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Global assessment of urban and peri-urban agriculture: irrigated and rainfed croplands

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Abstract
The role of urban agriculture in global food security is a topic of increasing discussion. Existing research on urban and peri-urban agriculture consists largely of case studies that frequently use disparate definitions of urban and peri-urban agriculture depending on the local context and study objectives. This lack of consistency makes quantification of the extent of this practice at the global scale difficult. This study instead integrates global data on croplands and urban extents using spatial overlay analysis to estimate the global area of urban and peri-urban irrigated and rainfed croplands. The global area of urban irrigated croplands was estimated at about 24 Mha (11.0 percent of all irrigated croplands) with a cropping intensity of 1.48. The global area of urban rainfed croplands found was approximately 44 Mha (4.7 percent of all rainfed croplands) with a cropping intensity of 1.03. These values were derived from the MIRCA2000 Maximum Monthly Cropped Area Grids for irrigated and rainfed crops and therefore their sum does not necessarily represent the total urban cropland area when the maximum extent of irrigated and rainfed croplands occurs in different months. Further analysis of croplands within 20 km of urban extents show that 60 and 35 percent of, respectively, all irrigated and rainfed croplands fall within this distance range.

S Online supplementary data available from stacks.iop.org/ERL/9/114002/mmedia

Keywords: urban croplands, spatial analysis, food security, irrigated croplands, rainfed croplands, urban and peri-urban agriculture, urban land use

1. Introduction

Food production is far more than a rural phenomenon, commonly occurring within the confines of cities and at their immediate periphery. Consideration of the role of urban agriculture in global food security has grown, and yet it remains poorly quantified. The topic of urban and peri-urban agriculture is one fraught with definitional challenges. The terms urban and peri-urban agriculture can refer to a diverse range of agricultural activities including crop, livestock, poultry, and aquaculture production, and this at any scale from a roof-top gardens to larger cultivated open spaces. The boundary between urban and peri-urban is along a land-use continuum and exhibits considerable heterogeneity across world regions [1]. Recent reviews of urban agriculture document the characteristics and challenges of urban crop production in numerous cities in developing and developed countries [2–5]. However, the global and regional extent of urban agriculture remains a major knowledge gap. While there are many case studies on urban agriculture [6–9], comparison across and extrapolation from such studies is difficult due to differences in metrics and methods. An analysis by Zezza *et al* [10] of the Rural Income Generating Activities (RIGA) database provides some initial insight into the scale of this practice developed using a consistent methodology. This study found that, in fifteen developing countries, ten to seventy percent of urban households participated in agricultural activities, with households in the poorest quintile disproportionately represented amongst those participants[5]. Extrapolation of this analysis suggests a median of 266 million urban households (207, 349 CI_{90}) engaged in crop production in developing countries [2]. Another approach estimates the land area that would be required to meet urban vegetable demand through urban agriculture [11]. Meeting this demand would require about one third of the global urban area, albeit with substantial differences between regions, depending on population density.

The objective of this study is to produce the first global-scale, spatially explicit assessment of the current extent of urban and peri-urban croplands using a consistent methodology. More accurate data will lead to a better understanding of the scale of this particular farming system relative to overall crop production and lend insight into its overall relevance for global food security. It is also a first step in the quantification of, for example, urban and peri-urban agricultural water use. Finer scale case studies and surveys remain a more appropriate tool for local decision making [6–9]. Better understanding the extent and characteristics of urban crop production at the global and regional scales should support better decisions on urban policy and planning.

The scale of available global-scale data necessitates limiting our analysis to a resolution of five minutes (about 9.2 km at the equator). Below, we present a global-scale spatial model to quantify the extent and characteristics of croplands occurring within growing urban landscapes around the year 2000, which is the year with the most recent available data. We then quantify the extent of urban and peri-urban irrigated and rainfed croplands globally, the fraction of urban lands being used for crop production, and cropping intensity in urban croplands. We also highlight how cropping patterns differ in urban irrigated and rainfed croplands.

2. Methods

2.1. Approach

In contrast to previous work utilizing case studies or survey data, this study uses a spatial overlay analysis of global scale datasets to define urban and peri-urban agriculture based on the spatial coincidence of urban extents (with populations exceeding 50 000) and areas of crop cultivation. Urban aquaculture, livestock, and poultry production are relevant components of urban agriculture, but are beyond the scope of this study. Given changing boundaries of urban extent, our results likely include a mixture of urban and near peri-urban croplands. Limitations in data resolution generally exclude backyard gardens and other small-scale urban agriculture from this analysis. For the sake of brevity and consistency with terminology used in input data sources, the term 'urban croplands' is used throughout.

[5] These urban households may be engaged in agriculture in urban, peri-urban, or, for some, rural areas. The RIGA database does not allow separation between these three categories.

2.2. Data inputs

Recently, high-quality land use and socioeconomic datasets have been produced at the global scale. Table 1 summarizes the data sources used in this analysis [12–18] and previous studies evaluating their quality [19–24]. Further discussion of data selection metrics is included in the SI.

2.3. Data processing

At the most basic level, we mapped irrigated and rainfed croplands occurring within an urban extent of more than 50 000 people through successive map overlays to identify intersections between urban extents and croplands. All analyses were conducted using ArcGIS and Python. Further details are included in the SI. Four major products for both irrigated and rainfed croplands were derived, including: (1) maximum monthly *urban* cropped area (all crops); (2) maximum monthly cropped area *within* 10 km *of urban extents* (all crops); (3) maximum monthly cropped area *within* 20 km *of urban extents* (all crops); and (4) annual *urban* harvested area (26 crop classes).

2.3.1. Identifying urban extents with populations exceeding 50 000 people. The urban extents in the GRUMP data are often agglomerations of urban settlements of varying sizes rather than distinct (administrative) city boundaries. The population of each urban extent was calculated from the GRUMP data by multiplying the grid cell population density by the urban extent area within the same grid cell, then summing the population of all grid cells located within a given urban extent. All GRUMP urban extents with populations less than 50 000 people were excluded from subsequent analyses. A population threshold of 50 000 was selected to reach a balance between overestimating croplands occurring around small towns and omitting larger towns with urban croplands. Tables S1(a) and S1(b) show how urban cropland indicators vary with different population thresholds. The resolution of the GRUMP data is 30 s.

2.3.2. Identifying urban irrigated and rainfed croplands. The stratified urban extents described above were intersected with the MIRCA2000 maximum monthly cropped area grids (MMCAG) for irrigated croplands and rainfed croplands to identify the total area of urban irrigated and rainfed croplands, respectively. The resolution of the MIRCA2000 data is five minutes with cropland area assumed to be evenly distributed across the grid cell area. Non-urban croplands are simply total (irrigated or rainfed) cropland area minus urban cropland

Table 1. Summary of key data inputs.

Name	Description	Data quality evaluation	Source	Data reference
Monthly irrigated and rainfed croplands in the year 2000 (MIRCA 2000)	From MIRCA 2000 • Maximum monthly irrigated cropped area grid • Maximum monthly rainfed cropped area grid • Annual irrigated harvested area grids for 26 crops • Annual rainfed harvested area grids for 26 crops	Portmann 2011, Ramankutty *et al* 2008, Siebert *et al* 2005	University of Frankfurt	Portmann *et al* 2010
Global rural urban mapping project v1 (GRUMP)	From GRUMP • Global urban extents grid • Population density grid	Linard *et al* 2012, Potere and Schneider 2007, Taylor *et al* 2009	NASA SEDAC	CIESIN 2011, Balk *et al* 2004, Balk *et al* 2006, Deichmann *et al* 2001
National administrative boundaries	National boundaries from CIESIN GPWv3		NASA SEDAC	CIESIN 2005
World regions	Regional groupings defined per the millennium development indicators[a]		MDG	UN Office of Statistics 2011

area. For analyses looking at cropping patterns, the total annual harvested area of each of the 26 crop classes[6] was intersected with these same urban extent boundaries. The total area of each of these classes was then obtained by summing the area of each class within each urban extent boundary. The total cropland area is slightly less than the MIRCA2000 cropland area because: (1) the MIRCA2000 totals represent annual harvested area including all crop rotations; and (2) the vector format regional and country boundaries used to clip the 5 min gridded MIRCA2000 data were developed at a finer resolution than the MIRCA2000 data. This resulted in portions of some cropland pixels in coastal regions extending beyond national boundaries being excluded from cropland totals. Further discussion of data processing is included in the SI.

2.3.3. Identifying peri-urban irrigated and rainfed croplands. What, exactly, defines urban agriculture remains a fundamental question. Urban boundaries are far from static [24, 25]. While other studies document some farmers living in the city, but cultivating lands located on the periphery or outside of cities [10, 26]. In household surveys, these instances may be classified as urban agriculture, but are excluded when using spatial methods defining urban agriculture based on urban extent boundaries. Given these considerations, this study also quantifies irrigated and rainfed croplands within 10 and 20 km of urban extents to provide a fuller picture of the extent of peri-urban croplands. To complete this analysis, 10 and 20 km buffers were created around the urban extent boundaries discussed in 2.3.1. Where buffers overlapped, the urban buffer areas were merged to create a single polygon. The area of irrigated and rainfed cropland within 10 and 20 km of urban extents was then tabulated using methods similar to those described above.

2.3.4. Additional metrics. From the four data products derived from this analysis, two additional metrics were calculated: (1) fraction of urban land used for irrigated and rainfed cropland; (2) cropping intensity in urban irrigated and rainfed croplands. Urban land allocation fraction was calculated at the national scale by dividing the maximum monthly urban cropped area (i.e., irrigated or rainfed urban cropland) (section 2.3.2) by the urban extent land area (section 2.3.1) for each country. Cropping intensity provides an approximation of the number of crop rotations within a given year. The cropping intensity of urban cropland was calculated by dividing the annual urban harvested area (26 crop classes) by the maximum monthly urban cropped area (all crops) for irrigated and rainfed croplands, respectively.

2.3.5. Validation. As a validation measure, 216 randomly selected urban cropland pixels and 201 randomly selected urban non-cropland pixels were compared to Google Earth imagery to develop a confusion matrix. The qualitative criteria used to evaluate the selected pixels included observation of the presence or absence of croplands in the Google Earth imagery and whether the MIRCA2000 percent cropland area appeared consistent with a visual interpretation of the Google Earth imagery. While this is a somewhat coarse metric, it provides an initial estimate of the accuracy of the MIRCA2000 data in urban and non-urban areas.

3. Results

3.1. Distribution of global croplands

Urban croplands constitute a small, but not negligible portion of the sum of the maximum monthly irrigated and rainfed cropland area at 67.4 Mha (5.9%). However, it is important to note that this sum does not necessarily represent the total maximum monthly cropped area in instances when the maximum monthly extent of irrigated and rainfed croplands occurs in different months (i.e., irrigated and rainfed cropland areas may not be mutually exclusive month-to-month). A greater proportion of urban croplands are irrigated (35.0%) than their non-urban counterparts (17.7% irrigated) (table 2). Urban croplands also proved to be extremely prevalent globally, with 87 percent of all urban extents with populations greater than 50 000 people containing at least some area of irrigated urban cropland and 98 percent containing at least some area of rainfed urban cropland (figures S1(a) and S1(b)). While the practice of urban crop cultivation appears to be highly prevalent, we also found substantial spatial heterogeneity in the characteristics of these croplands.

3.2. Comparison of urban irrigated and rainfed croplands by region

The distribution of urban and non-urban irrigated and rainfed croplands varies greatly across regions (figure 1). South and East Asia comprise 49 percent of urban irrigated croplands and 56 percent of the non-urban irrigated area globally. These same two regions account for 26 percent of urban rainfed croplands and 22 percent of non-urban rainfed croplands. Developed countries account for 20 percent of irrigated urban croplands, but 44 percent of urban rainfed croplands. Sub-Saharan Africa comprises less than one percent of urban irrigated and three percent of urban rainfed croplands, but fourteen percent of non-urban rainfed croplands. Such patterns are in contrast to those of much of Asia where more croplands are located within urban extents.

3.3. Allocation of urban land for irrigated and rainfed crop production

Regions with the most irrigated or rainfed cropland also dominate figures on urban croplands (figure 1). However, the actual extent of urban area in each region varies widely, making direct comparison between regions difficult. Normalizing urban cropland area by urban extent land area allows

[6] The 26 crop classes included in the MIRCA2000 data are wheat, maize, rice, barley, rye, millet, sorghum, soybeans, sunflower, potatoes, cassava, sugarcane, sugar beet, oil palm, rapeseed (canola), groundnuts, pulses, citrus, date palm, grapes, cotton, cocoa, coffee, other perennial, fodder grasses, and other annual.

Table 2. Distribution of global croplands.

	Irrigated croplands	Rainfed croplands	Maximum croplands (urban and non-urban)
Urban croplands	23.6 Mha	43.8 Mha	67.4 Mha
Non-urban croplands	190.6 Mha	888.1 Mha	1078.7 Mha
Total croplands (irrigated and rainfed)	214.2 Mha	931.9 Mha	—

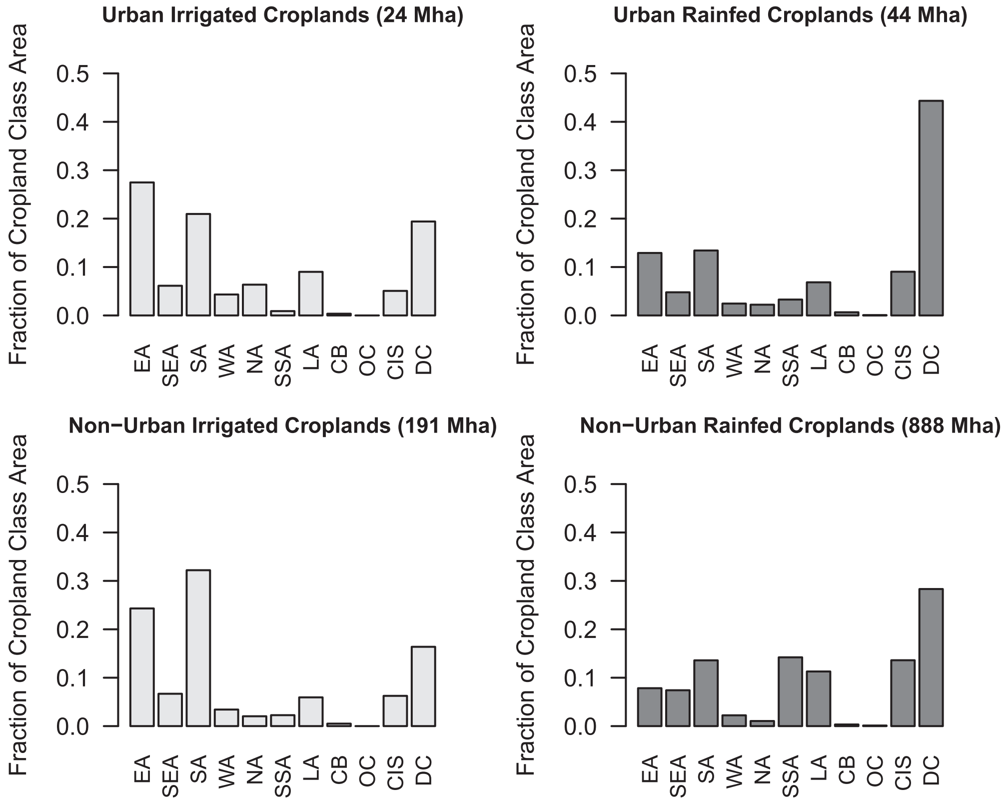

Figure 1. Urban and non-urban irrigated and rainfed croplands by region. Regional groupings and abbreviations are: Commonwealth of Independent States (CIS), Caribbean (CB), Latin America (LA), Oceania (OC), East Asia (EA), Southeast Asia (SEA), South Asia (SA), West Asia (WA), North Africa (NA), Sub-Saharan Africa (SSA), and Developed Countries (DC).

for the identification of countries where croplands constitute a larger proportion of urban land use.

The thematic maps of urban land allocation for irrigated and rainfed croplands (figures 2(a) and (b)) present distinct patterns. Regions with larger areas of irrigated cropland tend to have a higher proportion of urban extent area used for irrigated croplands. Whereas, the proportion of urban extent area used for rainfed croplands more closely parallels regional climate patterns, with more arid countries such as Namibia and Saudi Arabia having little or no rainfed urban croplands. Countries with wetter or monsoonal climates such as Rwanda and Cambodia have a greater proportion of urban land area allocated to rainfed croplands. Per capita urban cropland area by region is included in the SI (figure S2).

3.4. Cropping intensity

The maximum monthly irrigated urban cropland area is 23.6 Mha while the sum of the annual harvested area of all crop classes is 35.0 Mha, which equates to a cropping intensity of 1.48 (table 2 and S2). In contrast, for rainfed urban croplands, the maximum monthly cropland area is 43.8 Mha (table 2 and S2) while the sum of the area of all crop classes is 45.1 Mha, suggesting fewer fields with multiple rotations.

3.5. Irrigated and rainfed urban croplands by crop type

Within urban extents, rice, wheat, and maize constitute the three major crops grown in irrigated croplands and account for 62 percent of the annual harvested area of irrigated urban croplands. In rainfed urban croplands, wheat, maize, and fodder grasses constitute the top three rainfed crops and account for 40 percent of the annual harvested area of rainfed urban croplands.

At the regional level, a more heterogeneous picture emerges. Rice, wheat, and maize still dominate the total urban irrigated cropland area, but these areas consist largely of

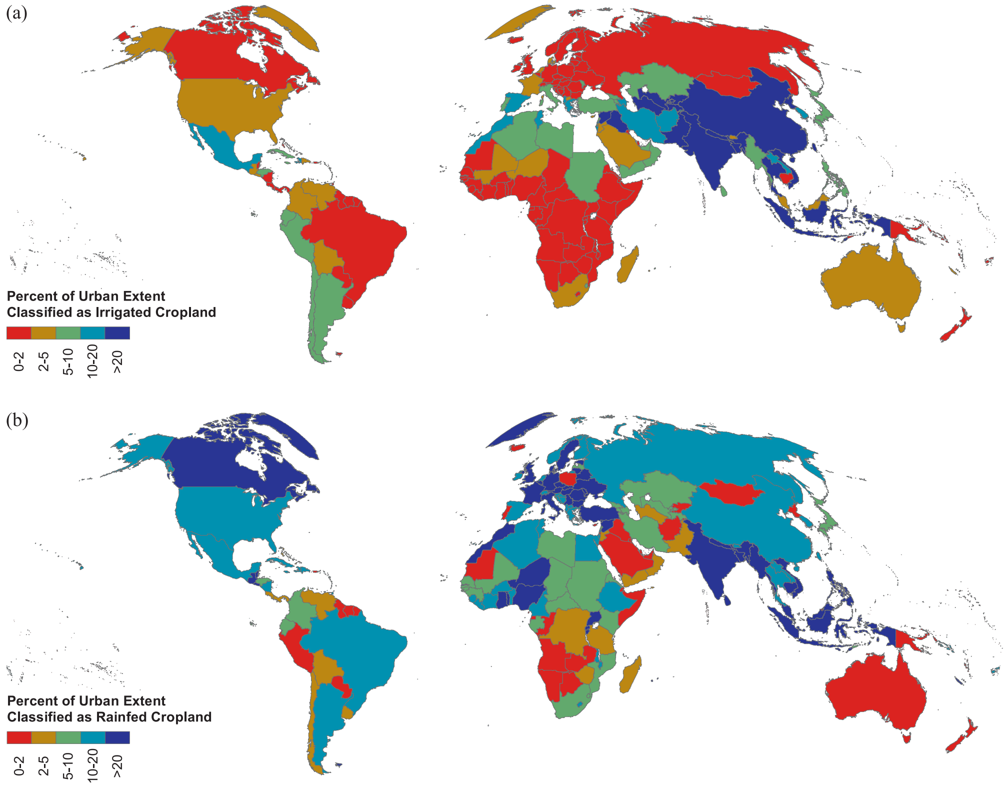

Figure 2. Percent of urban land area classified as irrigated (a) or rainfed (b) croplands by country.

Table 3. Frequency with which each class occurs in the top three irrigated crops for irrigated and rainfed urban croplands.

Crop class	Number of regions[a] top 3 irrigated	Per cent of regions in top 3 irrigated	Number of regions[a] top 3 rainfed	Per cent of regions in top 3 rainfed
Other annual	8	0.73	4	0.36
Wheat	6	0.55	5	0.45
Rice	5	0.45	2	0.18
Fodder grasses	4	0.36	3	0.27
Maize	3	0.27	4	0.36
Sugar cane	3	0.27	3	0.27
Other perennial	2	0.18	5	0.45
Cotton	2	0.18	0	0.00
Barley	0	0.00	3	0.27
Coffee	0	0.00	1	0.09
Cassava	0	0.00	1	0.09
Soybeans	0	0.00	1	0.09
Pulses	0	0.00	1	0.09

[a] Out of 11 regions.

croplands occurring in a few specific regions with extensive irrigated agriculture. Similar trends are present in the top three urban rainfed crops of wheat, fodder grass, and maize. The frequency analysis presented quantifies the number of times each crop class occurs in the top three crops produced by each of eleven regions (table 3). This approach allows for identification of the crop classes that are consistently playing a substantive role in urban crop production across regions. A complete table of the top three urban irrigated and rainfed crop classes for each region is included in table S3 in the SI. The class 'other annuals' was identified as a 'Top 3' urban irrigated crop class in 73 percent of regions. For rainfed urban croplands, 'other perennial' and 'wheat' were the two most common 'Top 3' crop classes. In general, rainfed urban croplands tended to exhibit greater diversity of crop classes and include more crops of regional significance compared to irrigated urban croplands.

3.6. Peri-urban irrigated and rainfed croplands within 10 and 20 km of urban extents

The total area of irrigated croplands within ten and 20 km buffers of urban extents is 87 and 130 Mha, respectively (or 40 and 60 percent of the total irrigated cropland area of 214.5 Mha). On average, the area of irrigated cropland within ten kilometers was 3.4 times the area of urban irrigated croplands, but ranged from 2.3 times in North Africa to 5.0 times in South Asia (figure 3(a)). The area of irrigated croplands within 20 kilometers of urban extents was, on average, 5.0 times the area of urban croplands, but ranged from 2.8 times in North Africa to 8.4 times in South Asia.

The total area of rainfed croplands within 10 and 20 km buffers of urban extents is 185 and 327 Mha, respectively (or

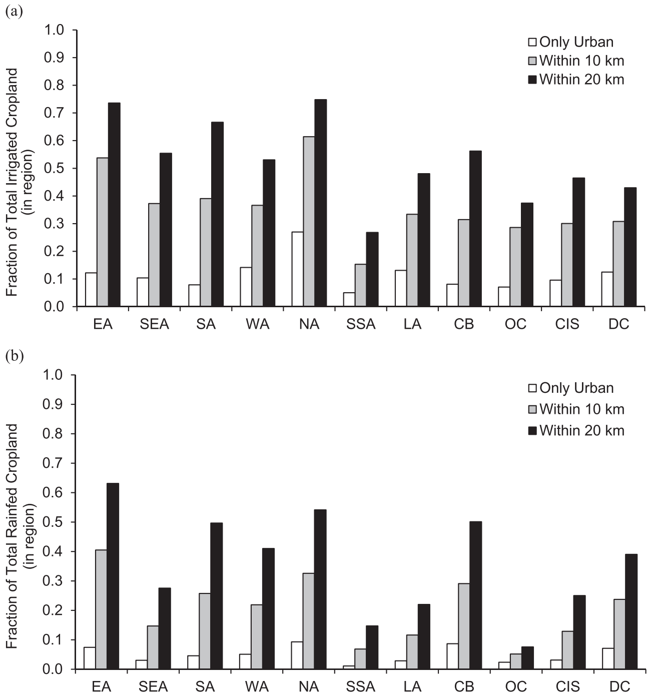

Figure 3. Fraction of total irrigated (a) and rainfed (b) cropland within 0, 10, and 20 km of urban extent boundaries.

20 and 35 percent of the total rainfed cropland area of 931.9 Mha). On average, the area of rainfed croplands within ten kilometers was 4.3 times greater than the area of urban rainfed croplands, but ranged from 2.2 times greater in Oceania to 6.2 times greater in Sub-Saharan Africa (figure 3(b)). The area of rainfed croplands within 20 km of urban extents was, on average, 7.8 times greater than the area of urban rainfed croplands, but ranged from 3.2 times in Oceania to 13.2 times in Sub-Saharan Africa.

3.7. Validation

This analysis found an overall accuracy of 0.79 with a Kappa coefficient of 0.57 (table 4).

4. Discussion

4.1. Implications of findings

These findings provide the first estimate of the global extent of urban and peri-urban irrigated and rainfed croplands developed using a globally consistent, spatially explicit methodology. Urban croplands constitute up to 5.9 percent of all croplands globally. Thirty-five percent of these croplands are irrigated compared to 17.7 percent of non-urban croplands. Similarly, in peri-urban areas 60 percent of irrigated croplands were located within a 20 km buffer of urban extents, but only thirty-five percent of rainfed croplands were located within this same 20 km buffer.

This analysis also found a higher cropping intensity for both irrigated and rainfed urban croplands as compared to the total areas of irrigated and rainfed croplands. For irrigated urban croplands, the cropping intensity of 1.48 is higher than the cropping intensity of 1.12 found by Portmann *et al* [12] across all irrigated croplands, suggesting that farmers of irrigated croplands within urban extents are producing more rotations per year as compared to irrigated croplands overall. For rainfed croplands, the urban cropping intensity is also higher at 1.03 compared to 0.84 found by Portmann *et al* [12] across all rainfed croplands. The resolution of these data do not allow for disambiguation of areas producing one crop as rainfed and a second crop with irrigation. In such cases, the overall cropping intensity could be higher still.

When examined together, these findings allude to the potential significance of the topic of urban and peri-urban agriculture at the intersection of urban water management and land use planning. The new data on urban croplands could also allow further testing globally, at a fine spatial resolution, of the much discussed relationship between population density and the intensity with which croplands are farmed [27, 28]. Further work combining the urban croplands data developed through this analysis with previous work on anthromes may provide further granularity and insights into the diversity of urban croplands around the globe [29].

When food production requires irrigation, this can increase strain on water resources and create competition between domestic and agricultural water users [30]. Additional work is needed to identify the magnitude and locations where urban and agricultural water users jointly face the greatest scarcity, but, nonetheless, these findings lend preliminary insight into patterns of urban irrigated croplands across the globe and demonstrate the greater prevalence of irrigated croplands in or near urban areas.

Many of the regional trends observed with irrigated urban croplands do not hold true with rainfed urban croplands. Rainfed urban croplands are more common in developed and Commonwealth of Independent States (CIS) countries, many of which tend to have more temperate climates than the regions where irrigated urban croplands are more prevalent. Likewise, patterns in rainfed croplands generally tend to parallel climate zones more closely than irrigated croplands [31]. Many questions remain as to how the extent and contribution of urban rainfed croplands will adapt to the dual stressors of urban growth and climate change.

Regional trends in crop production (particularly rainfed urban croplands) appear to be closely connected to regional markets, but disambiguation of specific drivers is beyond the scope of this analysis. More generally, while staple crops constitute a large portion of urban croplands, other annuals are a dominant urban crop in 73 percent of regions; a finding consistent with past reviews of urban agriculture [2, 3, 32]. Whether these crops are destined for local, regional, or international markets and, in turn, their contribution to local food security is likely a function of access to supply chains, transport, and processing facilities.

Understanding the role of urban and peri-urban crop production in urban food security at scale remains a major knowledge gap in the field of urban agriculture. Using a more conservative estimate of urban extent boundaries, Martellozzo *et al* [11] estimate that a mean of thirty percent of the global

Table 4. Confusion matrix comparing urban croplands derived from MIRCA2000 data to Google Earth imagery.

		Google earth imagery		
		Observed cropland	No observed cropland	Total
Derived from MIRCA2000 and GRUMP	Urban extent with cropland	199	17	216
	Urban extent without cropland	72	129	201
	Total	271	146	417

urban extent area would need to be allocated to meet actual urban vegetable consumption. However, this value varied substantially between countries ranging from 1.2 to 397.4 percent or urban extent land area. In contrast, this study found countries allocating an average of 4.8 percent (SD 8.3) and 13.4 percent (SD 13.3) of urban extent areas towards urban irrigated and rainfed croplands, respectively. In both studies the role of small and medium urban extents was substantial. While these two studies are not directly comparable due to differences in the urban extent boundaries used and the differing metrics of urban vegetable demand and urban cropland extent, these findings nonetheless suggest that urban and peri-urban croplands are playing a non-negligible role in meeting urban food demands at the global scale.

4.2. Limitations

While this analysis provides the first global estimate of the extent and distribution of urban and peri-urban croplands developed using globally consistent methods, the issue of spatial resolution remains a central consideration when interpreting these results. Specifically, the scale and methods used to develop the input cropland data are not structured to capture very small, spatially dispersed areas of urban croplands. Therefore, the types of urban cropland captured through these methods are, generally speaking, croplands over slightly larger areas occurring along the urban periphery. Given these exclusions, we would estimate that the areas of urban croplands found in this analysis are fairly conservative and underestimate the actual area of urban and peri-urban crop production. Additional case studies of urban agriculture focusing on urban and peri-urban plots found higher proportions of vegetable production [33–35] than were found in the types of urban croplands captured in our analysis suggesting that this analysis may also be underestimating the extent of vegetable and fruit production in urban croplands.

Urban boundaries are also frequently not static nor explicit. Taylor *et al* [24] found that the GRUMP data provide a generous estimate of urban extent boundaries when compared to MODIS 500 and other urban land cover data. This finding was further confirmed while conducting the validation analysis in this study. Since the focus of this analysis is identifying croplands within or along the urban periphery, this difference simply means this analysis is capturing one of many possible points along the urban to peri-urban continuum. The implication for this research is that the estimated urban cropland areas presented in this paper include a mixture of urban and peri-urban croplands. Further details on data analysis and limitations can be found in the supplemental information, available at stacks.iop.org/ERL/9/114002/mmedia.

5. Conclusion

Our analysis reveals some of the heterogeneity that characterizes urban crop production at scale. While rainfed agriculture continues to play a more substantial role in Sub-Saharan Africa and more temperate, water-abundant regions such as Canada and much of Europe; we see irrigated urban croplands playing a larger role in more densely populated and/or water scarce regions such as North Africa and South and East Asia. This study has estimated a total area of urban croplands of up to 67 Mha with 24 Mha irrigated and 44 Mha rainfed. Including peri-urban areas within 20 km of urban extents, we found up to 456 Mha of total croplands; of which, 130 Mha are irrigated and 327 Mha are rainfed croplands. Irrigated and rainfed croplands are not necessarily mutually exclusive when multiple crop rotations occur over the period of one year. These totals are based on the maximum monthly cropped area occurring within each grid cell over the course of the year (1146 Mha), which is in contrast to an estimated annual harvested area of 1305 Mha worldwide in 2000 when multiple irrigated or rainfed crop rotations are included [12].

When the context-specific details from Zezza *et al* [10] and multitude of detailed case studies on urban agriculture are combined with the new insight this publication provides on the extent of urban croplands across the globe, there is growing justification for further study on the impact of urban and peri-urban crop production on water resources management, livelihoods, and food security across the globe. Growing uncertainty in water resources availability, rapidly expanding urban populations, increasing urban food demand, and the rising incidence of rural-urban interactions along the peri-urban interface all underpin the need for a deeper understanding of the extent and drivers of urban and peri-urban agriculture across multiple scales.

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