CHAPTER 4

RESULTS

The purpose of the cost - effectiveness and cost - benefit study of Permethrin treated bednets comparing untreated bednets is to assess the outcome (In cost - effectiveness study the outcome is the number of patients avoided from malaria disease. In cost - benefit study, the outcome is assessed in term of cost avoided) and resource input requirement of two measures in preventing malaria disease. The results are expressed in term of cost per unit of effectiveness and in term of cost and cost avoided of two measures. The inputs should be those that are used for creating the outcome. Therefore, the cost and the effectiveness should be evaluated nearly in the same period of time.

4.1 Effectiveness of Permethrin Treated Bednets

Malaria Disease

After one year of using Permethrin impregnated bednets in Tan Tap and untreated bednets in Long Huu Dong communes (Long An province) and using Permethrin treated bednets in Nghia Trung and untreated bednets in Thong Nhat commune (Song Be province). The results showed that Permethrin treated bednet measure had more effectiveness than untreated bednets. The Chi square test was used to test the statistical significance of effectiveness of two groups in Long An and Song Be. The number of patients avoided from malaria disease decreased significantly as compared with that of untreated bednets group ($P < 0.01$).Since the population in two groups were different, we adjusted the number of malaria cases avoided based on standard population. Table 4.1 and Table 4.2 showed the expected number of malaria case avoided in standard population in treated and untreated group in Long An, Song Be provinces,respectively.

The number of patients in the group of children < 9 years old decreased more clearly than adult group in two provinces (see Appendix 2, Tabless A2.2, A2.4, A2.6, and A2.8)

Anopheles density

By applying the method of indoor and outdoor human bait, the results showed that the densities of the main anopheles species decreased in Permethrin treated bednet group in both Long An and Song Be provinces (see Appendix 2, Table A2. 11 and A2.12)

Table 4.1 : Comparing The Effectiveness between Two Measures in Long An Province Based on Standard Population

Items	Treated bednets group	Untreated bednets group
Population	1338	1342
No.of malaria patients before intervention	390	344
No.of malaria patients after intervention	106	295
Expected No.of malaria patients before intervention in standard population	391	344
Expected No.of malaria patient after intervention in standard population	106	295
Expected No.of malaria patients avoided	285	49

Table 4.2 : Comparing The Effectiveness between Two Measures in Songbe Province Based on Standard Population

Items	Treated bednets Group	Untreated bednets group
Population	1,318	1,331
No.of malaria patients before intervention	443	388
No.of malaria patients after intervention	123	350
Expected No.of malaria patients before intervention in standard population	447	388
Expected No.of malaria patients after intervention in standard population	124	350
Expected No.of malaria patients avoided	323	38

4.2 Cost Calculation

(Detailed calculation is presented in Appendix3)

4.2.1 Provider Cost

Provider cost of two measures in Tan Tap, Long Huu Dong communes (Long An province) is presented in Table 4.3 and the provider cost of two measures in Thong Nhat, Nghia Trung(Song Be province) is presented in Table 4.4. The results showed that the provider cost in treated bednet group was lower than that in untreated bednet group. Although in treated bednet group, the provider at first must pay the cost of treating bednets, but later no more cost of treating patient required thanks to the decreased number of patients who benefited from impregnated measure.

Table 4.3 : Provider Cost of Two Measures in Long An Province (Unit VND)

Components of cost	**Treated bednets**			**Untreated bednets**
Total	**4,408,239 (100%)**			**4,621,523 (100%)**
1. Capital cost	*326,218 (7.4%)*			*907,875 (19.64%)*
2. Recurrent cost	*4,082,021 (92.6%)*	*4,082,021 (100%)*		*3,713,648 (80.36%)*
2.1 Cost of treating bednets	2,820,633	2,820,633 (69.09%)	2,820,633 (100%)	
Cost of Permethrin	2,391,833		2,391,833 (84.79%)	
Labor cost	378,800		378,800 (13.43%)	
Equipment for Treating bednets	50,000		50,000 (1.77%)	
2.2 Cost of treatment	1,261,388	1,261,388 (30.9%)		3,713,648
Drug(Anti-malaria)	598,037			1,867,471
Salary	495,423			1,378,830
Maintenance of Building	41,285			114,898
Operational cost	20,643			57,449
Medical supplies	106,000			295,000

Table 4.4 Provider Cost of Two Measures in Song Be Province(Unit VND)

Components of cost	Treated bednets			Untreated bednets
Total	**4,812,052 (100%)**			**6,235,839 (100%)**
1. Capital cost	*306,610 (6.37%)*			*872,445 (13.99 %)*
2. Recurrent cost	*4,505,442 (93.63%)*	*4,505,442 (100%)*		*5,363,394 (86.01%)*
2.1 Cost of treating bednets	2,829,544	2,829,544 (62.8%)	2,829,544 (100%)	
Cost of Permethrin	2,399,544		2,399,544 (84.8%)	
Labor cost	380,000		380,000 (13.43%)	
Equipment for Treating bednets	50,000		50,000 (1.77%)	
2.2 Cost of treatment	1,675,898	1,675,898 (37.2%)		5,363,394
Drug(Anti-malaria)	958,979			3,323,380
Salary	527,928			1,502,235
Maintenance of Building	43,994			125,186
Operational cost	21,997			62,593
Medical supplies	123,000			350,000

4.2.2 Patient Cost

The patient cost of two measures in Long An and Song Be provinces is presented in Tables 4.5 and 4.6. The results showed that the patient cost in untreated bednet group was higher than that in treated bednet group.

Table 4.5 Patient Cost of Two Measures in Long An Province (Unit VND)

Components of cost	Treated bednets	Untreated bednets
1. Direct cost	*9,590,390 (65.91%)*	*16,595,610 (55.38%)*
Bednets	5,774,390	5,975,610
Drug cost (non – anti malaria)	636,000	1,770,000
Cost of food	3,180,000	8,850,000
2. Indirect cost	*4,960,000 (34.08%)*	*13,370,000 (44.61%)*
Income loss due to absence from work	4,450,000	11,300,000
Income loss due to absence from Work to take care of patient	510,000	2,070,000
Total cost paid by patient	**14,550,390 (100%)**	**29,965,610 (100%)**

Table 4.6 Patient Cost of Two Measures in Song Be Province (Unit VND)

Components of cost	Treated bednets	Untreated bednets
1. Direct cost	10,220,683 (64.08%)	18,514,634 (54.18%)
Bednets	5,792,683	5,914,634
Drug cost (non – anti malaria)	738,000	2,100,000
Cost of food	3,690,000	10,500,000
2. Indirect cost	5,730,000 (35.92%)	15,660,000 (45.82%)
Income loss due to absence from work	5,100,000	12,900,000
Income loss due to absence from work To take care of patients	630,000	2,760,000
Total cost paid by patient	**15,950,683 (100%)**	**34,174,634 (100%)**

4.2.3 Cost Structure of Two Measures

Provider cost

In treated bednet group : Capital cost took up small proportion: 7.4 % (Long An), 6.37% (Song Be) and in the cost of treating bednet, the cost of insecticide occupied a large proportion: 84.79% (Long An), 84.8% (Song Be). The results are presented in Tables 4.3 and 4.4

Patient cost

In untreated bednet group : Indirect cost in these groups were 44.61% (Long An) and 45.82 %(Song Be). The results are presented in Tables 4.5 and 4.6

In Long an, provider cost and patient cost were 23.25% and 76.75 % of total cost, respectively in treated bednet group while provider cost and patient cost were 13.36 % and 86.64 % of totalcost, respectively in untreated bednet group. In Song Be province, provider cost and patient cost were 23.18% and 76.82% of total cost, respectively in treated bednet group while provider cost and patient cost were 15.43% and 84.57 of total cost, respectively in untreated bednet group. So, in both provinces, patients seem to bear large proportion than the provider (see Table 4.7)

4.3 Cost - Effectiveness and Cost - Benefit Analyses

4.3.1 Cost - Effectiveness Ratios

The cost - effectiveness ratio of Permethrin treated bednets was lower than that in untreated bednets in both provider and patient perspective in both Long An and Song Be. The results of C/E ratios in Long An and Song Be provinces are presented in Table 4.7 and Figure 4.1

Table 4.7 Cost - Effectiveness Ratio in Two Provinces

Location	Group	Provider cost	Patient cost	Total	E	C/E
Long An	Permethrin treated bed nets	4,408,239 (23.25%)	14,550,390 (76.75%)	18,958,629 (100%)	285	66,522
	Untreated bednets	4,621,523 (13.36%)	29,965,610 (86.64%)	34,587,133 (100%)	49	705,860
Song Be	Permethrin treated bed nets	4,812,052 (23.18%)	15,950,683 (76.82%)	20,762,735 (100%)	323	64,281
	Untreated bednets	6,235,839 (15.43%)	34,174,634 (84.57%)	40,410,473 (100%)	38	1,063,434

Note : Cost in VND

4.3.2 Cost - Benefit

To calculate the cost - benefit, we need cost of treating bednets and the avoided cost. To get avoided cost: Calculate cost/case for treatment in both provider and patient side. Calculate the number of patients avoided from malaria disease and multiply the number of patients with cost/case in both provider and patient side. The cost/case for treatment in provider side (both groups) in Long An and Song Be are presented in Tables 4.8 and 4.9. Cost/case in patient side (both groups) in both provinces are presented in Tables 4.10 and 4.11 The number of patients avoided due to using treated bednet in Long An and Song Be provinces are presented in Tables 4.12 and 4.13

The number of patients avoided in Long An : $1338 \times (21.98 - 7.92)/100 = 188$

The number of patients avoided in Song Be : $1318 \times (26.29 - 9.33)/100 = 223$

Cost - benefit ratio is expressed between the cost of treating bednets and the avoided cost. This cost – benefit ratio is shown in Table 4.13 and Figure 4.2

Figure 4.1 C/E ratios in Long An and Song Be

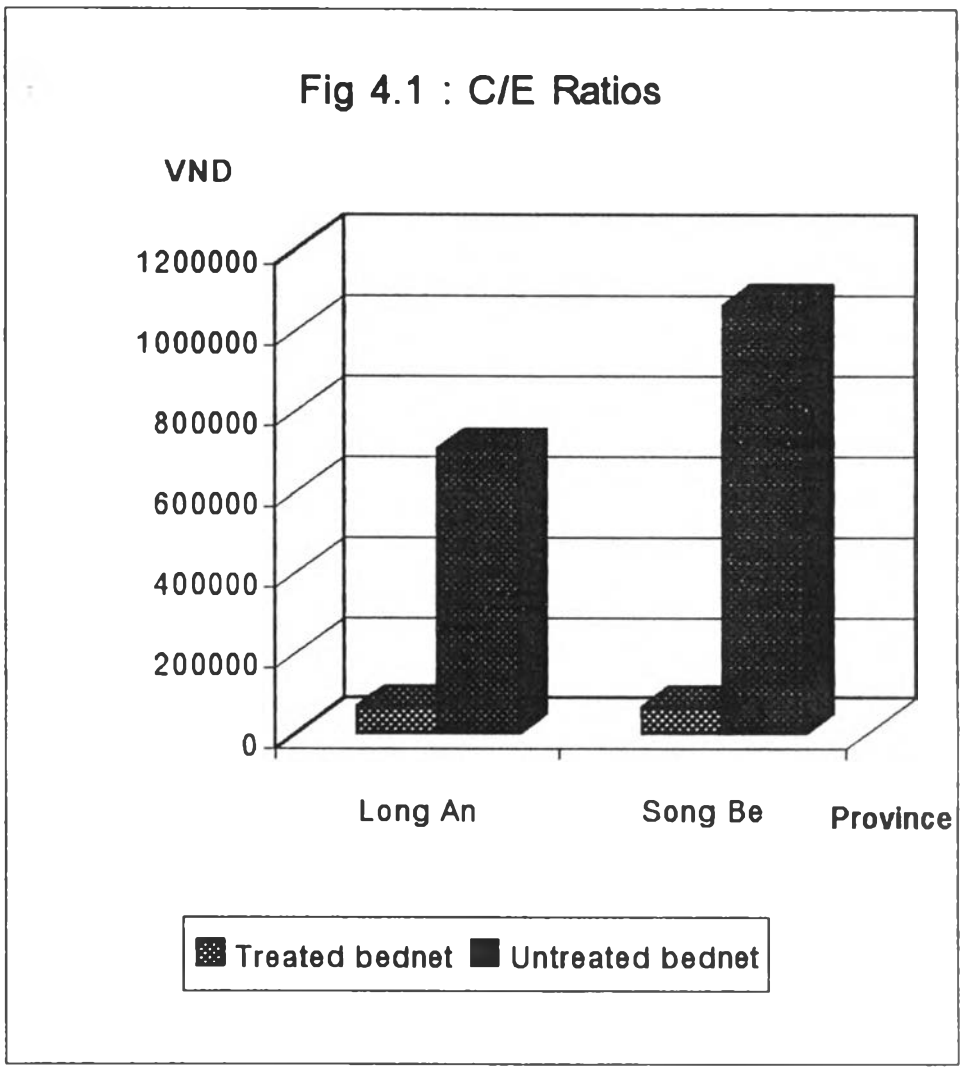


Table 4.8 Cost/Case for Treatment in Provider Side of Both Groups in Long An Province

Cost items	Cost of treatment
Drug	2,465,508
Salary	1,874,253
Building maintenance	156,183
Operational cost	78,092
Medical supplies	401,000
Capital cost	1,234,093
Total	6,209,129
Cost/case	15,484

Table 4.9 Cost/Case for Treatment in Provider Side of Both Groups in Song Be Province

Cost items	Cost of treatment
Drug	4,282,359
Salary	2,030,163
Building maintenance	169,180
Operational cost	84,590
Medical supplies	473,000
Capital cost	1,179,055
Total	8,218,347
Cost/case	17,375

Table 4.10 Cost/ Case in Both Groups in Patient Side in Long An Province

Cost items	Patient cost
Drug cost	2,406,000
Income loss due to illness	15,750,000
Cost of food	12,030,000
Income loss due to take care of patient	2,580,000
Total	32,766,000
Cost/case	81,711

Table 4.11 Cost/Case in Both Groups in Patient Side in Song Be Province

Cost items	Patient cost
Drug cost (Non- anti-malaria)	2,838,000
Income loss due to illness	18,000,000
Cost of food	14,190,000
Income loss due to take care of patient	3,390,000
Total	38,418,000
Cost/case	81,222

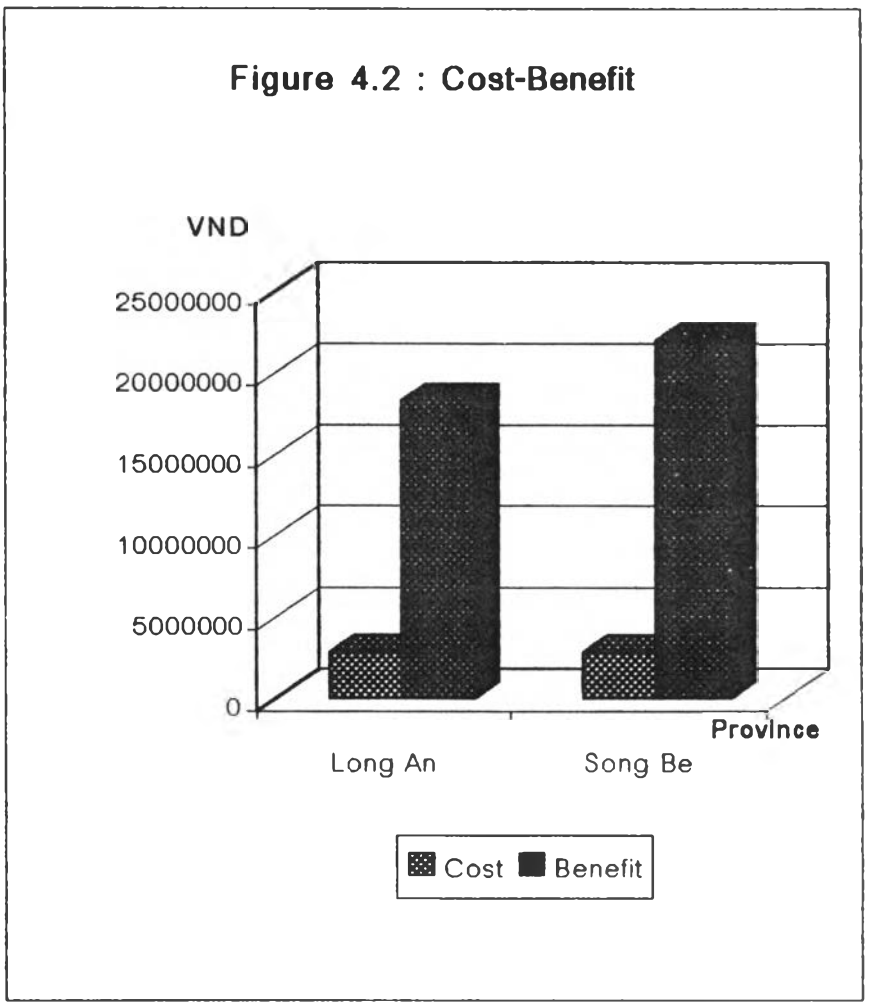
Table 4.12 Number of Patients Avoided Due To Treated Bednets in Two Provinces

Province	Group	No of patients used bednets	No people used bednets	% patient
Long An	Treated bednets	106	1,338	7.92
	Untreated bednets	295	1,342	21.98
Song Be	Treated bednets	123	1,318	9.33
	Untreated bednets	350	1,331	26.29

Table 4.13 Cost - Benefit in Two Provinces

Province	Cost (VND)	Provider	Patient	Total
Long An	Cost of treated bednets	2,820,633		2,820,633
	Avoided cost	2,910,992	15,361,668	18,272,660
	B/C			6.48
Song Be	Cost of treated bednets	2,829,544		2,829,544
	Avoided cost	3,874,625	18,112,506	21,987,131
	B/C			7.77

Fig 4.2 Cost – Benefit in Two Provinces



4.4. Sensitivity Analysis

4.4.1. Proportion of Sleeping under Bednets

In Tho Son, Dak Nhau communes, Song Be province, the proportion of sleeping under bednets only reached 60%. After one year of using Permethrin treated bednets, the rate of disease did not decrease significantly as compared with untreated bednet; so, it is not necessary to compare the cost - effectiveness, cost - benefit.(see Appendix 2, Table A2.9)

4.4.2 Occupation of The People

In Phu Rieng rubber company (Song Be), due to the requirement of the work, the workers must do outdoor and highly exposed to mosquitoes. After one year of using Permethrin treated bednets in this company, the rate of disease did not decrease significantly even when comparing untreated bednets (see Appendix 2, Table A2.10)