POTENTIAL THREATS OF PERI-URBAN TUONG-MANGO PRODUCTION AND POLICY IMPLICATIONS FOR HEALTHY AGRICULTURE FOR HEALTHY ECOSYSTEMS

TRUONG HONG VO TUAN KIET[1], PHAM THI NGUYEN[2] & NGUYEN THI KIM THOA[1]
[1]Mekong Delta Development Research Institute, Can Tho University, Vietnam
[2]School of Economics, Can Tho University, Vietnam

ABSTRACT

Understanding both positive and negative influences of urban agriculture (UA) could encourage countries to have suitable strategies in UA development, especially in developing country's cities. The study used the environmental impact quotient (EIQ) model to identify potential risks of agro-inputs usage on urban ecosystems (human and ecology). The paper concentrates on influencing agrochemicals on farmers, consumers and ecosystems in Tuong-mango cultivation in the peri-urban area of southern Vietnam. The results show that nitrogen fertilizer plays an important role in mango production but it can cause nitrate poisoning in the surrounding community, and is especially dangerous to infants, pregnant women (birth defects and miscarriages) and adults (stomach and esophageal cancers). In addition, the fungicide makes up the highest proportion of the total agro-inputs usage. The findings indicate that active ingredients of the paclobutrazol, mancozeb, probineb, ziram and carbenazim are high in Tuong-mango cultivation in southern Vietnam. Paclobutrazol and ziram are category II (moderately hazardous), and the mancozeb, probineb, carbendazim are in the list of category U (unlikely to present acute hazard when in regular use). Besides, the ecosystem EIQ triple the farmer EIQ, are fivefold the consumer EIQ for the seasons 1, 2, and 3. The field use EIQ average value of season 1 is the highest, followed by season 2, and season 3 is the lowest. For policy solution, stakeholder reference and policy dialogue should be discussed regularly before UA is carried out in cities. Sustainable progression of UA in cities require coordination between health, agriculture and environmental departments, education and training. Moreover, urban farmers need to be supported in technical advice, training, credit access, and collection economic development.
Keywords: Tuong-mango, peri-urban, agro-inputs, ecosystem.

1 INTRODUCTION

The concept of urban agriculture (UA) has become popular during decades recent. According to Mougeot [1], UA is agricultural production activities to take place intra-urban or peri-urban of a metropolis, a city, or a downtown. It is involved in activities of farming system, product process and delivery of food and non-food products to provide the commodities and services to residents in city. Overall, agricultural production in city is divide two main categories (urban agriculture and peri-urban agriculture). UA is conducted inside a city or a town with two levels. First, use of empty lands in city that is unappropriated for construction can be used for UA provisionally. Second, UA is carried out smaller scale level such as public gardens, garden houses, kindergartens, and roof gardening. Peri-urban agriculture is established in suburb or the vicinity of city. Farming area of farmers and agricultural companies in peri-urban are bigger than the farms intra-city and are market-oriented well [2].

The most outstanding feature of UA making it different from rural agriculture is its propinquity with city environmental and economic activities [1]. This has negative and positive influences on farm worker, consumer and environment in city [2]. It pays attention of academics, policymakers by both adverse and desirable effects. There is not any difficulty to understand why the role of UA is appreciated in sustainable development of academics, policymakers. Firstly, UA contributes to meet increasing demand of food and nutrition by

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growing city populations [3], [4]. Secondly, it is against several negative ecological and economic impacts of urbanization through income generation, organic waste reuse, green belts establishment, and landscape conservation [5], [6].

Although UA has a plethora of opportunities, it also has some challenges for sustainable development and cities management. Applying chemical agro-inputs in UA do harm to humans and ecosystem, especially is farm workers and the public health of neighboring communities. Initially, one noticeable damage of UA is environmental dangers. In detail, contamination of local water resources results in a part of agrochemical (fertilizers and pesticides) overuse; the excessive use of nitrate rich fertilizers can cause underground waters pollution. Subsequently, health dangers is mentioned as a potentially adverse aspect of UA. If UA relies heavily on agrochemical (fertilizers, herbicides, insecticides and fungicides) use, it will bring about contaminated river water and soil. This creates health problems for producer and consumer in city. They become vulnerable to contaminants by peri-urban agriculture. More specific, unsafety agricultural products with pathogenic organisms stem from polluted irrigation; Human diseases transferred from disease vectors by agricultural activities; pollution of agri-food and drinking water by agrochemical residues [7].

UA is one of the much discussed topics of researchers, policymakers, and practitioners during decades last. It is like sides of a coin, which runs parallel both positive and negative influence. Identifying its motivations and considering measures can help multiply benefits and mitigate risks. The study applies Environmental Impact Quotient (EIQ) model to give a measure of the ecosystem impact characterizing Tuong-mango production activities in the southern Vietnam where is considered Vietnam's main orchard. The model provides a better lens for analyzing health (human and ecosystem) issues related to UA. It focuses attention on impacting agrochemicals use on producer, consumer and ecosystem in Tuong-mango production in peri-urban area of the southern Vietnam. Beside, different policy perspectives is suggested for the sustainable development of intra- and peri-urban agriculture.

2 MATERIALS AND METHODS

2.1 Sampling techniques

Primary data in the study not only focuses on Tuong-mango cultivation but also is collected in peri-urban area of cities (Fig. 1). First of fall, members of research group discussed directly with agricultural extension workers in province and district levels to choose big mango villages near urban region. The result found out various areas such as Cho moi district next to Long Xuyen city (An Giang), Cao Lanh district next to Cao Lang city (Dong Thap), Cai Be district of Tien Giang province next to Vinh Long city (Vinh Long), Vung Liem district of Vinh Long province and Can Long district next to Tra Vinh city (Tra Vinh), Chau Thanh A of Hau Giang province next to Can Tho city, Xuan Loc district next to Long Khanh city (Dong Nai). Next, the paper carried out seven discussion groups (4 people per group) in seven Tuong-mango farming locals to design appropriate questionnaire. Finally, simple random technique was employed to collect 435 of sampling observations in the non-cooperative grower group (138, 158 and 139 for the seasons 1, 2 and 3, respectively), and 295 of sampling observations in the cooperative grower group (100, 90 and 105 for the seasons 1, 2 and 3, respectively) with the total 730 of sampling observations.

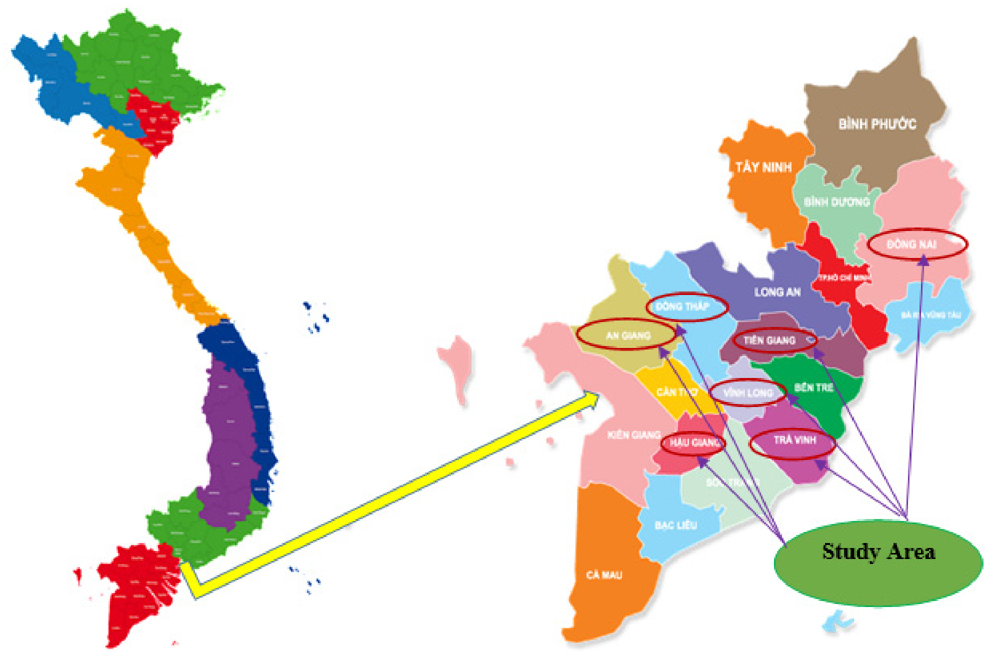

Figure 1: Study area in southern Vietnam.

2.2 Environment impact quotient model

The environment impact quotient (EIQ) model was developed by Kovach et al. [8] at Cornell University to evaluate effects of pesticide on ecosystems. The model is as a helpful tool for measurements of ecological risk of agrochemical use [9] as well as suggest policy for sustainable farming towards human health and ecosystem protection [10], [11].

A list of 11 items (Table 1) is used for measurement of farmer, consumer and ecosystem EIQ. These items are classified into three levels (scores 1, 3 and 5). The EIQ model refers to agro-inputs impacts on three main group including farmer, consumer, and ecosystem. For example, the farmer (applicator and harvester), consumer (exposure and groundwater effects), and environment (fish, birds, bees, other beneficial insects).

The farmer EIQ (eqn (1)) is established by three indicators (long-term health effects, dermal toxicity (Rat LD50), soil residue half-life (TI/2)). The consumer EIQ (eqn (2)) is computed based on five indicators (long-term health effects, plant surface half-life, soil residue half-life (TI/2), mode of action, leaching potential). The EIQ of ecosystem (eqn (3)) is worked out from seven indicators (fish toxicity (96h LC50), surface runoff potential, bird toxicity (8 day LC50), plant surface half-life, soil residue half-life (TI/2), bee toxicity, beneficial arthropod toxicity). The total EIQ is the average of the three components, and it is calculated for each pesticide active ingredient (eqn (4)) (see Table 2).

The field use EIQ is calculated based on information on the dose, formulation or percentage of active ingredient and the frequency of application [12]. Total impacts of agrochemical usage in each season can be measured by summing up the product of individual field use EIQ. The equation is presented in eqn (5). In this study, the theory EIQ values are done from using Cornell University's online EIQ calculator in May 2020 [13].

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Table 1: Definition for symbols and ratings for each toxicity category [8].

Variables	Symbol	Score 1	Score 3	Score 5
Long-term health effects (chronic)	c	Little–none	Possible	Definite
Dermal toxicity (Rat LD50)	dt	> 2,000 mg/kg	200–2,000 mg/kg	0–200 mg/kg
Bird toxicity (8 day LC50)	d	>1000 ppm	100–1,000 ppm	1–100 ppm
Bee toxicity	z	Non-toxic	Moderately toxic	Highly toxic
Beneficial arthropod toxicity	b	Low impact	Moderate	Severe impact
Fish toxicity (96h LC50)	f	>10 ppm	1–10 ppm	< 1 ppm
Plant surface half-life	s	1–2 weeks	2–4 weeks	> 4 weeks
Soil residue half-life (TI/2)	p	< 30 days	30–100 days	>100 days
Mode of action	sy	Non-system	Systemic	
Leaching potential	l	Small	Medium	Large
Surface runoff potential	r	Small	Medium	Large

Table 2: EIQ equation environmental components [8].

EIQ equation component	Equation
Farmer (applicator + harvester)	$c\times((dt\times5) + (dt\times p))$ (1)
Consumer (exposure + groundwater effects)	$(c\times(s + p)/2\times sy) + (l)$ (2)
Ecosystem (fish, birds, bees, other beneficial insects)	$(f\times r) + (d\times(s+p)/2\times3) + (z\times p\times3) + (b\times p\times5)$ (3)
Total EIQ = farmer + consumer + ecosystem $\{[c\times(dt\times5)+(dt\times p)]+[(c\times(s+p)/2\times sy)+(l)+[(f\times r)+(d\times(s+p)/2\times3)+(z\times p\times3)+(b\times p\times5)]\}/3$ (4)	
Field use EIQ = EIQ × % active ingredient × rate/ha (5)	

3 RESULTS AND DISCUSSION

3.1 The situation of synthesis fertilizer use in Tuong-mango production

Nowadays, synthesis fertilizer plays essential role in agricultural production, contributes to cropping productivity increase, and are sprayed directly on fields and orchards. These fertilizers do harm to human health and ecosystem. Research by Sobsey et al. [14] indicates that synthetic fertilizers overuse occur excess nutrients, which can enter waterways, aggravating algae progression, leading to harmful algal blooms more frequent. For instance, there were 169 toxic algal blooms in the United States in 2018 while there were only three cases in 2010 [15].

Table 3 shows consumption of chemical fertilizer (nitrogen, phosphorus, potassium) in Tuong-mango cultivation of the non-cooperative and cooperative farmer groups. Mango trees absorb nutrition from chemical fertilizer by manuring into root and on leaves. In general, the season 2 consumes fertilizer more than the seasons 1, and 3, and the non-cooperative farmers use fertilizer more than the cooperative farmers in the three seasons. More specific, chemical fertilizer for root, the number of fertilizer of the cooperative grower category in the second season is 1.58, and 1.35 times more than the first and third seasons. Similarly, these figures of the non-cooperative grower category is 1.12 and 1.20 times. For spraying chemical fertilizer on leaves for flowering stimulation, liquid fertilizer use of the non-cooperative grower category in the season 2 is 1.08 and 1.19 times higher than in the seasons 1 and 3. In the cooperative grower category, liquid fertilizer consumption in the season 2 is 1.4 times higher than in the season 3, but it is lower than in the season 1 about 0.91 time.

Table 3: The number of chemical fertilizer in Tuong-mango production. *(Source: Field Survey Data, 2018.)*

Items	Season 1			Season 2			Season 3		
	Non-coop (n=138)	**Coop (n=100)**	*T-test*	**Non-coop (n=158)**	**Coop (n=90)**	*T-test*	**Non-coop (n=139)**	**Coop (n=105)**	*T-test*
Root fertilizer									
N: nitrogen (kg/ha)	285.1	209.2	*	305.4	185.2	**	250.5	154.3	**
P: phosphorus (kg/ha)	177.5	142.2	ns	208.3	122.4	***	166.8	117.0	ns
K: potassium (kg/ha)	194.6	163.2	ns	224.0	176.1	ns	196.6	88.2	**
Microelements (gr/ha)	0.0	0.1	ns	0.0	1.0	ns	0.6	1.2	*
Leaf fertilizer (liquid) for flowering stimulation									
N: nitrogen (kg/ha)	5.8	5.5	ns	7.6	5.0	ns	6.1	3.2	***
P: phosphorus (kg/ha)	4.0	1.4	*	3.4	1.0	*	3.6	0.5	**
K: potassium (kg/ha)	11.6	10.5	ns	12.2	9.8	ns	9.8	7.5	ns
Microelements (gr/ha)	76.8	49.5	ns	150.7	62.8	**	197.6	41.4	*

* Significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level, ns: non-significant.

For the root fertilizer consumption, the total root fertilizer (N, P, K) of the non-cooperative farmer group is 657.2 kg/ha greater than 2.15 times that of the cooperative farmer group (305.4 kg/ha) in the season 1. In the season 2, this number of the non-cooperative farmer group (737.7 kg/ha) is one and half times compared with the cooperative farmer group (483.7kg/ha). In the season 3, consumption of the root fertilizer of the non-cooperative and cooperative grower groups are 613.9 kg/ha, and 359.5 kg/ha (more than 1.71 times). For the leaf fertilizer usage, the number of liquid fertilizer of the non-cooperative growers are higher than 1.23; 1.47, and 1.74 times that of the cooperative growers for the seasons 1, 2, and 3 respectively. The findings show that the number of applied synthesis fertilizer in Tuong-mango cultivation is relatively high compared to the result of [16] (624.8 kg/ha in Egypt, 301.5 kg/ha in China, 121.4 kg/ha in India, and 106.9 kg/ha in Indonesia). Moreover, nitrogen fertilizer plays essential role in agricultural production in general and mango farming in particular. In Tuong-mango production, used nitrogen fertilizer volume (root fertilizer) of the non-cooperative growers are 1.36, 1.65, and 1.62 times compared with that of the cooperative growers for the seasons 1, 2 and 3, respectively. These numbers of leaf fertilizer are 1.05, 1.52, and 1.91 for the seasons 1, 2, and 3 respectively.

The result of study shows that fertilizer consumption in Tuong-mango cultivation of the non-cooperative farmers are greater than the cooperative farmers, especially is nitrogen fertilizer. Its misuse leads to air pollution by nitrogen oxides (NO, N2O, NO2) emissions. Importantly, nitrate fertilizer can get into the waterways like groundwater and surface runoff to take nitrate poisoning for surrounding community, especially is dangerous to infants, pregnant women (birth defects and miscarriages) and adults (stomach and esophageal cancers) [17]. In short, city that is dense population area is sensitive with impacts around. Hence, agro-inputs of UA need to manage strictly to ensure minimum negative influences in citizens and ecosystem in urban. By contrast, it can occur negative impacts on human health (farm worker, consumer) and ecosystem (soil, water, air, terrestrial and aquatic ecosystems).

3.2 Human health and ecology impacts in Chu-mango production

Based on the classification of the World Health Organization (WHO) [18], agrochemicals usage in Tuong-mango production in the southern Vietnam, none are classified in category Ia (extremely hazardous). Category Ib (highly hazardous) is the abamectin, category II (moderately hazardous) comprises: the paclobutrazol, papraquat, 2,4 D, cypermethrin, chlorpyrifos, emamectin, imidacloprid, permethrin, ziram, difenoconazole, tebuconazole. Glyphosate and metaxyl are the list of category III (slightly hazardous), and mancozeb, probineb, carbendazim, azoxystrobin and trifloxystrobin are in category U (unlikely to present acute hazard when in regular use).

The result in Table 4 compares agrochemicals EIQ between the non-cooperative and cooperative farmer groups in the season 1. The field use EIQ average value of the non-cooperative and cooperative farmer groups are insignificant disparity approximately 59.8 kg/ha, in which fungicide EIQ of the cooperative farmer group is 107 kg/ha more than that of the non-cooperative farmer group. On the other hand, paclobutrazol, herbicide, and insecticide EIQ of the cooperative farm group is less than those of the non-cooperative farmer group. The four active ingredients are used the most regularly in Tuong-mango cultivation including: paclobutrazol, mancozeb, propiconazole, and ziram, with remarkable proportion of these components making up about 86.4% for the non-cooperative farmers, and 90.9% for the cooperative farmers in total of agrochemicals usage.

Table 5 compares the pesticides EIQ in the season 2 of the non-cooperative and cooperative grower groups. Overall, there is no significant difference in both farmer groups. In detail, the field use EIQ average value of the non-cooperative grower group is 1,028.59 kg/ha, higher than approximately 15.32 kg/ha compared with the cooperative grower group. The consumer and ecosystem EIQ of the non-cooperative growers are more than those of the cooperative growers approximately 50.87 and 31.45 kg/ha. By contrast, the farmer EIQ of the non-cooperative grower group is 36.41 kg/ha lower than that of the cooperative grower group. Furthermore, the study indicates the greatest proportion of agrochemicals is consumed by fungicide, at 57.9% for non-cooperative farmers and 48.1% for cooperative farmers. Less than, namely 33.8% and 45.9% for non-cooperative and cooperative farmers, is found out from paclobutrazol. The insecticide makes up 6.5% and 4.1% of agrochemicals usage for non-cooperative and cooperative farmer groups, leaving herbicide at only 1.7 and 1.9 for non-cooperative and cooperative farmer groups.

There is a considerable disparity in the field use EIQ between the non-cooperative grower and the cooperative grower categories (Table 6). Specifically, the farmer, consumer and ecosystem EIQ of the non-cooperative growers are 1.20, 1.55, and 1.37 times, respectively, more than those of the cooperative growers. Additionally, the field use EIQ average value of

Table 4: The practical values of the health and ecosystems impacts (EIQ) in the season 1. (Unit: kg/ha.) *(Source: Field Survey Data, 2018.)*

Active ingredient	**EIQ component value**						**Average EIQ value**	
	Farmer		**Consumer**		**Ecosystem**			
	Non-coop	*Coop*	*Non-coop*	*Coop*	*Non-coop*	*Coop*	*Non-coop*	*Coop*
(1) Paclobutrazol	**549.55**	**534.13**	**168.99**	**164.25**	**1,327.43**	**1,290.18**	**681.90**	**662.77**
(2) Herbicide	**18.55**	**11.57**	**5.00**	**3.21**	**33.67**	**27.59**	**19.07**	**14.12**
Glyphosate	3.56	4.41	1.33	1.65	15.57	19.30	6.82	8.45
Paraquat	7.62	5.70	1.51	1.13	8.57	6.41	5.90	4.41
2.4-D	7.37	1.46	2.15	0.43	9.52	1.89	6.35	1.26
(3) Insecticide	**18.95**	**12.45**	**8.71**	**6.25**	**163.71**	**101.74**	**63.79**	**40.14**
Cypermethrin	7.70	4.91	3.29	2.10	49.87	31.80	20.29	12.94
Chlorpyrifos	5.40	1.91	1.80	0.64	65.28	23.15	24.16	8.57
Emamectin	3.48	2.84	1.55	1.26	25.45	20.75	10.16	8.28
Abamectin	1.22	1.53	0.35	0.43	7.65	9.55	3.07	3.84
Imidacloprid	1.15	1.20	1.72	1.80	15.46	16.13	6.11	6.38
Permethrin	0.00	0.06	0.00	0.03	0.00	0.36	0.00	0.15
(4) Fungicide	**247.27**	**316.25**	**196.99**	**241.00**	**791.08**	**1,000.60**	**411.75**	**519.24**
Mancozeb	107.82	145.74	43.29	58.51	259.78	351.14	136.94	185.11
Propiconazole	54.02	76.70	85.53	121.44	287.65	408.41	142.38	202.16
Ziram	53.31	69.87	19.99	26.20	94.29	123.58	55.86	73.21
Carbendazim	12.99	5.52	21.04	8.94	44.69	18.98	26.24	11.15
Difenoconazole	9.75	7.86	15.27	12.31	55.89	45.04	26.97	21.74
Tebuconazole	5.51	6.72	8.54	10.42	19.29	23.52	11.11	13.55
Azoxystrobin	3.21	3.34	2.40	2.49	26.42	27.44	10.68	11.09
Metalaxyl	0.57	0.40	0.85	0.60	2.58	1.82	1.33	0.94
Trifloxystrobin	0.09	0.12	0.08	0.10	0.50	0.67	0.22	0.30
Field use EIQ	**834.32**	**874.40**	**379.69**	**414.72**	**2,315.89**	**2,420.11**	**1,176.51**	**1,236.27**

Table 5: The practical values of the health and ecology impacts (EIQ) in the season 2. (Unit: kg/ha.) *(Source: Field Survey Data, 2018.)*

Active ingredient	**EIQ component value**						**EIQ average value**	
	Farmer		**Consumer**		**Ecosystem**			
	Non-coop	*Coop*	*Non-coop*	*Coop*	*Non-coop*	*Coop*	*Non-coop*	*Coop*
(1) Paclobutrazol	**280.34**	**374.56**	**86.21**	**115.18**	**677.15**	**904.75**	**347.86**	**464.77**
(2) Herbicide	**13.06**	**11.10**	**3.87**	**3.87**	**35.48**	**42.13**	**17.47**	**19.03**
Glyphosate	6.30	9.09	2.36	3.41	27.58	39.75	12.08	17.41
Paraquat	4.97	1.32	0.99	0.26	5.59	1.49	3.85	1.03
2.4-D	1.78	0.69	0.52	0.20	2.30	0.89	1.53	0.59
(3) Insecticide	**19.52**	**13.02**	**10.44**	**6.23**	**172.02**	**106.19**	**67.32**	**41.81**
Cypermethrin	6.26	5.57	2.68	2.38	40.54	36.04	16.49	14.66
Chlorpyrifos	4.38	2.34	1.46	0.78	52.98	28.29	19.61	10.47
Emamectin	4.85	2.55	2.15	1.13	35.46	18.65	14.15	7.44
Abamectin	1.56	1.57	0.44	0.44	9.78	9.82	3.93	3.95
Imidacloprid	2.47	1.00	3.71	1.49	33.25	13.39	13.14	5.29
Permethrin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(4) Fungicide	**351.71**	**302.35**	**295.80**	**220.17**	**1,140.45**	**940.57**	**595.94**	**487.65**
Mancozeb	140.41	159.91	56.37	64.20	338.30	385.28	178.34	203.10
Propiconazole	83.98	71.19	132.98	112.72	447.22	379.08	221.37	187.64
Ziram	76.76	56.15	28.79	21.06	135.77	99.32	80.44	58.84
Carbendazim	27.93	2.58	45.24	4.18	96.07	8.87	56.42	5.21
Difenoconazole	12.03	6.78	18.85	10.62	68.97	38.87	33.28	18.75
Tebuconazole	5.88	3.19	9.11	4.95	20.57	11.18	11.85	6.44
Azoxystrobin	3.22	1.68	2.40	1.26	26.44	13.83	10.69	5.59
Metalaxyl	1.22	0.69	1.83	1.04	5.58	3.15	2.88	1.63
Trifloxystrobin	0.28	0.18	0.23	0.15	1.53	0.99	0.68	0.44
Field use EIQ	**664.63**	**701.04**	**396.32**	**345.45**	**2,025.10**	**1,993.65**	**1,028.59**	**1,013.27**

Table 6: The practical values of the health and ecology impacts (EIQ) in the season 3. (Unit: kg/ha.) *(Source: Field Survey Data, 2018.)*

Active ingredient	**EIQ component value**						**EIQ average value**	
	Farmer		**Consumer**		**Ecosystem**			
	Non-coop	*Coop*	*Non-coop*	*Coop*	*Non-coop*	*Coop*	*Non-coop*	*Coop*
(1) Paclobutrazol	**137.91**	**136.27**	**42.41**	**41.90**	**333.13**	**329.16**	**171.13**	**169.09**
(2) Herbicide	**12.64**	**9.05**	**3.72**	**2.95**	**29.17**	**30.64**	**15.18**	**14.21**
Glyphosate	4.36	6.27	1.63	2.35	19.06	27.44	8.35	12.02
Paraquat	3.50	2.27	0.69	0.45	3.94	2.56	2.71	1.76
2.4-D	4.78	0.50	1.39	0.15	6.17	0.65	4.11	0.43
(3) Insecticide	**17.62**	**8.94**	**8.72**	**4.32**	**150.96**	**78.39**	**59.10**	**30.55**
Cypermethrin	5.34	2.04	2.28	0.87	34.56	13.20	14.06	5.37
Chlorpyrifos	3.88	2.32	1.29	0.77	46.92	28.10	17.36	10.40
Emamectin	4.85	2.69	2.16	1.19	35.51	19.65	14.17	7.84
Abamectin	1.92	1.12	0.54	0.32	12.01	7.00	4.82	2.81
Imidacloprid	1.63	0.78	2.45	1.16	21.97	10.45	8.68	4.13
Permethrin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(4) Fungicide	**346.86**	**273.80**	**307.02**	**184.57**	**1,160.66**	**786.84**	**604.79**	**415.04**
Mancozeb	135.94	126.31	54.58	50.71	327.53	304.33	172.66	160.43
Propiconazole	91.57	51.74	144.98	81.93	487.60	275.54	241.36	136.39
Ziram	65.55	81.55	24.58	30.58	115.94	144.24	68.69	85.46
Carbendazim	32.10	4.10	52.01	6.65	110.43	14.12	64.85	8.29
Difenoconazole	11.38	3.34	17.82	5.23	65.22	19.12	31.47	9.23
Tebuconazole	5.86	5.22	9.08	8.09	20.50	18.27	11.81	10.52
Azoxystrobin	3.55	1.12	2.65	0.84	29.16	9.21	11.78	3.72
Metalaxyl	0.83	0.30	1.25	0.45	3.79	1.37	1.95	0.70
Trifloxystrobin	0.09	0.12	0.07	0.10	0.49	0.64	0.22	0.29
Field use EIQ	**515.03**	**428.06**	**361.87**	**233.74**	**1,673.92**	**1,225.04**	**850.20**	**628.89**

the non-cooperative grower category (850.20 kg/ha) is 1.35 times compared to the cooperative grower category (628.89 kg/ha). Noticeably, the fungicide occupies the highest percentage of the total agrochemical usage, at 71.1% and 66.0% for the non-cooperative and cooperative grower groups, while the opposite is true of the herbicide (1.8% and 2.3% for the non-cooperative and cooperative growers). Paclobutrazol ranks second in terms of popularity, at 20.1% and 26.9%, follows by insecticide with 7.0% and 4.9% for the non-cooperative and cooperative grower groups. In particular, the active ingredients of the paclobutrazol, mancozeb, probineb, ziram and carbenazim are applied popular in Tuong-mango farming, which account for approximately 84.5% and 89% of the total pesticide use for the non-cooperative and cooperative grower groups. Therefore, farmers can reduce agrochemicals use in Tuong-mango production, thereby controlling these active ingredients efficiently in their farming process.

It is noticeable that the EIQ of ecosystem is the highest in all three EIQ components (farmer, consumer and ecosystem) in the three seasons. It means ecosystem is undergone heavily by impacting negative agro-inputs. For example, the ecosystem EIQ triple the farmer EIQ, are fivefold the consumer EIQ for seasons 1, 2, and 3. The field use EIQ average value of the season 1 is the highest, next is the season 2, and the season 3 is the lowest.

Although pesticides (herbicide, insecticide, fungicide) can help grower control harmful organisms efficiently in farming, its negative impacts should be not ignored by health complications (especially children and pregnant women), comprising neural and hormonal chaos, congenital malformation, cancer and other diseases [19], [20]. Besides, farmers are susceptible to disease related to nausea, dizziness, and cancer because they are regular exposure to various agrochemicals from farming and harvesting process [21], [22].

Different from rural agriculture production, UA is a complex interaction between various ecosystems (farmer, consumer, ecology) in urban. Its policy and action planning involve multi-stakeholders and several sectors such as irrigation, food security and nutrition conditions, agricultural research and economic forces. Stakeholder references and policy dialogue should be discussed regularly before UA is carried out in cities. This paves the way for municipal authorities to have properly action planning and how to address the real needs of community members. It is an important pre-condition for its contribution to urban sustainable development. Hence, understanding both positive and negative influences of UA could encourage countries to have suitable strategies in UA development, especially is in the developing country's cities where little is known about urban and peri-urban agriculture as well how to develop UA in city sustainably. For instance, sustainable progression of UA in city requires coordination between health, agriculture and environmental departments, education and training. Moreover, farmers in urban need be supported technical advice, training, credit access, and collection economics development. The study shows that collective economics contributes importantly to fertilizer and pesticide control in fruit cultivation.

4 CONCLUSIONS

The number of chemical fertilizer is applied in Tuong-mango farming of the non-cooperative farmer group more than the cooperative farmer group, in which nitrogen fertilizer play important role in mango production. However, the nitrogen fertilizer can take nitrate poisoning for surrounding community, especially is dangerous to infants, pregnant women (birth defects and miscarriages) and adults (stomach and esophageal cancers).

For agro-inputs, there is not significant disparity of the field use EIQ between the non-cooperative farmer group and the non-cooperative farmer group for the seasons 1 and 2; however, there is a considerable difference in the field use EIQ of the non-cooperative and cooperative grower categories. Particularly, the fungicide makes up the highest proportion of the total agro-inputs usage. The result of study indicates that the active ingredients of the paclobutrazol, mancozeb, probineb, ziram and carbenazim are applied popular in Tuong-mango cultivation in the southern Vietnam. Paclobutrazol and ziram are category II (moderately hazardous), and mancozeb, probineb, carbendazim are the list of category U (unlikely to present acute hazard when in regular use).

Importantly, the study shows that collective economics should be encourage to develop in UA because it allows producers to manage agrochemicals better.

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