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Urban and Peri-urban Agriculture in Phnom Penh, Cambodia: Challenges and Opportunities

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ABSTRACT

The majority of the global population lives in cities. In the developing world, a three-fold challenge of population growth, urbanization, and urban food insecurity is posing challenges for cities. Urban agriculture has received increasing attention as one strategy to help cope with this. Using the annual statistical data of the Ministry of Agriculture, Forestry, and Fisheries, this paper reported on trends in urban agriculture (rice, vegetables, cattle, swine, and poultry) in Phnom Penh, Cambodia since 1993. At least 125 square kilometers (~20%) of the municipal area of Phnom Penh is used in agriculture, with nearly 300,000 swine, cattle, and poultry. It is the sixth largest industry in the city and the most important secondary economic activity. Yield data for rice and vegetables are not significantly different between Phnom Penh and the Cambodian average. Cattle, swine, and poultry populations have been declining in Phnom Penh since 1993 but all increased in 2011. Between 1993 and 2011, vegetable production and area cultivated have decreased, whereas rice production has increased. To maximize the multifunctional benefits of urban agriculture in Phnom Penh, further research is needed to understand its importance at the household level and to ensure that it is being practiced effectively and sustainably.

Keywords: urban agriculture, Phnom Penh, urbanization, population growth, food security
JEL classification: O18

INTRODUCTION

Urban and peri-urban agriculture (UPA) includes growing crops, raising animals, and their associated activities either within or along the fringes of cities (de Zeeuw, van Veenhuizen, and Dubbeling 2011). Notable for its multifunctionality, UPA provides a range of benefits such as economic opportunities, employment, social inclusion and cohesion, land preservation, enhanced recreational uses, and important environmental services, for example, flood protection and climate mitigation (Aubry et al. 2012; De Bon, Parrot, and Moustier 2010; de Zeeuw, van Veenhuizen, and Dubbeling 2011; Dubbeling, de Zeeuw, and van Veenhuizen 2010; Zasada 2011).

UPA has been found to play an important role in many cities around the world (De Bon, Parrot, and Moustier 2010), though it is often under-reported. Interest in urban agriculture as a policy tool has greatly increased in recent years due to two global demographic milestones. In 2008, the world's urban population exceeded that of the rural for the first time in history (UNDESA [United Nations Department of Economic and Social Affairs] 2010) and in the late 2011, global population surpassed seven billion (UNFPA [United Nations Population Fund] 2011). This trend is expected to continue and eventually peak in the 2050s at approximately nine billion, with 5.3 billion living in cities (UN-HABITAT [United Nations Human Settlements Program] 2008). Urban population growth between 2005 and 2010 in developing countries was 2.5 percent, five times greater than the rate of growth recorded in developed countries; in the least developed countries, it was 4 percent (UNFPA 2007). Further, 95 percent of the predicted urban growth over the next 40 years will occur in developing countries (UN-HABITAT 2008). This growth occurs against a backdrop of volatile food prices and increasing food insecurity, with over 900 million people globally classified as malnourished; critically, a growing proportion of this number now occurs in urbanized areas (FAO [Food and Agriculture Organization of the United Nations] 2008). These developments raise serious global, regional, and local challenges for employment, education, social cohesion, urban development, the environment, and food security.

The three-fold combination of growing population, increasing urbanization, and more widespread urban food insecurity is exemplified in the Southeast Asian country Cambodia and its capital city Phnom Penh (Cohen and Garrett 2010; UN-HABITAT 2008). Cambodia has seen a population increase of 2 percent per year between 2005 and 2010 and its current population of 14.6 million is expected to grow to 26 million by 2050 (UNFPA 2007, 2011). The urban growth rate is higher than population growth nationally, at 4.9 percent (UNFPA 2007). The population of the capital, Phnom Penh in 2012 is approximately 1.5 million, which is 54 percent of the urban population of Cambodia and 11 percent of the total (UNDESA 2011). Phnom Penh is expected to add another nearly one million inhabitants by 2025 (UN-HABITAT 2008).

While poverty reduction in Cambodia since 1992 has been impressive, the absolute numbers of people living in poverty in Phnom Penh are high and hunger has been exacerbated by high food prices in the last five years (Sophal 2011). The proportion of urban slum dwellers in Cambodia stands at 79 percent (UN-HABITAT 2008), and as Phnom Penh includes the dominant urban population of Cambodia, it is likely that the majority of the country's slum population is in this city. Rates of acute malnutrition are on the average lower in Phnom Penh (5.4%) than in the rest of the country (8%) (Harris and Jack 2011; Kruy, Kim, and Kakinaka 2010), however, acute malnutrition in the Mean Chay district of Phnom Penh is as high as 9.4 percent

(Harris and Jack 2011). Taken as a whole, the number of people living in poverty in Phnom Penh would be equivalent to the fourth largest city in the country. Phnom Penh thus embodies the three-fold challenges of urbanization, food security, and population growth and is a useful case study with which to examine the role of UPA.

Few systematic studies have been conducted on urban and peri-urban agriculture in Phnom Penh. The most readily available data for UPA in Phnom Penh are based around the cultivation of aquatic plants in wastewater lakes around the city (Muong 2004). However, the rapid and continued growth of Phnom Penh indicates that a broader and more systematic understanding of UPA is needed to determine its current importance and to help determine how to best develop UPA to contribute to the sustainability and food security of the city in the future. This study represents the first known analysis of the Cambodian Ministry of Agriculture, Forestry, and Fisheries' (MAFF) annual statistics to determine the extent of agricultural activity in Phnom Penh. Findings could inform future research and policy on how to best incorporate urban agricultural sustainability into the city's future planning.

METHODS AND MATERIALS

Study Site

Phnom Penh is in south-central Cambodia, at the junction of the Tonle Sap, Bassac and Mekong rivers (N 11°33′, W 104°55′) (Figure 1). It has a tropical–monsoon climate, with the rainy season from May to October and the dry season from November to April, the latter being the hottest periods of the year (Sao 2009).

Figure 1. Map of Cambodia showing the location of Phnom Penh

Source: Municipality of Phnom Penh (2010)

Phnom Penh municipality consists of eight districts, or *khans*, including 96 sub-district communes (*sangkats*) and 897 villages, for a total land area of 680 square kilometers (km^2) (Municipality of Phnom Penh 2010).

The data on the prevalence and economic importance of urban agriculture in Phnom Penh were sourced from the Phnom Penh provincial data of the 2008 census (National Institute of Statistics 2010). Information on agricultural production and yield estimates was obtained from annual statistical reports (Department of Planning and Statistics [DPS] 2008a, 2009, 2010, 2011, 2006, 2007, 2008b). The crops and livestock investigated were rice (both dry and wet season), vegetables, cattle, swine, and poultry. These choices were partly dictated by the available statistics, but were also based on what is usually grown in urban and peri-urban areas indicated in previous studies (De Bon, Parrot, and Moustier 2010; de Zeeuw, van Veenhuizen, and Dubbeling 2011) that were locally relevant.

Statistical Analysis

Data used in analysis included the total area under cultivation hectares (ha) and the yield (tons per hectare[t/ha]) for rice and vegetables and the annual total numbers of heads of cattle, swine, and poultry. Student's *t*-tests were applied to examine the variability between rice and vegetable yields between Phnom Penh and the national average. Correlation coefficients were calculated for long-term trends in area under cultivation and yields for rice and vegetables, and total cattle, swine, and poultry population. All calculations were performed on Microsoft Excel 2010.

RESULTS

Economic Role of Urban Agriculture in Phnom Penh

The number of people involved in agriculture as an identified economic activity is presented in Table 1. This indicates that agriculture is an important income source for almost 10 percent of Phnom Penh's population, either as primary or as secondary economic activity. As a primary income source, agriculture ranks as the sixth-largest sector in the city, out of 21 recognized industries in total (National Institute of Statistics 2010).

Table 2 shows the breakdown of agricultural activities. The cultivation of crops, which in this case included rice, vegetables, fruits, and other cereals, dominated agricultural activity at over 85 percent, with animal production undertaken by slightly over 13 percent of those involved.

Rice Production

Trends in rice production and harvest area in Phnom Penh between 1993 and 2011 are shown in Figure 2. Harvest area declined from 8,652 ha in 1993 to 4,650 ha in 2010. However, the year 2011 experienced the largest area harvested in 19 years, with 12,177 ha. Rice production fluctuated over the time period studied, with a minimum value of 10,225 tons (t) in 1993 and a maximum of 35,094 t in 2011.

The change in mean rice yield from 1993 to 2011 for both Phnom Penh and Cambodia are closely matched (Figure 3). Both exhibited an increase over time, with Phnom Penh increasing from 1.19 t/ha to 2.89 t/ha and Cambodia as a whole increasing from 1.31 t/ha to 3.77 t/ha.

Using a two-sample *t*-test, mean rice yields for the time period 1993–2011 were not significantly different between Phnom Penh (2.40 t/ha) and the national average (2.17 t/ha) (Figure 4).

Table 1. Proportion of economically active population in Phnom Penh involved in agriculture

	Number (Male and Females)	Percentage (%)
Economically active population	645,990	100.0
Agriculture – primary economic activity	31,391	4.9
Agriculture – secondary economic activity	28,694	4.4
TOTAL (agriculture as an economic activity)	60,085	9.3

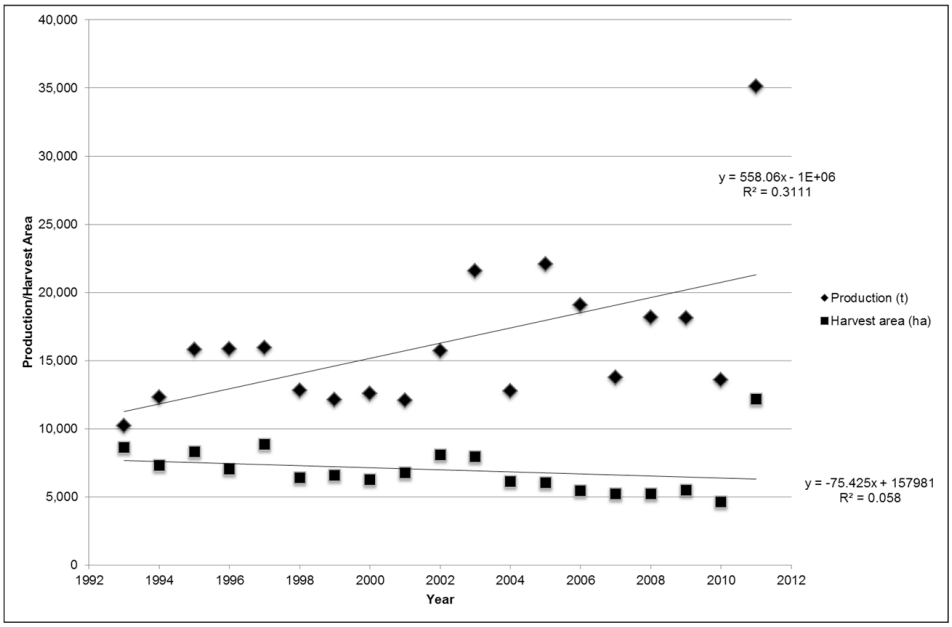
Source: National Institute of Statistics (2010)

Table 2. Proportion of population economically involved in agriculture by agricultural activity

Activity	Number (Males and Females)	Percentage
Growing of crops (non-perennial and perennial)	51,437	85.6
Animal production	7,909	13.2
Other (agriculture support activities, plant propagation, mixed farming)	739	1.2
TOTAL (employed in agriculture)	60,085	100.0

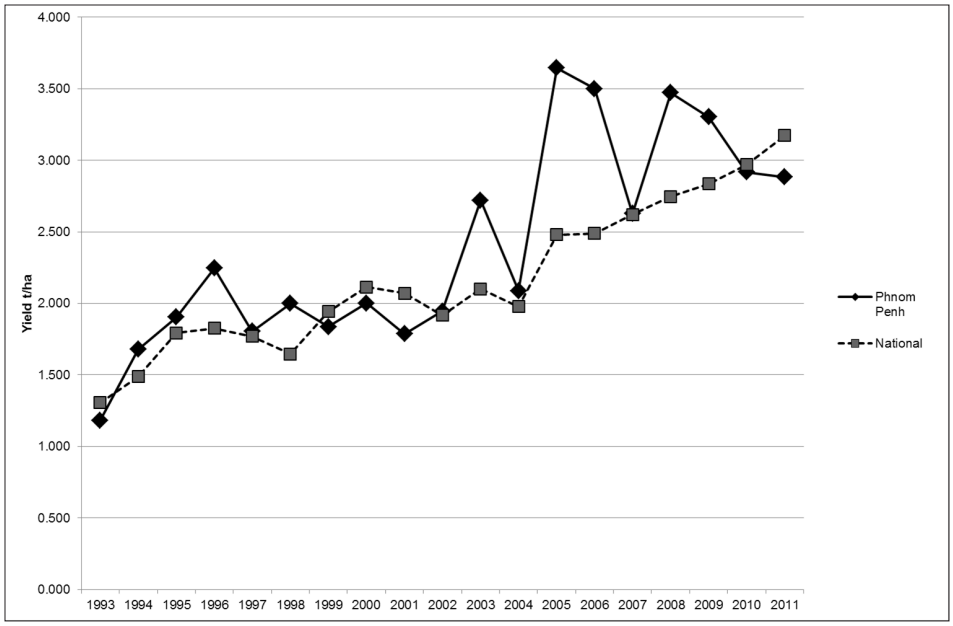
Source: National Institute of Statistics (2010)

Figure 2. Total production and harvest area of rice in Phnom Penh, 1993–2011



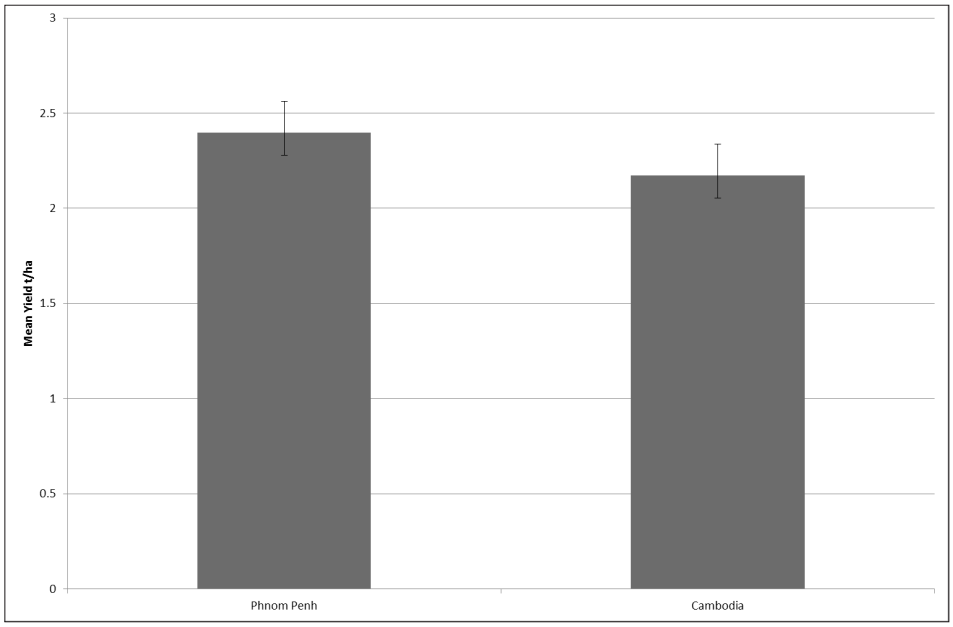
Source: Department of Planning and Statistics

Figure 3. Trend in rice yield, Phnom Penh and Cambodia, 1993–2011



Source: Department of Planning and Statistics

Figure 4. Mean rice yield in Phnom Penh and Cambodia, 1993–2011



Vegetable Production

The definition for vegetables was not specified in the statistical bulletins, but based on other crops surveyed, it appears to exclude cereal crops such as rice and maize and tubers such as potatoes, sweet potatoes, and cassava. The change in production and area harvested for vegetables in Phnom Penh since 1993 is shown in Figure 5. Total production of vegetables declined from 7,250 t in 1993 to 2,627 t in 2011, with a peak of 7,460 t in 2001. Harvest area was 625 ha in 1993, peaking at 2,941 ha in 2000 and then declining to a minimum of 410 ha in 2011.

The change in yield of vegetables per hectare in Phnom Penh closely matches that of the national yield (Figure 6), although it appears to have plateaued in Phnom Penh in the last three years. Phnom Penh shows greater variation in yield, ranging from 11.60 t/ha in 1993 to a low of 1.89 t/ha in 2000 and increasing again to 6.41 t/ha in 2011. In comparison, the national yield ranged from a minimum of 3.87 t/ha in 2003 to a maximum of 8.29 t/ha in 2011.

Using a two-sample *t*-test, mean yields for the time period were found to be not significantly different between Phnom Penh (6.18 t/ha) and the national average (5.76 t/ha) (Figure 7).

Cattle, Swine, and Poultry Production

The total population of cattle, swine, and poultry in Phnom Penh in 2011 was 290,339 heads. Cattle and swine populations both showed decreasing trends between 1993 and 2011 (cattle R^2=0.35; swine R^2=0.56) (Figure 8); however, increases were recorded from 2010 to 2011 such that cattle population grew by 115 percent, from 12,803 to 27,591, while swine population grew by 45 percent, from 12,902 to 18,732.

Poultry population showed a weak negative correlation between 1993 and 2011, but the numbers did fluctuate considerably in this period (Figure 9). The poultry population peaked at 360,040 in 1996 and reached a low of 86,669 in 2004; however, from 2010–2011, an 82-percent increase was recorded from 133,891 to 244,016.

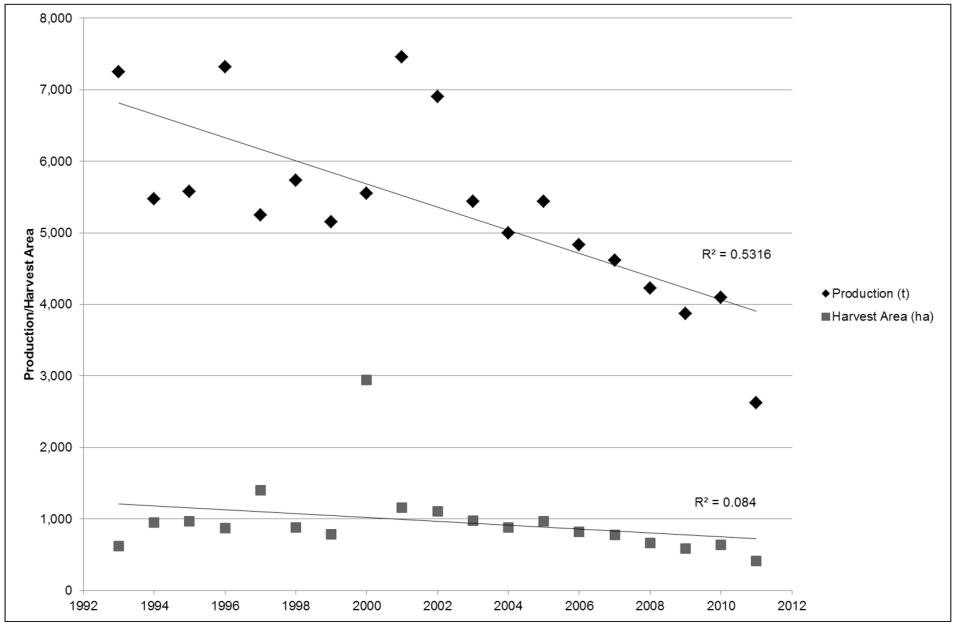
DISCUSSION

Increasing urbanization and population growth in the developing world have accelerated the need to reconcile these developments with current agricultural practices. It has been suggested (De Bon, Parrot, and Moustier 2010; de Zeeuw, van Veenhuizen, and Dubbeling 2011; Lee-Smith 2010) that cities will considerably benefit from preserving agricultural lands. However, research must underlie decisions on the allocation of agricultural lands in urban and peri-urban areas as well as policies for the promotion and sustainability of agricultural activities relevant to site-specific locations. In this regard, accurate data and their statistical analyses are needed, but have often been lacking in many parts of the world (Zezza and Tasciotti 2010).

As a step towards improved data analysis, the study is the first attempt to synthesize the MAFF statistics in the context of UPA in Phnom Penh and Cambodia. It thus provides a starting point for more in-depth investigations. Despite the rapid urbanization and population growth that have taken place in Phnom Penh over the last two decades, agriculture remains an important industry within the boundaries of the Phnom Penh municipal area, both as an economic activity and as a source of food. Nearly 20 percent of the city's area is dedicated to growing rice and vegetables. Livestock population is approaching 300,000. Almost 10 percent of the city's actively employed population relies on agriculture as either a primary or secondary economic activity.

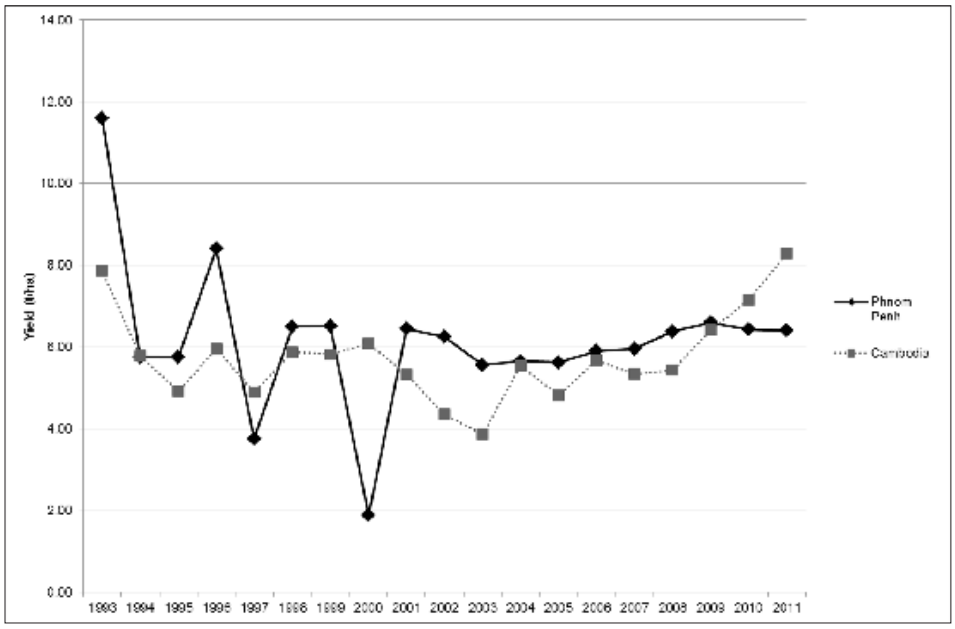
Annual yield for rice and vegetables from 1993 to 2011 closely matched those seen nationally and yield comparisons for

Figure 5. Change in production and harvest area of vegetables in Phnom Penh, 1993–2011



Source: Department of Planning and Statistics

Figure 6. Vegetable yield, Phnom Penh and Cambodia, 1993-2011



Source: Department of Planning and Statistics

Figure 7. Mean yield of vegetables for Phnom Penh and Cambodia, 1993–2011

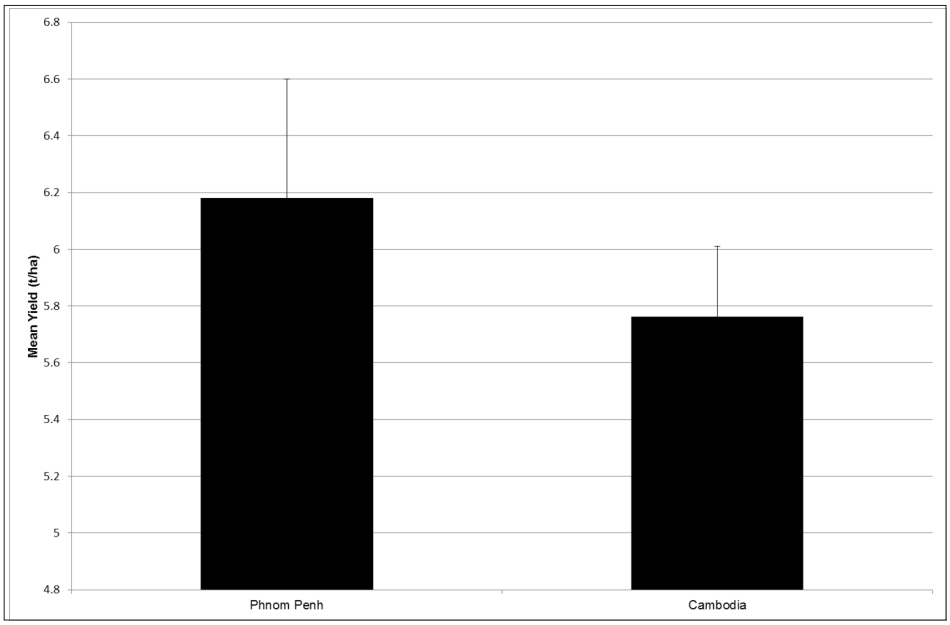
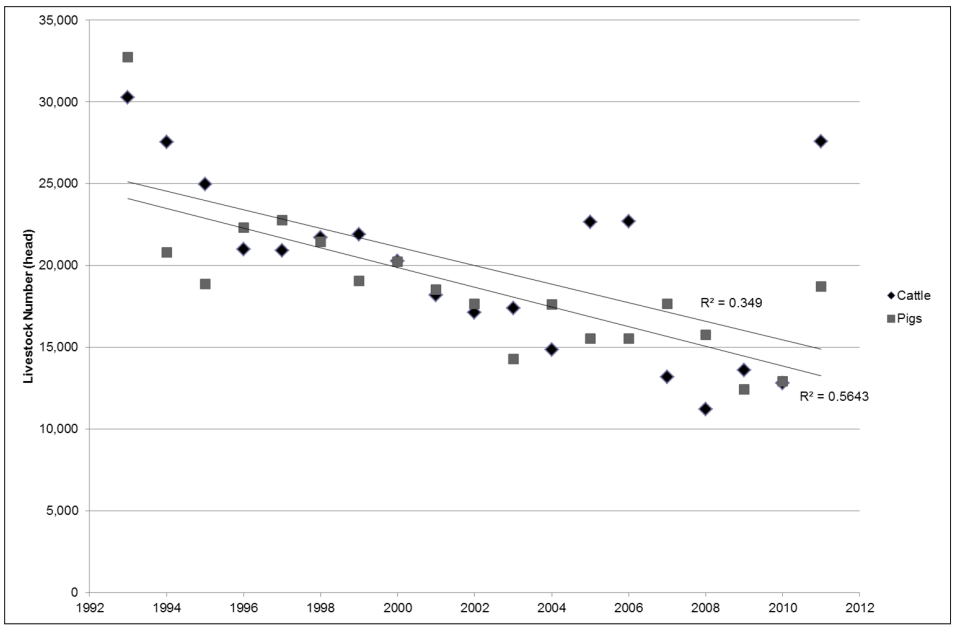
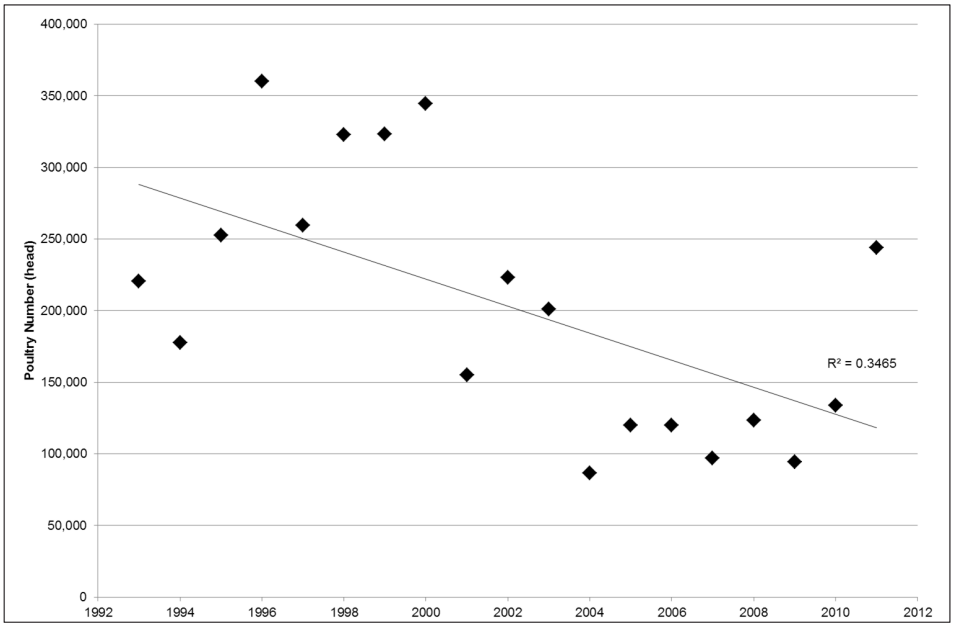


Figure 8. Trend in livestock (cattle and pigs) in Phnom Penh, 1993-2011



Source: Department of Planning and Statistics

Figure 9. Poultry numbers in Phnom Penh, 1993-2011



Source: Department of Planning and Statistics

rice and vegetables between Phnom Penh and the national average revealed no significant differences. Phnom Penh had an average rice yield of 2.40 t/ha and Cambodia's national average was 2.17 t/ha. Similarly, the average yield of vegetables in Phnom Penh (6.18 t/ha) compared favorably to the national average (5.76 t/ha). These data indicate that the urban and peri-urban environments in Phnom Penh are suitable for growing these crops at least as successfully as elsewhere in Cambodia. As such, continued promotion and development of these agricultural sectors can bring multiple benefits to a city. However, the urban environment also poses risks and challenges to UPA.

The area cultivated for rice declined in 2010 but increased to over 12,000 ha in 2011. It is probable that rice cultivation is done in the more peri-urban districts so as to avoid the pressures of urban development. Cereal crops can be challenging to grow close to cities, but in Antananarivo, Madagascar, for example, 14 percent of the rice supply comes from urban and peri-urban areas (Aubry et al. 2012). It is unknown what percentage of Phnom Penh's rice requirements are met through UPA.

The land area used for growing vegetables declined from a high of nearly 3,000 ha in 2000 to 410 ha in 2011. Fresh vegetables are among the most common and important crops grown in urban areas (De Bon, Parrot, and Moustier 2010). Being highly perishable, farmers can take advantage of higher prices, shorter marketing chains, and proximity to markets and consumers (de Zeeuw, van Veenhuizen, and Dubbeling 2011). Vegetables can also contribute to household food security by providing a cheap source of micronutrient-rich food, particularly for low-income families (Midmore and Jansen 2003; Lee-Smith 2010).

Factors that might be impacting vegetable production in the city include increased flooding and continued urban development (Sao 2009). In 2011, Cambodia experienced its most severe flooding in decades, with 247 deaths across the country and 1.5 million people affected

(Un 2011). Climate change predictions for Cambodia suggest that flooding will become more severe, frequent and of greater duration over the coming century (Mekong River Commission [MRC] 2009), creating continuing challenges for agriculture, health, and city planning. Rapid urban development in Phnom Penh has occurred in an unplanned and often unregulated manner, with arbitrary land seizures and evictions common as short-term economic opportunities are exploited (Cybriwsky 2009; Simone 2008; Un 2011). In the absence of strong planning and support, these factors will impact not only vegetable production but also all forms of urban agriculture.

The decreasing populations of cattle, swine, and poultry are also likely due to expansion of the built-up urban and peri-urban areas of the city. Poultry farmers also face increased competition from large egg producers in Thailand, whose economies of scale give them an advantage over Cambodian farmers (Moustier 2007). However, livestock population increased sharply in 2011. This may reflect growing affluence and consumption of these products in the city as urbanization continues. Nearly all swine farming in Cambodia remains small-scale and at the household level, but increasing industrialization has paved the way for larger commercial operations on the outskirts of Phnom Penh (Huynh et al. 2007). Pork consumption has been increasing at an annual rate of 5.7 percent, which will drive the industry's growth (Huynh et al. 2007).

In relation to this, the expansion of livestock operations near the city poses environmental challenges, thus the need for regulation to limit air, soil, and water pollution as well as the spread of diseases (De Bon, Parrot, and Moustier 2010). Despite these risks, UPA remains necessary and important as past studies indicate that it provides 95 percent of the poultry, pork, eggs, and milk consumed in a city (Moustier, Vagneron, and Bui Thi 2004; Moustier and Danso 2006; Van Veenhuizen and Danso 2007). In turn, UPA provides important nutritional diversity to the urban population. The high perishability of these items lend themselves to UPA and both small-scale and commercial farmers can use this to their advantage by farming near cities (de Zeeuw, van Veenhuizen, and Dubbeling 2011).

In addition to improving food security and providing economic opportunities, UPA has additional environmental benefits: (1) reduces the urban heat island effect, thereby lowering temperatures; (2) increases carbon sequestration; (3) improves water quality; (4) prevents erosion; and (5) reduces the severity and recurrence of floods by providing buffer zones and storing excess water (Aubry et al. 2012; Dubbeling, de Zeeuw, and van Veenhuizen 2010)—all important considerations in Phnom Penh. The enhanced flood-buffering potential of low-lying areas can be achieved by limiting urban expansion and maintaining agricultural production (Aubry et al. 2012). In addition, UPA can indirectly lead to decreased food transportation, packaging, and storage, thus reducing carbon emissions associated with these aspects of food production (Van Veenhuizen and Danso 2007).

It is important to recognize that the MAFF data analyzed in this study were collected at the macro-level, excluding non-commercial and small-scale household food production. It is thus likely that the study has underestimated the prevalence of UPA in Phnom Penh and its importance at the household level, especially for those who engage in the activity mainly for household consumption. This is particularly likely considering that UPA involvement of the urban population in Phnom Penh was pegged at 37 percent, based on household survey data (Moustier 2007).

Previous studies elsewhere in the world demonstrate that household-level UPA is an important contributor to food production and

consumption, serving as the primary reason for engaging in UPA (Maxwell, Levin, and Csete 1998; Van Veenhuizen and Danso 2007). Comprehensive household surveys should thus be a cornerstone of future UPA research in Phnom Penh. Further, more detailed data from local markets as to the source of produce and the amounts traded would also be useful in assessing the importance of UPA in the local food economy. Specific data, such as varieties of vegetables and their individual production levels may provide a more detailed view of trends in vegetable production but these data were not available. The nature of the data collected precluded more detailed statistical analysis and this should be a priority for future work. There is, thus, much scope for future studies on UPA in Phnom Penh.

The necessity of UPA begs the question whether limited funds and resources available in Cambodia should be used, if only in part, to further develop UPA in Phnom Penh when it has less poverty and food insecurity compared to the rural population that comprises 80 percent of Cambodia. As indicated earlier, although overall levels of poverty are relatively lower in Phnom Penh, absolute levels make poverty a critical challenge in the city. Further, poverty and food insecurity levels show variation throughout the city, with levels in some areas equal or even slightly higher than the national average. The data examined in this study suggest that UPA is an important economic activity in Phnom Penh, contributing to food production in the city and being practiced by many, and thus warranting further research. Given the lack of attention to UPA in Phnom Penh and the important issues that remain regarding land rights, environmental challenges, and secure land tenure, it would appear that UPA continues to be an important process in the city in spite of, rather than because of, any formal government or NGO assistance. This is evidence of the robust nature of UPA that has been observed in other cities in the developing world (Lee-Smith 2010) and suggests that with further support, there are real opportunities to benefit from the multifunctionality of UPA in Phnom Penh. The predicted high growth for Phnom Penh means that urbanization, population growth, and food security will continue to be important issues in the future. As such, UPA has enormous potential in addressing these issues, given its ability to provide important amounts of vegetables, rice, poultry, pork, eggs, and milk and to supplement economic activity.

One of the first steps required would be to formally recognize UPA and provide it with legal protection (Dubbeling and Merzthal 2006). The legal status of UPA in Phnom Penh is not known but given the regularity of land seizures, the tenuous nature of land titling, and the rate of evictions (Cybriwsky 2009; Loehr 2012), it is unlikely to have institutional support. A problem confronting UPA worldwide (Dubbeling and Merzthal 2006), the lack of legitimacy, together with intense land competition and its resulting high prices, has led to many practitioners of UPA farming on marginal and sometimes hazardous land and in unsustainable ways that may threaten their health and that of others (Van Veenhuizen and Danso 2007). As a result, policy also needs to be created that provides farmers with secure access to land (De Bon, Parrot, and Moustier 2010) and that integrates UPA into broader policies of urban development and planning (Midmore and Jansen 2003). In particular, studies that focus on the land use patterns of UPA in Phnom Penh and on the relative effectiveness and sustainability of these patterns would be beneficial. Financially, governments can help facilitate credit and create investment opportunities to provide the economic support that many urban farmers desperately need (Van Veenhuizen and Danso 2007). They can also contribute to research;

support; marketing assistance; and access to education, training, and expertise (Midmore and Jansen 2003; Van Veenhuizen and Danso 2007). Public-private partnerships have been advocated by the UN and other agencies, particularly in developing countries where public funds may be scarce (De Bon, Parrot, and Moustier 2010). Supporting data specific to Phnom Penh would be needed to ensure that these steps are practical, relevant, and effective to fully realize UPAs multifunctional benefits.

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