the distance, when measured in the cost of travel, increases and c) due to the time-cost effect of travel, customers will choose the nearest centre that provides the services they are looking for. By way of example Christaller proposes that shoppers for more expensive goods will be prepared to travel further than for cheaper ones. Christaller goes on to state that as a consequence there will be far fewer sellers of luxury goods than utilitarian ones. Therefore, by extension to the restaurant market, restaurants need a catchment area (Brown, 1993) that is located "*within acceptable travelling distance for consumers*" (Prayag et al., 2012: 3)

Restaurants are ubiquitously located and exhibit a clear clustering pattern on any high street, or Central Business District; clearly seen in Prayag's paper on "Restaurant Location in Hamilton, New Zealand" (Prayag et al., 2012). Why might this be the case? To answer this question, it is worth examining the second of the three classic retail theories, namely Hotelling's (1929) Principle of Minimum Differentiation. This introduced the idea that "*proximity to rivals is more important than proximity to customers*" (Litz et al., 2008: 4). Hotelling explores the idea that physical (location-specific) agglomeration is critical to the success of any one individual restaurant because once a potential diner has absorbed the travel costs, and decided in what restaurant they wish to dine, the clustering of restaurants in a city centre or an out of town shopping mall makes it easier to compare one

restaurant offering from another. Furthermore Nelson (1958) also postulated that clustering actually leads to increased sales; what this might mean in an online restaurant market is examined in the results section.

The Law of Retail Gravitation is a model that introduces the idea of the deterrent effects of distance (Brown,1993.) This idea was first introduced by Reilly (1929 & 1931) who stated that under "*normal conditions* [where] *two cities* [are identical] *they will draw trade from an intermediate city* /[location] *in direct proportion to their populations"* (Reigadinha et al., 2017: 2). In other words, consumers are subject to the same gravitational forces as Newtonian physics (Brown, 1993). This approach suggests that there is a dynamic at work whereby the attractiveness of a location is a function of the product and services on offer and that a consumer will intrinsically and implicitly trade off this attractiveness against the distance they have to travel (Litz et al., 2008). Prayag et al., (2012) suggests that a consumer might trade off travel related factors such as access to transport modes (train and bus stations and other road transport) with restaurant related location factors such as ambience and atmosphere, (Teller & Reutterer, 2008), parking (Austin et al., 2005), as well as type of cuisine, reputation and brand name (Kivela, 1997; Yuksel & Yuksel, 2003).

2.2.2. Economic Theories.

In this section the relevance to the restaurant market of four economic theories will be examined; namely i) Bid Rent Theory, ii) Agglomeration Theory, iii) Hedonic Pricing and iv) Behavioural Economics.

Bid Rent Theory was first introduced by Haigh in 1927. It proposes the notion of the market value of land and how this impacts its usage. Although it is largely silent on differentiating market forces of one retail sector over another it does recognise that businesses with a need to attract a wide customer base or "*the entire urban area*" (Brown, 1993:13) have to pay a higher price for the land. What is not clear from Haigh's writings is what is the relationship between prices charged for goods and the price paid for land. In other words, does a high cost of land result in a high product cost, or does the desire to offer a high priced offering require a wide consumer base, and therefore mandate the location in as central a location as possible. Nonetheless

there would appear to be an implicit connection between this theory and Central Place, and it is certainly the case that centrally located dine-in restaurants are able to command high prices.

There continues to be some substantial debate as to the significance of location as a factor in the success of a restaurant; Pillsbury (1987) stated that it is the single most significant factor, whereas in the research performed by Lussier (1996) it failed to make it in the top ten factors.

With this in mind what does Agglomeration Theory add to the debate? Although not explicitly evident in the early writings, much of retail theory has its genesis in Agglomeration Theory. Marshall (1890) stated that firms cluster as a result of exogenous externalities and endogenous externalities. Exogenous externalities broadly refer to what would now be considered as infrastructure (such as transport nodes) and amenities, (such as shopping centres). Endogenous externalities refer to the benefits arising from a reduction in the costs of production as a result of agglomeration. In a low-tech sector, such as the restaurant business, production costs are less significant than in other sectors but they still have a role. Endogenous externalities also include customer search costs (Jung & Jang, 2019). Canina (2005) goes further on this point by suggesting that the prime reason for geographic clustering is that it reduces customer acquisition costs. This is certainly consistent with the Principle of Minimum Differentiation whereby aggregation makes it easier to compare one restaurant offering from another and thus supports Nelson (1958) that clustering actually leads to increased sales.

Clustering is all about attractiveness to customers, and Central Place Theory argues that customers will travel further for more expensive goods than cheaper ones, (Christaller, 1933), but Lussier's (1996) research confirmed that the price of a meal was not one of the top ten reasons for a restaurant's failure.

Hedonic pricing (Lancaster, 1966) is a theory that suggests that in the minds of the prospective consumer there is a trade-off between the emotional value of a good or service and its economic value. Knutson et al., (1996) and Jung & Jang (2019) have applied this theory to the restaurant market and their research identified that

consumers are willing to pay more for what they perceive to be a better quality offering, and they conclude that restaurants that offer fine dining are able to charge higher prices than quick service restaurants[2]. These factors have the potential to influence the catchment area of each restaurant which can result in different clustering patterns for different restaurant segments. Dine-In restaurants with a higher priced offering have the potential to attract consumers from a wide area (as per Central Place Theory), have the potential to generate greater revenue and thus able to pay a higher price for the land. The result will be gravitation towards more expensive urban centres as per Bid Rent Theory. Customers whose focus is on the price of the goods over the emotional value will gravitate towards restaurants with a lower price offering, such as quick service restaurants. This has the effect of producing potentially lower revenue generation capabilities and therefore giving rise to the need for a lower cost base, all of which will result in clustering in those areas where land is cheaper, often arterial roads and areas of lower socio-economic status (Streichert et al., 2009.)

### 2.2.3. Location Theories.

One aspect of GIS is about interpreting the world through maps and through emphasising the importance of geographic location. We therefore need to examine what writings there are about location, what these have to add to economic and retail theories and what it might have to say about restaurants.

A good place to start is to examine the work of Pillsbury (1987 & 2010). Pillsbury's critique of retail dynamics is that past research has been too focused on distance, (i.e. Central Place, Principle of Minimum Differentiation and Law of Retail Gravitation), but it is not the prime driver in economic theories. Pillsbury argues that retail theories do not include what he calls location dynamics. Pillsbury also suggests that location dynamics differ significantly according to what type of dining is being

[2] A quick service restaurant is one largely provide a take-away offering, whereby customers order on site and then take away to consume elsewhere.

considered. Although the study was based on research undertaken in Atlanta in the mid 1980's it has ramifications for this paper because while general retail theories and economic theories may be of use at the macro level, they are of limited practical managerial and strategic value to restaurant operators whose focus is to consider the dynamics of the particular market segment in which they are operating.

Pillsbury's (1987) work suggested that at the heart of the success of a restaurant are certain basic locational criteria, and these relate to the interplay between accessibility, consumer goals, ambience and socio-economic factors. Pillsbury is of the view that clustering arises as a result of understanding the interplay of these factors, not a driver of them. Pillsbury's notion of accessibility is unlike other theories; in particular, with reference to Agglomeration Theory, access is not in terms of geographic distance, nor the idea of the interplay between cost-travel, but rather as the "*perceived difficulty of reaching or accessing the services of an individual store*" (Pillsbury, 1987: 16); a good example of this at work would be the deterrent effect of having to queue for a fast-food meal. The notion of service access relates to understanding and being able to tap into the reasons behind a choice to dine; an example might be two people dining in the same restaurant will be there for very different reasons and will have very different perceptions of the offering and of the ambience.

The idea of accessibility resonates in the earlier work of Smith (1985), whose research confirmed the importance of major arterial roads in the site selection criteria for fast food restaurants, and in the importance of parking facilities (Tzeng et al., 2002), and in "*visibility of premises and the presence of other complementary businesses"* (Schaefer et al., 1996: 4)

### 2.2.4. NRC, Deliveroo and Supply Side Theories

Both NRC and Deliveroo are on the supply side of the economic equation; NRC's business is the provision of physical restaurants where customers can dine-in or order food to be delivered to them at home; Deliveroo is in the business of supplying online access to restaurants from whom customers can order food for delivery. The

discussion section will consider to what extent supply side theories can be seen to be working in practice.

## 2.3. Demand Side Theories.

If location, retail and economic theories can be considered as influencers on the supply of restaurants, Behavioural Economics can be seen as providing some ideas around the influencers on the demand side of the equation.

### 2.3.1. Behavioural Economics.

As previously touched upon, the weakness of traditional theories is that they assume the consumer to be fully "*rational and fully informed*" (Brown 1993: 14) and that the market is operating in "*freely competitive equilibrium*" (Brown 1993: 3)

Hedonic pricing models refute the idea that the consumer is rationale, and the work of Jung & Jang, (2019) and Knutson et al., (1996) demonstrate how the trade-off between economic and emotional value influences choice. Thaler (2015) explored the idea of hedonic pricing further by suggesting that irrational behaviour influences choice and that value is relative rather than absolute; these notions developed into the concept of behavioural economics (Samson, 2018). This can be seen at work within the buying patterns of restaurant consumers: Prayag, et al., (2012) emphasises the significance of travel time, Teller et al., (2008) suggests ambience and atmosphere, Kincaid et al., (2010) suggests cleanliness, service, and food quality; all of these factors have relative values according to individual perceptions, motivations and physiological needs. Hsu SH et al., (2018) took these ideas further by correlating Maslow's hierarchy of physiological needs (Maslow 1954) to behavioural economics. It is clear from these studies and from academic research that individual perception of the price of a meal is a relative notion, and that other factors are far more significant in a dining choice. This is backed up in Lussier's (1996) work on restaurant failure, namely that price is not a determinant in success of the business.

### 2.3.2. Behavioural Mapping.

Where hedonic pricing models look at the interplay between the clustering ideas at the heart of central place, Thaler (2015) takes the ideas inherent in hedonic pricing further to suggest that irrational behaviour influences choice. How then can these irrational, subjective decisions be quantified? This is where the idea of behavioural mapping comes in. According to Cheuk Fan Ng (2016) behavioural mapping is a means of observing and recording behaviour at a set time and location. With specific reference to restaurants, Zhai et al., (2015) looked at social media comments on such things as food quality, decorations and service quality to determine the popularity of any one particular restaurants; these are exactly the factors that Prayag, et al., (2012) and Kincaid et al., (2010) considered to be significant. Zhai's work has made a valuable contribution to the debate on what influences demand for a particular restaurant.

### 2.3.3. NRC, Deliveroo and Demand Side Theories.

Customers who order food online have some of the same behaviours, motivations and physiological needs as do customers who eat at physical restaurants. This paper aims to uncover whether Deliveroo has identified what those needs might be and whether behavioural mapping occurs in practice.

## 2.4. GIS as a Management Tool.

### 2.4.1. Competitive Location Modelling.

For as long as companies wish to expand business managers will be faced with the challenge of identifying the optimum location for additional outlets in such a way as to minimise the impact this will have on existing ones.

Furthermore, in the restaurant market where chains are run on franchising principles there is the added challenge of balancing the competing interests of the franchisor (whose aim is to expand the business as a whole) and the franchisee (whose desire is to maintain or even expand his own market share) (Schneider et al., 1998).

Franchise contracts usually contain non-compete or revenue sharing clauses but do not necessarily impose restrictions governing the ability of franchisors to expand within their territories. Nonetheless many franchisees believe they have lost business as a result of cannibalization from new units in the same chain. (Drezner, 2011)

According to Suarez-Vega, et al., (2012) Competitive Location Models are used to "*represent the interrelationship between decision makers*" (Suarez-Vega et al., 2012:1). Location modelling can be used to identify optimum sites for future retail outlets by identifying sites that represent an expansion while at the same time minimise the risk of cannibalisation of sales. The work focuses on the interrelationship between maintaining market share and mitigating lost sales when the new entrants appear. The model assumes that the existing market participants and the new ones are broadly selling the same thing. In the case of Aggregators, the competitive dynamics are quite different; by offering to provide delivery logistics the Aggregators are acting as a provider of an outsourced service and thus are an extension to the business. At the same time by providing an online platform through which other restaurants are able to showcase their offering they are also acting as a competitor.

Suarez-Vega (2012) represents catchment areas through a series of concentric circles around each store, and the overlaps between them illustrate the zones of possible cannibalisation. This approach is relatively easy to replicate and has a valuable contribution to make even though real-world catchment areas are not uniform circles; they have to allow for natural features such as rivers, as well as the composition of the road layout, where for example the existence of a main road can significantly distort access and therefore the overall catchment area shape.

2.4.2. As a Management Tool.

Viswanathan (2005) is of the view that GIS is a vital tool for any marketing department, and states that *"geography is important to marketing since supply and demand vary with space* [and that] *points of supply and demand are spatially separate*" (Viswanathan 2005: 237). Furthermore, of particular interest to a

marketing department will be the location of competing interest and the ability to visualise catchment areas.

Given that restaurants are intrinsically spatial, and that according to Pillsbury, (1987) location, location, and location are the "*three most important ingredients for success in the restaurant trade" (*Jung & Jang, 2019:1) how then can GIS be best used in the restaurant business? Is it just a static tool to plan the initial location, or is it a dynamic tool that can be used at the heart of the organisation to drive informed decision making and thus enhance economic value? Given that GIS is a combination of database manipulation, spatial analysis and mapping (Hackbarth et al., 2005), what then does this mean for the restaurant business and how might GIS be used? The organisation as a whole will need to have an inventory of the restaurant locations, the finance department will want accurate information on the physical spatially located assets of the company, the sales department will want details on the sales for each of its TZs, and the marketing department will use it for tracking the socio-demographic characteristics of its customers, for analysing competitors, for segmenting the market, and visualising catchment areas.

2.4.3. Applying GIS Techniques in Practice.

The ultimate objective of this paper is to establish whether GIS can be used to answer two business management questions, and in so doing support or challenge the statement that "*Geographical Information Systems are an extremely useful tool for analysis and decision-making in a wide variety of situations*". (Hanada et al., 2010:1). The answers to the two questions are presented in the results section.

2.5. Network Analysis and its Relevance to Aggregators.

Without GIS applications, and in particular routing algorithms, the success of Aggregators would not have been possible. At the heart of their success has been their apparent ability to solve the problems associated with dynamic courier routing, (Steever et al., 2019), and dynamic pickup and delivery times (O'neil et al., 2019). Deliveroo uses a routing algorithm that takes the GPS co-ordinates of the customer's

chosen delivery location, and those of the nearest restaurants to provide individual delivery and waiting times (Iqbal 2019). Once the order has been placed it is then routed to the selected restaurant and when ready to be collected couriers within the delivery zone will be notified. As couriers are paid piecemeal they have the option of agreeing to the order or not, and if they choose to accept it, they will be presented with an optimum route map. Within this mix there are multiple variables, and these include the following: i) not all the couriers are available all the time, ii) each customer has a different location, iii) actual delivery times will vary during the day according to the traffic conditions, and iv) restaurants have different cooking times.

Through the collation of huge volumes of data on purchasing behaviour, Aggregators will soon be able to accurately manipulate data on customer orders, to construct dynamic behavioural maps and thus be able to accurately identify behavioural patterns. This is likely to lead to the active influencing of purchasing decisions. The results section examines how this might be happening in practice.

2.6. Summary.

There is a rich heritage of academic literature on retail theories, location theories, and economic theories, and these can be applied to restaurants. However, in one respect restaurant dining is very different to other retailing because at the heart of consumer demand is a function of individual emotions, perception and different priorities; Aggregators are becoming very good at exploiting these priorities and are now a significant competitive force.

The Aggregators are threatening the restaurant delivery market through the exploitation of GIS and have created a consolidated virtual market place where the time-cost of physical travel is less important than the delivery times, where physical market place is no longer important and where choice is key.

There is limited academic literature on Aggregators, how they might impact the restaurant industry as a whole or on anyone particular restaurant sector. This paper has two specific question to address and will aim to answer them through applying

GIS techniques while doing so within the context of prevailing theories on retailing. In so doing it hopes to go towards filling some of the current gaps in the literature.

# 3. METHODOLOGY

## 3.1. Introduction.

This chapter outlines the data used to answer the research question, together with it's source and outlines the processes through which the results, (as discussed in the next chapter) have been obtained.

## 3.2. Sources of Data.

### 3.2.1 Restaurant Locations.

NRC operates across the UK through a franchised network of restaurants that either operate a delivery only service ("Delivery") or a full dine-in service ("Dine-In"). The data provided by NRC includes information on the city and co-ordinates of each restaurant, and whether the restaurant is Delivery or Dine-In. An example of this data is provided in Table 1 below.

*Table 1. Example of Information Provided for Each Restaurant*

| Brand | Local Store Number | Store Name | Address | City | Region | Country | Channel Type | Latitude & Longitude |
|---|---|---|---|---|---|---|---|---|
| Name of brand. | 754 | Bath | xxx* | Bath | West Midlands | UK | Dine-In | xx.xx* |
| * As this information can be used to identify NRC it has been withheld.<br>Source: Data provided by NRC | | | | | | | | |

### 3.2.2 Deliveroo's Restaurant Network.

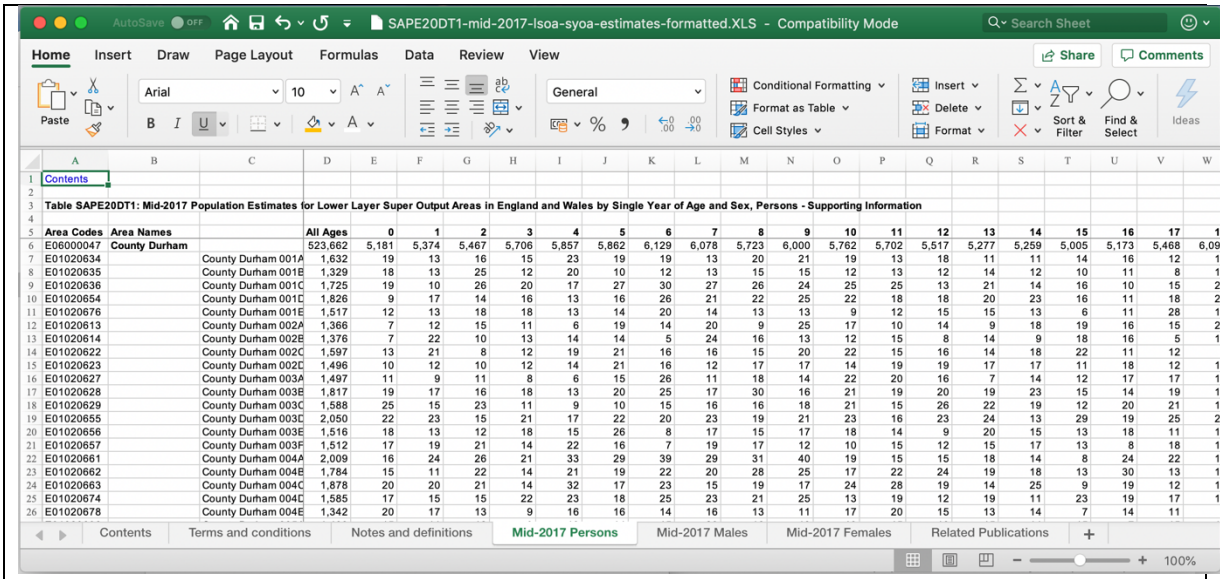
Deliveroo is one of three principle restaurant Aggregators operating in the UK, (the other two are UberEats and JustEat). It is the subject of this study because a) it is the fastest growing aggregator, b) its business model differs significantly from the other two, namely its focus is to provide delivery logistics to restaurants who

otherwise do not have their own, (Warner, 2018) and c) NRC are considering partnering with Deliveroo. Information on the number of restaurants (approximately 24,000) that Deliveroo's currently serves, the type of cuisine offered and their postcodes was obtained by reference to the company's site map[3] The geographical co-ordinates of relevant restaurants were obtained using an online postcode to coordinator convertor[4]. Section 3.4 outlines the sampling methodology in more detail.

### 3.2.3 Population Estimates.

Given that the 2011 census is almost eight years old, the next reliable estimate of current population is the mid 2017 estimate for the Lower Layer Super Output Area ("LSOA") made available online by the Office for National Statistics ("ONS"); an example of this data is provided in Table 2 below.

*Table 2. Population Estimates 2017*



Source: ONS

[3] https://deliveroo.co.uk/sitemap

[4] https://gridreferencefinder.com/postcodeBatchConverter/

### 3.2.4 Market Statistics.

a) Statistics on Deliveroo Market Users.

For the purpose of this study a Deliveroo customer is assumed to be someone who has a smartphone and has downloaded the Deliveroo App. Information on the number of people who have downloaded the app and on its frequency of use is commercial sensitive information. However, it has been estimated that by the end of 2018, Deliveroo would have had 6 million UK downloads and have 45,000 daily users (Iqbal, 2019).

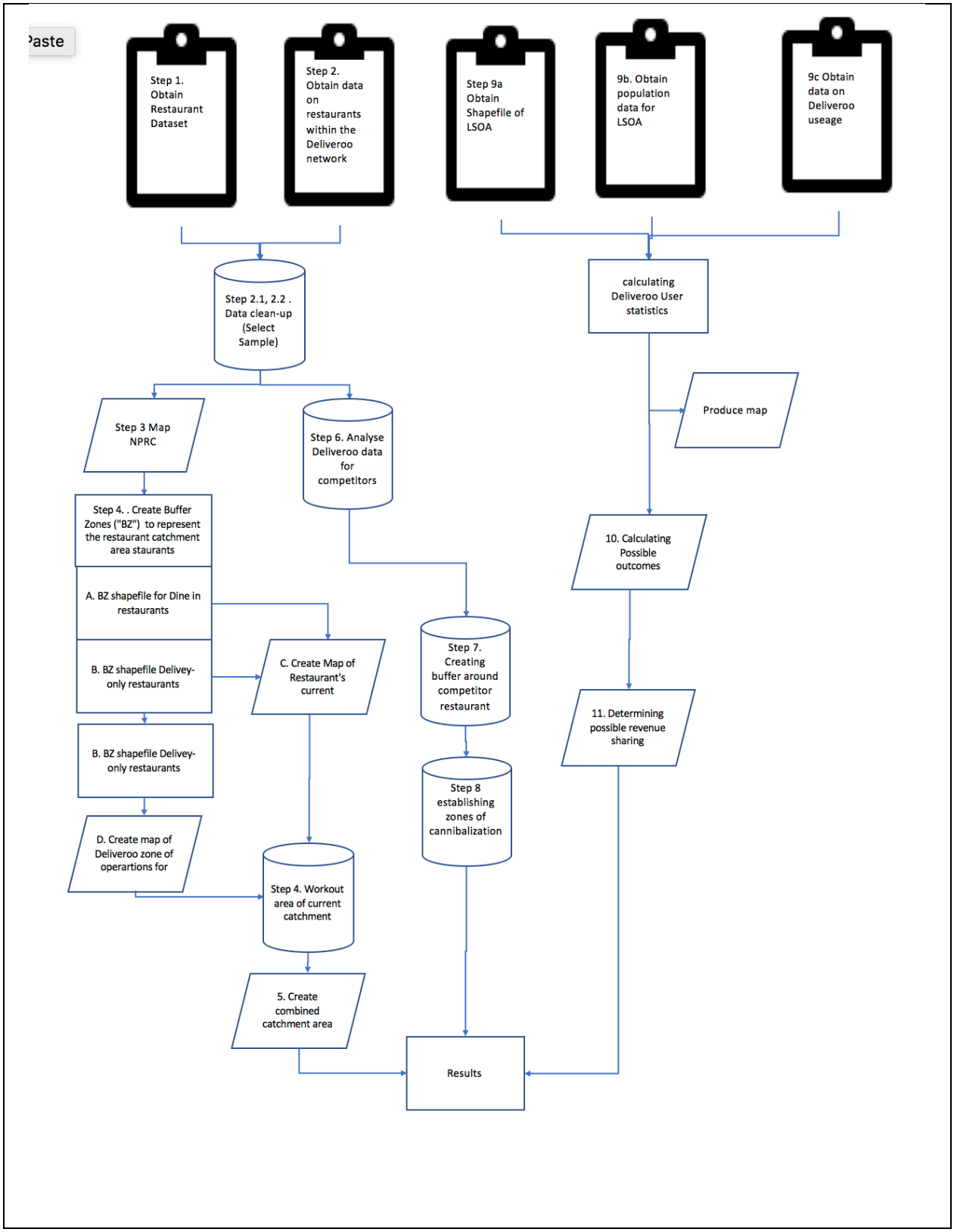
b) Size of Food Delivery Market and the Typical Deliveroo Customer.

The UK food delivery market in 2018 was worth £8.1billion, of which 33% was accounted for by sales of pizzas. (Malley, 2019), and Deliveroo is the third-most popular food delivery service with 23% market share (Gilsenan, 2018.) The typical consumer for ordering takeaways via an app is between 18-35 (Warner, 2018)

3.3. Workflow.

Figure 1 outlines the process used to analyse data sources and return the results.

*Figure 1. Methodology Workflow*



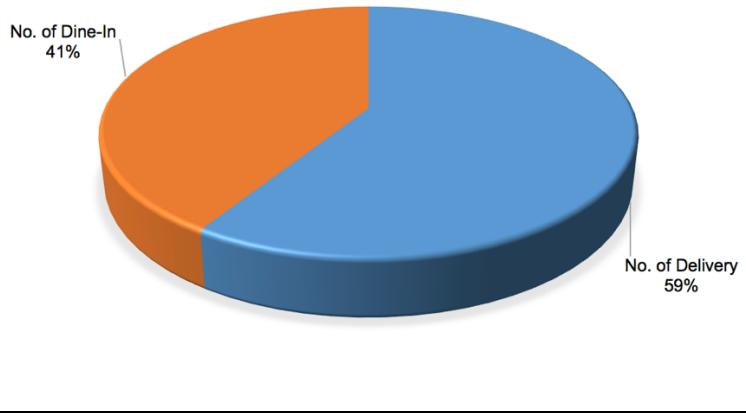
### 3.4. Methodology Further Explained.

Step 1. Manipulating the NRC dataset and compare to restaurants within Deliveroo's Network.

NRC operates a national network of 252 Dine-In and 416 Delivery restaurants, in 340 locations across the UK; collectively known as Channels. Delivery restaurants do not provide a dine-in service, but can deliver to a Dine-In TZ, and most Dine-In restaurants do not provide a delivery service.

Figure 2 illustrates the relative percentage splits for each channel. Referencing this split is significant because each type of restaurant has a different TZ.

*Figure 2. NRC's Restaurants by Type of Offering*




Source: Underlying data made available by NRC

Rather than undertaking this research on the entire network it will be performed on a sample of regional cities across England & Wales containing restaurants that mirror NRC's national split as much as possible. The selected sample need to be cities that were also serviced by Deliveroo. This was established as follows:

The full content of Deliveroo's sitemap was copied into excel and the data then manipulated so as to identify cities serviced by Deliveroo where NRC also had a restaurant. In total 107 locations were identified, from which a list of twelve regional cities were selected, these are shown in Table 3.

*Table 3. NRC Cities Selected for the Sample*

| City | Number of Dine-In | Number of Delivery | Total by City |
|---|---|---|---|
| Bradford | 1 | 2 | 3 |
| Bath | 0 | 1 | 3 |
| Bristol | 4 | 5 | 9 |
| Canterbury | 1 | 1 | 2 |
| Derby | 2 | 3 | 5 |
| Exeter | 1 | 1 | 2 |
| Leicester | 4 | 5 | 9 |
| Norwich | 3 | 2 | 5 |
| Nottingham | 2 | 7 | 9 |
| Oxford | 1 | 2 | 3 |
| Reading | 2 | 3 | 3 |
| Swansea | 1 | 2 | 3 |
| Sub Total by Type | 22 | 34 | 56 |
| % of total | 39% | 61% | |

Source: Data from NRC

Step 2. Creating a map to represent NRC cities selected.

From the location co-ordinates provided by NRC, and using QGIS's mapping software, two shapefiles were created to represent the locations of a) Delivery and b) Dine-in restaurants, (shapefiles S1 & S2[5]). S1 and S2 were each individually combined with the shapefile for Local Authority Districts obtained from data.gov.uk[6] to create two maps representing the geographical locations of Delivery and Dine-In restaurants.

[5] A summary of these shapefiles is available in Appendix A.

[6] https://data.gov.uk/dataset/daaafdcc-f7c7-41ff-80eb-b0b15efd1414/local-authority-districts-december-2017-generalised-clipped-boundaries-in-united-kingdom-wgs84

Step 3. Creating current and future TZs.

Step 3.1. NRC's current restaurant TZ for both restaurant types.

The current TZ for Delivery locations is an 8-minute drive time, and that of Dine-In is a 15-minute drive time. (Anon. 2019 Conversation with CNRK7 May 2019). From these drive time relevant buffers were created by way of QGIS' buffer algorithm using the distances outlined in Table 4.

Using the shapefiles of NRC's locations, (S1 and S2) and the buffer zone measurements two new shapefile were created to represent the 15-minute and 8-minute drive times; (S3 and S4)

Shapefiles S3 and S4 were then combined to create one shapefile (S5) for each city that represents the combined TZs.

*Table 4. Calibration of TZ & DSA Area*

| Restaurant Type | TZ (Minutes from restaurant) | Distance from Restaurant (Miles*) |
|---|---|---|
| Dine-In<br>Delivery | 15<br>8 | 2.5<br>1.3 |
| | | |
| Deliveroo | | 2 |
| *based on average UK traffic speed of 10 miles an hour (Bususersorg. 2019)<br>Source: TZ data from NRC | | |

Step 3.2. Deliveroo's Service Area ("DSA").

Deliveroo's delivery catchment area will throughout this dissertation be referred to as DSA (i.e. Deliveroo's Service Area)

Information on DSA is not easy to establish. Justin Landsberger who was Sales Director of Deliveroo in 2015 said that the company operates to a 2.2km to 2.5km

delivery radius (Mullen, 2015). However, a Deliveroo cyclist has suggested, more recently that 2 miles (3.2km) is the TZ (Bikeradarcom, 2019), and given that 80% of those who deliver are cyclists, this will be the basis for calculating the buffer. Using the buffer measurements in Table 4, a DSA based on the locations of NRC's restaurants was created. The resulting shapefile (S6) illustrates the area in which Deliveroo will be able provide a service to NRCs restaurants.

Step 4 Creating a shapefile of the combined Deliveroo and NRC TZs to determine areas of overlap.

NRC have existing TZs as illustrated by S5, and if they introduce the new DSA (S6) then the question is, to what extent will this expand or overlap the current TZ. In order to answer this question, it is necessary to combine S5 and S6 and calculate the area of overlaps (S7). The area of overlap between S7 and S5 represents the area of possible cannibalisation of sales, namely sales that in the absence of Deliveroo would otherwise go straight to NRC restaurants. For the purpose of this exercise an assumption has been made that Deliveroo will pay the franchisee any revenue collected rather than pay the franchisee direct, (Deliveroocom. 2019).

The areas of overlap were determined by way of QGIS's Clip and Difference Algorithms.

Step 5. Analysing Deliveroo restaurant data to determine possible competitors.

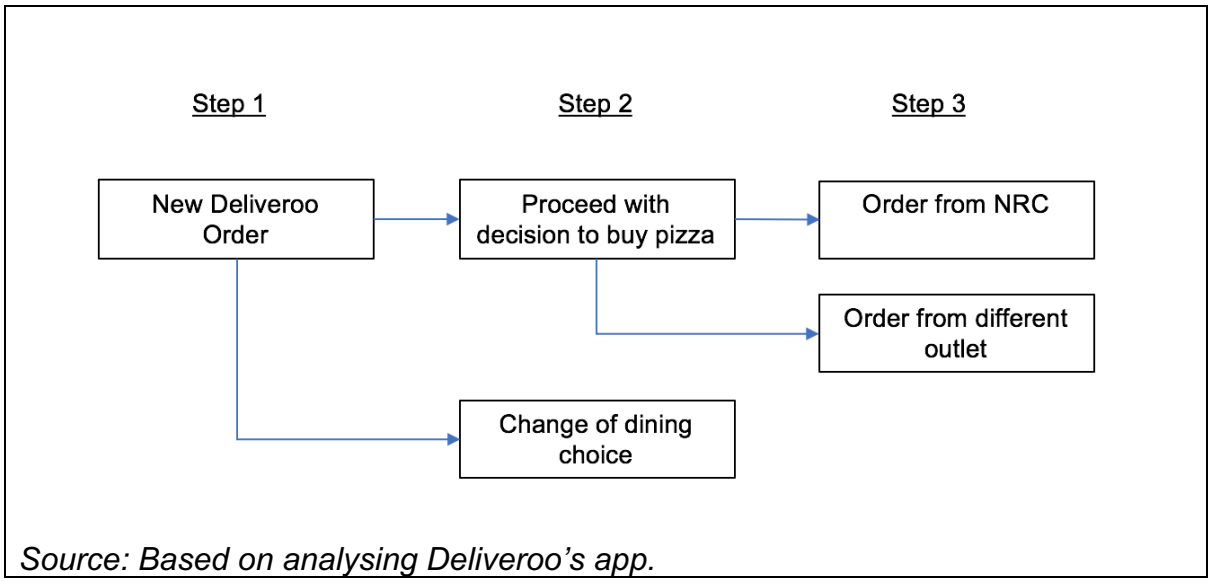
The purpose of introducing Deliveroo is to offer a delivery service to Dine-In restaurants that may not be currently providing it, and to expand the delivery offering to those already doing so. However, Deliveroo also provides a delivery service to other restaurant operators; some of these organisations are recognised by NRC as direct competitors while others are not. Therefore, as soon as NRC's customers are given the option of using Deliveroo to order a meal there is the risk that customers may choose another brand offering the same cuisine or choose different cuisine altogether. The process of choosing is best illustrated in the flow-diagram in Figure 3.

Given how easy it is for a customer to change their mind, it is necessary to consider what the Deliveroo induced competition might look like (see Figure 4). For the purpose of this study a competitor restaurant will have the following characteristics:

- It must be located in one of the twelve sample cities; and
- It must offer one of the following three cuisines; Pizza, Indian or Chinese. These have been selected because according to Statistacom (2019) the three represent 70% of the takeaway market.

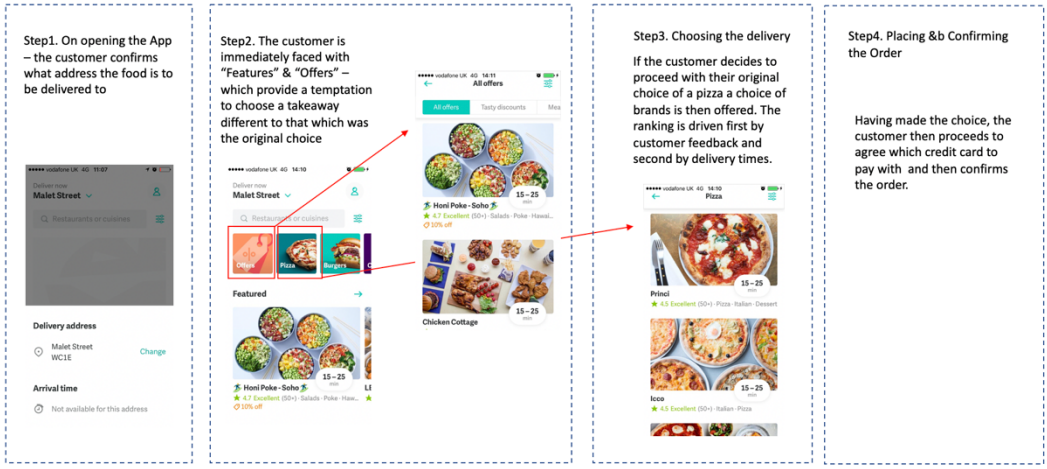
Competing restaurant information was obtained by way of accessing the details of each restaurant on Deliveroo's site, classifying the cuisine type, confirming that Deliveroo still delivers to them, and obtaining the postcodes. This resulted in a total of 285 competitor restaurants across the twelve cities.

*Figure 3. Selecting a Food Delivery from Deliveroo*




*Source: Based on analysing Deliveroo's app.*

*Figure 4. Screen Print of Deliveroo App Illustrating how to Order Food Delivery*




*Source: Pictures from Deliveroo's app, text added by CNRK7 (2019)*

Step 6. Creating a buffer around each competitor restaurant.

The first stage in the exercise was to obtain the co-ordinates of each postcode by way of a batch process via an online conversion tool[7]. A shapefile, (S8) of these co-ordinates was created; this illustrates the location of each restaurant. Using the TZ measurement described in Table 4, buffer zones were drawn around each restaurant to illustrate the maximum distance Deliveroo will travel in order to meet the maximum delivery time commitment made to its clients. The results were then combined with the LSOA map to create a map (S9) showing the location of each competitor restaurant together with the DSA.

Step 7. Establishing a zone of possible cannibalization and a zone at risk of lost sales.

The area of potential cannibalization is assumed to be the area of overlap between NRC's expanded TZ (S6), and the pre-existing TZ area for each channel (S5). This represents the area in which sales that would otherwise go to NRC may now be routed through Deliveroo. The areas of overlap were determined through running

[7] https://gridreferencefinder.com/postcodeBatchConverter/

QGIS's Clip and Difference Algorithms, and a shapefile (S10) of the results was created.

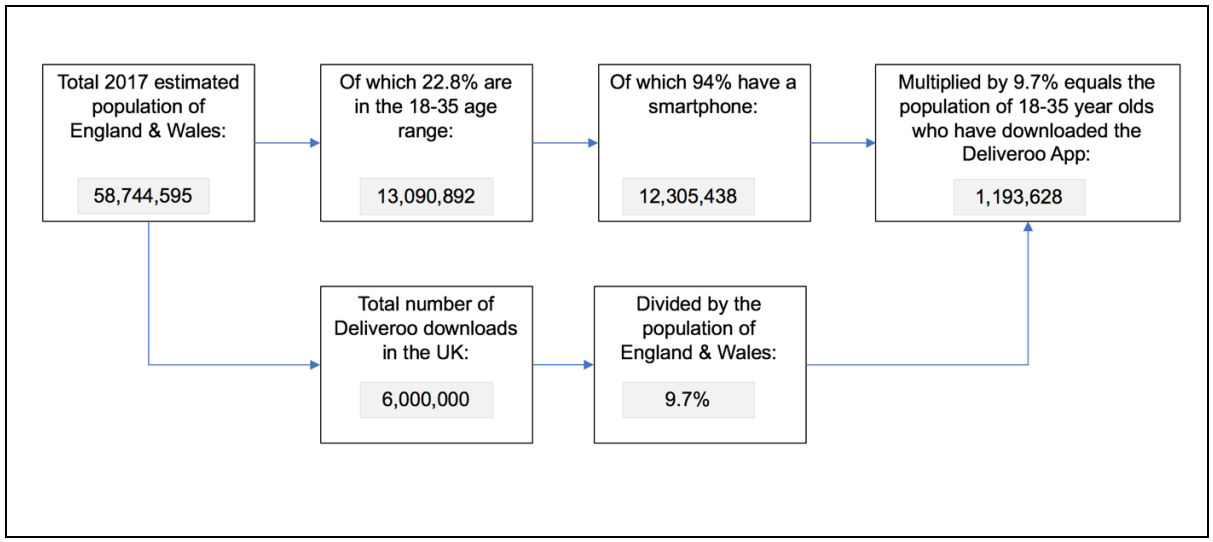
Step 8. Calculating the potential market value of the expanded TZ and zone of possible cannibalisation.

For this step the following has been assumed:

1. The key age profile for users of app based food deliveries is 18–35 year olds (Warner, 2018);
2. 94% of 18-35 year olds, will by the end of 2018 have smartphones (Deloittecom, 2019);
3. By the end of 2018 there will be 6 million downloads of the Deliveroo App in the UK (Iqbal, 2019) representing a 9% nationwide penetration rate;
4. The value of potential increased sales is directly proportionate to the percentage increase in the size of the TZ; and,
5. The value of business at risk to cannibalisation is directly proportional to the percentage of the area of overlap between NRC's previous TZ and the DSA. Further details on this are discussed in the results section.

With this information, combined with the data on population estimates from ONS it is estimated that target population of 18-35 year olds who have downloaded the Deliveroo app is 1.2 million. The calculation methodology is illustrated in Figure 5 These percentages will be used to calculate what might be the anticipated revenue for each of the LSOA areas within the twelve city TZs.

*Figure 5. Methodology for Establishing the Number of Deliveroo Downloads in the 18-35 Age Range.*




Step 9. Calculating the probability of lost sales or cannibalisation of existing sales.

Cognisant of how easy it is for the consumer to change their mind it is worth reflecting on the probability of the various outcomes when using Deliveroo. This probability has ramifications for the business decision as to whether or not to proceed with Deliveroo.

For this exercise a decision tree was used, (see Figure 6), to establish the probability of the outcome to the following five questions:

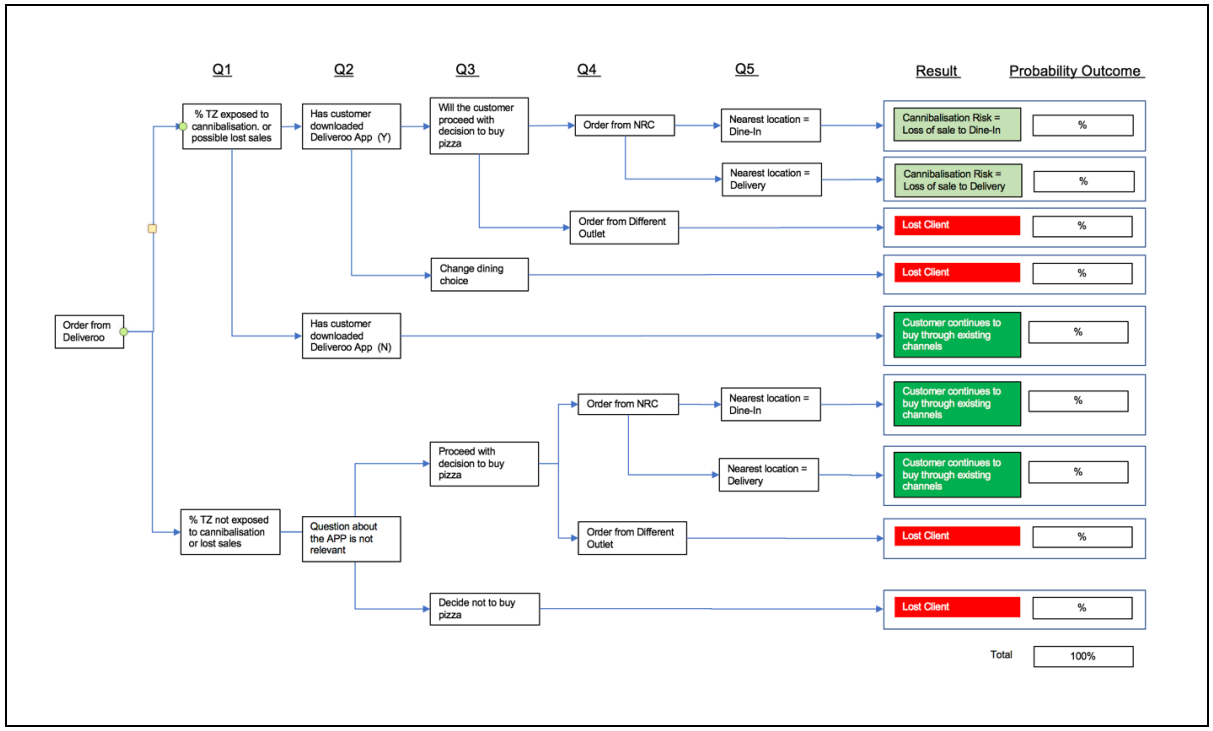
1. What percentage of the TZ is exposed to cannibalisation or lost sales?
2. Has the customer downloaded the Deliveroo App?
3. Will the customer decide to proceed to buy pizza or change their dining choice?
4. Will the customer stick with the NRC brand and,
5. Is the nearest location for Deliveroo to source the food a Delivery or Dine-In store?

The calculations together with supporting assumptions are described in the results section.

Through these questions it is possible to establish the probability of the following outcomes:

- Cannibalisation risk (to Delivery or Dine-In);
- Risk of lost sale (to a competing restaurant); and
- Customer continues to buy through existing channels.

*Figure 6. Decision Tree Probability Diagram.*




Step 10. Determining possible revenue sharing arrangements.

Although using Deliveroo offers the prospect of an expanded TZ it also presents the risk of cannibalisation, and lost sales.

Given that over 75% of UK users of food delivery apps are brand loyal (Mckinsey & Co. 2016) there is the risk that once a customer begins to use Deliveroo they will not migrate back to any previous ways of ordering food, and therefore the cannibalised sales may be lost for good. Given this risk it is necessary to consider how revenue

that in the future may be routed to the franchisor might be re-distributed equitably to franchisees.

Two alternative revenue allocation models are proposed. The first one requires the calculation of the size of individual Dine-In and Delivery current TZs and work out the area of overlap between them. From this information it becomes possible to work out the relative percentages of each TZ according to the overall combined size. The revenue is allocated to specific postcode. That data is then loaded on QGIS as a choropleth map onto which the TZs are overlayed. Through the use of QGIS's Clip and Difference algorithms it becomes possible to extract data on how much revenue is allocated to which TZ.

The second method is to allocate the revenue to its nearest restaurant. This approach requires using QGIS's Polygon-to-Point algorithm to convert postcode areas to points. The result is a map with a series of points that represent the mathematical centre of their corresponding postcode. The next step is to apply the nearest neighbour algorithm to the points and to the locations of the restaurants. This process will result in a map with a series of lines that link the points to the nearest restaurant. Having saved this information as both a shapefile and a CVS file it becomes possible to manipulate the data to allocate the income to its nearest restaurant. The merits of each approach are discussed in the results section.

# 4. RESULTS

## 4.1. Assessing the Impact of Deliveroo on NRC's business.

In order to determine the impact that Deliveroo might have on NRC's business it is necessary to first examine the TZs of both Dine-In and Delivery restaurants and the overlaps between them.

### 4.1.1. TZs: Existing Delivery and Dine-In.

NRC operates a national network of Dine-In and Delivery restaurants in 340 locations across the UK. From this a sample of twelve regional cities were selected. As can be seen in Table 5, the cities chosen are intended to broadly reflect the same split of Dine-In to Delivery as per the national chain.

*Table 5. Comparing Relative Percentages Between NRCs National Network & Sample Selected*

| | % No of Restaurants | |
|---|---|---|
| | Dine-In | Delivery |
| National Network | 41% | 59% |
| Sample Cities | 39% | 61% |
| Source: Data on national network from NRC | | |

The cities selected contain a total of 56 restaurants; five of these cities had five or more restaurants, five had three restaurants, and two had two restaurants. All cities, with the exception of Bath had both Dine-In and Delivery restaurants and most of these restaurants operate in overlapping TZs (see Table 6).

Under current arrangements the existence of overlapping TZs between Dine-In and Delivery is of limited concern to franchisees because Dine-In restaurants do not offer a take-away service and Delivery do not provide a Dine-In service, although Delivery restaurants are permitted to deliver within the Dine-In TZ. Revenue sharing

arrangements exist governing those situations (such as Bristol, see Figure 7) where Delivery restaurant have overlapping trade zones

*Table 6. Existence of Overlapping TZs Between Cities in the Sample*

| Location | Overlaps between both Dine-In and Delivery restaurants | Between competing Dine-In restaurants | Between competing Delivery Restaurants |
|---|---|---|---|
| Bath | No | No | No |
| Bristol | Yes | No | Yes |
| Bradford | Yes | No | No |
| Canterbury | Yes | No | No |
| Derby | Yes | Yes | Yes |
| Exeter | Yes | No | No |
| Leicester | Yes | Yes | Yes |
| Norwich | Yes | Yes | Yes |
| Nottingham | Yes | Yes | Yes |
| Oxford | Yes | No | Yes |
| Reading | Yes | Yes | No |
| Swansea | Yes | No | Yes |

4.1.2. The combined current TZs

If NRC wishes to expand its delivery offering in a particular city it may choose to offer this service to individual restaurants or to all restaurants within the city. For the purpose of this dissertation it has been assumed that NRC will be introducing Deliveroo across all restaurants within the same city zone. This being the case it will be necessary to look at the existing TZs not as distinct Dine-In and Delivery TZs but as combined units. This is because Deliveroo's algorithm works out which restaurant is nearest to the customer and, will then send the customer's order to the nearest restaurant. Figure 8 shows this approach applied to Bristol.

*Figure 7. Bristol Area Delivery Restaurants TZ*

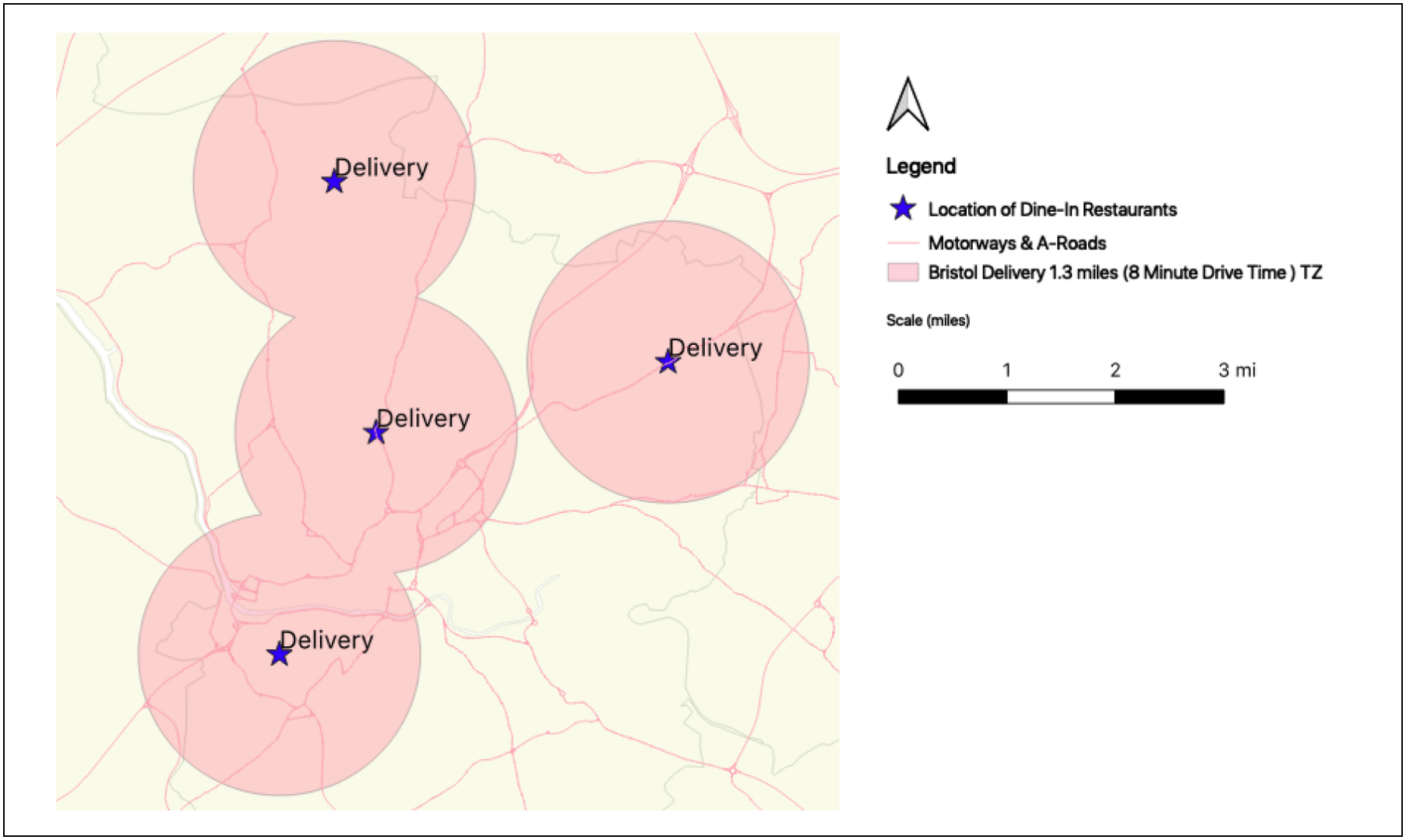
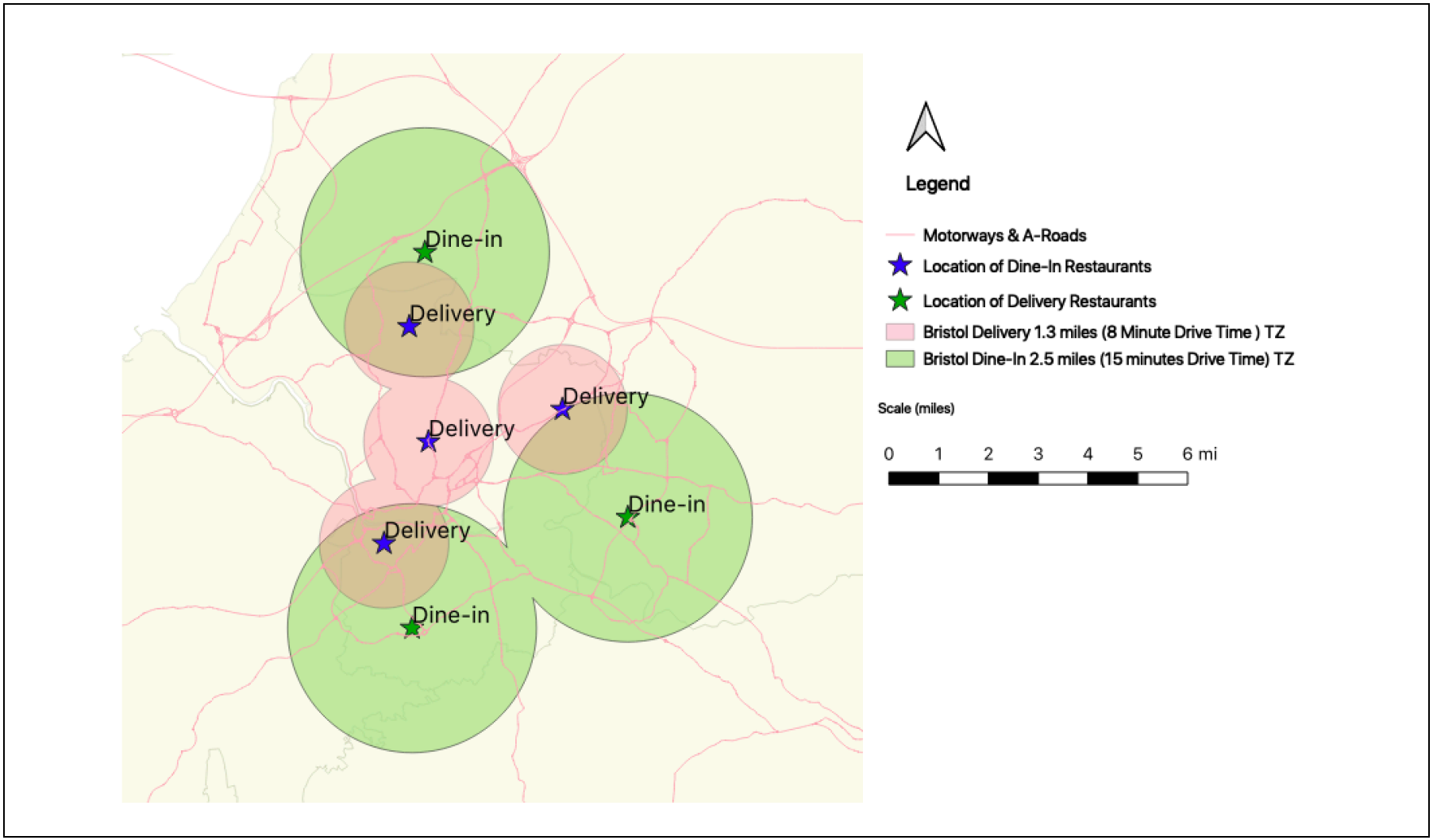


*Figure 8. Bristol Area: Combined Delivery & Dine-In TZ*



4.2. Revenue Sharing Models.

4.2.1 Introducing DSA across NRC's network.

Deliveroo will deliver within a 2 miles of the restaurant; this compares with existing TZs of a 1.5 mile radius for Delivery restaurants and 2.5 miles for Dine-In. This will therefore expand the Delivery TZ, but not the Dine-In TZ.

The introduction of a third party (Deliveroo) into an environment of overlapping TZs increases the complexity of the relationships. This can be illustrated by reference to the Bradford area ( see Figure 9 ). Here we see a multiplicity of overlapping TZs. Although the combined TZ has now expanded, the whole of the previous Delivery network and some of the Dine-In network is now at risk of cannibalisation. Figures 10 and 11 shows how much of the expanded TZ is at risk of cannibalization and how much is unaffected.

4.2.2. Measuring the Impact of Introducing Deliveroo.

As soon as NRC opens up its network to DSA it introduces its customers to the other dining choices available on the Deliveroo app, a significant level of competition that was not previously there (see Table 7). NRC's customers in Bradford now have access to deliveries from nine pizza restaurants, and across the twelve city sample a total of 238. In order to consider the extent of the area that might be at risk of lost sales it is necessary to examine what spatial influence these additional choices might have on NRCs now expanded TZ.

*Table 7. Number of Potential Competing Restaurants Within Sample Cities*

| City | Number of Restaurants by Type | | | |
|---|---|---|---|---|
| | Pizza | Chinese | Indian | Total |
| Bath | 14 | | | 14 |
| Bradford | 9 | | | 11 |
| Bristol | 44 | 5 | 9 | 57 |
| Canterbury | 9 | | | 9 |
| Derby | 21 | | | 21 |

| City | Number of Restaurants by Type | | | |
|---|---|---|---|---|
| | Pizza | Chinese | Indian | Total |
| Exeter | 12 | | | 12 |
| Leicester | 31 | | | 31 |
| Norwich | 16 | | | 16 |
| Nottingham | 33 | 11 | 10 | 54 |
| Oxford | 23 | | | 23 |
| Reading | 26 | | | 26 |
| Swansea | 11 | | | 11 |
| Total | 238 | 16 | 21 | 275 |
| % | 87% | 6% | 8% | 100% |
| Source: CNRK7 analysis from Deliveroo's site map (2019) | | | | |

The modelling exercise was performed on the TZs of all twelve cities, but in so doing the following assumptions have been made: a) the percentage increase in sales is directly proportional to the percentage increase in the TZ; and b) the average weekly revenue is £34,000.

4.2.3 Increased sales, cannibalisation and lost sales risk.

Given that over 75% of customers who use food delivery apps are brand loyal the risk of cannibalisation and lost sales should not be underestimated (Mckinsey & Co. 2016).

By working out the areas of overlap between the current TZ and the new DSA it is possible to measure how much of the existing TZ is at risk of cannibalisation. By working out the area of overlap between the existing TZ and that of competing restaurants who also use Deliveroo it is possible to work out how much of the current TZ is at risk of lost sales. Figure 12 provides an example of how this modelling has been applied to Bradford.

On average, across the twelve cities, introducing DSA will increase TZs by 25% which translates to an anticipated sales increase including the new area of 16%. However, it will expose 85% of the current TZ (Dine-In and Delivery combined) to

cannibalisation risk, and 74% of the current combined TZ to loss of sales to competing restaurants. How the results vary from one city to another is considered further in the discussion section.

4.2.4. Calculating the cost and probability of cannibalisation or lost sales.

Before calculating the probability of possible outcomes, the following assumptions, based on a small (n = 12) informal survey of app users, have been made:

- 90% of Customers who think about ordering a pizza will stick to this choice despite prevalence of offers available via the Deliveroo app (see Figure 4),
- Leading pizza brand's have very loyal customers and therefore 60% of them will, having originally decided to order a pizza, stick to their original choice (Wideopeneatscom, 2018); and
- There is only one Dine-In and one Delivery restaurant in the TZ, and Deliveroo will collect the pizza from the nearest restaurant, calculated for this purpose as a 50/50 choice.

Using the probability decision tree introduced in step 10 of the methodology it is possible to calculate the risk of cannibalization or lost sales; these are shown in Figure 13. Figure 14 illustrates what weightings have been allocated to each set of questions and how the final risk percentages were derived.

*Figure 9. Bradford Expanded TZ: Combining Existing Dine-In & Delivery TZs & New DSA*

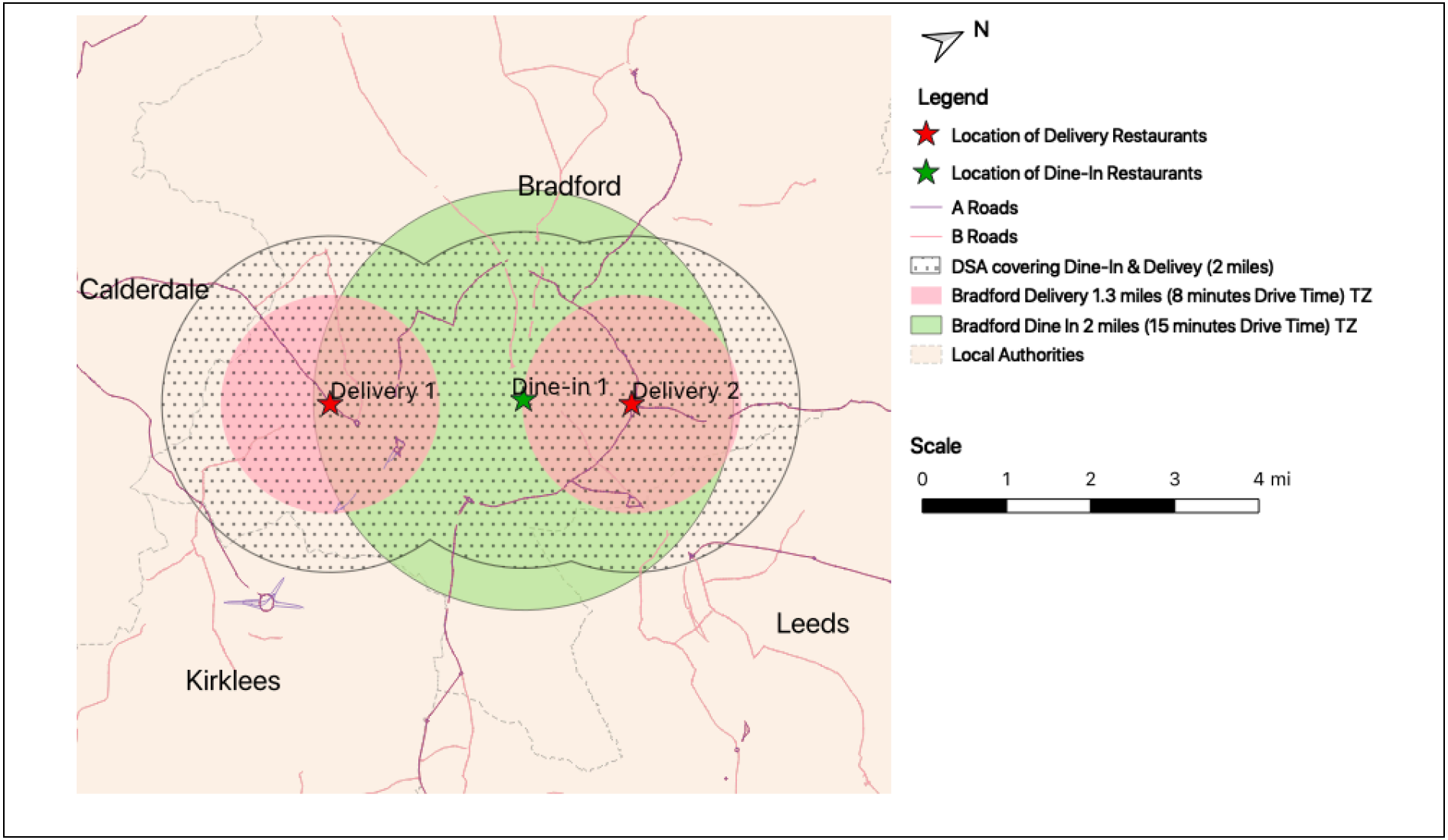


*Figure 10. Bradford's Expanded TZ Exposed to Cannibalisation*

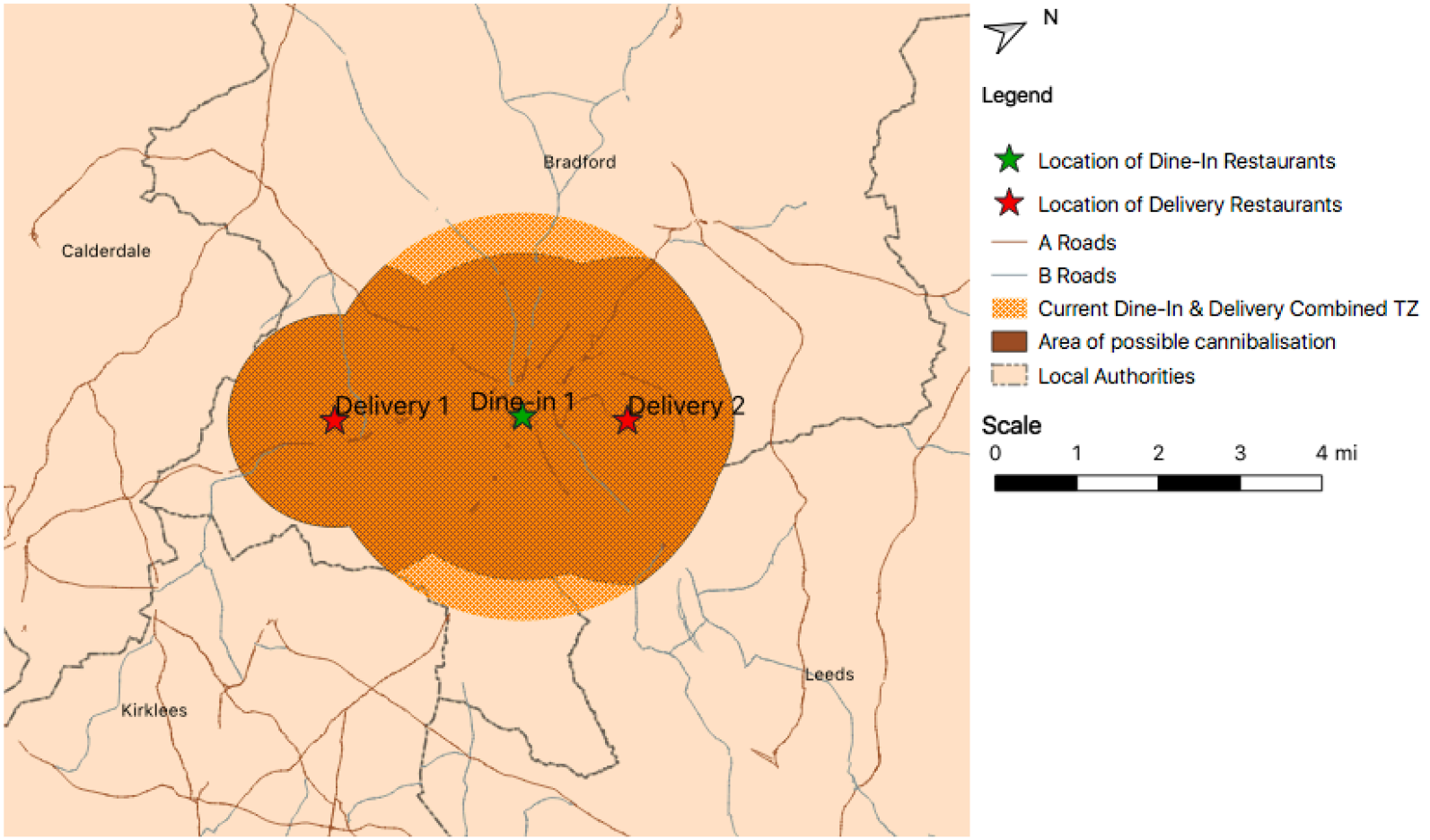


*Figure 11. Bradford Expanded TZ Unaffected by Cannibalisation*

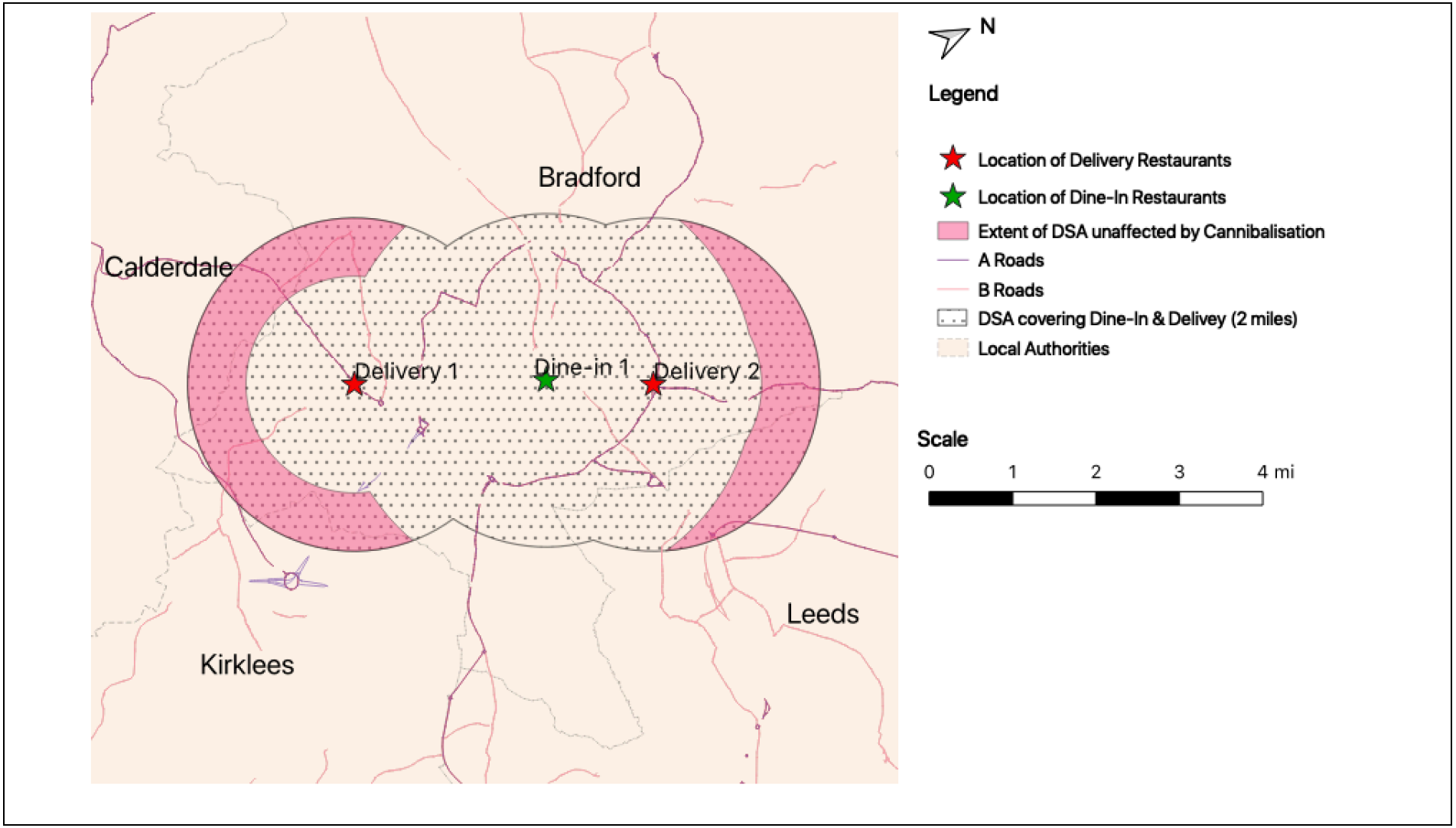


*Figure 12. Bradford TZ at Risk of Lost Sales to Competing Restaurants*

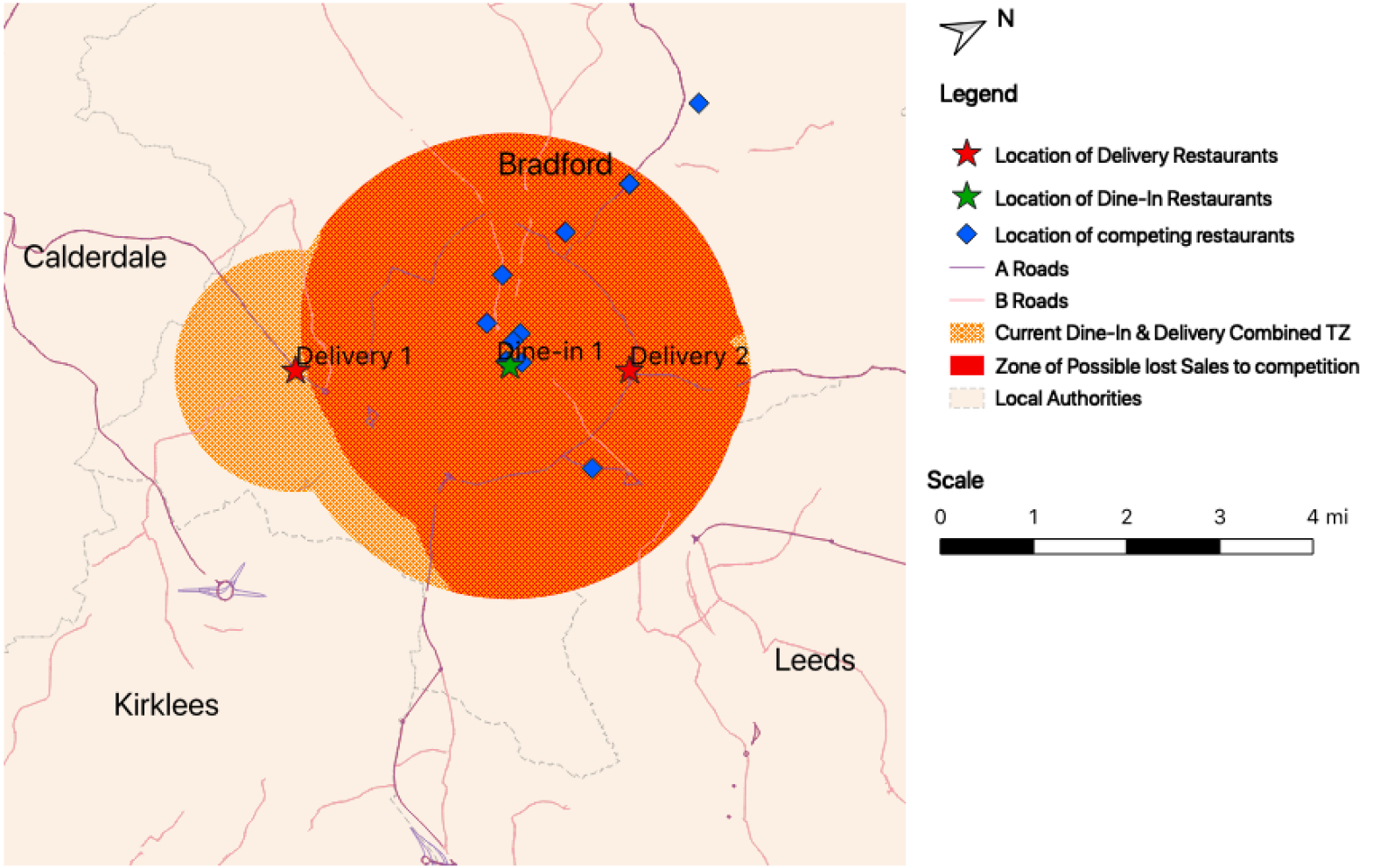


*Figure 13. Risk of Cannibalisation or Lost Sales Compared to Customers Continuing to use Existing Channels*

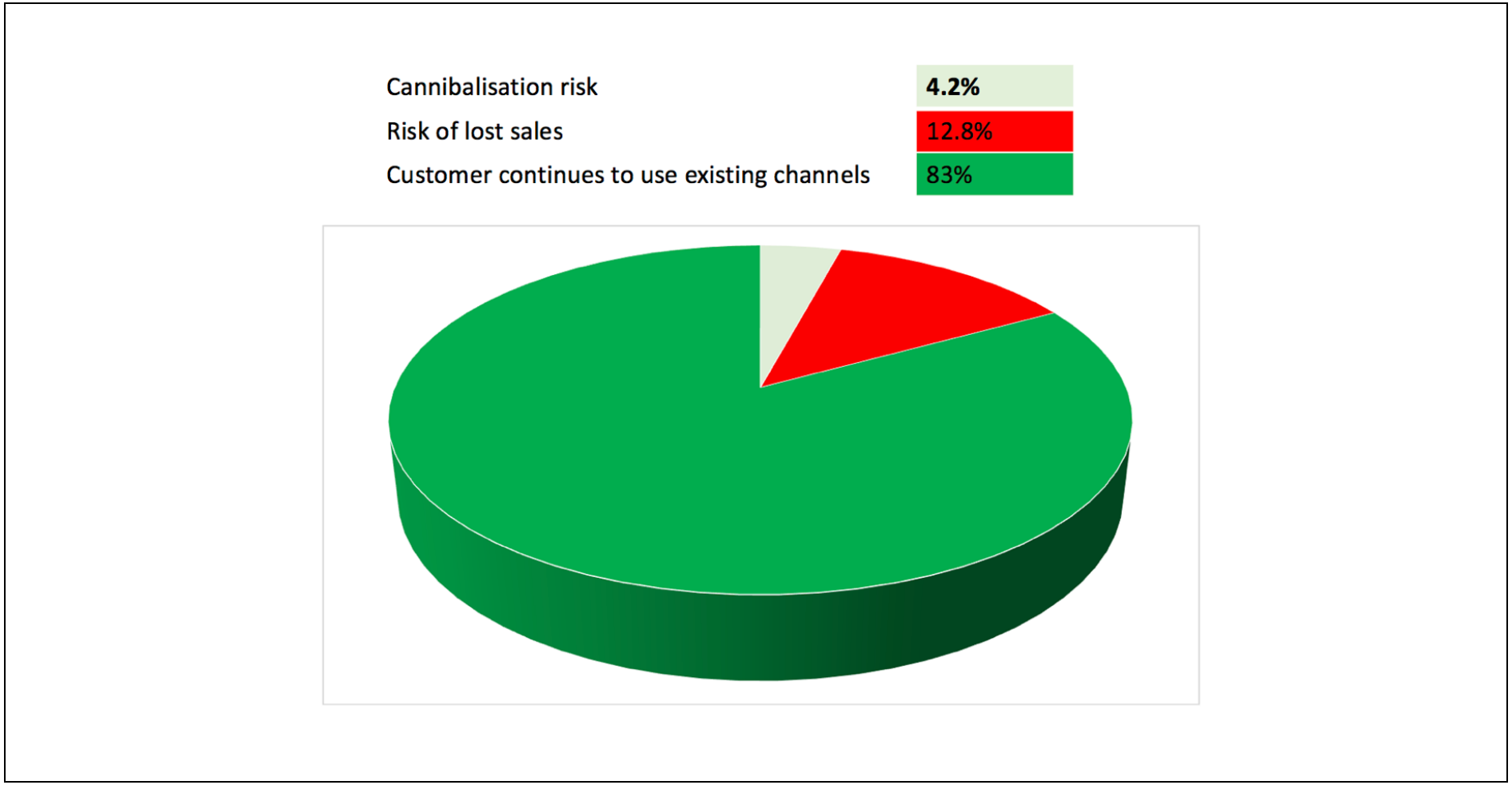
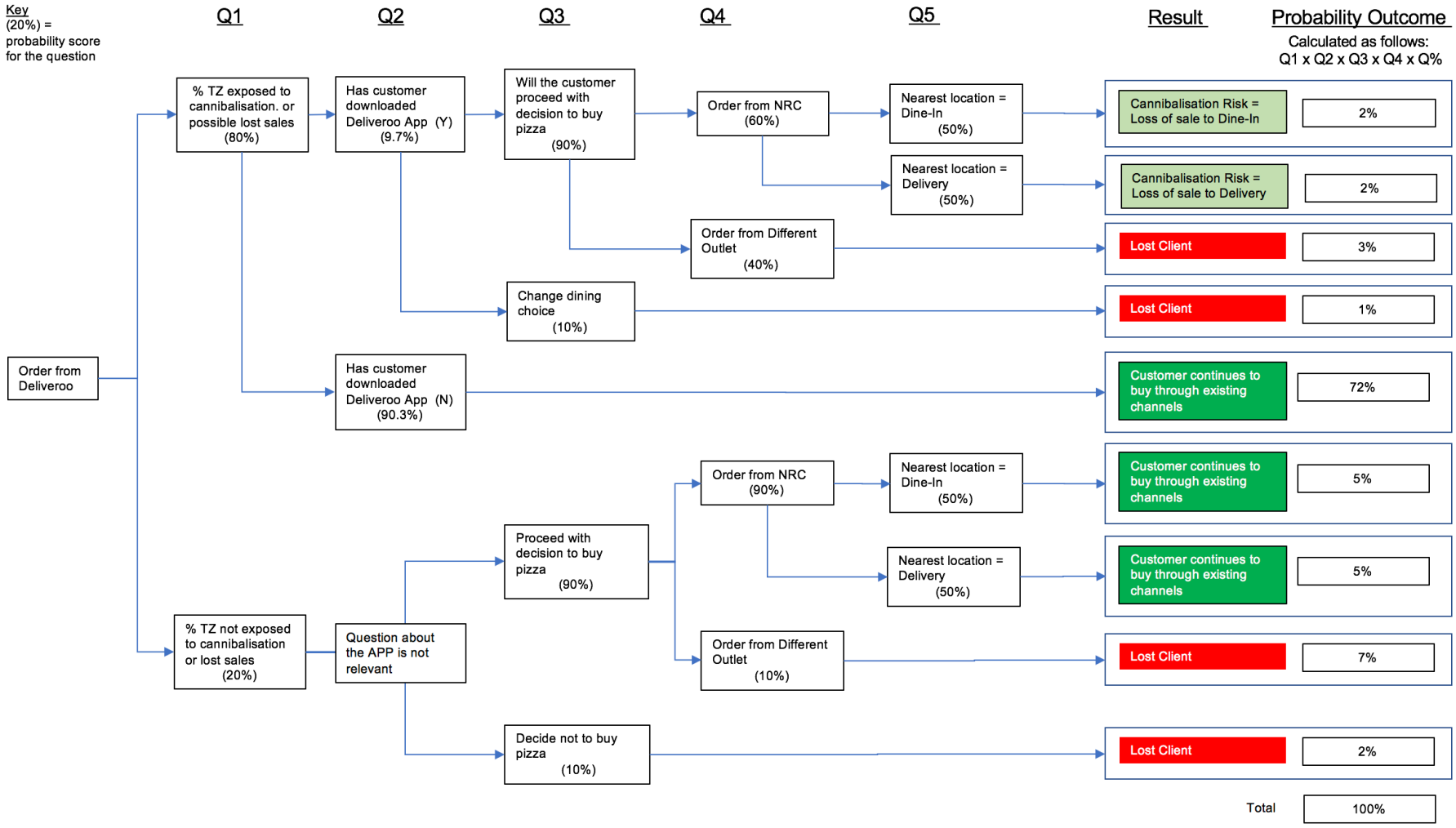


*Figure 14. Decision Tree Probability Calculations & Outcomes*



## 4.3. Revenue Sharing Models.

This paper proposes two possible revenue allocation models. One relies upon the existence of the current TZ with any income allocated according to the relative size of those zones. The second allocates the income to the restaurant that is nearest to the customer. This section explores these two approaches.

### 4.3.1. Allocation according to size of existing TZ

This method first requires the identification of the current TZs, establishing where the overlaps are as well as identifying those areas where the TZ has expanded. Figure 15 represents the outcome of this exercise.

The next steps are as follows: i) calibrate relative sizes of the respective TZs and the overlaps, ii) allocate the revenue according to each postcode, iii) overlay the TZ on to the postcode map and create a combined shapefile of the result. Figure 16 is an example of what the postcode map might look like, and Figure 17 shows the outcome when postcodes are overlayed onto the allocation model

Once the shapefile has been saved as a csv file it becomes possible to manipulate the data and allocate revenue. For the purposes of this exercise sales were calculated using an excel random number generator which allocated the number of pizza sales per postcode within the TZ, assuming the price of a pizza was £18.00.

### 4.3.2. Allocation according to nearest neighbour.

An alternative approach is to allocate the revenue to the restaurant nearest the customer. This requires the conversion of all postcodes into centroids, and then running a nearest neighbour algorithm which will perform this allocation, the results of this are shown in Figure 18. Once the resulting shapefile is converted to a csv file the data can be manipulated to identify what revenue is allocated to which restaurant.

*Figure 15. An Example of Revenue Sharing Arrangements by T*

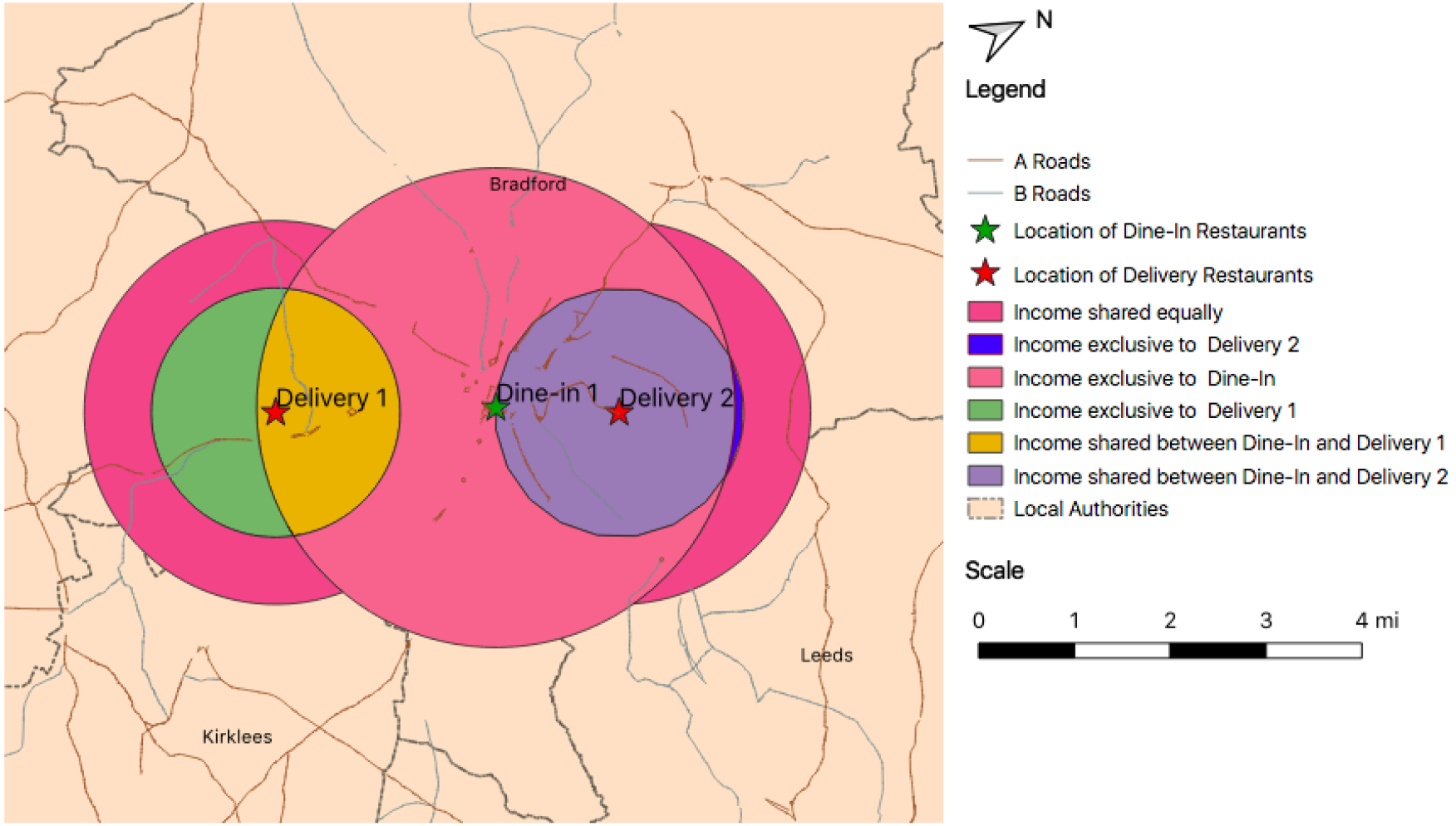


*Figure 16. Additional Weekly Revenue Allocated to Postcodes in Bradford's New TZ*

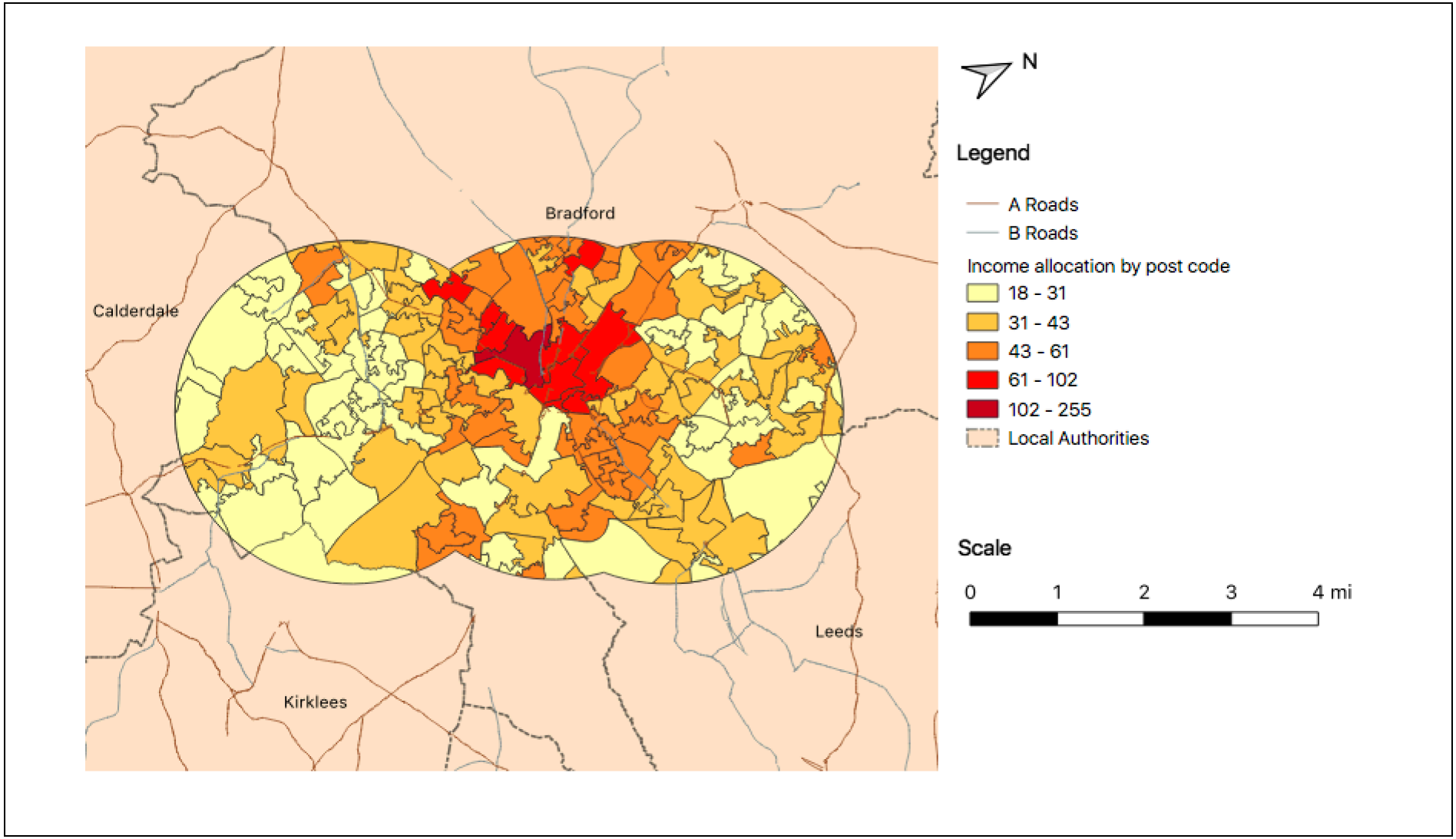


*Figure 17. Combining Postcode Data with TZ Revenue Sharing Arrangements*

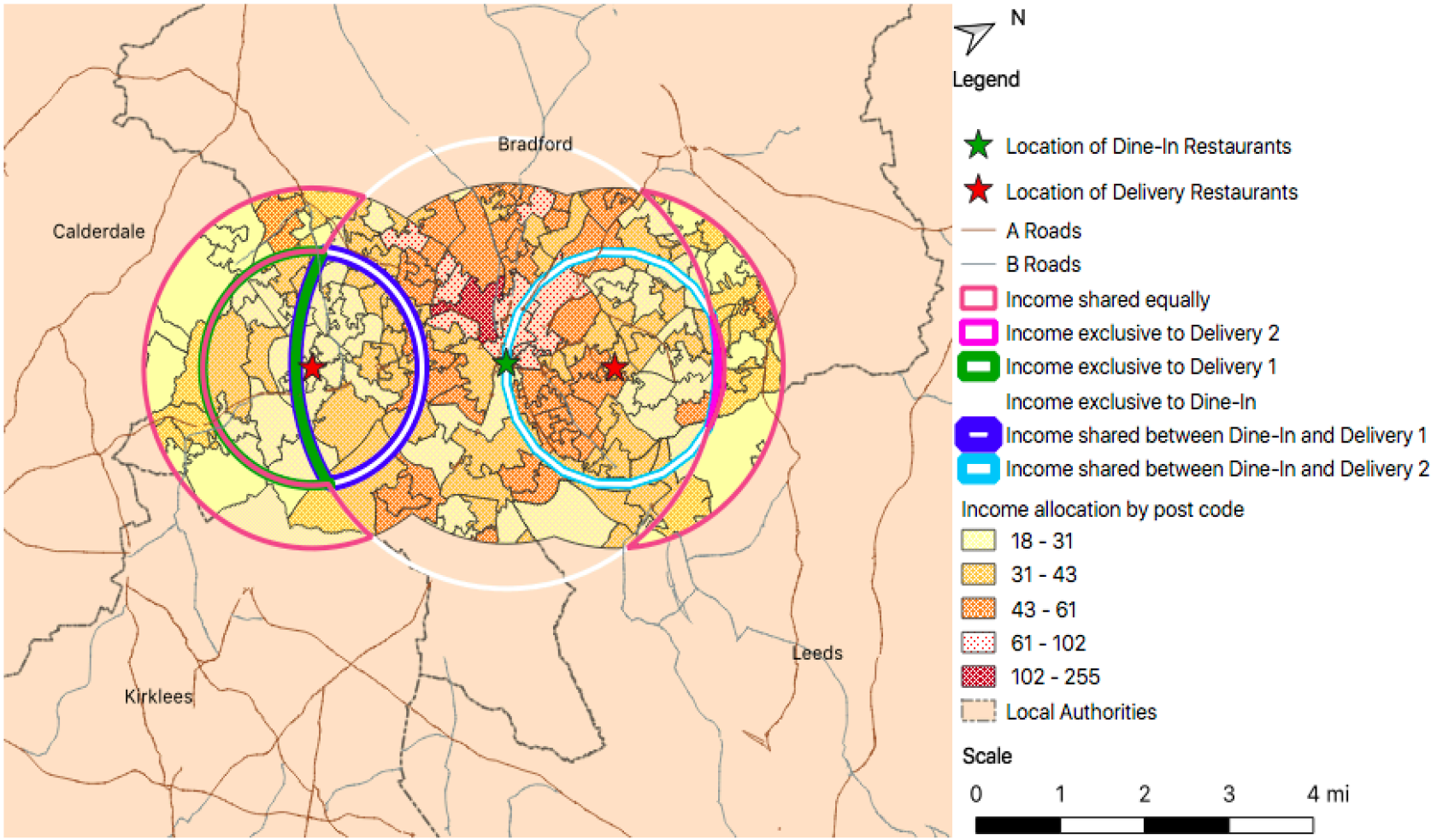
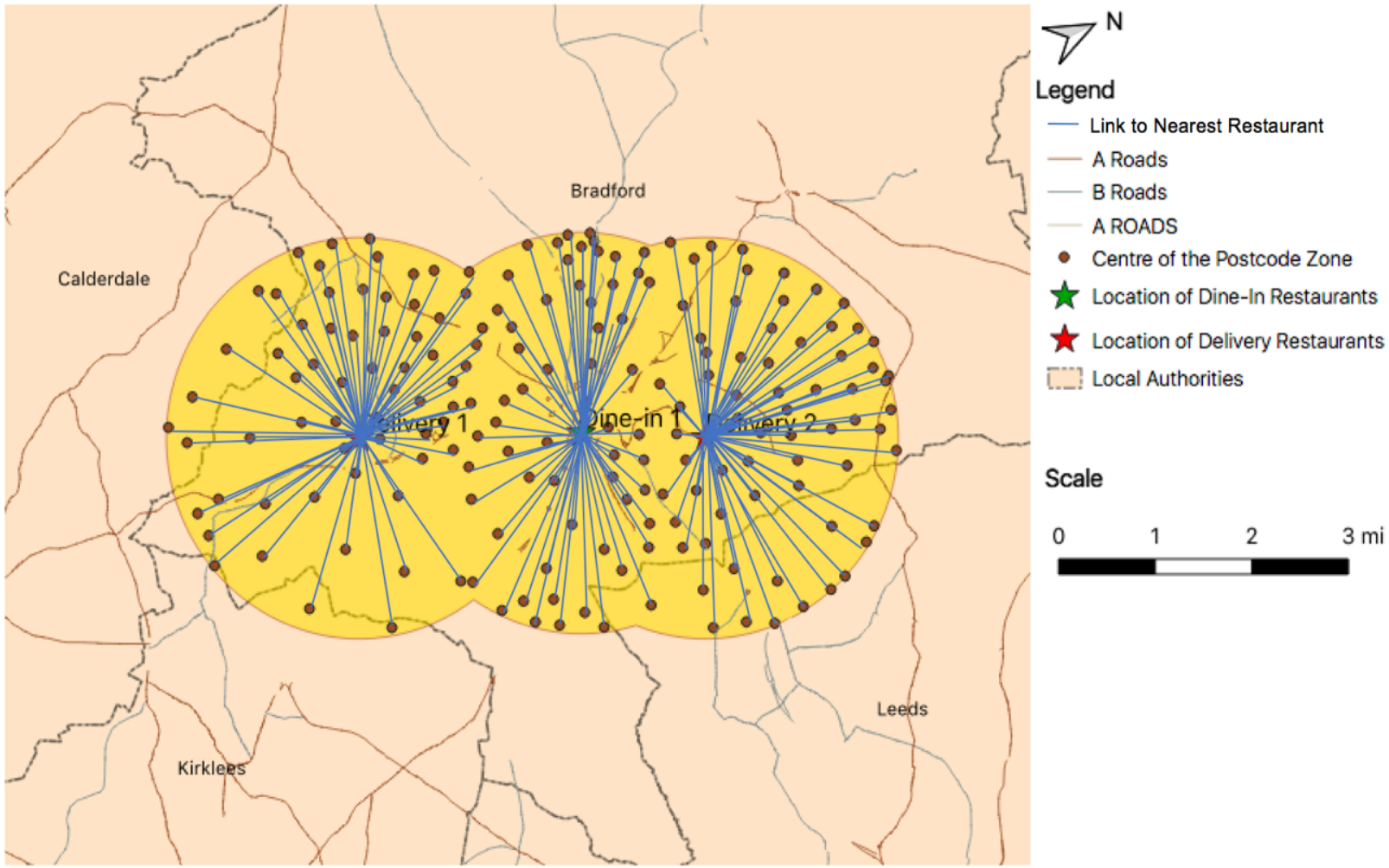


*Figure 18. Income Allocation by Nearest Neighbour*



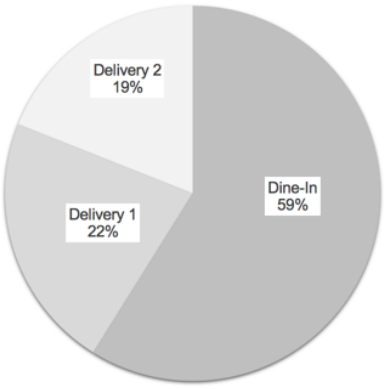
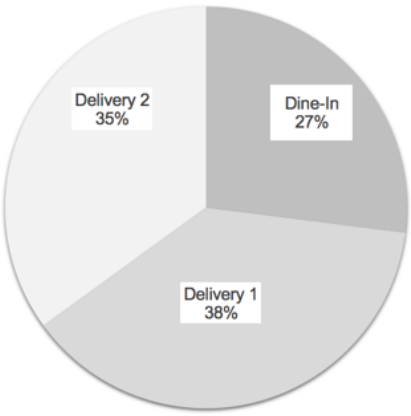
4.4. Comparing Each Approach

This research does not include an analysis of how the current non-compete agreement operates, instead it has been assumed that the agreements are routed in the principle of recognising the integrity of a restaurant's existing TZs.

Using Bradford as an example, allocating revenue by TZ maintains the integrity of the previously stated principle (see Figure 19a). However, where the TZ of Dine-In and Delivery restaurants overlap then the income allocation will always be weighted towards Dine-In because its existing TZ is larger than that of Delivery restaurants, and Dine-In will also benefit from sharing the revenue from any TZ overlap. Under these circumstances operators of Dine-In restaurants are likely to favour this approach.

Allocating revenue by nearest neighbour is a more accurate reflection of where the meals are actually prepared; and therefore is more equitable, but it challenges the current non-compete arrangements, in particular Dine-In restaurants will in future be providing a delivery service, albeit through the services of a third party, into what would otherwise have been the TZ of a Delivery restaurant. Therefore, Delivery restaurants are more likely to favour this approach (see Figure 19b)

*Figure 19. Comparing Income Allocation Models*

| *Allocation By Postcode & TZ* | *Allocation By Postcode & Nearest Neighbour* |
|---|---|
|  |  |

# 5. DISCUSSION

## 5.1. Answering the Research Question.

### 5.1.1. Understanding the impact Aggregators might have on restaurants.

Through applying diverse GIS techniques, such as the use of buffering algorithms to calculate and map TZs, and the manipulation of postcode data to model future revenue, combined with some relatively straightforward analytics it has been possible, at least theoretically, to determine what impact Deliveroo might have on a national restaurant chain operating on a franchise basis.

In introducing an Aggregator within its business operating model a franchisor may experience increased sales but this is likely to be at the expense of diverting a percentage of sales from franchisees to the aggregator's online delivery apps, (i.e. cannibalisation). There is also the increased risk from competing restaurants.

### 5.1.2. Developing a revenue allocation model.

Sales through Aggregators do not represent an income reduction but rather a rechanneling of how the revenue is collected. With this in mind it has been possible to construct a spatially based financial model designed to distribute any additional income equitably between competing franchisees. These models can be based on TZs or on the nearest neighbour principle.

### 5.1.3. The continued relevance of prevailing retail theories

The results suggest that some retail theories do apply in the online world. This section outlines examples where theories continue to apply, where they do not and what aspects of them have changed.

Central Place Theory focuses on the relationships between the time and cost of travel over distance. In the physical world the consumer travels to the product; in the

online world the product travels to the consumer. In the physical world distance is important to the consumer who will way up the time and cost associated with travelling vs the retail offering available at the destination; in the online world it is the Aggregator rather than the consumer who needs to consider distance. Time in the online world is no longer about how long the customer must travel but rather it is about how long the customer must wait for the product to be delivered to them. Distance remains as important in the online world as it does in the physical world, but its significance is now dictated by the Aggregator's maximum delivery distance. The relationships are summarised in Figure 20.

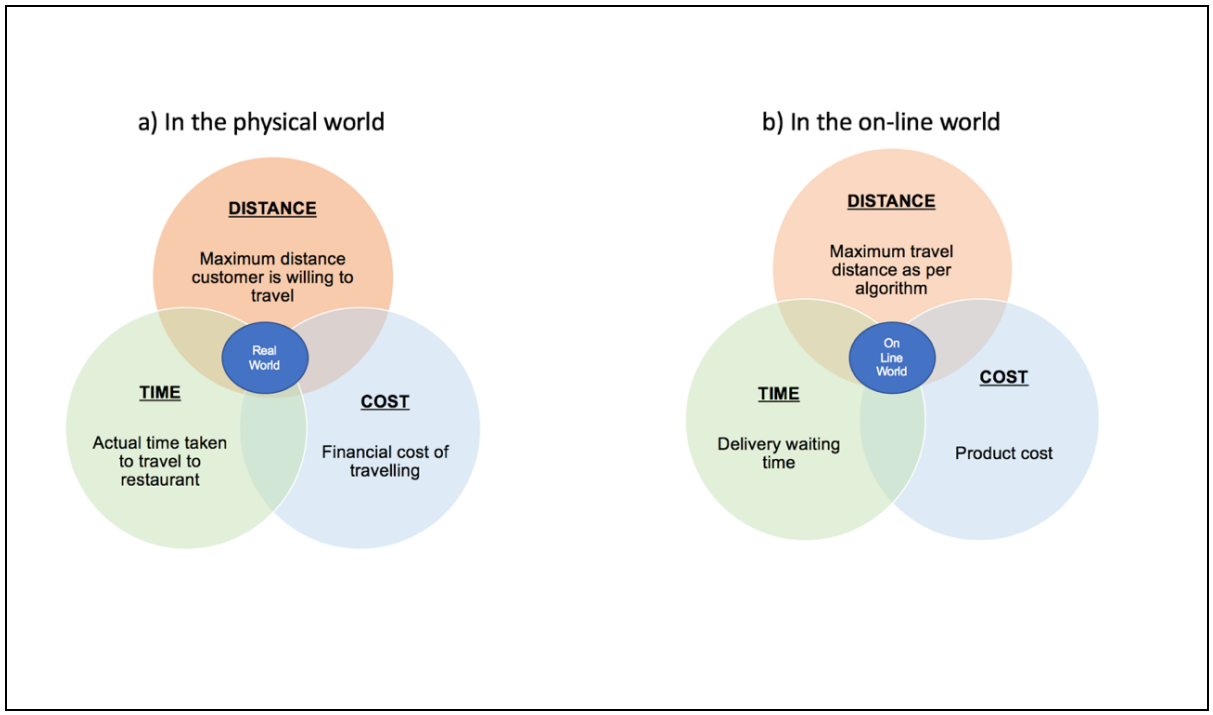
Bid Rent theory is not relevant in the online world. This is because market value of land is not relevant to online retailers. What is significant however is the role that Google advertising costs have in influencing where a restaurant appears in a customer's search results. This is important because this impacts a customer's ability to locate online a particular restaurant.

The Principle of Minimum differentiation states that restaurants aggregate because of the importance of proximity to rivals. In the online world proximity remains as important to the consumer as it does to the retailer because it facilitates comparison.

In the online world clustering is not driven by decisions taken by retailers but rather by algorithms designed by Aggregators and therefore the role of Agglomeration Theory will need to change.

Hedonic & Behavioural Economics remain important. The design of the app is a practical demonstration of behavioural economics at work. The order in which restaurants appear on screen is a direct function of delivery times as well as customer's appraisal of the restaurant. Factors affecting a customer's appraisal, such as restaurant variety and transparent hygiene standards are intrinsically hedonic (Gilsenan, 2018)

*Figure 20 Comparing Central Place Theory in the Physical World & the Online World*




5.2. Analysing the Results.

5.2.1. Cannibalisation and Loss of Sales Risk

Expanding the TZ by partnering with Deliveroo will increase the TZ (on average by 26%) and result in increased sales from the new area (on average 16%) but this is at the risk of introducing cannibalisation and lost sales. The risk differs across the twelve cities depending on the level of TZ overlap (see Figures 21 & 22).

A factor to consider in assessing the risk of cannibalisation is the spatial relationship between Dine-In and Delivery restaurants and DSA. Given that Dine-In restaurants have a larger TZ than that of Delivery but that the DSA is smaller than the Dine-In's TZ then the level of proximity will dictate how much of the DSA is absorbed by current TZ. Two examples illustrate this. Example 1: In the case of Canterbury, the Delivery TZ is completely absorbed by that of Dine-In but the DSA is wholly absorbed by the Dine-In's TZ (see figure 23). Example 2: In the case of Bath where only one Delivery restaurant operates, the DSA entirely absorbs the current. (see Figure 24).

A factor to consider in assessing the risk of lost sales is the locational pattern of competing restaurants. If the restaurants are concentrated, as in the case of Bristol then the area of overlap will be smaller than if the pattern is more disperse as in the case of Nottingham (see Figures 25 & 26).

### 5.2.2. Comparing Incomes

Figure 26 illustrates how the relative sizes in current and expanded TZs translates to changes in income and compares the relative impacts against current income. Some of the key outcomes of this analysis are as follows:

- Bath, Nottingham and Exeter can be expected to see the greatest increase in sales, with Canterbury likely to see the lowest increase and
- Bristol is likely to see the lowest risk of lost sales.

### 5.2.3. Analysis Summary

The different outcomes suggest that making a decision to partner with Deliveroo may need to be city specific rather than a national one. The analysis suggests that in order to protect current income while at the same time expanding the TZ it would make sense to focus on those cities towards the middle of the graph illustrated in Figure 26, namely Bradford, Derby, Reading and Bristol.

*Figure 21 Percentage of TZ at Risk of Cannibalisation & to Lost Sales*

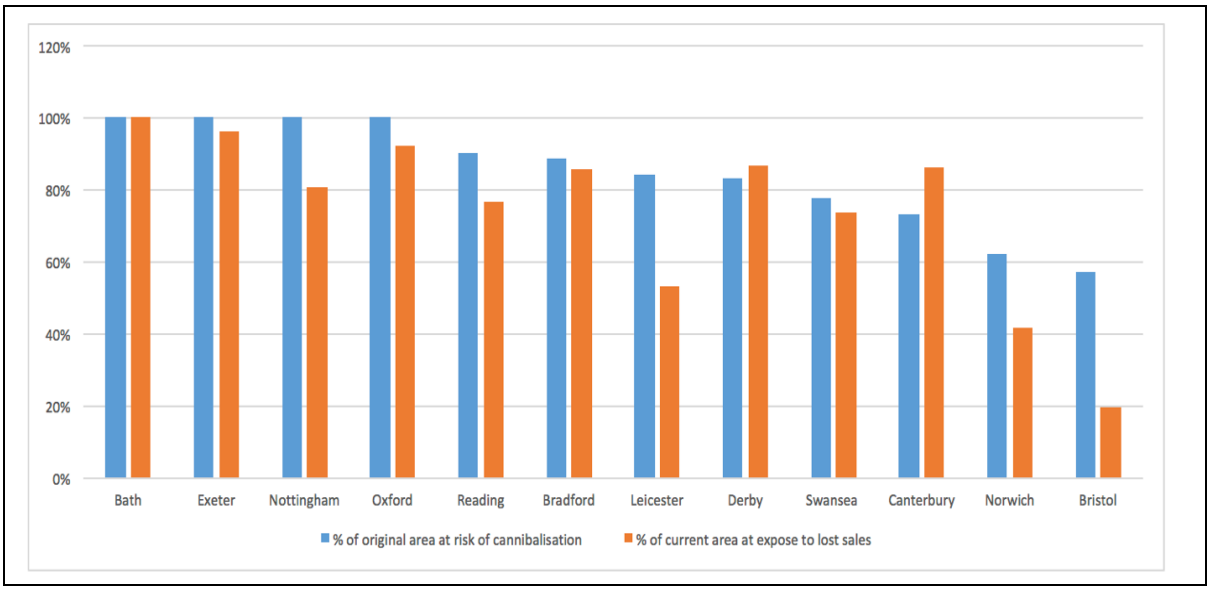



*Figure 22 Percentage of Current Income at Risk of Cannibalisation or Lost Sales*

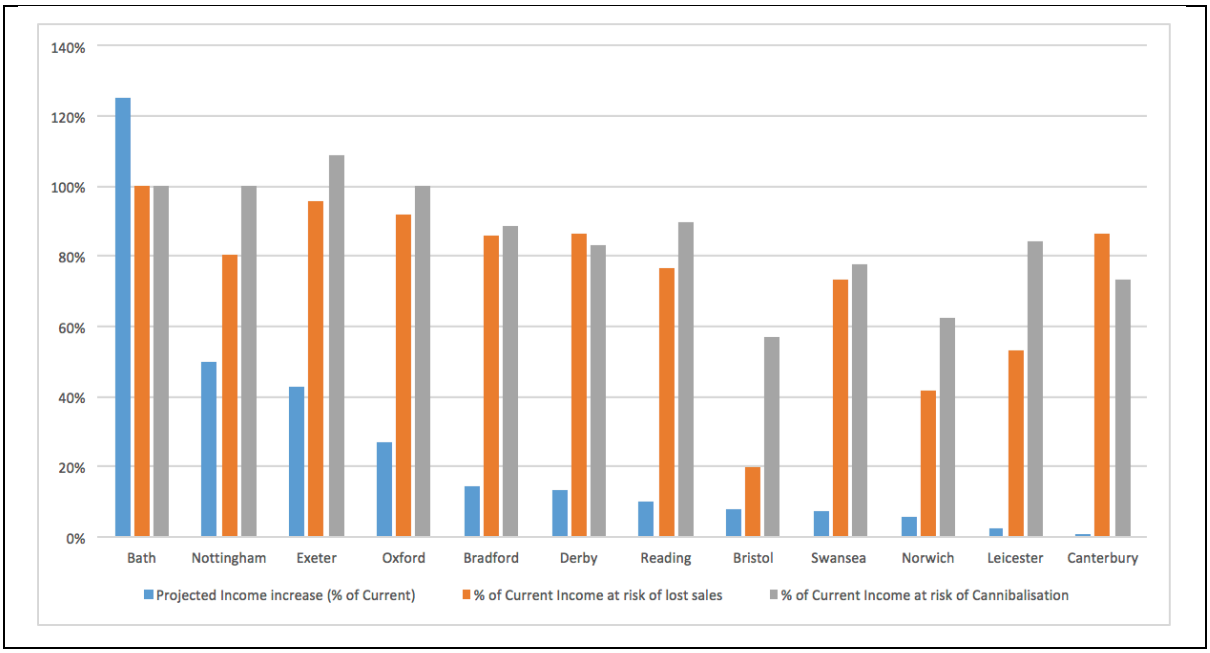


*Figure 23 Canterbury Area Impact of Introducing DSA*

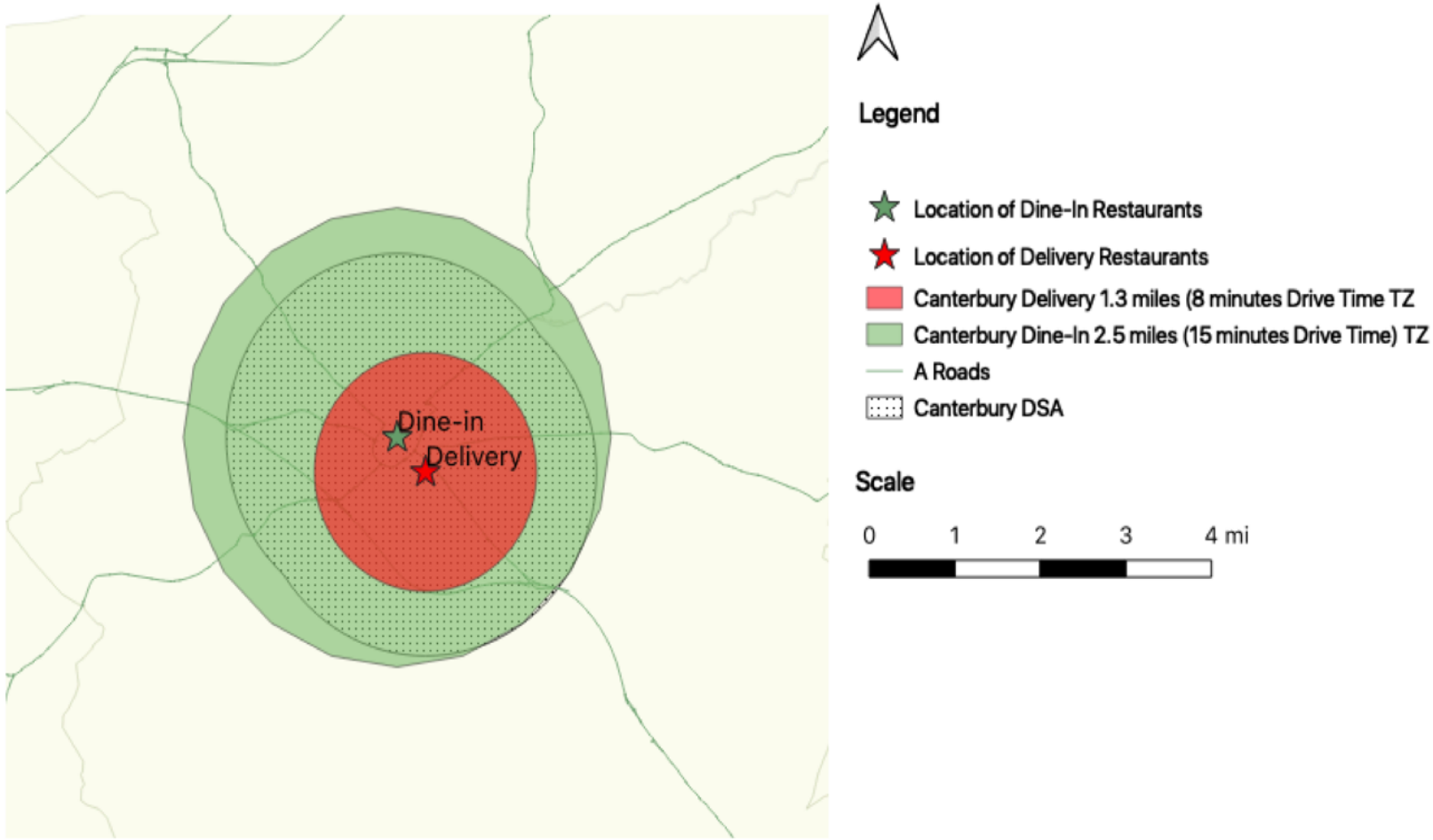


*Figure 24* Bath Area Impact of Introducing DSA

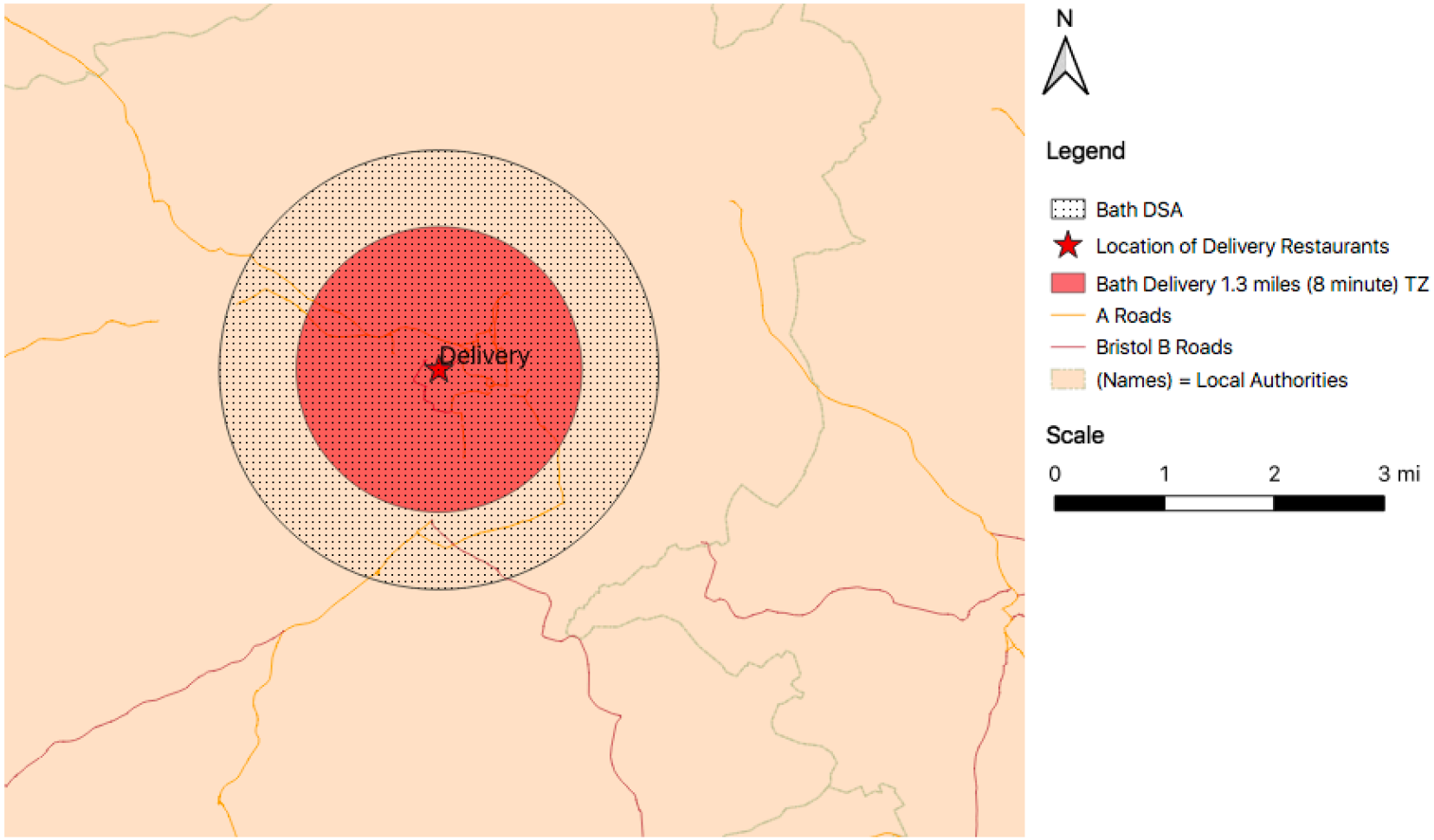


*Figure 25. Location of Competing Restaurants in Bristol*

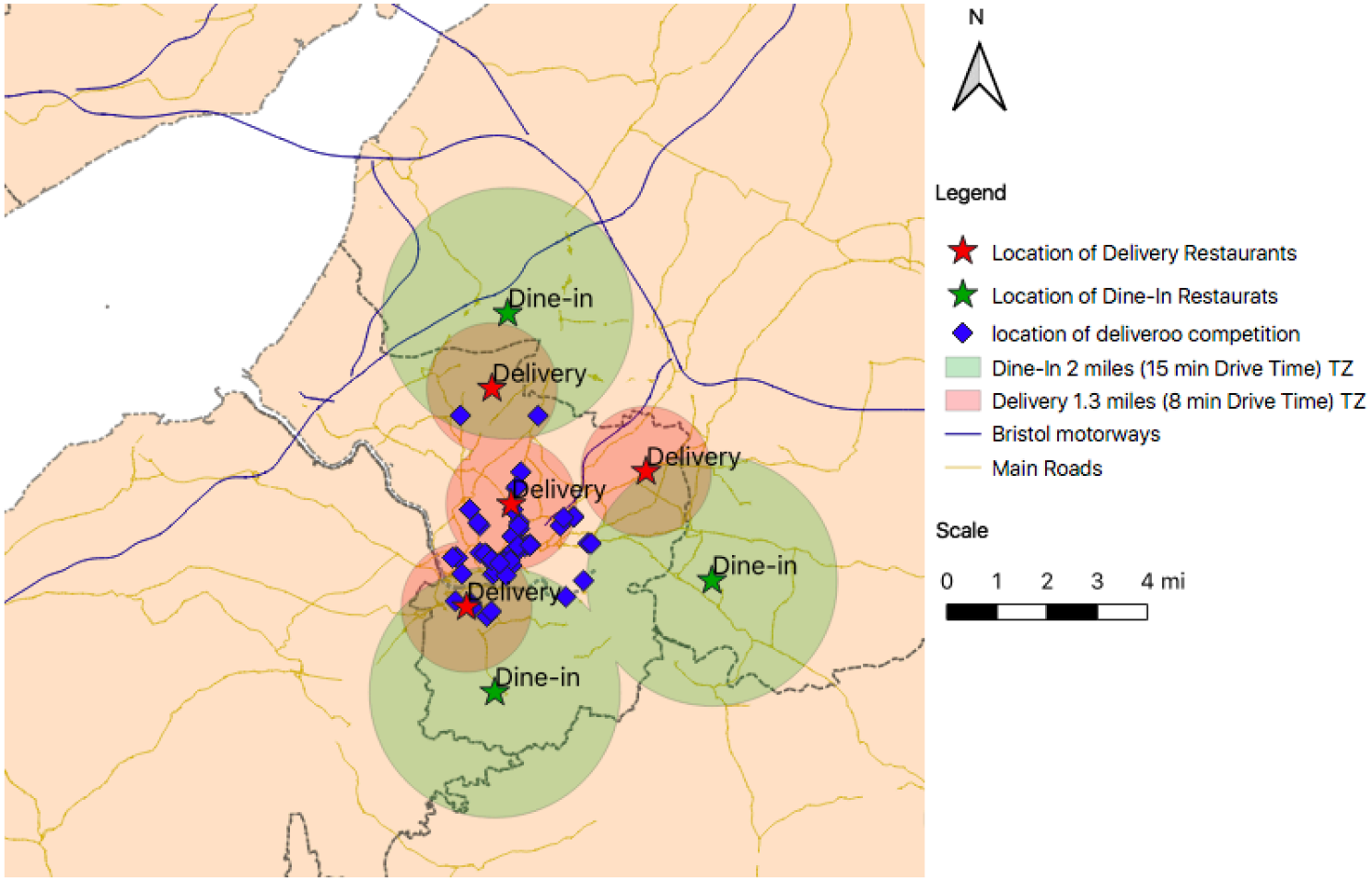
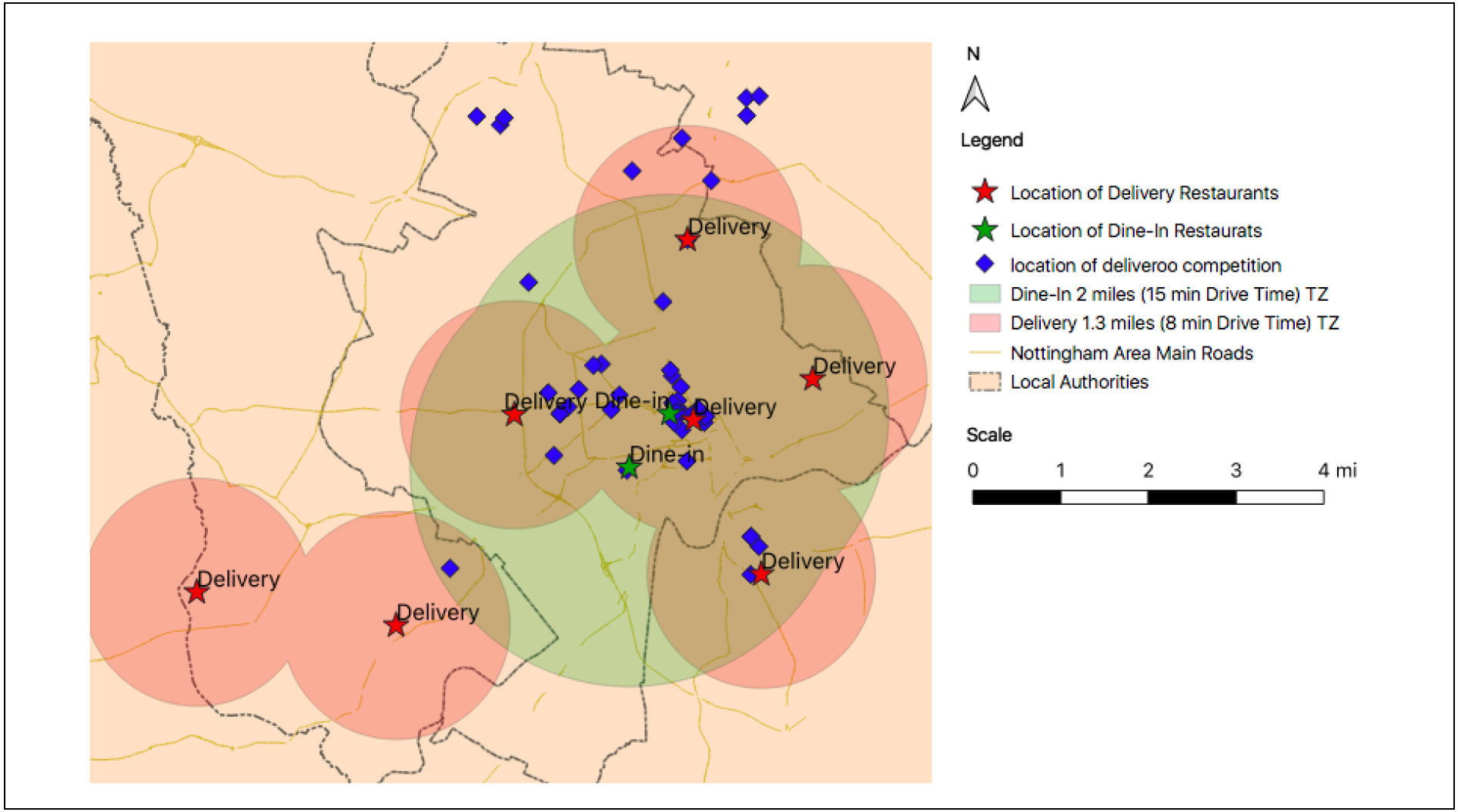


*Figure 65. Location of Competing Restaurants in Nottingham*



## 5.3. Limitations with the Approach.

### 5.3.1. Catchment Areas (TZs and DSA)

The key to the results is accurately measuring the TZs and the DSA. In order to create TZs that can be represented on a map and to run the QGIS buffering algorithm it is necessary to convert travel times into miles. This study has assumed a uniform national speed; in practice traffic movements can vary from one location to another and this has the risk of under or over-representing the size of the TZs.

The TZs are based on a radius that reflects time travelable within an hour, in practice this will vary according to the real life road layout. The circular TZ pattern makes no allowance for limitations associated with natural boundaries (i.e. rivers) or man-made ones (i.e. railways, or motorways), all of which will influence travel times. These factors will distort the area covered and actual size of the TZ.

### 5.3.2. Predicting Outcomes and calculating increased sales

Modelling the behaviour of a potential customer using the Deliveroo App would be best achieved by way of undertaking a systematic consumer survey; this would provide substantive evidence in support of the probability outcome. For this work, anecdotal research was conducted to establish the user flow and likely places for choice divergence. This involved a group of 12 people who were asked round for dinner. Each person was asked to install the Deliveroo app and use it to order a pizza. At the start each person was asked to name their brand preference. As each person proceeded with their ordering decisions they were asked to explain how the design and layout of the app might be influencing their thinking. Everybody started out to look for the brand of their choice, and on discovering that it did not exist then proceeded to make an alternative choice based on customer ratings, on delivery times and on the menu options. Two people decided not to proceed with ordering a pizza. The exercise was sufficient for this work as it confirmed how individuals might use the app but it did have a number of limitations. For example, i) brand loyalty was not able to be robustly tested, ii) the participants selected did not represent the

population at large or a section thereof and iii) measuring how people's individual choices might have been influenced by being in a group situation was not included.

The predicted level of increased sales, (16%) is not consistent with the 54% increase suggested by Pidgen (2016). Pidgen does not indicate over what period this increase was experienced, there is no analysis as to whether the increase itself is changing nor any recognition that this may be simply be a reflection of early adopter's enthusiastic take-up of new technology. With this in mind either Pidgen's assessment was widely optimistic, or the approach documented here has significantly underestimated the level of increased sales from the expanded TZ. Although the probability outcomes may be open to question, it does demonstrate the interplay between NRC's current TZs, its future one and the role Deliveroo has in supplying food from competing restaurants.

This dissertation assumes that the only way to order food via Deliveroo is through their app, even though it is actually possible to do so by way of its website. It is also based on the number of current downloads, and has not sought to make any projections for 2019 or beyond. Neither Deliveroo themselves nor the app industry as a whole have yet to publish any projections on the number of food delivery app downloads but there is no doubt that if the number of people who have downloaded the app is significantly higher than the 9.7% assumed then the risk of cannibalisation and lost sales will be substantially higher, but then so will be the value of increased revenue from new customers.

### 5.2.3. Sample Size

This study is based on a sample of twelve cities designed to be representative of NRC's network, it does not include the larger regional cities such as Liverpool or Manchester, or London. The reason for choosing a selection of cities was so as to illustrate the importance of the interrelationship between the relative locations of Dine-In, Delivery and competitor restaurants. It is unlikely that a different choice of cities would have resulted in any significant differences in the spatial patterns The revenue allocation models are based on Bradford, but the methodology is equally applicable to all locations.

### 5.3.4. Age Profile Dynamics

The revenue calculation model assumes the atypical customer to be an urban dweller living in one of twelve cities and in the 18-35 age range. The future sales by postcode is based on the 2017 estimate of the number of people in the 18-35 age range in each postcode district within Bradford, and therefore any variations in the number of people across postcodes is implicitly built in to the calculation (see Figure 15).

With the exception of the 18-35 age range the study did not consider any other socio-demographic factors. Of particular significance might have been the following; sex, marital, or dependency status or income brackets, as well as homeownership status. These are the type of characteristics that a marketing department, or advertising agency would consider of significance in order to accurately identify and target a particular consumer group. Research by Mintel (2019) suggests that "*Younger people and families are more likely than average to order a home delivery*" and research by GrubHub (Q4cdncom, 2019) found that that women order more food for consumption at work than men do. This suggest that socio-demographic factors are important and any future studies would benefit from researching these and incorporate them accordingly.

### 5.3.5 Urban vs Rural users of Apps

This dissertation's focus has been on urban consumers and therefore there has been no consideration in differences in urban/rural usage of apps or rural/urban distances. Mitchel (2017) suggests that there is a significant urban/rural divide in the use of apps, and gives the example where urban users are twice as likely to use the services of GrubHub, an Aggregator operating in the United States ("US").

Consideration would need to be given to the importance of download speeds; Riddlesdene, & Singleton (2014) have identified inequities in download speeds in different locations and in different societal groups.

Research would also need to be made into urban/rural drive-times. While rural driving speeds may be faster than in urban areas, the distances from restaurant to consumer are greater and therefore given the increased risk of a takeaway meal getting cold before it reaches the purchaser, a question might need to be answered as to whether current heat insulation standards used by the Aggregators will be sufficient for expansion in the rural market.

These factors would need to be incorporated into any future research on rural use of apps, and further research will be required in order to determine if the UK's urban/rural divide is as significant as in the US.

### 5.4. Areas for Further Research.

Although this dissertation references pizza as one particular type of food offering, its focus is not the cuisine but on the location of the restaurants; cuisine is only significant in the context of competing brands. With that in mind, the methodology designed here has broad applicability and could be of interest to any restaurant chain seeking to partner with any one of the Aggregators.

This study has demonstrated that Aggregators are likely to have a significant impact in the food delivery market. It has not assessed whether the methodology has applicability to other retail sectors, but there are parallels between restaurant food delivery and wider food retailing such as supermarkets and specialist foods. Supermarket operators already have a significant online presence, many of whom have their own bespoke delivery service, but many smaller more specialist outlets, such as Planet Organic (Planetorganiccom, 2019) or Fine Food Specialists (Finefoodspecialistcouk, 2019) do not, and therefore there is some scope to examine how this study might be applied to those operators.

The importance of waiting times is less significant in non-food retailing because perishability is not a factor to consider in calculating delivery distances, but consumers, whether in the real or online world, wish to physically possess their purchase as soon as possible, and therefore delivery times remain important. To that extent understanding the importance of TZs and corresponding overlaps with

competitors remains of equal importance, and therefore that aspect of this work is of potential interest to retailing at large.

The work is of potential interest to Aggregators who may be looking for empirical evidence refuting claims that partnering with them will result in high levels of lost or cannibalized sales. The revenue allocation models might also be applicable in any situation where a business is seeking to allocate revenue across competing as well as overlapping sales territories. Finally, although this study has been UK based the methodology has equal applicability in any country where Aggregators operate.

### 5.5. Summary.

This dissertation has demonstrated that GIS techniques can be used effectively to assess the impact that introducing an Aggregator will have on a retailer's delivery business. It also demonstrates how GIS can be used to create a spatially based financial model to allocate income. In addition, it has shown how retail theories first developed for the real world can now be applied to online retailing.

# 6. CONCLUSION

There were three aims to this study. The first aim was to investigate what impact Aggregators might have on the business of a UK national restaurant chain. The methodology focused on i) analysing changes in the size of the TZs before and after introducing the DSA, ii) on identifying the area of overlaps and iii) on analysing what impact the TZ of competing restaurants might have. The results, communicated through a series of maps, demonstrate that GIS techniques can be effective as management tools. By looking at the TZs in twelve cities the analysis has shown that all cities, with the exception of Canterbury can be expected to experience an increase in sales, (possibly by as much as 125% as in Bath). Introducing the DSA will expand TZs but as some of the DSA catchment area overlaps with the existing TZs this raises the risk of sales cannibalisation (from 57% in Bristol to 100% in Bath) Furthermore incorporating DSA into an expanded TZ introduces Deliveroo's catchment area for competing restaurants and therefore increases the risk of sales loss to competitors (from 20% Bristol to 100% Bath). It has demonstrated that understanding the location of Delivery, Dine-In and competing restaurants and the spatial relationship between them is important when deciding what strategy to adopt. These results suggest partnering with Deliveroo may be best rolled out on a city by city basis rather than on a national one.

The second aim of the study was to develop a financial model in order to equitably allocate increased sales to franchisees. Two models have been proposed, both use postcode as the basis for apportionment. One model is based on TZs, the other on apportioning the income to the restaurant nearest the postcode in question. Each approach has its attractions but also disadvantages.

The third aim was to explore how prevailing retail theories might be applied to the online world. The literature review illustrates how the physical location of restaurants are influenced by the relationships between i) time ii) cost of travel and iii) distance. This dissertation has shown that the way in which restaurants are ordered on Deliveroo's app demonstrates the continued importance of a number of these theories, in particular, proximity to rivals (i.e. Principle of Minimum Differentiation) and clustering (i.e. Central Place Theory). Given that restaurants in the online world

have a virtual rather than a physical presence the ideas behind Bid Rent Theory are not applicable but hedonic pricing and behavioural economics remain valid in influencing a customer's purchasing decision.  However, retail theories will need to be updated in order to apply to the online world. Whilst the main principles of retail theories remain current, the relationship between i) time, ii) cost of travel, and iii) distance is very different. The key differences are that in the online world it is the product that is doing the travelling and not the consumer and the distance needing to be travelled is determined by the Aggregator and not the consumer. Furthermore, Agglomeration Theory may also need to be updated to include in its definition of infrastructure access to internet, download speeds and the role of Aggregators.

This dissertation is seeking to identify some of the dynamics at play between the physical and online worlds. It is a new area of study and has not yet attracted a great deal of academic attention. Of particular interest for future research might be an assessment of online retailing in order to determine whether theories around the interplay between distance, time and cost are consistent from one online retail sector to another. Further work might also include reviewing the academic literature on courier routing, pickup and delivery times and comparing this against how Deliveroo appears to have solved the problem and suggest how this might be applied to other logistics businesses such as DHL or Parcelforce.

# AUTOCRITIQUE

I wanted to investigate an issue that had commercial value. With this in mind, the focus of this paper, namely the role that Deliveroo is having in reshaping the relationship between the online commercial world and its real world equivalent is a very topical one; this is something that many sectors of the economy are having to grapple with. Furthermore, investigating the interplay between catchment areas, as well as considering how spatial modelling might be applied to revenue allocation, are financial and strategic issues of relevance to most industries.

Given that Deliveroo's activities play a significant role in this dissertation it would have made sense to have met with them to understand their business model better, and in particular gain greater clarity as to how they define the radius of their delivery. Armed with this information I would have felt more confident that the area of the DSA is indeed an accurate representation of reality, and thus have more confidence around the overlaps in the DSA and TZ. Deliveroo may also have been able to shed more clarity around the percentage of people who have downloaded their app, as well as have some insights on future downloads trends, all this being valuable information for forecasting demand.

Deliveroo is but one of several Aggregators in the UK; the nearest competitors with similar business models are UberEats and JustEat. It would have been a valuable exercise to identify how many people have downloaded these apps and model the impact of these two aggregators; thus providing NRC with alternative partnering choices.

The risk probabilities are based on the likely answers to a series of 5 questions. The answers used for this dissertation are based on a small (n = 12) informal survey of app users, as well as, critically on an assumption as to how brand loyal customers are. Given that the scoring model is highly sensitive to changes in the percentages it would have been a good idea to undertake a more formal consumer survey to better understand buyer behaviour as well as to obtain more certainty as to brand loyalty.

Notwithstanding these limitations the exercise has, essentially delivered that which was originally required of it, and has been a worthwhile study.

# Appendix A: Summary of shapefiles referenced in the Methodology section

| Shapefile | Referenced Location |
|---|---|
| S1 Shapefile of NRC's Delivery Restaurant locations | Step 3 |
| S2 Shapefile of NRC's Dine-In Restaurant locations | Step 3 |
| S3. NRC's Delivery Restaurant TZ | Step 4 |
| S4. NRC's Dine-in Restaurant TZ | Step 4 |
| S5. NRC's combined TZ for both Dine-In and Delivery | Step 5 |
| S6. DSA from all NRC's restaurants | Step 5 |
| S7. NRC's new combined TZs (i.e. its existing ones and the new DSA | Step 5 |
| S8. Locations of competitor restaurants | Step 7 |
| S9. DSA for competitor restaurants. | Step 7 |
| S10. Areas of NRC's expanded TZ exposed to cannibalised or lost sales. | Step 8 |

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