



# Comparative Analysis of Production Costs and Revenue on the Banana Planting Season in Taiwan

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## Abstract

The planting season of crops has always been an important research topic to the revenue. This research aims to use bananas as a case study and use the principle of break-even analysis to explore the issues of profit and loss and market potential of the spring-summer's bananas and the autumn-winter's bananas in Taiwan. The secondary data were collected from Council of Agriculture, Executive Yuan Taiwan during 2011-2015. The concept of break-even analysis was applied in this research as the research methodology. The empirical results found that the break-even points of spring-summer's bananas and autumn-winter's bananas during 2010-2015 were decreasing due to the increase of an average market selling price. However, the spring-summer's bananas have a higher revenue ratio than the other season. Therefore, the bananas' growers in Taiwan should plant bananas during the spring-summer season in order to gain a higher profit.

## Subject Area

Economic System

## Keywords

Production Costs, Revenue, Break-Even Analysis, Planting Season, Banana Industry

## 1. Introduction

Banana is the most characteristic tropical fruit in the tropical region of Taiwan. Bananas grow fast, which are planted this year, and this year they will be harvested. Since banana is the world's largest trade and consumption of fresh fruit,

Food and Agriculture Organization of the United Nations (FAO) has ranked banana as the fourth largest fruit in the developing countries, after rice, wheat, and corn. According to FAO's statistics (2014) [1], the harvest area of bananas in the world was around 5.39 million hectares. The banana's production was about 112 million tons. Furthermore, an import and export values accounted for 29.35 billion US dollars, after wheat, soybeans, and corn.

The banana is one of the most important tropical fruits in Taiwan, mainly grown in Pingtung, Kaohsiung, Chiayi, Nantou, and Taichung. According to a planting time period, there are two main seasons: a spring-summer's banana together with an autumn-winter's banana.

This research aims to use the principle of break-even analysis to explore the issues of profits and losses and to market the potential of the spring-summer's bananas and the autumn-winter's bananas in Taiwan. The secondary data collected from Council of Agriculture, Executive Yuan Taiwan were used to analyze the changes in costs and revenues based on the concept of the break-even analysis in order to support the farmers to make a right decision. The results provide meaningful and important information to improve the banana's industry in Taiwan as well.

## 2. Literature Review

Banana is the world's largest fruit and is the most controversial crop in Taiwan. Refer to Taiwan's Agricultural Statistics Report in 2015, a cultivation area of bananas accounted for 14,605.44 hectares, and a selling price was about NT\$ 27/kg. In addition, the spring-summer's bananas, and the autumn-winter's bananas had annual profits about NT\$ 261,043/ha and NT\$ 375,769/ha, respectively.

The banana has been considered as a year round agriculture production in Taiwan. The main production period is normally from February to June because of no heavy typhoon and cold weather. Moreover, there are higher demands from both local and foreign markets. The production outputs for this season accounted for 60 - 70 percent of all annual outputs, especially the spring-autumn's bananas grown in Kaohsiung and Pingtung County. Nevertheless, the farmlands in Taichung, Chiayi, and Nantou County are mostly hillside, consequence of no irrigation facilities, and difficult to adjust the production period. Therefore, most of the farmers prefer growing the autumn-winter's bananas due to suitable cultivation land and appropriate climate. Most of the production period is from September to December.

The banana is not only the important economic fruits, but also the largest fresh exporting agricultural products in Taiwan. The banana of Taiwan has increasingly exported to Japanese market for a hundred years. In 1967, the export was the highest volume, accounting for 51.95 million US dollars (12 kg per hectare). In addition, the harvest areas were more than 50,000 hectares (Council of Agriculture, Executive Yuan Taiwan, 2017) [2].

Taiwan's economic structure has undergone a transition from agriculture to

industry. After 1971, Taiwan's economic structure dramatically changed a lot, a large number of rural labor forces moved far away from their hometown to work in an industrial estate, resulting in labor shortage in the rural areas and the rising wages. The banana's production dramatically suffered a lot, facing with a yellow leaf disease, which causes a huge reduction in banana's yields. Moreover, the selling price of banana in foreign markets like Japan, the Philippine and the South America was cheaper. The banana's growers had less profit and gave up easily towards the banana's industry.

In summary of the above literature review, there were many scholars have published more research regarding banana's industry in Taiwan, such as diseases resistant (Chen *et al.*, 2014; Chan *et al.*, 2013; Hwang, 2002) [3] [4] [5] and to establish the production system (Chiang *et al.*, 2012; Lee *et al.*, 2013) [6] [7], and industrial economic (Wang, 2012) [8]. There were also many publications in using break-even analysis to study costs and revenues of banana industry (Chen and Day, 2009; Mahama *et al.*, 2013; Lee *et al.*, 2015; Guo *et al.*, 2011) [9] [10] [11] [12]. However, there was no any research analyzing the situation of profit and loss and market competition potential of the banana's industry in Taiwan.

### 3. Methodology

This study used the break-even analysis method to analyze secondary data. The secondary data were collected from the Agricultural Statistic Annual Report, Council of Agriculture, Executive Yuan Taiwan during 2010-2015 in terms of the production costs and revenues of banana industry in Taiwan.

The financial analysis steps of this research method are as follows: a financial analysis requires identification of all revenues and costs streams over the life of the project. For the current study, the costs include fixed costs and variable costs. The fixed costs constitute the capital outlay of the firms. The fixed costs include land, structure and buildings, machinery, insurance, payment of interest and rent.

In fact, the fixed inputs decline in value or productivity as the annual use of the machinery, equipment, and buildings increase. Alternatively, these costs were completely excluded in one season. The annual depreciated values were estimated and used in undertaking the undiscounted break-even analysis. The depreciated values of the fixed inputs were summed to give the total fixed cost of a production cycle.

The variable cost can be divided into production cost, overhead cost, and research and development's cost. Overhead costs included the costs of indirect materials, indirect labour (management and staff officers), office expenses, and maintenance of vehicles. These costs were summed up as the total variable cost (TVC). The total cost (TC) of a production cycle, therefore, is the sum of the total fixed cost (TFC) and total variable cost (TVC). Total revenue is the cash value realized from the sales of bananas during the accounting period (a production cycle). To arrive at the sales revenue, the total quantity of bananas sold (Q) was multiplied by the unit price (P) of the product. Thus,  $TR = Q \times P$ , where TR is total revenue. Break-even analysis (B/E) is normally used to establish the relation-

ship between fixed costs, variable costs, sales revenue, and profit. The break-even point is derived from the revenue of the farms. It is assumed that the banana farm in Taiwan areas operating in a competitive local market; considered as a price taker. At the break-even point, the total cost of production is equal to the total revenue.

#### 4. Results and Discussion

According to the secondary data and break-even analysis, we can get the production analysis of the spring-summer's banana farms, and autumn-winter's banana in Taiwan. The outputs were about 33 tons per hectare, and the total revenue was about NT\$ 380,000 in 2010 and NT\$ 990,000 in 2014, and NT\$ 620,000 in 2015. The overall approach is increasing due to the banana price. The total cost was about NT\$ 387,000 per hectare each year except in 2010 due to typhoon. Therefore, the profits were gradually increasing, as shown in **Table 1**.

According to the secondary data and break-even analysis, we can get the production costs per hectare of the spring-summer's bananas in Taiwan during 2010-2015. The production costs were about NT\$ 168,000 per hectare, averagely, and slightly declined year by year. The costs of chemical and herbicide were increasing, up to NT\$ 23,439 in 2015. The fixed costs remained at about NT\$ 5200/ha. The costs of man-hour labor were decreasing year by year due to the increase of the family labor, as shown in **Table 2**.

According to the secondary data and break-even analysis, we can get the production costs and benefits of the autumn-winter's bananas during 2010-2015. The yields of the autumn-winter's bananas were about 20 tons/year, and the total revenues were increasing year by year, up to NT\$ 540,000 in 2014. The total costs were about NT\$ 260,000. The net profits were negative in 2010 and 2011 due to a typhoon. The remaining periods were surplus, and increased NT\$ 290,000 at the net profit rate of 117.56%, as shown in **Table 3**.

**Table 1.** The production costs and revenues per hectare of the spring-summer's bananas in Taiwan during 2010-2015.

Year	Production Costs Per Units (kg/ha)	Gross Output Value (NT\$/ha)	Total Costs (NT\$/ha)	Net Profit (NT\$/ha)	Profit Rate (%)
2010	33,481	380,670	413,672	(33,002)	(7.98)
2011	34,159	418,766	403,913	14,853	3.68
2012	34,804	586,354	392,466	193,888	49.40
2013	33,492	888,938	372,992	515,946	138.33
2014	33,067	989,929	370,601	619,328	167.11
2015	31,158	625,958	369,246	256,712	69.52

Source: Council of Agriculture, Executive Yuan Taiwan (2017). Note: The negative numbers were showed in parentheses.

**Table 2.** The production costs per hectare of the spring-summer's bananas in Taiwan during 2010-2015. Unit: NT\$/ha.

Type	2010	2011	2012	2013	2014	2015
Production costs	173,626	170,099	171,664	165,478	163,541	164,810
Direct costs	68,516	165,007	166,493	160,246	158,254	159,498
Established expenditure	22,978	23,640	23,846	22,799	22,133	22,733
Fertilizer	46,797	45,464	46,677	45,551	45,759	46,119
Contract labor	9908	8624	8736	7550	7645	8572
Chemical & herbicide	20,972	21,649	22,767	22,500	22,998	23,439
Energy	4546	4544	4695	4551	4529	4280
Materials of equipment	63,315	60,518	59,772	57,295	55,190	54,355
Irrigation charge	-	568	-	-	-	-
Extra charge (fixed costs)	5110	5092	5171	5232	5287	5312
Agriculture facilities expenditure (depreciation)	1589	1634	1663	1693	1707	1696
Agriculture facilities expenditure	530	545	555	565	568	565
Farming tools (depreciation)	2243	2185	2215	2231	2259	2288
Farming tools expenditure	748	728	738	743	753	763
Taxes	-	-	-	-	-	-
Labor costs	208,712	202,826	193,932	182,465	180,666	179,488
Man-hour labor	208,712	202,826	193,932	182,465	180,666	179,488
Family labor	172,923	166,357	165,033	142,314	148,504	164,059
Contract labor	35,789	36,469	28,899	40,151	32,162	15,429

Source: Council of Agriculture, Executive Yuan Taiwan (2017).

**Table 3.** The production costs and benefits of the autumn-winter's bananas during 2010-2015.

Year	Production Costs (kg/ha)	Gross Output Value (NT\$/ha)	Total Costs (NT\$/ha)	Net Profit (NT\$/ha)	Profit Rates (%)
2010	14,473	194,731	263,713	(68,982)	(26.16)
2011	18,275	239,726	263,286	(23,560)	(8.95)
2012	20,880	279,489	273,666	5823	2.13
2013	20,615	380,042	256,780	123,262	48.00
2014	19,821	541,413	248,854	292,559	117.56
2015	20,388	503,027	254,184	248,843	97.90

Source: Council of Agriculture, Executive Yuan Taiwan (2017). Note: The negative numbers were showed in parentheses.

According to the secondary data and break-even analysis, we can get the production costs per hectare of the autumn-winter's bananas in Taiwan during

2010-2015. On the production costs and benefits of the autumn-winter's bananas during 2010-2015, the production costs were decreasing year by year, mainly due to the decrease of direct expenditure, among which the costs of fertilizer and materials of equipment were large, the indirect costs are maintained at about 4600 TW\$, and the labor cost is declining, mainly from the employee's fee reduction, as shown in **Table 4**.

## 5. Conclusions and Suggestions

The results of this study find that the seasons for banana planting in Taiwan are different, and the profit from bananas is different. In this paper, the BEP analysis principle was used to explore the operation efficiency and market potential of the spring-summer's bananas and autumn-winter's bananas in Taiwan. From 2011 to 2015, the overall production values of bananas were increasing in Taiwan, and the costs were decreasing. The overall net profits of both the spring-summer's bananas and the autumn-winter's bananas were increasing, except for the damages by the typhoon.

In addition, the price of bananas is also an important influence. The analysis of this research finds that the increase in profits is mainly due to the increase of

**Table 4.** Production costs per hectare of the autumn-winter's bananas in Taiwan during 2010-2015. Unit: NT\$/ha.

Type	2010	2011	2012	2013	2014	2015
Production costs	111,797	111,692	118,492	107,869	103,038	104,502
Direct costs	107,362	107,103	113,821	103,110	98,253	99,660
Established expenditure	14,741	15,658	18,168	14,955	15,067	15,175
Fertilizer	35,810	33,937	34,920	32,895	32,130	32,518
Contract labor	147	-	638	-	-	-
Chemical & herbicide	10,560	10,451	11,588	11,513	11,931	12,235
Energy	4251	4011	4128	4173	4016	4090
Materials of equipment	41,853	42,873	44,379	39,574	35,109	35,642
Irrigation charge	-	173	-	-	-	-
Extra charges (fixed costs)	4435	4589	4671	4759	4785	4842
Agriculture facilities expenditure (depreciation)	1623	1740	1790	1827	1841	1853
Agriculture facilities expenditure	541	580	596	610	613	618
Farming tools (depreciation)	1703	1702	1714	1741	1748	1778
Farming tools expenditure	568	567	571	581	583	593
Labor costs	130,375	131,037	133,050	126,523	123,847	127,366
Man-hour labor	130,375	131,037	133,050	126,523	123,847	127,366
Family labor	108,409	104,681	119,730	108,373	103,571	107,838
Employee fees	21,966	26,356	13,320	18,150	20,276	19,528

Source: Council of Agriculture, Executive Yuan Taiwan (2017).

the selling price of the bananas. The yields were quite stable, except for the year which faced with a natural disaster. The operating costs were decreasing slowly. Therefore, the banana price plays the impact role in the decrease of the BEP.

The marginal revenue rates of the autumn-winter's banana were higher than the spring-summer's bananas. The growing season of the spring-summer's bananas has fewer typhoons and other natural disasters than the autumn-winter's bananas.

The temperature and related climate were also more suitable in the spring-summer's bananas than the autumn-winter's bananas. The yields of spring-summer's bananas were significantly higher than the autumn-winter bananas. Therefore, the overall marginal revenue rates of spring-summer's bananas were also significantly higher than the autumn-winter's bananas.

Taiwan has a great influence on the cultivation of bananas during the typhoon and windy seasons. As the spring-summer's bananas are always encountered by typhoons, the market competition and potential competition are higher than the autumn-winter's bananas. The farmers should avoid the windy seasons while growing bananas on their own areas in order to increase the revenue ratios.

### Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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