Proposal for Regional Environment Management System for Red Soil Protection in Ishigaki Island

Proposal for Regional Environment Management System for Red Soil Protection in Ishigaki Island *

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ABSTRACT : Ishigaki Island, (Okinawa Prefecture) lies at almost the west end of Japan. The area is 223km2, and the population is 43,000. Many people work in agriculture and tourism. Recently, at Ishigaki Island, the damage which the coral reef suffers, due to the Red Soil and nutrients running out of the land is a serious problem, and many measures are being taken to prevent the Red Soil and nutrient salts from running out into the sea.

In preventing the Red Soil from turning out, there have been hardware measures like modifying the incline of farming land, and software measures like covering the bare land up with plants taken, but such actions have various problems like "The cost is high" and "The farmhouse would not comprehend", and there is a need for an effective way. To solve these problems and to propose an effective action that would stop the Red Soil from running into the sea, we need to balance the values of the coral reef and the costs necessary to protect them, and we must make a relationship that both the users' and the constructors' social welfares reach maximum.

Modeling on each phenomenon which is Ecology, Economic and Lifestyle of citizen etc, also grasping the whole structure of existent community as well, it demands building the system of ecological community management which has functions such as impact on imaginable community and eliminating citizen or social response. The evaluation index of community ecological management system is the rate of out flow prevention of Red Soil. And also, this can be expressed that the achieving level of public enterprises (farming development) as engineering measure and by the rate of operation of out flow prevention of Red Soil in terms of farming plan which is in fields.

This research shows that is on the purpose of suggesting the system of community ecological management structure which will realize Red Soil outflow suppression by farming actions, and now, that draw attention as the structure of farming analysis management which is about catch cropping, and also it Introduced that the community ecological management system, which can realized without helping of the supporting plan that are funds or grant., the level of Red Soil out flow suppress. Also, on the bases of introducing effect, we suggest that supporting systems which are supporting plans for farming which are for improving catch cropping operation rate, or supporting systems which are funds and grants.

Keywords: Logic model, Environmental planning, regional planning

1. INTRODUCTION

1.1. Background

Recently, the coral reef by Ishigaki Island dies out and is deteriorated. Deterioration in the coral reef is caused by the outflow of the Red Soil from Ishigaki Island. Each organization such as local governments in the Ishigaki city is working on the solution of this problem. The above-mentioned two are typical measures. 1) Promotion of vegetation coating to farmland. 2) the inclination of the farmland is corrected. The above-mentioned two are typical measures. However, the problem is not solved by these measures. The main cause is cost, and farmer's cooperation posture[1)] . To protect the coral reef, a social public welfare of "User in the coral reef" and "People who protect the coral reef " should become the maximum. It should be equilibrium partial by "Value of the coral reef" and "Cost to pro

tect the coral reef" to satisfy this. However, even if a social public welfare becomes the maximum, the coral reef might not be protected. Because, it is thought that "Entrepreneur who protects the coral reef" pursues the profit. Moreover, the main cause that the Red Soil flows out to the sea is a raindrop splash to the truck farm of after harvesting sugarcane. Therefore, it is necessary to cooperate in the sugarcane farmer to restrain the Red Soil. However, the sugarcane farmer will not cooperate when their loads are large. In the means to restrain the outflow of the Red Soil to the sea, there is a technique "Farming measures"[1)]. In one of the farming measures, there is a technique "Pumpkin intercropping cultivation". The sugarcane field is changed to the intercropping cultivation of sugarcane and the pumpkin. Then, vegetation will be coated[1)] . As for the intercropping cultivation of the pumpkin, because it is possible to ship it by producing the pumpkins, an income increase can be expected. This income increase becomes incentive.

It is necessary to restrain the outflow of the Red Soil to protect the coral reef. "Farming measures" should evaluate the impact given to Ishigaki Island. It is necessary to analyze the reaction of the citizens in Ishigaki city including the sugarcane farmer to evaluate the impact to Ishigaki Island. Moreover, the Regional Environment Management System that keeps protecting the coral reef of Ishigaki Island that reflects the analysis result is necessary.

1.2. Objective

In this research, it proposes the Regional Environment Management System to protect the coral reef of Ishigaki Island. The Regional Environment Management System has aimed to achieve the coral reef protection rate in a sustainable method. A sustainable method is "Engineering works measures" and "Farming measures. Those analysis and evaluation are involved to the Regional Environment Management System. In this research, the Regional Environment Management System that limits it to "Farming measures" is described.

The Regional Environment Management System is composed of 2 small systems and one models. 1) Agricultural management analysis system 2) Auxiliary system that promotes execution of farming measures 3) Coral reef protection rate calculation model by Red Soil outflow restraining effect. In this thesis, it explains the outline and the design of the Regional Environment Management System. Next, it explains the agricultural management analysis system. In addition, it explains a auxiliary system that supports the sugar cane farmer. The shop establishment plan of the vegetable on the island is described as one example of a auxiliary system.

2. Regional Environment Management System of Ishigaki Island

This chapter describes the design of the Regional Environment Management System of Ishigaki Island. The Regional Environment Management System has aimed to achieve the coral reef protection rate in a sustainable method.

2.1. Necessity of Regional Environment Management System

In Ishigaki Island, the engineering works measures and the farming measures are executed as a means to restrain the flow of the Red Soil [2)] . However, it doesn't infiltrate with both measures. However, the engineering works measures are almost untried. Because the land improvement enterprise executed in 1970's is causing the outflow of the Red Soil. In a word, the sugarcane farmer has distrust for the municipality. In addition, the stone wall city cannot secure a budget necessary for the engineering works measures that are public works because there is no room in finance.

The farming measures are also almost untried. Because it is a load for the sugarcane farmer.. The load like labor and money, etc. includes many things. In addition, the case to receive the incentive to correspond to the load was few up to now. This amplified sugarcane farmer's "Anxiety".

It is necessary to solve these various problems, and to achieve the target of the Red Soil outflow restrain measures. Therefore, "Value as environmental resources of the coral reef" and "Cost necessary to protect the coral reef" are made a function. And, user and protection business execution person's social public welfares are maximized by the partial equilibrium of each value. Moreover, continuation and social a public welfare should keep being maximized. The Regional Environment Management System that satisfies it is necessary passes it.

Then, a direct stake-holder by farmer's execution desire and farming measures against the farming

measures is analyzed. Moreover, it is necessary to m odel each phenomenon of the grasp and the environm ent, economy, and the citizen's life etc. of a whole of e xisting local society structure. In addition, the constru ction of the system that evaluates the impact to the r egion by the farming measures is needed.

2.2. Design of the Regional Environment Manageme nt System of Ishigaki Island

Figure 1 shows the Regional Environment Management System of Ishigaki Island. "Pumpkin intercropping" that is one of the farming measures has the effect of restraining the Red Soil outflow. In addition, the sugarcane farmer can expect revenue growth by the pumpkin. In a word, the actual profit can be given to the sugarcane farmer by the coral reef protection measures. In this research, the outflow restrain rate of the Red Soil is calculated from the execution rate of the farming measures. The farming measures are only intercropping of the pumpkin.

Sugarcane farmer's profit and loss changes by executing the pumpkin intercropping. The pumpkin intercropping is executed by sugarcane farmer's execution desire. The pumpkin intercropping is continued based on sugarcane farmer's profit and loss at the first term. The profit and loss change by the sugarcane farmer's pumpkin intercropping is analyzed with the agricultural management analysis system. It explains the agricultural management analysis system in the next chapter.

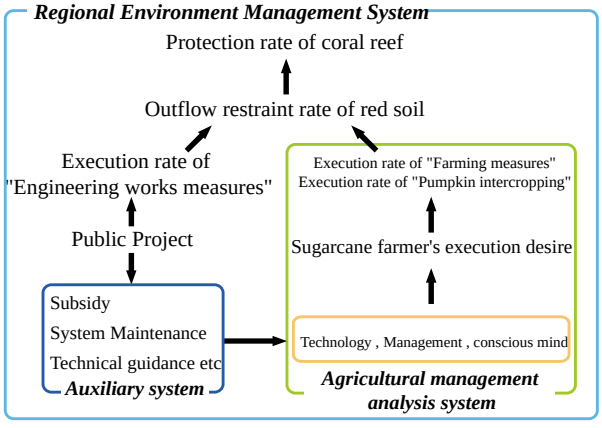


Figure-1 Regional Environment Management System

3. Structuring of agriculture management analysis system

This chapter explains the construction of the agricultural management analysis system. The agricultural management analysis system is a system that analyzes the profit and loss change by the sugarcane farmer's "Pumpkin intercropping" execution.

3.1. Outline of the agriculture management anal ysis system

Figure 2 shows the analysis process of the a gricultural management analysis system. First of all, t he sugarcane farmer judges whether to execute the p umpkin intercropping based on the execution desire. Next, sugarcane farmer individual's profit and loss is calculated through the market model and the cost mo del. Whether the sugarcane farmer continues "Pumpki n intercropping" from the calculation of profits and los ses is judged. "Pumpkin intercropping" execution rate is calculated repeating the above-mentioned process.

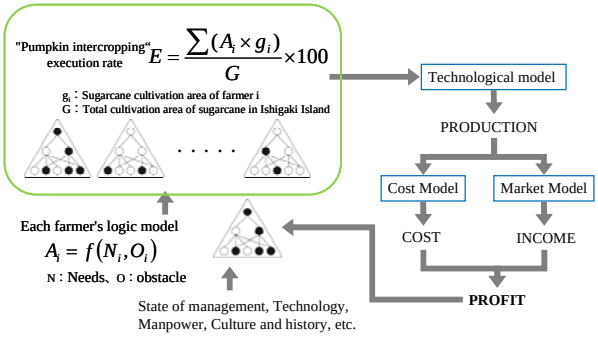


Figure-2 the analysis process of the agricultural management analysis system

Each sugarcane farmer decides the execution of intercropping the pumpkin according to own logic model. The logic model is a model of the consideration that should be considered in executing the pumpkin intercropping. All the sugarcane farmers judge whether to execute the pumpkin intercropping. The execution rate of the pumpkin intercropping in the sugarcane farmer of Ishigaki Island is calculated. For the sugarcane farmer who executes the pumpkin intercropping, the production of own pumpkin corresponding to each technology is decided. Earnings of "Pumpkin intercropping" are calculated from the cost of income and "Pumpkin intercropping". When earnings P are 0 or more, the sugarcane farmer examines whether to execute "Pumpkin intercropping" again. The sugarcane farmer discontinues "Pumpkin intercropping" when earnings P are lower than 0. Finally, the execution rate of "Pumpkin intercropping" in the state of "Market price of the pumpkin" balance is calculated. The execution rate of "Pumpkin intercropping" in the state of balance is an execution rate of "Pumpkin intercropping" trial

calculated in Ishigaki Island at present. It explains details in the next chapter.

3.2. The pumpkin market model's structuring

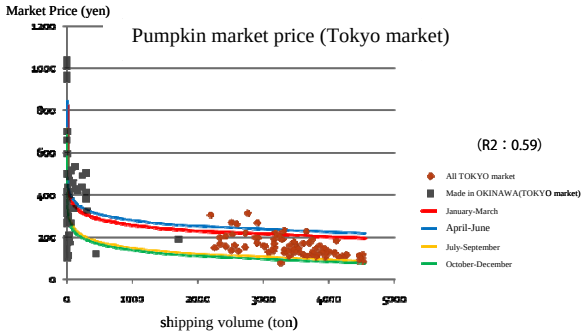
"Pumpkin intercropping" that the sugarcane farmer does can obtain the income by producing crops. In a word, the cost of "Farming measures" is reduced and farmer's living standard can be improved by the profit. Therefore, it is more effective than other "Farming measures". However, it is necessary to sell to the extent that crops produced by intercropping the pumpkin ship it.

In this chapter, the income by the sugarcane farmer's pumpkin intercropping is clarified. In this research, the pumpkin intercropping income of the sugarcane farmer is assumed to be directly connected with the market price. The price curve of the pumpkin market that can be shipped from Ishigaki Island is derived. In this research, the pumpkin market that was able to be shipped from Ishigaki Island was assumed to be corresponding to that of Okinawa Prefecture. The pumpkin in Okinawa Prefecture is shipped to the Tokyo market. First of all, the market price of the pumpkin in Okinawa Prefecture in the Tokyo market at the four seasons was investigated. As a result of the investigation, "Pumpkin in Okinawa Prefecture" in "Tokyo market" was high price. Because there are two reasons. First of all, the production of "Pumpkin in Okinawa Prefecture" is a little. Next, the shipment season of the pumpkin shifts because other regions and climates are different. The amount of the pumpkin shipment increases more than present "Okinawa Prefecture pumpkin" when the sugarcane farmer of Ishigaki Island executes "Pumpkin intercropping". Therefore, the market price of "Okinawa Prefecture pumpkin" in "Tokyo market" falls. In a word, the market price cannot be presumed from present "Okinawa Prefecture pumpkin". Then, it was assumed that it approximated to the price of the pumpkin of the entire Tokyo market when the amount of the shipment of "Ishigaki Island pumpkin" increased. The price of the pumpkin of the entire Tokyo market was investigated. And, a multiple linear regression analysis was done according to the investigated value, and graph and expression 1 in Table 1 were derived.

$$P = 704.9 + (-419) \times \ln(Q) + 118.1 \times T_1 + 140.4 \times T_2 + 9.3 \times T_3 \qquad (1)$$

P : Market price of Ishigaki Island pumpkin, Q : Amount of Ishigaki Island pumpkin shipment, T : Dummy coefficient by season (T_1 : January – March, T_2 : April - June, T_3 : July - September)

Table-1 Tokyo market price curve of Ishigaki Island pumpkin



3.3. Modeling of farmer's consideration structure

This chapter describes the sugarcane farmer's logic model construction. "Structuring technique of the problem" is used as a construction means of the logic model of consideration. "Structuring technique of the problem[7]" is used as a construction means of the logic model of consideration. Figure 3 showed the procedure of the logic model construction with structuring the problem.

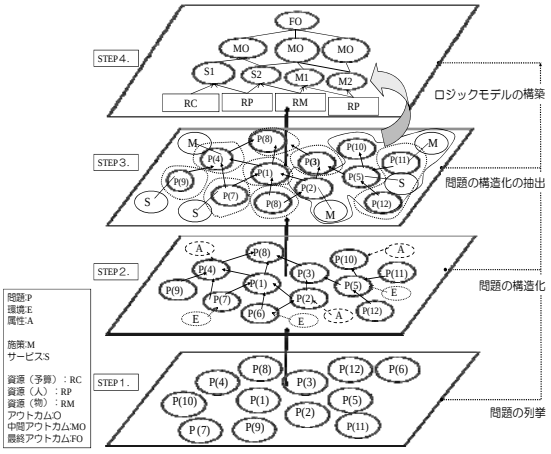


Figure-3 Construction process of logic model

First of all, to structures the problem, the interview was executed to 11 sugarcane farmers who were the stake-holders in the outflow question of the Red Soil. "Structured of the problem" was done from 11 interview results, and the logical correlation analysis between factors concerning sugarcane farmer's Red Soil outflow problem was done. Figure 4 is a structural chart of consideration concerning the outflow problem of sugarcane farmer's Red Soil. The factor that relates from the analyzed factor to the pumpkin intercropping has been extracted. The part enclosed in a red line in Figure

4 corresponds to it. The factor related to the pumpkin intercropping was classified into "The sugarcane farmer's consideration", "Sugarcane farmer's attribute", and "Social climate around Ishigaki Island". The logic model (Figure 5) related from "The sugarcane farmer's consideration" to the execution of the sugarcane farmer's intercropping the pumpkin was constructed.

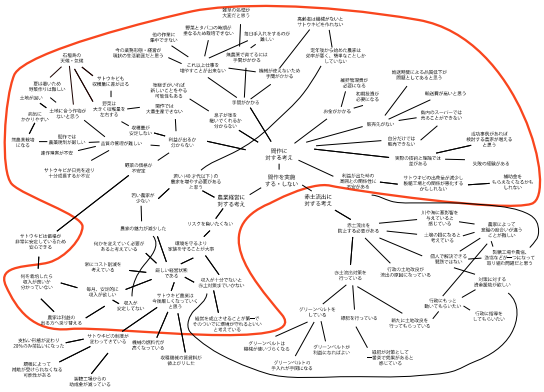


Figure-4 Structural chart of consideration concerning the outflow problem of sugarcane farmer's Red Soil

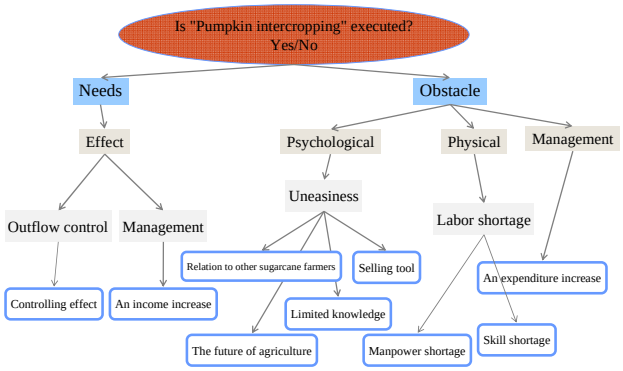


Figure-5 Logic model related to execution of sugarcane farmer's "Pumpkin intercropping"

The consideration model derives the execution desire of "Pumpkin intercropping" by logically setting up the hierarchy and connecting the factor that relates to "Pumpkin intercropping". A high-ranking factor and the subordinate position factor are in each hierarchy in Figure 5. A high-ranking element is derived from the subordinate position element, and strength of the relation with a high-ranking element is different because of each subordinate position element when there are two or more subordinate position elements. If the factor that influences the execution of "Pumpkin intercropping" is not quantitatively analyzed, the Regional Environment Management System cannot be achieved. It is necessary to clarify the correlation of a subordinate position element and a high-ranking element to analyze it quantitatively. To analyze the correlation between elements, the questionnaire survey was done for the sugarcane farmer of Ishigaki Island. The question item of the questionnaire corresponds to each element of the logic model. The questionnaire survey executed it in December, 2008. The logic model's function model making used a multiple linear regression analysis by setting Figure 6. The function model is constructed according to expression (2), expression (3), expression (4), expression (5), expression (6), and expression (7).

The expression of "Pumpkin intercropping" execution desire to calculate based on the questionnaire survey in December, 2008 is expression (8). And, "Pumpkin intercropping" execution desire and the relation in expression (8) are shown in Table 2. Table 2 shows the relation between "Pumpkin intercropping" execution desire of the sugarcane farmer calculated based on expression (8) and an actual "Pumpkin intercropping" execution probability.

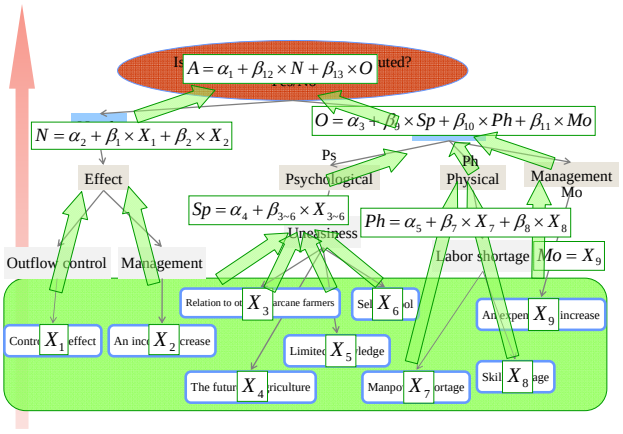


Figure-6 Relation between subordinate position element and high-ranking element of logic model

$$A = \beta_{12} \times N + \beta_{13} \times O + C_A \quad (2)$$

$$N = \beta_1 \times X_1 + \beta_2 \times X_2 + C_N \quad (3)$$

$$O = \beta_9 \times Sp + \beta_{10} \times Ph + \beta_{11} \times X_9 + C_o \quad (4)$$

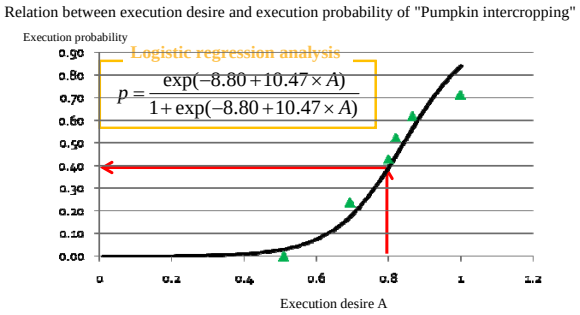
$$Sp = \sum_{n=3}^{6} \beta_n X_n + C_{Sp} \quad (5)$$

$$Ph = \beta_7 \times X_7 + \beta_8 \times X_8 + C_{Ph} \quad (6)$$

$$X_i = \alpha \times (At) + C_{X_i} \quad (7)$$

$$A = -0.26 \times N + 0.21 \times O + 0.97 \quad (8)$$

Table-2 Relation of execution probability of "Pumpkin intercropping" execution desire and "Pumpkin intercropping"



It explains the calculation result in Table 2. When "Pumpkin intercropping" execution desire is 0.8, the execution probability of "Pumpkin intercropping" becomes about 0.4. If "Pumpkin intercropping" execution desire is a low value, "Pumpkin intercropping" is not executed.

On the other hand, the coefficient of "Acknowledgment level of the necessity" concerning "Pumpkin intercropping" execution is a minus in expression (8). It is shown that "Pumpkin intercropping" execution desire decreases by the answer value of the necessity of "Pumpkin intercropping" high as for this. It is logically contradicted in a word. It is logically contradicted in a word. It will be necessary to verify this cause in the future.

4. Calculation of ratio in which pumpkin intercropping is executed by agricultural management analysis system

"Pumpkin intercropping" execution rate is cal culated by using the agricultural management analysi s system that constructs it. This chapter explains the calculation process and the calculation result of "Pum pkin intercropping" execution rate.

4.1. Calculation procedure of ratio in which pumpki n intercropping is executed

Figure 7 is a process where "Pumpkin intercropping" execution rate was calculated. Each sugarcane farmer calculates the execution desire of "Pumpkin intercropping" according to his logic model. Each sugarcane farmer has a peculiar value about the value of the bottom of the heap of the logic model. The sugarcane farmer decides whether to execute "Pumpkin intercropping" by the logistic curve. The logistic curve is a curve in Table 2. Table 2 is the one that the execution desire value of "Pumpkin intercropping" is shown in a horizontal axis, and the execution probability of "Pumpkin intercropping" was shown in the spindle.

The method of calculating the logistic curve is described. The execution desire of "Pumpkin intercropping" in all sugarcane farmers is calculated according to the logic model. Next, the sugarcane farmers who had the same execution desire were grouped. Whether sugarcane farmer what percentage had been answering in the questionnaire survey, "I want to execute the pumpkin intercropping" was calculated among groups. In all sugarcane farmer's group according to "Pumpkin intercropping" execution desire, the above-mentioned process was executed. If the above-mentioned data set is analyzed by "Logistic regression analysis", it becomes a result in Table 2. These processes consist by the following assumption. When the execution desire of "Pumpkin intercropping" calculated according to sugarcane farmer's logic model is high, the sugarcane farmer is answering also in the questionnaire survey, "I want to execute the pumpkin intercropping".

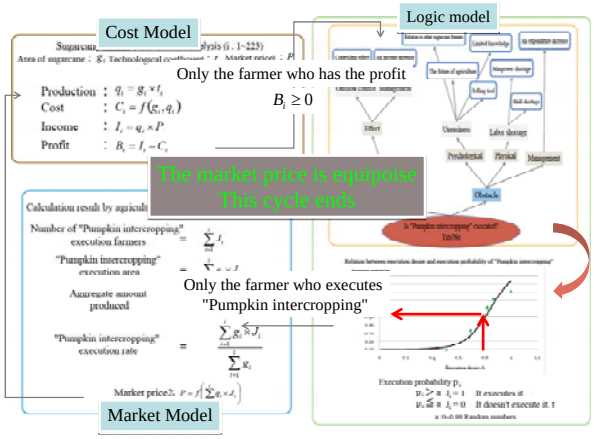


Figure-7 "Pumpkin intercropping" execution rate calculation process

The pumpkins that the sugarcane farmer produced are turned on to the market model. The sugarcane farmer who executes "Pumpkin intercropping" produces the pumpkins. The farmer who executes the pumpkin intercropping decides it by Table 2. Sugarcane farmer's pumpkin production is decided depending on a technological coefficient. Respectively, the sugarcane farmer obtains the income according to the market price decided by the production of the pumpkin. Cost uses and calculates the function of the early research[5].

If sugarcane farmer's revenue and expenditure is 0 or more, the sugarcane farmer continues "Pumpkin

intercropping". If sugarcane farmer's revenue and expenditure is lower than 0, the sugarcane farmer discontinues "Pumpkin intercropping". The market price of the pumpkin changes to the price corresponding to the amount of the shipment. The pumpkins that the sugarcane farmer of Ishigaki Island produced become the amounts of the shipment. The above-mentioned cycle is repeated. "Price corresponding to the amount of the shipment" and "Price before corresponding to the amount of the shipment" is corresponding by the repeated process. This corresponding price is an equilibrium price. Under such a condition, the management of the sugarcane farmer who executes all "Pumpkin intercropping" has been approved. Table 3 shows the data of the sugarcane farmer to whom management by "Pumpkin intercropping" has been approved. These are the number of houses, the execution areas of the sugarcane farmer in which "Pumpkin intercropping" is executed, and the forecast values of the pumpkin production. The Red Soil outflow restraining effect can be derived according to "Pumpkin intercropping" execution area in this calculation result. The protection effect of the coral reef can be derived from the Red Soil outflow restraining effect. A large purpose of this research is protection of the coral reef, and the protection rate of the coral reef is set in the future as the final outcome index. Therefore, it is necessary to calculate the Red Soil outflow restrain rate of the target from the coral reef protection rate of the target. And, it is necessary to calculate "Pumpkin intercropping" execution rate of the target from the Red Soil outflow restrain rate of the target. The next paragraph explains "Pumpkin intercropping" execution rate of the target.

Table-3 "Pumpkin intercropping" ideal execution rate and each data

- Number in which "Pumpkin intercropping" is executed : **137 households**
- Gross area where "Pumpkin intercropping" is executed : **345.5 ha**
- **Execution rate of "Pumpkin intercropping" : 28 %**
- Aggregate amount produced of pumpkin : **6859.0 ton**
- Market price of pumpkin : **178 yen / kg**

4.2. Calculation of execution ratio of target pumpkin in tercropping

Figure 8 is a calculation process of "Pumpkin intercropping" execution rate of the target. The amount of the Red Soil outflow restrain that becomes a target is calculated from the influence on the coral reef that the amount of the outflow of the Red Soil gives. The target Red Soil outflow restrain rate is calculated from the amount of the Red Soil outflow restrain that becomes a current amount of the Red Soil outflow and a target. It is necessary to satisfy the amount of the Red Soil outflow restrain that becomes a target by "Farming measures" and "Engineering works measures". "Pumpkin intercropping" execution rate that becomes a target when the amount of the Red Soil outflow restrained by "Pumpkin intercropping" is clarified is decided. And, "Pumpkin intercropping" execution rate is calculated according to the process in Chapter 4.1, and "Pumpkin intercropping" execution rates that become targets are compared. If "Pumpkin intercropping" execution rate that becomes a target is not achieved, it is necessary to improve "Pumpkin intercropping" execution rate. A auxiliary system improves sugarcane farmer's "Pumpkin intercropping" execution desire. A auxiliary system has the subsidy, the fund, and technical guidance, etc.

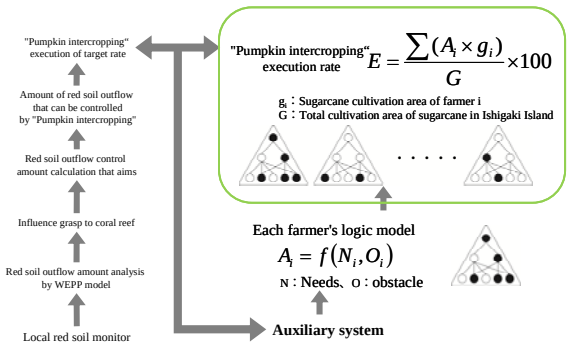


Figure-8 Calculation process of "Pumpkin intercropping" execution rate that becomes target

5. Proposal of Auxiliary system in the agriculture management analysis system

In this chapter, it proposes a auxiliary system that improves sugarcane farmer's "Pumpkin intercropping" execution desire. It is necessary to satisfy "Pumpkin intercropping" execution rate that becomes a target. It is necessary to improve sugarcane farmer's "Pumpkin intercropping" execution desire for that. Figure 9 is a proposal of a auxiliary system that improves sugarcane farmer's "Pumpkin intercropping" execution desire in the agricultural management analysis system. A auxiliary system influences the element with the logic model concerning sugarcane farmer's "Pumpkin intercropping" most below. The influenced element changes. In a word, "Pumpkin intercropping" execution desire by the logic model changes. The next paragraph explains the influence that a auxiliary system gives to

"Pumpkin intercropping" execution rate.

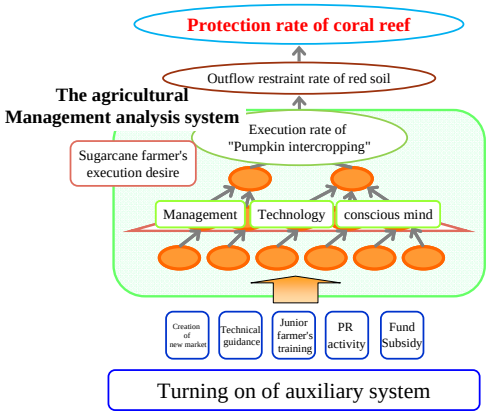
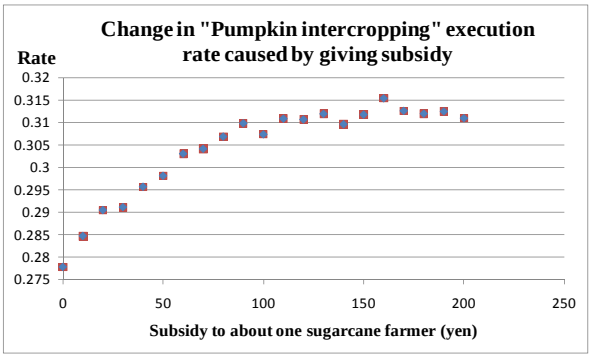


Figure-9 Relation between agricultural management analysis system and auxiliary system

5.1. Effect grasp by Subsidy introduction measure for Farmer who executes pumpkin intercropping

Table-4 Change of "Pumpkin intercropping" execution rate by subsidy



The effect of the subsidy that was one of the auxiliary systems was measured. "Pumpkin intercropping" execution rate changes depending on the subsidy. Table 4 shows the effect of the subsidy. When the sugarcane farmer executes "Pumpkin intercropping", the subsidy is given. "Pumpkin intercropping" execution rate has improved up to about 31% when the subsidy is given for two million yen. "Pumpkin intercropping" execution rate before the subsidy was introduced was 28%. Efficiency and the effect of a auxiliary system can be analyzed by comparing convenience by a auxiliary system with the cost of a auxiliary system. It is necessary for executing the business in the limited budget.

6. Establishment plan of shop that sells peculiar vegetable by Ishigaki Island

This chapter describes the result of the research in "SORA no EKI" plan of the “Ishigaki Island vegetables” shop with the Ishigaki airport.

6.1 About the establishment plan of the shop that sells a peculiar vegetable by Ishigaki Island

"SORA no EKI" is a shop in the airport where the vegetable of original Ishigaki Island is sold. It has aimed to use a part of sales of the “Ishigaki Island vegetables” as a coral reef protection fund. "SORA no EKI" plan is one of the auxiliary systems in the Ishigaki Island Regional Environment Management System. The tourist's purchase can be expected by selling the “Ishigaki Island vegetables” in the airport. Many of tourists are not buying the “Ishigaki Island vegetables” now. New demand arises if "SORA no EKI" is achieved. The supply source of the “Ishigaki Island vegetables” is a farmer of Ishigaki Island. An income increase of the supplier can be expected by the appearance of new demand. In a word, "SORA no EKI" plays the role as regional promotion. The “Ishigaki Island vegetables” is bought for the tourist by "SORA no EKI". The coral reef protection measures are executed by using a part of sales of "SORA no EKI". When the coral reef is protected, the drop in tourists is restrained. The “Ishigaki Island vegetables” of a constant amount is bought by the tourist. The farmer can secure the income source. "SORA no EKI" plays a basic role of the Regional Environment Management System. This chapter explains the research for "SORA no EKI" achievement.

6.2. Investigation result in research in the past

The questionnaire survey was executed in the Ishigaki airport in December, 2008[6]. The content of the questionnaire survey is whether to buy the “Ishigaki Island vegetables”. The target person of the questionnaire survey is a user in the stone wall airport. Annual sales were forecast based on the questionnaire survey. Figure 10 shows the forecast result. Table 5 showed the total of the” “Ishigaki Island vegetables” that the respondent to a questionnaire wants to buy”.

Respondent to a questionnaire's “Ishigaki Island vegetables” purchasing price was 1,088 yen. However, the time of the questionnaire survey was not a vacation. In a word, the tendency to an original Ishigaki airport user is not shown. The number of “Ishigaki Island vegetables” buyers during year became 265,450 people. This numerical value is 14% of about 1.9 million Ishigaki airport users. There is a possibility diffe

rent from an original number of “Ishigaki Island vegetables” buyers as well as the average “Ishigaki Island vegetables” purchasing price.

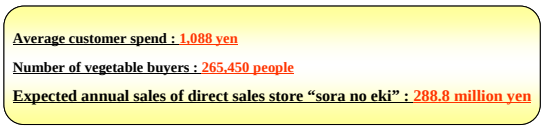
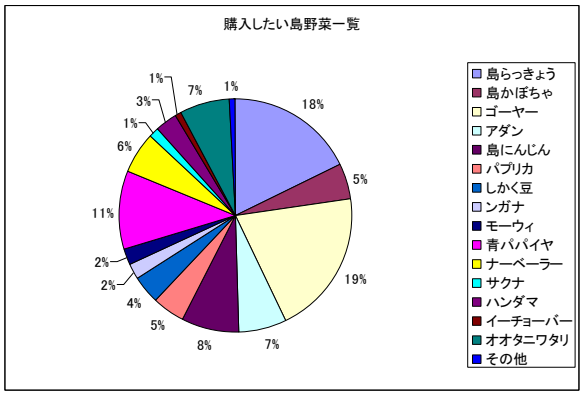


Figure-10 Annual sales of "SORA no EKI" that uses result of the questionnaire

Table-5 Popular "Ishigaki Island “Ishigaki Island vegetables”" clarified by questionnaire survey



In the “Ishigaki Island vegetables” that the respondent to a questionnaire wants to buy, the popularity of Gorya and "Island pickled scallion" is high. Gorya is acknowledged most in the Okinawa “Ishigaki Island vegetables”. The popularity of "Island pumpkin" is also high. "SORA no EKI" is thought as a shop where the pumpkins produced by "Pumpkin intercropping" are sold.

6.3. Execution of social experiment

The achievement of "SORA no EKI" is verified. The system of "SORA no EKI" is verified by a social experiment. Figure 11 shows the system of "SORA no EKI" for a social experiment. A social experiment was executed in January and February, 2010. The achievement of "SORA no EKI" is verified by using acquired data by a social experiment.

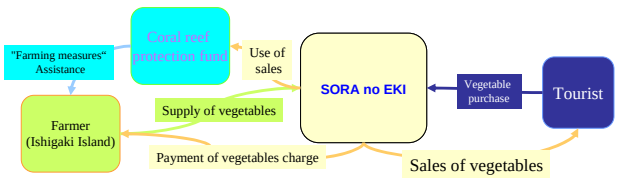


Figure-11 "SORA no EKI" system for social experiment

7. CONCLUSION

The general view of the Regional Environment Management System that aimed at the coral reef protection in Ishigaki Island was described in this thesis. Moreover, the agricultural management analysis system in "Pumpkin intercropping" in the Regional Environment Management System was constructed. In addition, it was a auxiliary system of the Regional Environment Management System, and "SORA no EKI" plan of "Ishigaki Island vegetable" shop was described. The problem in this research in the future is three points "The each model's accuracy improvement", "Scenario design for the system application", and "Examination of the system structure restructuring". First of all, the first problem is accuracy of each model that exists in the Regional Environment Management System. The model in the Regional Environment Management System should look like the event of the reality. For instance, it is difficult to forecast the market price of "Pumpkin" from Okinawa. However, we should try to improve the accuracy of the market model by the reality as much as possible. As for other models, it is similar. The accuracy of each model will improve in the future. Therefore, necessary data for the model is collected. In addition, the model is theoretically restructured. Next, it is a design of the scenario for the achievement of the Regional Environment Management System. It is necessary to achieve the Regional Environment Management System by Ishigaki Island. It is necessary to think who plays the role in the system in achieving the Regional Environment Management System. Similarly, it is what should discuss the rule etc. for the system implementation. Such a discussion is done with the stake-holder of Ishigaki Island. The third is "Examination of structural restructuring of the system. Figure 12 shows the Regional Environment Management System that introduces "Ishigaki Island vegetable" shop. After the system implementation is considered, an ideal system structure is reexamined and will be constructed in the future.

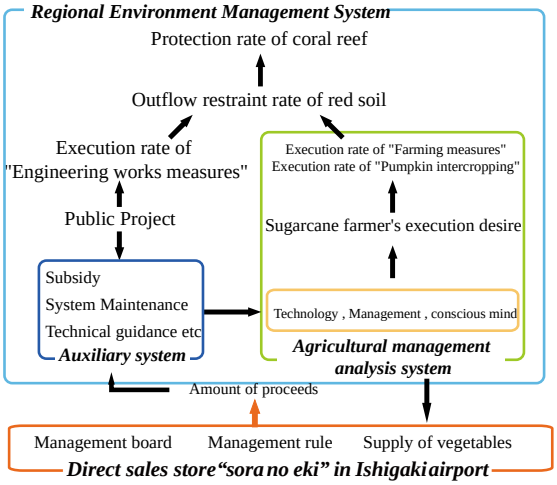


Figure-12 Regional Environment Management System that introduces "Ishigaki Island vegetable" shop

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