

Investment beneficial analysis of rice alternative plants

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Abstract : The price and revenue of rice are expected to decrease due to increasing rice imports, decreasing consumption and the discontinuance of the government's rice procurement. This degenerating profitability is leading to a rise in the cultivation of upland-crops such as beans, fodder crops and fruits in paddy fields. However, there is a lack of research on the selection of rice substitute crops which are adaptable to the relevant region through profitability analysis. This research, therefore, analyzed investment profitability of rice substitute crops for Cheorwon-gun area in Kangwon province. The study applied net present value (NPV) and internal rate of return (IRR), which fit for mutually exclusive investments that make one selection to the exclusion of other crops. Target crops are green house plants in Cheorwon-gun area. Financial analysis showed paprika and cucumber have investment feasibility for automated vinyl greenhouses and conventional plastic greenhouses respectively.

Key words : Alternative crop, Financial analysis, Internal rate of return, Net present value, Rice

I. Introduction

Rice production in Korea amounted to 5.6 million tons in 1990, and it has fallen from 5.92 in 2000 to 4.29 in 2010. Per capita rice consumption is no exception. In spite of the current decline in rice production, a sharp drop in consumption has contributed to the price of 141,740 won (/80 kg) in 2010, a 3.8% fall year on year. Such a price drop is likely to result in a decrease in farm income in the short term, triggered by the decline in the price received by farmers. In the long term, it can dwindle rice self sufficiency.

Meanwhile, once an investment project is proposed, criteria for investment decisions vary depending on the purpose to be achieved. It is desirable that investors who value liquidity choose a project with a short payback period, and who seek stability select the one with less revenue volatility. In this context, investors who give priority to lucrativeness are expected to

prefer projects of high current value or high return investments.

A lot of scholars had conducted studies that adopted this investment profitability in farm products. For example, Lee (2000) analyzed return, cost and investment profitability of cherry tomatoes, tomatoes, cucumbers and green chilies when grown in automated vinyl greenhouses, glass greenhouses and conventional greenhouses. Seo et al. (2008) studied the cost of production and gainfulness of six-year-old ginseng. Park et al. (2010) suggested the basis for investment decision of field culture cabbages by relating investment profitability and earnings. Park (2012) also analyzed returns of different sale prices for lycium including the sale price over the last five years, the sale price generating no earnings and the one as investment criteria. However, those studies have carried out on a nationwide scale, the analysis of investment profits of crops in specific regions is still lacking.

The rice industry in present Korea requires production adjustments because of the internal factors, such as aging farms, restrictions on production

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increase, and constraint on scale economies and also the external factors, such as decreasing rice consumption and import liberalization of rice. Jo (2011) has pointed out, because the rice production per unit area is stable, the optimum requirements for the rice farming area can be different through the expansion of consumers' annual rice consumption and rice food stuff. The analysis reveals it will require 5,000 ha~9,000 ha in 5 years, and 8,000 ha~3,000 ha in 11 years. Thus, in this current situation, where rice consumption decreases continuously and rice stock increases every year, the selections of rice substitute crops need to be considered based on the economic feasibility.

In accordance with the situation, Rural Development Administration (2008) has recommended the regionally specialized crops for rice substitutes. They are ginseng which is expected to have increasing demand by import or so, beans which have purchase support for promoting self-sufficiency, fodder crops which utilize unused area during winter time, floriculture, landscape trees, wild herbs, corns, grapes, grass, pian (coreanus), lotus roots, water parsley and chives. However, this is only for incomes or income ratio for a year without consideration of business period, it has the limits in using it as a management index of local conditions.

The farmers consider profitability as the first selection criterion for the crops, followed by the markets and technologies. This means profitability is the determining factor in performance measurement of their business investment. In this context, this study attempts to select rice substitute crops through an analysis of investment returns from rice and main upland crops. The study in particular, tries to offer information to the farms in a region who want to make decision on introducing rice substitute crops. For this purpose, the study limits its target region to Cherwon-gun area. Cherwon-gun area is number one rice production region in Kangwon province, and it produces one sixth of Kangwon province's overall output of rice. Especially, this paper explains the analysis model, and presents, according

to the types of facilities, an analysis of the investment returns of main crops under facilities that are in the substitute relationship with rice.

II. Study Methods

1. Rice Production and distribution

When we look at the changes in Korean rice industry policies, it shows Korea has become self-sufficient in rice owing to the expansion of food production policy in the early 1990s. Afterwards, in 2004 when pressure from other countries such as US on opening of agricultural product import was increased, and by going through the second delayed tariffication, Korea's rice industry has shifted its interest to improvement of international competitiveness of rice (Jo, 2011)

According to the main indicators for Korean rice industry, the number of cultivating household was 1,080,000 in 2000 but they dropped sharply to 750,000 in 2011. During the last 11 years, the whole numbers of farm households declined by 16%, while rice growing households decreased by 30%. However, about 70% of farms grow rice, and rice takes up 40% of per household earnings, which means rice is very important to Korean agriculture. Rice cultivating area has decreased from 979,000 ha in 2005 to 892,000 ha in 2010. For Cherwon-gun, our research target area, the rice paddies take up over 80% of the whole arable land, thus it has rice-centered cropping system.

Rice produced from the farmhouses is kept for self consumptions and seeds, and the rest is commercialized. 25% of the product is for self consumption, seeds, and donation or so, and 75% is commercialized through the government's purchase, the home agricultural cooperatives, the private milling shops, and the dealers from the producing area. These days, due to the aging farm labor force, the total production of rice is commercialized in the harvesting season, and the increasing numbers of farmers buy rice for their own consumption.

The marketing method of rice is divided according to selling to the agricultural cooperatives of the cultivators group, or to the private millers or grain merchants. Recently, the channel through private traders is declined, while sales volume through the associate organizations of the agricultural cooperatives is increasing. This is because, from the early 1990s the rice processing complex (RPC) centered around the home agricultural cooperatives has been established and operated, and the sales organization affiliated with the agricultural cooperatives is increasing continuously. To be specific, as of 2010 the ratio of direct trade between producers and consumers is 6%, and the government procurement is 9%, whereas trade through the group of producers (agricultural cooperatives RPC) is 50%.

The rice marketing channels of Cherwon area is as such, that producing farms sell to main 4 agricultural cooperatives, namely, Cherwon, Gimhwa, Galmal, and Dongsong agricultural cooperatives, and to Cherwon-Saemaul RPC. Take the example of rice sales conditions of 2010, of the total sum of 59,224 tons, Dongsong agricultural cooperative handled about 34% (20,099 tons), then Cherwon agricultural cooperative 13,143 tons, and Gimhwa agricultural cooperative 12,797 tons respectively.

Each agricultural cooperative sells 36% (21,099 tons) of the total purchase to major supermarkets. Specifically, Gimhwa agricultural cooperative sell 7,913 tons to Samsung HomePlus, it thus handles the largest amount of Cherwon rice as a single distributor. The next one is emart to which Cherwon and Dongdong agricultural cooperatives sell 5,201 tons. To agricultural cooperative marketing, Cherwon, Gimhwa, Galmal agricultural cooperatives sell 2,338 tons.

Cherwon-Saemaul RPC sells 255 tons to the Military Welfare Agency, which is regarded as an exploitation of new market. It is because the major agricultural cooperative RPCs of Cherwon-gun are securing the large distributors as their outlet, new startups like

Cherwon-Saemaul RPC was in need of a new distributor. Thus, it seems that it has exploited the Military Welfare Agency as a new outlet by utilizing the nature of the fact that Cherwon-gun has many military units in the area.

Since Cherwon-gun still has the rice-centered cropping system, the production structure of agricultural products is rather simple, and because the factors for the increase of the rice farm household income are not so big, it requires new economic crops. In other words, it needs to find new source of income through the selection of rice substitute crops. With the consideration that Cherwon-gun with the current rice-centered cropping system is having difficulty to improve farm household income, this study, therefore, attempts to examine the investment profitability with greenhouse plants.

2. Investment beneficial analysis

The feasibility analysis methods for the investment project, there are economic analysis which is an analysis taking the macro-economic standpoint, and financial analysis which is taking the private economic standpoint for farmers' stance. The economic analysis measures the economic contribution of the particular project made to the national economy and the public welfare, regardless who obtains benefits produced from the implementation of the project, or who covers the project cost. Thus, economic analysis only measures the economic efficiency of investment capital, it does not deal with the matters of relation of ownership or income distribution. Financial analysis, on the other hand, values the relation of ownership and income distribution from the project, and measures the profitability of private investment from the project participation units. Thus, financial analysis takes the target analysis as the financial profit from the investment capital made by individual farmer.

There are B/C, IRR, NPV in the indicators of the

financial analysis results, and these results can be used as the basic information for the investment decision criteria of the rice producing farm households in their selection of the other greenhouse plants. This research has applied NVP and IRR which can be used in the mutually exclusive investment, where selection needs to be made for one out of many plants in this case. NVP is newly created investment result meaning the incremental value, it is presented as formula (1). The standard of economic analysis of mutually exclusive projects is $NPV \geq 0$, and one with the largest NPV among the investment projects is believed to have economic feasibility. It is because the fact that NPV has a plus value means it compensates the selected opportunity cost. NVP measures future cash flow by the differences made by deducting the investment costs from underlying value that is discounted by the project capital costs. This is in the formula (1).

$$NPV = \sum_{t=1}^n \frac{B_n - C_n}{(1+i)^n} \quad (1)$$

B_n : n Year Revenue
 C_n : n Yea Cost
 n : Cultivation period
 i : Discount rate

NVP needs to set up ex ante discount rates when turning the project's cash flow into the current value. IRR is, on the other hand, a measuring indicator of the profit rate of the investment project itself without setting up the ex ante discount rates. IRR is the discount rate that equates the net present value of benefit which occurred when switched from rice to greenhouse items (NPB) with net present cost of the project costs (NPC), i.e., $(NPB=NPC)$, or makes the rate as 1, i.e., $(NPB/NPC=1)$. This means earning power of capital, that is, during the period of cultivating the relevant crops, invested project cost is recovered and project benefit is created at the same

time. The criteria for investment decisions are: if the internal rate of return is larger or same as the capital costs, the crop with the largest IRR among the investment project is analyzed as economically feasible. Internal rate of return for the items n investment life is i in formula (2). Thus, the priority order of the investment plants can be decided by the internal rate of return from various plants.

$$\sum_{t=1}^n \frac{B_n - C_n}{(1+i)^n} = 0 \quad (2)$$

B_n : n Year Revenue
 C_n : n Yea Cost
 n : Cultivation period
 i : Discount rate

3. Analysis data

The research limits its scope to the greenhouse plants in Cherwon-gun. It is because outdoor growing does not require a separate facility investment, and the earning returns of major outdoor plants are under *Agricultural Income Survey* (Rural Development Administration) examination. However, unlike the outdoor growing, the greenhouse cultivation seldom ends with one year production because of its fixed facility. Thus, the project needs to be analyzed for a certain period of time. Despite this, *Agricultural Income Survey* (Rural Development Administration) is overlooking the facts mentioned just above. *Agricultural Income Survey* (Rural Development Administration) carries out an income analysis of major plants, however, it does not take account of the project period, but just suggests a year income or income rate only.

Table 1 shows the major greenhouse plants in Cherwon-gun. For the cultivable land, the largest is for tomatoes which take up 47.9 ha, and cucumbers the next. Looking at the income rate of those plants, it shows that the highest is from cucumbers followed

Table 1. Major facilities cultivated crops (2009, Cheorwon-gun).

| Crop | Farmers | Area (ha) | Production (ton) | Income Rates (%) |
|----------|---------|-----------|------------------|------------------|
| Cucumber | 120 | 39.2 | 2,349 | 52.8 |
| Tomato | 257 | 47.9 | 4,625 | 43.6 |
| Paprika | 59 | 31.6 | 2,160.0 | 32.3 |

Table 2. Investment costs according to the type of facility.

| Type | Cost | | | |
|-----------------------|---|-------|------------------|----------------------|
| 07-Automatic -1(1-2W) | Total Facility Cost (1,000 won/m ²) | 86.5 | | |
| | Individual out-of-pocket costs (Government-subsidized rate 50%) (1,000 won/m ²) | 43.25 | Investment costs | 42,817,500 (won/10a) |
| 07-SingleSpan-3 | Total Facility Cost (1,000won/m ²) | 19.5 | | |
| | Individual out-of-pocket costs (Government-subsidized rate 50%) (1,000 won/m ²) | 9.75 | Investment costs | 9,652,500 (won/10a) |

by tomatoes. This income analysis is for a certain year only, and the income rate without consideration of the investment cost is difficult for a simple comparison. Therefore, for the greenhouse plants, a target analysis of the investment returns for a certain period of project is necessary.

This research has categorized and analyzed strawberries as greenhouse plants. It has taken the mid-summer weather conditions of Kangwon into consideration, and recognized the summer strawberries are distinctive plants from those of other regions. The summer strawberries have been cultivated from 2002 in Pyongchang area, and now the entire yields is exported to confectionary companies in Japan. The cultivating method is chiefly growing in the greenhouses with automated facilities, rather than relying on outdoor growing. Thus, this research attempts to analyze the economic feasibility of strawberry growing of Cherwon-gun, which has the advantage of alpine region in summer. But because of collecting income data is difficult, the national income standard (semiforcing) of strawberries is used.

The research has analyzed the investment profit by plants, by facility types, and setting up the project period of greenhouse as 10 years with an assumption

that the price, cost structure and income remain same as those of 2009. After the completion of each type of greenhouses, a certain amount of maintenance fees for each year is calculated for the maintenance and management of the facilities for their durable years. The particular facility requires to replace its plastic every four years, and ‘07–Automatic–1(1–2W model)’ model costs 3 million won per 10 a, ‘07–SingleSpan–3’ model 1.5 million won. This is calculated within the relevant year. And for the analysis of economic feasibility that analyzes investment feasibility of the national economy, its target is the total of facility investment costs including the government subsidy (Ministry for Food, Agriculture Forestry and Fisheries, 2010). For the financial analysis of individual farm household, on the other hand, the government subsidy is something given from outside. Therefore, this study examines only self-pay investment costs for each type of facility (Table 2).

III. Results and Discussions

It is assumed that only one type of plant needs to be selected, because the subject items of the research are in the mutually exclusive relation in terms of

Table 3. Investment Profitability of Major Facilities Vegetables. (10a standards)

| Crops | NPV (won) | IRR (%) |
|-----------------------|------------|------------|
| 07-Automatic -1(1-2W) | Paprika | 44,208,099 |
| | Strawberry | 27,118,071 |
| 07-SingleSpan-3 | Cucumber | 33,979,822 |
| | Tomato | 27,875,701 |

facility expansion or equipment purchase. If each plant is cultivated over the next 10 years, the cash flow gets discount lending rate (3%) of agricultural facility funds. NPV for each plant is as below. By the facility types, for the 07-Automatic-1(1-2W model), NVP of paprika is 44,208,000 won, which is higher than that of strawberries, that is 27,118,000 won. For the 07-SingleSpan-3, cucumbers' NVP is 33,980,000 won, which is higher than tomatoes' 27,875,000 won. This reveals that the investment profit is greater when selections are made of paprika for the 07-Automatic-1(1-2W model), and cucumbers for the 07-SingleSpan-3.

However, NVP needs to set up ex ante discount rates when turning the project's cash flow into the current value. Therefore, the project feasibility needs an evaluation, without setting up discount rate beforehand, by comparing internal rate of return that estimates profit rate from the project itself with lending interest of capital finance. The standard of decision on the selection of mutually exclusive plant is that IRR is being either same or larger than capital cost. The current lending rate for agricultural facility funds is 3.0%. The paprika for the 07-Automatic-1(1-2W model), IRR is 19.09%, which is higher than capital cost (3.0%), thus it may have investment feasibility. IRR for the strawberries is 13.35%. Thus, for the individual farm household, 07-Automatic-1(1-2W model) has investment feasibility in the both. For the IRR of 07-SingleSpan-3, it is 3% higher than capital cost in every item. IRR of cucumbers is 49.6%, which is higher than tomatoes' 42.4%, but the difference is not big (Table 3).

IV. Conclusions

The price and revenue of rice are expected to decrease due to increasing rice imports, decreasing consumption and the discontinuance of the government's rice procurement. This decreasing profitability had led to an increase in the cultivation of upland-crops such as beans, fodder crops and fruits in paddy fields. However, there is a lack of research on the selection of rice substitute crops which are adaptable to the relevant region through profitability analysis. This research has analyzed investment profitability of rice substitute crops for Cheorwon-gun area in Kangwon province. The study, therefore, can be of high value for the rice producing farmers of Cherwon-gun to use it as their management indicator for production of rice substitute plants.

The results and its implications of the research are summarized as below. The 80% of cultivable land of Cherwon-gun is occupied by rice paddies. This rice-centered cropping system has resulted in a simple agricultural production structure, and not many factors are available for higher income from rice production. With regard to the rice profitability, the net revenue rate and income rate have steadily increased up to the 2000s, but from 2002, due to the decreased rice import and the increased production costs, the business environment of rice farms began to degenerate. In particular, in 2009 and 2010 the price of rice dropped, which thus led to the decrease in the total income. Furthermore, the direct costs of production, such as costs of fertilizer and agricultural pesticides, and labor cost are expected to rise, the profit for the rice

farming households will be more degenerate. Therefore, development of new profitable plant is in demand.

In this context, the study has applied NPV and IRR which can be used for mutually exclusive investment, because it is a situation where one plant among many needs to be chosen. The analysis targets are the major greenhouse plants of Cherywon-gun, which are paprika, strawberries, cucumbers, and tomatoes. And summer strawberries are included. It is because they are specifically regional plant of Kangwon-province that reflects the weather conditions of the province. The results of financial analysis show that, for the 07-Automatic-1(1-2W model) NPV and IRR of paprika are higher than those of strawberries. For the 07-SingleSpan-3, cucumbers show higher profit (NPV, IRR) than tomatoes. From these results, it can be said that for the case of Cherywon-gun, paprika of the automatic vinyl greenhouse, and cucumbers of the conventional vinyl greenhouse have economic investment feasibility.

Some strategic suggestions can be made based on the analysis results. First, the target of the study, paprika of Cherywon-gun has more priority on export to Japan than domestic sales. Thus, in order to create a steady and stable demand through promotion of export paprika to Japan, the state-of-art facilities like the automatic vinyl greenhouse need to be expanded.

Second, in order to promote the controlled-environment agriculture with the rice substitute plants, the government subsidy is essential to the agricultural facilities of the farmers who grow vegetables in the facility. The research has applied the government subsidy as 50% of the investment cost of the facilities. Recently, the price of farming equipment and other materials is continuously increasing, but, despite the reality, the government subsidy is decreasing. Thus, for the farms with skills and enthusiasm to changeover to the greenhouse plants, it is necessary to get a steady government subsidy for the agricultural facilities.

Third, currently the summer strawberries of Pyongchang-gun are under contract cultivation, and the entire yields export to the Japanese confectionary companies. Since the steady market is established for them, the cultivating areas are expanding. However, for Cherywon-gun, strawberries are items for experimental cultivation. It is because the initial investment costs for facilities are rather high, the farmers who wish to cultivate them find it hard to approach. Thus, in order to foster strawberries as rice substitute plants, it needs to begin with securing the market. This requires to extend export countries, rather than confining to Japan, and to promote increase of domestic consumption.

A limitation of the study is that since the profit of relevant plants is based on 2009, there might occur differences in the results of financial analysis in the future if the profit changes according to the plants price fluctuations. In the financial analysis, depreciation cost and labor cost are excluded, so when they are included NPV and IRR can be lowered. Also, items such as profits, costs or applied discount rates in this study are assumed to be definite. Thus, if these items are considered with stochastic uncertainty, the results can be more desirable.

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