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SUSTAINABLE FOOD PLANNING FOR MAIDSTONE, KENT, UK

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Abstract: The use of Geographic Information Systems (GIS) was explored for mapping habitats, wildlife, landscape and land use for Maidstone, Kent, UK. Through meetings with various stakeholders, maps were generated showing landscape character areas and habitat biodiversity for the Maidstone area, followed by a zoned characterisation of agricultural land types and areas of land available for food production, which suggests a total potential area of available land of 372 ha and 1899 ha in the urban and peri-urban zones respectively. Various factors affecting potential yields from this land are discussed, but require further study. It is suggested that next steps should include a detailed biodiversity inventory and the construction of an integrated assessment framework in order to produce a useful and sustainable food planning strategy for Maidstone.

1. Introduction

Farming in the UK is currently unable to feed all resident citizens (Lee, 2015). Furthermore, the balance of imported food has been demonstrated to be vulnerable to interruptions of supply (Defra, 2010). Whilst international trade in food continues to be an ongoing and important component of the national economy (Department for Business Innovation & Skills, 2013), it would seem prudent to explore measures to improve security of domestic supply if that trade should be interrupted. Whilst there have been discussions about Sustainable Intensification (SI) as a means of enhancing food security (Kuyper & Struik, 2014) (Tittonell, 2014) such a holistic approach has yet to be applied to urban and peri urban production, at least for developed nations (Lee, 2012). As nearly 80% of European, including UK, citizens live near to towns and cities (Antrop, 2004) there is clear potential to explore holistic sustainable food planning (SFP) for urban yield improvements *via* urban agriculture (UA). It is posited that this will best be achieved by using an array of tools that allow towns and cities to be surveyed and mapped. So far, published literature includes the use of surveys and photography, but as (Rupprecht & Byrne, 2014) note, more technical Geographic Information Systems (GIS)-augmented and other mixed method approaches are still scarce. GIS is seen as central to SFP, providing a means of analysing spatial relationships in enable more informed decision making (Freeman, 1999). This paper reports on a case study for the town of Maidstone (UK), which utilises maps and other information sources to start the process of SFP. Whilst there have been some attempts in Maidstone to develop land use strategies (MaidstoneBoroughCouncil, 2013), an integrated use of GIS maps for SFP is still needed and this paper presents the results of a collaborative project to start that process.

2. Materials and Methods

Maidstone, the county town of Kent, UK, was mapped using ArcGIS. This was verified *via* face-to-face meetings with KCC officials (especially Ms Ruth Childs), informal meetings with the HadLOW CARBON

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Community (HCC, 2015) and expert advice from staff at Hadlow College (especially Mr Alan Harvey, Mr Stefan Jordan, Mr Will Hughes) during 2014 and 2015. The project outcomes were intended to:

1. Review a range of ArcGIS mediated maps, to cover Habitats, Wildlife Designation, Landscape Characters, Land Use;
2. Develop a tighter focus upon Agricultural Land types, and the generation of a detailed map-based assessment of land areas available for food production;
3. Consider the factors affecting the optimal urban and peri urban yield potential for Maidstone;
4. Speculate on the way forward as SFPs are developed more thoroughly by reviewing existing knowledge and options for future action.

The maps shown here were generated by data from ArcGIS version 10.2.2 overlaid upon OS 1:25,000 base maps (Figures 1 and 2), Edina Digimap using a 2007 land use classification (Figure 3) and ArcMap to isolate land-use attributes and drape over a 3D model using ArcScene (Figure 4).
Maps shown in this paper are as screen saves, due to the large memory requirements of the original files. As a conceptual introduction, Figure 1a shows the location of Hadlow College and the study site town, Maidstone in Kent, UK and 1b shows an aerial photo of the Maidstone study site.

Figure 1a. Map of Kent to show study site of Maidstone. Source: (HadlowCollege, 2015)

In Figure 1b it can be seen that the town is bordered by the M20 to the north and interfaces with rural land on other sides. One major river (the Medway) flows through the town. There is a clear delineation between the inner urban zone of Maidstone housing and adjoining land for agriculture and horticulture, though evidence of sprawl. Some ribbon development of housing is also evident, and this leads to one clear satellite site - Royal British Legion village in the north-west corner of Figure 1. This layout is broadly typical of many UK town and city plans, where 'green belt' land surrounding urban centres has had only partial success in limiting urban sprawl (Hennig, et al., 2015). The interest for this paper is how the layout of Maidstone can be understood holistically, to enable the SFP process to start. This assumes that the primary aim is the food production potential of the town, and Figure 1 indicates at least one site where allotments are already being managed. The challenge is how to develop a SFP approach which maps the extension of this and other types of local food growing across the town, whilst balancing that against the other needs of citizens.

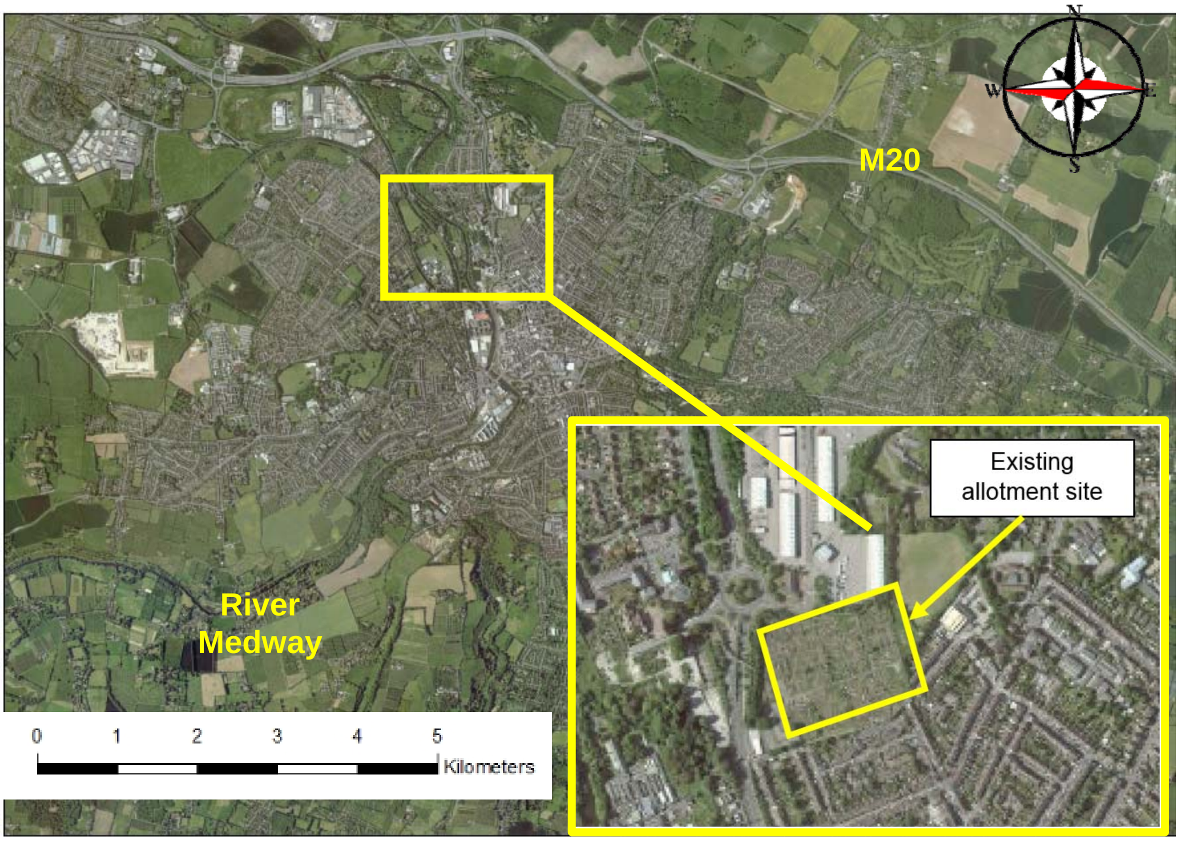

Figure 1b. Aerial photograph of Maidstone, showing M20 motorway across northern border. The town is surrounded by agricultural land and has the river Medway flowing through it. An existing allotment site is marked. Source: Childs, KCC

3. Results and discussion

Consultations

The various informal meetings with stakeholders described above took place in Hadlow College (HadlowCollege, 2015) on the main campus but also at venues in the village of Hadlow, which is situated in west Kent, approximately 15km from Maidstone (Figure 1a). Discussions also occurred at College sustainability workshops, which involved staff, students and residents of the village and nearby. There is much potential for further engagement with residents of Maidstone for a full SFP and the authors are keenly aware of the need for this.

The maps

The maps presented here attempt to lead towards a consideration of Maidstone as an integrated system, comprising a wide collection of plants and animals, varied landscapes and habitats, and how this links to food production potential.

Figure 2. shows landscape character areas across the town and indicates a shallow valley (vale) to the north, which contains sections of the motorway. To the east and south, landscapes are dominated by heath farmland and fruit production, respectively. To the west the landscape is dominated mostly by a suburban extension from the town and one satellite development (Royal British Legion village) as noted for Figure 1b. Within the fringes of the urban zone can be seen four parks - clockwise Oakwood, Invicta, Vintners and Mote.

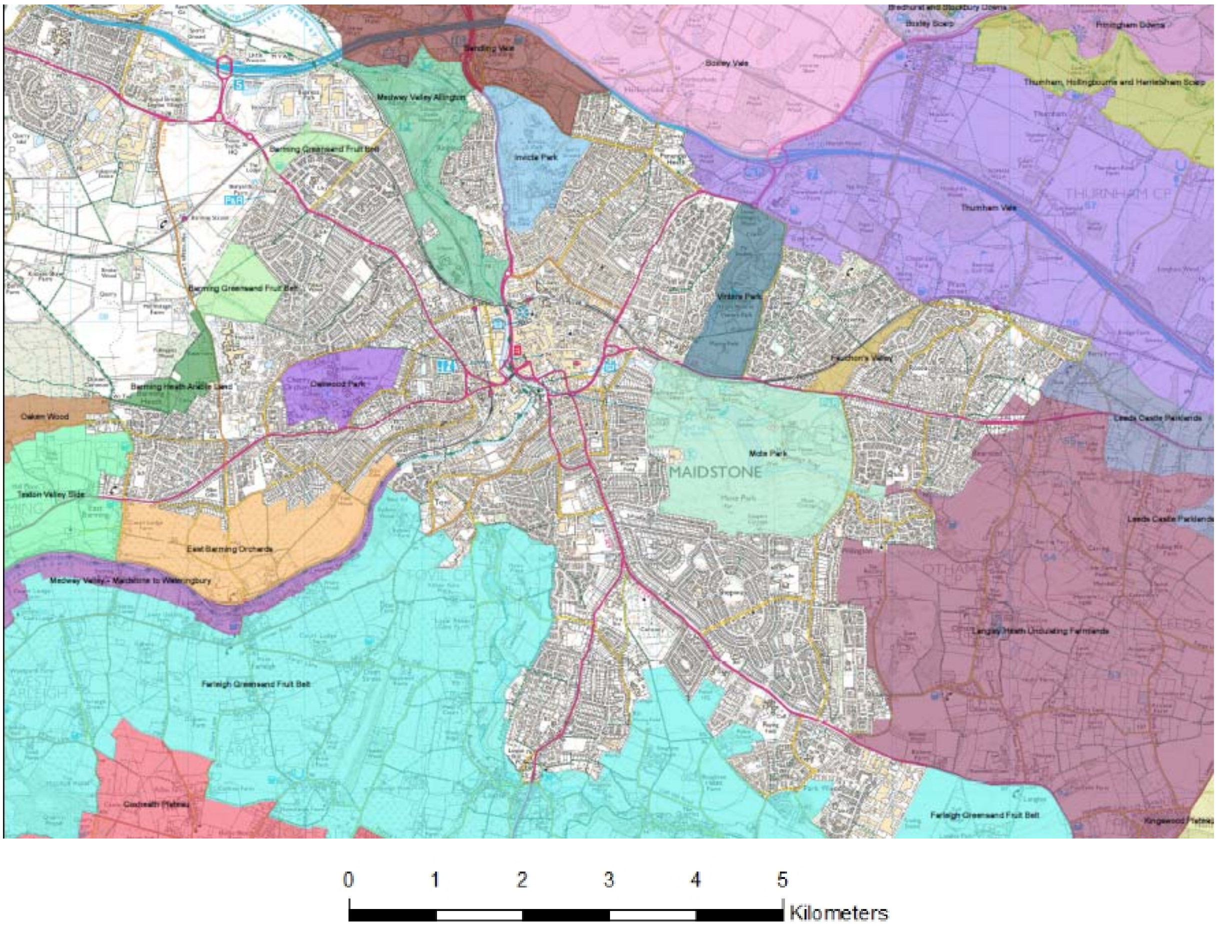

Figure 2. Maidstone Landscape Character Areas. Source: Childs, KCC

The diversity of all non-managed species (ranging across mammals, birds, invertebrates, plants, fungi) is of considerable interest and is well known to be dependent upon the diversity of habitats available (Freeman, 1999). This is shown in Figure 3 and indicates considerable biodiversity. An attempt to generate an inventory of species for Maidstone has not so far been achieved but is considered to be an important component of a systems approach to SFP.

Other research has established the importance of urban biodiversity (Farinha-Marques, et al., 2011) and is supported by a recent major review of green space planning in cities (Haaland & van den Bosch, 2015). The latter has highlighted the significance of 'densification' for biodiversity although positive or negative trends for this are contrary and unclear. The inner zone for Maidstone is quite densely populated by people (though exact data are currently unavailable), and little is known about habitat and species biodiversity. The land surrounding the town is more heterogeneous in terms of habitats and is probably more biodiverse. This is reviewed by (La Rosa, et al., 2014) from a European perspective, who refer to the: *“…relationship between the agricultural landscape and the city [which] is reflected in the particular contemporary peri-urban landscapes, where residential low-density settlements are intertwined with farmlands that have been partially modified and reduced by urbanisation.”* (p. 290).

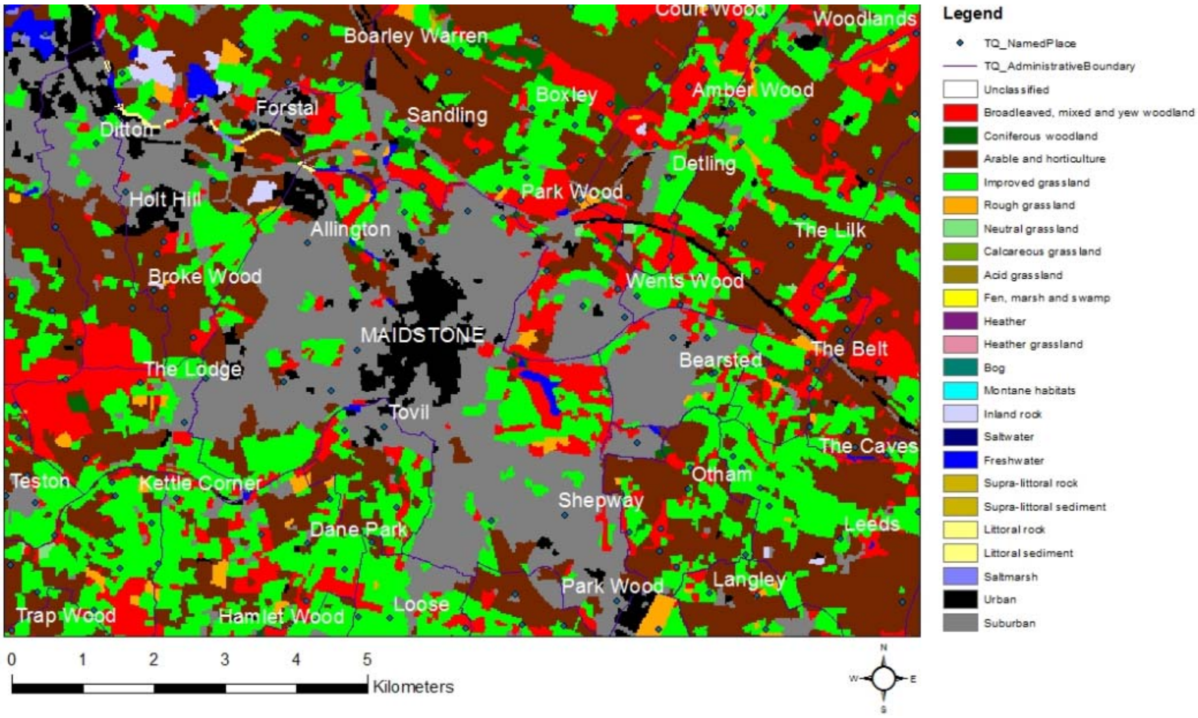

Figure 3. Map of habitat diversity for Maidstone. Source: Hughes, Natural Environment Research Council

Whilst well known species of vegetables and fruit may have use for food production, many others will be present for wildlife and aesthetic reasons (Altieri, 1999). Additionally, a more thorough understanding of the biodiversity of Maidstone is seen as important, since such species have value for local landscapes and human appreciation - i.e. quality of life (Egoh, et al., 2007) and urban zones in general are known to contribute useful ecological services, such as:

1. *“Supporting services (biodiversity, habitat, soil formation, ecological memory, seed dispersal, pollination, storage and cycling of nutrients);*
2. *Cultural services (recreation, enhancement of property value, community cohesion, source of knowledge);*
3. *Provisioning services (food, water, fuel); and*
4. *Regulating services (carbon sink, microclimate control, flood prevention, noise reduction, temperature modulation, pollution control, protection of water quality,etc.).” (Farinha-Marques, et al., 2011), 253.*

The next stage of this study is the generation of Agricultural Land types and land areas available for food production. This is shown in Figure 4.

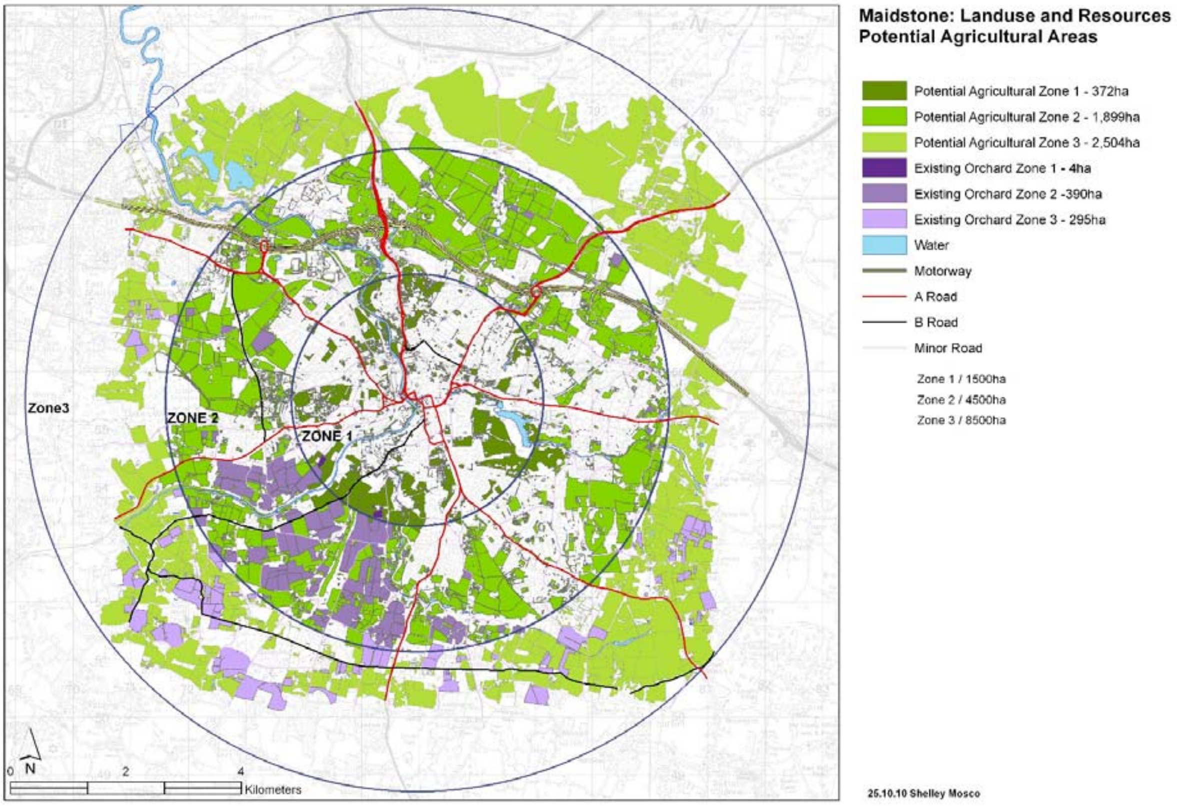

Figure 4. Agricultural Land types and land areas available for food production. Source: Mosco, University of Greenwich.

This map can be seen to include zones 1-3. This has been adapted from that by Growing Communities (GrowingCommunities, 2015), a London based community food growing organisation. They refer to a zone system for cities: 0 = urban domestic, 1 = urban traded, 2 = peri urban, 3 = rural hinterland, 4 = rest of UK, 5 = rest of Europe, 6 = further out. We have adapted this in Figure 4 to show our interpretation of zone 1 as their 0 and 1 combined and our zones 2 and 3 the same as theirs. City or town zoning for food planning has been poorly published elsewhere but is seen here as a useful means of rationalising food planning policies, since zones 1 and 2 are posited as considerably different: zone 1 has a higher density of citizens, town or city centre shopping areas which are often traffic free and less space for growing food, whilst zone 2 has a lower density, more commercial land use as trading sites, edge of city/town supermarkets etc. and more available land. There is no fixed formula for exactly where to allocate these zones on a town or city map, so those in Figure 4 are currently admitted as approximate and requires further study to rationalise a more consistent approach. For this paper, calculations for Zone 3 – the rural hinterland – are not pursued due to lack of accurate area data for Maidstone.

Figure 4 suggests a total potential area of land available for growing food as:

Zone 1 – 372 ha

Zone 2 – 1,899 ha

The factors affecting the optimal urban and peri urban yield potential for Maidstone

This paper reports the start of a process of urban agriculture (UA) yield determinations for Maidstone. Very little data exist for other urban projects: some have been reported by (Lee, 2012)

for unprotected (open plot) fruit and vegetable production, where yields varied from about 20-40 $t.ha^{-1}.year^{-1}$. This high variability is further affected by potential increases due to protected management under glass or polythene type covers, where colleagues have reported up to ten times that of the yield in open plots (Harvey, 2015).
Other factors affecting potential yields are numerous and shown in Table 1

Table 1. Examples from the literature of research on factors affecting UA

Factors affecting potential UA yields	Sources
Method of production – e.g. raised beds, open v. protected, hydroponics, soilless media, green roofs with concentrated fertility v. more extensive open plots	(Paranjpe, et al., 2008); (Vogl, et al., 2003); (Chenani, et al., 2015)
Efficiency of nutrient provision for crops – chemical/synthetic or organic	(Cui, et al., 2015)
Methods of weed, pest and disease management for crops – chemical/synthetic or organic	(Tomlinson, et al., 2015)
Livestock – species and breed, space, housing, feed, welfare, security etc.	(Huang & Drescher, 2015)
Water availability for irrigation as required for crops and livestock	(Minhas, et al., 2015); (Barthel & Isendahl, 2013)
Energy available – fossil/renewable, labour, biomass etc.	(Springer, 2012); (Denny, 2012a)
Choice of vegetable and fruit species and cultivar	(Moniruzzaman, 2015)
Seasonality -time of year that cropping takes place	(Denny, 2012a) (Denny, 2012b)
Post-harvest treatment, storage, processing	(Vedovato, et al., 2015)
Urban food transport	(Denny, 2012a) (Denny, 2012b)
Waste management	(Minhas, et al., 2015)
Relative presence or absence of soil contaminants	(Izquierdo, et al., 2015)
Knowledge, experience and health of participants	(Munoz-Plaza, et al., 2013)
Conflicts with other land needs – aesthetic, recreation, sport, wildlife etc.	(Moroney & Jones, 2006); (Millard, 2004)
Other socio-political factors such as theft, vandalism, refugees, cultural diversity, local political priorities etc.	(Porter, et al., 2014); (Cabannes & Raposo, 2013)
Implications of climate change and extreme weather	(Lisle, 2010)

Further studies are required for Maidstone to clarify many of the above factors. A wide range of stakeholders need to be interviewed, including allotment holders, community project members and local government officials. Additionally, some demonstration projects – already proposed by (Lee, et al., 2014) - are required in the town to explore the local factors affecting yields and obtain a realistic assessment of yield possibilities. Thus, no confident estimates can currently be made for likely yields of UA in Maidstone until the above issues have been investigated further.

A critique of determining a SFP for Maidstone

There are about 113,000 people living in Maidstone (KCC, 2015) and feeding them from production generated within zones 1 and 2 will be an enormous challenge. To help move towards a viable plan for this, a SFP for Maidstone needs to be investigated within an agroecological context. There have already been some excellent studies, such as that for Almere, Netherlands, by (Jansma, et al., 2012), where various management scenarios were considered in terms of energy dynamics, and combined with a useful assessment of local food consumption patterns. A wider and more detailed consideration by (Ravetz, 2000) used an integrated assessment (IA) approach to urban sustainability, constructed schematics for ‘material metabolism’ (see Figure 4 in that paper) and then an IA framework (Figure 5 in that paper). These ideas are an excellent attempt to develop a more holistic framework for sustainable development in cities. It is suggested here that Jansma’s and especially

Ravetz's ideas can be further developed for the generation of a SFP plan for Maidstone which involves:

- A detailed, spatial biodiversity inventory across zones 1 and 2 of the town to look for key indicators of sustainability for UA, such as beneficial species;
- An exploration of material metabolism options – especially mass balance flow,[4] nutrient budgets, as recently demonstrated for P in ecological agriculture by (Wu, et al., 2015) and water balance modelling as demonstrated by (Branger, et al., 2013);
- Building this into an IA – which in essence is an ecosystem study of stocks and flows of key components;
- Seeking outcomes for a SFP: how can we generate a useful food planning strategy for Maidstone that optimises the benefits for citizens in terms of amenity and landscape attractiveness, yet actually feeds people efficiently in terms of inputs *v.* outputs?

4. Conclusions

- A GIS-mediated study of Maidstone, Kent, UK has attempted to clarify landscape character areas, habitat diversity and land available for urban agriculture;
- The development of a Sustainable Food Plan for Maidstone is discussed as the next step, involving a detailed biodiversity inventory and the construction of an integrated assessment framework.

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[4] "The law of conservation of matter states that matter is conserved - that is, neither created nor destroyed. Thus, if we know the amount of material that enters a chain of processes, and keep an account of all the amounts in different paths, we can calculate quantities of materials that are hard to measure. For example, we can calculate the amount of material entering the atmosphere if we know the amounts that went in, the transformations, and the waste streams to land and water. This method is called the Mass or Material Balance technique." See http://environ.andrew.cmu.edu/m3/s4/matbalance.shtml

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