



An exploration of solutions for improving access to affordable fresh food with disadvantaged Welsh communities

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ABSTRACT

Our research is rooted in community operational research (community OR) and adopts a qualitative problem structuring approach to exploring potential solutions for addressing inequality in access to affordable healthy food in disadvantaged communities in Wales, UK. Existing food provisions are synthesised and barriers to their effectiveness are identified. A portfolio of actions and commitment packages is co-developed with multiple stakeholders in order to bring about desired changes. Although these solutions address concerns specific to local Welsh communities, they can be generalised and applied in similar settings where food desert problems prevail. We draw upon insights from the literature on inequality, food deserts, and social capital to conceptualise the solutions around both material (providing and accessing) and social (reconnecting and strengthening) aspects. By addressing both material and social aspects simultaneously, we show how community-driven intervention can contribute to reducing inequality in disadvantaged communities. Our research experience reveals that community OR is particularly effective in tackling a 'wicked' problem such as food deserts, and allows researchers to engage with communities, gain an understanding about the problematic situation and guide intervention efforts in a sustainable and systemic manner. A number of methodological reflections are offered as a way to contribute to the development of the field as a whole.

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1. Introduction

Income inequality has been on the rise in most Organisation for Economic Co-operation and Development (OECD) countries, including the UK, for many years and the situation has worsened for the poor (OECD, 2015). Yet the concept of inequality has not received much attention in management research, and when it has, it has predominantly been from the perspective of economic and income inequality (Bapuji, 2015). Without a sufficient understanding of the complex social and economic needs of the poor, initiatives seeking to address inequality, which may be imposed by large corporations or even governments, can have unintended negative consequences (Hall, Matos, Sheehan, & Silvestre, 2012). Community OR (COR) argues that the best way to generate commitment to new practices in order to promote elevation from poverty and social inclusion is to ensure that disadvantaged and vulnerable commu-

nities play a central role in identifying problems, generating and implementing solutions (Midgley & Ochoa-Arias, 2004; Mingers & White, 2010).

COR is well-positioned to respond to such issues of inequality because improving the social welfare of the least powerful is at the heart of both its conceptual contributions and its methodological orientation (Johnson, 2012; Midgley & Ochoa-Arias, 2004). COR considers how inequality can be addressed through the improved provision of goods and services and/or social policy actions. COR demands rigour in boundary critique and flexibility in methodology in order to solve systemic, complex, 'messy' social problems such as inequality (Henao & Franco, 2016; Midgley, Munlo, & Brown, 1998; Wong & Mingers, 1994). Boundary critique suggests that to be systematic, interventions need to encompass reflections about the issues of exclusion and inclusion of the system considered (Midgley & Ochoa-Arias, 2004; Midgley et al., 1998; Midgley, Johnson, & Chichirau, 2018). It is not about generating general comprehensive theories (Midgley et al., 2018) but rather about recognising and critiquing our own boundary and value judgements in order for our analysis and intervention to be more com-

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prehensive and to avoid the marginalisation of minorities (Kagan, Caton, Amin, & Choudry, 2004; Ulrich, 2000).

Our research focuses on the issue of inequality in relation to access to healthy and affordable fresh food in Wales, UK and discusses the community-driven solutions that emerged from a participative intervention. Areas where people do not have easy access to healthy and affordable fresh food – and in particular, poor communities where people have limited mobility – are known as ‘food deserts’ (Lang & Caraher, 1998; Wrigley, 2002). Food deserts represent a complex inter-linkages between growing health inequality, disparities in access to food, compromised diet, under-nutrition, and social exclusion (Walker, Keane, & Burke, 2010; Wrigley, 2002).

Studies of food deserts stress that poor access to nutritious food may be linked to poor diets and, ultimately, to obesity and diet-related diseases. Previous studies (O’Neill, Rebane, & Lester, 2004; Zachary, Palmer, Beckham, & Surkan, 2013) identified that local residents from disadvantaged communities, although keen to improve their diets, were prevented from doing so by various barriers, such as lack of access to affordable and healthy fresh produce. These studies call for non-health-care intervention and for effective intervention in retail provision to ensure the availability of diverse and affordable fresh produce (Clarke, Kirkup, & Oppewal, 2012; Zachary et al., 2013). Our project was set in some of most deprived areas of Wales (See appendix 1a), and motivated by the following overarching question:

How can we facilitate the development of community-driven solutions to alleviate the food desert problem that can serve as an integrative basis for social change?

2. The food desert problem and the social capital approach to community disadvantage

Inequality is defined by economic factors (such as pay and income) related to wealth distribution, and by normative aspects and ethical concerns (such as physical isolation and segregation) that cannot be readily measured objectively (Heathcote, Perri, & Violante, 2010; Mohan, 2002). The tangible and intangible aspects of inequality are closely interrelated and have a number of consequences such as poor health, social exclusion and eroding social capital (Ansari, Munir, & Gregg, 2012; Neckerman & Torche, 2007). Our research considers the relationship between inequality, food, and health, and specifically deals with the problem of access to affordable fresh produce. By addressing the problem of food deserts, we assert the utility of COR in tackling a grand challenge in society while developing new theoretical insights from our systemic intervention.

In Section 2.1, we articulate how inequality is linked to residential segregation, which results in difficulties for the disadvantaged regarding accessing affordable fresh produce. We address how mainstream food retail supply chains have worsened the situation as a result of their focus on profit maximisation. We then discuss how the food desert problem has led to social exclusion and negative health consequences. In Section 2.2, we explore the role of social capital in addressing the multidimensional aspect of the food desert problem.

2.1. Food deserts: a multidimensional issue

The metaphor of food deserts was coined to describe communities deprived of access to appropriate fruit and vegetable retailers in the late 1990s (Beaumont, Lang, Leather, & Mucklow, 1995). It denotes the ‘access’ component of food security. Despite a general agreement in the literature about the link between access to fresh produce, diet, and health inequality, and about food deserts being more prevalent in disadvantaged areas, there is no consensus about how food deserts are defined and identified (Wright, Don-

ley, Gualtieri, & Strickhouser, 2016; Wrigley, 2002; Walker et al., 2010). Food deserts emerge in disadvantaged communities due one or more of the following: access disparities, as a result of low income and residential segregation, or supply disparities, as a result of food retailers’ orientation towards profit maximisation – especially that of large corporations (Walker et al., 2010; Wright et al., 2016).

Residential segregation refers to a lack of diversity in the distribution and composition of the population in certain areas (Acevedo-Garcia, Lochner, Osypuk, & Subramanian, 2003). It can designate a separation between the rich and the poor as well as between ethnic minorities and majorities (Cheshire, Monastiriotis, & Sheppard, 2003; Watson, 2009). Where people live determines their social networks (Watson, 2009) as well as their access to local amenities and public goods, such as health care (Cheshire et al., 2003; Kawachi, 2002). Studies found that residential segregation reduces poor people’s access to reasonably-priced fresh produce and consequently, that living in poor neighbourhoods was associated with an increased risk of diabetes (Gaskin, Thorpe, McGinty, Bower, Rohde & Young, 2014; Zenk, Schulz, Israel, James, Bao & Wilson, 2005).

The growth of large chain supermarkets on the outskirts of cities has forced smaller, independent neighbourhood grocery stores to close, thereby creating access disparities for those with limited mobility (Coveney & O’Dwyer, 2009; Michele Ver Ploeg et al., 2009; Walker et al., 2010). Access to fresh produce is a challenge in rural areas due to the lack of supermarkets and distribution challenges faced by small grocery stores (Pinard, Byker Shanks, Harden, & Yaroch, 2016). Wright et al. (2016) and Donald (2013), point out that large chain supermarkets tend to be less interested in opening retail outlets in impoverished neighbourhoods because of their profit-seeking orientation. The lack of consumption scalability prohibits retailers from setting up stores in rural areas. Furthermore, deprived areas tend to have a higher density of fast food restaurants and corner shops selling processed food with high contents of sugar, fat and sodium (Clarke et al., 2012; Hilmers, Hilmers & Dave, 2012). These supply issues compound health problems such as obesity, which are disproportionately high in disadvantaged communities (Cetateanu & Jones, 2014; Rummo, Meyer, Green Howard, Shikany, Guilkey & Gordon-Larsen, 2015; Shaw, 2006). Unequal access to fresh produce leads to nutritional and diet-related inequalities between affluent and poor communities. It also contributes to social exclusion, which in turn reinforces health inequality among the disadvantaged. People from poor neighbourhoods have higher exposure to diseases and feel less happy due to status anxiety (how we think others see us) (Delhey & Dragolov, 2014; Inoue, Yorifuji, Takao, Doi, & Kawachi, 2013).

Therefore, ensuring proximity to local supermarkets is an important strategy for facilitating healthy eating (Apparicio, Cloutier, & Shearmur, 2007). Providing access to fresh produce is an essential step for encouraging people to eat healthily. Affordability coupled with other factors, such as culture, cooking skills, and food knowledge, is key in determining whether people will actually make a purchase (Hartmann, Dohle, & Siegrist, 2013; Pollard, Kirk, & Cade, 2002). However, despite the fact that there are currently multiple ways to shop for food, such as online shopping, access to affordable fresh produce remains a pressing problem faced by the disadvantaged worldwide. It exists across the UK (Clarke, Eyre, & Guy, 2002; Shaw, 2006), in China (as shown later in the article), the USA (Diao, 2015), Africa (Battersby & Crush, 2014), Australia (Coveney & O’Dwyer, 2009), Ireland (Layte, Harrington, Sexton, Perry, Cullinan & Lyons, 2011), France (Shaw, 2012) and Canada (Apparicio et al., 2007; Larsen & Gilliland, 2009). The food desert problem is one of the great challenges that policy-makers worldwide need to address.

2.2. The role of social capital in addressing the issue of food deserts

The nature of disadvantage is multifaceted. It is not only a matter of income and material redistribution, and demands more sophisticated responses (Basu, 2006; Cummins, 2014). One emerging perspective on disadvantage draws on the concepts of social capital and social cohesion (Schwanen, Lucas, Akyelken, Solsona, Carrasco & Neutens, 2015; Shortall, 2008; Shucksmith, 2000).

Social cohesion has various definitions (Chan, To, & Chan, 2006; Forrest & Kearns, 2001), but in most cases refers to the nature and strength of the relationships and interactions within a community or a society, and in particular relates to the level of trust and mutual commitment that exists between members of that community. Much of the literature discusses the necessity to remedy the erosion of social cohesion, often attributed to a rise in socio-economic inequality and in residential segregation, in order to improve the well-being of society as a whole (Chan et al., 2006; Coburn, 2000; Kawachi & Kennedy, 1997; Letki, 2008). Social cohesion is at times used interchangeably with social capital (Ansari et al., 2012; Veenstra, 2002) or is viewed as an overarching concept partly defined by the existence of social capital (Letki, 2008).

Among other things, social capital refers to 'the goodwill available to individuals or groups. It is rooted in the structure and content of an actor's social relations' (Kwon & Adler, 2014). The realisation of social capital through the social networks within and outside disadvantaged communities can be a mechanism through which individuals and groups can develop their capabilities. Bonding and bridging social capital play a critical role in community development (Ansari et al., 2012). While bonding is concerned with strengthening the relational ties that already exist within a community and thus strengthening its identity, bridging refers to the ties of a disadvantaged community to the wider society and enables accessing external resources, such as expertise or employment (Ansari et al., 2012; Forrest & Kearns, 2001; Portes & Landolt, 2000).

Literature on social cohesion alludes to exclusion as a major contributor to the 'restricted opportunity structure' of a community (Forrest & Kearns, 2001: 2134). Social exclusion implies a lack or denial of resources, rights, goods and services, and the inability to participate in normal relationships and activities, available to the majority of people in a society, whether in economic, social, cultural or political arenas. It affects both the quality of life of individuals and the equity and cohesion of society as a whole. Socially isolated people die at two or three times the rate of well-connected people (Dahl, Ivar Elstad, Hofoss, & Martin-Mollard, 2006; Kawachi & Kennedy, 1997). As such, the problem of food deserts and access to healthy food relate to social exclusion.

The development of social capital and social cohesion is crucial to developing healthy communities (Coburn, 2000; Kawachi, 2002; Kawachi & Kennedy, 1997), and the implementation of local participative food initiatives is particularly promising (Brehm & Eisenhauer, 2008; Macias, 2008; Twiss, Dickinson, Duma, Kleinman, Paulsen & Silveria, 2011). Schemes such as community-supported agriculture and community gardens (e.g. Firth, Maye, & Pearson, 2011) have been shown to have benefits in healthier lifestyles, skills development and the enhancement of a sense of community. However they still have a fairly mixed social impact overall. This is because they tend to appeal to people with higher levels of education and social backgrounds and require important time investments (Macias, 2008). These schemes tend to increase community bonds internally rather than promoting external relationship building, which is critical for increasing solidarity and respect across the social spectrum. Hence any community development initiative around food must be sensitive to the local context and must serve to empower members of the community through capacity building so that external ties can

be built (Portes & Landolt, 2000). Community involvement and participation is central to the achievement of wider socio-economic benefits (Ansari et al., 2012; White, 2003).

3. Research approach: a COR response to the food desert problem

Previous studies on food deserts tend to focus mainly on potential policy-related interventions to increase access to food; for example, to influence and persuade large retailers to set up a supermarket in a deprived area (Walker et al., 2010). However, there is a need to address the wider issue of who controls the food supply – beyond large chain supermarkets – and thus influences the food chain and food choices of disadvantaged communities.

Wright et al. (2016) argued that the only realistic resolution to the food desert issue was to give disadvantaged people access to a car because improving their income was clearly unattainable. While that solution might be somewhat difficult to finance and operationalise, it does highlight that if the travel/mobility issue is not addressed, there is little hope that the problem of food deserts will be resolved. Alternative approaches to food provision have only been considered in a few studies, such as those exploring the role of farmers' markets in improving food accessibility (Jilcott Pitts, McGuirt, Wu, Rushing, Uslan & Stanley, 2016; Larsen & Gilliland, 2009; Sage, McCracken, & Sage, 2013) that have shown mixed results. There is clearly a dearth of research that engages directly with the people in disadvantaged communities to explore potential solutions to the food desert problem, even though community-driven initiatives offer clear benefits for capability building and empowerment. Community participation raises the likelihood of the uptake of such initiatives because citizens who are actively engaged in the intervention processes show significant commitment to help make the project happen due to shared accountability and ownership of solutions (Wallerstein & Duran, 2010). COR is therefore well positioned to tackle the complex problems of food deserts. Its strength lies in the rigour of its critical systemic intervention, its flexibility in methodological approach, its strong encouragement of community participation, and multiple stakeholder involvement (Johnson, 2016). COR supports the use of both qualitative and quantitative models and methods (either separately or combined) that are suitable for local contexts (Johnson & Smilowitz, 2012; Midgley & Ochoa-Arias, 2004). Quantitative studies of food security issues tend to be efficiency-driven and use mathematical decision models and solution algorithms to address particular well-defined technical problems. For instance, Lien, Iravani, and Smilowitz (2014) solve the sequential resource allocation problem faced by a not-for-profit organisation distributing donated food from donors to agencies using heuristic optimisation methods. Mohan, Gopalakrishnan, and Mizzi (2013) use a simulation model to analyse and improve the efficiency and productivity of a food reclamation centre that redistributes donated food to various recipients. Lee, Sönmez, Gómez, and Fan (2017) develop a stochastic optimisation model to determine the schedule that maximises the volume of excess crops rescued from farm fields for the purpose of feeding food-insecure households, thus maximising social impact. As explained in the next section, our research adopted a qualitative approach.

3.1. Soft OR approach

We deployed a soft OR systemic intervention that aimed to explore ways to alleviate the impact of food deserts in South Wales. Food deserts represent one of the 'wicked (complex, long-term social) problems' facing society. The problem itself is not well-defined; there are multiple stakeholders involved with a high degree of uncertainty and often a lack of reliable data (Mingers,

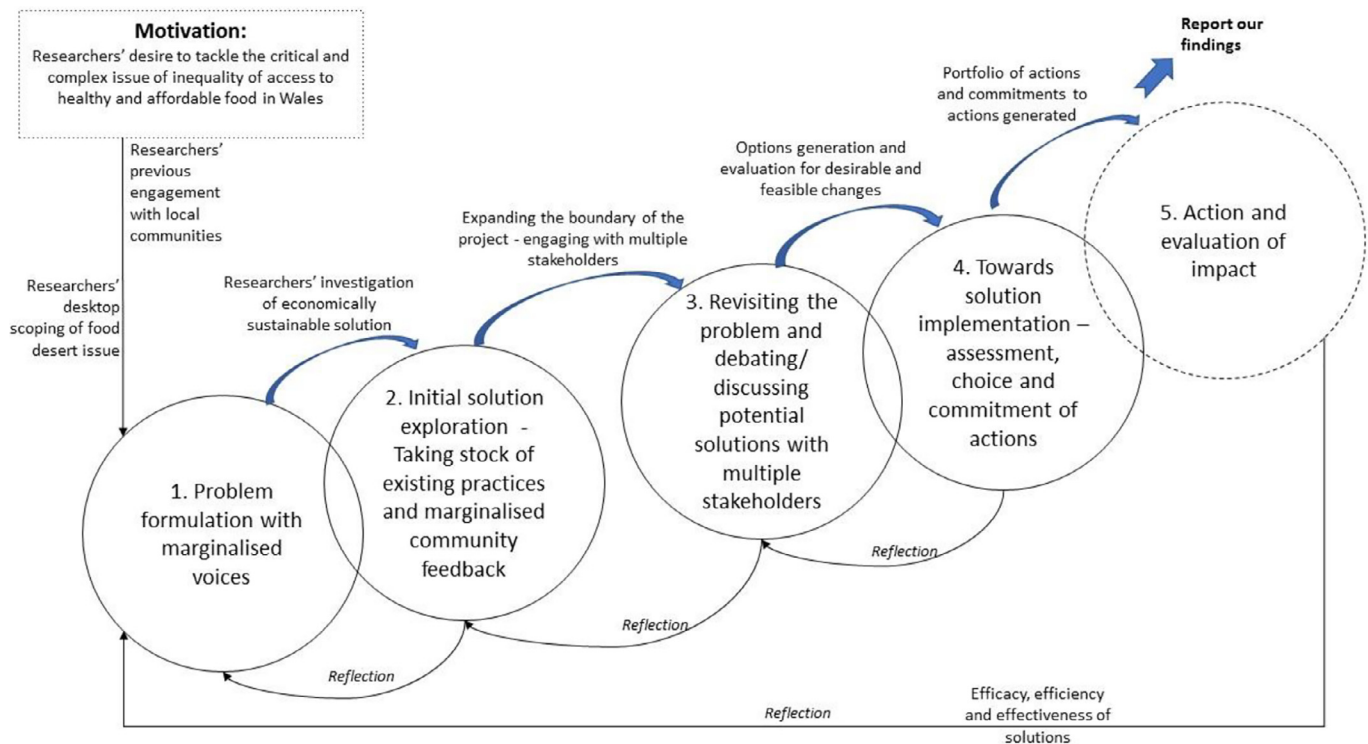


Fig. 1. The iterative and emergent research process (source: authors).

2011; Mingers & Rosenhead, 2004). This makes traditional 'hard (quantitative, modelling)' OR techniques less applicable and effective. Soft OR (debate-oriented, problem structuring) has long been recognised to be particularly suitable for dealing with such messy problems (Ackermann, 2012; Mingers & Rosenhead, 2004; White, 2009). Soft OR aims for exploration, learning and commitment rather than the optimisation and technical solution of a well-defined problem (Mingers, 2011). Given that a 'wicked' problem has no stopping rules, we never really come to a 'final', 'complete' or 'full' correct solution as the problem continuously evolves and mutates and there are no objective criteria, which enable us to prove that all the solutions have been identified and considered (Rittel & Webber, 1973). The criteria for judging the validity of a 'solution' to a 'wicked' problem are strongly stakeholder dependent. COR focuses as much on problem solving processes as on their outcomes (Midgley & Ochoa-Arias, 2004). It is about "designing interventions that are intended to improve the understanding of decision opportunities, data and solutions as much as producing specific prescriptions or strategies" (Johnson, Midgley, & Chichirau, 2018: 3). In this research, our aim is *not to identify an objectively best solution, but to achieve a shared understanding, the development of common purpose and the generation of a collective commitment to actions among stakeholders*. Fig. 1 summarises our iterative process of inquiry, which is ongoing.

Our research follows the typical logic of a systemic intervention (Johnson & Smilowitz, 2012; Mingers & Rosenhead, 2004) including the appreciation of the problem situation, analysis of the underlying structure/constraints, assessment of ways to improve the situation, and defining/taking actions to bring about the desired changes. In practice, however, research rarely follows such a neatly predefined and linear fashion where choices and steps are determined a priori. We need to be flexible and adaptive to the complexities and uncertainties of the real situation.

Our project originated from our motivation to address the complex social issue of the inequality of access to healthy and affordable food in their local context. Beyond our 'desire to do some-

thing socially useful' (Wong & Mingers, 1994), this motivation was grounded both in the experience of one of the researchers working closely with disadvantaged communities over decades, and the legal and socio-economic context in Wales, which promotes the search for pathways to sustainable transformation. One of our primary concerns was to understand and define who constituted the 'community'. In much business research, the focus remains on stakeholders with the most legitimacy, urgency and power despite calls to shift our attention to more marginalised 'fringe stakeholders' as a way to promote a more inclusive understanding of how 'wicked' problems are experienced and may be tackled (Hart & Sharma, 2004; McCarthy & Muthuri, 2016). Our intention was to promote a more bottom-up approach (White, 2003). Our approach is in line with the idea of doing research *with* rather than *on* communities and affirms the value of communities' experiential knowledge (Wallerstein & Duran, 2010).

In phases 1 and 2, our focus was on enabling those affected by the issue of food deserts to have a voice on how they experienced this issue in their daily lives, if it was high on their agenda, on what their real needs were and on how they envisaged its potential resolution. We initially defined 'the community' (Midgley & Ochoa-Arias, 2004; Midgley et al., 2018) as being those disadvantaged groups who were experiencing the issue of food deserts. An important outcome was the identification of social and material needs when accessing food, which are closely intertwined and cannot be treated separately. Our initial observations led us to discover that one critical problem of existing food provisions is their lack of economic and long-term viability. This finding prompted us to explore whether there were any commercially viable food supply chain models that could be brought into Wales to address the issue. Through research exploration and community focus groups we identified the supermarket home delivery model and the floating market model as existing commercially viable solutions.

As the research progressed we became increasingly aware of the 'blind spots' (White & Lee, 2009) that working with such a limited view of the community created in terms of develop-

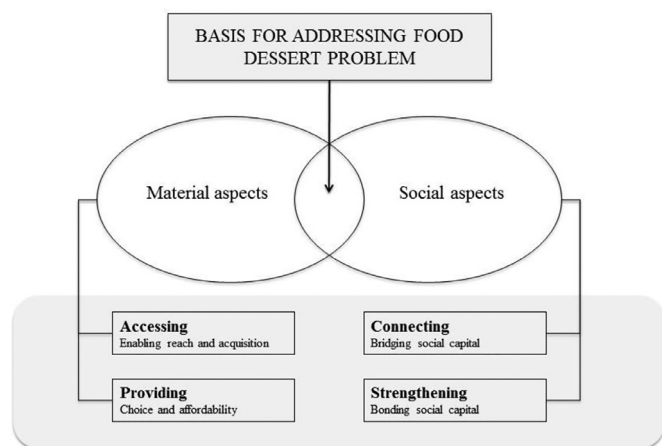


Fig. 2. A conceptual evaluation framework of the proposed solutions to the food desert problem (source: authors).

ing both meaningful and feasible solutions. The initial solutions identified were grounded in the disadvantaged communities' and researchers' mental models. While the focus groups with the disadvantaged participants were critical in articulating potential solutions, they were insufficient to effect meaningful change because they ultimately did not allow us to gain a systemic view of the question of food provision for disadvantaged communities in Wales nor did they involve stakeholders in positions of power who could share ownership of this complex problem. Reflecting on the actual 'usefulness' and the exclusion/inclusion boundaries of our research endeavour highlighted the need to broaden our engagement and re-define 'the community' as a wider stakeholder group including those having potential interests and power around the question of unequal access to food in Wales. This stemmed from the recognition that 'wicked' problems tend to have multiple problem owners (Taket & White, 2000). Activities in phases 3 and 4 primarily engaged with those stakeholders as potential problem owners and process champions to drive change. The main outcomes are a more comprehensive understanding of the problem situation, barriers to existing food supply provisions and a portfolio of desirable and feasible actions and commitment packages. Once we obtained a firm understanding of existing provisions, we realised that solutions do not have to be long-term nor do they have to be economically viable. As long as they add value to their intended beneficiaries, they are valid options. Rather than seeking economically optimal solutions to the food desert problem, we should aim to establish a portfolio of alternative food provisions, including both options identified through phases 1 and 2 as well as other options developed in phases 3 and 4 in order to address the issue more systematically.

We draw the closure to this paper after the identification of process champions and the generation of a list of commitment packages with stakeholders involved in Phase 4. Phase 5 in Fig. 2 will take place over a longer time frame over the next 2–3 years as some actions require substantial time to be implemented through collaborative actions between private, public and third sectors. During this stage, we will continue to engage, observe and evaluate the impact of those actions on the food desert problem.

3.2. Methods

While we followed a standard form of the principal problem structuring methods, our choice of method for each stage was dependent on its usefulness in supporting our objectives for each phase. Multiple methods were adopted (see Table 1) because the use of single method is often not sufficient to tackle the complexity of a problem situation, and method pluralism is critical

to a successful systemic intervention (Boyd, Geerling, Gregory, Kagan, Midgley & Murray, 2007; Henao & Franco, 2016; Howick & Ackermann, 2011; Mingers & Brocklesby, 1997). Techniques from Soft System Methodology (SSM) were used to make sense of complex situations, current food provisions and related barriers; while Strategic Choice was combined with SSM in the later stages of our intervention when decisions about, and commitments to, actions were being negotiated. The underlying logic of Strategic Choice is quite similar to and has much synergy with SSM. Mingers and Brocklesby (1997) point out that SSM has particular strength in appreciation and analysis while Strategic Choice is strongest for assessment and action. Such combination utilises the strengths and complementarities of the different techniques to provide a richer understanding of the situation and eventually better outcomes (Mingers, 2000).

4. Engaged communities in Wales and why they are in a food desert

Engagement is central to community development and requires a sensitive appraisal of the local context (White, 2003). The three selected communities are all categorised as deprived areas, according to the official 2014 Welsh Index of Multiple Deprivation (WIMD), where deprivation is defined as a lack of access to opportunities and resources. In our case, the common problem shared by the three communities is the relative unavailability of retail sources that regularly stock *affordable* fresh fruit and vegetables and other healthier eating options within the immediate locality. Health issues such as obesity and diabetes are disproportionately high in these areas. This problem was identified previously by the communities and frequently brought out to us via our long-term engagement activities with them. In order to tackle this issue, initiatives such as food box schemes, local farmers' markets, and local food cooperatives had been implemented, though with very limited degrees of success. Table 2 summarises the main characteristics of each of the communities involved throughout our research. A more detailed account of each community and an evaluation of their accessibility and journey time via various transport modes to affordable fresh food is included as supplemental material in Appendix 1b & c, providing further justification on the food desert phenomenon.

In order to appreciate the issue of food desertification in our context we adopt the most commonly used measures in the literature, which are area-based measures such as the travel distance (from the centroid of an area) to nearby stores and density (i.e. the number of supermarkets or convenience stores per resident within a geographic area (Jiao, Moudon, Ulmer, Hurvitz, & Drewnowski, 2012). Area-based measures are valid to examine areas where a relatively high proportion of poor people live, but will miss those who live in less poor areas but may also have limited access. Equally, not all people living in low-income areas are poor. Ownership of or easy access to a motorised vehicle may be the best marker of access regardless of whether someone lives in a poor area or not (Ver Ploeg, 2010). All three communities in this research are from concentrated deprived areas in Wales, and participants do not have easy access to a motorised vehicle.

A complete assessment of the food environment of the three communities would be desirable and is a worthwhile task in itself but is beyond the scope of this paper. Given that the lack of access to affordable fresh produce problem was previously established by the communities and further validated via our focus groups plus our evaluation of accessibility using area-based measures, we are confident that the areas we have studied are in a food desert. We believe our qualitative assessment of the problematic situation provides more insights than those quantitative evaluation of food deserts, as they are created by more than a

Table 1
Multimethod approach adopted and main outcomes of each research phase.

	Phase 0	Phase 1	Phase 2	Phase 3	Phase 4
<i>Iterative process</i>	Researchers' motivation to tackle the inequality of access to fresh food problem.	Problem formulation with marginalised voices.	Initial solution exploration – existing practices and economically viable solutions.	Revisiting the problem and potential solutions with multiple stakeholders.	Towards solution implementation.
<i>Timeline Techniques used</i>	October 2011–June 2012 Scoping study and narrative literature research.	November 2013–June 2014 Qualitative comparative analysis.	April–August 2015 SSM root definitions and CATWOE analysis.	August–December 2016 SSM root definition and rich picture.	August–December 2016 Strategic choices approach SSM root definition and CATWOE SSM model building.
<i>Activities</i>	Desk scoping of the food desert problem and preliminary engagement with local communities.	3 focus groups 1 small-scale survey.	1 case study (18 interviews and site visits) 2 focus groups.	1 workshop 2 focus groups.	1 workshop 2 focus groups.
<i>Key stakeholders involved</i>	Local communities engaged previously.	Three disadvantaged communities in Wales.	Case company in Beijing, Beijing government officers, UK retailers, two disadvantaged communities, Welsh government, WCVA, charity organisations, UK retailers.	Multiple stakeholders from public, private and third sectors.	Multiple stakeholders from public, private and third sectors.
<i>Outcomes</i>	Identified relevant studies and research gaps, developed research questions.	Top three factors identified that determine how disadvantaged people shop for fresh produce; Deep understanding of the experience of living in a food desert.	Assessment of current food supply provisions; Explored floating market and home delivery as desired solutions with the communities.	An enhanced understanding of current food provisions and related barriers.	A portfolio of actions and commitment packages developed by multiple stakeholders, process champions identified.

Table 2
Disadvantaged communities engaged in the study.

Name	Geography	Characteristics	Access to affordable fresh produce
North Merthyr Tydfil community	Semi-rural location, post-industrial.	Council estate with high levels of unemployment and crime, stigma associated with this community.	Access to most shops falls out of the half mile radius and only one convenience is within reach by foot yet it offers very limited choices on fresh produce and charges higher prices than supermarkets too.
Cardiff Riverside community	Inner-city, urban.	Multi-ethnic area, one of the poorest in the capital city, culturally and socially isolated.	There are a few convenience stores located in high streets which are more than half a mile away but within one mile radius. These tend to cater for people on the go and hence have fewer raw vegetables/fruits on offer (i.e. more sandwiches and ready to eat food). These stores tend to charge more than supermarkets. Three local ethical food shops are nearby, within half mile, yet again there are limited choices for fresh fruit and vegetables. A Sunday farmers' market is within walking distance but produce is perceived as too expensive.
Garw Valley community	Rural location, post-industrial.	Former mining community, high unemployment, isolation prevents access to food.	There is no shop within half a mile radius, and there are two convenience stores more than one mile away. Steep valley sides create further difficulty in access. The nearest supermarket is 16 miles away and takes about 1 hour and 20 minutes by public transport.

lack of physical proximity to retail outlets and encompass in their definition other important socio-economic, demographic, physical, financial, educational and cultural factors (Levin, 2011). There is still a lack of consensus in the literature regarding how a food desert can be measured and the concept remains imprecise, despite various efforts on the development of more robust measurement instruments (Beaulac, Kristjansson, & Cummins, 2009; Levine, 2011; Reisig & Hobbiss, 2000). Nonetheless, most studies do state some common characteristics of a food desert. For instance, Gordon, Purciel-Hill, Ghai, Kaufman, Graham and Van Wye (2011) developed a food desert index and concluded that food deserts are areas where there are few supermarkets, more small convenience stores (few of which sell healthy produce and food) and an abundance of fast food restaurants in urban neighbourhoods. Dutko, Paula, Ver Ploeg, Michele, Farrigan, and Tracey (2012) found that only two factors are strong and consistent predictors of food deserts through multivariate analysis: (a) concentrated poverty: areas with higher poverty rates are more likely

to be food deserts regardless of rural or urban designation, and (b) minority populations: in all but very dense urban areas, the higher the percentage of minority population, the more likely the area is to be a food desert. ERS/USDA (2017) characterise food deserts around two dimensions: low income (i.e. the tract's poverty rate is 20% or greater) and low access (e.g. access to the nearest supermarket is greater than 0.5 miles in an urban area or 10 miles in a rural area). While all three case communities were very different and characterised by different levels of physical access to retail food outlets, each community exhibits at least two defining characteristics of a food desert. All are poor, as defined by the WIMD (2014) and all have low access to affordable fresh produce.

Our purposive sampling excludes two types of people, namely (a) those who are relatively wealthy but live in poor areas, and (b) those who are poor and have limited access but live in wealthy areas. Wealthier individuals, regardless of where they live, are less of our concern as they generally can afford to travel to a

supermarket and have other means of accessing food e.g. via online shopping. For those who have low incomes and limited access and are scattered throughout areas with lower concentrations of poor people, we need individual level measures (i.e. the number of people with limited access). Such data is lacking in practice. Unlike the US where USDA's economic research service regularly collect a wider set of statistics on food choices, health and well-being, community characteristics and food access; data on household food access and insecurity is not currently collected through any routine national survey in Wales and in the UK.

5. Iterative approach to problem analysis and co-development of solutions and change

5.1. Phase 1: problem formulation with marginalised voices

Dialogues with local community organisations that have been actively involved in community regeneration initiatives, such as local community development workers, were established as a first step in developing a greater understanding of the social, political, and economic issues within the selected communities. In partnership with these groups it was decided that participants should be those responsible for buying and/or cooking food in their household and those who have difficulties in accessing fresh produce. These participants tended to be multi-disadvantaged, and typically included the elderly, single parents, people with learning disabilities, and the unemployed.

Communication with local community organisations was vital in deciding how to engage participants in the intervention. Rather than 'cold-calling' potential participants, we decided to take advantage of existing community groups that fulfil the inclusion criteria – for instance, in the North Merthyr Tydfil community development organisation, we approached an existing cooking group. One of the research team members had a strong relationship with this particular community organisation and had worked with them for over ten years. This played a critical role in enabling successful engagement between the research team, local participants and organisations.

Guided by our community partners, we opted for the development of a semi-structured focus group method as an effective means for consulting and co-exploring relevant issues with participants. Each focus group consisted of approximately 10–15 people, who were guided to prioritise and identify the main issues affecting access to healthier fresh food for them and their community. The design of our focus group sessions was planned with due consideration of participants' profiles. In order to avoid intimidating participants, we deliberately chose not to use PowerPoint types of presentations to aid the discussion. As some of our participants have low literacy levels or learning difficulties, we opted out of exercises such as using Post-It notes to prioritise issues and instead used jellybeans to enable them vote on the issues that mattered most to them or the options they favoured. The focus group sessions were voice-recorded with the permission of participants and transcribed for later analysis.

We explored existing shopping behaviours and food access issues that these disadvantaged communities were experiencing. We also conducted a small-scale survey targeted at people from more affluent areas. Most participants from this comparative group were from areas such as Penarth, Cyncoed, and Whitchurch in Cardiff, which are the least deprived areas based on the Welsh Index of Multiple Deprivation (WIMD 2014). Our primary criteria for selecting survey participants was based on WIMD's 'Wales (relatively) privileged reference group', i.e. living in Wales, in a non-manual occupation, working full time, with A level or more advanced qualifications, living in a house with/without mortgage and non-disabled. Given that qualifications have a major impact on

earnings and the impact is greater in Wales than that measured elsewhere (Davies, Joll, Jones, Makepeace & Parhi, 2011), we targeted both academic and professional service employees from higher education who tend to have at least a bachelor degree whilst fulfilling all the other characteristics. We distributed our questionnaire at a local library. In total, we collected 30 responses. This is obviously a relatively low response rate and therefore there are limitations to the conclusions we can draw from it. Yet the main purpose of conducting this small survey was to get a sense of the extent of the experiential and decision-making differences between the disadvantaged and more affluent groups, which was not based on our own biases. This small-scale comparative study has served as a basis to highlight more clearly the needs of the disadvantaged communities in terms of accessing food. We asked the same set of questions in both our focus group sessions and our survey of more affluent people (see Appendix 1b).

5.1.1. Identifying the issues

Table 3 shows the differences between the disadvantaged and more affluent groups in terms of the relative importance of decision-making factors in relation to food shopping. Price was one of the top factors reported as influencing where to go shopping; this is unsurprising considering the current economic climate. This is corroborated in the literature (Darmon & Drewnowski, 2008; Donkin, Dowler, Stevenson, & Turner, 2000). We identified three other important dimensions of the food shopping experience that are consistent across the three focus groups with disadvantaged communities: social interaction/experience, choice, and delivery. Note that choice and price were rated as equally important.

Social interaction

Early findings indicated that addressing the social aspects of shopping was crucial to developing any interventions aimed at improving the diet of the poorer communities. A vegetable box scheme in North Merthyr Tydfil had been piloted by the local community development organisation but proved to be unsuccessful. Although this scheme provided access to cheap and convenient fruit and vegetables, community group participants, many of whom were elderly and/or unemployed, told us they found the scheme to be isolating, as the journey to the shop and their interactions there were some of the few times they had the opportunity to socialise and catch up on local news and gossip. An unintended consequence of this piloted vegetable box scheme was to further socially isolate local residents.

The social aspects of shopping were mirrored in the South Riverside community, where the focus group involving South Asian participants indicated that shopping was a key part of the ethnic community network. In this locality, the two main centres for purchasing food items were the local community shops, where ethnically specific ingredients were bought, and the nearby national chain supermarket, where more general items would be bought. Visits to local shops provided an opportunity for family members to catch up on local news. Men, in particular, would often sit in the shops for quite long periods of time, often discussing community-related issues:

'In our culture men do the food shop; well, the women do the shopping but the men pay. Especially in Muslim culture, men are the providers for their family. He buys the food for his wife and his children. In the local shops, the Halal shops, it's an opportunity for the men to come in and catch up on the news and what not... The Halal shops are particularly a place for the elderly to congregate. To go out, to get out of the house, go round and browse, it can be a bit of a lift to their day.... It's also an opportunity to go visiting: "oh, I'm popping to the shops and I'll pop in and see so and so." In Ramadan, the shops are buzzing' (excerpt from South Riverside focus group participant #3).

Table 3
The top three factors affecting where to shop (disadvantaged vs affluent communities).

Responses/Factors	North Merthyr (n = 12)	Cardiff Riverside (n = 15)	Garw Valley (n = 15)	Total for disadvantaged group (%)	Comparative affluent group (n = 30) (%)
Social experience	12	13	13	38 (90%)	0 (0%)
Choice	6	10	7	23 (55%)	23 (77%)
Price	5	9	9	23 (55%)	22 (73%)
Ease of delivery	6	7	9	22 (52%)	0 (0%)
Convenience	7	3	3	13(31%)	18 (60%)
Journey safety	0	2	1	3 (7%)	0 (0%)
Available time for shopping	0	0	2	2 (5%)	1 (3%)
Quality	0	0	1	1 (2%)	25 (83%)
Others (e.g. presence of a local butcher)	0	1	0	1 (2%)	1 (3%)

The group from the Garw Valley echoed the importance of social interaction and how, particularly for the elderly, shopping trips provide an opportunity to reinforce their social network and catch up on local news. This group lamented the closing of two Co-operative shops located in the neighbouring villages. These stores had previously provided a key platform for people to shop and socialise, but had closed and been replaced by one in the middle of the two villages. This made economic sense to the company, but ultimately people felt that the social aspect of shopping had diminished and that they had lost 'their' co-op:

'Shopping at the local shop, you get better service. They know you, and it is more of a social experience, it's much better, it's like a bloody soap opera.... It keeps you connected with people in the community... I think local shops were useful for people who are lonely in the day as they can come out and have a chat... If I go to the shop and I meet someone I haven't seen in ages and we have a good chat, that can be the highlight of my day, it's really nice' (excerpt from Blaengarw focus group participant #7).

People mourned the loss of their local butcher and baker, as people felt they knew where their food came from. Those shops were central to the identity of these villages and their closure was seen as 'killing' the village:

'If you are going to bring life back to the rural areas, I think it is important you don't just concentrate on the big urban areas like Cardiff as that will suck the life out of the rural areas' (excerpt from Blaengarw focus group participant #4).

While people from the three disadvantaged communities rated social interaction as the most important factor, findings from our comparative more affluent group suggested that such factors do not impact their shopping decisions. Instead, quality was rated as the most important.

Choice and price

Another key issue identified was the importance of choice. In North Merthyr Tydfil, this was identified as another shortcoming of the box scheme. Additionally, when using the Internet or some sort of mobile market for food shopping was suggested during the focus group, participants indicated that they welcomed the choice offered by large supermarkets and would prefer to travel in order to have this choice first-hand because seeing, handling, and selecting produce was a very important consideration. With both the vegetable box scheme and Internet shopping, community members indicated that they had to tolerate what was provided rather than select the items they preferred:

'That's what I don't like about shopping online. I like to pick my own apples and things, with them (picking in the supermarket) they are just going to pick the first thing to hand' (excerpt from North Merthyr Tydfil focus group participant #9).

Choice was important to South Riverside's South Asian community. Community members recounted how, in their large extended families, there are often very different dietary needs. Older family members wanted traditional foods and often bought from local shops, while younger family members required more 'Westernised' foods.

Price was rated as equally important as choice. The group from North Merthyr Tydfil, expressed that, in the past, although they may have done the majority of their shopping in a large, centrally located supermarket in town, they felt that recently there had been substantial price increases. One of the older retired group members told how important price was to her, and her discussion in the focus group illustrated that she had very detailed knowledge of the different prices of commodities.

Price and choice were ranked third by our comparative affluent group. Both communities use major retailers as their main shopping outlets. The difference lies in their second choice of shops. People from more affluent communities use premium retailers that often charge a higher price for the products and services offered as complementary choices, while people from deprived communities tend to be more price-sensitive, visiting budget providers. This is unsurprising, given the difference in purchasing power between the groups.

Delivery

The North Merthyr Tydfil focus group in particular had limited access to cars or public transportation and recounted how the most significant barrier they faced while shopping at the local town centre some two miles distant was transporting purchases home. Community members said they would make a number of trips during the week, as it was impossible to carry everything in one go. They identified one scheme in particular whereby one chain of supermarkets would deliver shopping on orders over £25. Although this could be a significant outlay for individuals on a very limited income, sometimes people would shop together in order to achieve the required spend:

'The reason I don't use Internet shopping is because there is no free delivery. If they had free delivery it would swing it for me.'

'I could do with a cart horse to do all the carrying ...carrying means you can only do a certain amount of shopping at a time, when you are on the bus'(excerpts from North Merthyr Tydfil focus group participant #7 and #12).

Hauling food back home from the shops was also an issue in South Riverside. Certain food products such as rice and vegetable oil are bought in large quantities and often too large to fit in cars. The local Asian businesses catered to their customers by delivering sacks of rice and drums of vegetable oil:

'The local Halal food shops will deliver to your house like rice bags. It's a struggle for them to carry. Asian people don't buy half kilo of rice, they might buy 45 kilos as it will last four to

five months and it is better value, and 30 litres of oil and sacks of onions as well' (excerpt from South Riverside focus group participant #5).

The group from Garw Valley emphasised difficulties regarding transport and delivery. Residing in a rural area, they tended to buy everyday items from local convenience shops but acknowledged that it costs more to do so. All participants confirmed that they do their main shopping at supermarkets in the nearest large town, seven miles away. People who cannot afford a car, or who are unable to drive, constantly experience difficulties with carrying large quantities of items back home.

Responses from the comparative group indicate that more affluent participants use their own cars for shopping and do not think that transport or delivery is problematic. Both groups often used local convenience stores to top up their needs and typically walk to such stores for small-volume, impulse, or top-up purchases. Overall, online shopping is unpopular with disadvantaged communities due to a combination of factors, including cost, lack of access to IT equipment, and literacy and language issues. One focus group participant commented, 'I do not even know how to switch on a computer'.

These findings clearly illustrate that the way people shop for food is a complex matter. Shopping provides a forum for social cohesion by providing opportunities to meet and discuss local news and exchange gossip and a stage for displaying social norms to the wider community. Therefore, any potential solutions to this problem should centre on both the material and social needs of the disadvantaged and should design its offerings according to the top three priorities identified in Table 3.

5.2. Phase 2: initial solution exploration – existing practices and economically viable solutions

There is a need to evaluate the extent to which potential solutions promote more equitable access to fresh produce and the development of social capital. We propose a framework developed from the social capital literature (Fig. 2) as a means to evaluate the potential solutions identified.

5.2.1. Taking stock of existing food supply provisions

We conducted an extensive analysis of existing food provision initiatives currently available to the communities concerned – namely, food co-operatives, vegetable box schemes, farmers' markets, online shopping, convenience stores, and neighbourhood food collection (Fareshare). While each of these schemes has its own unique appeal to the customers they serve; they all have limitations in addressing the needs of disadvantaged people in terms of access to food (Table 4). These solutions are either economically unviable or do not address the social needs of the disadvantaged. We consider economic viability important because non-profit schemes would typically rely on sponsoring bodies such as government agencies or local councils to provide financial support to sustain the initiative. If the funds dry out, the scheme will then collapse. Moreover, any of the proposed initiatives have to address the social interaction needs of the disadvantaged people, which were strongly voiced by our focus group participants.

Of all the possibilities outlined in Table 4, the emergence of chain convenience stores provided by large retailers has played a significant role in replacing independent grocery stores, which could otherwise be a potential option for addressing the aforementioned challenges. However, this type of store tends to be located in areas where there is a condensed population, as it needs a reasonable daily sales volume (so-called 'critical mass') for long-term business. While this critical mass is difficult to achieve on a daily basis in rural or disadvantaged areas (where per-person spending

is likely to be lower), a 'convenience store on wheels' potentially provides a win-win solution. This forms the core of the concept of the floating market, which, if coupled with flexible supply and logistics provisions, may introduce a new, commercially viable and socially sustainable option. The rationale is that if we could mobilise a convenience store, we could then elevate the issue of setup and running costs in physical infrastructures, such as the rent and maintenance of estate and utilities.

Next we focused on exploring whether such an economically viable floating market existed in practice. We searched internationally and identified a few practice examples: the floating market launched by Nestlé Brasil to serve the riverside populations of the Amazon; the traditional floating markets in Bangkok; a 'mobile good food market' in Toronto; and a floating market example in Beijing, known as a 'fresh produce mobile market'. The Brazilian example has a primary aim to reach potential customers in the rural area without the consideration of providing a platform for social interaction, while the Bangkok floating market is not 'real' anymore, and most of the transactions are tourist-oriented. The example identified in Toronto is financially supported by the local government, and hence does not fulfil the criteria of autonomous economic viability. The example identified in Beijing appeared to fulfil both the economic viability and social interaction criteria. We had the opportunity to investigate this last example, which provided us with invaluable insights about its operation model. The main purpose of studying this floating market case in Beijing was to understand what it entailed, how it worked, and how it differed (if at all) from other approaches to bringing people and healthy food together. We are mindful that there may be examples elsewhere and specifically contextually closer to the situation of the communities in Wales that we are not aware of. Nonetheless, insights gained from investigating the case provide a refreshing perspective around the practical functioning of the floating market and how local communities experience it.

In the Beijing case, one single company is responsible for the operation of the floating market, centrally sourcing fresh produce from farms or wholesale markets, managing the storage of these produce, providing training to the affiliates, and obtaining approval from central municipal government offices and local residential community committees for setting up individual floating markets in local residential areas. The company operates an affiliate model for the distribution side, with affiliates using either their own or leased vehicles, paying a small fee to the company and being responsible for their own profits and losses. Local community members described how the floating market addressed their mobility issue by coming 'right at their doorstep' and had become a social hub. A more detailed description of how such a floating market operates in Beijing and our research activities can be found in Appendix 2.

5.2.2. Community-led assessment of commercially viable solutions

At this stage, we reported the findings of our exploration to the local communities involved at the beginning of the study in order to evaluate the potential applicability of floating markets to address the food desert problem they face in Wales and to investigate alternative options available. We were mindful not to impose our ideas but to build our enquiry with the community members in order to assess the proposed solution and enable the community members to solve the 'access to fresh produce' problem in the best way they knew how. We revisited and held additional focus groups with two of the original three groups involved in our first phase of intervention. We were unable to have the Riverside group participate in our focus group within our planned timeframe.

We asked whether the issues identified in the previous session were still their main concerns. We used the visual diagram to show

Table 4
Assessment of existing food provision initiatives (source: authors).

Initiatives		Description	Limitations
Not-for-profit	Local food co-operative.	Food co-ops are run weekly by volunteers from a community venue such as a school, community centre or workplace. Customers go along to their chosen food co-op at the allocated time/day and place their order one week in advance with the volunteer running the food co-op, and then goes along the following week to collect their bags.	Food co-ops rely purely on volunteers, and many of those are not economically sustainable.
	Vegetable box (government initiative)	Eligible people can receive a box of vegetable delivered to their doorstep every week.	People find it socially isolating and there is a lack of choice.
	Neighbourhood food collection (Fareshare)	A charity initiative, which receives food surplus from the food industry and send it to charities and community groups who transform it into meals for vulnerable people.	There is an uncertainty of what food is available and their primary beneficiaries are the homeless.
For-profit	Convenience stores	Convenience stores are small retail formats that stock a range of everyday items and are often located in residential areas, high streets and motorway service stations.	This retail format has to be located in a relatively condensed population area in order to justify investment on physical infrastructure. Hence, such stores are often not available to people living in a rural area. They also tend to charge a higher price.
	Online shopping	People use Internet based e-commerce outlets to buy groceries.	This retail format is not suitable for people who cannot afford or are unable to use a computer, or have no debit/credit card bank account.
	Farmers' market	Local farmers come to a designated place on a weekly basis to sell local produces.	This type of food provision attracts people who are more affluent, with produce often too expensive for the disadvantaged. Farmers' markets tend to be located in central urban areas where there is a condensed population.

the top three factors that had been identified. Participants confirmed that those issues were still significant. We asked whether there were additional concerns, and the participants did not identify new issues. Following this, we asked again how these issues could be addressed. We had not received any potential solutions from previous focus group sessions, but given that there was a time gap between the first and second sessions, we thought people may well have developed more insights regarding the problem. This step proved necessary.

One of the participants pointed out that a budget retailer specialising in frozen food had started to offer free home delivery since our last focus group if a customer bought over £20 worth of products from their store. Participants welcomed this initiative but complained that this particular retailer did not supply sufficient choices for fresh produce. Participants then commented that if other larger grocery retailers could offer the same type of home delivery service, this would help solve the problem they face. Recognising that home delivery may be a viable option, we asked them to further assess the feasibility of this option. We further guided the discussions using the CATWOE framework. SSM emphasises the use of *root definition* to succinctly describe a purposeful activity as a transformation process by considering the elements of C (customers), A (actors), T (transformation process), W (Weltanschauung, i.e. worldview in context), O (owners), and E (environment constraints) (Checkland, 2000: S27–28). We found that the CATWOE mnemonic is particularly useful in conducting a structural analysis of a complex notional system of human activity, such as our case of floating markets. For example, we asked participants who should take the lead in persuading other retailers – and in particular, the ones that have presence nearby – to provide home delivery services, who could benefit from this solution, who should own the transformation process, and what might be the potential constraints. Various answers to those questions were captured in writing, and a root definition and a CATWOE table was developed accordingly.

When no new ideas were proposed, we presented the example of the floating market and circulated the pictures taken in Beijing.

We shared the experience of walking through the whole process with the participants and explained why and how the floating market was developed in Beijing. The range of choices offered and the popularity of the floating market in China impressed all the participants. A few participants asked questions about the prices of the produce of the floating market compared to those of large supermarkets. We asked participants to think whether they would like to see a similar floating market in their local community and why. We followed the same CATWOE structure used for the home delivery solution. At the end of the session, we asked the participants to vote using jellybeans on which one of the two identified solutions was their favourite. It was a way to elicit preferences and open a conversation about the two options, without making the vote a tool for final choice and decision-making, which would raise concerns regarding power. Our approach stemmed from concerns for equitability and from our intention to facilitate sensemaking around potential solutions (Raymaker, 2016). Some preferred the home delivery option; while others believed the floating market was more desirable. Some commented that they would like to see both options in practice. We replicated the same structure in our second focus group session. No new solutions were identified. In terms of potential beneficiaries, other than the intended disadvantaged people, participants expected that either solution would help provide much needed job experience for the young people in their community. Table 5 summarises the CATWOE framework the participants developed for each solution.

In evaluating these two solutions in light of the framework proposed in Fig. 3, it is clear that the home delivery and the floating market models address the spatial and material aspects related to the unequal access to and supply of food. The home delivery model appears less promising when it comes to developing the capabilities of communities through the enhancement of social capital. The home delivery solution relies on existing channels of purchase and distribution and requires the participation of existing large retailers, who need to be convinced of the financial value of the initiative prior to implementation. The floating market model may actually prove more effective and powerful in addressing the social

Table 5
Community assessment of both floating market and home delivery options (source: authors).

ROOT DEFINITION	Economically viable supply chain solutions to provide affordable fresh produce to local communities in order to improve their diet, health, and social well-being.	
CATWOE	Home delivery	Floating market
Customers	All customers, particularly the disadvantaged; potential victims: local shops.	All customers, particularly the disadvantaged; potential victims: local shops.
Actors	Retailers that offer a sufficient range of fresh produces with affordable price (perhaps in smaller packs); third party logistics service providers.	An intermediary or a consortium of retailers or a large retailer (service providers), suppliers (farmers), and governments or charities (sponsor).
Transformation process	A home delivery service to the disadvantaged.	Floating market supply of fresh produce to local communities.
World view	Addressing the material needs of the disadvantaged: health inequality.	Addressing the material and social needs of the disadvantaged: health inequality and social exclusion.
Owner	Large retailers.	The service provider of the floating market.
Environment constrains	Culture change to promote new ways of shopping/working; retailers' reluctance and an individual store's capability to operate this model.	Spacs constraints, weather, uncertainty, and the cost of bulk sourcing (with some potentially from overseas).

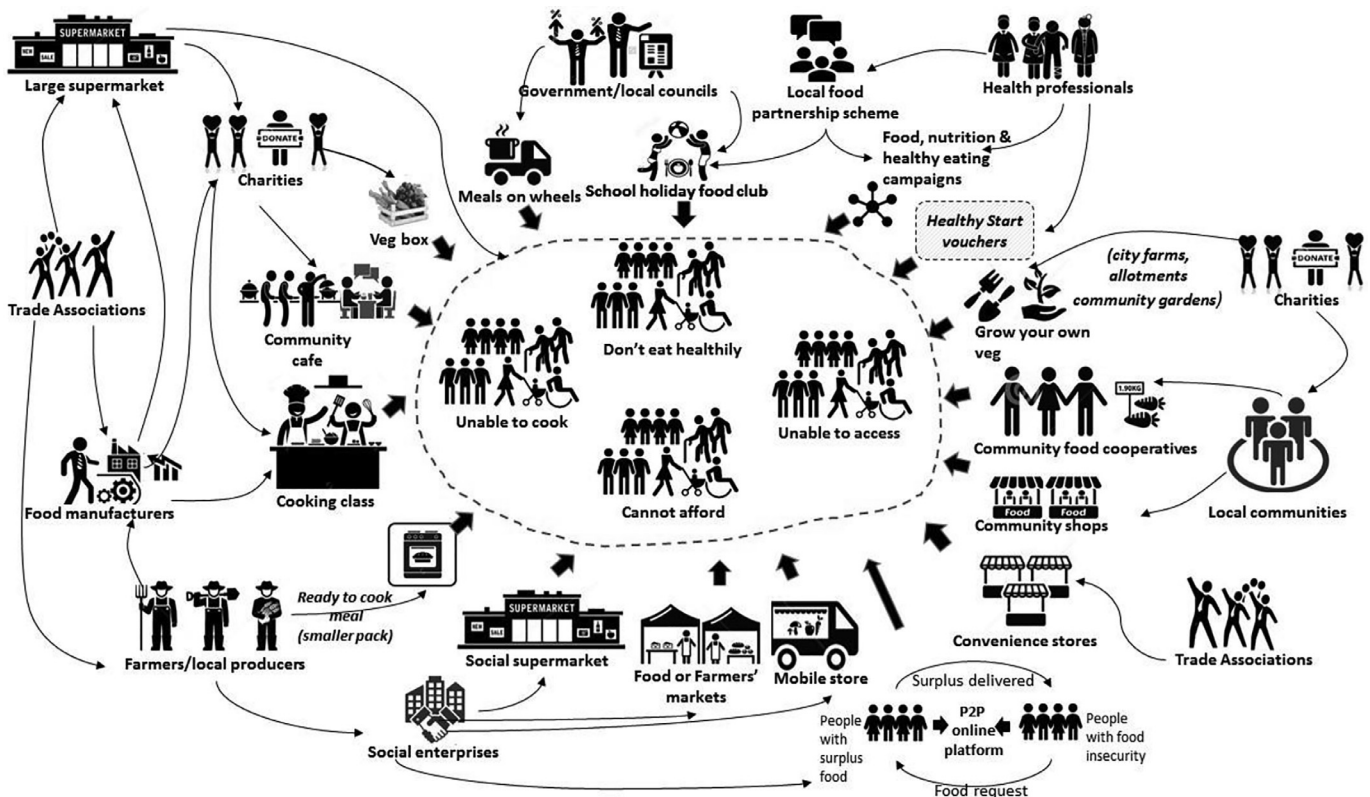


Fig. 3. Rich picture of food provision initiatives.

issues faced by disadvantaged communities. Our project showed that the floating market had a clear *bonding* effect by strengthening the intra-group interactions whereby group members can obtain emotional support and share information with each other. The floating market has a *bridging* effect, albeit less significant. This is because the floating market acts as a bridge by connecting disadvantaged people with the wider public and by removing social isolation and the exclusion caused by economic status. Overall, the floating market model, though more challenging to set up, appeared to be a promising solution, at least from a social capital perspective. The home delivery approach may involve potential risks to the disadvantaged communities, such as exploitation for short-term profitability.

5.3. Phase 3: revisiting the problem and potential solutions with multiple stakeholders

Given that food deserts are such a complex problem and local context varies among different communities, it is unlikely that one-size-fits-all solutions will work. There needs to be a portfolio of options available to cater for the diverse needs of deprived communities (Franklin, Newton, Middleton, & Marsden, 2011; King, 2008; Pearson, Duran, Martin, Lucero, Sandoval & Oetzel, 2011).

Reflecting our process of inquiry at this stage, we felt that there was a need to widen our boundary to include a broader range of stakeholders. This would allow us to identify a range of existing and new initiatives, their advantages and limitations, as well as barriers that may prevent them from going to scale or having

a bigger impact. More importantly, involving a wide range of actors would enable us to obtain commitments from potential process champions to drive desirable and feasible changes, and build essential links between the disadvantaged communities and potential problem owners. Local communities themselves felt that they were not able to drive the changes on their own and needed support – “We’re not going to at our age take a thing like that on, it’s too much. If you can organise it, get the place and what have you, and then we’re happy as volunteers” (participant aged over 60). Another participant commented “Like you know where to go to talk to about funding and stuff, but if somebody sets something up I don’t mind giving my time”. A clear message we got from our engagement with local communities is that they would like to be part of the co-creation process by committing their time and getting involved but they are not in the position to implement new initiatives on their own.

This led us down to two avenues. Firstly, we further explored how the two options discussed with community members could be operationalised. We started by raising awareness of our research via different communication channels – for instance, by posting on our university’s website, sending our research report to large retailers and government agencies, and attending non-academic conferences and workshops where government agencies and charities were present. With regard to the home delivery solution, despite our efforts with various large retailers and government organisations, we are yet to identify a process champion to take this initiative forward. Regarding the floating market option, we received a great deal of support from the Wales Council for Voluntary Action, who believe that this solution has the potential to address the strategic objectives of promoting prosperous and healthier communities, as set by the Welsh Government. With their support, we now have a large charity from Swansea willing to try out the floating market solution. Similar interests were received from a social enterprise currently operating a rural food and craft market and a local city food partnership programme, trying to take up this initiative. All three interested parties would like to try out the floating market solution by setting up a social enterprise. The social-enterprise-operated floating market would be run by the disadvantaged community members for the disadvantaged communities, creating much needed job experience for the young and serving the material and social needs of the elderly and other groups. At the time of writing, the scheme is at its planning stage, with the charity organisation progressing further into a detailed feasibility study. We are starting to investigate more local examples as well; for instance, two mobile grocery stores currently running in London and Brighton are being examined. There is no doubt that there will be plenty of challenges to adopt a successful business model identified elsewhere to South Wales. Unfortunately, academic literature lacks guidance on how to successfully replicate a business model from one context to another. Relevant context variations such as technical, cultural and political aspects may greatly influence the implementation and process execution of a business model (Ansari et al 2010). We hope that a combined understanding of domestic and international examples will provide us with useful insights to the trial. We will not know for sure the validity of the floating market unless we try this out in South Wales.

Secondly, we identified and engaged with other relevant policy and practice stakeholders (see Table 6). The shared concerns and perspectives of the local communities on the problematic situation were presented, as a basis for further discussions and debate.

5.3.1. Building a rich picture of the food desert issue with multiple stakeholders

Our workshop targeted specifically members from the Wales Food Poverty Alliance Network (WFPAN). WFPAN was set up by Welsh Government and Public Health Wales in April 2015 as a

think tank to bring a range of stakeholders together to identify strategic actions to tackle food poverty in Wales. Gaining access to this network offered us an invaluable opportunity to reach a wide range of stakeholders who actively attempt to improve the problematic situation at a national level. We started by presenting the insights gained through earlier phases – this prompted keen discussions among participants. We then asked participants what initiatives were currently in place to provide more fresh produce to the disadvantaged and encourage people to eat more fresh vegetables and fruits and fewer sugary products. A learning point from this workshop is that initiatives tend to tailor to a particular group of beneficiaries because there are different groups of vulnerable people who have difficulties in accessing affordable fresh food. Another key learning is the concern of those stakeholders about the long-term sustainability of existing provisions as many rely on funds from government or other sources such as the Big Lottery Fund. We were invited to become a regular member of the alliance as the value of our research aligns well with their strategic mission.

Utilising the network contacts and insights from the workshop, we were able to reach out to an even wider range of stakeholders from the private, public and third sectors. We organised two more focus group (FGs). The objectives for each FG are detailed in Table 6. We targeted organisations that provide either commercial or not-for-profit food supply chain provision to the disadvantaged, those leading multiple sustainable food initiatives, and academics actively researching in such areas. Therefore, solutions developed from the first FG tend to lean towards effective supply chain provisions. Potential opportunities were identified in the first FG for using planning policy to encourage more fresh vegetable provision and utilise public and/or group procurement to reduce cost and access barriers. Given that we did not have sufficient participants from planning or public procurement, for the second FG, we targeted stakeholders that specialise or operate in those areas.

A rich picture (Checkland, 2000) was co-developed with participants from the workshop and two focus groups, capturing existing food provision schemes combining insights gained from the workshop and FG sessions as well as from our wide literature research (Fig. 3). At the beginning of the workshop, we presented our initial draft of a rich picture based on our desk research and used it to probe discussions among participants. The diagram was then revised (mostly with added provisions), and later presented at the focus group sessions. It was then further refined and finalised based on the inputs from participants. The rich picture shows that there exists a range of schemes or initiatives trying to get more vegetables and fruit to the disadvantaged – led by organisations from different sectors. We classified them into four categories according to their target groups/population: people who are unable to access to fresh produce; people who cannot afford to pay for it; people who are unable to cook; and people who do not eat healthily.

5.3.2. Barriers to existing provisions

Participants in our focus groups were asked to list possible concerns and barriers to existing schemes, in order to build a comprehensive picture of the whole problematic situation – those issues and barriers were then clustered in collaboration with participants through iterative discussion (Table 7).

5.4. Phase 4: towards solution implementation

Once existing initiatives and barriers were exhausted, a range of opportunities for the alleviation of the problem was recommended. These can broadly be summarised as actions that target policy changes, enhance current initiatives or seek new approaches (see Appendix 3a for list of actions). We presented the basic principles

Table 6
Summary of stakeholder involvement activities.

	Stakeholder Workshop (SW)	Stakeholder Focus Group 1 (SFG1)	Stakeholder Focus Group 2 (SFG2)
Objectives	<ul style="list-style-type: none"> To raise awareness of the problematic situation within the Food Poverty Alliance network in Wales. To secure support from network members to take our work forward. To explore existing efforts that address food poverty and the food desert issue. 	<ul style="list-style-type: none"> To explore the range of existing instruments addressing the access and affordability issues of food insecurity. To discuss barriers to getting fresh produce to low income households To co-create commitments which could be made by businesses or public policy makers to scale up effective models or pilot new approaches. 	<ul style="list-style-type: none"> To discuss barriers to getting fresh produce to low income households. To co-create commitments which could be made by businesses or public policy makers to scale up effective models or pilot new approaches. To discuss how public sector could support a healthier food environment via planning and procurement.
Stakeholders involved	<ul style="list-style-type: none"> Public Health Wales (2) Local councils (1) Poverty division and food division representatives from Welsh Government (2) Voluntary organisations (5) Food and craft market social enterprises (1) Food consultants (1) <p>Local sustainable city food programmes (1)</p>	<ul style="list-style-type: none"> Charity organisations (8) Social enterprises (1) Local councils (1) Academics (1) Consultants (1) Food cooperatives (1) Local city food partnerships (2) The Association of Convenience Stores (1) Chain retailers (1) Large food manufacturers (2) 	<ul style="list-style-type: none"> Charity organisations (3) Public Health Wales (1) Local city food partnerships (2) Federation of City Farms and Community Gardens (1) Food in schools (1) City council planning officers (2) Farmers' market operators (1) Community growing programmes CLAS (1) National Farmers' Union (1) Food consultant (1)
Number of participants	13	18	14

of nominal group techniques (Potter, Gordon, & Hamer, 2004) as a way to facilitate the development of a list of actions through small group discussions and prioritisation. In both focus groups, participants were split into two or three sub-groups, and asked to compare and evaluate the list of options, and agree on two or three feasible options as priority action points. Participants agreed on the following principles when choosing their desired actions:

- 1 Actions need to build on and accelerate what is already in practice and should not duplicate or take over
- 2 Participants should not look for gains for individual businesses but explore workable solutions to improve the situation
- 3 Actions should follow the concept of proportionate universalism, i.e. lift all boats but pay special attention to the 'stuck (the vulnerable)' ones
- 4 Actions should be mindful of the potential negative impact on certain groups of stakeholders and negate potential conflicts in interests.

These principles helped ensure that the later agreed actions would be both systematically desirable and feasible. At this stage, we tried to move onto the SSM stage of model building and comparison, but it was deemed less useful given the time constrains of the workshop and the number of potential options developed. It was agreed with participants that model building could be conducted at a sub-system level after the workshop, when the problem owner and related actors would be identified for each agreed action (for an example of conceptual model developed by the convenience retail stakeholders, please see Appendix 3c). Focus group participants decided that the best way to ensure that options and actions were shared and owned by the participants was to produce a form of commitment packages – a portfolio of actions emerged as the result of debate and evaluation (Table 8).

The concept of 'commitment packages' comes from another problem structuring method, the Strategic Choice Approach, where decisions are seen as milestones rather than something that is final (Friend, 1992). Given the 'wicked' nature of the problem we are addressing and the emergence of our research, it appears more

appropriate because a 'commitment package is a package of incremental steps in a continuing decision process, in which immediate action is balanced with other more exploratory steps designed to work progressively towards future commitment'. Those actions will then lead to a further cycle of continuous improvement and decision-making. While Strategic Choice was adopted to structure the process of assessment and choice, CATWOE is used here to capture the outcomes, identify process champions (problem owners) and potential actors, as well as highlight potential constraints.

Agreed actions aim to either strengthen (for example, the convenience store offerings), extend (healthy start voucher) existing initiatives or to introduce (vegetable pledge and mobile convenience store) new schemes. Each initiative addresses a particular type of barrier identified earlier: the vegetable pledge tries to lead to a more profound change from policy perspective, healthy start vouchers deals with institutional barriers among local councils, the convenience store scheme utilises private actors to address the supply/access issue, while cooking aids led by food manufacturing target individual barriers of capacity and skills. The agreed commitment package represents a collaborative effort between public, private and third sector organisations in tackling the food insecurity and desert problem. It encompasses the voice of disadvantaged communities; for instance, via convenience retail offering scheme (approaches A and B). Appendix 3 provides a comprehensive list of actions developed as well as reasons why some options were ruled out.

In evaluating these solutions based on the framework presented in Fig. 3, it becomes clear that as a whole the portfolio proposed addresses material and social dimensions more holistically (see Fig. 4). Some schemes are more incremental such as enhancing the existing offerings of convenience stores and equipping people with sufficient nutrition knowledge and cooking skills. Others are more radical such the floating market is an innovative business model. Ideally, those interventions should improve both the affordability and accessibility of fresh produce while simultaneously providing an important social platform for communities.

Table 7
Issues and barriers identified by different stakeholders in current food provisions for the disadvantaged.

Stakeholders	Issues raised	Barriers	Barrier Type
Food and farming alliance	Low uptake of healthy start vouchers.	Government does not encourage the use of vouchers in order for cost saving.	Institutional barrier.
Local council	Lack of long-term sustainability of various schemes.	Lack of funds to support not-for-profit initiatives.	
Charity organisation	Knowledge/experience gained cannot be kept for long.	Project-based initiative lacks long-term sustainability. Once funds run out, knowledge and skills disappeared as well.	
Food policy development	Lack of sustainability of current scheme.	Economic viability of existing schemes.	
Sustainable food city partnerships	People are put off by some schemes that are designed to help them.	Aesthetics of various schemes (good intentions but negative impact).	
Food manufacturer	Mainstream food supply chain is not geared up to serve the disadvantaged.	Competition and fear of being the 'loser' if alternative supply chain model is put in place.	
Local food partnership	Planning and tax policy induced supply disparities.	Lack of incentives for fruit and vegetable retailers.	Policy barrier.
Local food partner programme	Lack of access to retail provision of fresh produce.	Law and regulation restrictions on alternative retail models such as local corner markets and mobile stores.	
Food social enterprise co-operative	Sustainability issues of various schemes.	Policy change and regulations attached to the day-to-day operational running of large amounts of surplus food.	
Academics Food Poverty Commission	Lack of access to affordable vegetable and fruit.	Poor people have more access to unhealthy food and less access to healthy produce.	Structural barrier.
The Association of Convenience Stores	Importance of convenience store.	Some stores especially independent stores do not sell much fruit and vegetables: cost and low profit margin.	Supply barrier.
Local food partnership	People's narrow choice of vegetables and fruit with sweet taste.	Supermarket further driving this behaviour	
Academics Farmers	Danger of agriculture off-shoring. Loss of nutrient values within fruit and vegetables.	Brexit induced supply uncertainties. Lengthy supply chain.	
Social care charity	Older people and people with long-term health conditions are unable to access healthy food.	Unable to cook due to lack of capacity.	Individual barrier (capacity and skills).
Local charity	Young men are not considered.	Unable to cook due to lack of cooking facilities.	
Food manufacturers	People don't know how to cook.	Lack of cooking skills.	
Poverty Commission	Growing as an alternative route to access to fresh produce.	Knowledge barriers on growing.	
Social care charity	People who have mental health problems and are isolated.	Difficulties and challenges in life make access to vegetables and fruit a low priority.	
Local food partnership	Lack of access to affordable fresh produce due to transport.	Public transport limitation: issue of carrying heavy purchases home.	Individual barrier (Transport).
Local food partnership	Lack of access to affordable fresh produce due to price.	Low income and the increasing price of fruit and vegetables.	Individual barrier (Income).
Charities encouraging foodgrowing	Growing as an alternative route to access to fresh produce: How to encourage more people get involved and benefited from growing.	Cost of growing.	
Food manufacturer	Change people's behaviours.	Cost per calories promotes choice of less healthy food.	
Food manufacturer	Change people's behaviours.	How to keep children immediately satisfied with something good.	
Social enterprise	People don't purchase enough vegetables and fruit even if access and affordability is not an issue.	Cultural issue and individual decisions people make about their food and health.	Individual barrier (culture and behaviour).
Food manufacturer	Change people's behaviours.	People's narrow choice on food in general.	
Local food partnership	Change people's behaviours.	People's narrow choice on food – bias towards 'sweet' vegetables.	
The Association of Convenience Stores	The role of convenience stores to serve local communities is underestimated.	People's misperception about convenience stores only selling rotten bananas and onions.	

6. Reflections and lessons learned

Reflection is inherent to the practice of COR (Midgley & Ochoa-Arias, 2004). Here we summarise our reflections and tease out some lessons that can be useful for other researchers.

6.1. Reflecting at the level of the researchers

The political dimension of the role of participatory researchers has attracted much attention in the action research and COR

literature (Coghlan & Shani, 2005; Marshall & Reason, 2007; Reason, 2006). Many authors mention that participative researchers perform different roles, which sometimes can be viewed as conflicting or situated at different ends of a spectrum (e.g. "advocates" to "objective observers" as suggested by Lippitt (1986)). While this role multiplicity is widely acknowledged across the literature, reflections on the emergence of these roles is rather scarce. We would argue that it is not possible to envisage all roles that one will play in a research project. We reflect on the different roles we have come to play at different stages of the research. At the start

Table 8
A portfolio of agreed actions for feasible and desirable changes.

ROOT DEFINITION	<i>Solutions to provide affordable fresh produce to local communities in order to improve their diet, health, and social well-being.</i>			
Initiatives/ CATWOE	Develop a pledge programme to ensure that all main meals procured through public funds include two portions of vegetables.	Proof of concept programme linking agricultural support to demand side incentives (healthy start voucher).	Convenience stores to increase fruit and vegetables on offer.	Brands of cooking aids offer link-save deals to fresh or frozen vegetables with a recipe card.
Root definition for each initiative (sub-system)	A voluntary sector led initiative to pledge and secure signatories from umbrella public sector procurement bodies to ensure that all main meals procured through public funds should include two portions of vegetables.	A government led voucher programme with the twin aim of improving health and supporting farmer incomes.	A private sector led initiative to increase access to fresh veg and fruit by developing mobile convenience stores as an additional retail channel (approach A) and enhancing existing stores' offerings (Approach B).	A private sector led initiative to provide educational support for cooking and healthy eating.
Customers	Those who consume public-procured meals e.g. NHS patients and schoolchildren.	Expectant mothers, new parents and their children, farmers.	All customers, particularly the disadvantaged.	All customers, particularly the disadvantaged.
Actors	National Procurement Service (Wales), NHS Improvement, Commissioning Authority, CCG, LEAs, large contract caterers, catering associations such as TUCO.	Government, Department of Health, NHS, National Farmers Union, DEFRA, retailers.	The Association of Convenience Stores, social enterprises, individual stores, suppliers, social impact investors.	Food manufacturers, retailers, dietitians.
Transformation process	Pledging public procurement bodies to commit two portions of vegetables per meal → commitments secured.	Need for a proof of concept for the revised healthy start voucher scheme → need met with proof of concept being developed.	Vegetable and fruit offerings → vegetable and fruit offering enhanced via new mobile store format and/or existing convenience stores.	Consumers' lack of cooking knowledge → consumers with improved cooking knowledge.
World view	Addressing the material needs of the disadvantaged: health inequality.	Addressing the material needs of the disadvantaged: health inequality.	Addressing the material and social needs of the disadvantaged: health inequality and social exclusion.	Addressing the material needs of the disadvantaged: health inequality.
Owner	Charity P	Department of Health and DEFRA.	The Association of Convenience Stores.	Manufacturers.
Environmental constrains	Reluctance from public procurement bodies; cost, existing practices, lack of persuasion power.	Budget constraints due to reasons such as Brexit, local council reluctance to encourage the uptake of the scheme; beneficiaries may see the value of vouchers as too limited; retailers feel extra administrative burden.	Space constraints, weather, uncertainty, and the cost of bulk sourcing (with some potentially from overseas); cost of waste if unsold.	Beneficiaries may not be able to get access to deals if offered via mainstream retail; lack of commitment from some manufacturers due to the added cost of operation and product design.

Abbreviations: CCGs (Clinical Commissioning Groups); DEFRA (Department for Environment, Food & Rural Affairs), LEAs (Local Education Authorities); NHS (National Health Service); TUCO (The University Caterers Association).

of the project we had clear intention of playing a facilitative role in bringing disadvantaged communities to explore their experience of access to food, whilst maintaining our position as academic researchers in terms of collecting, analysing, and reporting of data. As the project progressed, we found it more difficult to draw a line between these positions. The need to make more meaningful progress towards the actual development and implementation of solutions to the issue of food deserts became a central preoccupation. We find the taxonomy of roles proposed by Wittmayer and Schapke (2014) useful in making sense of the different roles we have played. We have made some adaptations in reflecting about our role from a social capital perspective, and specifically in the context of research with disadvantaged groups. Appendix 4 offers a more detailed account of our reflection on the multiplicity of our roles (from reflective scientist, change agent, to process facilitator and knowledge broker).

6.2. Reflecting at the level of the project

We reflect on the extent to which this project has actually been community-driven and has resulted in meaningful change. As the

voices of disadvantage communities are seldom sought, we needed to find ways to involve them in generating insights into the issue of food deserts. Our long term embeddedness in local communities plus the systematic and iterative research design allowed us to encourage them effectively to share their insights and experiences of how they access fresh food, which then formed the basis of solution exploration. In this way we gave the communities 'confidential space to develop their own views' (Midgley et al., 1998). In the subsequent phases of the project, we played an advocacy role in order to ensure that the concerns and issues expressed by these disadvantaged communities were not marginalised. We did this by first exploring desirable solutions with these communities and then acted as ambassadors to bridge their needs and desired actions with potential process champions and actors.

The practical value of the research lies in its contribution to gaining a valid understanding of existing and possible food provision solutions for the disadvantaged. Through iteration and boundary expansion, we have engaged in a process of collaborative sense-making with multiple stakeholders. The project has been rooted in the experience of local actors in Wales and therefore the insights developed are relevant for them. A collaborative space was built allowing participants to reflect and articulate their

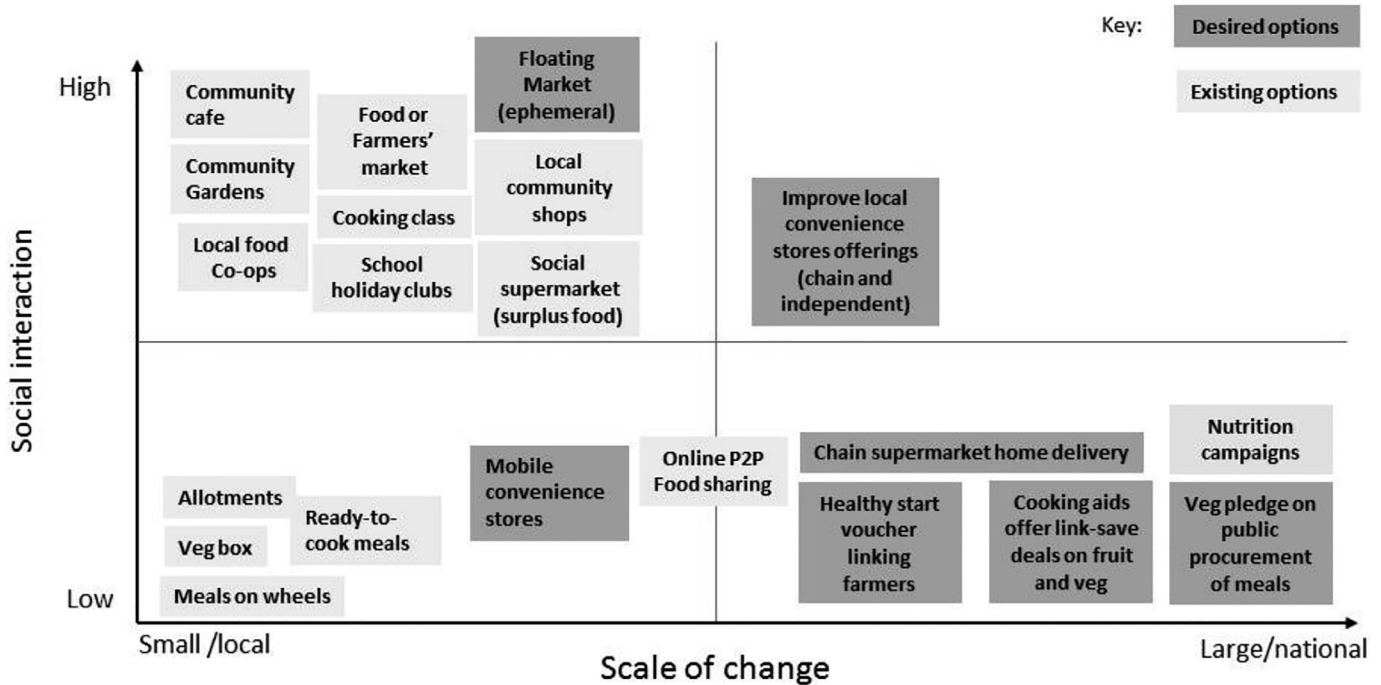


Fig. 4. Maps of potential identified solutions to the food desert problem.

conception of a desirable future in terms of food provision. This has contributed to increasing the capacity of the research participants for appropriate action and their ability for self-awareness. The broader value of the research is further evidenced in the work carried out in phases 3 and 4 to engage potential process champions across different sectors for developing future infrastructures. Such engagement reflects our strong commitment to embed the bridging element of social capital during the research.

We are aware of the limitations of our approach in terms of having defined a fairly narrow boundary at the beginning of the project. Engaging much earlier on with a wider group of stakeholders would have allowed a more systemic understanding of the issue of food deserts to emerge earlier and we may have been able to implement and evaluate some of the co-developed solutions by now. We remained preoccupied with the concerns of the disadvantaged groups and with finding commercially viable solutions for a large part of the project. By acknowledging these limitations and engaging in boundary critique in our research, we hope to convey how we have dealt with the 'inevitable absence of comprehensiveness' in the research.

6.3. Reflecting at the level of COR

This project has been a learning curve. Although the broad focus had been set at the beginning, the direction has evolved with time and along the progress. The 'doing' of COR requires stamina and endurance and is an emotional journey. It is a process that requires 'nurturing' and cannot be controlled as more traditional research would be (Minkler & Wallerstein, 2011). This may at times be overwhelming because there is no such thing as 'the end' of a participatory project tackling a 'wicked' problem. The researchers have a responsibility to the participants and need to find ways for meaningful change to occur, although they may face different limitations, pressures and performance indicators from their academic institutions. We believe that more accounts and reflections from COR researchers on these questions of emergence and time boundaries are needed in the future, in order to build collective learning on coping with emergence and uncertainty and with the challenges these may bring.

We would like to encourage further reflections on writing about COR as a significant way of knowing (Heron & Reason, 1997). Presentational knowing specifically embodied by the act of writing has received attention from a number of authors who encourage finding some level of congruence between form and content (Davies, 2004; Marshall, 2008). In writing this article, we have felt pulled in various directions. Our 'academic writing instincts' often led us down the path of established conventions of linearity and abstraction. We have found it particularly difficult to do justice to the iterative nature of the project. COR and other forms of participative research are often represented in the literature as neat cycles. Yet the messiness of COR makes its richness and we have tried therefore to find a balance between transparently reporting on this emergence and messiness and meeting the clarity standard of academic writing. Deliberating whether this has been a successful enterprise rests with the reader.

7. Conclusion and future research

Our research set out to address food deserts as one of the grand challenges of social and economic inequality. Placing the disadvantaged at the core of our systemic inquiry has given them a much-needed space to express their needs and desired ways of change. Three important factors were identified that affect the disadvantaged regarding accessing affordable and fresh produce: social interaction, choice and price, and ease of delivery. A combination of different methods from SSM and Strategic Choice were deployed to respond to contextual uncertainties arising along the progress. This methodological pluralism allowed us to be flexible and responsive to multiple stakeholders' concerns, helped build a fluid relationship between researchers and stakeholders, and improved participants' engagement and commitment to actions.

We contribute to the literature on food deserts through a more comprehensive understanding of current food supply provisions for the disadvantaged and their existing barriers. Most studies on food deserts examine access to supermarkets, and few have identified how other kinds of food provision can influence life in a food desert. A portfolio of feasible and desirable actions and commitment packages was developed by a variety of stakeholders from

the third, public and private sectors, in order to alleviate the food desert and insecurity problem. We further enrich the COR and food desert literature with the theoretical grounding and assessment of our intervention through the lenses of inequality and social capital. Our research shows that although nation-wide policy interventions are needed to reach large segments of the population, community-based solutions are required to solve local problems taking into account variations in local needs and contexts. This is an area where we envisage COR can play a significant role.

Although our project specifically addressed the concerns of disadvantaged communities in Wales, UK, the theoretical framework and the solutions explored could inform scholarship and practice more broadly, as food deserts are a worldwide issue. Our research highlights the value of COR for social sustainability (White & Lee, 2009) in connecting upstream supply chain design with a downstream approach to consumption-related inequality issues. To our knowledge, this study is the first of its kind to treat disadvantaged people as the focal subject of supply chain design and to promote a bottom-up, community-oriented approach to supply chain provision, clearly departing from the top-down approach taken by large corporations and policy-makers. Our research has important regional and national policy implications in terms of addressing both the material and social needs related to disadvantaged communities' ability to access to affordable fresh produce. Our project has resulted in an increased awareness of the food desert issue by government agencies, private and charity organisations. Their subsequent interest and commitment to the actions provide positive evidence of the impact of our project in trying to bring about desired social change.

As our research is exploratory and ongoing, there are exciting future research opportunities. We will follow up on the agreed actions and continue to engage with those multiple stakeholders in the execution and evaluation of these actions. We will further engage with the disadvantaged communities to ensure they are involved in the implementation phase and explore the subsequent impact on their economic and social wellbeing. Further research is needed on how the solutions proposed can help build resilience into the local food systems. Another avenue for research is to identify the factors driving the engagement with the different solutions in disadvantaged communities. This would provide valuable planning information to both practitioners and policy-makers in directing potential policy interventions. Finally, our research calls for an inter-disciplinary approach to developing more innovative approaches to addressing the multilevel impact of inequality issues such as food deserts. This will require joint efforts from scholars and practitioners from areas such as marketing, retailing, supply chain, policy and planning, operations research, health care, and management. COR is well positioned to play a significant role in helping to address such complex social problems and make a real difference in shaping the world we live in.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.ejor.2017.11.065](https://doi.org/10.1016/j.ejor.2017.11.065).

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