Secrets of your veggie patch: What does science say?

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Committee Member of the SA Urban Food Network
And the Urban Ag. Scientist
“Foundation Building”

What we will cover

1. Introduction to the research & the Edible Gardens Project
2. What we have collected
3. What we have learnt
4. How can people use this knowledge?
Urban agriculture is any form of food production (including keeping urban livestock) occurring within the boundaries or outskirts of urban areas.

*It is not defined by:*

- Size of production
- Type of crops
- Intended use of the food
- Placement in urban landscape
  (indoor, outside, rooftops or vertical spaces)
In our vision of a sustainable future, urban agriculture is widely perceived as scalable approach to improving urban food security.

Yet we still do not know enough about all the different ways people grow food...
Even though home gardens are the most prevalent form of urban food gardens\textsuperscript{1,2,3}, they remain severely understudied\textsuperscript{2,4,5}.

Challenges of studying home gardens

- Huge diversity
- Wide geographic spread
- Low physical accessibility

Even though home gardens are the most prevalent form of urban food gardens\textsuperscript{1,2,3}, they remain severely understudied\textsuperscript{2,4,5}.

\section*{CITIZEN SCIENCE}

"Public participation in organised research efforts" – Louv et al. 2012\textsuperscript{6}

And is an effective approach to help us overcome these challenges\textsuperscript{7,8,9}

Introducing the *Edible Gardens* project (2016-18)

**Purpose:** To learn more about the productivity, resource efficiency and social value of urban agriculture in South Australia

**Methods**

**Phase 1** – **Online social survey (very detailed)** (more than 400 responses from gardeners aged 18 to 81+)

**Phase 2** – **In-field garden data collection** (although 70 gardens were registered, 36 were persistent in their data collection)
The Edible Gardens project was open to all food gardens in SA:

**HOME**
- High survey interest
- High garden data collection interest
- 34 home gardens (with over 90 garden areas) collected data

**COMMUNITY**
- Some survey interest
- Low garden data collection interest
- 0 community gardens collected data

**SCHOOL**
- Some survey interest
- Some garden data collection interest
- 2 schools collected data
Edible Gardens Project | DATA COLLECTION TOOLKIT

Welcome to Phase 2 of the Edible Gardens Project!
You will be measuring and recording 5 things:

1. Time spent on your food producing area/s (minutes)
2. Money spent on your food producing area/s (dollars)
3. Water used by your food producing area/s (litres)
4. Weight of the produce you harvest from your growing area/s (kilograms)
5. Any produce you share or give away to others (kilograms)

It may sounds simple, but... just designing the data collection toolkits took months to get right!
Urban food gardens are complex systems. Water remains the most difficult input to measure.

### Water Sources
1. Mains
2. Rainwater*
3. Recycled / blended
4. Greywater
5. Other

### Irrigation Methods
1. Manual
2. Drip irrigation
3. Sprinkler
4. Wicking beds
5. Animal water
6. Other

This is one possible toolkit. We posted out more than 70!
What we have collected:

Our data treasure
### Home Gardener Motivations (n = 369)

<table>
<thead>
<tr>
<th>WHY DID YOU ORIGINALLY START GROWING FOOD?</th>
<th>%</th>
<th>WHY ARE YOU CURRENTLY GROWING FOOD?</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Produce related (mostly taste &amp; freshness)</td>
<td>44%</td>
<td>1  Produce related (mostly taste &amp; freshness)</td>
<td>70%</td>
</tr>
<tr>
<td>2  Enjoyment</td>
<td>35%</td>
<td>2  Health (Mostly chemical input concerns and organic food)</td>
<td>47%</td>
</tr>
<tr>
<td>3  Health (Mostly chemical input concerns and organic food)</td>
<td>32%</td>
<td>3  Enjoyment</td>
<td>46%</td>
</tr>
<tr>
<td>4  Natural connection</td>
<td>21%</td>
<td>4  To save money</td>
<td>27%</td>
</tr>
<tr>
<td>5  To save money</td>
<td>18%</td>
<td>5  Natural connection</td>
<td>25%</td>
</tr>
<tr>
<td>6  Tradition*</td>
<td>15%</td>
<td>6  Convenience*</td>
<td>21%</td>
</tr>
<tr>
<td>7  Connection to others (mostly family)</td>
<td>14%</td>
<td>7  Satisfaction &amp; accomplishment</td>
<td>21%</td>
</tr>
<tr>
<td>8  Satisfaction &amp; accomplishment</td>
<td>14%</td>
<td>8  Environmental consideration*</td>
<td>18%</td>
</tr>
<tr>
<td>9  Knowledge building</td>
<td>14%</td>
<td>9  Connection to others (mostly family)</td>
<td>17%</td>
</tr>
<tr>
<td>10  Convenience*</td>
<td>13%</td>
<td>10  Knowledge building</td>
<td>17%</td>
</tr>
</tbody>
</table>

Average length of food growing experience: 11+ years (43%) and then 1-5 years (30%).

**The key difference in top motivations of community gardeners was:**

| 2  | Connection to others (community interaction) | 35% | 1  | Connection to others (mostly community interaction) | 70% |
Other differences between home and community gardeners

We care about the **health**, **social value** and **happiness** benefits from urban agriculture

**But are these benefits perceived in the same way?**

**Community Gardeners**
“overt sociability”

*more motivated by connection to others*

**Home Gardeners**
“subtle sociability”

*more motivated by health*

Both are motivated by **tasty**, **fresh produce** and **enjoyment**, and most **share food**

**Both** home and community food gardening may help support resilient **health & wellbeing**

*Beyond productivity: Considering the health, social value and happiness of home and community food gardens*  
C. Pollard, P. Roetman, J. Ward, B. Chiera and E. Mantzioris  
*Urban Science* - 2018

To read more about this visit: [https://www.mdpi.com/2413-8851/2/4/97/htm](https://www.mdpi.com/2413-8851/2/4/97/htm)
The greatest finding from the survey? 
The incredible diversity of people’s food gardens!

From our scientific paper: “Typically diverse: The Nature of Urban Agriculture in South Australia”

- **Total area under production**: small 5-15m² (28%) OR medium 16-30m² (28%).
- **Gardening consistency**: “All year round” 62%
- **Typical no. of production methods**: 4
  - Top 5 production methods: 1. Fruit trees (84%), 2. Pots & planters (74%), 3. In-ground beds (70%), 4. Raised beds (61%), 5. Poultry—chickens (39%)
- **Typical no. of gardening approaches**: 4
  - Top 5 gardening approaches: 1. Composting (70%), 2. Conventional digging & tilling (66%), 3. Organic (57%), 4. Companion planting (53%), 5. Low use of chemical pesticides & pesticides (48%)
- **Typical no. of water sources**: 2
  - Top 2 water sources: 1. Mains water (82%), 2. Rainwater (60%)
- **Typical no. of irrigation methods**: 3
  - Top 3 irrigation methods: 1. Manual (86%), 2. Drip irrigation (51%), 3. Sprinkler (25%)
We also found out about estimated inputs and challenges...

Typical time spent: 4 hours per week (range = <1—30 hours)
Typical setup cost: $500 (range: $0—$20,000)
Typical monthly cost: $30 (range = $0—$1,000)

Do you produce food to save money? 47% ‘Agree’
Do you think you succeed in saving money? 48% ‘Yes, some money’

Top 6 original challenges: 1. Lack of time; 2. Unsuitable space, soil, climate; 3. Not enough space; 4. Lack of knowledge; 5. Livestock, pet or pest issue; 6. Cost

Do you experience any current challenges? 38% = ‘No’, 62% = ‘Yes’

Top 6 current challenges: 1. Lack of time; 2. Unsuitable space, soil or climate; 3. Livestock, pet or pest issue; 4. Water issues; 5. Physical / health issues; 6. Cost

From our scientific paper: “Typically diverse: The Nature of Urban Agriculture in South Australia”
A screenshot of our very detailed dataset which has almost 10,000 entries. This will be available online and open-access soon.

Open-access means that anyone can view, download and use this data for free! *(This is unusual for most scientific publications)*
School Food Gardens

Although community gardens and school gardens only constitute a small fraction of UA activity, they can still have considerable positive impacts on everyone involved.

Of the two schools we built relationships with, this school collected an impressive amount of data:

<table>
<thead>
<tr>
<th>Garden Area No.</th>
<th>Size</th>
<th>Production method</th>
<th>Typical crop</th>
<th>Water source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>300</td>
<td>Raised garden bed</td>
<td>Vegetables &amp; Herbs mixed</td>
<td>Rainwater with pump</td>
</tr>
<tr>
<td>2</td>
<td>50</td>
<td>Poultry keeping (chooks)</td>
<td>Eggs</td>
<td>Rainwater with pump</td>
</tr>
</tbody>
</table>
Blair Athol North B-7 school asked for a spreadsheet to help them track their harvests across the year.

<table>
<thead>
<tr>
<th>Produce name</th>
<th>produce code</th>
<th># of entries</th>
<th>JAN</th>
<th>FEB</th>
<th>MAR</th>
<th>APR</th>
<th>MAY</th>
<th>JUN</th>
<th>JUL</th>
<th>AUG</th>
<th>SEP</th>
<th>OCT</th>
<th>NOV</th>
<th>DEC</th>
<th>SUMMER</th>
<th>AUTUMN</th>
<th>WINTER</th>
<th>SPRING</th>
</tr>
</thead>
<tbody>
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<td>Artichoke</td>
<td>arti*</td>
<td>3</td>
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<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>1.1</td>
<td>0.0</td>
<td>0.0</td>
<td>1.4</td>
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</tr>
<tr>
<td>Asian Greens</td>
<td>asian*</td>
<td>3</td>
<td>0.65</td>
<td>0.0</td>
<td>0.7</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
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<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
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<td>0.1</td>
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<td>4.94</td>
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<td>0.0</td>
<td>0.0</td>
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<td>0.0</td>
<td>0.1</td>
<td>3.4</td>
<td>0.7</td>
<td>0.8</td>
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<td>0.0</td>
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</tr>
<tr>
<td>Beans</td>
<td>bean*</td>
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<td>1.92</td>
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<td>0.0</td>
<td>0.4</td>
<td>0.0</td>
<td>1.5</td>
<td>0.0</td>
<td>0.0</td>
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<td>0.0</td>
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<td>0.0</td>
<td>1.9</td>
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<tr>
<td>beetroot</td>
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<td>13</td>
<td>5.05</td>
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<td>broad beans</td>
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<td>0.9</td>
<td>2.0</td>
<td>0.6</td>
<td>1.1</td>
<td>0.3</td>
<td>0.0</td>
<td>0.0</td>
<td>0.6</td>
<td>4.9</td>
</tr>
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<td>0.0</td>
<td>0.0</td>
<td>0.1</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
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</tr>
<tr>
<td>Capsicum</td>
<td>cap*</td>
<td>8</td>
<td>1.60</td>
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<td>0.3</td>
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<td>0.0</td>
<td>0.1</td>
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<td>0.0</td>
<td>0.0</td>
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<td>1.3</td>
<td>0.1</td>
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<tr>
<td>carrots</td>
<td>carr*</td>
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<td>2.01</td>
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<td>1.1</td>
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<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.4</td>
<td>0.0</td>
<td>0.0</td>
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<tr>
<td>cauliflower</td>
<td>caul*</td>
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<td>0.64</td>
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<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.6</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>celery</td>
<td>cel*</td>
<td>10</td>
<td>1.76</td>
<td>0.0</td>
<td>0.2</td>
<td>0.9</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
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<td>0.7</td>
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<td>0.0</td>
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<td>0.0</td>
<td>0.2</td>
<td>0.9</td>
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</tr>
<tr>
<td>Chilli</td>
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<td>1.7</td>
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<td>0.0</td>
<td>0.0</td>
<td>0.6</td>
<td>2.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Corn</td>
<td>corn*</td>
<td>5</td>
<td>3.18</td>
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<td>0.0</td>
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<td>0.0</td>
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<td>0.0</td>
<td>3.2</td>
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<td>0.0</td>
</tr>
<tr>
<td>Cucumber</td>
<td>cucu*</td>
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<td>4.49</td>
<td>0.0</td>
<td>2.6</td>
<td>0.8</td>
<td>0.7</td>
<td>0.4</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
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<td>0.0</td>
<td>2.6</td>
<td>1.9</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Eggplant</td>
<td>eggp*</td>
<td>25</td>
<td>22.64</td>
<td>0.9</td>
<td>4.1</td>
<td>8.6</td>
<td>4.2</td>
<td>4.0</td>
<td>0.8</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>5.0</td>
<td>16.8</td>
<td>0.8</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

This excel spreadsheet included their harvests of fruits, herbs, vegetables and chicken eggs.
This was part of their final report – they garden definitely saved money! *Note the impact of herbs on the total value.

There is great potential for further research into school food gardens, particularly the inclusion of a simple measurement and monitoring program to improve practical food skills and act as a “hands on” pathway for STEM based learning.
What we learnt: Our 5 science secrets

Tell everyone!

*Please note!*

These “secrets” are based on our analyses, results and findings which will soon be published as a new scientific paper. Please keep your eye out for it and cite this information accordingly 😊
Producing food doesn’t take as much time as people think (once you get going)

Reported median time spent from the survey:

3.4 hours / week

Recorded median time spent from garden data:

1.3 hours / week

Harvesting (27%)
All irrigation (25%)
Weeding / Pruning (9%)
Livestock care (8%)
Soil prep / mulch (7%)
Building (7%)
Planting / sowing (6%)
2 Garden size does matter! (but not the way you might think)

As the area under production increases...

Not only do all of the major inputs per unit area go down...

But the major outputs per unit area also go down.
Diversity can help your food garden
(Just don’t go too far!)

Some diversification of cultivation techniques can help to:

<table>
<thead>
<tr>
<th><strong>even out</strong></th>
<th><strong>provide</strong></th>
<th><strong>produce</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>the inputs and outputs of a single garden</td>
<td>more consistent year-round harvests</td>
<td>the most even (&amp; diverse) combination of foods</td>
</tr>
</tbody>
</table>

**Other ways to diversify:**
Mixing crop types or varieties to produce a range of early-, standard, and late-season crops.
Home gardeners... can save money “growing their own” (Under CERTAIN CIRCUMSTANCES!)

If you ignore your setup costs.

(almost) 80%
Of the EG gardeners would save more than $250 per year.

If you do consider your setup costs.

14% X never
21% >5 years
65% “break even” in 5 or less years

If you apply a wage rate to your time

(just over) 1 in 6
EG gardeners produced enough to effectively pay themselves

Minimum wage ($18.93/hr)
5 Water is a BIG deal for food gardens
(It’s all about “water use efficiency”)

“Is a measure of how efficiently production systems convert water (rainfall and/or irrigation) into a harvestable yield or into money” (Pollard et al. 2018, pg. 4).

The aim is to get your water use to go down as much as possible…

While keeping your yields the same or better.

From our scientific paper: “Water use efficiency in urban food gardens: Insights from a systematic review and case study”
We developed 3 water use efficiency equations
(Total water is irrigation + rainfall)

\[ WUE_{\text{gross}} = \frac{\sum Y}{\sum W} \]
- Gross Water Use Efficiency
  - total yield to total water use

\[ WUE_{\text{nut}} = \frac{\sum (Y_k N_k)}{W} \]
- Nutritional Water Use Efficiency
  - total nutritional unit of yield to total water use

\[ WUE_{\text{fin}} = \frac{\sum (Y_k F_k)}{W} \]
- Financial Water Use Efficiency
  - total retail value of yield to total water use

(looks like)
2.5 kg / 1 kL

(looks like)
4,247 kJ / 1 kL

(looks like)
$38.16 / 1 kL

If WUE does become a key metric for measuring the success of UA – this will help shift the focus from pure productivity, to a more inherently sustainable focus of food, water and land.
What now?
Using these foundations
Yet we still face the challenge of high variability in productivity and resource efficiency. Many people grow only small amounts, but some people grow food extremely well.
Theoretical comparisons between:

**Less Experienced Gardener**

- **Stronger challenges** (including "lack of knowledge")
  - **Similar Motivations** (↑ desire for connection to tradition)
    - **Place / Space / Land**
      - Less "SELF" to draw upon
        - ↓ Experience
        - ↓ Use of learning sources
        - ↑↓ Tradition

**Experienced Gardener**

- **Fewer challenges**
  - **Similar Motivations** (↑ desire for convenience)
    - **Place / Space / Land**
      - More "SELF" to draw upon
        - ↑ Experience
        - ↑ Use of learning sources
        - ↑↓ Traditions
Motivations and challenges can be matched to the most appropriate garden areas.

<table>
<thead>
<tr>
<th>Motivations and challenges</th>
<th>BED-ORCH</th>
<th>BED-VEG/VEG/HERB/OTHER</th>
<th>CHKN-EGG</th>
<th>RAISED-VEG/VEG/HERB/OTHER</th>
<th>WICK-VEG/VEG/HERB/OTHER</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOWEST SETUP COST</td>
<td>★★★</td>
<td>★★★</td>
<td>★★★</td>
<td>★★★</td>
<td>★★★</td>
</tr>
<tr>
<td>LOWEST INPUTS: TIME, TOTAL WATER (IRRIGATION &amp; RAINFALL) AND ONGOING COSTS</td>
<td>★★★</td>
<td>★★</td>
<td>★★★</td>
<td>★★★</td>
<td>★★</td>
</tr>
<tr>
<td>HIGHEST OUTPUTS: YIELDS AND AVERAGE RETAIL VALUE OF HARVEST</td>
<td>★★★</td>
<td>★★</td>
<td>★★★</td>
<td>★★★</td>
<td>★★</td>
</tr>
<tr>
<td>HIGHEST WATER USE EFFICIENCY SCORES: SIMPLE, NUTRITIONAL AND FINANCIAL</td>
<td>★★</td>
<td>★★</td>
<td>★★★</td>
<td>★★</td>
<td>★★</td>
</tr>
<tr>
<td>MEDIAN TIME TO “BREAK EVEN”</td>
<td>2.3 YEARS</td>
<td>0.6 YEARS</td>
<td>4.6 YEARS</td>
<td>1.1 YEARS</td>
<td>2.0 YEARS</td>
</tr>
</tbody>
</table>

What are your key motivations?  
What are your key challenges?
Key points for Local Councils

- Home food gardens are the **largest target** for potential sustainable change in local food.

- Support ways for gardeners to **learn from each other** (food swaps, garden meet ups, workshops, grow free carts etc.)

- **Support businesses** who want to use locally home grown produce.

- Guide low-income households on **cost effective** ways to set up a new food garden.
Thoughts for potential future businesses

- Setup costs may be a serious challenge.
- Labour is going to be one of the largest costs $$$
- But there are likely combinations of labour-saving techniques and tools.
- Can they get a retail or wholesale price?
- Home gardens are the potential building blocks of future commercial UA businesses.
Where to from here?

Our final paper will be published soon and the raw data made publicly available.

Work will continue with:

SA Urban Food Network

We are what we eat

We invite you to join the SA Urban Food Network, which is working towards a sustainable food system.

The network aims to:

- exchange connections, knowledge and opportunities across local organisations, community groups and individuals
- educate and build capacity across the food system
- enable the transition to a sustainable local food system.
Take Home Messages

☆ Brodest range of input and output data ever collected on existing home food gardens. All publicly available and open-access!

☆ People can save money by “growing their own” – if they produce a reasonable amount of food and are thrifty with their resources.

☆ By increasing people’s awareness of the in’s and out’s of their food gardens and by providing some guidance along the way – we can hope to increase the flow of fresh food to ourselves and others and contribute more to our vision of a sustainable urban future.
Thanks for listening!
Any further questions?

Please visit: www.urbanagscientist.com for links to all our published scientific articles (available to everyone!)

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References


Edible Gardens Project Publications (all open-access!)


