Economic Sustainability of Family Farming in Depopulated Areas —A Case Study in Tottori Region—

by

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This paper provides an econometric model approaching to the economic viability of depopulated communities. My analytical focus in addressed to the assessment of the economic sustainability of family farming, which is very vulnerable to changes in market conditions. A *kengyo* farmer running agricultural production as a side job is described in a form of a producer-consumes complex, which is an economic agent simultaneounly possessing twofold aspects both of a producer and a consumer. The final tenet of this study is to develop an analytical model to assess the administrative sustainability of family farming in depopulated communities. A case study conducted for Tottori region illustrates how family farming in depopulated communities will be able to be viable under the coming free trade regime of agrarian products. It also demonstrates the applicability and the potential of the model in assessing the illustrated points.

Key words : Family Farming, Producer-Consumer Complex, Economic Sustainability, Viability

1. INTRODUCTION

Depopulated communities of Japan are currently undergoing fundamental transformation of their socio-economic structures in the midst of the global integration of agrarian markets. Community economies are very vulnerable to the down-ward volatility of the prices of agrarian products. Local communities should be prompt in adjusting their traditional agrarian structure to exogenous changes in economic and political environment. The relevant metabolism of rural community systems should be accelerated in order that rural communities in marginal areas are to be viable under the coming free trade regime of agrarian products.

Today, Japanese agriculture does not give the margin for a rich cultural life for farmers. If they cannot hope to enjoy the same recreational, cultural, and educational activities and entertainment as others, the farmers will probably not get full satisfaction from their works. It is difficult to call life rewarding, or ever human, when old people and woman labor in the field while the younger men commute to part-time jobs; when women come home exhausted from farm works or a low-paying factory job so the family can have cash income; or when a family is temporarily separated because the father has gone to one of the big cities to make enough to provide for his wife and children[1) 2)].

The major reason for the plummeting population in periphery has been the attraction of rapidly expanding industries which continue to absorb much of the farm labor force in their productive years. The average age of the farm labor force has also risen steadily. Farming lost out as priorities shifted elsewhere in the concern for economic progress. The number of people in farming will continue drop and the agricultural labor force will probably continue to age. Agriculture would benefit if the labor force were shrinking parallel with a declining number of farm families and concurrent expansion of land area per family, but the decline in the farm labor force has not been accompanied by a decline in farm families.

Men in their productive years are seeking jobs elsewhere, leaving women and older men on the farm to do the work. This fact commonly observed in depopulated communities helps to explain the rising popularity of small power cultivators, which have brought the power input per unit of land above that of any other country. An increase in the number of households in which married women and older men provide the farm labor is almost inevitably accompanied by a decline in households that derive income solely from farming. Thus, due to disadvantage of small plots of land, farmers in marginal areas rely heavily on non-farming work just make a living, and eventually all farmers will have to spend part of their time at outside jobs.

The problem in depopulated communities is that the agrarian structure consisting of relatively homogeneous small family farms, which was efficient in the low-wage economy, has now become serious obstacle to the introduction of highly value-added farming systems and machinery geared for saving labor and exploiting scale economies in the high wage economy. High support on product prices and subsidies on inputs under the essentially unchanged traditional agrarian structure have resulted in input applications above optimum levels. The high level of governmental protection has been preserving an inefficient agrarian organization. This difficulty of the agrarian adjustment problem inevitably leads to the danger of sliding into the fatal stage for the disappearance of agrarian communities in periphery [3)]

This paper provides an econometric approach to the assessment of the economic viability of depopulated communities. The life-sustaining behavior of a *kengyo* farming family, which runs agricultural production as a part-time job, is formalized in a form of a "producer-consumer" complex, which can be regarded as an economic agent simultaneously possessing aspects of a producer as well as a consumer. I also develop an analytical model to assess the economic sustainability of individual family farming in marginal areas. A case study is made for Tottori area in order to investigate how family farming can be viable under the coming free trade regime of agrarian products.

2. ANALYTICAL STRAND

The problem of the theoretical foundations of family farm organization gradually emerged in the heart of practical work in agricultural advice and cooperation, and was initially posed in the form of numerous isolated doubts and consideration of individual organizational problems. By a "family farmer", I refer only to those households that rely almost exclusively on the laborforce of family members. It does not mean a family-run enterprise aiming to make a profit. In other expression, "family farmers" mean those who normally run farming only by family members without hired outside wage labor.

Two streams of research work have merged to form my views in approaching to family farming in depopulated areas. The first one of such development is in the school of household production theory, derived from the publication by Becker[7], Lancaster[8], Muth[9] and others. In particular, Becker explicitly recognized the household as the relevant decision making unit regarding the related questions of labor-force participation and hour-of-work decisions, on the one hand, and home production and consumption decisions, on the other. Becker's model integrated the production, consumption, and labor-supply decisions within a household framework and demonstrated quite clearly, how utility-maximizing behavior by households can determine not only the division of each member's available time between market and non-market activities, but also their chosen mix as between home-produced and market-purpchased goods and their chosen division of labor as between various household members in the performance of the range of alternative tasks. Although the Becker-type framework has developed in a variety of directions, it essentially excludes the possibility that households can be capitalists by monopolying their family resources available for agricultural production. The home-produced products are assumed to be exclusively consumed by family members, though family farmers usually transact their products in markets.

The second approach can be found in the assortment of the so-called family enterprise models. The modeling of the family enterprise in the context of "peasant" agriculture has a long tradition beginning with Chayanov [4]. Singh et al.[12] and Maruyama [10] provided excellent overviews and summaries of the relevant work concerned with modeling and econometrically estimating the family enterprise models in agriculture. The traditional family enterprise models presume that households (i) are price-takers for all production inputs and consumption goods (including leisure) and (ii) family members and hired labor are perfectly substitutable in production. In this tradition, in which all markets exists and are perfectly competitive, consumption and production allocation are separable; the allocation of production inputs are independent of the households' preference ordering. Though we acknowledge that enterprise farm theory is powerful, it has serious limitation in approaching to our family farmers since factor markets are not matured in depopulated communities and transaction of factor inputs are heavily limited. The assumptions of the competitiveness of land, capital and other factor markets lack of empirical relevance if we try to apply this theory to small-size family farming in periphery.

Though, by deducting from its gross product, the outlays on materials and wages, an enterprise family's business concern can ascertain its net profits, it is the typical feature that a small-sized family farmer in periphery seeks an annual output adequate for its basic needs; but this involves drudgery, and the family does not push its work beyond the point where the possible increase in output is outweighed by the irksomeness of the extra work. Each family farm strikes a rough balance or equilibrium between the degree of satisfaction of family needs and the degree of drudgery of labor. This paper tries to crystallize the basic characteristics of a family as having a twofold nature, combining in himself the attributes of both a producer and a consumer in the framework of a "producer-consumer" complex within which his life-sustaining behavior can be formulated as a utility maximizer.

For a family farmer, available income is divided according to the equilibrium of production and consumption evaluations or, more accurately, a desire to maintain a constant level of well-being. A family farmer as a producer-consumer complex, differed from the traditional enterprise family, consumes part of their agrarian

outputs and supplies part of surplus laborforce to outside jobs. If net profits are emerged in family farming, they are allocated among family members. If the production sector runs into the debt, the family members owe all of the responsibility to bear it. In the following, I formulate the life-sustaining behavior of a family farmer within a utility maximization framework and investigate how for different families the balance between the level of consumer satisfaction and the degree of drudgery is affected by the size of the family and the ratio of working members to nonworking members.

3. FORMULATION OF THE MODELS

3. 1 Basic Assumption

Let me classify the types of farmers in depopulated communities into two categories: 1) *kengyo* farmers and 2) *kinro* families. I try to envisage their allocative decisions of family resources into production and consumption within the utility maximization framework. By the term "a *kengyo* farmer", I designate the household which runs agricultural production as part of means to get monetary income irrespective of its magnitude to the total income. A *kinro* family refers to that who had given up farming and gets the whole income from outside jobs. Both family types are pervasive across alomost all depopulated communities in Japan.

In formulating our *kengyo* famer model, we take account of the following basic characteristics of family farming in depopulated communities. The scope of farm-size expansion by means of land lease has so far been very limited. In a village community, agricultural production may be predeterminantly an individual operation, but farmers still require some cooperation based on collective ownership of capital, finance and knowledge to carry through their productive activities. The traditional, institutional and social constraints of the closed, self-contained universe that pervade human lives in hamlets restrict the scope of individual activities. *Kengyo* farmers may require the services of coops which provide crop drusting, for example, while they may not need to participate in the shipping and sales cooperative. Thus, family farming in depopulated communities is not operated in competitive manners. Those characteristics peculiar to family farming should be taken into account in the formulation of the models.

3. 2 *Kengyo* Family Model

Let us formulate the life-sustaining behavior of the representative *kengyo* farmer in the framework of a producer-consumer complex. As assumed in much literature, agricultural production technology is supposed to be decreasing-returns-to-scale, and to be captured in a Cobb-Douglas production function:

$$Q = aT_\omega^\alpha \bar{K}^\beta \bar{G}^\gamma, \tag{1}$$

where T_ω is time resources available for agricultural production; $\bar{K}$: the area of farm land; $\bar{G}$: the amount of capital (agricultural machines), a, α, β, γ: parameters which satisfy $(\alpha + \beta + \gamma < 1)$. Since, as described above, land markets are not highly developed in depopulated communities, let us assume that no transactions for land services are possible; each farmer is forced to utilize the fixed area of farm land for agricultural production. The machinery capital is under communal ownership and each family is rationed the flows of capital services. The amount of capital service for agriculture production is also predetermined. A farmer cannot optimize the amounts of service flows of land and capital to be invested for agricultural production. Thus, in eq. (1),$\bar{K}$ and $\bar{G}$ are not variables, but constant parameters. The amount of time consumed in agriculture production T_ω is the only variable under a farmer's control. Under these assumptions, the profit by agriculture production can be described by

$$\pi = (p - d)Q - \{\omega_1 T_\omega + \omega_2 \bar{K} + \omega_3 \bar{G}\}, \tag{2}$$

where p is the price of agricultural products, d: the variable unit cost for production, ω_1: the rent of time resources, ω_2: the tax rate for agricultural land, ω_3: the rent for capital. It must be noted that the economic

category "wages" is devoid of content and the economic theory of wages irrelevant to family farming. We can see no validity in circumventing the absence of wage data by imputing values to unpaid family labor. The rents of time resources can be evaluated by the opportunity costs of time, which are assumed to be approximately estimated by the wage rates in labor markets.

Taking the entire family household as a single economic unit and treating their annual products minus their outlays as a single return to family activity. Then, the agricultural income Y_{agr} can be defined by

$$Y_{agr} = \pi + \omega_1 T_\omega. \tag{3}$$

Let us consider the representative family which constitutes n workers and m non-workers. Each family member is endowed with time resources T common to all members. The member i allocates his/her time resources between leisure and working activities. Non-working family members can also contribute to agricultural production. The productivity of non-working members is less than that of working members. In order to commensurate differences in productivity among different family members, the effective value of time resources of a non-working member can be evaluated to be κ times as large as that by a working member. If the rents of time resources for agricultural production are valuated by use of market wage rates, wage incomes by outside jobs can be perfectly substitutable for factor incomes by family farming.

Assume that non-working members cannot get outside income opportunities due to institutional, social and physical constraints in rural communities. A *kengyo* family can provide its surplus time resources for outside jobs in order to gain wage incomes. The time resource constraints of the whole family and of each family member are expressed respectively by

$$T_\omega = \sum_{i=1}^{n} S_i + \sum_{j=1}^{m} S_i/\kappa, \tag{4}$$

$$T = S_i + L_i + (1+\tau\sigma)R_i \quad (i = 1, \cdots, n), \tag{5}$$

$$T = S_j + L_j \quad (j = 1, \cdots, m), \tag{6}$$

where R_i is working time in outside jobs, τ: commuting time per a day, σ^{-1}: average working time in outside jobs per a day. Let Y be the capital income and $Z_i, (i = 1, \cdots, n+m)$ be the demand for composite goods by a family member i. Assume that the farmer's products and market agricultural products are fully substitutable. The self-consumption of the agricultural outputs can be interpreted that the household sells the agricultural outputs to itself at market prices. Then, applying the fullincome-fullcost principle [7], the full-income constraints of the household can be rewritten to

$$\begin{aligned} &\sum_{i=1}^{n+m} Z_i + \omega_1\{\sum_{i=1}^{n}(L_i + \tau\sigma R_i) + \sum_{j=1}^{m} L_j/\kappa\} \\ &= \omega_1(n + m/\kappa)T + Y + \pi. \end{aligned} \tag{7}$$

In general, there are definite agreements among household members on the consumption and time allocation schedules. A key property of the family welfare function is that it is just that, one utility function: the allocative schedules of the children and other members of the family are assumed to enter the utility function of a single decision maker, thus obviating the necessity of a family utility function with all of the concomitant difficulties of aggregation associated with it. The family can be said to act as if it maximizes such a group preference function. It is assumed that the household has the egalitarian welfare function and the weights of the needs for the consumption of leisure time and composite goods are same across all family members [11]. Then, a household welfare function can be described by a function of the effective values of aggregated leisure time over family members, $\sum_{i=1}^{n} L_i + \sum_{j=1}^{m} L_j/\kappa$ and the aggregated consumption of the composite goods, $\sum_{i}^{n+m} Z_i$. Let us describe the household welfare function by a CES utility function:

$$W = [\{c_1(\sum_{i=1}^{n} L_i + \sum_{j=1}^{m} L_j\kappa)\}^\rho + \{c_2(\sum_{i=1}^{n+m} Z_i)\}^\rho]^{1/\rho}. \tag{8}$$

Then, the production-consumption behavior of the representative *kengyo* family can be described by the following utility maximization problem:

$$V_1 = \max_{L_i,Z_i,R_i,S_i}[\{c_1(\sum_{i=1}^{n} L_i + \sum_{j=1}^{m} L_j/\kappa)\}^\rho + \{c_2(\sum_{i=1}^{n+m} Z_i)\}^\rho]^{1/\rho},$$
$$\text{subject to} \quad \text{eqs.(5),(6),} \quad \text{and} \quad (7), \tag{9}$$

By solving this problem, we can get the household labor supply function for outside jobs (10), the household demand function for leisure time(11), and the household demand function for the composite goods(12):

$$\sum_{i=1}^{n+m} R_i = \omega_1^{-1}(\frac{c_1}{c_2})^{\frac{1}{1-\rho}}\xi\frac{1}{1-\rho}\Omega\Phi^{-1} - \Psi), \tag{10}$$

$$\sum_{i=1}^{n} L_i + \sum_{j=1}^{m} L_j/\kappa = \Phi^{-1}\Omega, \tag{11}$$

$$\sum_{i=1}^{n+m} Z_i = (\frac{c_1}{c_2})^{\frac{1}{1-\rho}}\xi^{\frac{1}{1-\rho}}\Phi^{-1}\Omega, \tag{12}$$

where $\Phi = (\frac{c_2}{c_1})^{\frac{1}{1-\rho}}\xi^{\frac{\rho}{1-\rho}} + 1$, $\xi = \frac{\omega_1}{1+\tau\sigma}$, $\Psi = Y + \xi^{\frac{\alpha}{\alpha-1}}\alpha^{\frac{\alpha}{\alpha-1}}\{(p-d)a\bar{K}^\beta\bar{G}^\gamma\}^{\frac{1}{1-\alpha}} + \xi^{-1}\Psi$, $\Omega = (n+m/\kappa)T - \xi^{\frac{1-\alpha}{\alpha}}\{\alpha(p-d)a\bar{K}^\beta\bar{G}^\gamma\}^{\frac{1}{1-\alpha}} + \xi^{-1}\Psi$. The terms of "household demand/supply functions" refer to those which aggregate the individual demand/supply functions over all family members. The indirect utility function $V_1(p,\omega,Y,\bar{K},\bar{G})$ can be obtained by substituting eqs. (11) and (12) into the (direct) household welfare function (8):

$$V_1(p,\omega,Y,\bar{K},\bar{G}) = \{1 + (\frac{c_2}{c_1})^{\frac{2\rho-\rho^2}{1-\rho}}\xi^{\frac{\rho}{1-\rho}}\}\Phi^{-\rho}\Omega^\rho \tag{13}$$

The indirect utility function can play the basic roles in the assessment of the economic sustainability as discussed in 4.

3. 3 *Kinro* Family Model

Most of households in depopulated areas are small-sized *kengyo* families whose economic base are principally dependent upon outside wage incomes. The major workers in a family are substantially wage workers and part of leisure time bote of working and non-working members are consumed for family farming. Due to the long-term decrease of the prices of agricultural products, many *kengyo* families have given up family farming. A farmer who cannot sustain their family farming in rational ways and gives up farming may falls into that category of a "*kinro* family".

By a "*kinro* family", I designates a household who remains to live in a rural community without farming. The life-sustained behavior of a *kinro* family can be formulated within the framework of traditional household production theory. The representative *kinro* family model can be described by the utility maximizing problem:

$$V_2 = \max_{L_i,Z_i,R_i}[\{c_1(\sum_{i=1}^{n} L_i + \sum_{j=1}^{m} T_j/\kappa)\}^\rho + \{c_2(\sum_{i=1}^{n+m} Z_i)\}^\rho]^{1/\rho},$$
$$\text{subject to}$$
$$\sum_{i=1}^{n+m} Z_i + \omega_1\{\sum_{i=1}^{n}(L_i + \tau\sigma R_i)\} + \omega_2\bar{K} = \omega_1 n T_i + Y,$$
$$T_i = L_i + (1+\tau\sigma)R_i, \quad (i = 1,\cdots n),$$
$$T_j = L_j, \quad (j = 1,\cdots,m), \tag{14}$$

where V_2 is the indirect utility function of the *kinro* family. By solving this problem, we get the demand functions for leisure time and composite goods:

$$\sum_{i=1}^{n} L_i + \sum_{j=1}^{m} L_j/\kappa = \{(\frac{c_2}{c_1})^{\frac{1}{1-\rho}}\xi^{\frac{1}{1-\rho}} + \xi\}^{-1}\Lambda, \tag{15}$$

$$\sum_{i=1}^{n+m} Z_i = (\frac{c_2}{c_1})^{\frac{1}{1-\rho}}\xi^{\frac{1}{1-\rho}}\{(\frac{c_2}{c_1})^{\frac{1}{1-\rho}}\xi^{\frac{1}{1-\rho}} + \xi\}\Lambda, \tag{16}$$

where $\Lambda = \xi(n - \frac{m}{\kappa})T + Y - \omega_2 K$. The indirect utility function of the *kinro* family is given by

$$V_2 = \{1 + (\frac{C_2}{C_1})^{\frac{2\rho-\rho^2}{1-\rho}} \xi^{\frac{\rho}{1-\rho}} \{(\frac{C_2}{C_1})^{\frac{1}{1-\rho}} \xi^{\frac{1}{1-\rho}} \xi^{\frac{1}{1-\rho}} + \xi\}^{-\rho} \Psi^{\rho}. \quad (17)$$

4. ASSESSMENT OF ECONOMIC SUSTAINABILITY OF HOUSEHOLDS

Farm houses in Japan usually are clustered together in hamlets. Farmers cultivate fields that are extremely small by international standards. Since full-time farming is quite rare in depopulated communities, I classify the types of families in rural communities into three categories: (1) Type-1 *kengyo* families, (2) Type-II *kengyo* families, and (3) *kinro* families. While Type-I *kengyo* families refer to those part-time farmers who earn its major incomes from farming, Type-II *kengyo* farmers those earning from non-farming. Due to the long-term decrease of the prices of agrarian products, especially rice, and the stagnation in productivity growth of farming, the families' major income sources are gradually shifting from farming to wage incomes. Accordingly, the life-sustaining patters are transformed from "Type-I *kengyo*" to "Type-II *kengyo*", and finally to "*kinro*" patterns. If most of farmers in a local community heavily rely upon wage income from outside jobs or give up family farming, it does not portend security for the future of community and does not pretend from the aggravation of farm lands. For the future of rural communities, the sustainability of part-time farming is crucial. The needs for preserving the social viability of rural communities can best be met by enabling part-time farmers to stay in the rural communities and to reduce its own operations by consigning production to enterprise farming. In proclaiming the viability of family farming, I assailed the characterization of families' choices of its life-sustaining pattern. If a family is rational in its choice of life-sustaining pattern, it may choose that which can convey the highest utility level to itself. Thus, its choice can be characterized by the optimal pattern, k^*, which can be defined:

$$k^* = \text{argmax}\{V_1, V_2\}, \quad (18)$$

where V_1 is the indirect utility when the family continues part-time farming, and V_2 is that if it gives up farming. Type-1 and Type-II *kengyo* families can be classified in terms of the magnitude of its agricultural income to the total income. If $Y_{out} = \sum_{i=1}^{n} \omega_1 R_i \leq Y_{agr}$, the family falls into Type-1 category; if it is not so, it dose into Type-II.

It is often the case in depopulated cummunities that families do not cease part-time farming after farming is turned to be no mote rational to get incomes. Even though it recognizes farming non-rational, a family farmer may not lose its incentive to continue farming as far as the agrarian revenue pQ exceeds the variable costs dQ. The farmer's attachment to its farming has been buttressed by an ancestral identification with the land, a desire to maintain the farm as a productive post-retirement vocation, the psychological frictions for transformation of living style, and the expectation of higher land prices in the future. If a family is, however, operating non-rational farming, it is very likely that it may cease farming in near future triggered by accidental events like heavy snow, price fluctuation of agrarian products, change in family structure, etc. The communities, where most of families are operating part-time farming in non-rational manners, are under the danger of sliding into the forfeiture of communal economic base, which may lead to the death of the community in the long run.

5. EMPIRICAL ANALYSIS - A CASE STUDY IN TOTTORI

5. 1 A brief description of the case study area

A total of twenty depopulated hamlets in Tottori region (See Fig. 1) are chosen as case study areas. Those hamlets are fallen into three groups in terms of commuting time to Tottori city. All hamlets are faced with serious decrease in the number of farmers and fertility loss of farm lands. Questionnaire surveys were made for all 300 rice producing family farmers in the case study hamlets. From the agriculture census, the following parameter values are estimated: the price of products $p = 20,000 yen/1 pyou$, the variable unit cost $d = 5000 yen/1 pyou$,

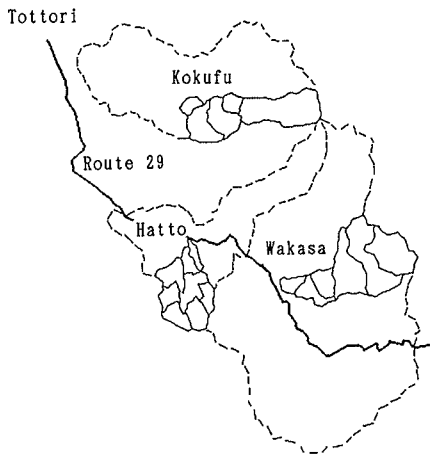

Fig. 1 Case Study Area

the wage rate $\omega_1 = 100yen/1hour$, the property tax for farm lands $\omega_2 = 3000yen/1are$, the rent for capitals $\omega_3 = 3000yen/1hour$, the coefficients of the effective time value of non-working family member $\kappa = 2$, average working hours at wage jobs $\sigma = 8hours/1day$, time budgets $T = 5840hours/1year$. The machinery capitals are under common ownership of the hamlet farmers. Available time of machinery for each family is fixed to $G = 100hours/1year$.

Based on the data from the questionnaire surveys, the labor force supply functions for farming and those for outside jobs, the demand function for composite goods, and the indirect utility function are estimated according to the following manners: 1) to estimate the parameters, α, β, and γ of the production function; 2) given the parameter values, α, β, γ,to estimate simultaneously the family supply functions of labor force for farming and those for outside jobs, and the family demand function for composite goods; 3) to estimate the indirect family utility function. The multi-correlation coefficients of supply and demand functions are 0.625 and 0.688, respectively, each of which shows fairly good reproductivity of the original data. Estimated results of the indirect utility functions are:

$$\begin{aligned} V_1 &= (0.003\xi^{0.754}+1)^{-0.435}[26280 - 280.73\xi^{1.821}(p-82)^{1.821}\bar{K}^{0.646} \\ &\quad +\xi^{-1}\{Y + 622.15\xi^{-0.821}(p-82)^{1.821}\bar{K}^{0.646} - 3000\bar{K} - 3000\}], \\ V_2 &= (0.003\xi^{-0.245}+1)^{-0.435}\xi^{0.571}(26280\xi + Y - 3000\bar{K}), \end{aligned}$$

where $\xi = 1000/(1+0.125\tau)$.

5. 2 Sustainability of individual farms

An important direction of agricultural development is to foster communities selectively into viable systems that can sustain the economic income from agricultural activities comparable to the level of nonfarm household income. In order to improve farming efficiency, it is essential to increase the scale of the farm operation by promoting both the exodus of family farm units and entrepreneurial operations among remaining, more efficiently operated farms.

Before the assessment of the viability of the communal economic base, I try to judge the economic sustainability of individual family farming. Figs. 2 and 3 show the relationships among capital income, Y, the farm land area, $\bar{K}$, and its choice of life-sustaining patterns of individual six-members families (three generational families) in

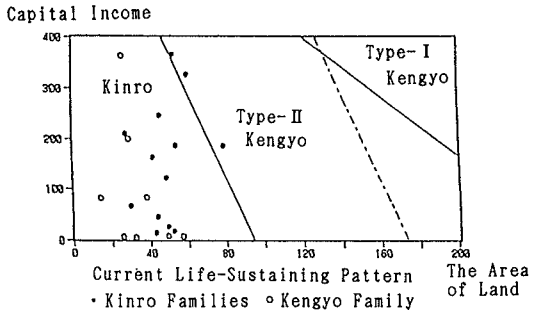

Fig. 2 Effects of Capital Income and the Area of Land to the Choice of Life-Sustaining Pattern (Community A)

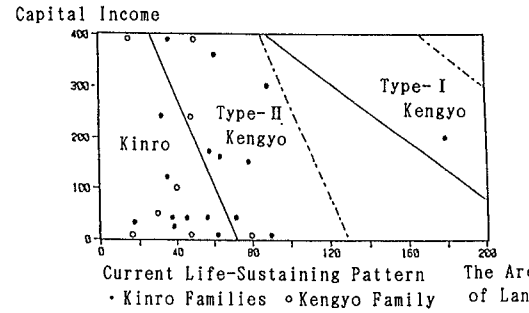

Fig. 3 Effects of Capital Income and the Area of Land to the Choice of Life-Sustaining Pattern (Community B)

Communities A and B. These figures also explain the combinatorial set of the endowments of Y and $\bar{K}$ which make rational farming possible. Community A is located in the vicinity of Tottori city, while B is in mountainous region. In both communities, as the farmers' endowments become poorer, the rational life-sustaining patterns change from "Type-I *kengyo*" to "Type-II *kengyo*" and "*kinro*" families. Given the same capital income level, the critical levels of farm land areas which delimit rational and non-rational farming in Community B are smaller than those in Community A. In fact, in the hamlets around Tottori city like Community A, many family farmers have ceased farming and the aggravation of farm land is going on.

On the other hand, in Community B many farmers still have incentives to continue farming. However, it does not means that the welfare levels of farmers in Community B are greater than those in Community A. As shown in Fig. 4, average indirect utility values of farmers in communities close to Tottori city are generally higher than those in communities in mountainous region since the residents in suburban community are endowed with rich opportunities for outside jobs. Due to the low availability of outside jobs, the welfare of farmers in mountainous

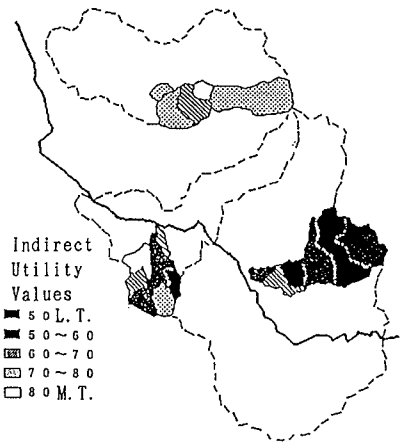

Fig. 4 Average Indirect Utility Values by Communities

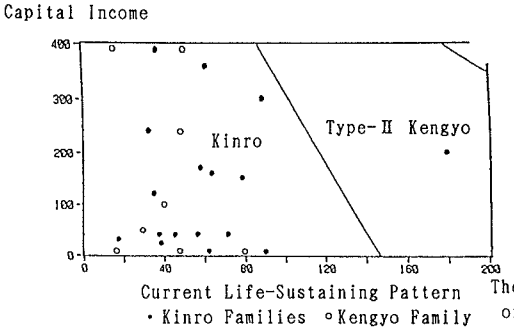

Fig. 5 Effects of the Reduction of Commuting Time to the Choice of Life Sustaining Pattern

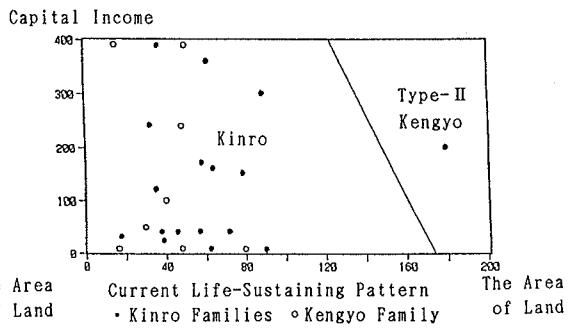

Fig. 6 Effects of the Increase of Market Wage Rates to the Choice of Life Sustaining Patterns

communities still remain relatively low levels.

Figs. 2 and 3 also explain how the sustainability of individual firms will change if the rice prices decrease to the 3/4 level of the current one. As delineated by dotted lines, the conditions for rational farming are dramatically narrowed. In Community A, all six-members family farmers are fallen into non-rational category after market deregulation. In Community B, only one family will be able to be viable. Thus, it is clearly expected that in the coming free trade regime of rice, the economic base of family farmers will be seriously damaged and communal agricultural activities seem not to be viable. Figs. 5 and 6 explains how infrastructural arrangement affects the economic viability of family farmers. Fig.5 explain what will be happened in the economic viability of family farming if the commuting time to Tottori decrease to the 3/4 levels of the current one through the improvement of Route 29 highway. Fig. 6 shows the economic viability in the case when the wage rates of outside jobs increase 25% of the current level by incubating community firms. The above results are rather pessimistic from the agricultural point of view. While infrastructural arrangement greatly contributes to the enhancement of the welfare of residents, it gives negative impacts on the viability of communal agriculture.

One may legitimately ask the following inquiry - Has communal agriculture in depopulated areas of Japan lost all options for survival, except as a hobby? We must find solutions soon to redirect communal agriculture if we wish to prevent it from progressing into an irretrievable quagmire. The demand for preserving economic viability of communal agriculture may be best met by consigning production to enterprise farming. Due to the strong attachment to the land, transfers of land ownership seem to be difficult. The only way to expand operational scale is through an activation of the land-rental market. First while guaranteeing highly stable employment opportunities in nonagricultural sectors, it should promote greater fluidity of cultivation rights. It will be a truly unprecedented achievement if we can build upon this success and create a dual structure: a small number of competitive full-time farmers, and the rural majority who continue to hold titles to their land even as they earn the bulk of their income from nonfarm occupations, and who continue to live in the communities earning the same income level as the efficient full-time farmers.

6. CONCLUSIONS

This paper has presented an econometric model to assess the economic viability of agrarian communities in depopulated areas, where our focus is addressed to the economic sustainability of family farming, which is very

vulnerable to changes in market conditions. We showed that a *kengyo* farmer running agricultural production as a side job can be described in the form of a producer-consumer complex, which is an economic agent simultaneously possessing both aspects of a producer and a consumer. We also have developed an analytical model to assess the economic sustainability of family farming in depopulated areas.

A case study conducted for Tottori region illustrates how agricultural activities in depopulated areas can be viable under the coming free trade regime of agrarian products. We understand that most family farmers in periphery will lose their economic viability of family farming, except as a hobby. We point out the significance of guaranteeing highly stable employment opportunities in nonagricultural sectors and of promoting greater fluidity of cultivation rights. As pointed out in the above, it will be a truly unprecedented achievement if we can build upon this success and create a dual structure of a small number of competitive full-time farmers and the rural majority of land owners earning the bulk of their income from nonfarm occupations.

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