

ផលិតកម្មដំណាំក្រូចពោធិ៍សាត់នៅខេត្តបាត់ដំបង

ORANGE CROP PRODUCTION IN BATTAMBANG PROVINCE

Srean Pao^{1,*}, Em Chenda¹, Teng Oun¹, and Touch Visalsok²

¹Research and Development Center, University of Battambang, Battambang, Cambodia

²University of Battambang, Battambang, Cambodia

សង្ខេបអត្ថបទ (ABSTRACT)

ក្រូចពោធិ៍សាត់ គឺជាផ្លែឈើសំខាន់ និងមានតម្លៃនៅប្រទេសកម្ពុជា ដែលផ្ទៃដីដាំដុះក្រូចពោធិ៍សាត់ច្រើនជាងគេនៅ ខេត្តបាត់ដំបង។ ជំងឺ សត្វល្អិត ចង្រៃ និងរុក្ខជាតិចង្រៃ ត្រូវបានគេរាយការណ៍ថា ជាបញ្ហាសំខាន់ក្នុងផលិតកម្មក្រូចពោធិ៍សាត់នៅខេត្តបាត់ដំបង។ គោលបំណងសំខាន់នៃការស្រាវជ្រាវនេះ គឺដើម្បីអង្កេតអំពីផលិតភាពដំណាំក្រូចពោធិ៍សាត់ ប្រសិទ្ធភាពដំណាំក្រូចពោធិ៍សាត់ និងទីផ្សារក្រូចពោធិ៍សាត់នៅខេត្តបាត់ដំបង។ អ្នកដាំក្រូចពោធិ៍សាត់ចំនួន ៨៩ នាក់ ស្ថិតក្នុងស្រុក បាណន់ បវល និងអាជីវករក្រូចពោធិ៍សាត់ចំនួន ៦២នាក់ ក្នុងក្រុងបាត់ដំបងត្រូវបានសម្ភាសន៍ដោយប្រើប្រាស់ប្រតិបត្តិសំនួររៀបរយ និងពាក់ កណ្តាលរៀបរយ។ ចំការក្រូចពោធិ៍សាត់ចំនួន ៣០ ដែលមានផ្ទៃដីជាមធ្យម ១,១៣±០,២ ហិកតា ស្ថិតក្នុងស្រុកបាណន់ ហើយមានអាយុច្រើនជាង ១៥ ឆ្នាំ ត្រូវបានវិភាគរកប្រាក់ចំណេញ និងផលចៀបចំណេញនិងចំណូល។ លទ្ធភាពទទួលបានប្រាក់ចំណេញរបស់អាជីវករក្រូចពោធិ៍សាត់ត្រូវបានប៉ាន់ប្រមាណ។ នៅខេត្តបាត់ដំបងមានកសិករប្រមាណ ៨០% ដាំក្រូចពោធិ៍សាត់ដោយអនុវត្តចន្លោះដើម ៤ម៉ែត្រ x ៤ម៉ែត្រ និងកសិករប្រមាណ ៦០% ដឹករណ៍ទំហំ ២០សង់ទីម៉ែត្រ x ២០សង់ទីម៉ែត្រ x ២០សង់ទីម៉ែត្រ ដើម្បីដាំកូនក្រូចពោធិ៍សាត់។ ការចំណាយទៅលើផលិតកម្មក្រូចនៅឆ្នាំទី ១ ប្រមាណ ១.៤៦០ ដុល្លារ/ហិកតា គឺប្រហាក់ប្រហែលនឹងការចំណាយនៅប្រទេសវៀតណាមដែរ ប៉ុន្តែទិន្នផលវាជាមធ្យម ៥,៥±១ តោន/ហិកតា គឺនៅមានកម្រិតទាប បើប្រៀបធៀបទៅនឹងប្រទេស វៀតណាម ថៃ ឥណ្ឌា និងកូរ៉េ។ ផលចៀបចំណេញនិងចំណូលគឺ ៣៥% ក្នុងរយៈពេល ១០ឆ្នាំ នៃផលិតកម្មក្រូចពោធិ៍សាត់លើផ្ទៃដី ១ហិកតា។ នៅលើទីផ្សារក្រូចពោធិ៍សាត់គុណភាពខ្ពស់លក់រាយក្នុងតម្លៃមធ្យម ៤៣.២០០±១៤០០ រៀល/ផ្លែ ឬ ១,៦០ដុល្លារ/គីឡូក្រាម ចាប់ពីខែមករា ដល់ មេសា និង ៣៦.២០០±៨០០ រៀល/ផ្លែ ឬ ១,៣៥ ដុល្លារ/គីឡូក្រាម ចាប់ពីខែ កញ្ញា ដល់ ធ្នូ។ អាជីវករក្រូចពោធិ៍សាត់ លក់ក្រូចគុណភាពខ្ពស់អាចទទួលបានលទ្ធភាពចំណេញច្រើនជាងការលក់ក្រូចគុណភាពមធ្យម និងអន់។

Oranges are one of the most important and valuable fruits in Cambodia where Battambang Province is being the largest growing area. Diseases, weeds and pests are the main problems in orange crop production in Battambang. The aim of this descriptive study, therefore, is to report orange crop productivity, effectiveness of crop production and the marketing of oranges in Battambang. Eighty-nine orange growers in the Banan & Bavel District and 62 traders in Battambang Town, Battambang Province were interviewed using structured and semi-structured interview methods. Profit and profit & revenue ratio per ha were analyzed in thirty orange orchards with 1.13±0.2 ha in average in Banan over a 15 year period. The return on sale of orange trading was estimated. In Battambang, 4m*4m of plant spacing was observed in 80% of the orange growing regions, and pit size (20Cm*20Cm*20Cm) in 60% of orange growers. Expenses on the orange crop production, approximately US\$ 1,460 per ha in the first year, are similar to Vietnam, but the average yield of 5.5±1 tons per ha is relatively low compared to Vietnam, Thailand, India and Korea. The profit and revenue ratio was 35% in 10 years of crop productivity. The average price of high quality oranges for retailing is 43,200±1,400 (mean±CI) Reils per Phloun or about US\$ 1.60 per kg in Jan – Apr and 36,200±800 Reils per Phloun⁻¹ or US\$ 1.35 per kg in Sep – Dec. The return on sale of high quality orange fruit is higher than medium and low quality.

ពាក្យគន្លឹះ: ដំណាំក្រូចពោធិ៍សាត់ ផលិតភាពដំណាំ ប្រសិទ្ធភាព ទីផ្សារក្រូចពោធិ៍សាត់
Keywords: Orange crop; Crop productivity; Effectiveness; Marketing of orange

* Corresponding Author: pao.srean@gmail.com
Tel: +855 (0) 12 387 004

1. Introduction

Oranges are one of the most important, and valuable fruits. It contains excellent Vitamin C, which is useful for human health (USDA, 2009). In Cambodia, there are six provinces; Battambang, Kampong Cham, Siem Reap, Kampong Thom and Pursat which are the primary areas for orange crop production. Among those, Battambang is the largest and the best region for producing good quality oranges (Figure1).

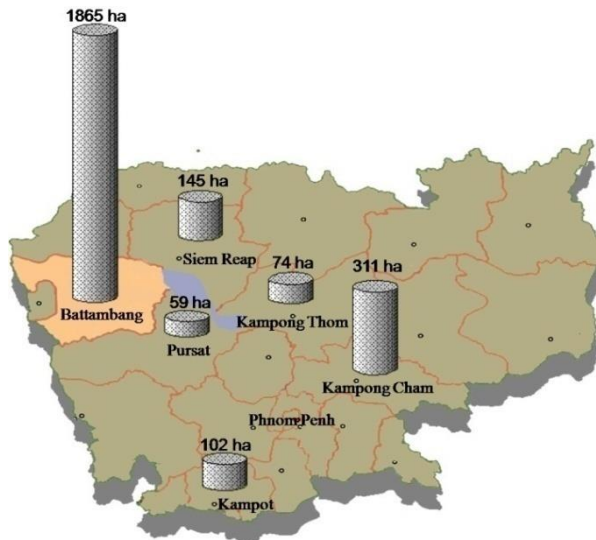


Figure 1: Cambodia map showing main growing areas (in hectares) of orange crop production in Cambodia (PDA, 2008 and SCW, 2006).

The oranges of Battambang have become a symbolic fruit in this province, because of the quality. Orange growing areas in Battambang are located in the upland area along the Sanker, Mongkolbory and Moung rivers, in Bavel (550 ha), Sanker (472 ha) Banan (365 ha), Rattanakmondoul (124 ha), Moungrusse (102 ha), Thmakoul (93 ha), Ekphnom (82 ha), Kamrieng (37 ha), Battambang (27 ha) and Samlout (13 ha) District (Jautzy, 1997 and PDA, 2008). Plant cultivation techniques significantly affect orange crop productivity (Mitra, 2009). In Battambang, most of the orange orchards are family farms, which creates approximately 50% of family income (Srean, 2009), using traditional agriculture (Nhim, 2003). Plant diseases, pests, and weeds are the main problems for orange crops in these areas as previously reported (Por, 1994; Nou, 1994; Jautzy, 1997; Yi, 1999; Nhim, 2003; Rin, 2006; Tho, 2007; Song, 2007 and Srean, 2009). Battambang imports about 13.3 - 53.3 tons of oranges a year from Vietnam (Jautzy, 1997) and a smaller amount from Thailand (Nhim, 2003).

However, no reports are available on the orange crop productivity, crop effectiveness or marketing of oranges in Battambang. Therefore, the primary focus of this research is to observe orange crop productivity,

crop effectiveness and the marketing of oranges in Battambang province.

2. Materials and Methods

2.1 Study areas

This survey was conducted in three target areas of Battambang Province (Figure 2), during January, 2009 to January, 2011:

- Banan District (Code: 0201): Chengmeanchey, Cheouteal and Kanteu 1 commune.
- Bavel District (Code: 0204): Khnaramneas, Kdoltahen and Preykhpus commune.
- Battambang Town (Code: 0203): Thmey, Leu, Beongchhouk, Nat and Anlongvil market.

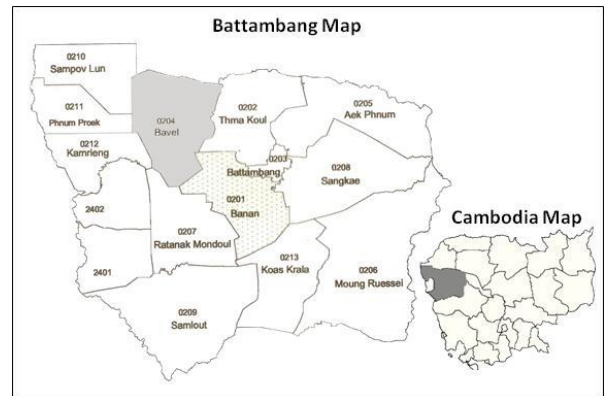


Figure 2: Maps show study areas in Battambang province.

2.2 Data collection

Eighty-nine orange growers and 62 orange traders were interviewed using structured and semi-structured interview methods. Samples of orange diseases were collected from Orange orchards in the Banan and Bavel districts in Battambang province.

2.3 Data analysis

Quantitative data was analyzed including linear regression, standard deviation (SD), standard error (SE) and confidence interval (CI) using the Statistical Package for the Social Sciences software (SPSS, version 16.0). Qualitative data was analyzed using chi-square test and cross-tab through SPSS.

Thirty orange orchards in Banan with 1.13 ± 0.2 ha (Mean \pm SE) in average over a 15 years period (planting period 1979-1994) were analyzed for profit and profit & revenue ratio, where expenses include cost per ha of land preparation, plantlets, irrigation, fertilizers, pruning, weeding, pesticides, and labor. Return on sale of orange trading was estimated by income/price.

3. Results and Discussions

3.1 Plant Cultivation

In Battambang, orange trees are planted in upland areas along the Sanker, Monkolborey and

Moung Rivers, on soil which was classified by Crocker (1963) as Brown Hydromorphics, Regurs and Basic Lithosols. The soil is plowed for 1-3 times before the pits are dug. Most orange growers plant in the early rainy season and use a 20Cm*20Cm*20Cm pit for planting. Yi (1999) observed similar planting techniques in the Svaypo District of Battambang. In India, a pit size of 60Cm*60Cm*60Cm was used for orange crop production (Mitra, 2009). Rivers, underground water, and ponds are the main sources for watering orange trees in Battambang.

Grafting (12.5%) and layering (87.5%) plants were observed in the orange orchards of Battambang. A similar observation in Svaypo was made by Yi (1999), and most of the trees were spaced 4m*4m (625 trees per ha). Yi in 1999 observed 5m*5m of plant spacing. In India, Mitra (2009) reported that normal spacing is 6m*6m (275 trees per ha) for fertile soils and 5m*5m (400 trees per ha) for low fertility soils and/or high rainfall areas. Free space in orange orchards is used for growing other crops to support the household economy during the unproductive period of the 1st to 5th year of orange crop production.

DAP (Di-ammonium Phosphate), Urea, 15:15:15 and cow manure were frequently used by orange growers in this areas. Fertilizers are applied to orange trees several times a year, before bloom (December to January) and the fruiting stage (March to April or September to October). Also Mitra (2009) reported that

3.2 Disease Damage

Citrus greening (Huanglongbing-HLB) (Figure 4), Foot Rot (Figure 5), Citrus Canker (Figure 6), and Citrus Tristeza Virus (CTV) (Figure 7) diseases have been observed in the orange orchards of Battambang. HLB is the most serious, with 97% of orange growers finding it on orange trees in recent years. Also Tho (2007) reported that HLB (81%), Citrus Canker (49%) and Foot Rot (32%) were spreading to trees in orange orchards in Banan. Song (2007) found 74% of orange plantlets in a citrus nursery in Banan, were affected by HLB.

In Battambang, orange trees generally decline within 5-8 years due to citrus greening (Figure 3). A similar observation was by Roistacher (1996) in Thailand.

in citrus plants, fertilizer should be applied three times a year. In Battambang, some farmers spray micro-nutrients (Zinc Sulphate – ZnSO₄) of 1,000ppm on leaves. Por (1994) observed symptoms of Zinc deficiency evident in most the trees in orange orchards in Battambang.

Pesticides were utilized in the orange orchards of Battambang such as Folidol, Jacket, Antrine, Videci, Fokaran, and Faifor of 68%, 21%, 5%, 3%, 2% and 2% respectively. Tho (2007) reported that the pesticides Fitor, Folidol, Marathion, Golden door and Foxentol of 83%, 37%, 10%, 7% and 3% respectively, were used in the orange orchards of Banan district, Battambang province.

Banan was the first area to grow orange trees among the growing areas in Battambang. Land productions increased quickly in Bavel in the first decade of 2000, but more slowly in Banan (Figure 3). Tek (2006) reported that the number of orange growers increased 5% in Banan and 30% in Bavel. Forty-three percent of orange growers reported that they were going to stop growing because of citrus greening disease, and would switch to mango, longan trees and annual crops such as, chili pepper, maize, cassava and soybean. Similar observations were made by Jautzy (1997).

In Battambang, the average plantings area of orange crops per household is quite small (1.13±0.2 ha) as a family farm.

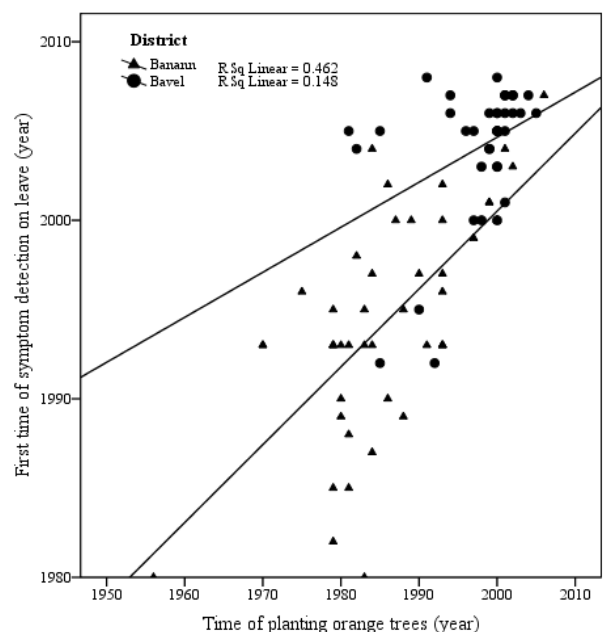


Figure 3: The correlation between time of start planting orange trees and time of symptom detection on leave.

3.3 Productivity and Profit

Orange trees start bearing fruit four or five years after planting. Mature fruits are picked from September to November, with 5.5 ± 1 tons per ha average (Mean \pm SE) or 743.8 ± 9.8 Phlouns per ha or 52 ± 1 fruits per tree (400 trees per ha; 6 fruits = 1 Kg; 1 Phloun = 40 fruits) in the sixth to tenth year of crop productivity in Banan (Figure 8). Jautzy (1997) a similar observation (700

Phlouns per ha) in Kanteu 1, Banan. In 1960s, the average yield was 10 tons per ha or 1,500 Phlouns per ha in Battambang (Jautzy, 1997). Average yields are considerably higher in other countries: The Mekong delta of southern Vietnam 15.67 tons per ha (Ha *et al*, 2005), India 10.3 tons per ha (NABRD, 2007), Thailand 15 tons per ha, Korea 26 tons per ha and Taiwan 15 tons per ha (FFTC, 2007).

Table 1: HLB has seriously affected orange trees in many countries.

Country	First year of HLB found	Source
Cambodia	1980s	Survey data in 2009
Brazil	2004	Anonymous (2004)
China	1919	Bove (2006) and da Graca & Korsten (2004)
India	1929	Raychauduri <i>et al</i> (1974)
Indonesia	1940s	Aubert <i>et al</i> (1985)
Japan	1988	JIRCAS (2003)
Laos	1998	CAB International (1998)
Malaysia	1988	Ko (1988)
Myanmar	1998	CAB International (1998)
Nigeria	1993	Varma and Atiri (1993)
Philippines	1921	Lee (1921)
South Africa	1947	Su (2001)
Taiwan	1951	Schwarz <i>et al</i> (1973)
Thailand	1973	Schwarz <i>et al</i> (1973)
USA (Florida)	2005	APHIS (2007)
Vietnam	1960s	Thu <i>et al</i> (2004)



Figure 4: Symptoms of HLB (*Candidatus Liberibacter*) on orange tree.



Figure 5: Symptoms of Foot Rot (*Phytophthora* spp.) on trunk.



Figure 6: Symptom of Canker disease (*Xanthomonas axonopodis*) on fruits and leaves.



Figure 7: Symptom of CTV on fruits. The fruits fall down when it became yellow skin.

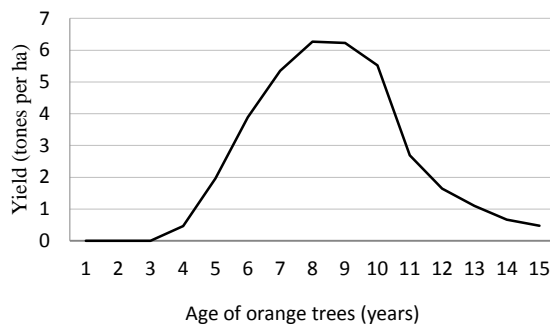


Figure 8: Trend of orange crop yield (tons per ha) in 15 years of crop production in Banan (1 ton = 136.4 Phlouns).

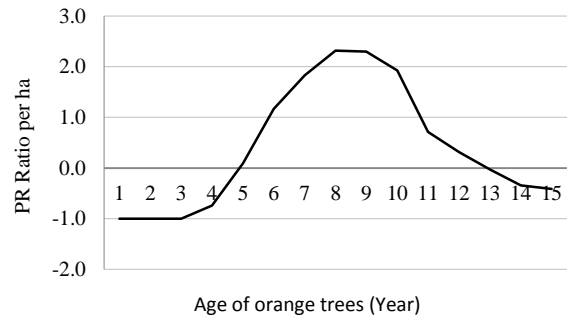


Figure 10: Trend of PR ratio of Orange crop productivity in Battambang.

In Battambang, average expenses per ha in the first year of production excluding equipment and tools were 5,832,200 Reils per ha (Figure 9) or 1,460 US\$ per ha (US\$ 1 = 4,000 Reils). This expense is similar to that of Vietnam (US\$ 1690 per ha) as reported by Nguyen *et al.* (2006).

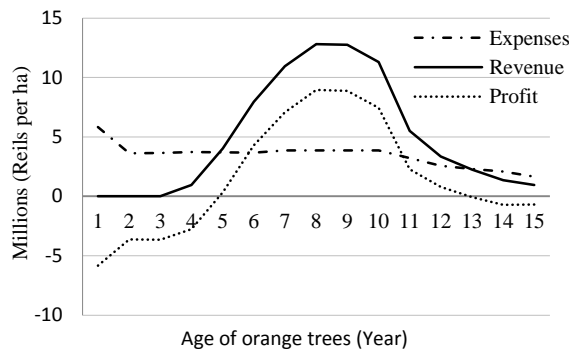


Figure 9: Trends of expenses, revenue and profit per ha of orange crop in Battambang.

Table 2: Comparison of average expenses per ha of orange crop production in first year.

Expenses	Battambang	Vietnam
Land preparation	11.16%	17.71%
Plantlets	29.48%	42.5%
Fertilizers	7.13%	6.14%
Pesticides	3.33%	2.66%
Irrigation	45.74%	11.51%
Equipments and tools	n.a	2.95%
Labor	3.15%	14.76%
Electricity and fuel	n.a	1.77%
Total	US\$ 1460	US\$ 1690

Orange groves must be a minimum of 10 years old in order to make a profit. A similar observation from Thailand was reported by Roistacher (1996) and in Vietnam (Nguyen *et al.*, 2006). In Battambang the Profit and Revenue ratio (PR ratio) = 35% in 10 years (1st-10th) of crop production (Figure 10).

3.4 Orange Market

Leu, Thmey, Beongchhouk, Nat and Anlongvil market are the main areas for selling oranges in Battambang. Most oranges in those areas come from Banan, Bavel, Sanke, Rattanamonol and Moungrusey districts in Battambang province and from Vietnam. Jautzy (1997) reported that Battambang imports oranges from Vietnam as follow: 2,000-8,000 Sleks (1 Slek = 10 Phlouns) or 13.3 to 53.3 tons a year. The orange price varies depending on the growing areas, fruiting season, and fruit size and quality. Oranges from Banan are considered the best quality, when compared to others. There are three quality level oranges available in the markets of Battambang; high, medium and low.

The average retail price (mean±CI) for high quality orange fruit is 43,200±1,400 Reils per Phloun or about US\$ 1.60 per kg in January to April and 36,200±800 Reils per Phloun or US\$ 1.35 per kg in September to December (Figure 11). Similar observations were made by Nhim (2003). In 1997, an average price of 17,000±5,900 Reils per Phloun in the raining season and 25,300±5,200 Reils per Phloun in dry season was observed by Jautzy (1997). In Vietnam, the average price of VND 7,000 per kg or US\$ 0.41 kg or about 10,000 Reils per Phloun (VND 19450 = US\$ 1) was reported by Nguyen *et al.* (2006). Therefore the recent price of orange fruit in Battambang is two times higher than any time in the last ten years, and about four times higher than in Vietnam.

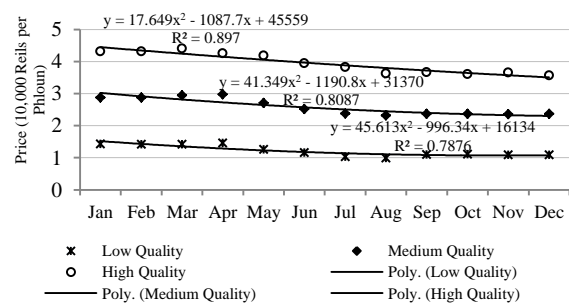


Figure 11: Trends of average retail price per Phloun of different orange fruit quality on the market for the period January to December in Battambang. Fruit qualities were categorized by authors.

The return on sale per unit of orange fruit is 17% (low), 18% (medium) and 23% (high) respectively. Selling high quality oranges has a greater benefit than medium and low quality during the entire year of trading (Figure 12).

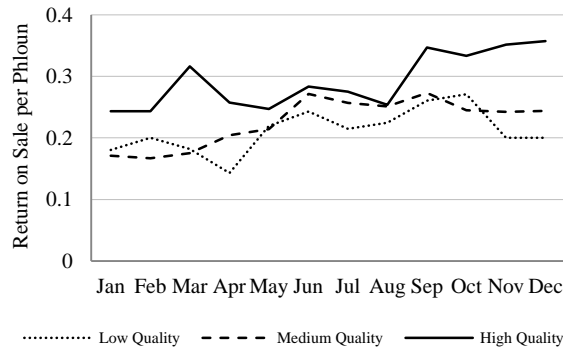


Figure 12: Trends of return on sale per unit of different Orange fruit quality.

4. Conclusions and Recommendations

In Battambang, orange orchards are small scale farming, with an average of 1.13 ± 0.2 ha. Most orange growers use plant spacing and pit size cultivation techniques which are smaller than those in Vietnam and India. HLB, Foot rot, Citrus Canker and CTV disease have been the most serious threats to orange trees in recent times. Expenses of orange crop production are about US\$ 1,460 per ha in the first year which is similar to Vietnam and the average yield of 5.5 ± 1 tons per ha is relatively low compared to Vietnam, Thailand, India and Korea. Orange groves require a minimum of about 10 years before returning a profit.

Oranges are divided into three categories: low, medium and high quality and are available in the markets of Battambang all year. Orange prices decrease slowly during the year. All year traders get greater benefits from selling high quality oranges than medium or low quality.

This research suggests that crop improvement through agricultural bio-technology could be applied to orange crop production in Cambodia and this would benefit Cambodian growers.

Acknowledgements

The authors are grateful to the University of Battambang (UBB) for the financial support of this work.

References

Anonymous. (2004). Estudos indicam que a nova doença tem relação com o greening. Fundecitrus. Available at: <http://www.fundecitrus.com>.

APHIS. (2007). Citrus Greening: Questions and Answers. Plant Protection and Quarantine. United States Department of Agriculture, Animal

and Plant Health Inspection Service, Safeguarding American Agriculture. USA.

Aubert, B., Gamier, M., Setiobudi, L., Nurhadi, F. (1985). Greening, a serious threat for the citrus production of the Indonesian archipelago. Future prospects of integrated control. *Fruits* 40, 549-563.

Bove, J. M. (2006). Huanlongbin: A destructive, newly-emerging, century-old disease of Citrus. *Journal of Plant Pathology*. 88, 7-37.

CAB International. (1998). Distribution maps of plant diseases. Compiled by CAB International in association with EPPO. Map 766.

Crocker, C. D. (1963). General Soil Map of the Kingdom of Cambodia, Scale, 1:1,000,000. Royal Cambodian Government Soil Commission/ USAID Joint Publication, Phnom Penh, Cambodia.

da Graca, J. and Korsten, L. (2004). Citrus huanlongbin: Review, Present Status and Fruit Strategies. *Disease of Fruits and Vegetables*. 1, 229-245.

FFTC. (2007). Citrus Production in Asia. Food and Fertilizer Technology Center for the Asian and Pacific Region. Taipei 10616, Taiwan R.O.C.

Ha, M. T., Hong, L. T. T. and Vien, N. V. (2005). Establishment of a Disease-Free Citrus Nursery System and Demonstration of Integrated Crop Health Management of Citrus Orchards. Food and Fertilizer Technology Center for the Asian and Pacific Region. Taipei 10616, Taiwan R.O.C.

Jautzy, Y. (1997). Citrus Crop Production in Battambang Province. ANS Organization, Phnom Penh, Cambodia.

JIRCAS. (2003). The Distribution of Vector Insects of Citrus Greening Disease Coincides with that of Orange Jasmine in the Southwest Islands of Japan. *JIRCAS Newsletter No.36* September 2003.

Ko, W. W. (1988). Plant Indexing to detect the greening disease in Malaysia. (Progr. rept.) *Proc. FAO/UNDP Greening Workshop, Lipa Philippine*, pp. 84-86.

Lee, R. F. (1921) The Relation of Stocks to Mottled Leaf of Citrus Leaf. *Philipp*. 11, pp. 255-257.

Mitra, K. (2009). Citrus Cultivation in India. Available at: <http://citrusindia.blogspot.com/>. Retrieved on August 29, 2010.

NABARD. (2007). Citrus Cultivation. National Bank for Agriculture and Rural Development. Retrieved on September 01, 2010. Available at http://www.nabard.org/modelbankprojects/plant_citrus.as.

Nguyen, P. T. N, Truong, C. T., and Luu, T. D. H. (2006). Market Structure and Marketing Channel Analysis: The Case of Orange in the Mekong

- River-Vietnam. Research Paper in the Framework of NPT Programme (B3). Cantho University, Vietnam.
- Nhim, S. A. (2003). The Study on Orange Production and Marketing in Battambang Province. Royal University of Agriculture, Phnom Penh, Cambodia. BSc. Thesis (Version in Khmer), p. 55.
- Nou, K. S. (1994). Insects on Orange Crop in Battambang. Royal University of Agriculture, Phnom Penh, Cambodia. Bsc. Thesis (Version in Khmer), p. 57.
- PDA. (2008). Statistic of Fruit Tree in 2008. Provincial Department of Agriculture, Battambang, Cambodia.
- Por, K. H. (1994). Agronomy Problems and Potential of Orange Crops in Battambang. Royal University of Agriculture, Phnom Penh, Cambodia. BSc. Thesis (version in Khmer), p. 120.
- Raychauduri, S. P., Nariani, T. K., Ghosh, S. K., Viswanath, S. M., and Kumar, D. (1974). Recent Studies on Citrus Greening in India. *Proc. Conf. Int. Org. Citrus virol.* 6th, pp. 53-57.
- Rin, S. R. (2006). Orange Production base Income of the People in Banann District, Battambang Province. Prek Leap National School of Agriculture, Phnom Penh, Cambodia. BSc. thesis (Version in Khmer), p. 51.
- Roistacher, C. N. (1996). The economics of living with citrus diseases: Huanglongbing (greening) in Thailand, pp. 279-285 *In* J. V. da Graça, P. Moreno, and R. K. Yokomi [eds.], *Proc. 13th Conference of the International Organization of Citrus Virologists (IOCV)*. University of California, Riverside.
- Schwarz, R. E., Knorr, L. C., and Prommintara, M. (1973). Presence of Citrus greening and its Psylla vector in Thailand. *FAO Plant Prot. Bull.* 21, 132-138.
- SCW. (2006). The Atlas of Cambodia. Save Cambodia's Wildlife, Phnom Penh, Cambodia.
- Song, M. (2007). Productivities Situation of Pursat Orange in Banann District, Battambang Province. Royal University of Agriculture, Phnom Penh, Cambodia. BSc. Thesis (Version in Khmer), p. 52.
- Srean, P. (2009). Strategy to Minimize Citrus Greening Disease on Orange Crop in Battambang Province. Royal University of Agriculture, Phnom Penh, Cambodia. MSc. Thesis (version in Khmer), p. 48.
- Su, J. H. (2001). Citrus greening disease. Food and Fertilizer Technology Center (FFTC), Technical Note. *Plant Protection*. No. 2001-2.
- Tek, B. (2006). Potential of orange in Battambang Province. Royal University of Agriculture, Phnom Penh, Cambodia. BSc. Thesis (version in Khmer), p. 42.
- Tho, K. E. (2007). Studying on the important pests of sweet orange in Banorn district, Battambang province. Royal University of Agriculture, Phnom Penh, Cambodia. BSc. Thesis (Version in Khmer), p. 86.
- Thu, H., Dien, L. Q., Lan B., Tuan, D. H., Vung, S. and Nguon, B. (2004). Some Investigations on Citrus in Cambodia. Phnom Penh, Cambodia. Presentation on 20-28 October, 2004.
- USDA. (2009). Composition of Foods Raw, Processed, Prepared; USDA National Nutrient Database for Standard Reference, Release 22. U.S. Department of Agriculture, Agricultural Research Service Beltsville Human Nutrition Research Center Nutrient Data Laboratory 10300 Baltimore Avenue Building 005, Room 107, BARC-West Beltsville, Maryland 20705.
- Varma, A., and Atiri G. I. (1993). Virus and virus-like diseases of citrus in Nigeria, pp. 462-463 *In* P. Moreno, J. V. da Graça, and L. W. Timmer [eds.], *Proc. 12th Conference of the International Organization of Citrus Virologists*. University of California, Riverside.
- Yi P. (1999). Small Scale Orange Crop Production in Svay Po District of Battambang Province. University of Agriculture, Phnom Penh, Cambodia. Bsc. Thesis (Version in Khmer), p. 41.