



## Seasonal Direct-Use Value of Cheung Ek Peri-Urban Lake, Phnom Penh, Cambodia

**SEILA SAR**

*Royal University of Agriculture, Phnom Penh, Cambodia*

*Email: sar\_seila2005@yahoo.com*

**COLAS CHERVIER**

*Royal University of Agriculture, Phnom Penh, Cambodia*

**PUY LIM**

*Ecole Nationale Supérieure Agronomique de Toulouse, Toulouse, France*

**CRISTY WARRENDER, GARRY W. WARRENDER AND  
ROBERT G. GILBERT**

*The University of Queensland, Centre for Nutrition and Food Sciences, Australia*

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**Abstract** Cheung Ek Lake receives 80% of Phnom Penh's urban wastewater. Since most of the lakes around Phnom Penh are being reclaimed for urban development, surveys were undertaken to analyze the direct-use economic value of Cheung Ek lake in the dry season, which could serve for policy-makers' future considerations. The direct-use value was assessed by summing total income of all activities performed on the lake. Income was calculated using a bottom-up approach based on a stratified sampling and on in-depth interviews of 192 households using structured questionnaires for each household's activity. The primary activities are water spinach, water mimosa, and rice cultivation, fishing, and duck raising. Over a six-month period, farmer receive an average profit of 4,168 USD/ha from water mimosa cultivation, 1,553 USD/ha from water spinach cultivation, 512 USD from fishing, 506 USD/ha from dry season rice cultivation, and 157 USD/100 ducks from duck raising. After multiplication by the total area of plants (from remote sensing), and number of household and duck numbers (by direct investigation), the direct-use value was estimated at more than 1 million USD, of which water spinach production contributes 65%, fishing 20%, water mimosa production 13%, duck raising 1%, and dry season rice production 0.7%. The study suggests that almost a thousand of direct-beneficiaries can generate part of their income from agriculture or fishery-related activities performed on the lake. Moreover, the research targeted only one part of direct-use value of the lake and thus largely underestimated the overall value of the lake. Indirect-value components are community health (which can be greatly improved through water purification), and indirect-use value of the lake (e.g. tourism), both of which have major economic implications and which must be taken into account in further research.

**Keywords** direct-use value, Cheung Ek Lake, water spinach, Phnom Penh

### INTRODUCTION

Wastewater use in agriculture and aquaculture has a long history in China (Zhiwen, 1999), Cambodia and Vietnam, to culture fish and aquatic plants in peri-urban wetlands (Kuong et al., 2005; Leschen et al., 2005; Lan et al., 2007). Phnom Penh, with a surface area of 375 km<sup>2</sup>, is surrounded by wetland, of which 80% comprises natural lakes and low-plain agriculture. Every day, about 55,600 m<sup>3</sup> of urban household wastewater and nearly 1 million m<sup>3</sup> of storm water are discharged into these wetlands (Muong, 2004). This wastewater is used in numerous plots located within and around the wetlands in peri-urban Phnom Penh, and provides important sources of

edible aquatic vegetables and fish farming to supply the food demand of the city and other areas of Cambodia (Khuong et al., 2005). Cheung Ek Lake, a seasonally inundated lake located about 5 km to the south of Phnom Penh, is a large water body that receives 80% of the wastewater from Phnom Penh's urban population and from factories (garment and various other factories). Rainfall run-off also discharges into the lake (Seyha and Tuan Anh, 2004). Cheung Ek Lake is an important area for growing aquatic plants and fish production, and harvesting is undertaken throughout the year. The activities on the area of Cheung Ek Lake represent not just the most important source of the income of many households, but also the employment and income earning opportunities for many seasonally hired labourers engaged in setting up, maintaining and harvesting the plants (Balmissse and Sylvain, 2003), as well as low-cost wastewater treatment. In 2009, 429 hectares of water spinach, 32.1 hectares of water mimosa, and (during the dry season) 13.5 hectares of dry-season rice were cultivated within the Cheung Ek Lake boundary (Teang, 2009).

The purpose of this research is to understand the economic value of Cheng Ek Lake by identifying the primary human activities performed on the lake and assessing the direct use value of the lake from those activities that could assist policy-makers' future considerations.

## **METHODOLOGY**

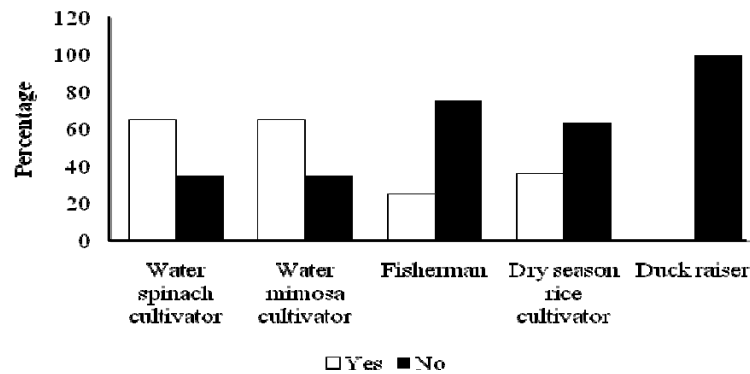
An inundated lake, Cheung Ek Lake, was the research site of this study. The sampling was primarily stratified by activity, as the human activity performed on the lake is very diverse. It was then stratified by village in order to obtain more reliable results, as farmers involved in each activity live in 15 different villages around the lake. 192 households from a total of 900 households working directly on the lake were randomly selected for in-depth interview using a structured questionnaire. The study was conducted from December 2008 to May 2009, which was a period of dry season. Direct observation and interviews with key informants were first used to better understand the diversified activities and the landscape of the area, followed by direct household interviews to obtain information on the household's income-generating activities performed on the lake. The direct-use value of the lake was assessed by summing up the total profit of all activities performed on the lake. The profit of each activity was calculated by the total income minus by the total expense. This excluded the labour costs of 2–3 producers per household in each activity; these producers were not paid salary, being all family workers.

## **RESULTS AND DISCUSSION**

On Cheung Ek Lake, five main socio-economic activities are undertaken by the farmers who have migrated from other provinces throughout Cambodia. These five major activities are: water spinach cultivation (350 households), water mimosa cultivation (110 households), dry season rice cultivation (19 households), fishing (402 households) and duck raising (19 households). In 2009, a total of 900 households were working directly on the lake during the dry season.

Many of the respondents are not born in the districts, communities or villages where they currently reside; they are mostly migrants from other provinces throughout the country. They came from Kampong Chhnang, Kampong Thom, Kandal, Prey Veng, Svay Reang and Takeo provinces. As shown in Fig. 1, most of the water spinach and water mimosa cultivators and less than half of fishermen and dry season rice cultivator are migrants while all the duck raisers were born in this region. The study indicated that the migration from the provinces for water mimosa cultivation in Cheung Ek Lake started within the last five years, while for water spinach cultivation it started more than 20 years previously and has been increasing with time. The results from this research indicate similar reasons for the migration process to those found by Rigg and Salamanca (2006a). It is suggested that the major reasons that respondents gave for moving to peri-urban aquatic plants production region are: to find work, to follow or join their families, to move into a new economic zone, to pursue a work-related initiative, as well as due to war or marriage. Thus, it can be assumed that the movement of people to peri-urban regions are propelled primarily by work or livelihood

concerns. The migration rate has been steadily increasing over time, which leads to greater demand of land for agricultural activities, thus pushing the renting cost to increase significantly.



**Fig. 1 Migration of farmers to Cheung Ek Lake**

As most of the farmers working on the lake were migrants from other provinces throughout the country, they needed to rent the land on average 300-400 USD per hectare for their activities: as shown in Table 1, almost of the water spinach and water mimosa cultivators were renters, as were more than half of dry season rice cultivator and duck raisers. Some of the producers on the lake own the land for cultivation. In a very few cases, farmers were asked to look after the land by the landlord and were able to work on the land without paying rent. According to Rigg and Salamanca (2006b), the ownership of the land among surveyed households in Aquatic Food Plants Production Systems in both Bangkok and Ho Chi Minh City is high, but this is not the case for either Phnom Penh or Hanoi. Kuong et al. (2006) stated that, in Phnom Penh, about 10% of the households from two villages, Kbal Tumnub and Thnout Chrum, owned the land for water spinach cultivation. The present research has found similar results: most of the water mimosa and water spinach cultivators and the duck raisers in Cheung Ek Lake need to rent the water surface area from the landlord for their cultivation (95%, 92% and 63% respectively). In addition, only 53% among 19 households of dry season rice cultivators need to rent the land for dry season rice practice on the lake.

**Table 1 Land ownership by activity**

Activity	Rent (%)	Owned (%)	Other (%)
Water spinach cultivation	92.4	7.6	0.0
Water mimosa cultivation	95.0	5.0	0.0
Dry season rice	53.0	21.0	26.0
Duck raising	63.2	21.0	15.8

Generally, villagers can only own water surface area they inherited from their forebears. Few migrants own the water area they use for cultivation. Most farmers find difficulty in facing the high cost of water-surface area rental and the expense of chemicals. Thus, they need to borrow money in any way they can for their initial inputs. The cultivators usually borrow money from the middlemen and they pay the interest in the form of selling the product back at slightly lower than the market price, or they borrow from their neighbours at a high rate of interest (about 10%) and can sell their products at the market price. There are a limited number of farmers who borrow money from micro-credit banks or organizations, as most do not want to follow the institution’s restrictions. It is very rare for the fishermen, rice cultivators, and duck raisers to borrow the money from their production as their initial input is not as high as water spinach and water mimosa production. Most of the farmers working on both aquatic plants cultivation and fish culture in the four main cities in Southeast Asia mentioned the need to take a loan for their initial costs of production, except in Ho Chi Minh City where most of the farmers could not take the credit from any sources of loan as they did not meet the loan terms set by the government. According to Yoonpundh et al. (2006), fewer aquatic plant cultivators took out loans for their cultivation (water spinach cultivator 27% and