
Financial Cost and Benefit Analysis of Pak-wan Pa (*Melientha sauvis* Pierre) Farming in Ban Mo District, Saraburi Province, Thailand

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This study aimed to investigate the financial cost and benefit of Pak-wan Pa (*Melientha suavis* Pierre) farming in Ban Mo district, Saraburi province, Thailand. Questionnaires were used to collect data from 34 farmers, according to their possession of the plantation. The samples were divided into three groups regarding the size of plantation: small-sized farm (less than 5 rai), medium-sized farm (between 5-10 rai) and large-sized farm (more than 10 rai). Data were analyzed using descriptive statistics and Net Present Value (NPV), Benefit-Cost Ratio (BCR), Internal Rate of Return (IRR) and sensitivity analysis. The result showed that for the small-sized farm, the average cost was 21,781 Thai Baht (THB)/rai, and the average revenue was 53,355 THB/rai. For medium-sized farm, the average cost was 18,486 THB /rai and the average revenue was 37,042 THB/rai, while the average cost and the average revenue of the large-sized farm were 16,172 THB/rai and 24,890 THB/rai, respectively. The financial analysis revealed that all farm sized of Pak-wan Pa farming is worth investing in the current situation. The small-sized farm is the most suitable for investment since NPV was 213,277 THB; BCR was estimated at 4.38 and IRR on investment was 66.92%. For the medium-sized farm, NPV was 93,163 THB; BCR was 2.20, and IRR was 44.25%. As for large-sized counterpart, NPV was 29,786 THB; BCR was 1.52, and IRR was 30.62%. In addition, the results of sensitivity analysis presented that all cases of investment in Pak-wan Pa farming were financially worthy and profitable. In order to gain more return from an investment, small-size of farming would be recommended.

Keywords: *Melientha sauvis*, financial cost and benefit analysis, sensitivity analysis, Pak-wan Pa, Saraburi Province

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Introduction

In the situation that population are unremittingly increasing, while the resources for food production are limited. Edible wild plants play a very important role for their high nutritional value. The use of edible wild plants for culinary purposes is increasingly worldwide (Tshering *et al.*, 2014). Pak-wan Pa (*Melientha suavis* Pierre) is an edible plant which can be found in the forests of Thailand and Southeast Asia. Pak-wan Pa is a deciduous tree in the Opiliaceae family and grows in different locations in Thailand (Charoenchai *et al.*, 2015), particularly in Kanchanaburi, Saraburi, Sakon Nakhon, Chiang Mai, Lamphoon, and Surat Thani (Satapornwarasak, 2001). This vegetable is considered as an important wild tree served for local Thai people (Prathepha, 2000).

Pak-wan Pa is an indigenous plant that can live for a century. It needs the shadow of other trees to cover up. Young leaves, young stems, and blooming flowers are used as edible parts. This plant is always found in local markets around Thailand, even in Bangkok. The market price of Pak-wan Pa is relative high (Prathepha, 2000). Generally, Pak-wan Pa is made available to markets in March and April (Prasritong, 2004). It is full of nutrients and high beta carotene, vitamin B1, vitamin B2, vitamin C, phosphorus, calcium, protein, and fiber (Tianpech *et al.*, 2008; Charoenchai *et al.*, 2013). Fiber can help improving digestive and immune system. Its roots can assist neutralize toxins; whereas, its leaves and stems are taste good and can be cooked in various kinds of food for Thai people. The highest amount of consumption of this vegetable is in the northeast of the country, while the main commercial seedling nurseries can be obtained from Ban Mo district, Sababuri Province (Suksomboon, 2001; Tapprajan, 2004; Chiarawipa *et al.*, 2010).

There is a long harvesting period of Pak-wan Pa in the forest area. It takes more than three years for producing edible parts (e.g. young leaves, young stems, and blooming flowers) (Piluk *et al.*, 1993; Chiarawipa *et al.*, 2010). Accordingly, Ban Mo district, Saraburi province, central Thailand, is an area that many farmers cultivated Pak-wan Pa for commercial purpose. There were 549 farmers or 90.60% of all farmers who cultivated Pak-wan Pa in Saraburi province covering 1,650 rais (264 ha.). The total production per year was about 549,005 kilograms (Saraburi Provincial Agricultural Extension Office, 2014). In the past, farmers picked Pak-wan Pa from a forest, while some farmers tried to grow Pak-wan Pa in their own farms. Later, the number of this vegetable then increased. Farmers had developed, conducted research and experiment on breeding by themselves. The success in breeding later became a local wisdom of the area such as grafting, roots-cutting, and seedling (Tapprajun, 2004).

However, Pak-wan Pa is highly demanded in markets and can generate high income for farmers. From the past studies, many pieces of research focused on the method to increase productivity such as a study of Prathepha (2000) who investigated the patterns and distribution of genetic variability in natural populations of *Melientha suavis* Pierre in north and northeast Thailand. Amprayn, et. al. (2013) investigated the growth enhancement of Pak-Wan Pa markers. While, commercial cultivation of Pak-Wan Pa faced a constraint of long seedling period (Amprayn *et al.*, 2013). There is still a lack of information available on cost and benefit, a financial analysis and sensitivity analysis on Pak-Wan Pa. Interestingly, the result from this paper can provide recommendations for other farmers who are interested in Pak-wan Pa farming and can make a decision on effective farming.

The main objective of this study was to investigate the financial cost and benefit of Pak-wan Pa farming in Ban Mo district, Saraburi province, Thailand.

Materials and Methods

The Study Area

The study was conducted in Ban Mo district, Saraburi province, central Thailand. It is located on latitude 14°36'56"N and longitudes 100°43'35"E. The area consists of 9 sub-district covering about 203.6 square kilometres and has the population of 14,155 people (Wikipedia, 2015) (Fig. 1).

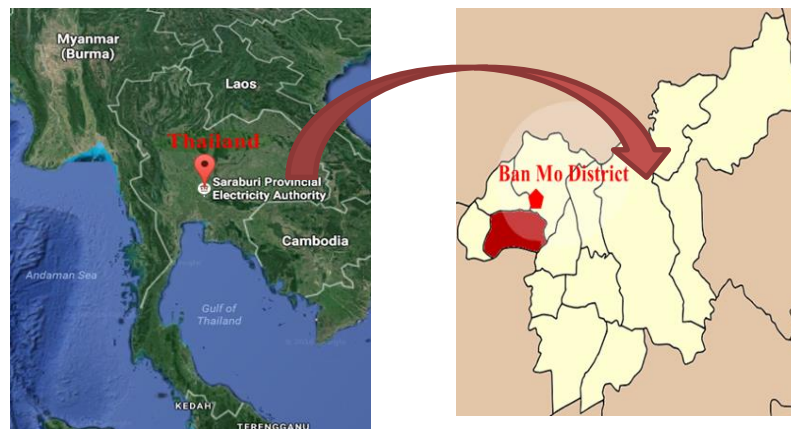


Fig. 1 Map of Ban Mo District, Saraburi Province, Thailand.
Source: Adapted from Wikipedia (2015).

Population and Sampling Procedure

The population of this study was 549 farmers who cultivated Pak-wan Pa in Ban Mo district, Saraburi province in the crop year 2014. The sample size was 34 farmers by purposive sampling according to their possession of Pak-wan Pa plantation area. The samples were divided into three groups: small-sized farm (SF) (less than 5 rai), medium-sized farm (MF) (between 5-10 rai), and large-sized farm (LF) (more than 10 rai) according to their possession of Pak-wan Pa plantation area (by average of 5 rai per household). By considering all the circumstances, of 34 respondents, which 18 farmers (52.64%) had small-sized farm; 12 farmers (35.29%) owned medium-sized farm, and only 4 farmers (11.76%) had large-sized farm. Questionnaires were used to collect data from respondents through face to face interview by the author.

Method of Data Analysis

Data were analyzed using descriptive statistics such as frequency, percentage, mean, and standard deviation. The analysis of cost and benefit was conducted by using economic concept. Net Present Value (NPV), Benefit-Cost Ratio (BCR), Internal Rate of Return (IRR), and sensitivity analysis were used as discussed by Gupta and George (1974), Vaidya *et al.* (1991) and Bakhsh *et al.* (2006). It can be computed as follows: the NPV is the present value of the net return obtained from Pak-Wan Pa farming throughout the period of 30 years. If the NPV is positive, it means that Pak-wan Pa farming is a worthwhile investment. The formula for calculating NPV is presented below.

$$NPV = \sum_{t=1}^n (B_t - C_t) / (1 + r)^t$$

Where:

- t = the time in year
- B_t = benefits in each year
- C_t = costs in each year
- n = number of year
- r = discount rate (12%)

Internal Rate of Return (IRR) is a rate of return of the project expressed in percentage. In other words, the discount rate that makes the NPV equal to zero (Mmopelwa *et al.*, 2005). When the value of r is set equal to the IRR, the value of r can be calculated as follows:

$$NPV = \sum_{t=1}^n (B_t - C_t) / (1 + r)^t = 0$$

Benefit Cost Ratio (BCR) is the ratio of the present value of return relative to the present value of the investment on Pak-wan Pa farming. The BCR value for decision making is more than 1, which means that Pak-wan Pa production is a worthy while investment. It can be calculated as follows:

$$BCR = \frac{\sum_{t=1}^n B_t / (1 + r)^t}{\sum_{t=1}^n C_t / (1 + r)^t}$$

Where:

- B_t = benefits in each year
- C_t = costs in each year
- n = number of years
- r = discount rate (12%)

Payback period (PB) is the time in which the initial cash outflow of an investment is expected to be recovered from the cash inflows. It is considered as one of the simplest investment appraisal techniques which can be calculated as follows:

$$\text{Payback Period} = \frac{\text{Initial Investment}}{\text{Cash Inflow Per Period}}$$

A sensitivity analysis is a technique that can be used to examine the degree of uncertainty in a cost-benefit analysis (BCA) and how it affects study's results. This research conducted a sensitivity analysis under three assumptions (Pipatsitea, 2001) namely:

- 1) If cost increased by 10% and benefit remains constant
- 2) If cost remains constant and benefit decreased by 10%
- 3) If cost increased by 10% and benefit decreased by 10%

Results and Discussion

The socio-demographic backgrounds of respondents

The majority of respondents were female (67%), had an average age of 55.91 years old, graduated from primary school (58.80%). Their primary occupation was Pak-wan Pa farming (88.20%) and secondary occupation was running their own business (26.50%). The average year of farming experience on Pak-wan Pa farming was 11.44 years old. The average number of family members was 4.15 per household. In each household, 2.07 people were farm labors. The average size of Pak-wan Pa growing area was 5.94 rai (0.95 ha.) and Pak-wan Pa production was around 5.71 rai (0.91 ha.). Pak-wan Pa can be harvested every four days or seven times per month. The majority of farm labors were their family members. The average income of participants was during 40,001 - 50,000 THB per rai per year (29.40%). Most of them sold the products to local middlemen with an average selling price at 58.33 THB per kilogram.

The analysis of cost and benefit of Pak-wan Pa farming

The analysis of cost and benefit of Pak-wan Pa farming in Ban Mo district, Saraburi province was categorized into three groups as follow:

1. Small-sized farm (SF) (growing area less than 5 rai): The average cost per rai was about 21,781 THB. The fixed cost was about 1,090 THB or 5.00% of the total cost whereby the variable cost was about 20,691 THB which was 95.00%. The average income was 53,355 THB.

2. Medium-sized farm (MF) (growing area between 5 to 10 rai): The average cost per rai was around 18,486 THB. The fixed cost was about 1,693 THB or 9.45 of the total cost whereby the variable cost was around 16,739 THB which was 90.55%. The average income was 37,042 THB.

3. Large-sized farm (LF) (growing area of more than 10 rai): The average cost per rai was about 16,172 THB. The fixed cost was about 2,641 THB or 16.33 of the total cost whereby the variable cost was approximately 13,531 THB which was 83.67%. The average income was 24,890 THB. The fixed cost included land tax, and agriculture equipments. The variable cost consisted of Pak-wan Pa's seedling, labor cost, chemical and manure fertilizers, and Public utility (Table 1).

Table 1 Cost and return of Pak-wan Pa *Melientha suavis* Pierre. (THB/rai/year)

Items	SF <5 rai (N=18)		MF 5-10 rai (N=12)		LF >10 rai (N=4)	
	Mean (THB)	S.D	Mean (THB)	S.D	Mean (THB)	S.D
Revenue	53,355	15,159	37,042	8,810	24,890	3,075
Expenses Cost						
- Fixed cost						
1. Land Tax	55		55		55	
2. Agricultural Equipment	1,035	500	1,638	487	2,586	1,772
Total fixed cost	1,090	500	1,693	487	2,586	1,772
- Variable cost						
1. Seedling	9,141	2,183	9,660	2,224	8,332	3,449
2. Labor	6,384	4,667	3,899	3,636	2,213	4,236
3. Chemical Fertilizer	1,451	955	274	412	757	711
4. Manure Fertilizer	1,069	625	985	744	230	195
5. Public utility	2,646	2,819	1,975	1,000	1,999	625
Total variable cost	21,691	4,993	16,793	4,596	13,531	1,320
Total cost	21,781		18,486		16,172	
Net income	31,574		18,556		8,718	

The analysis of financial feasibility

The analysis of financial feasibility of Pak-wan Pa farming in Ban Mo district, Saraburi province was conducted by using net present values (NPV), benefit-cost ratio (BCR), and internal rate of return (IRR). A discount rate used in this study was 12% per year. This was because an appropriate discount rate for developing countries was ranked between 8%-12% (ODA, 1988; Shukla, 2002) and Gittinger (1982) has suggested 12% for most projects (Shukla, 2002). The project duration was 30 years based on the harvest time of Pak-wan Pa. The result revealed that the investment could be possible in every size of growing area as NPV was positive. The IRR was greater than the opportunity cost of investment (interest rate of 12%), and BCR was greater than 1, indicating that the margin between the returns (benefits) and the costs of Pak-wan Pa farming were relatively high. A payback period (PB) is the time required for the amount invested in a project to be repaid by the net cash

outflow generated by the project. The study revealed that SF had the shortest payback period of Pak-wan Pa farming than MF and LF.

Comparing between the three different sizes of growing area, SF was the most appropriate size of Pak-wan Pa farming. This was followed by MF and LF, respectively. The details are presented as follows:

SF presented the NPV of 213,277 THB, IRR of 66.92%, BCR of 4.38, and PB of 3.32 years

MF presented the NPV of 93,163 THB, IRR of 44.25%, BCR of 2.20, and PB of 4.14 years

LF presented the NPV of 29,786 THB, IRR of 30.62%, BCR of 1.51, and PB of 5.47 years

The result may imply that Pak-wan Pa farming was the major source of household income for smallholder farmers and the main source of farmers' livelihoods, because farming in a small scale was the worth investing in a current situation. Pak-wan Pa should be introduced to small farmer due to its impacts on livelihoods of smallholder farmers (Akinnifesi *et al.*, 2008). In addition, small-scaled farming produces more output than other farm sizes since small investments can enable farmers to provide an increasing yield and yield stability, as well as allowing better use of inputs (Haddad *et al.*, 2011).

Sensitivity Analysis

Table 2 shows sensitivity analysis. The farmers were categorized into three groups in order to know the potential of the investment success and to investigate the expectation of generated income or expenditures. The analysis was conducted by studying the change in NPV, IRR, and BCR categorized into three cases:

Case 1: The cost was increased by 10% and the benefit remained constant. All farmers in three groups were possible to cultivate Pak-wan Pa. The details are as follows:

1) SF presented the NPV of 204,878 THB, IRR of 62.70%, BCR of 3.95, and PB of 3.43 years.

2) MF presented the NPV of 83,723 THB, IRR of 40.97%, BCR of 2.07, and PB of 4.62 years.

3) LF presented the NPV of 22,126 THB, IRR of 28.02%, BCR of 1.35, and PB of 3.43 years.

Case 2: The cost remained constant while the benefit was reduced by 10%. All farmers in three groups were also possible to cultivate Pak-wan Pa. The details are as follows:

1) SF presented the NPV of 183,547 THB, IRR of 62.26 %, BCR of 3.91, and PB 3.48 years.

2) MF presented the NPV of 74,405 THB, IRR of 40.63%, BCR of 2.04, and PB of 4.65 years.

3) LF presented the NPV of 19,144 THB, IRR of 27.75%, BCR of 1.34, and PB of 6.24 years.

Case 3: The cost was increased by 10%, while the benefit was reduced by 10%. Again, all farmers in three groups were also possible to cultivate Pak-wan Pa. The details are as follows:

1) SF presented the NPV of 175,148 THB, IRR of 58.23%, BCR of 3.52, and PB of 3.69 years.

2) MF presented the NPV of 64,965 THB, IRR of 37.51%, BCR of 1.83, and PB of 4.87 years. 3) LF presented the NPV of 11,489 THB, IRR of 25.28%, BCR of 1.18, and PB of 6.64.

Table 2 NPV, IRR, BCR and PB in Pak-wan Pa (*Melientha suavis* Pierre).

Items	SF <5 rai (N=18)	MF 5-10 rai (N=12)	LF >10 rai (N=4)
Financial analysis			
NPV (THB)	213,277	93,163	29,786
IRR (Percentage)	66.92	44.25	30.62
BCR	4.38	2.20	1.52
Payback period (year)	3.32	4.14	5.47
Sensitivity analysis			
Case 1: 10% increased in cost			
NPV	204,878	83,723	22,126
IRR	62.70	40.97	28.02
BCR	3.95	2.07	1.35
Payback period	3.43	4.62	6.20
Case 2: 10% decreased in benefit			
NPV	183,547	74,405	19,144
IRR	62.26	40.63	27.75
BCR	3.91	2.04	1.34
Payback period	3.48	4.65	6.24
Case 3: 10% increased in cost and 10% decreased in benefit			
NPV	175,148	64,965	11,489
IRR	58.23	37.51	25.28
BCR	3.52	1.83	1.18
Payback period	3.69	4.87	6.64

Conclusions

The finding of the study showed that the SF, MF, and LF of Pak-wan Pa farming generated average net income at 31,574, 18,556, and 8,718 THB/rai/year, respectively. The financial cost and benefit analysis showed that all cases of Pak-wan Pa farming investment had worthy and profitable investment in the current situation because three basic financial measures were acceptable. NPV of the investment was positive; BCR was greater than 1 and the IRR was greater than the opportunity cost of investment (12%). The SF was the most suitable size for investment since its NPV, BCR, IRR and PB presented 213,277 THB, 4.38, 66.92% and 3.48 years, respectively. This was followed by MF because NPV, BCR, IRR and PB demonstrated 93,163 THB, 2.20, 44.25%, and 4.62 years, respectively. Finally, NPV, BCR, IRR and PB of LF revealed 29,786 THB, 1.52, 30.62%, and 3.43 years, respectively. In order to gain more return on an investment, small-size of farming should be recommended. The findings were beneficial to related organizations in promoting Pak-wan Pa farming for supplying markets and generating income for local people targeting in a small-scaled farming.

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References

- Akinnifesi, F.K., Sileshi, G., Ajayi, O.C., Chirwa, P.W., Kwesiga, F.R. and Harawa, R. (2008). Contributions of agroforestry research and development to livelihood of smallholder farmers in Southern Africa: 2. Fruit, medicinal, fuel wood and fodder tree systems. *Agri. J.* 3(1): 76-88.
- Amprayn, K., Keawduang, M., Tangkoonboribun, R., and Tanpanich, S. (2013). Growth enhancement of Pak Wanpa (*Melientha suavis* Pierre) by inoculating with plant growth-promoting microorganisms and incorporated sowing with agasta (*Sesbania grandiflora* (L.) Poir.). Proceedings of 51st Kasetsart University Annual Conference: Plants [Online]. Available: http://agkb.lib.ku.ac.th/ku/search_detail/result/13186 [2015, October 5].
- Bakhsh, K, Hassan, I. and Akhter, M.S. (2006). Profitability and cost in growing mango orchids. *J. Agri. Soc.Sci.* 2(1): 46-50.

- Ban Mo District Agricultural Extension Office. (2014). Area planted Pak-wan Pa Ban Mo District [Online]. Available: http://invention53.blogspot.com/2010/09/blog-post_09.html [2015, October 5].
- Charoenchai, L., Settharaksa, S., Songsak, T., Ruangrungrasi, N. and Kraisintu, K. (2013). Phytochemical screening tests of *Melientha suavis* Pierre and *Urobotyra siamensis* Hiepko extracts. Bulletin of Health, Science and Technology (BHST) 11(2): 13-20.
- Charoenchai, L., Settharaksa, S., Songsak, Madaka, F. and Sueree, L. (2015). Evaluation of the antioxidant activities, total phenolic and flavonoid contents of *Melientha suavis* Pierre. Bulletin of Health, Science and Technology (BHST) 12(2): 29-37.
- Chiarawipa, R., Keawdoug, M. and Tanpanich, S. (2010). Growth development and yield of *Melientha suavis* Pierre in southern Thailand. KKU Res J. 15 (10): 941-950.
- Gupta, G.S. and George, P.S. (1974). Profitability of Nagpur Sangtra cultivation. Indian J. Agri. Econ. 29:150-60.
- Haddad, N., Duwayri, M., Oweis, T., Bishaw, Z., Rischkowsky, B., Hassan, A.A. Grando, S. 2011. The potential of small scale rainfed agriculture to strengthen food security in Arab countries. Food Security (2011) 3 (supplement 1): S163-S173. doi:10.1007/s12571-010-0099-7.
- Piluk, K., Pisuksantiwattana, Y. Jiamjumnanja, J, Babprasert, C., Chobkua, R., Karinthuyakit, P. and Poonsanguan, P. (1993). Pak-Wan Pa. Nakhon Pathom: Extension and Training Office, Kasetsart University.
- Prasritong, N. (2004). *Auropus androgynous - Melientha suavis* Pierre. Nonthaburi: Book publisher Neon Media.
- Prathepha, P. (2000). Detection of RAPD variation in a forest tree species, *Melientha suavis* Pierre (Oiliaceae) from Thailand. Science Asia 26: 213-218.
- Rawiponsatanan, P. (2009). Knowledge management of *Melientha suavis* Pierre to develop conservation and promote community economy. Ph.D. Dissertation, Mahasarakham University.
- Saraburi Provincial Agricultural Extension office. (2014). Acreage crop production classified as the district [Online]. Available: http://www.saraburi.doae.go.th/data_agri.html [2015, October 5].
- Satapornwarasak, T. (2001). Pak-wan Pa *Melientha suavis* Pierre. Unpublished Manuscript.
- Suksomboon, A. (2001). Pak-wan Pa (*Melientha suavis* Pierre) : indigenous vegetables make money in Saraburi. J. Agricultural Extension 32: 23-25.
- Tapprajan, S. (2004). *Melientha suavis* Pierre Production and Marketing by farmers in Banmo district, Saraburi province. Master's Thesis, Agricultural Extension, Sukhothai Thammathirat Open University.
- Tianpech, N., Swatsitang, P. and Tianpech, S. (2008). Antioxidan capacity and nutritional values of Pak-wanpa (*Melientha suavis* Pierre). KKU Sci. J. 36(Supplemnet): 75-82.
- Tshering, K., Thapa, L., Matsushima, K., Minami, M. and Nemoto, K. (2014). Edible wild plants of Bhutan and their contribution to food and nutrition security. In Promotion of underutilized indigenous food security and nutrition in ASIA and the PACIFIC. FAO of

- the United Nations Regional Office for Asia and the Pacific Bangkok [Online]. Available: <http://www.fao.org/3/a-i3685e.pdf> [2015, October 5].
- Vaidya, M, Tewari, S. and Raina, K. (1991). An economic analysis of apple plantation in Shimla district of Himachal Pardesh. *J.Agric. Devel. Policy* 2: 9-31.
- Wikipedia. (2015). Ban Mo District [Online]. Available: https://en.wikipedia.org/wiki/Ban_Mo_District [2015, October 5].