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DATA CURATION AND AGROECOLOGY

Examining data requirements for short supply chains

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Abstract – Digital preservation discourse tends to focus the organisational and technical processes required to make data, held in a recognised custodial environment, accessible and usable over the long-term. It rarely focuses on data needs requirements across the full lifecycle as defined by the *DCC Curation Lifecycle Model* (ref). This paper introduces the problem space for a project in mid-Wales which is taking a holistic approach to data curation and preservation. The *Tyfu Dyfi food, nature and well-being* project is supporting and developing agroecological practice in the UNESCO designated Dyfi Biosphere towards a more resilient and participatory local food system. Gaps in the creation and distribution of data necessary for successful collaborative food production and marketing are currently being identified. Next steps are the analysis of information flows across the partners to identify requirements for their long-term capture and access.

Keywords – digital curation, agroecology, food security, supply chains
Conference Topics – Environment; Resilience

I. INTRODUCTION

Data are created, stored, managed and accessed across all sectors of society making digital preservation and curation a cross disciplinary activity that is a meta-discipline of information science [1]. The widely cited foundational model adopted for the discipline, the *OAIS Reference Model* describes a custodial paradigm for data that is to be preserved [2]; while the *DCC Curation Lifecycle Model* looks outside the 'archive' to consider the full data lifecycle including the original creator and their creation of the data, and the use and reuse that might be made of it [3]. Best practice advice suggests that data curators should work with data creators in designing a data architecture that is fit for use, reuse and preservation. Studies have used the *DCC's Model* to analyse post-creation requirements for improving data curation methods [4], [5], and research into co-creation of arts and humanities data curation have been undertaken [6] but only a few have worked within a commercial sector to understand their needs and ensure curatable data at the pre-creation stage. Notable in this space are Martin *et al.* [7] who are developing interoperable data architectures the curation of fisheries data towards their eco-system-based management.

This paper identifies agroecological supply chains as an information space that requires robust data modelling, and a data architecture that embraces the full lifecycle from creation to post-creation curation, access and use, to ensure the success of the sector in the marketplace. It describes how the *DCC Curation Lifecycle Model* will be used to structure research into data requirements for the sector, in tandem with anthropological research methods, to profile information needs as part of *Tyfu Dyfi*. This pilot project aims to contribute towards showing how food can be sustainably produced using agroecological practices, contributing to food security and resilience in a local community, while improving the area's biodiversity and reducing greenhouse gas emissions.

II. FOOD SYSTEMS AND AGROECOLOGY

Access to adequate and sufficient food is a human right [8] and in the UK the COVID-19 pandemic, Brexit and more recently the war in Ukraine have highlighted the need for sustainable food systems to safeguard this right for its citizens

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[9], [10]. The complex global networks that ensure food availability can be readily disrupted and are generally outwith the control of those who need to eat [11]. Global food systems adopt factory style production methods which create large farm units, use chemical and intensive livestock production systems to maximize output, and prioritize quantity over quality or environmental protection [11].

Local food systems can create greater food security while also bringing better quality produce to the table. Community resilience is improved through local participation in food production and short supply chains, enabling appropriate responses to supply and demand and effective responses to national social priorities such food poverty and improved health and wellbeing [12], [13]. Local food systems can also play a part in mitigating the effects of climate change and biodiversity loss through their agroecological focus [12], [13].

Agroecology 'is a holistic and integrated approach [to agriculture] that simultaneously applies ecological and social concepts and principles to the design and management of sustainable agriculture and food systems' [14]. This transdisciplinary approach to food production 'includes the ecological, socio-cultural, technological, economic and political dimensions of food systems, from production to consumption' [8]. The values accrued by local food systems and agroecological methods are at the heart of the European Commission's *Farm to Fork Strategy* [10] and the reform of their Common Agricultural Policy (CAP) [15]. The UK's Department for Environment, Food and Rural Affairs' *Path to Sustainable Farming* acknowledges 'the connection between environmentally sustainable farming and an effective food supply chain' [16]; while The Welsh Government's report *Codesign for a Sustainable Farming Scheme* recognizes that farms need to be environmentally sustainable, the value of family run farms in protecting local cultures and the opportunities afforded by short supply chains [17].

III. Food systems information

In the era of 'big data', like other sectors of the economy (e.g., finance, manufacturing, and healthcare), 'big' farming is now information driven. Precision technology creates data which is used to increase yields in both crop and animal production. Spatial data tools including remote sensing and geographical information systems (GIS) technologies are used to monitor environmental conditions such as weather, soil health and crop growth. Through licensing agreements for the technologies used, this data, although created by the farmer, is increasingly in the ownership and control of big technology companies [13]. Similarly, market access to food for the consumer is also driven by data and more crucially access to that data.

Agroecology also needs information systems to create successful food systems but those created for 'big' farming do not scale down, as the user needs are so different. The full information ecology for supporting agroecology has received little research attention. Sligo *et al.* [18] identified that small to medium scale farmers tend to rely on interpersonal relationships for their information, while Clavert-Mir *et al.* [19] notes that traditional knowledge, shared through informal networks, invaluable for agroecology, are fragile. Their *e-CONECT Project* aims to capture these with 452 landraces – traditional or locally adapted species - documented. Several projects have focused on digitisation as a means to preserving published advice and research [20]–[22]. Meanwhile, a number of advice portals targeted at the sector aggregate information sources as advisory services. The Food and Agricultural Organization's (FAO) *Agroecology Knowledge Hub*[1] offers an international service that distributes information on research, legal frameworks, policies and programmes. In the UK, The Soil Association[2] offers a certification service and both advice and a brokering system between producers and markets for organic produce; while the Land Workers' Alliance[3] offers support, guidance and training for 'agroecological and sustainable land-based sectors.' Garden Organic[4] undertakes policy campaigning and research, offers an advisory service, and operates a heritage seed library.

The Open Food Network's[5] offer is more immediately applied to the problem, providing an online marketplace to support the development of a

[1] Food and Agricultural Organization's (FAO) Agroecology Knowledge Hub: https://www.fao.org/agroecology/policies-legislations/en/
[2] Soil Association: https://www.soilassociation.org/
[3] Land Workers' Alliance: https://landworkersalliance.org.uk/
[4] Garden Organic: https://www.gardenorganic.org.uk/our-work
[5] Open Food Network: https://openfoodnetwork.org.uk/

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sustainable food network along with its advisory information. Crucially for data systems to support agroecology their national Lottery funded *Food Data Interoperability Project*[6] is collaborating with the Data Food Consortium to develop open standards for technical and semantic interoperability that can 'be applied to tools for short food supply chain systems'.

IV. Tyfu Dyfi

Tyfu Dyfi - Food, Nature and Wellbeing is a pilot project supporting and developing agroecology in the UNESCO Dyfi Biosphere Reserve. Funded by the Welsh Government's Enabling Natural Resources and Well-being (ENRaW) scheme it is bringing together a range of partners and producers using agroecological methods to demonstrate 'how communities can be involved in their local food systems and enumerating the multiple benefits that accrue'.[7] It aims to 'provide a national exemplar demonstrating how multiple organisations can cooperate on local food systems.' It is supporting and training people to grow and cook food, investigating the potential for a community led agriculture initiative, undertaking field scale trials of crops with local growers, and developing a local market for products. The project is led by ecodyfi, an NGO that co-ordinates activity across the Biosphere Reserve and partners with Aberystwyth University, Garden Organic and local organisations concerned with food growing, sustainability and food justice - Penparcau Community Forum, Aber Food Surplus, Mach Maethlon and the Centre for Alternative Technology.

The project aligns with the UNESCO Dyfi Biosphere Reserve's vision to 'be recognised and respected internationally, nationally and locally for the diversity of its natural beauty, heritage and wildlife, and for its people's efforts to make a positive contribution to a more sustainable world'.[8] Designated in 2009, and home to a bi-lingual community of around 26,000 people, the continuing development of a locally-based economy which is 'more self-reliant and less carbon intensive, based largely on local culture, resources, products and environmental assets' is among its 5 principles.[8]

V. The Information Gateway

Tyfu Dyfi builds on the results of the project *Mixed Farming: Histories and Futures*.[9] This project, funded by the Welsh Government's LEADER Scheme and the Laura Ashley Foundation, was an ecodyfi led collaboration with Aberystwyth University, National Library of Wales and Environment Systems Ltd. It developed a local advice portal around suitable land and crops for those considering agroecology in the Dyfi Biosphere by identifying former agricultural practices to inform possible future practice. It used archival material and oral history, combined with layers of contemporary data from the National Forest Inventory,[10] OpenStreetMap[11] and multi-temporal satellite imagery to build GIS based *Information Gateway* identifying former arable land, and opportunity maps of land suitable for reinstatement of arable practices. It focused particularly on land-use information captured in the apportionment schedules which accompanied the tithe maps created in the 1830s-1840s and digitized and transcribed through crowdsourcing by the National Library of Wales, to identify land that was designated arable before the opening of the railway line from 1862-1864 disrupted the local food markets. This was supported by data from the 1930s *Land Utilisation Survey of Britain* by Dudley Stamp of the London School of Economics and digitized by the *Great Britain Historical GIS Project* at the University of Portsmouth. Oral histories with older farmers in the area collected narrative memories of crop production before EU subsidies changed agricultural priorities and emphases towards livestock farming. Crops formerly grown, in fields, now given over to sheep and cattle rearing, included different cereals, swedes, potatoes, carrots and carrots.

Mixed farming also identified current key enterprises involved in producing and distributing fresh local produce, mapping their location against former arable land, enabling a start point for building networks in *Tyfu Dyfi*. This mapping activity revealed a range of small-scale food producers working both solo and in collaboration to market their produce in a small range of specialist shops. The organic

[6] Food Data Interoperability Project: https://about.openfoodnetwork.org.uk/introducing-the-food-data-collaboration/
[7] Tyfu Dyfi: https://www.dyfibiosphere.wales/tyfudyfi
[8] UNESCO Biosphere Reserve: https://www.dyfibiosphere.wales/dyfi-biosphere-wales
[9] Mixed Farming: Histories and Futures: https://www.dyfibiosphere.wales/mixed-farming-histories-and-futures
[10] National Forest Inventory: https://www.forestresearch.gov.uk/tools-and-resources/national-forest-inventory/
[11] Open Street Map: https://www.openstreetmap.org/

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vegetable bag scheme, run by *Tyfu Dyfi* partners Mach Maethlon, brought many producers together in this shared guaranteed market. This scheme orchestrates crop production across participating growers ensuring a variety of products for their customers.

VI. INFORMATION NEEDS REQUIREMENTS

1. *First steps*

The Open Food Network's marketing platform was piloted by Mach Maethlon as the Bwyd Dyfi Hwb (Dyfi Food Hub) for 3 months during the 2020 vegetable growing season. This brought together a total of 8 food producers and 8 buyers (shops and hospitality) in one information space. Producers and distributors were found to be in a vicious cycle where producers wouldn't sell on the online marketplace if distributors didn't buy, and distributors wouldn't buy unless there was a range of produce available. Additionally, an increase in production was identified as a criterion for success, which requires greater access to arable land than currently possible for the producers, or more producers entering the market.

This negative feedback cycle can be broken through timely data interventions and a mechanism for its creation, sharing, curation and analysis. Data gaps identified by the pilot for the development of a more resilient local food system can be seen in Table 1.

Table I
Data gaps for agroecology in the Dyfi Biosphere

Actor	Data Gap	Data purpose
Producers	Land availability	Enables plans for new entrants or existing producers to expand
	Distribution systems	Ensures easy delivery to distributors
	Crops preferred by the market	Enables informed decisions on what to plant
	Market prices	
	Range and quantity of crops being produced by other producers	Enables co-ordination so that a range of produce is available
Distributors	Range and quantity of crops being produced	Enables informed decisions on what to buy
	Supply dates	

2. *Next steps*

The next step towards developing a local data ecology to support agroecology in the Dyfi Biosphere is a more detailed analysis of the data requirements of both producers and distributors participating in *Tyfu Dyfi*. This will use an anthropological research strategy to gain a more granular understanding of the data gaps experienced and the datasets required. An anthropological research strategy is appropriate for illuminating the problem, as it uses mixed methods approaches to understand how people behave and their motivations [23]. This will facilitate appropriate requirements gathering towards the development of a data architecture which is fit for purpose.

Qualitative data will be collected through interviews and observation; and analysed to identify both further data gaps and the specifics of the datasets and data classes required to ameliorate each identified gap. This will be complemented with quantitative research around inputs and outcomes from the actors' activities to inform requirements for data flow between the different datasets needed to address the gaps. Focus groups with both producers and distributors will help to identify interoperability issues between the datasets required by the two groups.

The DCC Curation Lifecycle Model will then be used to benchmark each of the identified and specified datasets to ensure that all the actions it specifies can be adequately addressed. This will enable the further specification of a data architecture which is usable and accessible, and that methods can be put in place to ensure that the data created can be curated and preserved over the long-term to support ongoing needs.

VII. CONCLUSIONS

Data creation and its ongoing curation and preservation underpins much of the commercial sector. The data needs of global food systems have received attention due to their possible commercial exploitation. The agroecological sector's data needs have received less attention, but timely data interventions could ensure greater resilience of local food systems and help improve human health, and the degradation of the environment. *Tyfu Dyfi* has started to address this data gap at a local level and is moving forward with research to understand data requirements in more detail.

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