

An Investigation of Predominant Agricultural and Waste Reuse Practices in Selected Peri-Urban Areas of Harare, Zimbabwe

R.L. Mhindu¹, M. Wuta², E. Ngorima³

¹Department of Land and Water Resources Management
Midlands State University
Gweru, Zimbabwe

²Department of Soil Science and Agricultural Engineering
University of Zimbabwe.
Harare, Zimbabwe

³CSIR, BE, Water and Sanitation for Development,
Pretoria, South Africa

Abstract

Peri-urban areas are often caught up in the pressure for land as cities expand due to rapid urbanization. The growth of cities in developing countries is also accompanied by waste management challenges and declining food security. This combination of factors has resulted in the expansion of urban and peri-urban agriculture and also creates opportunities for recycling household and yard waste. We studied the characteristics and agricultural practices in peri-urban areas of Harare through surveys conducted during the year 2000. Key informant interviews were conducted and questionnaires administered to peri-urban households in order to investigate predominant agricultural practices, waste disposal strategies and the potential for waste reuse to benefit crop production in peri-urban areas. We noted that peri-urban households earn low incomes through agriculture, formal employment and informal trade activities. Households in peri-urban areas use refuse pits for waste disposal and periodically use decomposed refuse as a fertility amendment. Access to livestock manure is limited and farmers use a combination of refuse, inorganic fertilisers and manure to improve yields. We concluded that there is potential for improved recycling of wastes through composting so as to mitigate the shortage of fertility amendments. Opportunities also exist for increasing compost production by linking peri-urban and urban areas so that waste generated in urban areas may be transported and composted in peri-urban areas.

Key words: Waste, Peri-Urban, Refuse, Income Sources

Introduction

The growing of crops in and around cities has been increasing, apparently as a survival strategy in response to serious economic hardships ((Drescher, Nugent De Zeauw, 2000; Bowyer Bowyer, 1997, Smit and Nasr, 1992). In Zimbabwe, hyper-inflation, unemployment and the ensuing economic hardships have been blamed for serious food and nutrition security problems (Mudimu, 1993; Jongwe, 2013). Households in urban areas are usually affected the most because of their

reliance on the earned wage. Urban and peri-urban agriculture have therefore gained eminence as a strategy for improving urban food security. Urban agriculture has the capacity to generate extra income and savings from sales or consumption of own produce. However the significance of such savings is dependent on the availability of resources essential for agriculture.

The shortage of such resources as land, fertility inputs and water, a result of economic hardships, rapid urbanization, and population growth, are major limitations to agricultural production in urban and peri-urban areas (Mugisa, Ngategize and Sabiiti, 2000; Mkwambisi, Fraser and Dougill, 2011). Peri-urban areas are typically short of land and production systems are intensive hence aggressive with regard to soil fertility since small pieces of land are cultivated continuously to meet household requirements (Mcgregor, Adam-Bradford, Thompson and Simon, 2011). The need to safeguard sustainability while increasing agricultural production in the urban and peri-urban areas was noted (Bowyer Bower and Tengbeh, 1997; Mougeot, 1999). Linking rural and urban through waste re-use, thereby replenishing soil fertility, has been proposed and even implemented in many parts of the world (Arku *et. al.*, 2012; McGregor *et. al.*, 2011).

To what extent can the use of urban wastes contribute to soil fertility needs of peri-urban households? The answers to this question have a lot to do with the type of farming systems in question and waste generation rates. Peri-urban farmers have been identified as being very different from city or intra-urban farmers, utilising more sophisticated technology and being more heavily commercially oriented (Drescher *et. al.*, 1999). It is thus note worthy that the socio-economic context of peri-urban agriculture is very broad. This study investigated the predominant agricultural practices and waste disposal strategies of selected peri-urban areas of Harare.

Study sites

Three peri-urban areas were selected around Harare, Epworth, Porta Farm Holding Camp and Domboshava. Sites were selected for their proximity to the city of Harare and the existence of interaction in the form of exchange of goods, commodities, labour and energy. Epworth is a former Methodist Mission established by the British missionaries in the early 19th century. It is located 15 km south east of Harare. In the pre-independence years political unrest resulted in the influx of refugees and squatters to the mission in a bid to escape political disturbances from the rural areas. Overwhelmed by the influx of refugees the mission handed over the farm to the government. This saw the birth of the Epworth Local Board in 1991. With the increasing shortage of housing in Harare

and the rising cost of living many home seekers continued to invade Epworth where accommodation was cheaper and where there were no electricity bills to worry about. Efforts by the Local Board and the police to rid Epworth of the illegal settlers met with great resistance due to political interference. As such Epworth is a haphazard settlement that is in a transition from being a predominantly rural settlement to becoming an urban suburb under the City of Harare. Plans are under way to introduce electricity; safe tapped water and water borne sewerage system. Epworth consists of eight areas that are at various stages of development. Studies for this research were done in Area Four, Makomo extension where running water is only available at central points and water borne sewerage system is still under construction.

Porta settlement*, a squatter holding camp established in 1991 by the government to temporarily accommodate vagrants from the city of Harare and squatters evicted from Epworth, was located about 30 km south west of the City of Harare on a city council farm. The housing was largely shanty as it was intended to be temporary. Houses were closely spaced with very little space between houses in most instances. However the settlers were beginning to put up more permanent structures, as the Government had taken too long to resettle them.

Domboshava on the other hand is a very rural district renowned for supplying vegetables to markets of the city of Harare. One village located 39 km from the city of Harare was selected for the study in Domboshava. Villagers practice market gardening selling vegetables to the Harare Mbare market.

Methodology

The socio-economic status and agricultural practices in three peri-urban areas was investigated by means of a questionnaire survey, key informant interviews as well as focus group discussions. The questionnaire was developed with contributions from a social scientist and an agricultural extension worker. Three peri-urban areas, Domboshava, Epworth and Porta Farm, were selected for the study by virtue of them being close to the city of Harare. The selection of study sites, also done with assistance from a social worker, was aimed at capturing the rural-urban continuum.

For purposes of this survey, a household was considered as any group of people living together and sharing food from the same cooking point and adults as all members of the household above the age of 12 years. The head of the household was defined as that member of the household responsible for decision-making and the day to day running of the household's affairs on the ground. Family members living in town and only visiting home occasionally were not counted

when stating the size of the household. Servants and extended family members living together with a core family were considered along with the household they lived with. No differentiation was made to separate the various forms of access people have to land and other resources from true ownership and property rights. Where no monthly incomes were recorded, annual estimates were converted accordingly to obtain a monthly equivalent.

The questionnaire was pre-tested using a sub-sample of 5 randomly selected households at each of the sites to facilitate implementation of relevant adjustments before the questionnaire could be administered at any site. The surveys were conducted in the period April-July, 2000. The questionnaire was administered with the help of an assistant, identified and trained at each site. The heads of households or their spouses were targeted as respondents to the questionnaire. Special arrangements had to be made to secure appointments for later visits where the head or his/her spouse could not be reached during the first visit. Visits were timed to coincide with the early morning hours or the late afternoon hours to catch people at home. During the busy hours of the day visits were made to the fields where appropriate. For the working folk visits were also organised over the weekends. Visits were also aimed at assisting farmers with estimating the sizes of their fields where the need arose. The survey relied on the respondent's memory and estimates in cases where records and measurements were not kept.

Results

Household Characteristics

The main characteristics of peri-urban households are summarised in (Table 1). Peri-urban households consisted of 4-6 people in most cases. This was true for all three sites with 91, 68 and 81% of participating households at Domboshava, Epworth and Porta Farm respectively having households of six people or less. In comparison to Domboshava, there was a higher proportion (32 and 19%) of larger households (over 6 people) at Epworth and Porta farm respectively. Approximately half the household members were adults and the rest children below 12 years of age. At all three sites, males headed most households (68-73%). Most household heads at Domboshava (70%) and Porta farm (67%) were not formally employed, and made a living from informal trade or crop husbandry. Epworth had a higher proportion of respondents (61%) indicating that their heads were employed on a part or full time basis. Most households had married heads (70-78%) but very few of the heads had spouses in fulltime employment.

Composting and Waste Management

Most of the respondents at Domboshava (98%) claimed to use compost in their fields while the majority (over 50%) at the other two sites did not. Reasons for using composts cited included the need to improve the soil and reduce costs (81% of Domboshava respondents) by making up for mineral fertiliser requirements (Fig. 2.6). Composts used were derived from grass, maize straw, garbage, ash and tree leaves obtained as yard wastes. For most farmers composting involved heaping materials together in a rubbish pit and the occasional addition of water. In some cases the material would be turned at least once before it was considered ready for use in 6-12 months on average. The composting work seemed to be the responsibility of both men and women at all sites.

Hardly any households (0, 8 and 23% for Porta, Domboshava and Epworth respectively) had one other member in employment, and those that were employed did lowly paid unskilled jobs. Apart from Domboshava with 17% widowed household heads, few households had single heads. The main sources of income varied from site to site. At Domboshava, crop cultivation was the main source of income, informal trade for Porta respondents while the majority of Epworth respondents made a living from informal trade in addition to part time or formal employment (Table 1).

Average monthly incomes were generally low although slightly higher for Domboshava. Approximately 80% of Porta respondents indicated incomes less than US\$40 while the same proportion of Domboshava respondents were claiming to have average monthly incomes above this amount (Fig 1). Slightly over 60% of Epworth respondents earned more than US\$40 monthly. The lowest incomes were recorded for residents of Porta Farm holding camp where 52% of the interviewees indicated that their households earned less than US\$40 monthly compared with 38% and 20% for Epworth and Domboshava respectively.

Agricultural Practices

Access to land

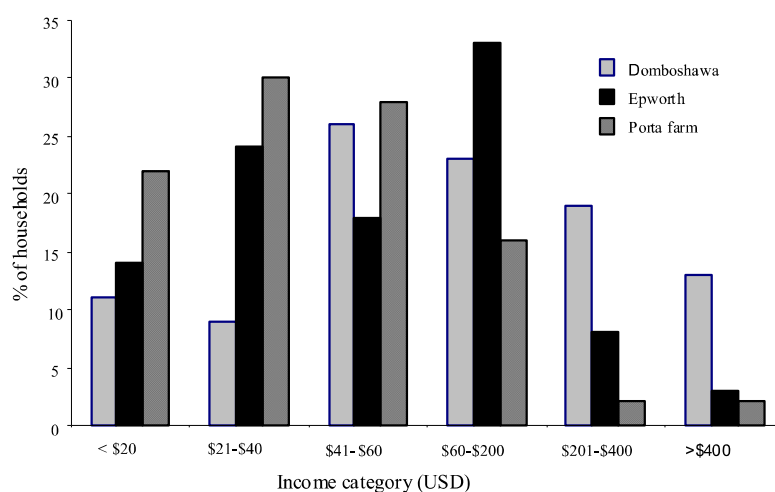
Peri-urban households that participated in this survey seemed to suffer a critical shortage of land. This was more evident at Porta Farm and Epworth than Domboshava (Fig 2). At Porta Farm, 50% of the respondents estimated the amount of land they cultivate to be less than 100 m² while 7% claimed to have no access to land at all. For Epworth 17% of the respondents claimed to have no access to land while 24% estimated the land accessible for their use to be less than 100 m² (0.01 ha). The situation for Domboshava was different with 25% of the farmers using land approximating to or in excess of 2 ha.

Table 1. Characteristics of peri-urban households at three peri-urban sites of Harare.
Results of a questionnaire survey conducted at three peri-urban sites April-
July 2000

Household characteristic	% of respondents		
	Domboshava (n=47)	Epworth (n=96)	Porta (n=94)
1. Household size:			
(i) 1-3 people	23	22	34
(ii) 4-6 people	68	46	47
(iii) 7-10 people	9	25	15
(iv) > 10 people	-	7	4
2. Members >12 years old:			
(i) 1-2	32	31	35
(ii) 3-5	53	43	57
(iii) >5	15	26	8
3. Gender of household head			
(i) Male	68	72	73
(ii) Female	32	28	27
4. Employment Status of hh head:			
(i) Employed part-/ full-time	30	61	37
(ii) Informal employed	15	34	9
(iii) Unemployed/communal farmer	55	1	51
(iv) Other (contract worker)	-	4	3
5. Head: Marital status			
Widowed	17	11	13
Single	2	3	4
Married	70	78	76
Other (divorced)	11	8	7
6. Major source of income			
Part/ full-time employment	19	52	28
Farming crops/livestock	2	-	7
Market gardening	75	-	14
Informal trade	2	23	39
Other	-	22	12

Figure 1. Distribution of peri-urban households by income at three sites according to a survey conducted in April-June 2000

Table 2. How peri-urban households got access to land. Results of a questionnaire survey conducted at three peri-urban sites of Harare

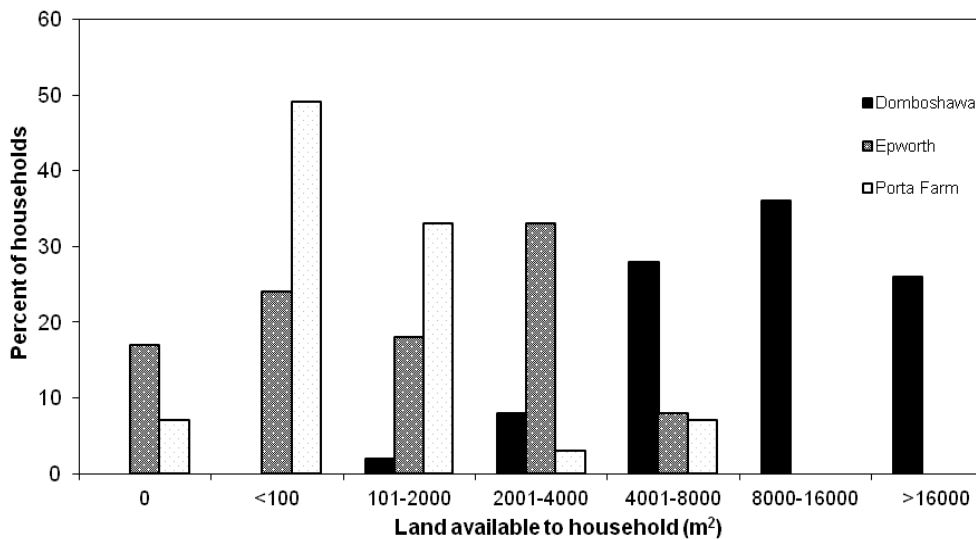


How household got access to land	Percent of households		
	Domboshava (n=47)	Epworth (n=96)	Porta (n=94)
Does not have land (n/a)	-	4	9
Inherited, allocated or bought	89	85	54
Rented, borrowed or occupied illegally	11	6	37
Other	-	5	-

For the majority of respondents access to land was obtained as allocations from relatives from their own portion, through inheritance, purchase or by borrowing. This category of respondents represented 89%, 85% or 54% for Domboshava, Epworth and Porta Farm respectively. Illegal occupation and use of land was the other major means by which Porta farm respondents (37%) claimed to have got access to land. This category of people also seemed to be the only ones who were using land that was situated away from the house since 63% of the Porta Farm respondents claimed not to have any access to fields or parcels of land other than that around their houses. All households interviewed in Domboshava had land in fields or vleis away from home while 15% indicated they had

none around the home. McGregor *et. al.*, (2011) also reported similar patterns in land ownership and an increase of the use of wetlands in peri-urban areas of Kumasi, Ghana.

Figure 2. Distribution of peri-urban households by access to land Results of a questionnaire survey conducted at three peri-urban sites of Harare in the period April-June 2000.



Crops commonly grown in peri-urban areas

Overall the most commonly grown crops included maize, sweet potatoes, leaf vegetables and tomatoes (Table 3). On the basis of the area committed to crop the major peri-urban crop is maize as indicated by the majority of households (92% for Domboshava, 71% for Epworth and 60% at Porta Farm). The purpose for engaging in crop cultivation seems to be subsistence for Porta Farm and Epworth households since 60 and 80% respectively of the households interviewed did not sell their produce. The land close to the family home was used for growing both vegetables in winter, and field crops maize and sweet potatoes as the most common crops in the rainy season. Similar cropping systems to those observed in peri-urban areas of Harare were also observed by Mkwambisi *et. al.* (2011) in his study of urban agriculture in Malawi.

Maize was ranked first by 94% of the respondents at Domboshava compared with approximately a third (28 and 34 % respectively) of the respondents at Epworth and Porta. To the majority (40%) of respondents at Porta and Epworth,

sweet potatoes were the most important crop cultivated for food. Vegetables were considered the most important income generating crops at Domboshava where 60% of the respondents ranked tomatoes and leafy vegetables first in this category. However 30% of the Domboshava respondents still had other crops that they considered more important as money earning crops. Okra, sweet potatoes and maize were among the other crops ranked highly in this category.

Table 3. Crops grown by peri-urban residents. Results of a questionnaire survey at three peri-urban sites of Harare conducted during the period April-May 2000

Crops grown	Percent of households		
	Domboshava (n=47)	Epworth (n=96)	Porta (n=94)
(i) Leaf vegetables	96	45	67
(ii) Maize	100	86	69
(iii) Okra	2	2	12
(iv) Paprika	75	0	1
(v) Peas or beans	23	8	19
(vi) Sweet potatoes	62	51	34
(vii) Bambara or ground nuts	24	8	3
(viii) Pumpkins	11	5	21
(ix) Tomatoes	70	13	11
(x) Other (sunflowers)	11	2	3

Generally few farmers kept livestock especially at Porta and Epworth (Table 4). The majority of Porta (89%) and Epworth (82%) respondents did not keep any form of livestock. A very small proportion (13%) of farmers at Domboshava kept no livestock at all. The few that kept livestock at Porta Farm or Epworth had the smaller stock like fowls and rabbits. Livestock types kept at Domboshava included cattle, donkeys and goats as well as fowls and rabbits with cattle as the most common type. Head sizes were however generally small. The majority of Domboshava farmers kept less than 10 animals: goats, sheep, donkeys and cattle taken together. Only 6% of the Domboshava kept more than 10 animals at any one time. A few households at Porta kept rabbits or fowls. Most respondents who indicated that they had stopped keeping livestock blamed thieves who they claimed had frustrated them.

Figure 3. Types of livestock kept by peri-urban dwellers at three peri-urban sites, Harare. Results of a questionnaire survey conducted in the period April-May 2000

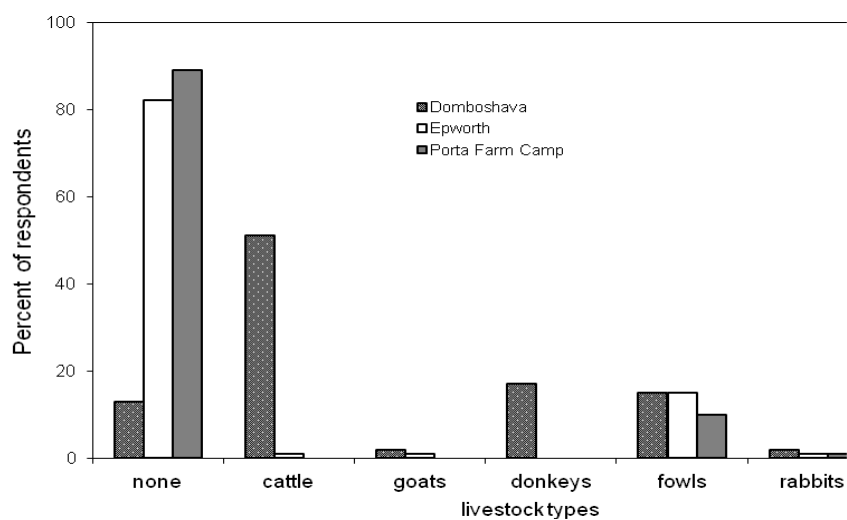


Table 4. Total number of all animals kept by a single peri-urban household. Data excludes fowls and rabbits and was collected during the period April-June 2000.

Numbers of stock	% of respondents		
	Domboshava	Epworth	Porta Farm
0	32	98	100
1-4	38	2	-
5-8	22	-	-
9-10	2	-	-
>10	6	-	-

Fertiliser Usage

All respondents at Domboshava indicated that they used mineral fertilisers in their crop production practices but 16% and 58% of respondents at Epworth and Porta respectively claimed they did not use fertilizers at all. At all sites the fertilisers most commonly used by the peri-urban dwellers in the seasons 1997/98 and 1998/99 were compound D (8-6-6, N-P-K) and ammonium nitrate (34.5% N) (Table 2.4). Such compound fertilisers as compound C (6-7.5-12.5, N-P-K), compound X (20-4.5-4, N-P-K) and compound S (7-9.5-7, N-P-K) were also used especially by the farmers from Domboshava but to a lesser extent. Only 2% of the respondents at Domboshava indicated that they had used lime in the two seasons that were under consideration for purposes of the survey. The Porta or Epworth respondents purchased little fertilizer in the period 1997-2000 and 20% of the respondents indicated they had purchased less than 2 kg of fertilizer in any year. However fertilizer usage by Domboshava households was more widespread and much higher with more than 50% of the respondents indicating they used mineral fertilizers in excess of 250 kg per year.

Figure 4. Mineral fertilisers used by peri-urban farmers. Results of a survey conducted during the period April-June, 2000.

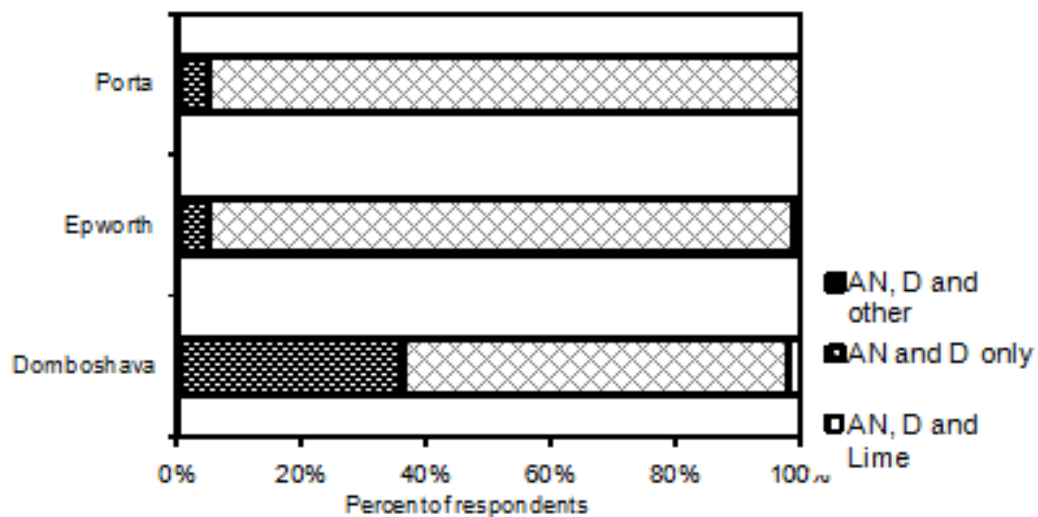
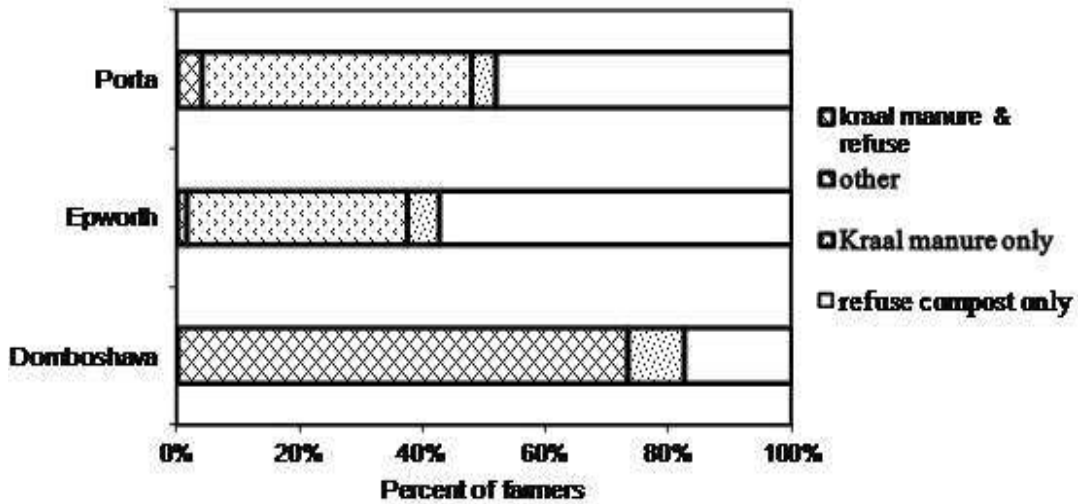


Figure 5. Types of organic amendments used by peri-urban farmers. Results of a survey conducted during the period April-June, 2000



A variety of organic fertilizers were also used by the peri-urban dwellers interviewed (Fig. 5). Kraal manure, decomposed refuse or water hyacinth, chicken manure and rabbit manure are among the organic manures that respondents had used in the period under investigation. Quantities of manure varied widely with some reporting usage in the order of carts-full wheelbarrows or tins full. Greater use of manure was reported at Domboshava, 23% of the respondents claiming they had used more than five ox-carts whilst little was reported at Epworth or Porta farm where 34% and 40% respectively of respondents had used small quantities that could not be measured in wheel barrows. The use of organic waste for agriculture may therefore be expected to benefit the residents of the peri-urban areas like Porta Farm and Epworth where livestock manure seems to be relatively scarcer than at Domboshava.

Ownership of agricultural implements

A marked difference in the ownership of tools or implements commonly used in agriculture was evident among sites. While almost 10% of respondents owned no implement or tools at all sites, and over 30% owned hoes only at Epworth and Porta Farm, a considerable proportion of Domboshava residents even owned diesel or petrol powered engines and pumps (19%), oxcarts (19%) while 28% had their own plough. None of the respondents at Porta Farm owned ploughs. Only 3% of

Porta Farm residents and 23% of The Epworth residents owned wheelbarrows. The single most common tool across all three sites was the hoe followed by the axe and shovel. It is also of interest to note that very few (6%) of the Epworth residents owned axes. This supports the observation that the extent of agricultural practices in Domboshava is more compatible with rural than with urban farming systems.

Table 5. Agricultural tools owned by peri-urban farmers. Results of a survey conducted during the period April-June, 2000

Household tools	Percent of households		
	Domboshava	Epworth	Porta
e	-	8	9
Hoes only	-	40	33
Hoes & axes only	17	6	34
Hoes, axe and shovel	17	23	21
Wheel barrow +/- or plough	28	23	3
Oxcart	19	-	-
Engine	19	-	-

Table.6. Summary of composting methods and practices used by peri-urban farmers

Composting: Attributes	% of respondents		
	Domboshava	Epworth	Porta
1. Reasons for using compost:			
(i) N/a - does not use compost	2	66	53
(ii) Compost cheaper than fertiliser	4	5	19
(iii) Improves soil	51	14	6
(iv) Complements fertilisers	32	5	2
(v) Other (faster growth, healthier plants)	11	9	19
2. Raw materials composted			
(i) Maize straw	45	13	24
(ii) Tree leaves	62	26	16
(iii) Ash	81	0	19
(iv) Grass straw	68	18	35
(v) Dung	30	1	3
(vi) Other	28	10	11

Composting: Attributes	% of respondents		
	Domboshava	Epworth	Porta
3. Composting duration			
(i) N/a- does not compost	2	68	60
(ii) Less than one month	4	9	6
(iii) About 3 months	26	6	27
(iv) About 6 months	53	12	-
(v) About one year	15	5	-
4. Those responsible for composting:			
(i) N/a	2	68	56
(ii) Men	32	17	20
(iii) Women	49	10	13
(iv) Children	6	4	11
(v) Anyone	11	1	-
5. Method of composting			
(i) N/a	2	68	56
(ii) Pit	94	30	37
(iii) Heaps	4	2	7
6. Additives used during composting			
(i) None	23	71	28
(ii) Fertiliser	9	20	7
(iii) Dung	4	9	14
(iv) Green vegetable wastes	2	-	-
(v) Ash	26	-	2
(vi) Water	36	-	3

Problems associated with composting included mosquitoes becoming a menace as they breed in rubbish pits that become water filled in the rainy season. While 63 % of Porta Farm respondents indicated that they had no problems with current ways of composting or household waste disposal methods, 15% cited shortage of space as one of their main constraints to proper management of wastes. Most respondents had basic knowledge of composting obtained through their basic education. Twenty-six percent of the Domboshava residents interviewed, acquired this knowledge from extension workers while 60% of respondents acquired their knowledge from school agricultural lessons, from neighbours or parents. Most respondents affirmed that they were not using this knowledge fully and cited reasons like sheer laziness and the shortage of space, time or materials. Respondents considered the rainy season or the period following harvesting as being ideal for composting activities.

Table 7. Constraints: waste management and composting.

Attribute	-----% of respondents-----		
	Domboshava	Epworth	Porta
1. Waste disposal problems			
(i). None	72	70	63
(ii). Bad odours and flies	4	6	3
(iii). Mosquitoes during rainy season	11	5	15
(iv). Shortage of space	-	12	15
(v). Other (Waste dispersal, labour to dig pits, laziness)	13	7	4
2. Problems associated with composting			
(i). Does not compost	2	80	71
(ii). No problems encountered	66	16	17
(iii). Shortage of labour	4	2	-
(iv). Shortage of materials or water	2	-	6
(v). Other (non degradable matter, animals)	26	2	6
3. Source of composting knowledge			
(i). Does not know how to compost	2	12	28
(ii). Learnt from parents or employers	36	37	27
	26	3	6
(iii). Extension workers health or agric.	32	41	37
	4	8	2
(iv). Primary or secondary education			
(v). Other (neighbours, personal experience)			

Discussion

The study of peri-urban areas has to acknowledge the dynamic nature of life and agriculture as these areas bridge the gap between the rural and the urban. Changes in geographical and economic features have to be accommodated. In this study the selection of three diverse sites managed to capture the various features of the rural-urban interface.

Comparison of study sites

Domboshava is predominantly rural as evident in the high proportion of interviewees who earned their living from agricultural activities. The major income

earning enterprise is the market garden which provides a direct linkage with the city as peri-urban gardeners grow fresh vegetables for urban dwellers whilst obtaining agricultural inputs like fertilizers, pesticides and seed from the city. High annual incomes are realized as the peri-urban gardeners have ready markets for the disposal of their produce and for the acquisition of inputs. A marked difference exists between Domboshava and some suburbs of Harare (including Epworth) studied by Smit and Tevera, (1997) where predominantly low incomes from urban agriculture were reported. Higher incomes observed at Domboshava were a result of more sophisticated production where irrigation plays an important role in ensuring some cash in-flows all-year-round. Although access to land is relatively limited, the majority of farmers interviewed used about 2 ha (Fig.2) so that their major limitation to production is not land but such inputs as fertility amendments, pesticides seeds and the ability to manage disease and pest problems.

Land pressure was more acute (Fig. 2) for Epworth, which is more of an urban area. With more pronounced exchange with the city, mainly in the form of labour and goods, a higher proportion of the Epworth population relied on the earned wage to meet all household needs of food, shelter, housing and clothing. However wages were generally low (Smith and Tevera, 1997) leading to higher dependency on informal sources of income (Table 1). Where possible, a number of households resort to sub-letting of the household accommodation (Butcher, 1993) to augment their incomes. This had the effect of increasing population density, which is the other reason why a high proportion of Epworth households had very little land around their houses on which to grow vegetables (Fig. 2). Tenants and landlords alike end up deprived of access to land as the expansion of housing squeezes out the kitchen or backyard gardens. A similar phenomenon characteristic of the more rural city fringes was also documented in Guinea Bissau (Lorenco-Lindell, 1997) and is attributable to rapid and uncontrolled urbanization whereby landowners sell their land mostly to city people for housing construction. The higher proportion of households claiming to have no access to land are also thus lodgers renting rooms or makeshift housing put up as an extension of the landlord's house, which is common in Epworth. This might account for the 22% of Epworth respondents (Table 1) whose major source of income was other than formal or informal employment or trade. This conjecture is supported by the staggering figure of 7.1 persons estimated as the average number of people occupying a single room in Epworth (Butcher, 1993).

A close relationship existed between the occupants of Porta Camp and those of Epworth as some of the residents of Porta Camp originated from Epworth. The high degree of unemployment and extreme poverty (Table 1) was evidenced by the fact that the settlement was a squatter holding camp. Consequently the major sources of income were informal trade and the majority of residents irked out a

living from buying and selling fish or scavenging. The majority of part time jobs done by Porta residents actually involved servicing the surrounding farmers as seasonal farm labourers. Incomes were therefore highly unreliable and very seasonal. So unreliable were the incomes that in evaluating average monthly incomes a number of respondents cited fines they had to pay on getting arrested for poaching fish at Lake Chivero. It is noteworthy that food security was a great challenge for Porta settlers. The cultivation of crops had a great role to play, more so for the unemployed. The food security challenges for peri-urban dwellers was also evident in the findings of a study in selected suburbs of Harare carried in 1995 (Mudimu, Siziba and Mlambo, 1998; ENDA, 1996) and is also affirmed by Jongwe (2013) in his study of food security among urban households in Gweru. One major predicament for Porta Camp is land pressure judging by the high proportion of respondents having no other fields around their homes and generally less than 50 m² (Fig.2) i.e. less than 0.005 Ha, to till for subsistence.

Agricultural Practices

Agricultural activities at Porta and Epworth were limited more by unavailability of land and other resources. Mkwambisi *et. al* (2011) observed that access to land and type of land tenure are major limitations to the contribution of agricultural activities to the livelihood and food security of urban households. The main crops grown are an indication of how greatly land is limiting agricultural production of the sites closer to urban centres. Whereas Domboshava respondents indicated maize and vegetables as being the most important cash earning or food crops, Porta and Epworth crops such as sweet potatoes and okra were ranked more highly instead. Maize requires bigger fields for yields to be obtained that contribute significantly to a household's requirements (Mkwambisi *e.t al.*, 2011). The dilemma in which peri-urban areas close to the city find themselves in is that, with a greater need to increase agricultural production, access to land and inputs is limited and diminishing daily. This dilemma was also noted in the peri-urban areas of Kumasi, Lilongwe and Blantyre (McGregor *et. al.*, 2011 and Mkwambisi *et. al.*, 2011)

There is a greater need to increase crop production for Porta Camp and Epworth. The findings of this and other studies (ENDDA, 1996; Mudimu *et. al.*, 1998; Smith and Tevera, 1997; McGregor *et. al.*, 2011 and Jongwe, 2013) show that the greatest force driving agricultural activities in the more urban peri-urban areas is subsistence. Where households have access to only 50 m² of land intensified production is the only way towards making meaningful contribution to households' food needs. At all sites peri-urban gardeners used fertilisers extensively, suggesting that peri-urban soils were depleted of nutrients and required the use of fertility amendments to sustain productivity. McGregor *et. al.*, (2013) also noted intensified pressure on land and an increase in the cultivation of areas proximal

to streams and rivers. With the exception of Domboshava, most households did not keep livestock (Tables 3 and 4). This necessitates that nutrient requirements of crops be met by means other than animal manures.

None of the peri-urban agricultural practitioners grew crops without relying on the use of mineral or organic fertilisers. Domboshava residents (98%) used both organic and mineral fertilisers (Fig. 4). While organic amendments are used to improve soil, the specific need to make up for shortage of money to buy fertilisers was evident in that most respondents (31-51%) cited escalating fertiliser costs or the need to make up for fertiliser shortage as the other reasons for using both organic and inorganic fertilizers. The shortage and need of organic inputs was evident even at Domboshava where, despite keeping both small and large livestock, 98% of respondents used refuse 'composts' to supplement their manure requirements. Studies in Ghana by McGregor *et. al.* (2011) identified specific problems of waste management and water pollution in the rural-urban interface. They also singled out composting as a key strategy for managing both waste disposal and soil fertility resource needs. Though precise fertiliser value of decomposed waste is not known, the potential of composted waste to increase soil organic matter has multiple long term soil fertility benefits.

Composting and Waste management

Composting is the manipulation of environmental conditions to facilitate the biooxidative stabilization of organic waste materials to produce humus. The composting process is optimized under specific conditions of temperature, moisture and aeration. The majority of farmers interviewed however, did not attend to their 'composts' or do anything specific to improve the quality of their composts. The main ingredients of the refuse composts used were those materials that normally constitute refuse or garbage i.e. fallen tree leaves and ash (Table 6). Composts were not attended to and took long before they were ready for use. It is subject to debate whether what farmers claimed to be compost was not just mere decomposed refuse, and not 'true' compost. The majority of the farmers interviewed claimed that raw materials composted were continually added and rarely turned. No effort was made to cover up the materials except in a few instances, as is the case with refuse pits. There was therefore room for improvement in the way wastes were managed. Already some of the residents separated out non-decomposable materials though there were indications that this was not done regularly or thoroughly as some of the problems encountered in the use of refuse was the occurrence of such undesirable materials as bones, plastics and broken glass. McGregor *et. al.* (2011) also noted plant materials and ash as significant constituents of waste. They explored various strategies like aerobic and anaerobic waste decomposition methods for recycling nutrients and the use of covers to manage flies during composting.

The potential of household wastes to contribute significantly to peri-urban organic fertiliser requirements could have been greater for Epworth and Porta residents who cultivated small fields less than 100 m² (0.01 Ha). An application rate of 30 t ha⁻¹ could easily be achieved by applying 30 kg to 0.01 ha. Since very small pieces of land were cultivated on average, high compost application rates could easily be attained. The major setback to this however was obviously the shortage of space especially for Porta and Epworth residents. The need for developing and implementing improved and efficient methods of managing wastes is therefore a necessary pre-requisite for the successful utilisation of solid wastes. Mkwambisi (2011) in his assessment of factors affecting productivity through urban agriculture noted higher efficiency among urban plots that were rented or owned by higher income earners than on land held through other types of tenure by low income earners. This suggests that access to resources is a major determinant of the profitability and relative contribution of agricultural activities to food security in and around cities.

Conclusion

The difference between Porta and Epworth on the one hand and Domboshava on the other as regards pattern of settlement and access to land was marked being clearly reflected in ownership of tools and livestock their different sources of income or livelihoods. Practices in agricultural activities also varied widely. In all peri-urban areas land pressure was evident necessitating the intensification of crop production through the use of fertility inputs. A shortage of manure and other fertility amendments makes improved waste management and the production of high quality household waste compost desirable even for Domboshava that keeps livestock. The main household waste components that ended up as soil amendments included fallen tree leaves, grass, ash and maize stover. The absolute and relative quantities of organic waste components and their management are key determinants of the value and contribution of household waste composting to peri-urban agriculture and hence the sustainability of composting as a waste management strategy for peri-urban areas.

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Footnotes

*Porta Farm Settlement has since been demolished