The Local Nexus Network Project Synthesis Report

Building sustainable local nexuses of food, energy and water

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Executive summary

Introduction

The LNN project was designed as a multi-institution, multidisciplinary project which was tasked with the goal of developing an evidence-based comprehensive research agenda. In so doing the project sought to foster an inclusive community of researchers and stakeholders for sustainable local nexuses organised around the environmental and social considerations linked to the redistributed manufacturing (RDM) of food. To achieve this, the LNN project undertook a complex multidisciplinary programme. This involved seven linked projects exploring a range of issues concerning the interplay between RDM and different aspects of the local nexus as well as of the policy and business implications of RDM. Issues covered included engineering technology and systems for food processing and energy/water supply, business models and supply chains, governance and whole-system integration.

To support effective integration of the data generated through these disciplinary studies and address questions regarding the practical "real world" value of RDM the studies focussed on two geographical case studies; Oxford and Northstowe and two exemplar products; bread and tomato paste. The selection of contrasting geographical areas allowed for comparison between the different challenges posed in affecting RDM of food in retrofitting RDM (Oxford) as opposed to incorporating RDM into a newly developed urban centre (Northstowe). The selection of two contrasting products allowed for an exploration of how RDM was likely to work in relation to products with significantly different supply chain characteristics. The report will then briefly discuss some of the main findings that the project reports yield, focussing on what they tell us about the feasibility of RDM and its capacity to address local nexus challenges.

RDM, the local nexus and the food sector.

Redistributed Manufacturing (RDM)

The term RDM is applied to a wide range of activities and processes through which manufacturing activity takes place in a more dispersed way than is currently the case, and involving new relationships in which the manufacturing process is more closely linked to the specific demands of diverse consumers. Thus RDM may encompass any technology, systems or strategies (or combination thereof) that enables such changes in the economics and organisation of manufacturing with specific reference to scale and location. It is important to note that while the focus in RDM is often placed on the manufacturing process itself. The emergence of such a model requires more widespread change than is suggested by a simple dispersal of manufacturing implies. As, if not more important, are innovations in the way in which producing firms communicate with their customers.

As the concept itself suggests, RDM in any specific sector is shaped by the nature of the product itself and highly fluid relationships between customers and producers. This makes it particularly

difficult to make generalisations about RDM which apply across different sectors. In the case of the LNN project such issues featured in many of the final reports of the different feasibility studies. Rather than a single form RDM in the food sector is likely to assume a variety of guises depending on the nature of specific products, the different demands that production at different scales places on resources (including energy and food) and the level of local demand for redistributed products.

RDM in the UK food sector

The food manufacturing sector in the UK accounts for a total of 16% of all manufacturing in the UK (figure 2.1) and employing at least 400,000 people directly. Over the last two hundred years food production in the UK has gradually changed from being a small scale locally-based process, to a sector which is dominated by mechanised, quality-controlled, and large-scale manufacturing process. However, the depiction of the food manufacturing sector as an intensive centralised activity tells only a partial story. The social and cultural values related to food and its specific physical characteristics, add to the potential and also to the complexity of RDM in the food sector. For such reasons, food occupies something of an outlier position in relation to RDM. The food manufacturing sector is part of a complex food system through which diverse nutritional, social, economic and cultural needs can be met in multiple ways. Rather than a movement away from one form of manufacturing to another RDM in the food sector may be better understood as shifts in scale within the food system in which nutritional and other needs are met in different ways by firms servicing different markets. In this context, and as the reports reveal, changing demand plays a critical role in shaping the ways in which food is produced and on the potential for RDM in the food sector.

The "local nexus" vision and its relevance to re-distributed manufacturing

Rising demand for food poses challenges not only to the food system but also to the interconnected water, energy and food systems. There has been an increased recognition that there is an interrelationship between water, energy and food systems and that meeting the needs for one of these resources may have implications on the availability of others. The growing recognition of such interdependencies between the water, energy and food systems has increasingly led for calls to recognise the significance of the nexus that links water, energy and food resource systems. Doing so presents significant challenges, not least in overcoming disciplinary barriers and policy practice which have tended to deal with water, energy and food (WEF) as separate systems which need dedicated scrutiny and specific separate policies. The LNN project is thus particularly concerned with exploring the potential impacts both negative and positive that RDM has for the local WEF nexus in specific areas. The WEF Nexus is thus employed as the lens through which the feasibility of RDM in food is assessed.

Programme and methodology

Underlying the LNN project was a concern with the question of the capacity of RDM to offer the potential for sustainable manufacturing through the framing of the local nexus of food, energy and water impacts. The LNN project did so by investigating localised food manufacturing and the

decentralised energy and water systems that interact with the food system along four research themes namely engineering, business, policy and society, and systems integration and three different sectors; food energy and water. The research was organised into a series of seven work packages. The outputs took the form of feasibility studies each of which focussed on one of the themes or sectors with an additional study which focussed on the delivery of a whole systems analysis;

Case Studies

The work undertaken through these feasibility projects focussed on two case study locales. One of these locations representing a situation of "retrofitting", where an existing system is to be changed to benefit from the paradigm of local nexuses and another representing "new development", where opportunities exist to introduce a new food, energy and water system. The first of the locations selected was Oxford, a small city in southern England with a population of 155,000 people. Compared with the average for Great Britain Oxford's population is relatively affluent. Moreover, it has a high proportion of non-national residents. This combination provides a demand for a diverse and high value added food offer and a strong local food culture exists in Oxford. The second location is Northstowe, an area of new development 5 miles outside Cambridge. These case study locales provide a common background for the different research themes to interact and integrate and served purposes ranging from collection of empirical data to stakeholder engagement. In addition, two contrasting exemplar crops; bread and tomato paste were also examined in some depth.

Exemplar products

Questions of location and scale in food manufacturing are closely linked to the specific characteristics of different products. With this in mind the two exemplar products were used to explore questions of scale of manufacturing in detail. The idea being that these products would serve as means by which to test the likely implications of RDM for different food products. The two products chosen, namely bread and tomato paste, were selected because they are currently supplied via very different value chains affording researchers the opportunity to explore the divergent likely impacts of the RDM of different products.

Findings

Food Feasibility Report

The food report suggests that RDM in the food industry is likely to be a partial process which is suited to certain processes and products and which is heavily reliant on the changing shape of demand. This suggests that an optimum arrangement for any specific product will vary depending on the nature of that product and the shape that demand takes. The report further suggests that there are more significant indications of social and cultural benefit from redistributed food manufacturing,

than of environmental benefit. There is also potential for economic benefit in reconsidering the location of manufacturing. The study cautioned against the danger of assuming that smaller-scale, more localised manufacturing is intrinsically environmentally and socially preferable. An in-depth approach is needed in order to evaluate the likely environmental costs and benefits associated with producing specific products at different scales and locations.

Understanding RDM in the food sector means understanding the key drivers of location and scale in food manufacturing businesses. A movement back towards smaller scale manufacturing will depend on different drivers such as changes in the combination of costs in the production process and demand drivers. A number of key characteristics can be discerned for products that have a high suitability for localised artisan manufacturing. These include freshness, culturally distinction or the 'authentic' nature of higher quality products. Yet such values are not in themselves sufficient to support RDM. Further work could explore in greater detail the full range of characteristics that make certain products more suitable for RDM. Such work would need to identify not only products for which the process of RDM is technically feasible but also the economic and social drivers that would support the move to RDM.

Energy Feasibility Report

An assessment of the likely energy impact of redistributing the manufacture of bread to the local level suggested that moves to more redistributed production would result in a significant increase in the energy required to produce the country's bread. In addition, there is likely to be a slight increase in emissions under this scenario unless local production was based on the technologies employed in highly energy efficient, larger scale bakeries. It may also be possible to reduce the energy requirements of locally based bakeries through, for example, mini hydro or solar installations, though this would be heavily dependent on sites possessing access to water resources or space for solar panels. Thus, from an energy point of view, RDM would only contribute to reduced demand if it involved the development of highly energy efficient local bakeries and home baking equipment. Whether such a situation could be economically feasible or structurally possible is open to question. This suggests that, from the point of view of energy efficiency and emissions reduction there is at best, a weak case to be made for RDM in the food sector from an energy perspective. Rather the report suggests that different scales produce better energy outcomes for different processes, the question of which scale works best depends on the characteristics of the specific process involved.

Water feasibility report

While the water study found that some elements of RDM could result in a marginal improvement in water supply these benefits would need to be offset against additional environmental and energy costs of securing water from local resources. When this is taken into account the extent of the benefit to be derived from RDM is limited. The most effective and economically efficient way of meeting the water requirements of small scale producers of bread would be through the provision of water from existing domestic supplies while the scope for tapping into alternative local supplies for these small scale producers is limited. By contrast somewhat larger scale producers might be better placed to exploit such alternative sources. Thus as is the case for energy, the water feasibility study found only limited evidence to support the idea that RDM in the production of bread would lead to greater efficiencies in the local WEF nexus. Rather the evidence presented in the report

suggest that some changes in scale at which production takes place could yield some efficiencies, however from the WEF point of view the optimum scale for particular processes is varied and is related to the specific characteristics of the process itself and the capacities available at different scales.

Business Feasibility Report

The business report found that when considering available resources it is currently not feasible to re-localise the production of tomato paste confirming the findings from the Food feasibility report. In terms of bread, re-localising the entire bread supply chain may not be feasible, but there are opportunities to re-localise parts or all of the value chain. Again this result adds further emphasis to the need for re-localising in the food sector to proceed with reference to the specific characteristics of particular products and of stages in the production of these products. The report also draws attention to the need for moves toward RDM to explore the commercial, as well as technical case for RDM. What the report suggests is that rather than full RDM there is scope for partial RDM whereby certain steps in particular supply chains could be relocated. The suitability of RDM in the food sector is dependent on each specific product and will vary from one location to another and therefore requires individual evaluation taking into account economic, social and environmental benefits and costs. In each case there must be;

- Available resources in order for businesses to invest in RDM. These resources extend from environmental e.g. water, land; to labour, with the necessary skills to carry out a job within RDM,

- A market demand for the product whether this is the local market, national or international markets.

- Available and affordable technologies.

Policy and society feasibility report

The report primarily focused on the question of public procurement finding that moves towards local procurement had been adopted by UK public procurers in the period leading up to 2008 as part of a drive to sustainability. The overriding trend since the financial crisis has been towards securing value for money. This has tended to restrict the extent to which public procurers can employ local sourcing as a criterion when making purchasing decisions. Nevertheless, while public procurement is a relatively small component of overall food consumption, public procurers are often among the largest purchasers of food within local economies and they do have considerable potential to support food RDM. However, while the potential of public procurers to positively contribute to the development of the local food sector through local sourcing has been asserted in the past, developments since the onset of the financial crisis mean there has been a reduction in the capacity of those charged with the direction of local procurement to source locally. Moreover, there is some evidence that suggests that the extent to which local public procurement contributes to making the food system more sustainable is limited. Further research and a renewed commitment to local procurement in public policy would be needed to support the sourcing of more food locally.

Systems feasibility report

The study showed that designing and optimising a food supply system from the WEF nexus perspective is a particularly complex task if factors from the physical, socio-economic and policy layer are taken into account. This notwithstanding, exploring the feasibility of RDM from a whole system perspective identifies opportunities for RDM, however in the short term the RDM business model is unlikely be able to compete on a price basis with mass manufactured food products. Rather the study confirmed that RDM produced foods need to focus on the other benefits that RDM offers to consumers to make a business case and justify higher prices. These include better quality food (e.g. fresher and healthier). From the policy side, the evidence suggests that RDM of certain food products does provide benefits for a region as a whole (e.g. more employment, better environment, less pollution, better health, less spending on health care). Thus, the systems report points to the broader role that RDM can play in delivering public goods. There may be a strong case for public policies to support for RDM of certain foods through, for example, policy measures to tackle energy price differences for large and small energy consumers in order to create a level playing field.

Key Learning

The reports suggest a rather mixed outcome, while some of the reports pointed to potential benefits to be accrued from the redistributed manufacture of food many also pointed to the fact that RDM is likely to have detrimental as well as beneficial impacts on the local WEF nexus. Other key learning included

1. RDM in food cannot be understood in terms of a direct like-for-like replacement of mass produced products with local alternatives.

2. There are more significant indications of social and cultural benefit from redistributed food manufacturing, than of environmental benefit.

3. Smaller-scale, more localised manufacturing is not intrinsically environmentally and socially preferable.

4. An in-depth product specific approach is needed in order to evaluate the likely environmental costs and benefits associated with producing specific products at different scales and locations.

5. An optimum arrangement in terms of the scale at which production for any specific product will vary depending on the nature of that product and the shape that demand takes.

6. RDM in the food industry is likely to be a partial process which is suited to certain processes and products and which is heavily reliant on the changing shape of demand.

7. From a resource point of view (energy and water) there is little evidence that RDM per se would contribute to reduced demand.

8. RDM can offer some opportunities for small producers to manufacture products potentially leading to a re-shaping of some supply chains, and bringing the product closer to the consumer.

9. While the potential of public procurers to positively contribute to the development of the local food sector through local sourcing has been asserted in the past, there has been a reduction in the capacity of those charged with the direction of local procurement to source locally since the onset of the financial crisis.

10. The business case for RDM in any particular product will depend on
    - Available resources in order for businesses to invest in RDM
    - A market demand for the product
    - Available affordable technologies.

11. RDM in foods generally leads to increased use of socio-economic resources. Any impact on the bio-physical sphere depends on the specific food product, process, local water footprint and crop yield.

12. Many of the potential benefits of RDM in the food sector take the form of public goods or benefits that accrue to localities as a whole rather than individual firms or consumers.

Gaps in evidence

The reports also identified a range of gaps in evidence these included:

Understanding of the complex dynamics that drive local food systems is limited and requires further exploration and clarification of key concepts.

There is a need for a comprehensive approach to the question of measuring the impacts of location and scale in food manufacturing taking into account not only the environmental considerations explored in the LNN but also the wider societal impacts of any move towards RDM.

There is a need to develop robust methodologies to assess the relative cost and value of different approaches to food purchasing and food processing which incorporates a comprehensive range of social, economic and environmental indicators.

The Business feasibility study in particular, pointed to certain opportunities for successful RDM, as well as to barriers that are likely to limit that potential. There is a need for further detailed work to explore such barriers and opportunities.

There is a need to increase knowledge concerning both the technical requirements of such waste conversion and also concerning its real impact on energy demand and how it could lead to synergies among different local processes.

Further work needs to be undertaken concerning the quality of data available and also on the development of strategies for overcoming deficiencies in data available.

More work is required to understand the determinants of local food demand and how best these can be changed in ways which support the wider consumption of locally produced food.