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TIME-USE AND RESOURCE USE IN PRIVATE OPEN SPACE IN NEW ZEALAND

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Abstract:

New Zealand is a large land area with a low population and consequently a country of gardens. It also has a temperate climate and according to Statistics New Zealand in 2013, 81.1% of NZ dwellings were detached, and therefore had open space. There is also a growing trend for buying more outdoor furniture for New Zealand houses. However, a time-use microenvironment study on 538 individuals living in 212 owner-occupied houses in New Zealand shows that on average New Zealanders spend 0.52 hours/day using the gardens/decks of their home in summer. Analysis shows that time-use at home-outdoors differs by day type and age, and that having more outdoor furniture does not necessarily lead to more time-use at home-outdoors by the household. This paper presents the life-cycle implications of making and furnishing the outdoor spaces of this sample of New Zealand homes, and further investigates this as a proportion of the total life-cycle environmental impact of the house. It also discusses the productive nature of private gardens, and how the use of gardens has changed.

Key words: New Zealand, House, Gardens, Outdoor furniture, Large housing, Life Cycle Assessment.

1. Introduction:

According to CIA World Factbook (United States Central Intelligence Agency, 2009), New Zealand's population density was 15.72 persons/km^2 compared to 343.96 for Belgium, 23.75 for Germany, 1282.17 for Malta, 252.96 for the UK, 33.53 for the US, 339.11 for Japan, with lower values of 3.68 for Canada and 2.79 for Australia (United States Central Intelligence Agency, 2009). A low population density gives residents the opportunity to live in houses located on large pieces of land, leading to the New Zealand myth of living in the half-gallon quarter-acre pavlova paradise (Mitchell, 1972).

Gardens in urban areas became important following urban expansion in the 19th century. The private garden did not appear in the overcrowded and unhealthy cities of the industrial revolution as an aid to health; improved health was achieved through new systems of sanitation and water supply. Rather the private garden and 'garden cities' and garden suburbs' were a reaction to the new sanitary by-law housing where, "…in the majority of cases nature has been completely dethroned" (Cadbury, 1915:113). At first green space was provided as groups of allotments at a distance from the housing for growing food and flowers, similar to the kleingarten still found on the fringes of many German cities. Later it was thought more convenient for family life if the garden was around the house, even though this could raise the rent through adjustment to the rates (Cadbury, 1915:114, 116). The gardens for Cadbury's industrial village of Bournville in Birmingham, UK were designed to keep the worker fit and away from the pub, with space to grow flowers on the front, a vegetable garden behind and three rows of fruit trees at the end (Cadbury, 1915:117; Adshead, 1923:121).

The value of growing vegetables at home in terms of their superior quality is mentioned in gardening books both past and present (James, 1937:173). The prime minister of New Zealand, Walter Nash, in the introduction to an NZ Department of Agriculture Bulletin on home vegetable growing urged, "…every citizen who has access to land, to do everything in his power to supply his own family with vegetables" (Pritchard, 1944) as part of the World War II 'Dig for Victory' campaign. By 1950 although acknowledging the delight in and superior taste of home grown vegetables, the advice to the householder with a very small garden was to forgo vegetables in favour of a flower garden as, "…you can never buy its equivalent from a florist's shop as you can buy vegetables from the green grocer" (Elliot, 1950:13). In one view this changing of all food to a bought commodity can be seen as furthering the split between people living in urban areas and the experience of the natural cycles and ecosystems that support such living.

The garden at the front of the house has normally been for display and that at the back for production (Ravetz and Turkington, 1995:180-181). However, with the advent of the car streets were no longer safe places for children to play and often space for play took over from space for vegetables. Moreover gardens became subject to fashion, such as the replacement of the once fashionable Hybrid Tea rose, now considered vulgar, with older shrub roses with their attendant mildew (Quest-Ritson, 2001:238). Such a movement has now culminated with television series based around the idea of the instant garden make-over, with the garden a reflection of the house and its owner. This is suggesting that nature can be designed, something that usually comes with an expensive price tag, rather than seeing the garden as a place where the householder comes to understand that nature is always evolving and that gardening is about moving with this evolution, whilst nudging it towards the desired outcomes, whether fruit or flowers.

According to Statistics New Zealand (2014) in 2013, 81.1% of NZ dwellings were detached, and therefore had open space. Given that New Zealand gardens are large and New Zealand prides itself on having an outdoor life-style, this study set out to find how well used the gardens of a sample of today's owner-occupier households are. It also probed the equipment these gardens contained, with a view to looking at the environmental impact of this.

2. Study design and methodology:

The contents of this paper emanate from a PhD study designed to discover more about different aspects of large housing in New Zealand. This was further broken down into four sub-studies. The first was a preliminary study of New Zealand houses advertised on Trade Me, currently claimed as "the leading online marketplace and classified advertising platform in New Zealand" (Trade Me, 2014). This study was undertaken to find out more about the types of rooms in New Zealand houses along with overall house size and types of furniture, and the size of plots. The written descriptions and random photos of 60 houses (10 each of 1-6 bedrooms) were examined to collect information on which to base the questionnaire for the main survey. The number of bedrooms was used as an indicator of house size.

The second sub-study was a pilot study for the main survey. A questionnaire was prepared based on the findings of the Trade Me (2014) study, and was undertaken by 7 households (14 individuals) living in Wellington. Of the seven participating households, 2 were single person (1 living in a small and 1 living in a large house), 3 were couples (1 living in a small and 2 in large houses) and 2 were couples with one child (1 living in a small and 1 in a large house). The survey asked about their household composition, house features and furniture. Based on house layout, a time-use diary was prepared for each person to report the time he/she spent in each room, garden/deck (if available) and "out of home" for 14 consecutive days in winter. A full description of this study and the results are presented elsewhere (Khajehzadeh and Vale, 2015a).

The third and main study was an on-line survey administered in February-April 2015 in New Zealand. The survey was limited to single people, couples and couples with 1 or 2 children living in owner occupied houses. The survey asked about family members, house features (number and names of rooms), furniture (type, number and location) and time-use in different rooms of the house, garden/decks and out of home for each family member for 1 day. Overall 445 households took part in the survey with 285 (64.0%) finishing the house/furniture part and 212 households (538 individuals) the time-use part. A part of this study considering the energy impacts of the house is presented elsewhere (Khajehzadeh and Vale, 2015b).

The fourth and final study was a floor plan study of New Zealand houses. This study was designed to investigate the size of rooms in New Zealand houses based on an analysis of the available floor plans of New Zealand houses. This paper is linked to the results of the first (Trade Me study) and the third (online questionnaire survey) studies.

In the questionnaire survey, participants were asked to report if they have garden, decks, balconies and patios. In the furniture part, they were asked about availability of outdoor furniture and some selected gardening tools and where they keep these. In the time-use part of the questionnaire, each member of the household reported the time they had spent in various rooms, garden, balconies, decks and patios (if available) along with the time spent out of home for one day. The subtotal of these usages had to be 24 hours if not an error message appeared asking the respondent to review his/her answers. Questionnaire data for the outdoor furniture, its location and time-use in open spaces of the house by each occupant/household were sorted in a SPSS file for further analysis. To find the differences between various aspects of outdoor furniture ownership and time-use in open spaces of the house, several Independent Sample T test and some ANOVA one-way tests were performed in SPSS. Where the ANOVA one-way test showed a significant relationship, a Post HOC analysis using Tukey test was also performed to show the details of the difference.

3. Results:

3.1. Land area and house size:

As a part of the questionnaire, participants were asked to report the plot area of their house if known. Those who answered this question (171 households) show the average land area in this study is 2946 m^2 which is very high. As seen in Table 1, the average land area varies with house size and 6 room houses have the lowest land area. This could be related to the fact 6 room houses are probably the popular 3 bedroom type and many developers try to make the final price for these houses reasonable. An ANOVA one-way test was performed to see if the average land area is significantly different by house size but the result was negative ($F(4,166)=1.61$, $p=0.17$), meaning that different size houses could be built on any size of plot.

Table 1 also shows the Standard Deviation and the range of floor areas for different sized houses are very high and this is related to some households having very large land areas (10,086-108,900 m^2). To control this, all houses with a land area higher than 10,000 m^2 were excluded from the analysis and the resultant average land area by house size is presented in Table 2. Table 2 shows the average plot size for this group of houses is 890 m^2 and houses with 5 or fewer and 6 rooms (2 and 3 bedroom houses) occupy the smallest plots. The ANOVA one-way test was performed again excluding houses on land over 10,000 m^2 and again the results show the average land size is not significantly different by house size at 0.05 level ($F(4,156)=0.89$, $p=0.47$). Figure 1 compares the average land area by house size for the whole sample and for the part with plot size less than 10,000 m^2.

House size (based on the number of rooms)	Mean (m^2)	N	Std. Deviation	Minimum	Maximum	Range
5 or fewer rooms	1716	19	3,017	100	10,086	9,986
6 rooms	950	49	1,735	200	10,117	9,917
7 rooms	7157	38	23,562	150	108,900	108,750
8 rooms	2080	28	4,728	299	25,200	24,901
9-9+ rooms	2551	37	8,102	304	48,000	47,696
Total	2946	171	12,064	100	108,900	108,800

Table 1 Average land area (m^2) by house size for all sample

House size (based on the number of rooms)	Mean (m^2)	N	Std. Deviation	Minimum	Maximum	Range
5 or fewer rooms	731	17	670	100	2300	2200
6 rooms	759	48	1118	200	8094	7894
7 rooms	914	34	1301	150	7896	7746
8 rooms	1224	27	1376	299	6238	5939
9-9+ rooms	868	35	717	304	4550	4246
Total	890	161	1098	100	8094	7994

Table 2 Average land area (m^2) by house size for sample with land area less than or equal to 10000 m^2

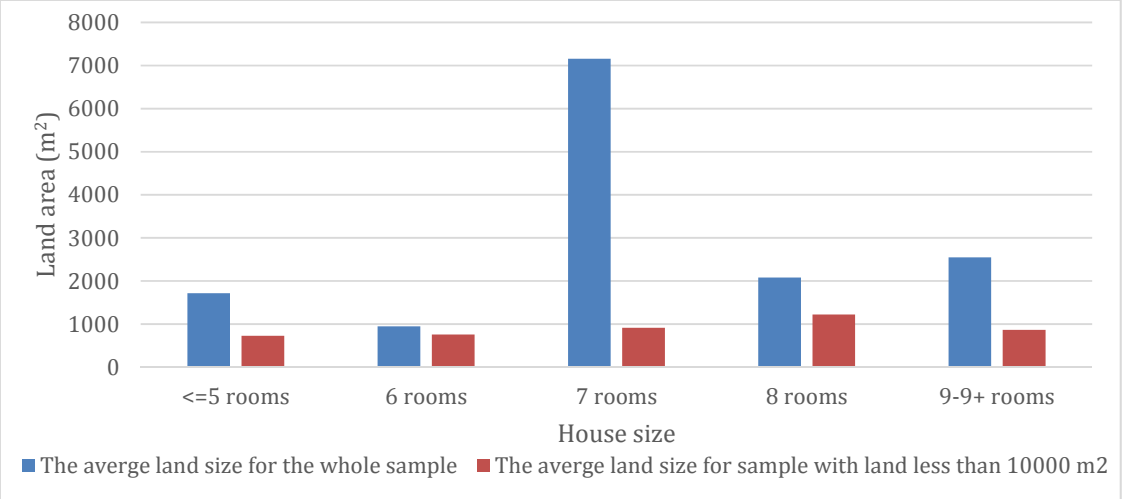

Figure 1 The average land area for the whole sample and for samples with land less than 10000 m^2

An investigation of 60 New Zealand houses differing in size advertised in Trade Me (2014) shows an average land area of 788m^2 for this sample, which is comparable with the results of this study. In the Trade Me (2014) study houses with land areas higher than 10,000 m^2 were excluded. Table 3 and Figure 2 present the average floor area (m^2) and land area (m^2) of the different sized sample houses from the Trade Me study. As seen in Table 3 and Figure 2, the house floor area increases with an increase in the number of bedrooms and 1 and 3 bedroom houses are located on the smallest plots. Table 3 and Figure 2 also show that land size does not necessarily increase with house size.

House size (based on number of bedrooms)	Average floor area (m^2)	Average land area (m^2)
1 bedroom houses	74.5	428.9
2 bedroom houses	106.3	728.5
3 bedroom houses	130.9	627.1
4 bedroom houses	237.2	906.5
5 bedroom houses	324.9	1128.8
6 bedroom houses	350.4	905.7

Table 3 The average floor area (m^2) and land area (m^2) of different sized houses from TradeMe study

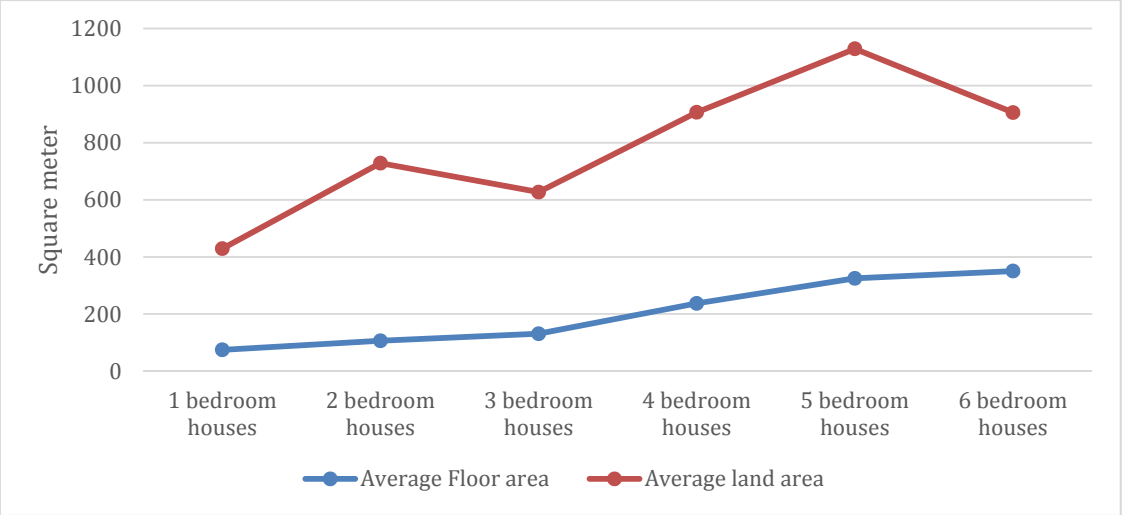

Figure 2 Average floor and land area (m²) for 1-6 bedroom houses according to the Trade Me study

3.2. Time-use at home outdoors and its relationship with house and household features:

The average time spent at home outdoors using a garden, deck or patio is 1.25 hours/day per household and 0.52 hour/day per person for houses with at least 1 garden or deck/patio. The time-use at home outdoors per household and per person is different for different household types as listed in Table 4 and shown in Figure 3. An ANOVA one-way test was performed and showed that time-use at home outdoors is significantly different by household type at 0.05 level ($F(3,215)=2.95, p=0.034$), which is related to the different number of people in each household. As Table 4 shows time spent outdoors decreases from a maximum for couples with two children, very slightly less for couples with one child, then a drop for couples, and a minimum for single person households. However, when the ANOVA one-way test was repeated for time-use at home outdoors per person by household type no significant difference was found ($F(3,215)=0.35, p=0.787$). This shows that though larger families make more use of private outdoor spaces this is because there are more people in the household.

	Household type			
	Single persons	**Couples**	**Couples with one child**	**Couples with two children**
Time-use per household	0.60	1.05	1.63	1.68
Time-use per person	0.60	0.52	0.54	0.42

Table 4 Time-use per household and per person at home outdoors (hours/day) for different household types

To find out whether having larger houses, having more decks/patios, and more outdoor furniture items/tools are positive motivation for spending more time at home outdoors, several ANOVA one-way test were performed. The results showed that time-use per household and per person at home outdoors is not significantly different by house size ($F(4,214)=0.210$, $p=0.933$) and ($F(4,214)=0.212$, $p=0.931$)). This means that living is larger houses, which is correlated with having more decks and more outdoor furniture/tools (see part 3.3), does not mean more time-use at home outdoors. Additionally, the number of decks/patios in a house does not significantly affect the average time-use per household and per person at home outdoors ($F(2,216)=0.97$, $p=0.381$) and ($F(2,216)=1.33$, $p=0.268$)). This means that living in houses with several decks does not mean more time spent outside using them.

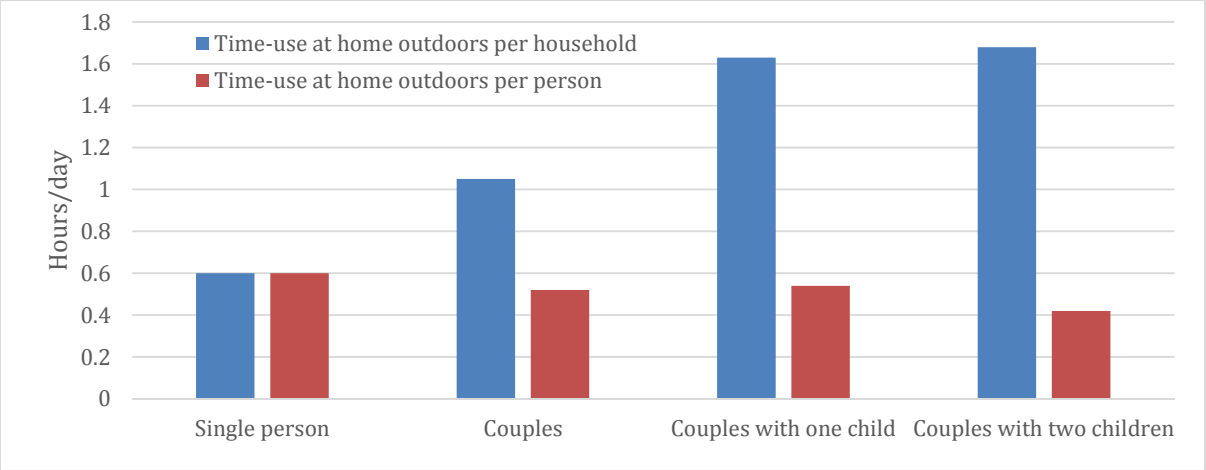

Figure 3 Time-use outdoors per person and per household by household type

The results of the ANOVA one-way tests indicated the average time spent at home outdoors by a household is significantly different by the number of outdoor furniture items/tools at 0.05 level ($F(3,208)=4.62$, $p=0.004$). A further Post HOC test revealed the average time-use at home outdoors was significantly different at 0.05 level between houses with 5 or fewer and 11-15 outdoor equipment items ($M=-1.12$, $SD=0.42$) and houses with 5 or fewer and 16+ outdoor equipment items ($M=-1.42$, $SD=0.40$). The same test was repeated to see whether time-use at home outdoors per person is significantly different by number of outdoor furniture items/tools at 0.05 level and the result was positive ($F(3,208)=3.15$, $p=0.026$). A further post HOC test was also performed and showed that the significant difference only happens between houses with 5 or fewer and houses with 16+ outdoor equipment items ($M=-0.49$, $SD=0.17$).

According to the ANOVA test results and Figure 4, the average time-use at home outdoors increases with an increase in the number of outdoor furniture items/tools. However, it should be noted that the significant difference mainly happens between houses with very few outdoor furniture items (who spend very little time at home outdoors) and houses with many outdoor furniture items (who spend a lot of time at home outdoors) (see Figure 4).

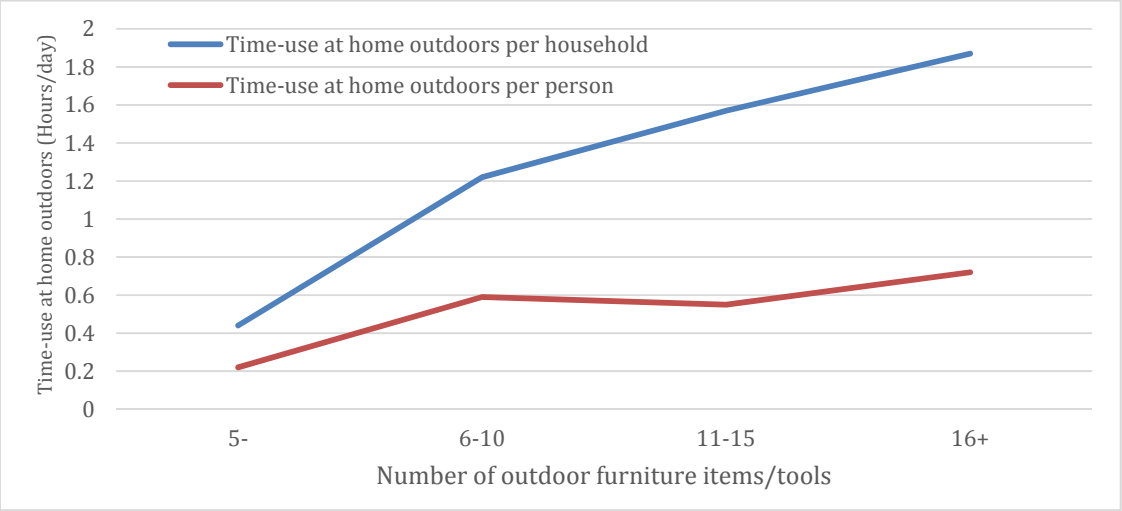

Figure 4 Time-use at home outdoors per household and per person according to the number of outdoor furniture items/tools

Most people do not work at weekends and this could be a good time for a family to use their garden. Results of international time-use studies (Hussein et al. (2012), Yoon et al. (2012) and Wu et al. (2011)) show that time-use patterns of weekdays and weekends are different. An Independent T test was performed to look for differences between weekdays and weekends. The results show that the average time-use at home outdoors per household and per person at weekends and weekdays is not significantly different at 0.05 level ((t(37)=-0.97, p=0.34) and (t(195)=-0.08, p=0.94). To see if this pattern repeats for all household types, the analysis was repeated for each household type separately as presented in Table 5, which shows the results are negative for all household types.

	df	t	Sig.	Result
Time-use per person/household by Single person households	33	0.98	0.34	×
Time-use per person/household by Couples	72	-0.05	0.96	×
Time-use per person/household by Couples with 1 child	46	0.02	0.98	×
Time-use per person/household by Couples with 2 children	38	-1.61	0.12	×

Table 5 Results of the ANOVA one-way test to see differences in the average time-use at home outdoors for different household types on weekdays and at weekends

3.3. Outdoor furniture/gardening tools in New Zealand houses:

In the questionnaire survey, participants were asked to report whether they had selected outdoor furniture/gardening tools and the number of each. Table 6 shows the most popular outdoor furniture items in NZ houses are BBQs, outdoor chairs/couches, outdoor dining/picnic tables, and umbrellas/gazebos. A work bench and drill are the most popular d-i-y items and a lawn mower and weed eater the most popular gardening tools. On average a household in this sample has 8 outdoor furniture and 4 d-i-y/gardening tools, although it should be noted that this study only covers the furniture and tools mentioned in the questionnaire and items like routers, sockets sets and pruning shears were omitted. Although respondents were able to add unlisted items, some items might have been missed and so the true number of outdoor furniture/tools is probably more than this.

Furniture/tool item	Percentage of houses with at least one item	Average number per house
Outdoor dining/picnic table	71.7%	0.89
BBQ	70.5%	0.78
Outdoor chair/couch	64.6%	3.39
Outdoor umbrella/gazebo	43.9%	0.53
Sun lounger/deck recliner chair	19.4%	0.30
Swing seat/hammock	16.0%	0.19
Outdoor coffee table	11.2%	0.12
Spa pool	5.1%	0.05
Trampoline	16.5%	0.16
Paddling pool	14.3%	0.15
Swing	10.5%	0.13
Play house	8.9%	0.09
Slide	8.0%	0.08
Sand box	7.2%	0.07
Climbing frame	1.7%	0.02
Lawn mower	63.3%	0.71
Leaf blower	17.3%	0.18
Chipper	12.2%	0.12
Drill	82.7%	1.12
Work bench	53.6%	0.59
Water blaster	35.0%	0.35
Chain saw	34.6%	0.41
Drop saw	21.9%	0.23
Hedge trimmer	25.3%	0.27
Weed eater	59.1%	0.62

Table 6 Popularity of different outdoor furniture itmes/tools in New Zealand houses

Households living in houses with gardens would normally be expected to have more outdoor furniture/gardening tools although it is not clear whether this is true, and if it is true whether this applies to all items. The relationship between having a garden and outdoor furniture/tools was tested using an Independent Sample T test and the results are given in Table 7. According to Table 7, overall having a garden means having more outdoor furniture/gardening tools although this is not necessarily the case all items.

Furniture/Tool item	df	t	Sig. (2-tailed)	Test result
Outdoor dining/picnic table	235.00	3.30	0.001	✓
BBQ	41.00	0.84	0.408	×
Outdoor chair/couch	57.49	3.44	0.001	✓
Outdoor umbrella/gazebo	56.10	2.46	0.017	✓
Sun lounger/deck recliner chair	235.00	-0.13	0.895	×
Swing seat/hammock	65.52	1.45	0.153	×
Outdoor coffee table	235.00	0.69	0.492	×
Spa pool	201.00	3.56	0.000	✓
Trampoline	235.00	0.87	0.387	×
Paddling pool	235.00	0.15	0.880	×
Swing	78.69	1.64	0.105	×
Play house	84.48	2.07	0.042	✓
Slide	201.00	4.57	0.000	✓
Sand box	235.00	0.36	0.719	×
Climbing frame	235.00	0.84	0.403	×
Lawn mower	235.00	3.25	0.001	✓
Leaf blower	235.00	0.56	0.577	×
Chipper	235.00	0.71	0.476	×
Drill	235.00	1.93	0.055	×
Work bench	235.00	2.07	0.040	✓
Water blaster	56.12	2.92	0.005	✓
Chain saw	50.08	1.71	0.094	×
Drop saw	235.00	0.86	0.391	×
Hedge trimmer	58.54	2.09	0.041	✓
Weed eater	235.00	2.61	0.010	✓
Subtotal number of all outdoor furniture/tools items	235.00	3.84	0.000	✓

Table 7 Results of the Independent Sample T test to compare the averge number of outdoor furniture items/tools in houses with and without gardens

As seen, the average number of all outdoor furniture/tool items in houses with a garden is significantly more than houses with no garden at 0.05 level ($t(235)=3.84$, $p=0.000$). Further analysis show that households with gardens have an average 12.31 outdoor items, and households with no garden still have an average 7.40 items.

Many people use their outdoor furniture on the decks of their houses. The influence of having a deck was tested for all outdoor furniture items/gardening tools using an Independent Sample T test and the results are shown in Table 3. As seen, the average number of all outdoor furniture/tools in houses with decks is significantly more than houses with no decks at 0.05 level ($t(235)=5.42$, $p=0.000$) although this is not necessarily the case for all items. Further analysis shows houses with decks have an average 12.82 items and houses with no decks an average 6.96 items.

Furniture/Tool item	df	t	Sig. (2-tailed)	Test result
Outdoor dining/Picnic table	235.00	3.62	0.000	✓
BBQ	62.94	1.81	0.075	×
Outdoor chair/couch	96.28	4.72	0.000	✓
Outdoor umbrella/Gazebo	106.94	3.61	0.000	✓
Sun lounger/Deck recliner chair	235.00	0.89	0.375	×
Swing seat/Hammock	228.70	3.55	0.000	✓
Outdoor coffee table	115.58	1.84	0.069	×
Spa pool	130.08	1.47	0.144	×
Trampoline	96.16	1.59	0.114	×
Paddling pool	235.00	0.66	0.508	×
Swing	228.70	3.55	0.000	✓
Play house	128.46	1.82	0.071	×
Slide	169.52	2.59	0.010	✓
Sand box	104.13	1.17	0.244	×
Climbing frame	186.00	2.02	0.045	✓
Lawn mower	235.00	2.45	0.015	✓
Leaf blower	102.97	1.87	0.065	×
Chipper	110.05	1.87	0.065	×
Drill	235.00	2.01	0.046	✓
Work bench	235.00	2.04	0.042	✓
Water blaster	108.41	4.40	0.000	✓
Chain saw	89.33	2.99	0.004	✓
Drop saw	82.75	1.33	0.186	×
Hedge trimmer	90.71	1.24	0.218	×
Weed eater	235.00	5.17	0.000	✓
Subtotal number of all outdoor furniture/tools items	235.00	5.42	0.000	✓

Table 8 Results of the Independent Sample T test to compare the averge number of outdoor furniture items/ tools in houses with and without a deck

An ANOVA one-way test was also performed to see if the number of decks a house affects the total average outdoor furniture/tool items. The results show that this average is significantly different at 0.05 level ($F(2,234)=16.94$, $p=0.000$), although a further Post HOC test indicates that significant difference happens only between houses with 0 decks and 1 and 2+ decks at 0.05 level and there is no significant difference between the averages for houses with 1 and 2+ decks. However, Figure 5 does show that the average number of outdoor furniture items/tools increases as the number of decks a house has increases.

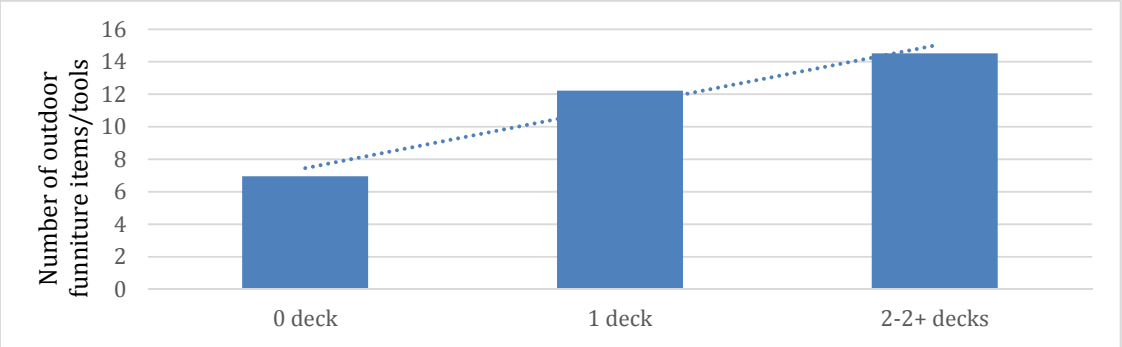

Figure 5 The average number of outdoor furniture items/tools by number of decks

To see if having a large house means having more outdoor furniture/tools an ANOVA one-way test was performed. The results show that the average number of outdoor furniture items/tools is significantly different according to house size at 0.05 level ($F(4,232)=7.79$, $p=0.000$). The results of a

further Post Hoc test indicate that significant difference happens between pairs of houses with 5 or fewer rooms and 6 rooms (M=-3.18, SD=1.38), 5 or fewer rooms and 7 rooms (M=-5.55, SD=1.46), 5 or fewer rooms and 8 rooms (M=-7.40, SD=1.63), 5 or fewer rooms and 9-9+ rooms (M=--6.56, SD=1.44) and 6 rooms and 8 rooms (M=-4.22, SD=1.47) at 0.05 level, and 6 rooms and 9 or more rooms (M=-3.38, SD=1.27) at 0.1 level. Overall Figure 6 shows the average number of outdoor furniture items/tools increases with house size.

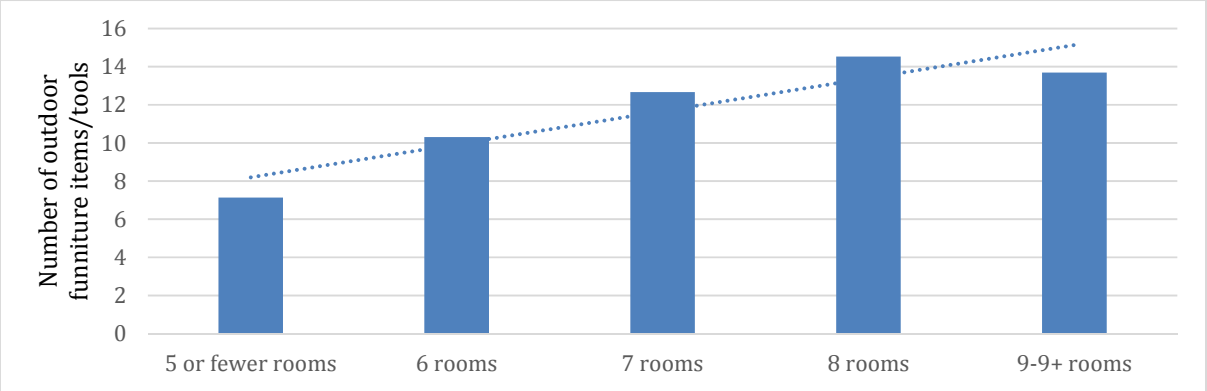

Figure 6 Average number of outdoor furniture items/tools by house size

To examine the effect of house size on outdoor equipment and tool ownership an ANOVA one-way test was performed for each furniture/tool item (Table 9). Where the average number of all outdoor items is significantly less by house size at 0.05 level a green tick appears in the last column. This shows the average number of most outdoor furniture/gardening tools is significantly different by house size and a further Post HOC test proves that the average number for all items is higher in larger houses than in small houses.

Furniture/Tool item	df	F	Sig.	Result
Outdoor dining/picnic table	4,232	7.93	0.000	✓
BBQ	4,232	5.65	0.000	✓
Outdoor chair/couch	4,232	4.71	0.001	✓
Outdoor umbrella/gazebo	4,232	2.88	0.023	✓
Sun lounger/deck recliner chair	4,232	0.74	0.565	×
Swing seat/hammock	4,232	0.04	0.997	×
Outdoor coffee table	4,232	0.69	0.600	×
Spa pool	4,232	1.90	0.111	×
Trampoline	4,232	3.02	0.019	✓
Paddling pool	4,232	1.62	0.171	×
Swing	4,232	2.96	0.021	✓
Play house	4,232	1.01	0.405	×
Slide	4,232	3.04	0.018	✓
Sand box	4,232	3.01	0.019	✓
Climbing frame	4,232	1.07	0.37	×
Lawn mower	4,232	4.27	0.002	✓
Leaf blower	4,232	0.16	0.957	×
Chipper	4,232	0.96	0.433	×
Drill	4,232	1.07	0.372	×
Work bench	4,232	3.50	0.008	✓
Water blaster	4,232	2.55	0.040	✓
Chain saw	4,232	0.55	0.701	×
Drop saw	4,232	1.24	0.294	×
Hedge trimmer	4,232	2.10	0.081	×
Weed eater	4,232	6.39	0.000	✓

Table 9 Results of the ANOVA one-way test to compare the average number of outdoor furniture items/tools in different sized houses

An ANOVA one-way test to see the effect of household size on ownership of outdoor equipment showed the average number of outdoor furniture items/tools is significantly different according to household size at 0.05 level ($F(3,233)=4.30$, $p=0.006$). The results of a further Post Hoc test indicate that significant difference only happens between pairs of single person households and couples with 1 child (M=-4.58, SD=1.42) and single person households and couples with 2 children (M=-4.45, SD=1.44) at 0.05 level, although Figure 7 does shows the average number of all outdoor furniture items/tools increases with household size.

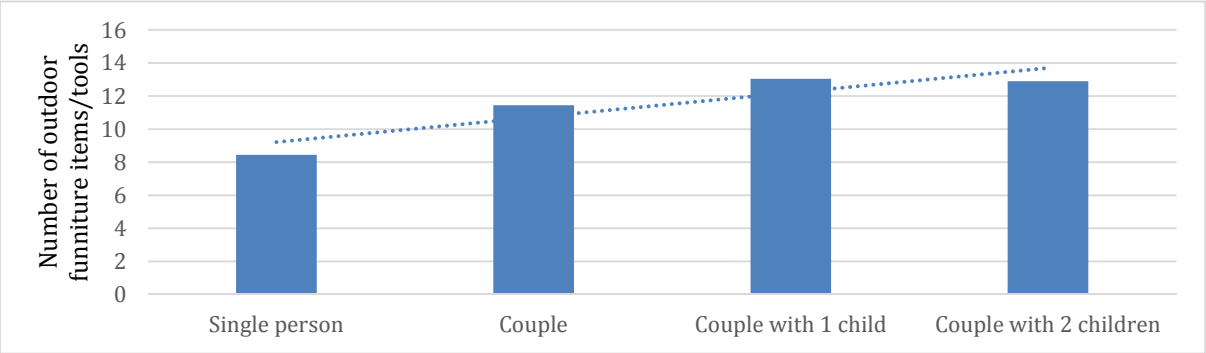

Figure 7 Average number of outdoor furniture items/tools by household size

The question arises as whether having/not having particular outdoor furniture items/tools affects the average time-use at home outdoors. An Independent Sample T test was performed for each furniture item/tool separately and the average time-use at home indoors per person and per household. The results are presented in Table 10 and any significant difference at 0.05 level is shown by a tick. As seen in Table 10, the presence or absence of just a few furniture items/tools relates to the time-use at home outdoors per household and per person.

	Time-use per household				Time-use per person			
Furniture/Tool item	**df**	**t**	**Sig.**	**Result**	**df**	**t**	**Sig.**	**Result**
Outdoor dining/Picnic table	210	1.75	0.08	×	210	1.60	0.11	×
BBQ	210	0.56	0.57	×	210	0.13	0.39	×
Outdoor chair/couch	197	2.34	0.02	✓	210	1.39	0.17	×
Outdoor umbrella/Gazebo	153	2.98	0.00	✓	143	3.18	0.00	✓
Sun lounger/Deck recliner chair	210	-0.76	0.30	×	210	-0.56	0.57	×
Swing seat/Hammock	33	2.62	0.01	✓	33	2.80	0.01	✓
Outdoor coffee table	210	-0.44	0.66	×	210	0.11	0.91	×
Spa pool	210	-0.39	0.70	×	210	-0.76	0.45	×
Trampoline	42	1.04	0.05	✓	210	0.31	0.76	×
Paddling pool	210	1.84	0.07	×	210	0.41	0.68	×
Swing	210	0.78	0.44	×	210	0.45	0.65	×
Play house	210	0.30	0.77	×	210	-0.34	0.74	×
Slide	17	1.77	0.10	×	210	1.73	0.09	×
Sand box	16	1.38	0.19	×	210	1.12	0.27	×
Climbing frame	210	0.04	0.97	×	210	-0.30	0.77	×
Lawn mower	206	3.10	0.00	✓	204	2.97	0.00	✓
Leaf blower	210	0.02	0.98	×	210	0.16	0.88	×
Chipper	210	0.74	0.46	×	210	0.91	0.36	×
Drill	98	3.75	0.00	✓	210	1.88	0.06	×
Work bench	210	1.33	0.19	×	210	0.65	0.52	×
Water blaster	210	1.37	0.17	×	210	0.98	0.33	×
Chain saw	102	2.46	0.02	✓	110	2.57	0.01	✓
Drop saw	210	1.73	0.09	×	210	0.66	0.51	×
Hedge trimmer	210	0.03	0.97	×	210	0.50	0.62	×
Weed eater	208	2.92	0.00	✓	210	1.83	0.07	×

Table 10 Results of the Independent Sample T test to see the difference between the average time-use at home outdoors per household and per person and presence and absence of each furniture item/tool

4. Analysis:

4.1. The impact of these equipment: A Life-cycle analysis

This part of the paper sets out to see impacts of outdoor furniture/tools using a life cycle assessment method, based on Fay (1999). Fay used values of 10 and 8 MJ/A$ as the embodied energy of domestic appliances and furniture (Mithraratne et al. 2007:127-128). The useful life of various appliances and furniture is shown in Table 11, with their outdoor equivalents, for only those items that appear most frequently in our sample. Prices were taken from chains like Bunnings warehouse (2016) and Mitre 10 (2016) rather than designer shops. Useful life of various items is taken from (Mithraratne et al. 2007), with a value for the trampoline from Trampoline country (2016).

Item	Useful life	Cost NZ$	Ave no per house
Electric Range/oven	15	NA	NA
Barbecue	15	500 (range 200-10,000)	0.78
Dining table	25	NA	NA
Outdoor dining table	25	400 (range 300-1,400)	0.89
Chair	25	NA	NA
Outdoor chair	25	80 (range 12-200)	3.39
Trampoline	20	1500	0.16
Washing machine	14	NA	NA
Lawn mower	14	400 (400-800)	0.71
Iron	8	NA	NA
Drill	8	250 (125-500)	1.12

Table 11 Useful life, cost in NZ$ and the average number of each for frequently occurring outdoor furniture/tools

The next step is to create a table of the impact of this equipment at 0, 25, 50 and 100 years. The result is then multiplied by the average number found in our sample and presented in Table 12.

	Embodied and life cycle energy (MJ) at different life stages			
Item	Year 0	Year 25	Year 50	Year 100
Barbecue	3,900	7,800	15,600	23,400
Outdoor dining table	2,848	5,518	8,366	11,392
Outdoor chair	2,170	4,339	6,509	8,678
Trampoline	1,920	3,840	5,760	11,520
Lawn mower	2,840	5,680	11,360	19,880
Drill	90	358	627	1,165
Total GJ	13.8	27.5	48.2	76.0

Table 12 Embodied energy and life cycle energy of frequently occurring outdoor furniture/tools at different life stages

However, this table only accounts for 7.05 items and each house has 12 items. Adjusting the table gives the following embodied energy for outdoor equipment (Table 13). This is then compared with a 100m² house of lightweight construction, including annual operating energy. Although the impact of the outdoor furniture and tools decreases over the life of the house it is still a significant component of the whole life-cycle energy.

	Embodied and life cycle energy (MJ) at different life stages			
	Year 0	Year 25	Year 50	Year 100
Outdoor equipment (12 items)	23.5	46.8	82.0	129.4
1 average item	2.0	3.8	6.8	10.8
House 100m²	191.0	535.0	939.0	1697.0
Stuff as % of total	10.9%	8.0%	8.0%	7.1%

Table 13 Life cycle energy of all outdoor furniture/tools for typical New Zealand house compared with embodied energy and life cycle energy of a typical 100 m² light construction NZ house

4.2. Productive gardens

In the 1970s it was possible to grow 75% of the food for a family of five (2 adults and three small children), as measured by the University of Cambridge, on 0.7 ha (Vale and Vale, 1976). This took 2 hours a day shared between 2 adults. Assuming 3 children equate to 1 adult, this gives an equivalent ecological footprint of 0.9ha/person. The diet was based on meat, dairy, fruit and vegetables with grains bought in. The ecological footprint of food in the UK as measured by the University of Cardiff is 1.33gha/person (Vale and Vale, 2009:40-42). It appears that growing food at home does reduce environmental impact, in this case by 32%.

Using the ecological footprint example above the impact of buying vegetables is 0.07gha/year for each person (7GJ/year based on Wackernagel and Rees (1992:74) conversion factor of 100GJ to the hectare). This allows construction of Table 14 to compare the impact of a productive garden (which reduces GJ) and one full of stuff. The house with vegetables has no outdoor equipment and grows enough vegetables for one person a year on 60m^2 (Ghosh, 2014).

	Embodied and life cycle energy (MJ) at different life stages			
	Year 0	Year 25	Year 50	Year 100
House 100m^2 with outdoor equipment (12 items)	215	582	1021	1826
Negative impact of growing vegetables	0	175	350	700
House 100m^2 growing vegetables	191	360	589	997
% reduction	11%	38%	42%	45%

Table 14 Comparison of the impacts of a 100m^2 NZ house with outdoor furniture/tools and a 100m^2 house without furniture/tools which uses its garden for growing vegetables

5. Conclusion:

This study has shown that modern New Zealand gardens have become a little used consumer product and are no longer the site of food production as in the past. The brief LCA analysis shows the value not just to the household of growing food at home but also to the overall environmental impact of the house and garden. However, in resilience terms these gardens are a buffer to future unwelcome change and could once again becomes productive.

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