THE EFFECT OF VILLAGE LABOR RESOURCE ON THE FEASIBILITY OF NEW CROPPING SYSTEM IN INDONESIA

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ABSTRACT

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Transmigration in Indonesia refers to the movement of people from densely populated regions to less populated one for the purpose of improving their economic situation. This is one of the alternatives for alleviating Java's population pressure problem and increasing development in rural areas. The introduction of multiple cropping in resettlement areas is seem as a key to increasing the welfare of transmigrants.

The main objective of this study is to determine the feasibility of experimental multiple-cropping patterns with respect to labor supply in selected upland and lowland rice growing villages in transmigration projects of Lampung Sumatra. In addition to this, another objective is to examine the role of family labor, hired labor and exchange labor in increasing cropping intensity for achieving the socio-economic objectives of farmers.

A linear programming model was constructed for three farm types representing a lowland farm, a long-settled upland farm, and a newly upland farm. The real activities included in the model are experimental cropping patterns and existing cropping patterns in the respective villages. Farm resources included in the model are weekly levels of cash and labor, and seasonal land availability. Exchange labor

Chapter I

INTRODUCTION

1.1 Statement of the Problem

The high rate of population growth and the uneven regional distribution of population in Indonesia is among the many problem facing this country in enhancing economic development. Indonesia is a big country located between Northern top of Australia and Southern part of Southeast Asia. The archepelago consists more than three thousand islands of which the five biggest are, Sumatra, Kalimantan, Sulawesi, Irian Jaya and Java in addition to two major island groups Maluku and Nusatenggara islands.

The imbalance of population distribution is one of its serious problems. About 60 percent of people live in Java island although it represents only 7 percent of total land area of the country[1]. Java has the most fertile soil and is the seat of Central Government, trade, industry and leading universities. Irrigated agriculture has been developed for centuries although significant modernization and expansion did not start until the end of nineteenth century.

Presently, 42 percent of the total arable land in Java is being irrigated[2]. With heavy concentration of population in this island land is a scarce resource relative to labor. The landless labor class

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[1]Central Bureau of Statistics Indonesia. Ulasan Singkat Census Penduduk 1971. For arable land Department of Agriculture, 1969. See also World Bank Agricultural Sector Survey Indonesia, Vol. 1, 1974.

[2]Central Bureau of Statistics Indonesia, 1958, 1961, 1962, p. 48.

now consists of about one half of the households in many villages in Java[3].

The reverse is the case in the other islands where land is abundant and labor is scarce. Due to limited power sources for land cultivation in sparsely populated areas outside Java, the arable land per inhabitant is about the same as in Java where a greater percentage of total land is cultivated. Farm sizes range from 0.50 to 3.00 hectares, a small area indeed for supporting farm families and providing food to the large non-farming population[4].

In most discussions about Indonesia's rural development possibilities, and Java's population problem, reference is often made to transmigration. It refers to the movement of people from the more densely populated regions to the less populated ones, for the purpose of improving their economic situation. Transmigration in a narrower sense refers only to the organized migration of people from Java to the other islands. It covers not only the settlement scheme for landless or near landless Javanese farming families but also workers recruited by the estate, forestry enterprises and mines in the outer islands.

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[3] Thalaw, J. and Widya Utami, Klaten, Central Java in Change on rice farming in selected areas of Asia, IRRI, 1975. p. 149-178.

[4] Central Bureau of Statistics of Indonesia, Agricultural Census, 1963, op. cit.

Transmigration schemes were established on the assumption that the new settlements would be permanent[5]. If the transmigration to new agricultural lands was to be successful, the new farms had to be permanently productive and economically viable. Priority was placed on producing food for family with some surplus for sale. If this were demonstrated successfully, there may be a complementary effect on the local population still engaged in shifting cultivation who may also wish to pursue a more stable type of agriculture. In order to use all land, a more diversified farming system is needed, but settlers are now likely to diversify their foodbase is dependable. The amount of land a farmer and his family can cultivate for food crops with hand labor is less than one hectare, and the rest consequently lies idle. They may be able to cultivate a larger area if a suitable cropping patterns can be developed.

While very few settlers have returned to Java, this does not mean that settlement transmigration has been an overall success. It has been common for settlers to move out of the schemes to places with better soil conditions. Nevertheless most of the earlier settlements have proved more prosperous for the transmigrants than where they came from. To accelerate the achievement of the main objectives of the transmigration program, it is very important to provide and

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[5]See preliminary Report of A. Syarifuddin and J. L. McIntosh, "Cropping System for Transmigration Areas in Lampung on Upland, Red-Yellow Podzolic Soils". Paper submitted to Symposium Pencegahan dan Pemulihan Tanah-tanah Kritis, Jakarta, Indonesia, October 27-29, 1975. Also see Suryatna E.S. and J.L. McIntosh, "Food Crops Production and Control of Imperata cylindrica on Small Farms", presented at the Workshop on Alang-alang (Imperata cylindrica), Central Research Institute for Agriculture, Bogor, Indonesia, July 28-29, 1976.

introduce a new technology to the setlers. Increased food production has been traditionally accomplished by expanding the area or by improving the yields of individual crops. It is also possible to make fuller use of time by introducing multiple cropping, that is, the practice of growing more than one crop on the same piece of land in a year. Multiple cropping enables an increase in both area cultivated per year, as well as in total yield per unit area per year[6]. Multiple cropping usually absorbs more labor than single cropping although labor utilization is more complicated. Timing and amount of labor input are very important factors, sometimes biologically feasible cropping patterns cannot be applied by the farmers because of insufficient labor when it is needed. The village labor system is complicated because culture and traditional institutions influence the amounts and timing of labor used from the various sources such as hiring family labor and the gotong-royong system. Gotong-royong is a system of exchange labor having operating characteristics that are specific to Indonesia tradition. To develop economically viable cropping patterns detailed investigation of labor systems in the village is necessary, especially in order to assess the viability of new cropping patterns in particular regions.

This study is concerned primarily with the problem of allocating resources at the farm level, especially labor resources, to achieve the socio-economic objectives of the farmers in Sumatran resettlement schemes.

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[6]Dalrymple, D. G., Survey of Multiple Cropping in Less Developed Nations. U. S. Department of Agriculture and U. S. Agency for International Development, Washington, D. C., 1971, p.1.

The study focuses on the labor system in relation to potential cropping system in selected agricultural villages in the resettlement scheme in Central Lampung, Sumatra island, Indonesia.

Recent developments in farm planning techniques such as the use of linear programming, facilitate the study of resource allocation. The technique can be used to determine the manner in which available resources of labor, land and capital should be allocated to establish a more rational farm plan. Application of the technique to models of resettlement scheme farms in Central Lampung is aimed at investigating possible alternatives to improve the present farmers' condition. The analysis is also expected to throw some light on various viable farm plans which might be useful for development planning.

1.2 Objectives and Hypothesis of the Study

The specific objectives of this study are:

(1) To determine the feasibility of experimental multiple cropping patterns with respect to labor supply in selected upland and lowland rice growing villages in a resettlement scheme in Central Lampung.

(2) To examine the role of family labor, hired labor, and "gotong-royong" labor in increasing cropping intensity, particularly in relation to farm cash flow, and

(3) To explore the implications of the above for adoption of the new cropping systems in Indonesia.

Statement hypotheses:

(1) By encouraging the farmers to practice multiple cropping they will increase the average productivity of land and labor. Moreover, this will increase labor requirements which will increase employment opportunities through time.

(2) a. Labor practices vary among regions as a result of differences in the agro-economic environment.

b. Labor practices vary among farms due to varying farm characteristics, i.e. farm size, cropping pattern, income, and others.

c. Labor practices vary within the year because of seasonal factors.

(3) a. Increasing cash flow will shift labor utilization from --- "gotong-royong" source to the hired labor source.

b. In existing systems, despite farmers' objectives of maximizing profit, they stop using hired labor before reaching the point where the marginal value product of labor is equal to nominal wage because cash is limited.

(4) By introducing new cropping patterns, farmers will re-allocate available resources in the village and this will make it possible to increase net income of the farmer. This reallocation will redistribute labor within the year because this is one of the ways multiple cropping can increase profit.

1.3 Review of Literature

The pressure of rapid population growth with limited growth in non-farm employment opportunity is a major factor influencing agricultural productivity in Southeast Asian countries[7]. Java in particular shows the effect of relatively intensive population pressure Labor productivity is low where labor is used more intensively and where there are few opportunities for off-farm employment. The introduction of high-yielding rice varieties has increased the requirement for the human labor input in rice production in several areas of Java[8].

Hayami[9], has pointed out that the human saturation of all farm land has made unemployment the prime agricultural problem in Southeast Asia. There is little possibility of augmenting the cultivated land area to mitigate the pressure of population. The traditional pattern of agricultural growth through expansion of crop land has ceased in Java island. Now the problem is how to increase food production on small farms and simultaneously solve the unemployment problem.

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[7] Barker and V. Cordova, Labor Utilization in Rice Production Resource Paper No. 5, December 13-16, 1976, Conference Economic Consequence, New Rice Technology, IRRI, Los Baños, p. 1. Hayami, Y. et al., Agricultural Growth Against Land Resource Constraint the Philippines Experience, Paper No. 75-14, Agricultural Economics Department, International Rice Research Institute, Philippines. 1975, p. 2.

[8] Collier and Sayogo, Employment Opportunities created by the HYV in several areas in Java, Agro-Economics Survey of Indonesia, Research Notes No. 8, June, 1972. p. 972.

[9] Hayami Y, et al, 1975. Agricultural Growth Again Land Resource Constraint. The Philippine Experience, Paper No. 75-14. Agricultural Economics Department, IRRI (mimeo). p. 1.

In a case study in Indramayu regarding the employment aspect of multiple cropping farm, Aman Djauhari (1976)[10] found out that on a lowland rice farm in Indramayu, introduction of multiple cropping patterns increaased labor use by about 200 percent. Apparently, it is possible to increase the opportunity for employment in rural araas by promoting suitable cropping patterns. The use of labor can be increased by introducing cropping systems that require intensive use of labor. This does not necessarily result in greatest efficiency and profitability because this depends upon the level of technology, crop varieties, management and environment of the production process. Therefore, development of cropping patterns suitable local conditions is urgently needed.

As the pressure of population growth forces a more intensive labor use in Java island, and a large amount of unexploited land is available outside Java, expansion of cultivated areas through new settlements appears to be the cheapest alternative for increasing agricultural output (Hayami, et al., 1975)[11]. However, as population continues to press against the supply of land, it becomes increasingly costly to expand the open new lands. Eventually, investment to improve land quality and intensive utilization of land becomes more profitable.

T.H. Lee postulated that increased employment opportunities and increased agricultural production can be achieved by encouraging cropping systems that can absorb large labor inputs and turn out high production per unit area. Given the limited araa of new land available

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[10]Aman Djauhari, Employment Aspect of Multiple Cropping. A case study in Indramayu. The paper is presented in cropping system workshop, CRIA, August 23-24, 1976, Bogor, Indonesia.

[11] Hayami, Y. et al., op cit., p.1.

in Southeast Asia, it appears that increasing land productivity is the only feasible way toward agricultural development. Increasing land productivity enhances labor return. Agricultural development is directly related to intensive utilization of farm land and labor as well as by the improvement in the cropping system (Lee, T.H.)[12].

According to Banta it does not matter in traditional one-crop system if the farmer is 4 or even 6 weeks late in planting his rice. However, in a cropping system in which a farmer is planning to grow more crops in one year, planting dates are critical. Once a crop is harvested, it is often essential that another crop be seeded immediately if the farmer is to grow the crops at their optimal periods. The critical periods in intensive cropping systems are harvesting and planting which usually occur one or two days apart. Labor utilization and subsequent production costs of intensive systems are related to the requirement for rapid field operations. The cropping intensity and the area a farmer can handle are thus determined by labor use (Banta, G.R.)[13].

Oshima's study of Taiwan's experience suggests that multiple cropping was chosen as a strategy to increase employment and achieve rural reconstruction and this may have been the case also for Japan in the 1950's. The strategy appeared successful as far as rural reconstruction and rural development was concerned. Multiple cropping played a major role in Taiwan villages,especially the smaller farms,

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[12]Lee, T. H. Agricultural Diversification and Development, Paper presented at a SEADAG Rural Development Panel Seminar, January 6-8, 1971. Manila, Philippines.

[13]Gordon R. Banta and Richard Harwood, The Multiple Cropping Program at IRRI, The Philippine Economic Journal, Vol. XIV, Nos. 1 & 2, 1975.

in increasing farm family incomes from both farm and non-farm sources to the level of urban incomes. This occurred in 1966 when the multiple cropping index reached the historically unprecedented peak of 190 (Oshima, 1975)[14].

In order for multiple cropping to be successfully increased in Indonesia there is much work to be done. One of the important things is to design the cropping patterns for economic criteria, in which the objective is to combine crops into a pattern and specify the technique to execute the pattern (Price, 1976)[15]. The guiding principle in designing new patterns is to stabilize the flow of inputs into farm enterprises. This is related to profitability in that reducing fluctuation in the use of input such as labor and cash can reduce the cost of production both by employing slack resources, the opportunity cost of which are low, and by reducing input requirements in period of peak use when costs can be relatively high. Slack inputs such as unused family labor, machinery, and financial resources can be considered to cost the farmer the rate at which the input would be paid in the highest paying off-farm employment, less the cost of finding and holding that employment.

1.4 Organization of the Thesis

The thesis is divided into 5 chapters. Chapter 1, the general introduction, defines the problems, sets the objectives and hypotheses

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[14]Harry T. Oshima, Multiple Cropping in Asian Development: Summary and Further Research, The Philippine Economic Journal. Vol. XIV, Nos. 1 & 2, 1975.

[15]Price, E. C. Design of Cropping Pattern for Economic Criteria. Paper presented at Symposium on Cropping System Research and Development for the Asian Rice Farmer, IRRI, Los Baños, September 21-24, 1976, p.7.

of the study, and includes a review of literature. Chapter 2, presents the research methodology and conceptual framework, data collection, description of the area of study, and analytical procedures. Chapter 3, gives the background of transmigration and the research project that has been formulated to solve the problem of agricultural production in transmigration areas. The section on transmigration explains recent history of transmigration in Sumatra, and the agroclimatic and social conditions faced by the transmigrant in Lampung.

Chapter 4 deals with quantitation of linear programming model as the effect of labor supply on feasibility introducing new cropping system. Chapter 5 deal with optimal solution of Linear Programming model investigating the effect of different cash available in the farm, wage-rate and "gotong-royong" practices to various cropping pattern combinations, to land, cash and labor utilization, as well as the effect to the net income.

Chapter II

Research Methodology

2.1 Conceptual Framework

Labor is basic to production and from the standpoint of economic theory, labor productivity is an important indicator of economic efficiency. The more a unit of labor produces, the more it will contribute to aggregate product, resulting in higher per capita income and standards of living. In other words, to increase labor productivity is to take an important step in economic development. Where labor is in surplus and farm land is limited, it is possible to raise farm labor productivity through more labor-intensive enterprises[16].

A major factor in the choice of multiple cropping to achieve the objective of profit maximization, is the farmers' overall resource allocation. Highest profit of a farm is attained when the values of the marginal product of resources are equalized in all alternative uses[17].

Mathematics is the major tool researchers employ to formulate and analyse the resource allocation problem. The entrepreneur ---

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[16]Lee, T.H., op cit

[17]See micro-economic textbooks. Henderson, J. M. and J. F. Quandt, Microeconomic Theory: A Mathematical Approach, Tokyo, McGraw-Hill, Kogabusha Ltd, Leftwich, R. F. The Price System and Resource Allocation, Fifth edition, Oklahoma State University, Hindale, Illinois 60521, The Dryden Press; an Baumol, W.J., Economic theory and Operation Analysis, Fourth Edition, Englewood Cliffs, New Jersey 07632, Prentice-Hall, Inc.

be viewed as maximizing his output level at a given cost level, or as minimizing the cost of producing a given output level. The first-order conditions for both problems require that the rate of technical substitution between the inputs be equated to their price ratio. More comprehensives, the entrepreneur may be viewed as varying both output levels and cost, and maximizing his profit. Here are first-order conditions require that the value of marginal physical product of each input be equated to its price. The second order condition is that the production function be strictly concave in the neighborhood of a point at which the first-order conditions are satisfied. That is, the marginal productivities of inputs must be decreasing.

A difficulty occurs in the above analysis when faced with non-differentiability and a limited variable range of a levels. To deal with such an optimization problem (frequently in economics) where the marginal maximization condition fails, a new system of analysis called mathematical programming has been applied. It has proved to be of very great significance for economics and business decision-making[18].

One of the techniques of mathematical programming is linear programming, a more advanced approach than the more common inter-commodity budget. It can be used to maximize (or minimize) an objective function such as profit (or cost), to obtain a single optimum solution. It can also provide information on factors limiting further increase in the maximum value of the objective function. The optimum solution

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[18]Baumol, W.J., Economic Theory and Operation Analysis, Fourth Edition. Englewood Cliffs, New Jersey 07632, Prentice-Hall, Inc. pp. 297-317.

can be used as a guide in decision making. Mathematical programming differs from classical optimization in that it is not requisite that the optimizer utilize all the available resources. On the other hand, the classical approach to optimum resource allocation employs the marginal analysis of continuous product-factor relationships by using the Lagrange multiplier method for the constrained optimization problem[19].

2.2 Linear Programming Model

In general, the linear programming model maximizes an original objective, or the "primal" problem, and at the same time minimizes a corresponding objective function under different constraints called the "dual" problem.

More fully elaborated, a maximization program in a n variables and subject to m constraints will appear as follows:

$$\text{Maximize } Z = c_1x_1 + c_2x_2 + \ldots\ldots\ldots\ldots + c_n x_n$$

$$\text{Subject to } a_{11}x_1 + a_{12}x_1 + \ldots\ldots\ldots\ldots + a_{1n} x_n \leq r_1$$

$$a_{22}x_1 + a_{22}x_2 + \ldots\ldots\ldots\ldots + a_{2n} x_n \leq r_2$$

$$\vdots \qquad\qquad \vdots \qquad\qquad \vdots$$

$$a_{m1}x_1 + a_{m2}x_1 + \ldots\ldots\ldots\ldots + a_{mn}x_n \leq r_m$$

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[19] Ibid. p. 297.

and $x_j \geq 0$ (j = 1,2, ... n)

In matrix notation the "primal" problem is:

Maximize $Z = c\,X$

Subject to $AX \leq r$

$x \geq 0$

where:

Z = Net Income

$\underline{X}$ = The (nx_1) Xj vector of activities

$\underline{c}$ = The (n x 1) vector of net income per hectare, i.e. C_j is the net income per hectare from activity X_j, j = 1, ... n

$\underline{r}$ = The (m x 1) vector of r_i giving the available level of the $i^{\underline{th}}$ resource (i = 1, 2, ... m)

The dual problem is:

$$\text{Minimize } I = r_1 V_1 + r_2 V_2 = \ldots\ldots\ldots\ldots + r_m V_m$$

$$\text{Subject to } a_{11}V_1 + a_{21}V_2 + \ldots\ldots\ldots\ldots + a_{m1} V_m \geq C_1$$

$$a_{12}V_1 + a_{22}V_2 + \ldots\ldots\ldots\ldots + a_{m2} V_m \geq C_2$$

$$\vdots \qquad \vdots \qquad\qquad\qquad\qquad \vdots \qquad \vdots$$

$$a_{1m}V_1 + a_{2m}V_2 + \ldots\ldots\ldots\ldots + a_{nm} V_m \geq C_n$$

$$\text{And } V_i \geq 0 \quad (i = 1, 2, \ldots\ldots\ldots\ldots m).$$

In matrix notation, the "dual" problem is:

Minimize $I = r'V$

$A'V \geq C$

$V: \geq 0$

Where: I refers to the total imputed value of the m resources

V refers to the (m x 1) vector of V_1 giving the imputed value (shadow price) of the i^{th} resource

r', A' - The transposes of r, A respectively.

The slack variables make equalities out of the constraints.

Primal $AX + U = r$, and

Dual $AV - L = C$

Where: U = The (m x 1)vector of U giving the unused capacity of i^{th} resource

L = The (n x 1) vector of L_j giving the relative loss per unit of the j^{th} activity.

2.2.1 The vector of activities

The activity vector X in the "primal" problem includes the transfer activities, experimental cropping pattern activities and existing cropping pattern activities which are possible in each site. The activities represented by the X_j in the primal problem correspond to the slack variable L_j in the dual problem.

2.2.2 The vector of resource constraints

The vector of resource constraints r represents the m resources which may constrain the optimization. This study will focus on the labor problem and therefore interest is in increasing labor productivity for a given level of available labor by allocating it to present and experimental cropping patterns. The labor availability each week during the cropping season period whether family labor, hired labor, or "gotong-royong" labor, will be used as constraints, along with cash

and land resources. Corresponding to each r_i is a slack variable U_i in the primal problem and a V_i in the dual which give the shadow prices of each resources.

2.3 Study Area

2.3.1 Geographical location

The geographical area of the outreach site is between 4°47' and 5°12' south latitude and 105°04' and 105°24' east longitude. Administratively, the project area belongs to Central Lampung Province on Sumatra island. Until recently most of the area was cultivated by shifting cultivation. Now the area has been converted to permanent cropping, especially in the transmigration areas. The research area was divided into three sub regions based upon agronomic and physical conditions.

Sub-Area I is represented by Nambahdadi village. Lowland rice is grown here with water from the recently established Seputih River irrigation system. Irrigation is available 5-6 months annually and rice is usually grown during the wet season.

Sub-Area II is represented by Bandar Agung village consisting of fields opened for more than 20 years. The land is poor, eroded, and now locally infested with alang-alang (Imperata cylindrica).

Sub-Area III is represented by Komering Putih village consisting of field opened for not more than 3 years, with some erosion. The land is covered by a mixture of crops, alang-alang and scrub.

2.4 Source of Data and Data Collection

The data used in this study are obtained from a: (a) baseline survey, (b) farm record keeping, (c) a supplementary survey.

Baseline Survey. The basline survey was conducted in August and September 1975, as part of the descriptive phase of cropping system study. The objectives of the baseline survey were to obtain farm information needed to develop new multiple cropping patterns and to eventually evaluate the impact of the new cropping system.[20] In conducting the baseline survey and subsequent research, the study area was stratified into three subareas based on agronomic and physical conditions that have been described above. Record keeping data that were available contained information on daily use of land, labor, power and cash in all farm activities during 1975-76. The supplementary survey involved gathering of additional information for the major thrust of the study.

In each sub-area, 4 villages were selected randomly so that a total of 12 villages were included. In each village 15 farmers were randomly selected from a list of all farms, giving a total of 180 farmers in the three sub-areas altogether in Lampung site. Of all the questionnaires completed, about 25% were not processed because of gaps and inconsistencies in the data.[21]

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[20] Central Research Institute for Agriculture Cooperative CRIA-IRRI Program, Annual Report 1975-1976 Cropping Systems Research.

[21] Djauhari, A, Cropping Patterns in Indramayu and Central Lampung Areas; Result of baseline survey. Bagian Sosial Ekonomi Pertanian Lembaga Pusat Penelitian Pertanian, Bogor, Indonesia 1977.

Farm record keeping. Records of all farm activities of a sample group of farmers were taken by CRIA staff during the 1975-76 crop year in order to learn more accurately the levels of present farm resource availability and use. They use two information to design new patterns that hypothetically will use resources more efficiently. After the new patterns have been grown in the field, their performance is compared to farmers present patterns, again based upon daily farm records.

The study was started on the first week of October, 1975. Nine farmers operating at least 0.50 hectares, willing to cooperate, and provide about 0.1 hectare of land for experiments were selected at random from each sub-area. These were divided into three groups and each was assigned one of three types of cropping patterns the project intended to test. In each sub-area, three farmers grew the "farmers' cropping pattern"; three grows the "farmers' cropping pattern without constraint"; and three tried a new"improved cropping pattern". Records were kept on the economic and agronomic performance of the trials on these 9 farms. Additionally, another 6 farmers in each village were selected in each sub-area to record all farm activities on their own fields.

The most common cropping pattern grown in the area was identified through discussion with farmer cooperators and this then became the "farmers' pattern"to be used as a check. Improved cropping patterns were designed by research workers at CRIA, Bogor. Farmers were also asked to choose still another pattern they would like to try, and to choose the level of inputs they would like to use, with CRIA testing the bill. This was called the "farmers cropping pattern without

constraints". After the three kinds of cropping patterns were determined, the group of these farmers to test each pattern was randomly selected in each sub-area.

In cropping pattern A, (the farmers' cropping pattern), the farmers were asked to grow the crops under their level of management. Cropping pattern B, (farmers' cropping pattern without constraint), the farmers were asked to grow the crops under their level of management, but the project would help them to remove any financial constraints on the level of inputs. In cropping pattern C, (introduce/improve cropping pattern), the farmers grew the crops without constraints and with technical assistance.

Each farmer kept input and production associated with every crop activity on a form provided by the project under the guidance of the field assistant. These data were summarized each week by the project supervisor.

Supplementary survey. The supplementary survey was conducted in May 1977 in order to obtain additional information on labor practices in each sub-area. In each village representing the respective sub-areas (Nambahdadi in sub-area I, Bandar Agung in sub-area II, and Komering Putih in sub-area III) 35 farmers were selected at random. Thus, a total of 105 farmers were indluced in the three sub-areas of the study.

2.5 Analytical Framework

The analytical framework consists of three parts. The first part describes the labor system in the village, showing what labor hiring and exchange practices are found on each type of farm. In the

third part, the model will be applied to determine the feasibility of certain new cropping patterns.

2.5.1 Village labor system

One of the questions related to labor practices is what are the factors that influence the labor use. To identify these factors, comparison will be made of labor use across sub-areas, across, farms and across time periods within the year. Here we sould like to know if labor practices are affected by physical and agronomic environment, farm characteristics, or by aeasonal factors. From the comparison, relationships will be identified regarding the role of gotong-royong. For example, we are interested in knowing when must the incoming gotong-royong be repayed, and is the use of gotong-royong related to wage rate varies.

The hypothesis is that the availability of cash will shift labor use from the gotong-royong source, to hired labor. In other words, does the gotong-royong practice occur in periods when adequate cash is not available for paying labor.

2.5.2 Quantitative model

Some of the workings of the village labor system described in the first part can be easily reflected in an LP model, but some cannot particularly there is a divergence when observed farmer behavior appears not to be based upon profit maximizing which LP assumes.

The activities included in the model are transfer activities and crops activities.

Labor transfer activities. The labor transfer activities operate to create a homogeneous pool of available labor in a given week either by allocating family labor directly to available labor in a current week or by sending family to work off-farm in order to create a gotong-royong labor debt payable in a given week, or by converting cash to available labor, i.e. hiring of workers.

(a) Create gotong-royong labor from family labor.

CGF - t-t' = create gotong royong labor to be incoming in week t, from family labor working off-farm in week t'.

X_1 = CGF-1-2

X_2 = CGF-1-3

⋮

X_{202} = CGF-52-51

(b) Create available labor from "gotong royong" labor.

CLG-t-t' = create available labor week t from gotong royong labor incoming in week t'.

X_{203} + CLG-1-1

X_{204} = CLG-2-2

⋮

X_{254} = CLG-52-52

(c) Create available labor from family labor.

CLF-t-t' = craate available labor at week t from family labor week t'.

X_{255} = CLF-1-1

X_{256} = CLF-2-2

⋮

X_{306} = CLF-52-52

(d) Create available labor from available weekly cash,

CLC-t-t' = create available labor at week t from available cash week t'.

X_{307} = CLC-1-1

X_{308} = CLC-2-2

⋮

X_{358} = CLC-52-52

Transfer cash balance activities. The total cash balance in each crop season is transferred to the weekly available cash. Cash balance in the first crop season is created from crop period 0 (previous year); cash balance in the second crop season is created from the first crop season; and the third cash balance is created from the second crop season.

CCB-t-t' = create available cash at week t, from total cash balance week t'.

X_{359} = CCB-1-1

X_{360} = CCB-2-1

⋮

X_{410} = CCB-52-1

Crop activities. Crop activities reflect the obserable crop enterprises of farmers. Cropping patterns A, B, and C, it has been described, were field tested under researchers supervision. The other patterns are those that were observed on farms outside the experimental design and who either kept daily records or were interviewed in the baseline survey.

(a) Nambahdadi village, Sub-area I

X_{411} = Cropping pattern A

X_{412} = Cropping pattern B

X_{413} = Cropping pattern C

X_{414} = Lowland Rice - fallow

X_{415} = Lowland rice - lowland rice

X_{416} = Cassava - fallow

X_{417} = Upland Rice + Cassava - fallow

X_{418} = Lowland Rice - corn

(b) Bandar Agung village, Sub-area II

X_{411} = Cropping pattern A

X_{412} = Cropping pattern B

X_{413} = Cropping pattern C

X_{414} = Upland rice + cassava - fallow

X_{415} = Cassava- fallow

X_{416} = Upland rice - fallow

X_{417} = Lowland rice - fallow

X_{418} = Upland rice + corn - fallow

(c) Komering Putih, village, Sub-area III

X_{411} = Cropping pattern A

X_{412} = Cropping pattern B

X_{413} = Cropping pattern C

X_{414} = Upland Rice + cassava - fallow

X_{415} = Cassava - fallow

Resource constraints. Multiple cropping requires the same kind of inputs as the ordinary single-cropping enterprise. The difference between the two systems is the intemporal resource application in multiple cropping. The resources used in this study are:

Land. The area of land used as constraints represents the amount of upland and lowland that an average farmer operates in each of the these subareas.

Capital. Generally there are two types of capital investment confronted by the farm operator, operating capital and fixed capital. Operating capital is entered into model as the capital constraint, and it is differentiated by cropping period, whether first crop or second crop. Also it is specified at different levels for each subarea.

Labor. As this study focused on the effect of labor supply on the village cropping system, the weekly availability of labor is used as constraints. Particularly when he attempts multiple cropping the farm operator is confronted with short time periods for carrying out operations. For instance, the operator suffers economic losses if he delays for one week when weeding is needed. This is also true for other operations such as planting, weeding, fertilizing and spraying insecticides. For this reason, the availability of labor by weekly period will use as a constraint and it is broken down into specific sources. The three sources of labor considered in this study are family labor, hired labor and Gotong-royong labor having the notations.

$r_1 - r_{52}$ = Available labor, week 1 - 52

$r_{53} - r_{104}$ = Available family labor, week 1 - 52

$r_{105} - r_{156}$ = Available Gotong-royong labor, week 1 - 52

$r_{157} - r_{208}$ = Hired labor, week 1 - 52

$r_{209} - r_{260}$ = Total cash, week 1 - 52

r_{261} = Available cash crop season I

r_{262} = Available cash crop season II

r_{263} = Lowland area, hectares

r_{264} = Upland area, hectares

2.5.3 The analysis of income and related factors

Farm income as measured by the return above variable cost (RAVC) represents a return to fixed farm resource i.e. land, operator and family labor, and long term fixed capital investment such as land, buildings, tools, and equipment. The return above variable cost is computed by deducting total variable cost from total farm crop receipts. The value of crop receipts is calculated by multiplying total production by prices received by farmers for their crops. The quantity of home use and product held for sale are valued at the prevailing price and included in the total farm receipts.

Items of variable costs are expenses for seeds, fertilizer, insecticide, weedicide, hired labor and other miscellaneous expenses such as rent and transportation costs for transporting supplies and products. In the model farm income (RAVC) is calculated on a per hectare basis. The levels of all expenses except hired labor are fixed aspects of each crop activity. Cash expenses for labor are determined endogeneously and subtracted from the RAVC.

2.6 Application of the Model

The input-output relationship and all the constraints which were quantified in part two of the study, are used to construct the simplex tableau. The optimal solution of the model answers the first and second objectives of the study.

The first objective is to determine the feasibility of experimental multiple cropping pattern with respect to labor supply in selected upland and lowland rice-growing villages in Indonesia settlement schemes. The labor utilization and practices by which the farmers can maximize net income was calculated by using the shadow prices of labor at different periods of the year.

Repeated linear programming models for three sub-areas were applied with the objective of maximizing net income, subject to weekly labor, capital, and land constraints. The model also depicted the effect on the optimum solution of variations in wage rate in each village, modifications of the gotong-royong system, and variations in cash availability. More specifically, the effect of these factors on total land use, cropping intensity, amount and sources of labor used, and various other system performance criteria can be found in the optimal solution.

Chapter III

SOLUTION IN TERMS OF TRANSMIGRATION

3.1. Transmigration Project Over Time

A World Bank report recounted that the first organized transmigration started in the second half of the last century when the culturstelsel, the system of compulsory production by villages of export crops was widespread and it became possible for private entrepreneurs to grow such export crops. The new estates were at first established in Java where sufficient labor was available. However, after the introduction of estate production on the Northeast coast of Sumatra, and later elsewhere in Sumatra and the outer islands, the estates started to depend on labor imported from Java. Sumatra was sparsely populated and the local population were not interested in estate work. It is not known how many Javanese may have migrated to the estates before the War II. After World War II, the flow of Javanese workers to the estates on the outer islands dropped considerably below prewar levels.

The Dutch Colonial Government carried out colonization in Lampung in South Sumatra from 1905 up the outbreak of World War when about 40,000 families (200,000 people) were resettled. The scheme was interrupted by the war but was continued by the Indonesian Government and since 1950 it has been called transmigration.[22]

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[22] World Bank, Agriculture Sector Survey Indonesia 1974. Vol. II Annexes 3, p. 12.

For 1950's and early 1960's objectives of transmigration began to emphasize Indonesianization, assimilation of Javanese with the other ethnic groups, and eventually defense considerations. However the approach in terms of recruiting and organization remained largely the same. From 1950 to 1959, 56,013 families or 227,044 people transmigrated and in 1960-1971, 112,508 families or 464,692 people. The peak years for resettlement were in 1953, 1959 and 1965.

Up to 1972 resettlement was carried out by a number of private and public institutions, of which the most important was the Ministry of Transmigration and Cooperatives (Trans-Kop). The Ministry set up the settlements with the help of several other Government agencies. Settlement schemes were set up by the University Dipenegoro (Semarang). The Catholic and Protestant churches and the University of Indonesia (Jakarta) organized the transmigration of skilled workmen per year to the outer islands.

By General Order No. 3 in 1972, only the Ministry of Transmigration and Cooperatives was authorized to carry out transmigration, reducing to one the some 15 public agencies that had been involved. Recent transmigration policy is aimed toward the development of the outer islands, national defense, alleviation of Java's population pressure, and Indonesianization.

According to the World Bank's assessment of the Second Five Year Development Plan (1974-1978), transmigration figures importantly in economic development as well as a social-humanitarian undertaking to relocate poor and landless people. The focus is on regional development

and more favorable spatial distribution of economic activity and improved national resource allocation. Present land settlement is aimed toward agro-development by establishing growth centres in the new region. In this way, more and more spontaneous migration from the densely populated Java and Bali islands will be encouraged into the outer islands.

Table 3.1. Number of transmigrants settled since 1950

Year	Number of families	Number of people
1950-51	790	2,954
1952	3,885	17,605
1953	10,141	40,009
1954	8,409	29,638
1955	5,491	21,389
1956	6,091	25,549
1957	4,968	23,201
1958	4,799	20,603
1959	11,439	46,096
Total 1950-51	56,013	227,004
1960	5,622	22,075
1961	5,165	20,548
1962	4,874	22,003
1963	7,692	32,159
1964	3,440	14,361
1965	13,296	53,362
1966	1,148	4,648
1967	1,312	6,166
1968	2,991	13,742
1969	1,881	7,934
Total 1960-69	47,421	196,998
1970	4,377	19,696
1971[1]	4,727	20,954
1972[2]	14,700	
Total 1950-1972	112,508	469,692

[1] Provisional
[2] Planned

Source: Ministry of Trans-kop
Cited from: World Bank Agriculture Sector Survey Indonesia, Vol:II, Annexes 3. p. 12

3.2 Agroclimatic Condition Facing Transmigrants

3.2.1 Agricultural background

The red-yellow podzolic soil of Lampung have low fertility, mostly contained in the organic matter. The rate of infiltration is high and nutrients are quickly lost by leaching. The main cropping pattern used by the farmers in transmigration areas is upland rice intercropped with corn and cassava. Little fertilizer is applied and fertility of the soil declines rapidly and productivity remains stable for only 3-4 years. If land is cultivated longer the production of food crops declines rapidly and only cassava produces satisfactorily. Consequently, because cassava is a monoculture, the land is open during a portion of the rainy season when Imperata cylindrica seeds can germinate and grow with little competition. Production is so low that farmers appear to have little incentive to weed their fields. The grass becomes firmly established before cassava is tall enough to shade the ground.

3.2.2 Rainfall and soil

According to CRIA Annual Report of Multiple Cropping Project that rainfall data recorded by the station of Bandarjaya, the main town lying in the project area. The average monthly rainfall during the period 1970-1975 is shown in Figure 3.1. The project areas have 9 wet months, the annual rainfall is 1873.6 mm with an average of 103.5 rain days. The wettest month is December and the driest one is July as shown in Figure 3.1 [23]

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[23] Central Research Institute for Agriculture, Annual Report 1975-1976 Cropping System Research. Cooperative CRIA-IRRI Program, Bogor, Indonesia.

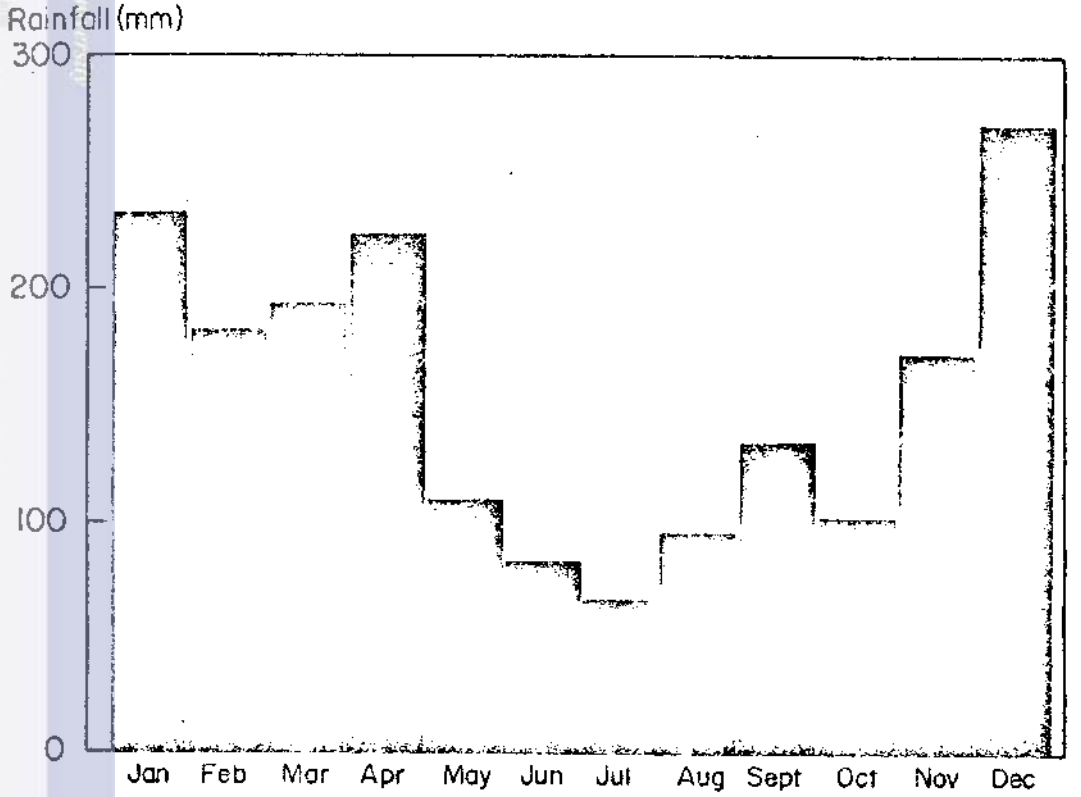

Fig. 3.1. Monthly rainfall pattern in Lampung, Indonesia, 1970-75. (6 yrs. average).

Source: Central Research Institute for Agriculture 1976. Annual Report 1975-76 Cropping Systems Research. Cooperative CRIA-IRRI Program, Bogor, Indonesia.

According to Oldeman (1973), Lampung has 2 wet consecutive months and 3 dry consecutive months. Soil of the area is the red-yellow podzolic type and has a low Ph. It is poor in nitrogen, phosphorous, and potassium, and is very susceptible to erosion due to its sandy texture. Most upland areas are covered with alang-alang (Imperata cylindrica) where base saturation is generally low.

The red-yellow podzolic soils have generally been considered as waste land having little potential for food production, probably 15-20 million hectares out of about 46 million hectares are suitable for food crop production. In these areas the rainfall usually exceeds 200 mm for at least six months a year. For the remainder of the year the long-term average exceeds 100 mm per month. In July and August the rainfall may be much less. Generally, cassava and other drought tolerant crops can grow during these dry periods. These soils are actually responsive to fertilizer.

3.3 Research to Improve Agricultural Production in Lampung [24]

Growing more than one crop on the same piece of land each year is an old practice in Southeast Asia. The best approach toward developing cropping systems technology for small farmers may be to find ways of maintaining or improving their cropping systems rather than replacing them entirely. But there is a difference between the subsistence farmers' approach and modern methods of increasing agricultural production. Subsistence farmers change the system gradually to meet the needs of their families, while modern agricultural technology usually changes the system

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[24] Central Research Institute for Agriculture 1976 Progress Report of Multiple Cropping Project, Bogor, Indonesia.

rapidly and drastically. The first approach is slow and it seldom meets food requirements because population increases faster than food production. The second approach is sometimes too fast for many farmers and is often not acceptable to the more traditional ones. Drastic changes in the rural environment can also upset ecological balances, resulting in a net loss of production capability. It is possible to alter modern technology according to principles found in traditional systems, thereby making it more acceptable to the farmers whose resources are limited. Based on these ideas CRIA researchers began in 1975 intensive work to develop new technology for transmigrant's farms in Lampung.

Objectives of research. The overall objectives of CRIA's cropping systems research were as follows:

(1) To increase food production by increasing total area in crops and production per hectare.

(2) To increase employment opportunity.

(3) To improve the small farmers bargaining position by increasing the frequency of harvest and minimizing the need to borrow (which may include items other than money).

Research approach. The research was conducted both in experimental plots and in farmers' field. The CRIA Annual Report of 1975-76 summarized the approach as follows:

(a) Development of component technology is conducted mainly at experiment stations. These scientists investigate the interactions

among plants in mixed cropping combinations and cropping sequences, and how they affect insects, diseases, weeds, soils and crop performance.

(b) Studies in farmer's field are managed by researchers with the objective of designing and testing new cropping patterns for target areas. They determine the agro-economic potential of new cropping patterns and the likely cultural problems.

(c) New technology is finally evaluated before implementation through multi-locational trials over the target area both under farmers' conditions and management and also with certain constraints removed, such as credit, seeds, fertilizer, pesticides and market facilities. An intermediate technological step between the farmers' patterns and improved patterns can be studied by examining farmers' responses to the removal of certain constraints.

Prior to the start of the experiment a baseline survey was conducted in the target areas to identify the most common cropping patterns used by farmers and to accumulate as much physical, social, economic and climatic data as possible before designing the trials.

Selection of research sites in Indonesia. Two sites were selected for cropping systems research, Indramayu West Java and Central Lampung. The agroclimatic conditions of these two sites are found also in Southern Thailand, in the Northwestern, Central and Southern Philippines, and Northeastern Malaysia. The West Java site was selected because it has a coastal alluvial soil in an area where rainfall is of high intensity over 4 to 7 months. It also has partial irrigation. Generally only one crop is now growing there but there is potential for two crops of rice, or rice and an upland crop, on most of the area.

The site in Lampung, South Sumatra includes both red-yellow podzolic and latosol soil types which represent the bulk of Indonesia's soils and are common to much of Southeast Asia. The rainy season lasts for 6 or 7 months. This area receives many transmigrants from Java, Madura, and Bali islands. Low cropping intensity and low yields compound the social problems of resettlement. The area was divided into three sub-areas based upon present agronomic and physical conditions.

Three different types of cropping patterns were tested within each subarea. Each trial was replicated 3 times by different farmers. The cropping patterns were selected on the basis of the same criteria, but were not necessarily the same between subareas. They are:

(1) Cropping pattern A - Farmers' present cropping pattern. The objectives is to establish a base check for comparison.

(2) Cropping pattern B - Farmers' choice of cropping pattern if inputs and market constraints were removed. The objective is to evaluate the farmers' level of technical competence and managerial skill and uncover hidden socio-economic constraints.

(3) Cropping pattern C - Improved cropping patterns with inputs and market constraints removed and technical assistance provided. The objective is to determine the production and economic potential.

The experiments were located in three villages each representing a subarea.

Nambahdadi village represents subarea I (Area with 5 months irrigation). Bandar Agung village represents subarea II (old alang-alang fields opened more than 3 years). Komering Putih, represents subarea III (newly opened secondary forest or alang-alang fields). Tables 3.2, 3.3, 3.4 and Appendix C show cropping patterns management practices, and cost and returns analysis for experimental cropping patterns.

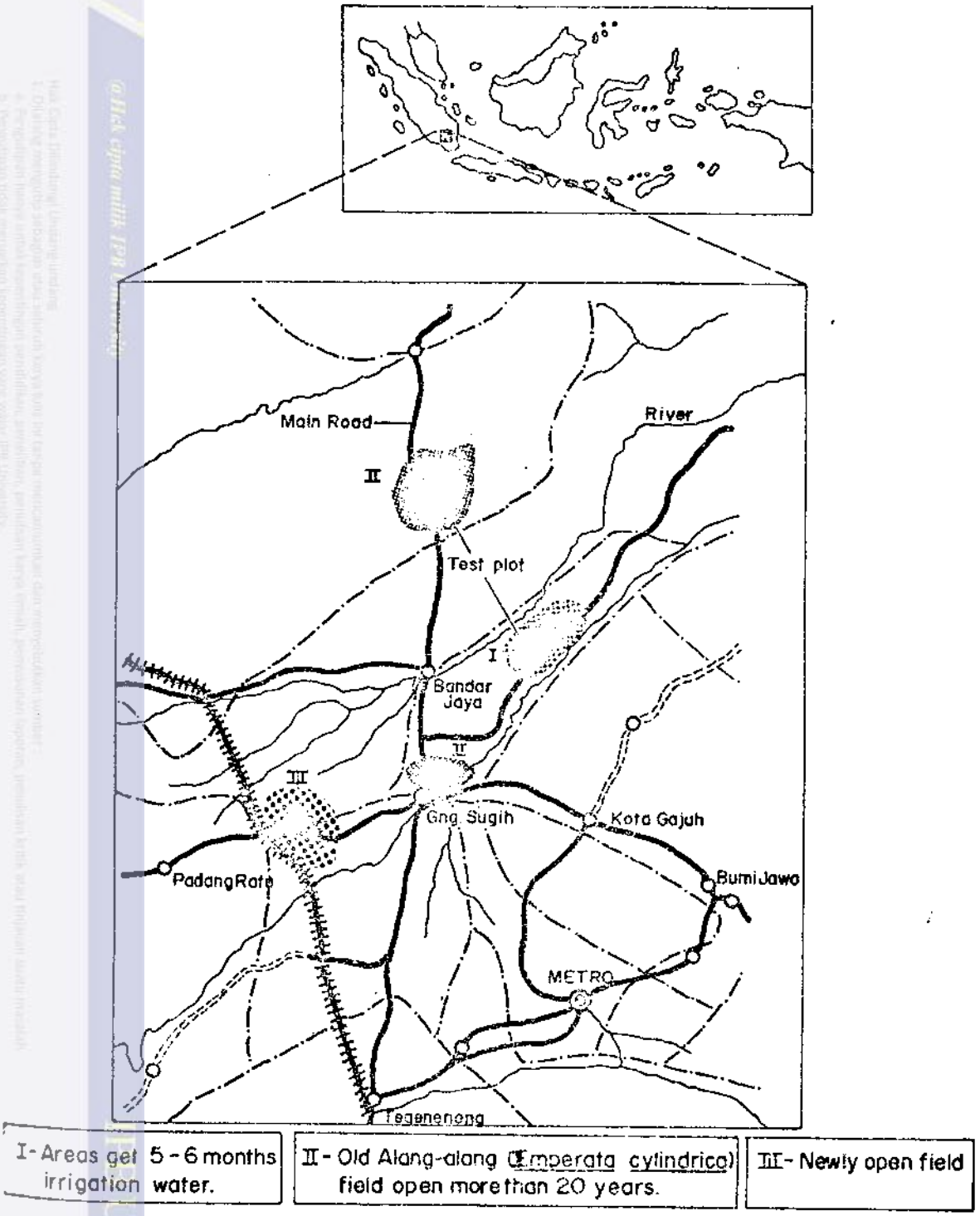


Fig. 3.2. Outreach-site, Lampung, Indonesia, 1975-1976.

Source: Central Research Institute for Agriculture 1976. Annual Report 1975-76 Cropping Systems Research, Cooperative CRIA-IRRI Program, Bogor, Indonesia.

Table 3.2 Cropping patterns and management practices for 6 months irrigation area (Category 1), Namdahdadi, Lampung, 1975-76

Cropping Pattern	Sequence	Variety	Seedling age	Spacing	Population	Fertilizer N	Fertilizer P_2O_5	Fertilizer K_2O
			(days)	(cm)	(plants/ha)		(kg/ha)	
IA - Farmer's Cropping Pattern	LLR -	Pelita I/1	35	25 x 25	160,000	-	-	-
	Corn +	DMR-5	-	300 x 80	12,500)	-	-	-
	Peanut	Local	-	25 x 25	160,000)			
IB - Farmers' Cropping Pattern without	LLR -	Pelita I/1	35	25 x 25	160,000	67	45	-
	Corn +	DMR-5	-	300 x 80	12,500)	60	33	
IC - Introduced Cropping Pattern	LLR -	Pelita I/1	21	25 x 25	160,000	90	45	25
	Corn	DMR-5	-	75 x 25	53,333	90	45	25

Source: Central Research Institute for Agriculture 1976. Annual Report 1975-76. Cropping System Research, Cooperative CRIA-IRRI Program, Bogor, Indonesia.

Table 3.3. Cropping patterns and management practices for old alang-alang fields (Category II). Bandar Agung, Lampung, 1975-76.

Cropping pattern	Sequence	Variety	Spacing	Plants/ hill	Fertilizer N	Fertilizer P_2O_5	Fertilizer K_2O
			(cm)		(kg/ha)		
IIA - Farmer's Cropping pattern	Corn +	Local	300 x (100-75)	2-4	-	-	-
	ULR -	Local	25 x (30-20)	5-8	-	-	-
	Corn	DMR-5	100 x (100-75)	3-5	-	-	-
IIB - Farmer's Cropping pattern without constraints	Corn +	DMR-5	300 x (150+100)	2-4	3	3	-
	ULR -	Bicol	30 x (25-15)	5-8	65	42	-
	Corn	DMR-5	100 x 50	3-5	60	33	-
IIC - Introduced cropping pattern	Corn +	DMR-5	(200 x 40)	2	45	22	25
	ULR +	Bicol	(40 x 15)	5-6	90	45	25
	Cassava +	Gading	(400 x 40)	1	33	11	37
	Peanut	Gajah	(20 x 20)	1	18	36	20

Source: Central Research Institute for Agriculture 1976. Annual Report 1975-76. Cropping System Research, Cooperative CRIA-IRRI Program, Bogor, Indonesia.

Table 3.4. Cropping patterns and management practices for newly opened fields (Category III). Komering Putih, Lampung, 1975-76

Cropping Pattern	Sequence	Variety	Spacing	Plants/ hill	Fertilizer		
					N	P_2O_5	K_2O
					(kg/ha)		
IIIA - Farmer's Cropping Pattern	Corn +	Local	200 x (100-75)	2-4	-	-	-
	ULR	Local	30 x (25-15)	5-10	-	-	-
	Cassava	Local	100 x (100	1	-	-	-
IIIB - Farmers' Cropping Pattern without Constraints	Corn +	DMR-5	200 x (200-100)	3-5)			
	ULR	Local	30 x (25-15)	5-10)	67	45	-
	Cassava	Local	100 x 100	1	-	-	-
IIIC - Introduced Cropping Pattern	Corn +	LMR - 5	200 x 40	2	25	22	25
	ULR	Bicol	40 x 15	5-7	90	45	25
	Cassava	Gading	400 x 40	1	33	11	37
	Peanut	Macan	20 x 20	1	18	36	20

Source: Central Research Institute for Agriculture 1976. Annual Report 1975-76. Cropping System Research, Cooperative CRIA-IRRI Program, Bogor, Indonesia.

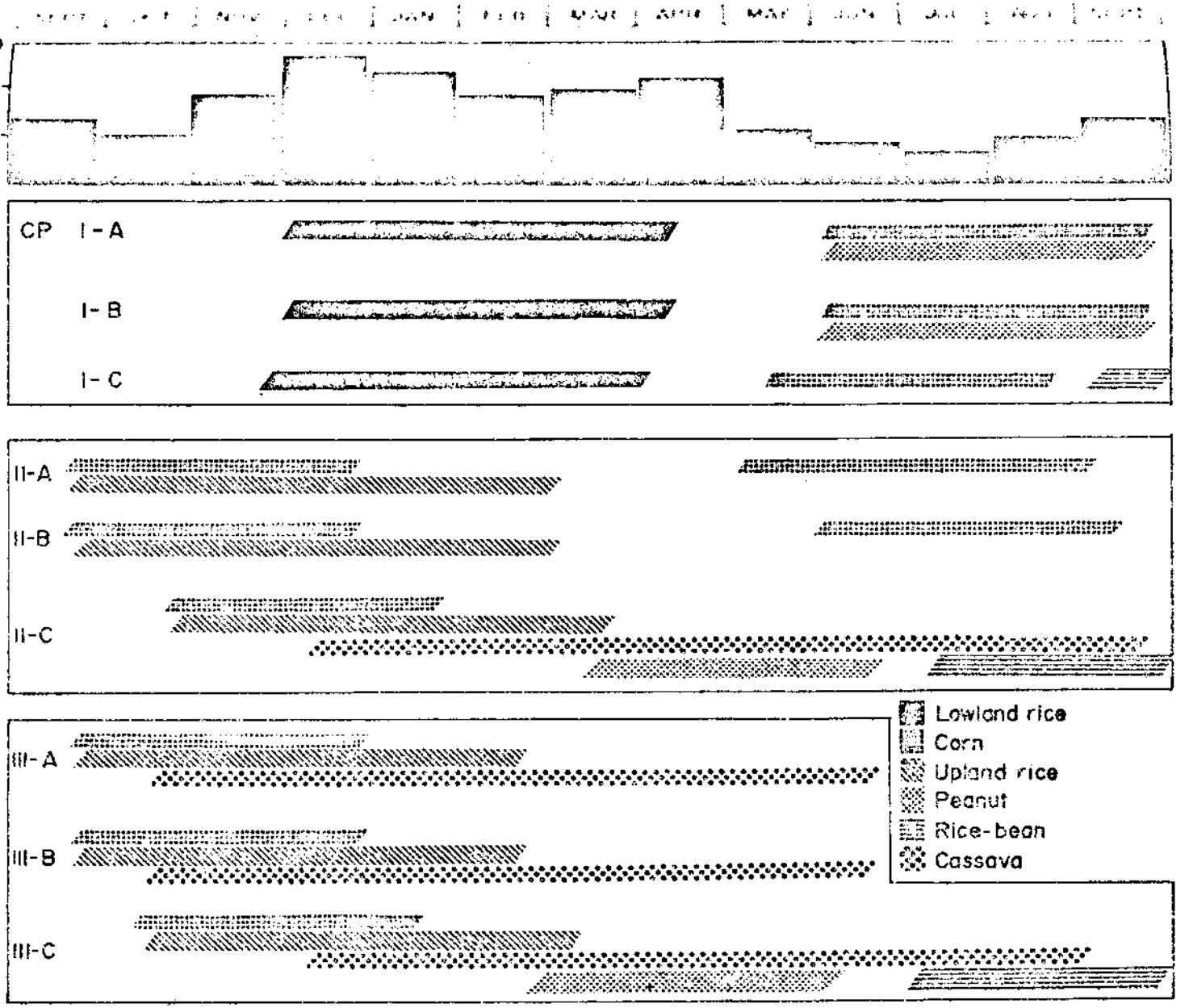


Fig.3.3. Working calendar of cropping pattern research program, Lampung, Indonesia, 1975 - 1976.
Source: Central Research Institute for Agriculture 1976. Annual Report 1975-76 Cropping Systems

3.4. Description and Labor Supply of Village Representative of Subarea

As has been mentioned on this study three villages were selected to represent their respective subarea. These villages, namely Nambahdadi, Bandar-Agung and Komering Putih has different agronomic and social economic characteristics.

Nambahdadi village. Represents subarea I which gets its irrigation from way Seputih river for 6 months annually. Out of 25,000 ha of irrigation area, 17,000 ha can be planted by lowland rice since 1975. Formerly, upland rice or upland crops were planted by transmigrant since they transmigrated around 1950s from their original places of Java and Bali. At present time, the social condition of transmigrants in this village did not show much variation.

In this village, about 40 percent of the total area is lowland field and 44 percent upland. The rest of the other groups includes homeyard and swamp. The average per farm household is 1.4 hectares, which consists of 0.57 hectare of lowland and 0.62 hectare of upland (Table 3.5). The average farm size is small compared to the initial field that were given to the transmigrants which is 2.5 hectare and has been settled for about 20 years. Relatively it has good facilities compared to the other villages such as road, water canals, market facilities, etc. The location is not quite far from the town which makes it possible for people from other town or places to come to this village. Some of them are the second generation of the previous settlers.

About 10 percent of the village households cultivate between 0.1 and 0.5 hectare, 55 percent cultivate between 0.5 to 2.0 hectares, and about 30 percent cultivated more than 2.0 hectare (Table 3.6).

Bandar Agung village. This village represents subarea II, or old alang-alang fields opened more than three years ago. Initially, the soil in this area was fertile from the ash of burned trees. Usually there are no weed problems in the first year, during the dry season after the first harvest, the residues are burned and again the land is usually safe from weeds. During the second season the growth and production decreases noticeably as weeds begin to appear. In the third year, production decreases further and weeds proliferate. Alang-alang begins to appear, particularly in spote where the crops grow poorly. Usually the land is abandoned to alang-alang after the third year.

In this village, irrigation is not yet available. Most of the area is upland, with about 8 percent of land in homeyard and the rest in upland fields (Table 3.6). The average amount of land available to each household is 6.4 ha, which is high compared to other areas. This is based on total land available in the village, but average ownership is less than 2.0 hectares. This village has been used for resettlement of retired military men since beginning five years ago the number of farm households is around 360. These retired army transmigrants receive income every month from their pensions. Some have purchased additional land.

The farm size distribution is not much different Nambahdadi village. All the farm households have more than 0.50 hectare of land. Sixty-nine percent have between 0.5 to 2.0 hectares, and about 31 percent have more than 2.0 hectares (Table 3.6).

Komering Putih village. This village represents subarea III where fields were opened no more than three years ago. Land is marked by some erosion and covered by a mixture of alang-alang and shrubs. In this newly opened area, the most common cropping pattern is upland rice intercropped with corn and cassava. Generally after rice and corn are harvested, farmers do not plant anything between the remaining rows of cassava. Farmers in this subarea come from varied backgrounds, including spontaneous transmigrants, retired police transmigrants and the native Lampung farmers. Some of the spontaneous transmigrants came from other resettlement areas. Though resettled for several years, they unfortunately did not succeed on their previous farms. Also, some of them are descendants of previous settlers. Learning of the new resettlement projects, they are attempting to improve their fortunes. They do not get free field as common transmigrants. They purchase land at their own expense and receive some benefits given by the Chief of the village. Their social and economic condition is unenviable.

The retired police transmigrants are similar to retired army farmers in subarea II, in that they receive monthly pensions. They have the capability to hire labor for some activities in their farm. It appears that this group is better organized than the other groups in Komering Putih if convinced of its profitability they adopt new technology.

In this village, only 5.4 percent of total area is lowland; the rest is upland. The average farm land per household is 1.64 hectares, which is less than the standard amount of land owned by transmigrants. The reason is that some of the farmers came as spontaneous transmigrants who have less resource for buying land. Usually for the first second years th

Table 3.5. Landholdings per farm household in three Lampung villages, 1977

	Nambahdadi			Bandar Agung			Komering Putih		
	Total (ha)	Percentage	Average farm household (ha)	Total (ha)	Percentage	Average farm household (ha)	Total (ha)	Percentage	Average farm household (ha)
Homeyard	212	13.5	0.19	18.5	8.0	0.50	-	-	-
Lowland	635	40.4	0.57	-	-	-	8.0	5.4	0.09
Upland	698	44.3	0.62	211.5	92.0	5.89	139.6	94.6	1.56
Swamp	25	1.6	0.02	-	-	-	-	-	-
Others	3	0.2	-	-	-	-	-	-	-
Total	1573	100.0	1.40	230.0	100.0	6.39	147.6	100.0	1.65

Source: Village chief office, 1977.

Table 3.6 Distribution of farm size in 3 villages, Lampung, 1976

Farm size (Ha)	Nambahdadi (%)	Bandar Agung (%)	Komering Putih (%)
0.1 to 0.5	9	0	9
0.5 to 2.0	60	69	54
2.0	31	31	31
Landless employ	0	0	6
Landless unemploy	0	0	0
TOTAL	100	100	100

Source: Random sample survey of 45 farmers in three villages. Lampung, 1977.

3.4.1. Labor supply and draft power.

Table 3.7 shows the number of households in three villages. The total population of Nambahdadi village is 1123 people, of whom 51.6 percent are economically active. The percentage of the population of age less than 12 years is 47.6 percent; and less than one percent of the population is older than 65 years old. The average size of the family is 5.4.

The farmers in this village cultivate their fields without using mechanization, but they are familiar with new technology such as high yielding varieties, fertilizer, and insecticides, mainly as a result of the Government "Bimas" program. For land preparation, they use oxen for plowing, as well as hand tillage done by men using hoes. Oxen are also used for harrowing and sometimes for hauling. Table 3.9 shows the number of cows available in this village averaging one for every 2 farmers. These were mostly purchased on credit from the Government. Water buffalo is not found in this area even among the farmers who came from West Java, where water buffalo is commonly used for land preparation. This is probably because water is not sufficient to maintain buffalo during the available six dry months.

Farmers who do not have oxen for plowing their fields occasionally hire them from other farmers. But more often, they borrow them with only the obligation of feeding the oxen while they use them. The other practice for borrowing an oxen for land preparation is to repay by working on the farm of the oxen's owner. For a day's use of the carabao, one must work 2 days.

In Bandar Agung village the transmigrants mostly are retired army. There are 359 families with a total population of 2,608 people. The average family size is 7 people including about 4 economically active persons and 3 underage. The labor force is almost equally distributed between male and female.

Komering Putih has a total population of 4597 people consisting of 896 household with the average size of 5 members. About 44 percent of the people are below 12 years old. Fifty-four percent are economically active, of whom 26 percent are male and 28 percent are female.

Table 3.7. Population and average household size in three Lampung villages, 1975-76

	Nambahdadi			Bandar Agung			Komering Putih		
	Total	Percent-age	Member/ household	Total	Percent-age	Member/ household	Total	Percent-age	Member/ household
No. of households	1123			359			896		
Population	6104		5.4	2608		7.3	4597		5.1
Age 1-12 years									
Male	1636	26.8	1.5	651	25.0	1.8	1047	22.8	1.2
Female	1273	20.9	1.1	544	20.9	1.5	959	20.9	1.1
Total	2909	47.7	2.6	1195	45.8	3.3	2006	43.6	2.2
Age 12-65 years									
Male	1640	26.9	1.5	639	24.5	1.8	1218	26.5	1.4
Female	1510	24.7	1.3	754	28.9	2.1	1282	27.9	1.4
Total	3150	51.6	2.8	1393	53.4	3.9	2500	54.4	2.8
Age 65 years +									
Male	29	0.5	0.02	13	0.5	0.05	61	1.3	0.1
Female	16	0.3	0	8	0.3	0.05	30	0.7	0
Total	45	0.8	0.3	21	0.8	0.1	91	2	0.1

Source: Village chief offices, 1977.

Table 3.8 Population and labor force in three subareas, Lampung, 1976

	Population	Economically active	Labor force ratio
Nambahdadi/Subarea I			
Male	3305	1640	0.50
Female	2799	1510	0.54
Total	6104	3150	0.52
Bandar Agung/Subarea II			
Male	1417	639	0.54
Female	1191	754	0.53
Total	2608	1393	0.53
Komering Putih/Subarea III			
Male	2326	1218	0.52
Female	2271	1282	0.56
Total	4597	2500	0.54

Source: Village chief offices, Lampung 1977.

Economically active: 13-65 years old
Labor force ratio: Economically active/population

Table 3.9 Cattle available in three villages, Lampung, 1977

	Nambahdadi		Bandar Agung		Komering Putih	
	Total	Average head/ household	Total	Average head/ household	Total	Average head/ household
Total household	1123		359		896	
Cow	663	0.6	102	0.3	111	0.1
Carabao	25	0	-	-	2	-
Goat	746	0.7	128	0.4	494	0.6
Horse	-		-	-	-	-
Poultry	5000	4.5	520	1.5	6000	6.7

Source: Village chief offices, 1977.

3.4.2. Existing labor practices and utilization

Gotong royong system. Village people have close relationships with one another. If one builds a house, he can request neighbors to help him; then later he will help his neighbor in return. No cash is exchanged but meals are provided. This practice of communal work without payment in cash is called "gotong-royong," or, "one help another." Gotong royong also refers to activities for public purposes such constructing village roads, canals for irrigation, etc.

In the resettlement project people came mainly from Java and Bali islands and have the same social background. In leaving their home towns and resettling in new areas, they faced many problems. This makes them especially close to one another. Shortage of labor and cash are common conditions in transmigration areas, and most probably these factors also make it important to work together in gotong royong. Labor can be found for hiring only within the same village, because of the long distance between villages and little transportation.

There is no social arrangement on how to use and repay gotong royong labor, but everybody understands and agrees that the farmer or members of his family can work as repayment. There is no standard time within which to repay borrowed labor, but on average the time span for repayment is within 2 weeks. This gives a total span of about 4 to 5 weeks over which family labor can be spread through gotong royong.

This tradition in transmigration areas was seen to give way somewhat when a larger private agricultural corporation began operation near the resettlement projects. This gave the opportunity for off-farm

employment, and increased incomes and cash flow in the villages. According to farmers this resulted in a slight shift from gotong royong to use of hired labor on farms.

Bawon system. The bawon or "harvest share" is commonly given by Asian farmers to harvest workers. Again, this system is likely the result of labor and cash shortage. Harvesting is an activity that requires a large amount of labor over a short period. It cannot be done by family members alone, particularly since the size of farm is relatively large in the transmigration area and it is not possible to use hired labor if cash availability is insufficient. With limited cash, most farmers use the bawon system for harvest, especially for rice.

When harvesting crops the owner normally gives a harvest share to the harvesters of 1/6 or 1/5 of what they harvested. This share is called "bawon." Through this kind of arrangement, it is easy to get laborers, as they are attracted by bawon. For a single harvest, as many as 75 up to 100 participants come from the same village. On the harvest of a one-hectare rice field work starts at 7:00 o'clock in the morning. At 11:00 o'clock usually the harvesting is finished and then threshing and winnowing is done. Some thresh in the field and some do it at the house of the owner.

Table 3.11 shows a sample of bawon payments to males and female in various age groups recorded in Nambahdadi village in 1977. The amount of bawon received depended upon amount harvested which in turn appears related to age and sex. Males between 15 to 60 years old got highest the shares averaging 16 kg per day. For males less than 15 years old, the average was about 10 kg per day. Women between 15 and 30 years old got an average share of about 11 kg per day; and those less than 15 years got around 8.6 kg per day.

The value of bawon in terms of money is between Rp 500 to Rp 800 per day for males, and Rp 430 to Rp 555 per day for females. Males between 15 and 60 years old got around Rp 800 per day, more than twice the average market wage of Rp 350. Males of age less than 15 years old received 1.5 times the average market wage rate. Therefore, it is not surprising why workers prefer joining harvests compared to other available jobs. Usually there are more participants than are needed to get the job done in the desired time period.

Labor utilization. Labor practices of farmers are influenced by the traditions they brought from their original homes. The settlers mostly came from Java and Bali, and brought the customs of those areas. As they adapted to the Sumatran environment, some of their traditions also changed.

The study site is divided into three subareas having different agroeconomic characteristics that have been described. Table 3.10 shows the labor utilization in three villages representing each subarea.

The labor utilization varies according to source in three villages. Family labor is used more in upland areas, represented by Bandar Agung village (opened for a relatively long time), and Komering Putih, for the area newly opened. Cash flow is lower in upland areas than in the lowland area, represented by Nambahdadi village, perhaps partly explaining farmers' use of more family labor. Lowland farms used more hired labor, representing about one-fourth of total labor used. In the longer settled upland area, hired labor is 13 percent of all labot, but only 10 percent in the newly opened upland area. This underscores the possible importance of cash availability.

Nambahdadi village has been used for resettlement more than twenty years, and the settlers, mostly farmers from Java and Bali, share closed personal relationships compared to the other villages. Partly for this reason, gotong royong represents about one-third of the labor used. Gotong royong labor was used much less in Bandar Agung and Komering Putih villages, perhaps because of the diverse historical backgrounds of these farmers.

Table 3.10. Average labor utilization of six farmers, by activity and by source, in each of three villages, Lampung, Indonesia, 1975-1976 (Parentheses indicate percentages)

Item	Nambahdadi/Sub-area I				Bandar Agung/Sub-area II				Komering Putih/Sub-area III			
	Family labor	Hired labor	Gotong royong labor	Total	Family labor	Hired labor	Gotong royong labor	Total	Family labor	Hired labor	Gotong royong labor	Total
	-- manhours --											
Land preparation	62	480	-	542	772	310	-	1082	818	184	-	1002
Planting	100	-	92	292	210	-	141	351	251	-	113	364
Weeding	324	38	-	362	363	-	-	363	711	45	-	756
Fertilizing	22	16	-	38	33	-	-	33	48	-	-	48
Spraying	16	2	-	18	5	-	-	5	-	-	-	-
Harvesting	300	-	586	786	414	-	101	515	648	61	102	811
Total	824 (40)	536 (26)	678 (33)	2038 (100)	1797 (77)	310 (13)	242 (10)	2349 (100)	2476 (83)	290 (10)	215 (7)	2981 (100)

Source: Daily farm records of six farmers in each of three study villages of the Multiple Cropping Project of the Central Research Institute of Agriculture (CRIA), Bogor, Indonesia, 1975-1976.

Table 3.11 Average harvest share, by age and sex. Subarea I/Nambahdadi, Lampung, 1977

	No. of Harvesters	Average hrs./ labor	Average share/ day		Average share/ hour	
			kg	value (Rp)	kg	value (Rp)
<15 years						
Male	17	6.5	10.1	505	1.3	65
Female	10	5.4	8.6	430	1.1	55
15 to 30 years						
Male	27	6,1	15.9	795	2.0	100
Female	17	7.2	11.1	555	1.4	70
30 to 60 years						
Male	7	6.3	16.0	800	2.0	100
Female	9	6.0	10.0	500	1.1	55

Source: Recorded from harvesting time, Nambahdadi Village, Lampung, 1977

CHAPTER IV

QUANTITATIVE MODEL

A linear programming model is used here to determine the feasibility of experimental multiple cropping patterns with respect to labor supply and to examine the effect of(various) conditions on farmers' income. Application of the technique to three models of resettlement scheme farms in Lampung is aimed at investigating possible alternatives for improving the farmer's present economic condition. Essentially, a solution of the linear programming LP model shows the most profitable combination of farm activities, from a given set of alternatives, and given the levels of farm resources that are considered most relevant to farmers' capacity to execute the alternatives.

The activities included in this study are certain transfer activities as well as crop activities. The transfer activities consists of:

a. Transfer weekly available family labor to weekly available gotong-royong labor.
b. Transfer weekly available gotong-royong labor to weekly available labor.
c. Transfer weekly available family labor to weekly available labor.
d. Transfer available previous season cash balance to weekly available of cash
e. Transfer weekly available cash to weekly available of labor.

The crop activities included are experimental cropping patterns and existing farmer's cropping pattern in each subarea.

4.1 Transfer Activities

4.1.1 Transfer weekly available family labor to weekly gotong-royong labor

This study investigates in some detail the process by which family labor is channelled through the gotong royong system to achieve higher incomes, and relates this to farmers' possible adoption of new cropping patterns. The LP technique is used to identify the appropriate levels of gotong-royong labor activities and also examine the effect of varying the period of time within which gotong royong labor is repaid. The latter is accomplished by varying the repayment period in the model over the range of times desccibed below.

a. 0 weeks. This has the effect of not including gotong royong practices in the model

b. 2 weeks. This means that available gotong royong labor is created from available family labor either one week before or one week after the farmer "borrow" labor from other farms. For example, available gotong royong labor in week 2 is created from available family labor week 1 and available family labor at week 3.

c. 4 weeks. This means that available gotong-royong labor is created from available family labor either within 2 weeks before or within 2 weeks after it is used in crop activities.

Table 4.1. Activities creating gotong-royong labor in week t from family labor week t

		C G F 1 2	C G F 1 3	C G F 2 1	C G F 2 3	C G F 2 4	C G F t-2 t	C G F t-1 t	C G F t t+1	C G F t t+2	C G F 5 1 1	C G F 5 1 1	C G F 5 1 1	C G F 5 1 2	C G F 5 1 2
PROFIT	N														
AVGR 1	L	-1	-1												
AVGR 2	L			-1	-1	-1									
.	.														
.	.														
.	.														
AVGR t	L						-1	-1	-1	-1					
.	.														
.	.														
.	.														
AVGR 51	L										-1	-1	-1		
AVGR 52	L													-1	-1
. . . .	. . . . .														
AVFL 1	L			1											
AVFL 2	L		1												
AVFL 3	L			1		1									
AVFL 4						1									
.	.														
.	.														
.	.														
AVFL t-2	L						1								
AVFL t-1	L							1							
AVFL t	L								1						
AVFL t+1	L									1					
AVFL t+2	L														
.	.														
.	.														
.	.														
AVFL 49	L										1				
AVFL 50	L											1			
AVFL 51	L												1		
AVFL 52	L													1	1

CGF t-(t-1) = Create gotong-royong week t from family labor week t-1
AVGR-t = Available gotong-royong labor week t
AVFL-t = Available family labor week t

d. 6 weeks. This means that available gotong royong labor is created from available family either within 4 weeks before or within 4 weeks after it is used.

Table 4.1 shows the coefficient matrix used in LP model for transferring gotong-royong practices for the 4-week repayment period. For the creation of one unit of gotong-royong labor from one unit of available family labor, the coefficient sign is positive for available family labor and negative sign for gotong-royong labor. In an LP model the use of a resource is indicated by a positive sign and the production of creation of a resource is indicated by a negative sign. This activity does not affect net income, therefore the coefficient for the objective function is zero. When the repayment period of gotong-royong practices is varied to 0 weeks, 2 weeks, 6 weeks, and 8 weeks, the coefficient matrix is almost the same as for 4 weeks except that the length of time the practices are used depends on the weekly period.

4.1.2 Transfer of weekly available gotong-royong labor to weekly available labor

Crop activities (real activities) need labor for operation but it does not matter from what source the labor comes from. Therefore, the available weekly gotong-royong labor is transferred again to a homogeneous labor pool called "weekly available labor." Table 4.2 shows the coefficient matrix for transferring one unit (one manhour) of gotong-royong labor is positive and negative for available labor. These activities do not affect the net income and so the coefficient for the objective function is zero.

Table 4.2 Activities for creating available labor in week t from available gotong royong labor week t

		CLG 1 1	CLG 2 2	CLG 3 3	CLG t t	CLG 50 50	CLG 51 51	CLG 52 52
PROFIT	N							
AVL 1	L	-1						
AVL 2	L		-1					
AVL 3	L			-1				
.	.							
.	.							
.	.							
AVL t	L				-1			
.	.							
.	.							
.	.							
AVL 50	L					-1		
AVL 51	L						-1	
AVL 52	L							-1
. . . . .								
AVGR 1	L	1						
AVGR 2	L		1					
AVGR 3	L			1				
.	.							
.	.							
.	.							
AVGR t	L				1			
.	.							
.	.							
.	.							
AVGR 50	L					1		
AVGR 51	L						1	
AVGR 52	L							1

CLG-t-t = Create available labor week t from gotong royong labor week t
AVL-t = Available labor week t
AVGR-t = Available gotong royong labor week t

4.1.3 Transfer of weekly available family labor to weekly available labor.

In order for family labor to be applied directly to crop activities, without being channelled through the gotong-royong system, family labor available is transferred to the homogeneous weekly labor pool, "available labor." Weekly transfer using the coefficient matrix in Table 4.3 shows that one unit (one manhour) family labor is transferred directly to weekly available labor. Whenever labor is needed, one unit of family labor is transferred to available labor from family labor. Weekly 1 has available labor negative sign and positive sign is shown. For available family labor, the activities do not affect net income, therefore the coefficient in objective function are zero.

4.1.4. Transfer of available cash balance to weekly available cash

Available weekly cash is created by transferring the cash balance from the previous crop season to weekly available cash. Cash is used to hire labor or to buy the necessary materials. The coefficient matrix of these transfer activities is shown in Table 4.9. One unit of cash balance (one rupiah) is transferred to one unit of weekly available cash (one rupiah). This activity reduces net income by one unit (one rupiah), therefore the coefficient for the objective function is minus one.

Table 4.3. Activities for creating available labor in week t from available family labor by week t

			CLF-1-1	CLF-2-2	CLF-3-3	.....	CLF-t-t	.....	CLF-50-50	CLF-51-51	CLF-52-52
PROFIT		N									
AVL	1	L	-1								
AVL	2	L		-1							
AVL	3	L			-1						
AVL	t	L					-1				
AVL	50	L							-1		
AVL	51	L								-1	
AVL	52	L									-1
AVFL	1	L	1								
AVFL	2	L		1							
AVFL	3	L			1						
AVFL	t	L					1				
AVFL	50	L							1		
AVFL	51	L								1	
AVFL	52	L									1

CLF-t-t = Created available labor week t from family labor week t
AVL-t = Available labor week t
AVFL-t = Available family labor week t

Table 4.4. Activities for creating available cash week t from cash balance

		CCB1	CCB2	CCB3		CCB23	CCB24	CCB25	CCB26	CCB27	CCB28		CCB50	CCB51	CCB52
PROFIT	N	-1	-1	-1	....	-1	-1	-1	-1	-1	-1	....	-1	-1	-1
AVCH 1	L	-1													
AVCH 2	L		-1												
AVCH 3	L			-1											
.	.														
.	.														
.	.														
.	.														
.	.														
AVCH 23	L					-1									
AVCH 24	L						-1								
AVCH 25	L							-1							
AVCH 26	L								-1						
AVCH 27	L									-1					
AVCH 28	L										-1				
.	.														
.	.														
.	.														
.	.														
.	.														
AVCH 50	L												-1		
AVCH 51	L													-1	
AVCH 52	L														-1
CHBL 1	L	1	1	1	....	1	1	1							
CHBL 2	L								1	1	1	....	1	1	1

CCB -t = Created available cash in week t from cash balance
AVCH -t = Available cash week t
CHBL 1 = Cash balance at end of first crop season

4.1.5. Transfer of weekly available cash to weekly available labor.

The weekly available labor can be created also from weekly available cash, meaning that labor can be hired. For these transfer activities, one unit of available labor (one manhour) is created by reducing net income by the value of the wage rate per manhour. Therefore, in the coefficient matrix (Table 4.5), minus one is shown for weekly available labor (one manhour), and a positive sign for the wage rate shown in weekly available cash. As mentioned above, the available cash is first transferred from the previous season cash balance.

For the purpose of comparing the three subareas, the same schedule of variable market wage rates were applied in the model of each representative village. Therefore in each village five levels of wages were used, i.e. Rp 55, Rp 50, Rp 45, Rp 50, and Rp 35 and Rp 30 per hour. Actually Rp 55 represents the present wage rate in Nambahdadi, and Rp 35 the wage rate in Bandar Agung and Komering Putih.

4.2. Crop Activities

Crop activities include CRIA's experimental cropping patterns and the cropping patterns existing in each village. Furthermore in the experiments the cropping patterns presently grown by farmers were also tested, along with improved cropping patterns. Since we are interested in comparing the experimental results with the real farmers' management, we included in the model the cropping patterns presently grown in respective villages.

Table 4.5. Activities for creating available labor in week from available cash in week

		C L C 1 1	C L C 2 2	C L C 3 3	C L t t	C L C 5 0	C L C 5 1	C L C 5 2
PROFIT	N							
AVL 1	L	-1						
AVL 2	L		-1					
AVL 3	L			-1				
.	.							
.	.							
.	.							
AVL t	L				-1			
.	.							
.	.							
.	.							
AVL 50	L					-1		
AVL 51	L						-1	
AVL 52	L							-1
. . . . .								
AVCH 1	L	B						
AVCH 2	L		B					
AVCH 3	L			B				
.	.							
.	.							
.	.							
AVCH t	L				B			
.	.							
.	.							
.	.							
AVCH 50	L					B		
AVCH 51	L						B	
AVCH 52	L							B

CLC-t-t = Created available labor week t from available cash week
AVL-t = Available labor week t
AVCH-t = Available cash week t
B = Average wage rate per hour in respective villages

Table 8.6. Net income and coefficient matrix of crops activities by weekly available labor, available cash and land, Nambahdadi, Lampung, 1975-1976

Net Income:		Cropping pattern A 203025	Cropping pattern B 226935	Cropping pattern C 258860	Cropping pattern D 52130	Cropping pattern E 79894	Cropping pattern F 41228	Cropping pattern G 151916	Cropping pattern H 80991
AVL	1	-	-	-	-	-	76	83	156
AVL	2	51	76	102	37	23	76	83	156
AVL	3	146	120	130	37	23	76	83	156
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
AVL	50	-	-	-	408	-	204	274	-
AVL	51	-	-	-	-	-	-	-	-
AVL 52									
AVCH	1	-	-	-	1013	743	-	1040	1570
AVCH	2	1050	1050	1750	-	-	-	-	-
AVCH	3	-	-	-	-	-	-	-	-
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
AVCH	50	-	-	-	-	406	-	-	775
AVCH	51	-	-	-	-	-	-	-	-
AVCH	52	-	-	-	-	-	-	-	-
LND	1	1	1	1	1	1	11	-	-
LND	2	-	-	-	-	-	-	-	-

Source: Farm records of Multiple Cropping Project, Central Research Institute of Agriculture, Bogor, Indonesia, 1975-1976. See Appendix Table 8.5

AVL 1 = Available labor week 1 (and so on)
AVCH 1 = Available cash week 1 (and so on)
LND 1 = Lowland
LND 2 = Upland

Table 4.7. Net income and coefficient matrix of crop activities, by weekly available labor, and weekly available cash and land, Bandar Agung, Lampung, 1975-1976

Net Income:		Cropping pattern A	Cropping pattern B	Cropping pattern C	Cropping pattern D	Cropping pattern E	Cropping pattern F	Cropping pattern G	Cropping pattern H
		91827	77565	147703	37852	16237	15883	84331	27427
AVL	1	–	–	–	259	250	63	80	233
AVL	2	–	–	–	259	250	63	80	233
AVL	3	80	100	92	259	250	63	55	233
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
AVL	50	–	–	49	–	–	–	–	–
AVL	51	35	42	–	–	–	–	–	–
AVL	52	35	42	–	–	–	–	–	–
AVCH	1	–	–	–	–	–	–	–	–
AVCH	2	–	–	–	–	–	–	–	–
AVCH	3	–	–	–	–	–	–	–	–
:	:	:	:	:	:	:	:	:	:
AVCH	50	–	–	–	–	–	–	–	–
AVCH	51	–	–	–	–	–	–	–	–
AVCH	52	–	–	–	–	–	–	–	–
LND		1	1	1	1	1	1	1	1

Source: Farm Record, Multiple Cropping Project, Central Research Institute of Agriculture, Bogor, Indonesia, 1975-1976. See Appendix Table B.6.

Table 4.8. Coefficient matrix of crop activities, Komering Putih, Lampung, 1975-1976

Net Income		Cropping Pattern: A 106160	Cropping Pattern: B 104444	Cropping Pattern: C 162189	Cropping Pattern: D 44783
AVL	1	175	168	27	18
AVL	2	300	354	497	11
.		.	.	.	.
.		.	.	.	.
.		.	.	.	.
.		.	.	.	.
AVL	51	56	56	52	83
AVL	52	-	-	-	45
AVCH	1	-	-	-	-
AVCH	2	-	-	-	-
.		.	.	.	.
.		.	.	.	.
.		.	.	.	.
.		.	.	.	.
AVCH	51	-	-	-	-
AVCH	52	-	-	-	-
LND		1	1	1	1

Source: Farm Record Multiple Cropping Project, Central Research Institute of Agriculture, Bogor, Indonesia, 1975-1976.

See Appendix Table B.7.

The coefficient matrix for the latter are taken from farm records kept by farmers for a one-year period. The farmers recorded all daily activities and expenses in the farm. In the LP model the coefficient matrix is shown in Appendix B. Every cropping pattern utilizes weekly available labor, which is created from gotong-royong labor, family labor, and hired labor. In Appendices B.6, B.7., and B.8 are shown the inputs and the value of cash needed by these cropping activities in respective weeks for purchasing the necessary materials such as fertilizer, insecticides, and other inputs. All coefficients of crop activities are based on one hectare, therefore the land coefficient is one for all crop activities. The net return of each crop activity (Appendix C) was used as the coefficient in the objective function.

4.3. Resource Constraints Included in the LP model

Weekly resource constraints of each resource were used in the model. There are available labor, available gotong-royong labor, available hired labor and available family labor, in addition to available cash and land

4.3.1. Weekly availability of labor

Labor availability is broken down into weekly periods such that in one year there are 52 weeks of available labor (AVL.1 - AVL.52). These resources are to be used durectly by the real activities, however, at the beginning of the program, the value of weekly available labor is zero. However, as soon as the real activities need labor, the model transfers labor either from family labor, gotong-royong labor or from hired labor. The coefficients of these transfer activities are shown in Table 4.2, 4.3, and 4.5.

Only the real activities earn income. As soon as the real activities need labor in a respective week, the model transfers units of labor needed from the respective week of family labor available, but this is limited by the present amount available of family labor. When the family labor available in that week has all been transferred, and still some more labor is needed, the model transfers family labor from other weeks through gotong-royong activities, or by transferring weekly cash available to available labor through hiring arrangements.

4.3.2 Weekly availability of gotong-royong labor

Weekly gotong-royong labor, or exchange labor availability, is used as a constraint in the model with the aim of investigating more specifically the labor resources used by crop activities when the farmers' objective is to maximize profit. Actually the gotong-royong labor supply fully depends on weekly family labor, because as soon as real activities need gotong-royong labor, the model transfers from weekly family labor. The coefficient matrix for transferring is shown in Table 4.5, and Appendix B.

At the beginning of the program, the values of gotong-royong from week 1 up to week 52 (AVGR. 1 - AVGR. 52), are all zero. The crop activities or real activities in the model do not directly use gotong-royong labor, but use instead the"available labor resource" as the primary constraint. When available labor is needed, first the family labor in the respective week is used directly. Then if all family labor on that week has been used, family labor from other weeks is transferred to weekly

available gotong-royong labor, which in turn is transferred to weekly available labor resources and ultimately used by real activities in the model.

The limitation of gotong-royong labor is the amount of family labor resource available, and the length of time permitted for family members to work for others as repayment, either 2 weeks, 4 weeks, and so on. As the length of time agreed for repayment of borrowed labor increases, the availability of gotong-royong labor also increases.

4.3.3 Weekly available family labor

Weekly available family labor is denoted as AVFL 1 to AVFL 52. Family labor is first directly transferred to weekly availability of labor. But if all family labor has been exhausted in a given week, then family labor from other weeks through the creation of gotong-royong labor.

The availability of family labor is limited average family size and the average time available for working in the farm. The average time available for working in the farm varies between village to another. In Nambahdadi village, because off-farm opportunities for employment are better than in the other villages, the time available for working on the farm is lowest. Table 4.9 shows the time available in each village for working in the field.

Table 4.9. The average time available for families to work in the field, by village, Lampung, 1975-1976

Village	Average family size (people)	Average time available/week/ member (manhours)	Average weekly available family labor (manhours)
Nambahdadi	3	16	48
Bandar Agung	4	19	75
Komering Putih	3	26	80

Source: The average time available per member per week was provided by the farm record keeping project of CRIA.

4.3.4. Available cash on the farm

Weekly availability of cash. Weekly availability of cash is neede to buy materials such as fertilizer, insecticides, seeds, and other necessary materials, as well as for hiring labor. At the beginning of the program the weekly availability of cash (AVCH.1 - AVCH.52) is zero, but as soon as the cash is needed it is transferred from available cash balance to weekly cash. The coefficients for transferring cash balance to weekly cash are shown in Table 4.4. Since weekly available cash is needed for hiring labor (Table 4.5), available labor hiring may ultimately be limited by the available weekly cash, which has been transferred from the cash balance.

Available cash balance. The cash balance used as constraint in this LP model consists of cash balance I and cash balance II. Cash balance I comes from the average income of the previous years harvest of second crop in 1975, and cash balance III come from average income from first crop season in 1975-1976.

Table 4.10. Availability of cash used as constraints in the model

Level of cash balance available for crop inputs	Total cash available for purching labor and other inputs								
	Nambahdadi Village			Bandar Agung Village			Komering Putih Village		
	Cash balance I (Rp)	Cash balance II (Rp)	Total (Rp)	Cash balance I (Rp)	Cash balance II (Rp)	Total (Rp)	Cash balance I (Rp)	Cash balance II (Rp)	Total (Rp)
Present level	20,307	20,307	40,615	9,540	9,540	19,080	6,950	6,950	13,900
25% of GFI	19,555	65,060	84,615	9,865	26,830	36,695	12,634	25,880	38,514
50% of GFI	39,111	130,120	169,231	19,730	53,660	73,390	25,269	51,760	77,029
75% of GFI	58,665	195,180	253,846	29,595	80,490	110,085	37,903	77,640	115,543
100% of GFI	78,221	260,240	338,461	39,460	107,320	146,780	50,537	103,520	154,057
Unlimited	-	-	-	-	-	-	-	-	-

Present level = Average level of cash used by farmers in respective villages.

GFI = Gross farm income or gross return from crop production, in respective villages.

To get more information of the effect of cash balance availability on the optimal solution, different levels of cash balance available were used, beginning with the average level presently used by farmers in respective villages. Unlimited cash availability was also considered. The following levels of limited cash availability were considered:

a. 100% of Gross Farm Income (GFI) means that all cash derived from crop production is available for farm operations.

b. 75% of Gross Farm Income means that 25% of the value of crop production is reserved for other expenses, and 75% is available for farm operation.

c. 50% of Gross Farm Income means that 50% of the value of crop production is used for other expenses, but the rest is available for farm operations.

d. 25% of Gross Farm Income means that 75% of cash from crop production is used for other expenses, and 25% is available for farm expenses.

4.3.5. Average of land ownership is land constraint

Settlement were established in the past allocating 2-hectare plots to each settler family, consisting of 0.25 hectare for the homestead and the rest as fields for crop production. Initially the area is secondary forest, scrub or alang-alang fields. The soil in the first year is fertile as ash from burned trees stimulates plant growth by the third year fertility declines, production decreases, serious weed infestation occurs.

In the subarea that has been settled more than 20 years, an irrigation project has been constructed, making it possible to plant lowland rice. The farm size is less than that originally allocated because of increased population, partly composed of descendants of the settlers. Nambahdadi village represents this area with an average farm size of 1.38 ha. This consists of 0.57 ha lowland fields and 0.81 ha upland fields.

Bandar Agung village represents an upland area opened for more than 20 years, and Komering Putih, an upland area newly opened. The average farm size in the two villages together is 1.64 ha. Bandar Agung village is mainly populated by retired Army transmigrants. In 1975 they had not yet received all of the land they were supposed to be allocated although it is in process. Their average farm size is less than 2 has. Komering Putih farm sizes are also less than the 2 ha normally available to transmigrants because they came and bought land at their own expense.

The average value of 1.38 hectares for Nambahdadi village, and 1.64 hectares for Badar Agung and Komering Putih villages were used as land constrained in LP model.

Table 4.11. Farm size of 35 farmers in three villages, Lampung, Indonesia, 1977

Farmer No.	Nambahdadi			Bandar Agung			Komering Putih		
	Lowland	Upland	Total	Lowland	Upland	Total	Lowland	Upland	Total
1	1.00	0.75	1.75	-	1.25	1.25	-	2.75	2.75
2	-	0.50	0.50	-	2.50	2.25	-	0.50	0.50
3	1.00	-	1.00	-	1.65	1.65	-	1.00	1.00
4	0.75	1.00	1.75	-	4.91	4.91	-	1.02	1.02
5	0.75	1.50	2.25	-	1.43	1.43	-	1.50	1.50
6	0.25	1.00	1.25	-	1.45	1.45	-	1.25	1.25
7	0.75	-	0.75	-	1.25	1.25	-	2.25	2.25
8	-	1.50	1.50	-	1.37	1.37	-	1.91	1.91
9	1.00	0.75	1.75	-	4.39	4.39	-	2.00	2.00
10	1.50	2.00	3.50	-	1.25	1.25	-	2.00	2.00
11	1.00	2.00	3.00	-	1.75	1.75	-	2.00	2.00
12	0.75	1.00	1.75	-	1.41	1.41	-	2.00	2.00
13	1.00	1.00	2.00	-	1.81	1.81	-	2.50	2.50
14	0.50	-	0.50	-	1.57	1.57	-	3.00	3.00
15	0.50	-	0.50	-	3.25	3.25	-	3.00	3.00
16	0.50	-	0.50	-	1.25	1.25	-	3.00	3.00
17	0.50	-	0.50	-	1.25	1.25	-	1.50	1.50
18	0.25	0.50	0.75	-	2.05	2.05	-	0.75	0.75
19	0.50	2.00	2.50	-	1.89	1.89	-	0.75	0.75
20	1.00	1.75	2.75	-	1.25	1.25	-	1.00	1.00

Table 4.11. Cont'd.

Farmer No.	Nambahdadi			Bandar Agung			Komering Putih		
	Lowland	Upland	Total	Lowland	Upland	Total	Lowland	Upland	Total
21	0.50	1.00	1.50	-	1.75	1.75	-	0.75	0.75
22	0.50	0.50	1.00	-	1.69	1.69	-	1.50	1.50
23	-	0.50	0.50	-	1.10	1.10	-	0.50	0.50
24	1.00	-	1.00	-	1.00	1.00	-	2.45	2.45
25	0.25	0.13	0.38	-	2.54	2.54	-	3.00	3.00
26	-	1.24	1.24	-	1.00	1.00	-	2.45	2.45
27	0.50	1.00	1.50	-	1.08	1.08	-	1.02	1.02
28	0.50	1.00	1.50	-	1.12	1.12	-	1.00	1.00
29	0.75	0.50	1.25	-	2.50	2.50	-	2.00	2.00
30	0.70	1.50	2.20	-	0.53	0.53	-	0.66	0.66
31	0.50	1.10	1.60	-	0.70	0.70	-	1.72	1.72
32	0.50	1.25	1.75	-	0.85	0.85	-	1.00	1.00
33	0.50	0.25	0.75	-	0.60	0.60	-	1.50	1.50
34	0.25	0.25	0.50	-	1.00	1.00	-	1.10	1.10
35	1.00	0.88	1.88	-	1.00	1.00	-	1.27	1.27
Total	19.95	28.35	48.30	-	57.39	57.39	-	57.40	57.40
Average	0.57	0.81	1.38	-	1.64	1.64	-	1.64	1.64

Source : Survey of multiple Cropping, Lampung, Indonesia, 1977.

CHAPTER V

OPTIMAL SOLUTION OF LINEAR PROGRAMMING MODEL

The transmigration program is considered one of the most important possibilities of Indonesia mitigating the problem of population imbalance through rural development. Transmigration per se refers to the movements of people from the more densely populated region to the less populated ones. To achieve the rural development objective, transmigration has been worked to the development and introduction of improved agricultural technology through the research program of Indonesia's Central Research Institute for Agriculture. This study is concerned primarily with the problem of labor resource allocation at the family farm level to achieve higher incomes through more intensive cropping in the transmigration projects of Central Lampung, Sumatra Island, Indonesia.

To achieve of the objective of this study a linear programming model was constructed for three farm types representing the three sub-areas. The typical farm in Nambahdadi village represents irrigated lowland. The typical farm in Bandar Agung village represents an upland farm, opened for some time and infested with alang-alang (Imperata cylindrica). The typical farm in Komering Putih village represents an upland farm opened for no more than three years, where cash flow is particularly low and cropping less intense.

The real activities included in the model are experimental cropping patterns as well as those presently grown in the respective

villages for a given set of available farm resources. Farm resources included weekly levels of cash, labor and land available. To learn why certain patterns are better suited than others, the level of farm resources and their prices were repeatedly altered in the models and each new optimum combination of cropping patterns was compared to other solutions.

5.1. The Effect of Variation of Available Cash

Available cash in the farm mostly came from the income from crop production. In first crop season in the current year, cash is derived from income of second crops in the previous year. In this study it is called cash available I. The first crop season of the current year provides cash available II to be used for farm activities in the second crop season.

The amount of cash available varies from one subarea to the other. For the purpose of looking into the effect of different available farm cash to the optimal solution, the value of available cash was varied, starting from the amount of the average level presently used by the farmers up to unlimited available cash. Between those limits, different levels of cash available were 25%, 50%, 75%, and 100% of the gross farm income (gross value of crop production) in the respective villages.

5.1.1 The effect of different levels of available cash on cropping patterns, land uses, multiple cropping index and income

In Nambahdadi village (Subarea I) representing irrigated lowland, the effect of available cash was observed by varying the cash availability.

Table 5.1. Cropping pattern and land used in optimal solution by level at cash available in Nambahdadi, Lampung, 1975-1976

Total cash available	Land used by cropping pattern				Total land used		Multiple cropping index
	Cropping pattern	Lowland (ha)	Upland (ha)	Percent of total area	(ha)	Percentage	
Present level	CPB	0.1229	-	9	0.7225	52	104
	CPC	0.3704	-	27			
	CPH		0.2292	16			
25% of GFI	CPB	0.1173	-	8	0.7666	55	111
	CPC	0.3034	-	22			
	CPH		0.3459	25			
50% of GFI	CPB	0.1670	-	12	0.9606	69	139
	CPC	0.4028	-	29			
	CPH		0.3908	28			
75% of GFI	CPC	0.5700	-	41	1.0703	77	155
	CPH		0.5003	36			
100% of GFI	CPC	0.5700	-	41	1.2110	87	175
	CPH		0.6410	46			
Unlimited	CPC	0.5700	-	41	1.2106	87	175
	CPH		0.6406	46			

CPB = lowland rice followed by corn intercropped with peanut.
CPC = lowland rice followed by corn followed by rice bean.
CPC = upland rice followed by corn.

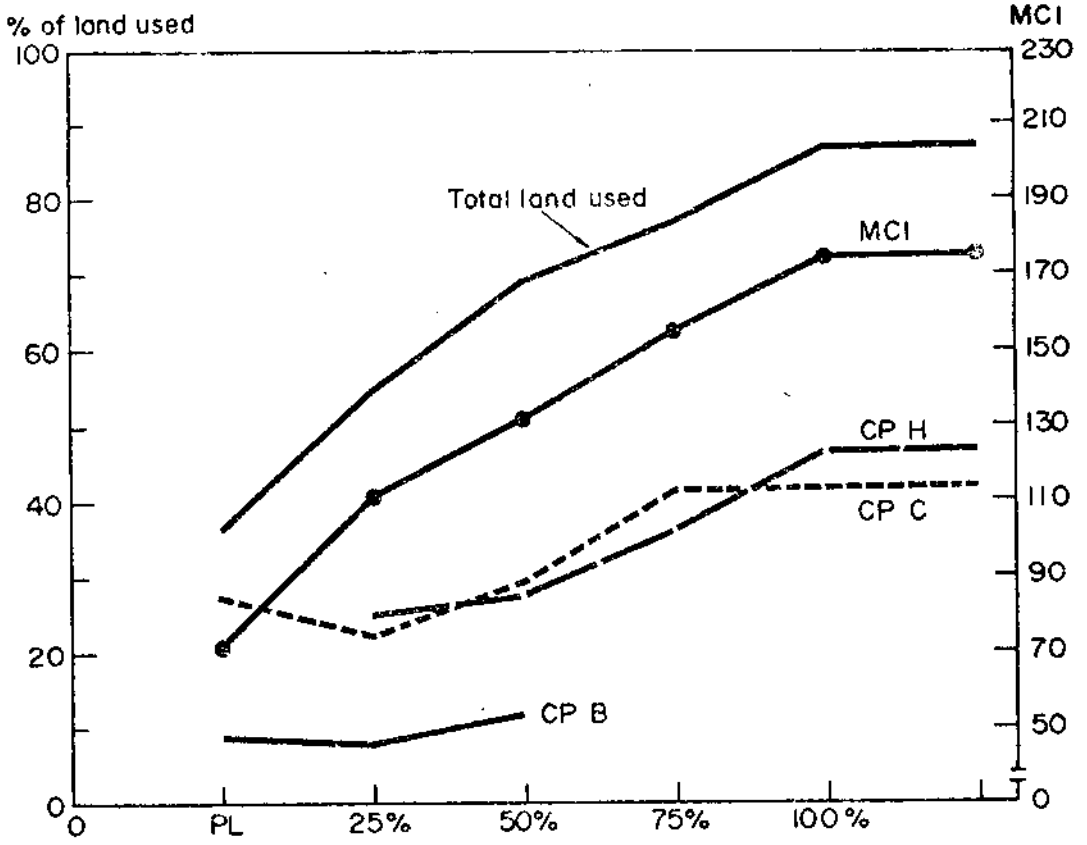


Fig. 5.1a. The effect of cash available on the cropping pattern(CP) and land used, Nambahdadi, 1975-1976.

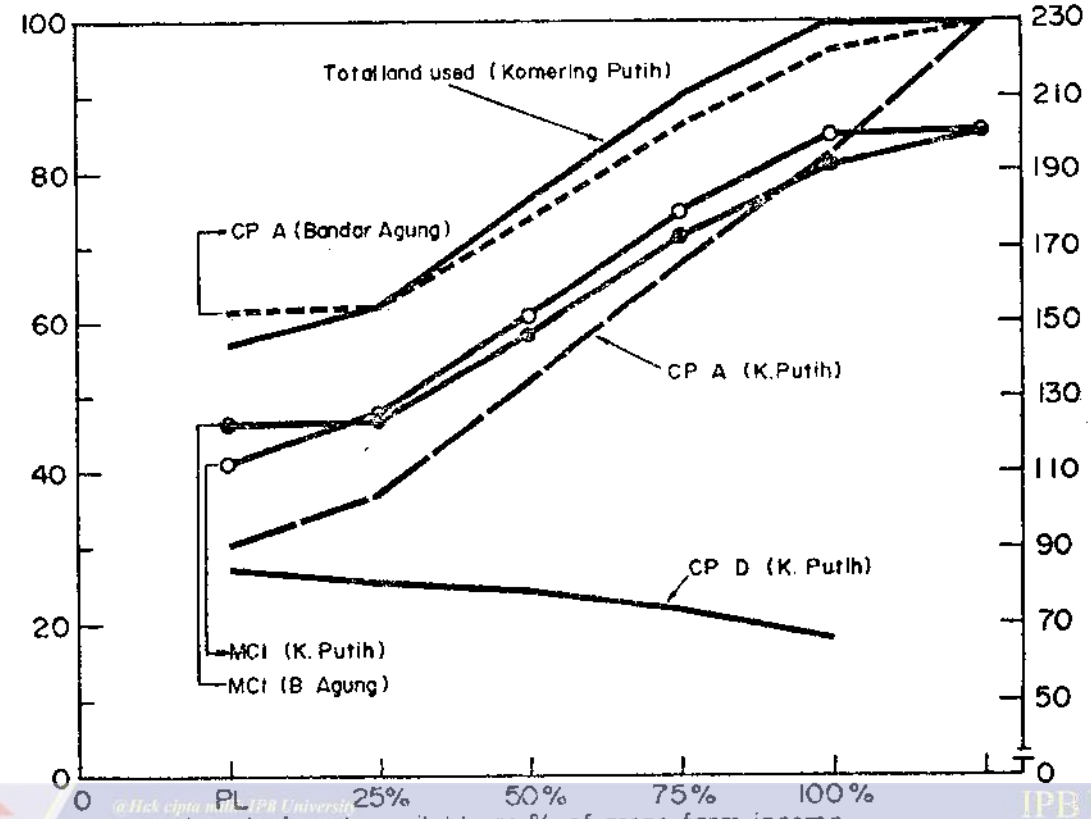


Fig. 5.1b. The effect of cash available on the cropping pattern (CP) and land used, Bandar Agung and Komering Putih, Lampung, 1975-1976.

The most profitable cropping pattern grown under the labor and cash conditions presently faced by farmers in this village is combination of cropping pattern B (lowland rice corn + peanut) that is, an improved farmers' cropping pattern without constraints and cropping oattern C (lowland rice-corn-rice bean) introduced cropping pattern, and cropping pattern H (upland rice-corn) farmers cropping pattern managed by the farmers themselves. This combination gave a multiple cropping index of 104.

This indicates that based on 1975-1976 performance, under present conditions, the experimental improved lowland pattern is a promising alternative. However when cash availability is increased up to 75% of gross farm income (GFI), cropping pattern B is no longer included in the solution and cropping pattern C uses all available lowland, while cropping pattern H uses 36% of total upland available. The multiple cropping index is 155 for this combination. With cash available at 100% of gross profit income (GFI), the same optimal solution was obtained, and also with unlimited cash available, the farmers' present pattern as managed by themselves appeared to be a profitable alternative for one-quarter of estimated upland planting.

In Bandar Agung Village (Sub-area II), an upland area covered by alang-alang (Imperata cylindrica) and opened more than 20 years, the most profitable cropping patterns is cropping pattern A (Corn + upland rice - corn), the farmers pattern grown by researchers. Application of the farmers level of inputs under researcher supervision appeared to be more profitable than the same pattern but with treatments conducted by the farmers themselves. This perhaps shows that transmigrant farmers

accustomed to the technology and resources applied in the area they originated, have more to learn about the efficient use of inputs in the Sumatran environment. Increasing the available cash did not change the best corpping pattern in the solution. It only affected total land that can be planted to that pattern. With the present level of available cash, wage levels and other labor conditions only 61 percent of land can be cultivated. Increasing cash by about $300 to 100% of gross farm income level available increased the area of land that can be cultivated up to 96 percent of total.

In this village, the experimental improved cropping pattern (CPC) was not included in the optimal solution. However, 1975-1976 was an abnormally dry year and this perhaps affected the improved cropping pattern more adversely than farmers present patterns. Only with unlimited cash available can all area be planted and multiple cropping index increased from 123 to 200.

In Komering Putih village (Sub-area III), representing the newly opened upland area covered by alang-alang (Imperata cylindrica), the most profitable combination of cropping patterns are cropping pattern A (Corn + upland rice - cassava), that is, the farmers cropping pattern supervised by researchers, and cropping pattern D (Upland rice - cassava), the present farmers cropping pattern managed by the farmers themselves. As in Bandar Agung Village, (Sub-area II) the farmers' pattern grown by researchers using farmers level of input appear to do better than the alternative cropping patterns. With present levels of available cash labor, and prices, only 57% of land can be cultivated with a multiple cropping index of 113.

Table 5.2. Cropping patterns and multiple cropping index, at various levels of cash availability in Bandar Agung and Komering Putih villages, Lampung, 1975-1976

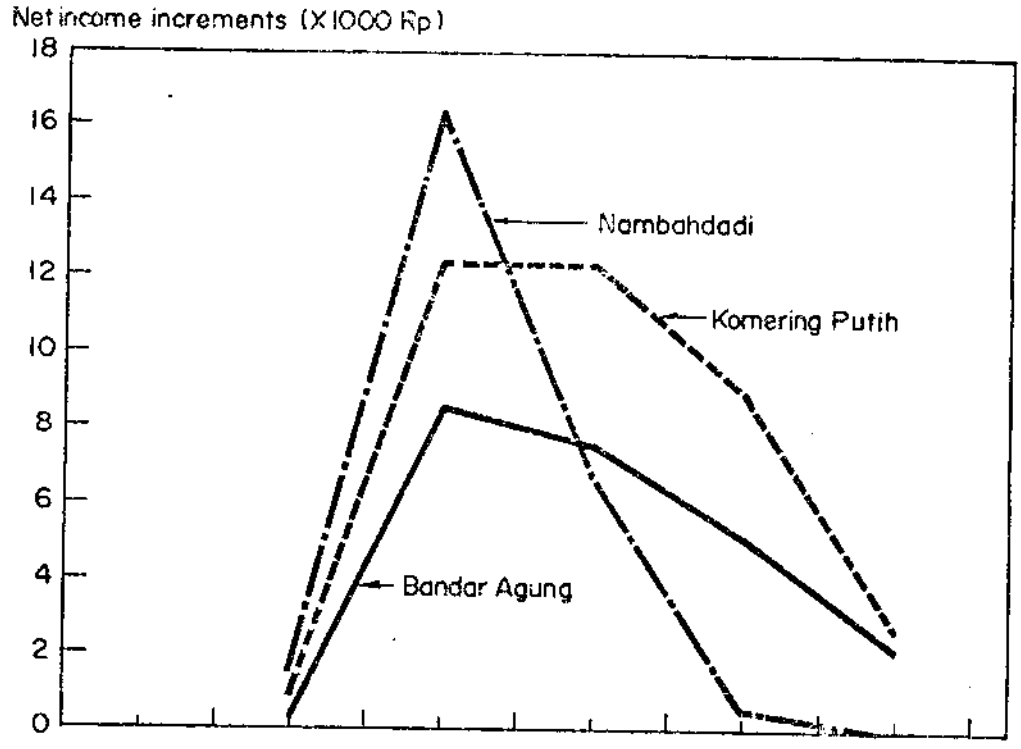
Total cash available	Bandar Agung Subarea II[a]				Komering Putih Subarea III[b]			
	Cropping pattern	Area used	Total land used	MCI	Cropping pattern	Area used	Total land used	MCI
Present level	CPA	1.006	1.006 (61)	128	CPA	0.4923	0.9306 (57)	113
					CPD	0.4383		
25% of GFI	CPA	1.013	1.013 (62)	124	CPA	0.604	1.026	125
					CPD	0.422	(63)	
50% of GFI	CPA	1.216	1.216 (74)	148	CPA	0.8600	1.246	152
					CPD	0.386	(76)	
75% of GFI	CPA	1.409	1.409 (86)	172	CPA	1.114	1.468	179
					CPD	0.354	(90)	
100% of GFI	CPA	1.573	1.573 (96)	192	CPA	1.344	1.64	200
					CPD	0.296	(100)	
Unlimited	CPA	1.640	1.640 (100)	200	CPA	1.64	1.60 (100)	200

GFI - gross farm income

In Bandar Agung CPA = Corn intercropped with upland rice followed by corn,
In Komering Putih CPA = corn followed by upland rice followed by cassava, and
CPD = Upland rice followed by cassava.

Table 5.3. Net income at optimal solution by various cash balance available in three villages. Lampung 1975-1976

Cash balance available	NAMBAHDADI/SUB AREA.I		BANDAR AGUNG/SUB AREA II		KOMERING PUTIH/SUB AREA III	
	Net Income (Rp)	ΔNet Income (Rp)	Net Income (Rp)	ΔNet Income (Rp)	Net Income (Rp)	ΔNet Income (Rp)
Present level of cash	117276		81847		64092	
25% of "GFI"	118969	1693	82130	283	69386	5294
50% of "GFI"	135300	16331	90695	8565	81875	12489
75% of "GFI"	141718	6418	98375	7680	94307	12432
100% of "GFI"	142111	393	103412	5037	103116	8809
Unlimited	142111	0	105468	2056	105423	2307



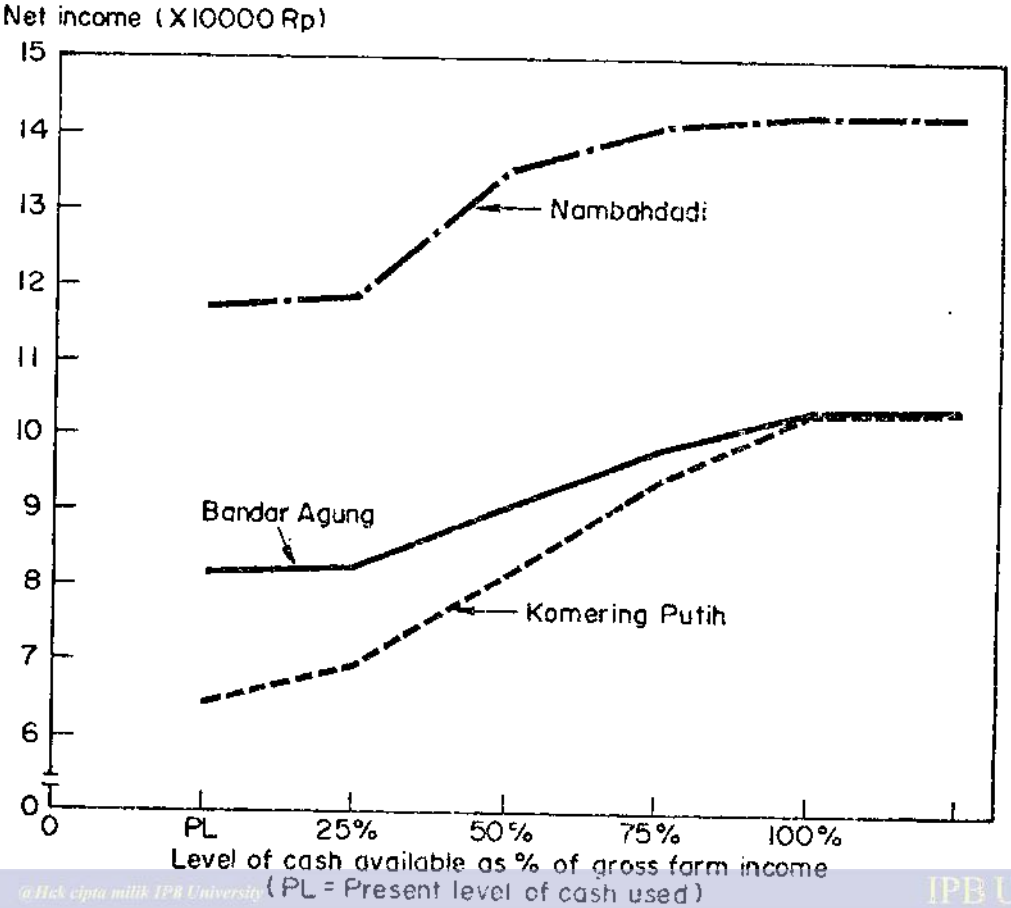


Fig. 5.2. The effect of cash balance on the increment of net income in three villages, Lampung, 1975 – 1976.

Increasing the availability of cash does not change the most profitable combination of cropping patterns, except that with unlimited cash available, it appeared most profitable for farmers to allocate all land to cropping pattern A. All lands can be planted at 100% of gross fixed income is available for cash inputs.

On upland areas, both newly opened and the area opened for more than 20 years, the improved cropping pattern was not included in the optimal solution. This most probably is because the 1975-1976 data used in this study reflected the specific conditions in that year when there was an abnormally dry season affecting the second crops.

The projected low levels of percentage of total land utilized in the villages under present conditions closely coincides with levels of land use that have been observed in the area. In this aspect, the model appears to correctly simulate present conditions.

Planting the experimental, improved cropping pattern which utilized on all lowland and fields, combined with a cropping pattern managed by themselves planted on one-half of upland fields, gave highest income in Nambahdadi Village. This can be reached when available cash is at 100% of GFI, giving a multiple cropping index of 75. It is obvious that net income increases as available cash in the village increases but net income increases at a decreasing rate. Survey data showed this village has the highest net income followed by Bandar Agung and Komering Putih. This results therefore closely simulate existing conditions, indicating the model is correct in this aspect.

Typical farmers in Bandar Agung village have lower net income than in Nambahdadi village (Subarea I), but slightly higher than in Komering Putih village (Subarea III). The percentage change of net income for a 1% increase in available cash is higher than in Nambahdadi, but lower than Komering Putih. This shows that the effect of available cash on net income is highest in Komering Putih, followed by Bandar Agung village and Nambahdadi village.

In Komering Putih village (Subarea III), by increasing cash to about $337, an increase in net income of about $99 was generated. This is about a 30 percent rate of return annually as most cash is used for labor hiring. The effect of cash in this village is linked to the high productivity of labor.

5.1.2. The effect of different levels of cash availability on the amount of cash used.

In Nambahdadi village, with the present level of cash available, the optimal solution indicates the use of all available cash. Increasing the available cash above 100% of GFI did not increase cash use. This means that the maximum amount of cash needed has already been reached. The ratio of cash used, during first season to second crop season ranges from 1.0 to 2.53; that is, the cash needed in the first season was about two times that of the second season. When total available cash is increased by about 8 times of the present level, cash available from the first crop season is all applied to crop production, but excess cash remains available in the second crop season.

Table 5.4 Cash used, at various levels of cash available, Nambahdasi, Lampung, 1975/1976

Cash available	Total value of cash available (Rp)	Cash available I		Cash available II		Total cash used(Rp)	Δ Total cash used(Rp)
		Used (Rp)	Δ Used (Rp)	Used (Rp)	Δ Used (Rp)		
Present level	40615	20308 (100)	- 953	20308 (100)	- 1128	40616 (100)	- 5179
25% of GFI	84615	19555 (100)	19555	19180 (29)	8009	38735 (46)	27560
50% of GFI	169231	39111 (100)	19555	27184 (21)	- 4011	66295 (39)	15544
75% of GFI	253846	58666 (100)	14982	23173 (12)	5931	81839 (32)	20213
100% of GFI	338461	73648 (94)	0	29104 (11)	0	10275 (30)	0
Unlimited		73648		29104		102752	

GFI = gross farm income

Note : Inside bracket is percentage value.

Table 5.5. Cash used at various levels of cash available, Bandar Agung Lampung, 1975-1976

Cash available	Total value of cash available (Rp)	Cash available I		Cash available II		Total cash used (Rp)	ΔTotal cash used (Rp)
		Used (Rp)	Δ Used (Rp)	Used (Rp)	Δ Used (Rp)		
Present level	19090	9540 (100)		1006 (11)		10546	
			325		7		332
25% of GFI	36695	9865 (100)		1013 (38)		10878	
			9865		203		10068
50% of GFI	73390	19730 (100)		1216 (23)		20946	
			9865		193		10058
75% of GFI	110085	29595 (100)		1409 (17)		31004	
			9865		164		10029
100% of GFI	146780	39460 (100)		1573 (15)		41033	
			4028		67		4095
Unlimited	(*)	43488		1640		45128	

GFI = Gross farm income

Note = Inside bracket is percentage used

Table 3.8. Cash balance used at various levels of cash available, Komering Putih, Lampung, 1965-1976

Cash available	Total value of cash available (Rp)	Cash I		Cash II		Total cash used	Δ Total cash used
		Used	Δ Used	Used	Δ Used		
Present level	13900	6950 (100)	5684	0		6950	
25% of GFI	38514	12634 (100)	12634	0	0	12634	5684
50% of GFI	77029	25269 (100)	12634	0	0	25269	12635
75% of GFI	115543	37903 (100)	12634	0		37903	12634
100% of GFI	154057	50537 (100)	15330	0	0	50537	12634
Unlimited	∞	65867			0	65867	15330

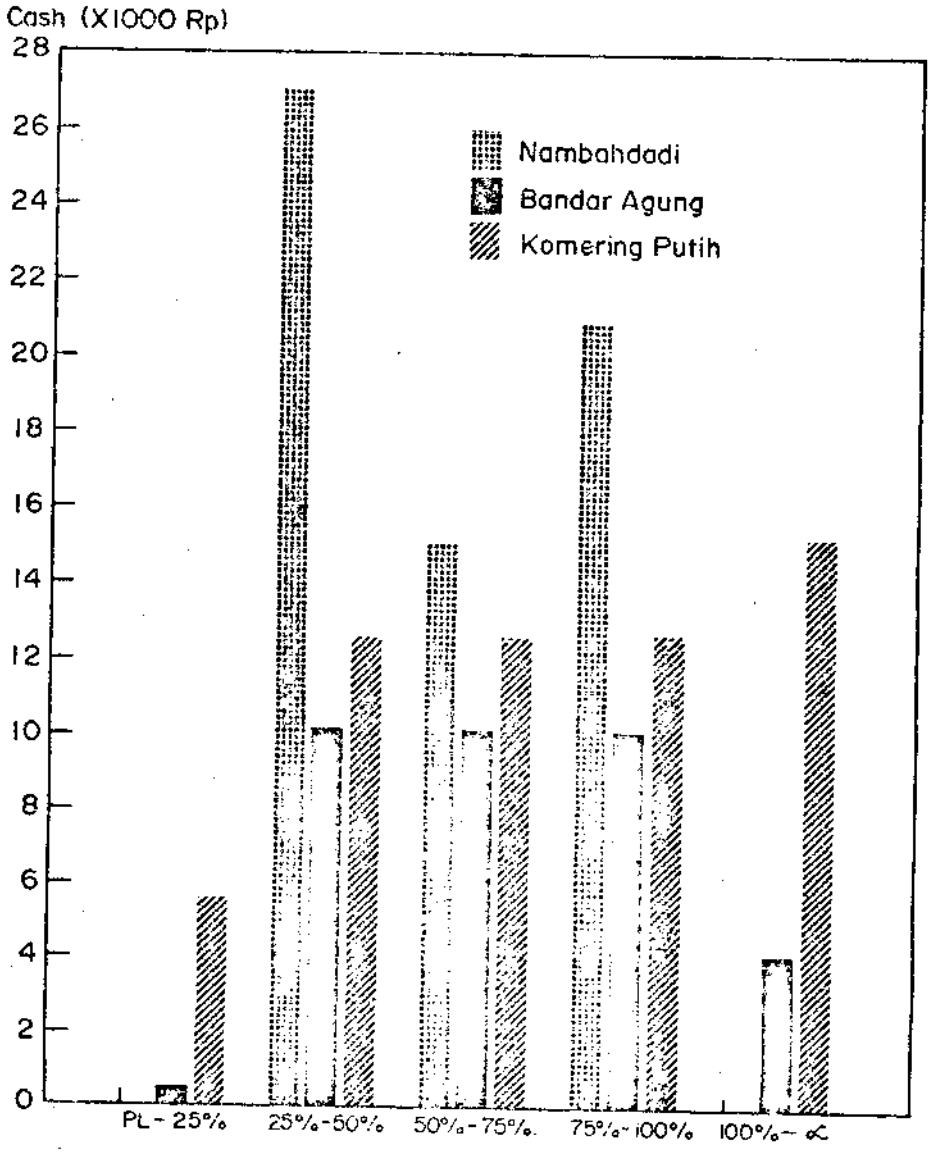


Fig. 5.3. Change in cash use, by change in cash available in three villages, Lampung, 1975–1976.

In Sub-area II, represented by Bandar Agung village, the cash available in the first crop season was more important. Even at the present level of cash available for the second crop, there was slack. The ratio of cash used during first season to cash used for the second crop season ranged from 10 to 26. It is obvious that the available cash in the first season is more important than in the second season. The maximum cash needed was about 4.5 times the present level available. Analysis of Sub-area III, represented by Komering Putih village shows that the cash used in this village was entirely applied in the first season (Table 5.6). The maximum amount of cash used was about 10 times the present level of cash used. The additional use of cash when cash available is increased from 25% of GFI level up to 100% of GFI level is in constant increments representing the additional amounts made available.

5.1.3 The effect of different levels of cash available on the amount of cash used

In Nambahdadi village, increasing the cash available from present levels increased the total labor used. The proportion of hired labor increased, while the proportion of family labor and gotong-royong labor declined (Table 5.7). At the present level of cash availability, 13 percent of labor was hired, 36 percent and 51 percent were from direct family labor and gotong-royong, respectively.

In Bandar Agung village, representing Sub-area II of upland, at the present level of available cash, only 10 percent of labor is hired. Increasing the cash available up to the unlimited level increases the

Table 5.7. Labor used by source and levels of cash available, Nambahdadi, Lampung, 1975-1976

Total cash available	Total value of cash available (Rp)	Family labor	Hired labor	Gotong royong labor	Total
		manhour			
Present level	40615	687 (36)	244 (18)	974 (51)	1905 (100)
25% of GFI	84615	696 (32)	287 (13)	1162 (55)	2145 (100)
50% of GFI	169231	590 (22)	769 (28)	1353 (50)	2712 (100)
75% of GFI	253846	804 (27)	975 (33)	1186 (40)	2965 (100)
100% of GFI	338461	808 (23)	1390 (40)	1270 (33)	3468 (100)
Unlimited	∞	808 (23)	1390 (40)	1270 (33)	3468 (100)

Note: GFI - Gross farm income
Inside bracket is percentage value.

Table 5.8. Labor used by source at various levels of cash available, Bandar Agung, Lampung 1975-1976

Total cash available	Total value of cash available (Rp)	Family labor	Hired labor	Gotong royong labor	Total
		man hour			
Present level	13500	810 (42)	192 (10)	921 (48)	1923 (100)
25% of GFI	36695	814 (41)	201 (10)	956 (49)	1971 (100)
50% of GFI	73390	926 (39)	466 (20)	974 (41)	2366 (100)
75% of GFI	110085	960 (35)	733 (27)	1049 (38)	2742 (100)
100% of GFI	146780	662 (21)	1056 (34)	1397 (45)	3115 (100)
Unlimited	∞	799 (25)	111 (35)	1281 (40)	3191 (100)

Note: Inside bracket is percentage value.

Table 5.9. Labor used by source, by various levels of cash available. Komering Putih, Lampung 1975-1976

Total cash available	Total value of cash available	Family labor	Hired labor	Gotong-royong labor	Total
		manhours			
Present level	13900	1301 (57)	163 (7)	802 (36)	2266 (100)
25% of GFI	38514	1163 (47)	309 (13)	977 (40)	2449 (100)
50% of GFI	77029	1108 (39)	642 (32)	1115 (39)	2865 (100)
75% of GFI	115543	998 (30)	975 (30)	1316 (40)	3289 (100)
100% of GFI	154057	896 (25)	1310 (36)	1385 (39)	3596 (100)
Unlimited	∞	560 (17)	1715 (51)	1066 (32)	3341 (100)

Note: Inside bracket is percentage value.

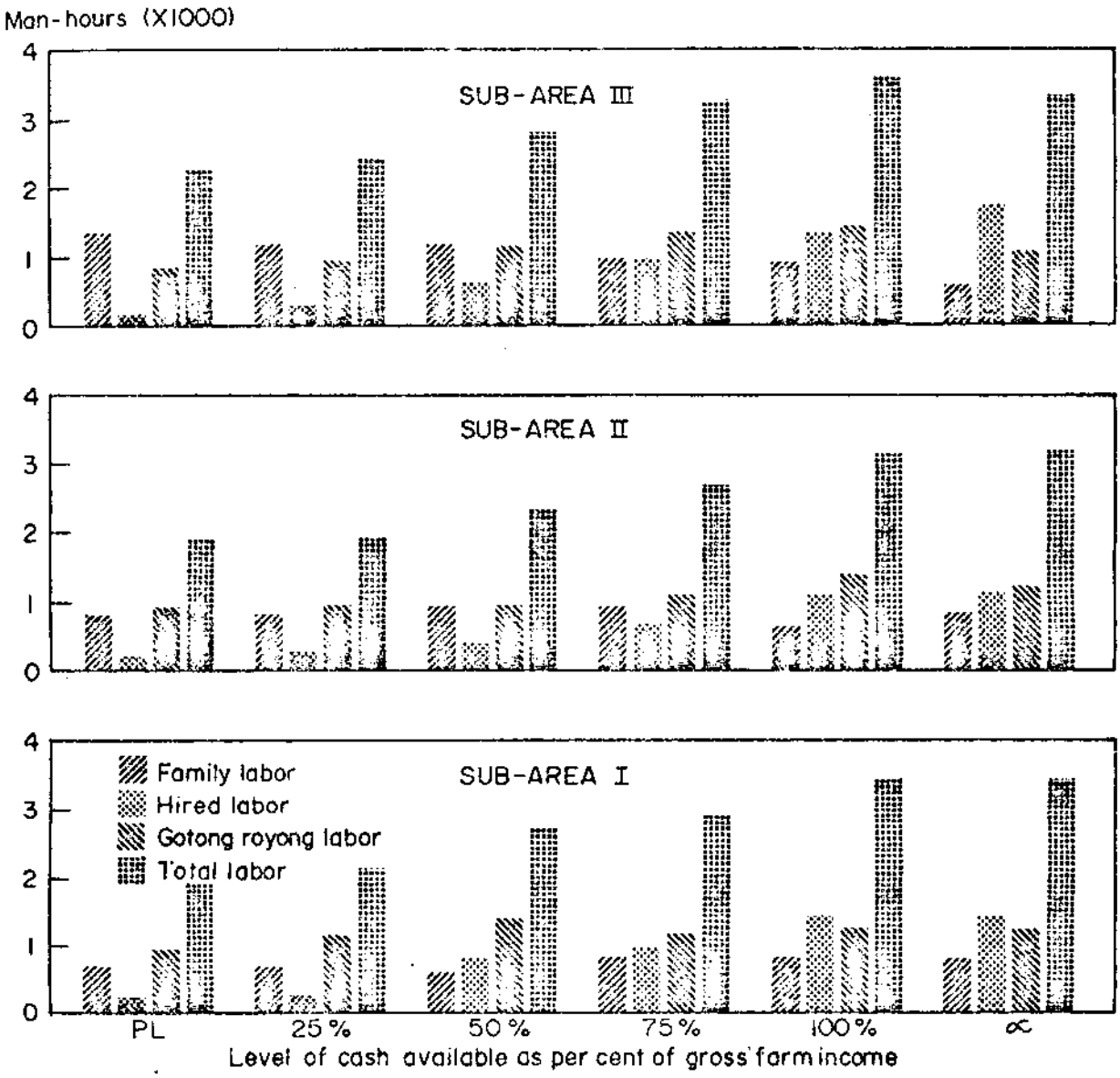


Fig.5.4 Labor utilization in optimal solution, by level of cash available in three sub-areas, Lampung, 1975-1976.

proportion of direct family labor, but only slight changed gotong-royong labor (Table 5.8).

In Komering Putih village (Sub-area III), the optimal solution shows that relatively higher total labor use than the other two villages. At the present level of cash availability, only 7 percent of total labor was hired labor. The highest proportion, 57 percent, was from family labor. When available cash was increased, the proportion of hired labor gradually increased; the proportion of family labor decreased and gotong-royong labor changed slightly. It seems that the variation of available cash affected more the proportions of hired labor and family labor. With unlimited cash available, 17% of labor was directly from the family, 51% was hired and 32% came from gotong-royong (Table 5.9).

5.2. The Effect of Different Wage Rates on the Solution

Wage rates and available cash both theoretically affect the farmers' use of hired labor. Theoretically, farmers will hire labor as long as the marginal value product of labor is higher than the market wage rate. Difference in wage rates will theoretically affect also the net income, cash used, and the cropping pattern in the optimal solution of LP model.

In this study, the effect of different wage rates was observed at two levels of cash available in the farm; the present level of cash used and at 100% of GFI level. The latter means that all the income from crop production is made available for farm operations.

Average market wages differ among sub-areas. In Nambahdadi village where lowland areas dominate the average market wage is Rp 350/day, or RP 50/hour, for a work day of 7 hours. Bandar Agung and Komering Putih villages, representing Sub-areas II and III of the upland show an average market wage of Rp 245/day or Rp 35/hour according to survey data.

5.2.1. The effect of different wage rates on cropping patterns, land used, and net income

In Nambahdadi village with cash available at the present level used and with variable market wages, the best combination of cropping patterns was CPB (lowland rice - corn + peanut, i.e. the farmers experimental cropping pattern executed researcher without supervision and constraints), cropping pattern C (lowland rice-coron-rice bean, the improved cropping pattern), and cropping pattern H (upland rice-corn). Change of available cash to 100% of GFI level, gave a different combination of cropping patterns in excluding cropping pattern B. A combination of cropping C and H was most profitable. This means that when more cash is available to the farm, farmers in this area will more intensively cultivate their lowland fields by using more cash.

Variation of the wage rate with those two levels of available cash did not change the most profitable combination of cropping pattern. Increased wage rates slightly decreased cultivated land. Stable combination of patterns and levels of labor use was because the change in the wages was nost sufficient to reveal any differences in the labor productivity between patterns.

Table 5.10 Cropping pattern, and multiple cropping index, with cash available fixed at 100% of gross farm income (GFI) and at present levels of cash used by various wage rates, Nambahdadi, Lampung 1975-1976

Wage-rate (Rp/hour)	At 100% of GFI, cash available			At present level of cash available		
	Cropping pattern	ha.	MCI	Cropping pattern	ha.	MCI
30	CPC CPH	0.5700 0.8100	200	CPB CPC CPH	0.1611 0.2962 0.3843	122
35	CPC CPH	0.5700 0.8100	200	CPB CPC CPH	0.1521 0.3013 0.3570	117
40	CPC CPH CPC	0.5700 0.8100	200	CPB CPC CPH	0.1241 0.3909 0.2209	107
45	CPC CPH	0.5700 0.7826	196	CPB CPC CPH	0.1225 0.3832 0.2226	106
50	CPC CPH	0.5700 0.6405	175	CPB CPC CPH	0.1229 0.3704 0.2246	104
55	CPC CPH	0.5700 0.4104	142	CPB CPC CPH	0.1215 0.3626 0.2264	103
60	CPC CPH	0.5700 0.4104	142	CPB CPC CPH	0.0930 0.3019 0.3538	109

CPB: Lowland rice followed by corn intercropped with peanut.
CPC: Lowland rice followed by corn followed by rice bean.
CPH: Upland rice followed by corn.

Table 5.11. Land used in optimal solution with cash available fixed at 100% of gross farm income (GFI) and at present level of cash used by various wage rates, Nambahdadi, Lampung, 1975-1976

Wage rate (Rp/hour)	Cash available fixed at 100% of GFI			Cash available at present level		
	Total land used (ha)	Lowland (ha)	Upland (ha)	Total land used (ha)	Lowland (ha)	Upland (ha)
30	0.5700 (100)	0.8100 (100)	1.38 (100)	0.4573 (81)	0.3843 (47)	0.84 (61)
35	0.5700 (100)	0.8100 (100)	1.38 (100)	0.4534 (80)	0.3570 (44)	0.81 (59)
40	0.5700 (100)	0.8100 (100)	1.38 (100)	0.5149 (90)	0.2209 (27)	0.74 (54)
45	0.5700 (100)	0.7826 (97)	1.35 (98)	0.5057 (89)	0.2226 (27)	0.73 (53)
50	0.5700 (100)	0.6406 (79)	1.21 (88)	0.4933 (87)	0.2246 (28)	0.72 (52)
55	0.5700 (100)	0.4104 (51)	0.98 (71)	0.4841 (85)	0.2264 (28)	0.71 (51)
60	0.5700 (100)	0.4104 (51)	0.98 (71)	0.3950 (69)	0.3538 (44)	0.75 (54)

Table 5.12 Net income at optimal solution with cash available fixed at 100% of gross farm income (GFI) and at present level of cash used, by various wage rates, Nambahdadi, Lampung, 1975-76

Wage-rate (Rp/hour)	Available cash fixed at 100% of GFI			Available cash fixed at present of cash used		
	Net Income (Rp)	Δ Net Income (Rp)	e*	Net Income (Rp)	Δ Net Income (Rp)	e*
30	179281	-9650	-0.32	130987	- 4842	-0.22
35	169631	-7958	-0.33	126145	- 3884	-0.22
40	161673	-9644	-0.48	122261	- 2063	-0.13
45	152029	-9918	-0.59	120198	- 2922	-0.22
50	152111	-889	-0.06	117276	- 2065	-0.18
55	141222	-4308	-0.34	115211	- 400	-0.04
60	136914			114811		

Note: Wage Rp 50/hour, is the existing wage rate in Nambahdadi Village.

$$e^* = \frac{\%\ \text{change of Income}}{1\%\ \text{change of wage}}$$

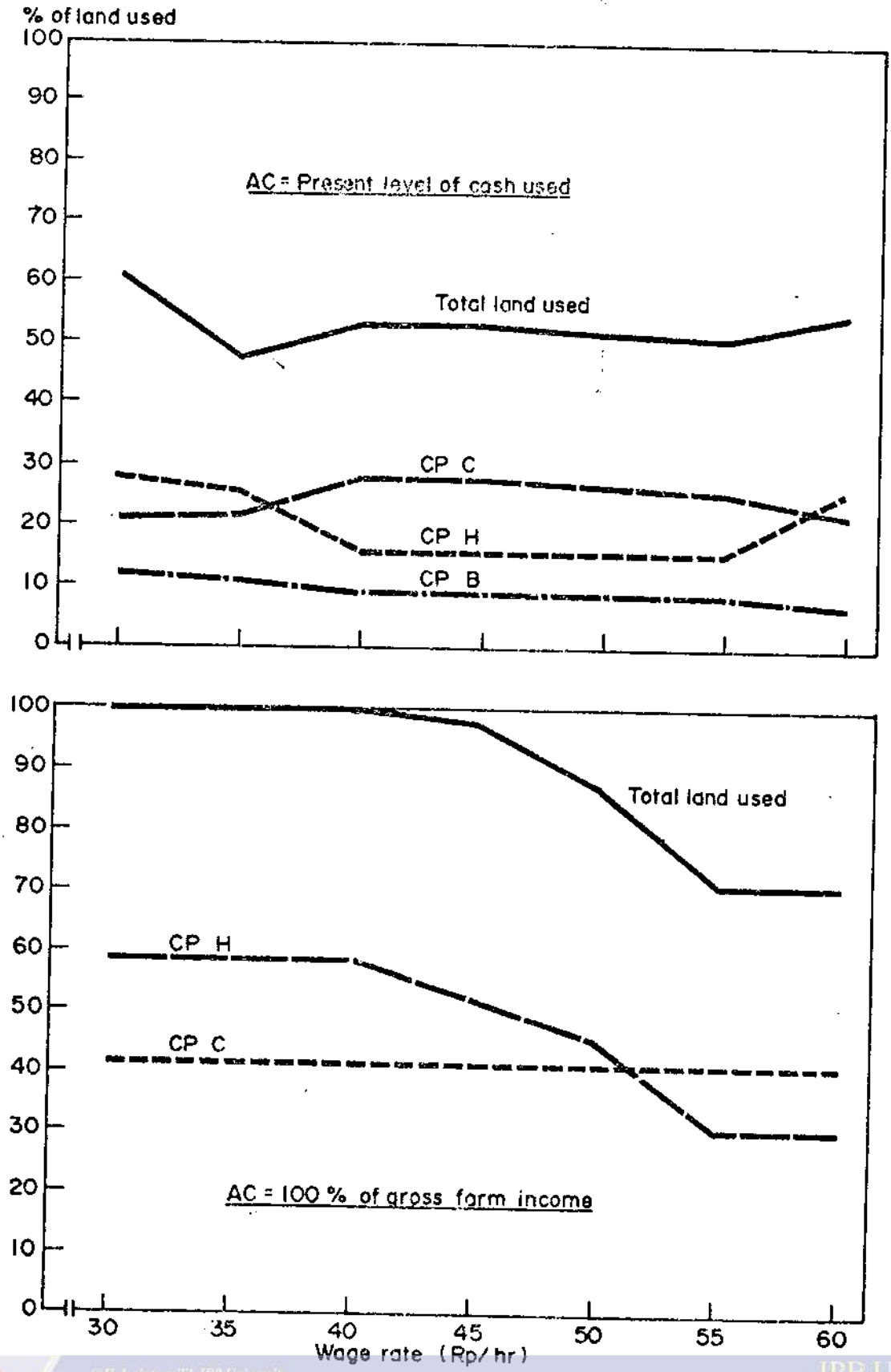


Fig. 5.5. Percentage of total land used in various cropping patterns (CP) and total land used, by wage rate and available cash (AC), Nambahdadi, Lampung, 1975-76.

By altering the value of wages different amounts of land can be planted, but the effect is small. Obviously, the effect of available cash is more dominate than variation the wage rates. With cash available at 100% GFI the variation wage rates did not affect the use of lowland fields, but affected only the use of upland. When cash available is at the present level used, the variation in wage rates affected both the areas lowland and upland planted by reducing the total amount of labor that could be hired with the cash resource.

In the upland areas represented by Bandar Agung and Komering Putih villages, the most profitable cropping pattern based on presently constraints faced by farmers was the most common present cropping pattern as it performed under researcher supervision in the experimental design.

In Bandar Agung, the pattern alone was most profitable.

In Komering Putih, pattern A was combined with farmers; cropping pattern managed by themselves, the latter occupied one third of the total area when cash available was fixed at 100% GFI, and one-half of land when cash available was fixed at the present level cash used.

The possible reason that the improved experimental cropping pattern had was included in the solution was that in 1975-1976, the dry season was longer than usual. This made planting of the second crop very late. Presumably, however, a dry year would also affect existing patterns. This suggests that the input/output relationship were more adversely affected by weather in the upland. Note that where water was available in the lowland area the high input experimental pattern was the result of the fact that supervised farmers cropping pattern gave higher income than the farmers' cropping pattern managed by themselves. Probably, because farmers treated it more intensive than their other fields.

Table 5.13. Cropping patterns and multiple cropping index (MCI), with available cash fixed at 100% of gross farm income (GFI) and at present level of cash used by various wage rates in Bandar Agung and Komering Putih villages, Lampung, 1975-1976

Wage-rate (Rp/hour)	Bandar Agung/sub area II						Komering Putih/sub area III					
	at 100% of GFI			at present level of cash used			at 100% of GFI			at present level of cash used		
	Cropping pattern	Hectare	MCI	Cropping pattern	Hectare	MCI	Cropping pattern	Hectare	MCI	Cropping pattern	Hectare	MCI
30	CPA	1.640	200	CPA	1.029	125	CPA CPD	1.525 0.115	200	CPA CPD	0.5119 0.4355	116
35	CPA	1.573	192	CPA	1.006	123	CPA	1.370 0.270	200	CPA CPD	0.4923 0.4383	113
40	CPA	1.500	133	CPA	0.988	120	CPA	1.249 0.354	196	CPA CPD	0.4770 0.4405	112
45	CPA	1.442	176	CPA	0.969	118	CPA	1.172 0.354	186	CPA CPD	0.4655 0.4421	111
50	CPA	1.400	171	CPA	0.953	116	CPA	1.100 0.354	177	CPA CPD	0.4560 0.4435	110
55	CPA	1.355	165	CPA	0.940	115	CPA	1.049 0.359	172	CPA CPD	0.4482 0.4445	109
60	CPA	1.315	160	CPA	0.929	113	CPA	0.983 0.368	165	CPA CPD	0.4416 0.4453	108

In Bandar Agung, CPA = Corn intercropped with upland rice followed by corn.

In Komering Putih, CPA = Corn intercropped with upland rice followed by cassava and CPD = Upland rice intercropped with cassava.

Table 5.14. Land used in optimal solution with available cash fixed at 100% of Gross Farm Income (GFI) and at present level of cash used, by various wage rates, Bandar Agung and Komering Putih villages, Lampung, 1975-1976

Wage-rate (Rp/hour)	Bandar Agung/Subarea II		Komering Putih/Subarea III	
	at 100% of GFI (ha)	at present level cash used (ha)	at 100% of GFI (ha)	at present level of cash used (ha)
30	1.640 (100)	1.029 (63)	1.640 (100)	0.947 (58)
35	1.573 (96)	1.006 (61)	1.640 (100)	0.931 (57)
40	1.500 (91)	0.988 (60)	1.603 (98)	0.918 (56)
45	1.442 (88)	0.969 *59)	1.526 (93)	0.908 (55)
50	1.396 (85)	0.953 (58)	1.450 (88)	0.900 (55)
55	1.355 (93)	0.940 (57)	1.410 (86)	0.893 (54)
60	1.315 (80)	0.929 (57)	1.351 (82)	0887 (54)

Inside the bracket is shown the percentage from total land available.

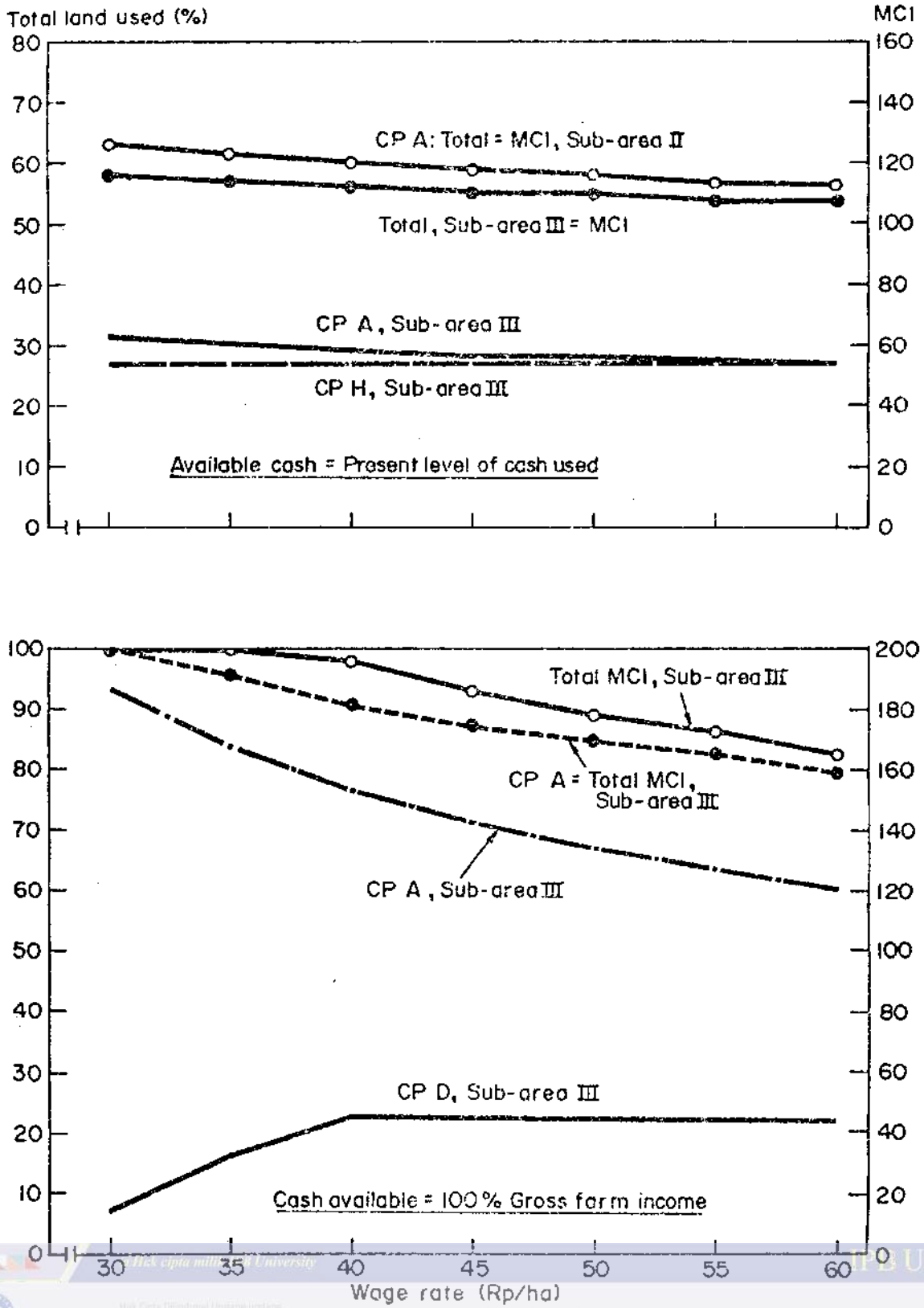


Fig. 5.6. Cropping pattern, multiple cropping index (MCI) and land used by wage rate and available cash in sub-area II and III, Lampung, Indonesia, 1975 – 1976.

able 5.15. Net income in optimal solution with available cash fixed at 100% of gross farm income (GFI) level and at present level of cash used, by various wage rates, Bandar Agung and Komering Putih villages, Lampung, 1975-1976

Wage-rate (Rp/hour)	Bandar Agung						Komering Putih					
	At 100% of GFI			At present level of cash used			At 100% of GFI			At present level of cash used		
	Net Income (Rp)	ΔNet Income (Rp)	e*	Net Income (Rp)	ΔNet Income (Rp)	e*	Net Income (Rp)	ΔNet Income (Rp)	e*	Net Income (Rp)	ΔNet Income (Rp)	e*
30	111024			83921			113863			66018		
		-7612	-0.41		-2074	-0.15		-9194	-0.48		-1926	-0.18
35	103412			81847			104669			64092		
		-6658	-0.45		-1694	-0.14		-8871	-0.59		-1467	-0.16
40	96754			80153			95798			62625		
		-5232	-0.43		-1721	-0.17		-8026	-0.67		-1155	-0.15
45	91522			78432			87772			61470		
		-4221	-0.42		-1396	-0.16		-7547	-0.77		-932	-0.14
50	87301			77036			80225			60538		
		-3705	-0.42		-1156	-0.15		-5118	-0.64		-770	-0.13
55	83596			75880			75107			59768		
		-3621	-0.48		-1035	-0.15		-6481	-0.95		-651	-0.12
60	79975			75845			68626			59117		

e* $\frac{\%\text{ change of Net Income}}{1\%\text{ change of wage rate}}$

Also, the [illegible] field size [illegible] therefore they were able to tr[illegible]it more intensively. [illegible]dy, cropping pattern A was exactly the same as the farmers cropping pat[illegible] had the same management but it was planted in 1000 [illegible] field and [illegible] often visited by field assistants.

The variation value of market wage did not change combination of cropping pattern, but only affected the area that can be planted. Changing the level cash available to 100% of GFI showed strong impact on the multiple cropping index.

5.2.2. The effect of different wage rates on cash used

In Nambahdadi village (Sub-area I), in the optimal solution at the present level of cash use, the available cash is used. At all wage-rates 100% of cash continued to be used. Increasing cash available up to 100% of GFI resulted in an excess of cash balance. This means that not all cash available was used, especially cash II, the cash available in second crop season. At the present market wage of Rp 50/hour, 94% of cash in the first crop season was used, but only 11% in the second crop season. With the wage slightly reduced, cash I was all used, but only 12 percent of cash II. As wage rates decreased, cash used slightly decreased.

In Lendar Agung village (Sub-area II), at the present level of cash [illegible] at the present level of market wages (Rp 35/hour), the opti[illegible]tion in [illegible]ilization of all cash I, available, and 9 pe[illegible] cash II. At different levels of wages ([illegible] 5.17), the optimal solution used 100% of cash I, and only slightly changed the use

Table 5.16. Total cash used in optimal solution with cash available fixed at present level of cash used and at 100% of gross farm income (GFI), by various wage rates, Nambahdadi, Lampung, 1975-76

Wage-rate (Rp/hour)	At present level of cash used			at 100% of GFI		
	Cash I used (Rp)	Cash II used (Rp)	Total	Cash I used (Rp)	Cash II used (Rp)	Total (Rp)
30	20308 (100)	20380 (100)	40616	61814 (79)	29507 (11)	91321
35	20308 (100)	20308 (100)	40616	69571 (89)	31400 (12)	100971
40	20308 (100)	20308 (100)	40616	75636 (97)	33293 (13)	108929
45	20308 (100)	20308 (100)	40616	78221 (100)	31619 (12)	109840
50	20308 (100)	20308 (100)	40616	73648 (94)	29104 (11)	102752
55	20308 (100)	20308 (100)	40616	50526 (65)	18148 (7)	68674
60	20308 (100)	20308 (100)	40616	54691 (70)	18293 (7)	72984

Inside bracket is shown percentage of total available.

Table 5.17. Total cash used in optimal solution with available cash fixed at present level of cash used and at 100% of gross farm income (GFI), by various wage rates, Bandar Agung, Lampung, 1975-76

Wage rate	At present level of cash used			At 100% of GFI		
	Cash I used (Rp)	Cash II used (Rp)	Total (Rp)	Cash I used (Rp)	Cash II used (Rp)	Total (Rp)
30	9540 (100)	1029 (1.0)	10569	37931 (96)	1640 (1.5)	39571
35	9540 (100)	1006 (0.9)	10564	39460 (100)	1573 (1.5)	41033
40	9540 (100)	988 (0.9)	10528	39460 (100)	1500 (1.4)	40960
45	9450 (100)	969 (0.9)	10509	39460 (100)	1442 (1.3)	40902
50	9540 (100)	953 (0.8)	10493	39460 (100)	1396 (1.3)	40856
55	9540 (100)	940 (0.8)	10480	39460 (100)	1354 (1.3)	40814
60	9540 (100)	929 (0.8)	10469	39460 (100)	1315 (1.2)	40775

Inside bracket is shown percentage of total available.

Table 5.18. Total cash used in optimal solution with available cash fixed at present level and at 100% of gross farm income (GFI) by various wage rates, Komering Putih, Lampung, 1975-1976

Wage rate (Rp/hour)	At present level of cash used			At 100% of GFI		
	Cash I used (Rp)	Cash II used (Rp)	Total (Rp)	Cash I used (Rp)	Cash II used (Rp)	Total (Rp)
30	6950 (100)	0	6950	50537 (100)	0	50537
35	6950 (100)	0	6950	50537 (100)	0	50537
40	6950 (100)	0	6950	50537 (100)	0	50537
50	6950 (100)	0	6950	50537 (100)	0	50537
55	6950 (100)	0	6950	50537 (100)	0	50537
60	6950 (100)	0	6950	50537 (100)	0	50537

Inside bracket is shown percentage of total available.

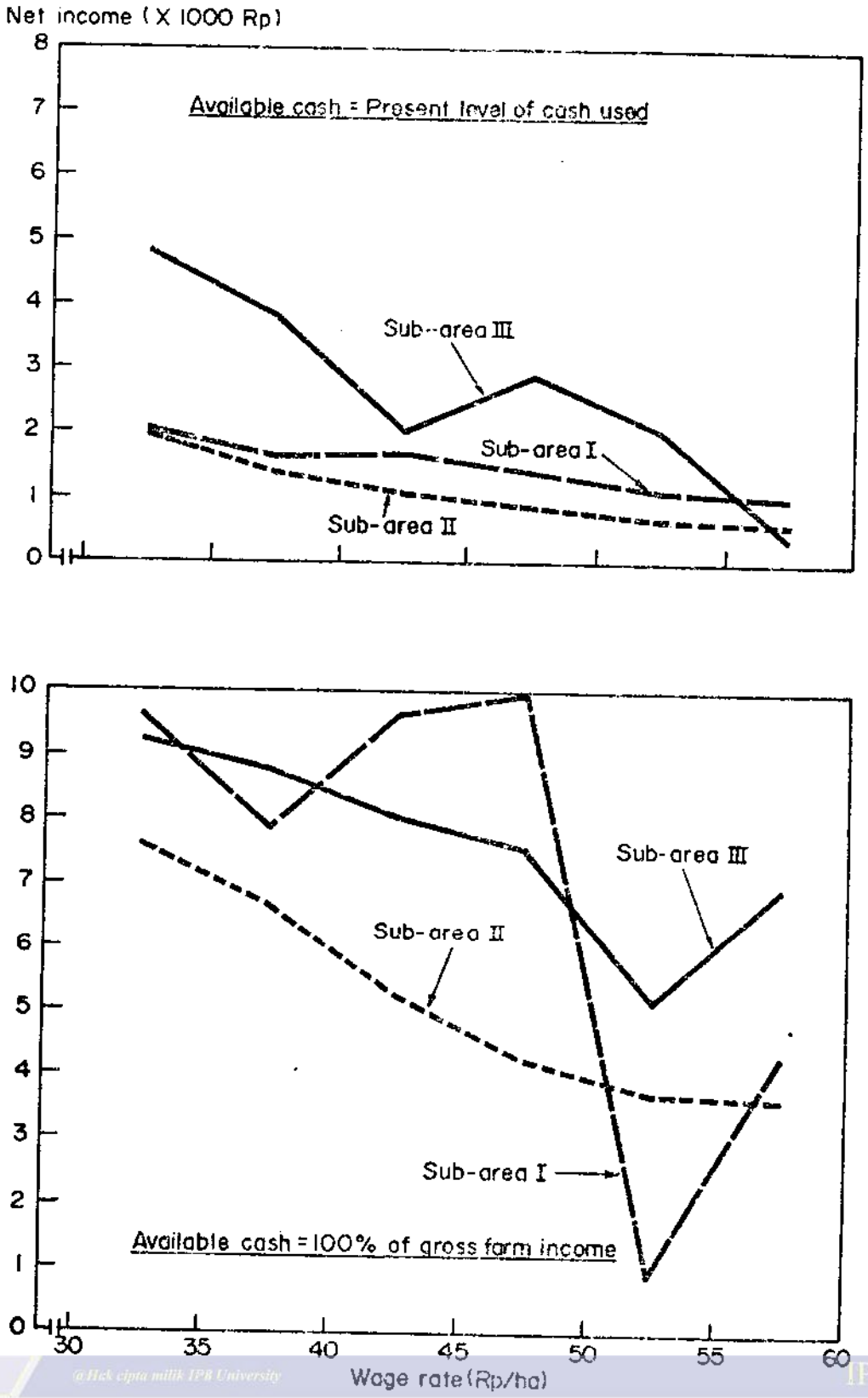


Fig. 5.7. Change in net income by wage rate and level of cash available in three sub-areas, Lampung, 1975-1976.

of cash balance II. Increased cash availability up to the value of gross farm income (100% of GFI), with the present level of market wages (RP 35/hour), all of cash I was used and only 1.5% of cash II. At all wage levels, 100% of cash balance I was used except at a wage of Rp 70/hour.

In Komering Putih village (Sub-area III), the variation of wage rates did not affect the amount of cash that was used, both at present level of cash used and at 100% of GFI. The optimum solution shows that only cash I will be used, and none of cash II. This result shows that the available cash in the first crop season was very important.

In Komering Putih village (Sub-area III), at the present level of cash used the optimal solution indicated more use of family and gotong-royong labor and very small proportion (less than 10%) of hired labor. Incresing of availability cash up to 100% of GFI, gradually increased the proportion of hired labor used, compensated by a decrease in the proportion of family labor used. More available cash increased profit through use of more hired labor and gotong-royong labor than family labor (Table 5.21).

5.3. The Effect of Gotong-royong Practices on the Optimal Solution

Gotong-royong practice similar with exchange labor in the other countries in which the length of time for repayment may vary. The average is within one month (4 weeks); that is, if some borrows labor one week, he must work either one week or two weeks after, or he may work for others one or two weeks before he uses the gotong-royong labor.

Table 5.19. Labor used by source and wage rate in optimal solution with available cash fixed at 100% of gross farm income (GFI) and at present level of cash used, Nambahdadi, Lampung, 1975-1976

Wage-rate (Rp/hour)	At 100% of GFI				At present level of cash used			
	Family labor	Hired labor	Gotong-royong labor	Total	Family labor	Hired labor	Gotong-royong labor	Total
	--manhour--							
30	971 (24)	1030 (99)	1099 (27)	4000 (100)	665 (29)	469 (20)	1196 (51)	2330 (100)
35	752 (19)	1930 (49)	1270 (32)	3952 (100)	482 (22)	384 (18)	1297 (60)	2163 (100)
40	812 (21)	1888 (48)	1252 (31)	3952 (100)	908 (47)	274 (14)	755 (39)	1937 (100)
45	670 (17)	1800 (47)	1394 (36)	3864 (100)	738 (39)	243 (13)	927 (48)	1908 (100)
50	808 (23)	1390 (40)	1262 (37)	3460 (100)	687 (36)	244 (13)	974 (51)	1905 (100)
55	542 (22)	748 (30)	1225 (48)	2515 (100)	796 (42)	231 (12)	858 (46)	1885 (100)
60	607 (23)	667 (25)	1406 (52)	2680 (100)	679 (32)	254 (12)	1184 (56)	2117 (100)

Note: Inside bracket is shown the percentage of total labor used.

Table 5.20. Labor used by source and wage rate in optimal solution with available cash fixed at 100% of gross farm income (GFI), Bandar Agung, Lampung, 1975-1976

Wage-rate (Rp/hour)	At 100% of GFI				At present level of cash used			
	Family labor	Hired labor	Gotong royong labor	Total	Family labor	Hired labor	Gotong royong	Total
	--manhour--							
40	833 (27)	1001 (32)	1247 (91)	3081 (100)	797 (40)	222 (11)	983 (40)	2002 (100)
35	662 (21)	1056 (34)	1397 (45)	3115 (100)	810 (42)	192 (10)	921 (48)	1923 (100)
40	724 (25)	822 (30)	1313 (45)	2919 (100)	851 (44)	169 (9)	902 (47)	1922 (100)
45	597 (21)	787 (28)	1422 (51)	2806 (100)	789 (43)	152 (8)	910 (49)	1851 (100)
50	512 (19)	711 (26)	1492 (55)	2715 (100)	845 (46)	137 (7)	873 (47)	1855 (100)
55	659 (25)	648 (25)	1330 (50)	2637 (100)	702 (39)	126 (7)	970 (54)	1798 (100)
60	725 (28)	596 (23)	1238 (49)	2558 (100)	813 (45)	148 (8)	846 (46)	1807 (100)

Inside bracket is shown the percentage of total labor used.

Table 5.21. Labor used by source and wage rate in optimal solution with available cash fixed at 100% of gross farm income (GFI) level and at present level of cash used, Komering Putih, Lampung, 1975-1976

Wage-rate (Rp/hour)	at 100% of GFI				At present level of cash used			
	Family labor	Hired labor	Gotong royong labor	Total	Family labor	Hired labor	Gotong royong labor	Total
	--manhour--							
30	989 (29)	1557 (45)	923 (26)	3469 (100)	1230 (54)	189 (8)	879 (38)	2298 (100)
35	871 (24)	1345 (38)	1351 (38)	3567 (100)	1301 (57)	163 (7)	802 (36)	2266 (100)
40	964 (27)	1185 (33)	1416 (40)	3565 (100)	1207 (54)	144 (6)	890 (40)	2241 (100)
45	1037 (30)	1057 (31)	1313 (39)	3407 (100)	1246 (56)	128 (6)	848 (38)	2222 (100)
50	1020 (34)	655 (22)	1286 (44)	2961 (100)	1323 (60)	116 (5)	768 (35)	2207 (100)
55	1080 (34)	887 (28)	1191 (39)	3158 (100)	1350 (62)	106 (5)	738 (33)	2194 (100)
60	1126 (37)	801 (26)	1137 (37)	3069 (100)	1265 (58)	97 (4)	821 (38)	2183 (100)

Inside bracket is shown the percentage of total labor.

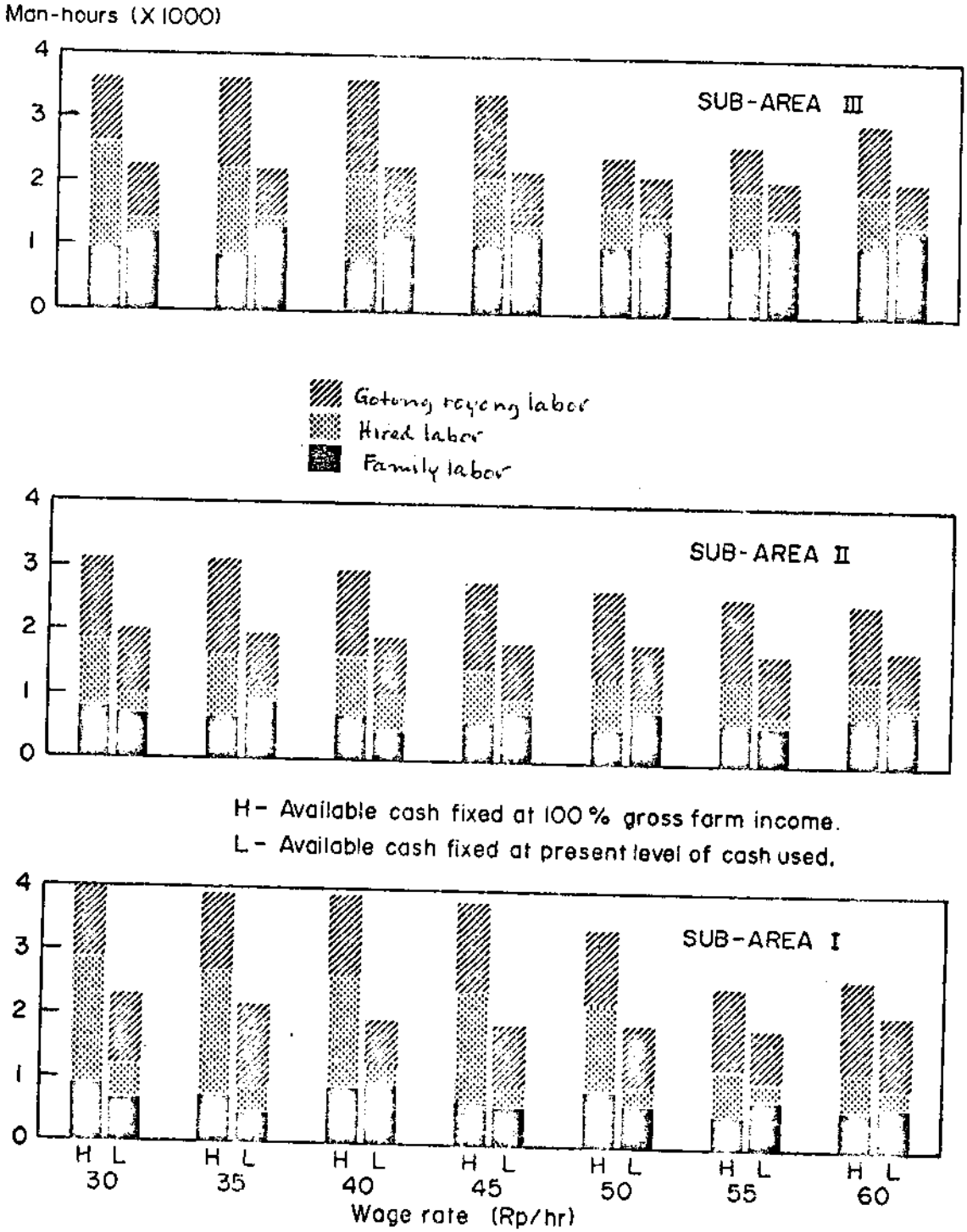


Fig.5.8. Labor utilization by wage rate and available cash in three sub-areas, Lampung, Indonesia, 1975 – 1976.

To investigate in detail the effect of gotong-royong practices on the optimal solution in relation to cropping patterns, net income, and land, and labor used, the length of time and family members have to repay gotong-royong labor was varied. The variation started from no gotong-royong practices (by requiring repayment within 0 weeks) up to an 8-week repayment span. That is for instance, gotong-royong used in the current week or had to be repaid by family working in 4 weeks before or 4 weeks after the week gotong-royong was used. Between 0 and 8 weeks, results were obtained for repayment spans of 2 weeks, 4 weeks and 6 weeks.

Two levels of available cash were exercised, first the present level of cash used by farmers, and second, at 100% of gross farm income (GFI).

5.3.1. The effect of gotong-royong practices on cropping patterns, land use, and net income in the optimal solution

Nambahdadi village (Subarea I). At the present level of cash used and at present level of gotong-royong practices (4 weeks) the optimal combination of cropping pattern are cropping pattern B (lowland rice-corn + peanut, a farmers' cropping pattern without input constraint), and cropping pattern C (lowland rice - corn - rice bean, the experimental improved cropping pattern). This combination resulted in a multiple cropping index 104 (Table 5.22). Eighty-seven percent of lowland and only 28% of upland were planted (Table 5.23). The variation of gotong-royong practices did not affect the combination of cropping patterns at this level of cash available. Only the area and MCI increased.

For 6 weeks of gotong-royong, the multiple cropping index was 111 and 86% of lowland plus 34% of upland were utilized. For an 8-week repayment period, 100% of lowland and 32% of upland field were planted. Inversely, when the gotong-royong period decreased, the combination of cropping patterns remained the same but the area that was planted decreased. Without gotong-royong, only 58% of lowland and 30% of upland can be planted.

With cash available increased to 100% of gross farm income with present gotong-royong practices (4 weeks), the optimal combination was cropping pattern C (lowland rice - corn-rice bean, the experimental, improved cropping pattern) and farmer-managed cropping pattern H (lowland rice - corn). This is a stable combination in that the variation of gotong-royong practices affected only the area planted. At 4 weeks gotong-royong practice, 100% of lowland and 79% of upland was planted. Increasing or decreasing the number of weeks of gotong-royong affected only the upland area planted. The multiple cropping index of 176 resulting from present practices was the highest level with respect to gotong-royong. When increasing or decreasing the weeks of gotong-royong the multiple cropping index decreased.

The effect of gotong-royong on net income is shown in Table 5.24. It shows that shifting gotong-royong from zero to 2 weeks, income increased tremendously, but when extended to 4 weeks the increment decreased about one half and continued to decrease thereafter. This happened also with available cash at 100% of GFI. As gotong-royong was extended, net income increase at a decreasing rate.

Table 5.22. Cropping patterns in optimal solution at various lengths of gotong-royong repayment period, and with available cash fixed at 100% of gross farm income (GFI) and at present level of cash used, Nambahdadi, Lampung, 1975-1976

Gotong-royong repayment period (weeks)	At 100% of GFI			At present level of cash used		
	Cropping pattern	Hectares	Multiple cropping index (MCI)	Cropping pattern	Hectares	Multiple cropping index (MCI)
0	CPC	0.5700	145	CPB	0.14368	82
	CPH	0.42857		CPC	0.18643	
				CPH	0.23906	
2	CPC	0.57000	174	CPB	0.15398	97
	CPH	0.62916		CPC	0.28483	
				CPH	0.22916	
4	CPC	0.57000	176	CPB	0.12292	104
	CPH	0.6410		CPC	0.37037	
				CPH	0.22462	
6	CPC	0.57000	160	CPB	0.04499	111
	CPH	0.5315		CPC	0.44481	
				CPH	0.27633	
8	CPC	0.57000	159	CPB	0.17431	120
	CPH	0.52767		CPC	0.39569	
				CPH	0.25622	

CPB - lowland rice followed by corn with peanut intercrop
CPH - lowland rice followed by corn followed by rice bean
CPH - upland rice followed by corn

Table 5.23. Land used at various length of gotong-royong repayment span with available cash fixed at 100% of gross farm income (GFI) and at present level of cash used, Nambahdadi, Lampung, 1975-1976

Gotong-royong repayment period (weeks)	At 100% of GFI			At present level of cash used		
	Lowland (ha)	Upland (ha)	Total (ha)	Lowland (ha)	Upland (ha)	Total (ha)
0	0.5700 (100)	0.4286 (53)	0.9986 (72)	0.3301 (58)	0.2391 (30)	0.5692 (41)
2	0.5700 (100)	0.6292 (78)	1.1992 (87)	0.4388 (77)	0.2292 (28)	0.6680 (98)
4	0.5700 (100)	0.6406 (79)	1.2106 (88)	0.4933 (87)	0.2246 (28)	0.7179 (52)
6	0.5700 (100)	0.5315 (66)	1.1015 (80)	0.4898 (86)	0.2763 (34)	0.7661 (56)
8	0.5700 (100)	0.5315 (66)	1.1015 (80)	0.5700 (100)	0.2562 (32)	0.8262 (60)

Inside the bracket is shown the percentage of total cash available.

Table 5.24 Net income in optimal solution by length of gotong royong repayment period, with available cash fixed at 100% of gross farm income (GFI) and at present level of cash used, Nambahdadi, Lampung, 1975-1976

Gotong-royong repayment period (weeks)	At 100% of GFI			At present level of cash		
	Net Income (Rp)	Δ Net Income (Rp)	e *	Net Income (Rp)	Δ Net Income (Rp)	e*
0	113807	16272	-	76566	26307	-
2	130079	12032	0.09	102873	14403	0.14
4	142111	9295	0.13	117276	13754	0.23
6	151406	4832	0.10	131030	9872	0.23
8	156238			140902		

e * = arc elesticity of income with respect to gotong-royong.

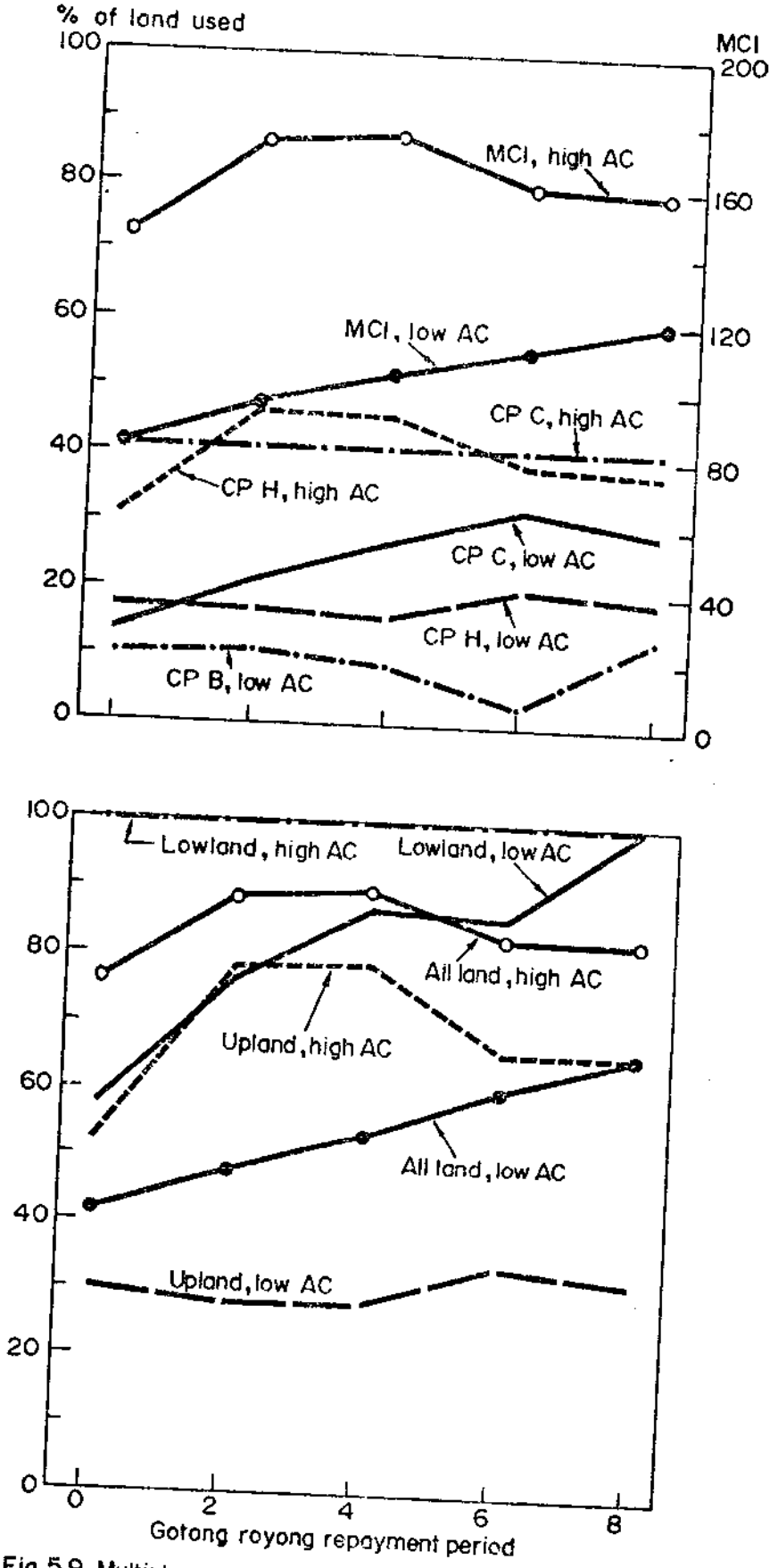


Fig. 5.9. Multiple cropping index (MCI) and land use by cropping pattern (CP), by gotong royong repayment period and with level of available cash (AC) fixed at present level of cash used (low) and at 100% gross farm income (high), Nambahdadi, Lampung, 1975–1976.

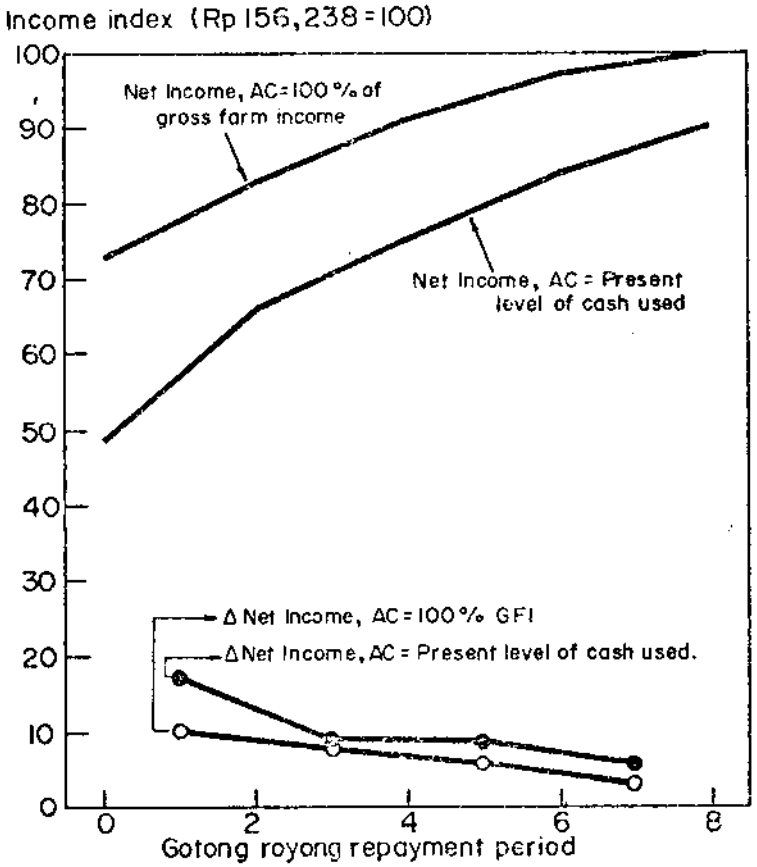


Fig. 5.10. Net income and increments in net income by gotong royong repayment period and level of available cash (AC), Nambahdadi, Lampung, Indonesia, 1975 – 1976.

Bandar Agung village (Sub-area II). At the present level of cash used, cropping pattern A (corn + upland rice - corn) gave the highest income. With 4 week of gotong-royong, only 61% of land was cultivated and the multiple crpping index was 123. Without any gotong-royong, only 33 percent of land was planted and the multiple cropping index was 66. By increasing gotong-royong to 8 weeks the area that was planted increased to 68% and the multiple cropping index to 134.

When the cash available was increased to 100% of the GFI, and with the present practice of gotong-royong (4 weeks), cropping pattern A remained in the optimal solution and 96% of the land was cultivated. Without gotong-royong only 59% of land was cultivated. Extending the gotong-royong to 6 weeks and 8 weeks decreased the area for cropping pattern A, but it was combined with cropping pattern H (upland rice + corn-fallow) and all available land was cultivated. The multiple cropping index at this level of available cash ranged from 117 to 200. The effect of net income of increasing gotong-royong practices was positive at both the present level of cash use and at 100% of GFI level. The increase in net income, however, was at a decreasing rate. Actually, this result is best interpreted as showing the value of gotong-royong and the value of spreading labor requirements through technology since it can be assumed that farmers make arrangements to extend gotong-royong when there are gains from doing so.

Komering Putih Village (Sub-area III). In this village, the supervised farmers cropping pattern A (corn + upland rice - cassava), and farmers cropping pattern D (upland rice + cassava), is the best combi-

Table 5.25. Cropping patterns in optimal solution with available cash fixed at 100% of gross farm income (GFI) level and at present level of cash used in Bandar Aguung and Komering Putih villages, Lampung, 1975-1976

Gotong-royong repayment period (weeks)	At 100% of GFI cash level			At present level of cash used		
	Cropping	Ha	MCI	Cropping	Ha	MCI
	---------- Bandar Agung ----------					
0	CPA	0.962	117	CPA	0.541616	66
2	CPA	1.398	170	CPA	0.84379	103
4	CPA	1.573	192	CPA	1.00617	123
6	CPA CPH	1.362 0.278	200	CPA	1.06017	129
8	CPA CPH	1.330 0.310	200	CPA	1.11416	134
	---------- Komering Putih ----------					
0	CPA CPD	0.97881 0.35398	163	CPA CPD	0.32969 0.35398	93
2	CPA CPD	1.18879 0.35398	188	CPA CPD	0.43398 0.44616	107
4	CPA CPD	1.370 0.270	200	CPA CPD	0.49225 0.43831	113
6	CPA CPD	1.44414 0.19586	200	CPA CPD	0.55058 0.42996	120
8	CPA CPD	1.50923 0.13077	200	CPA CPD	0.60891 0.42162	126

In Bandar Agung, CPA = Corn and upland rice followed by corn, and
CPH = Upland rice and corn intercrop

In Komering Putih, CPA = Corn and upland rice intercrop followed by cassava, and
CPD = Upland rice and cassava intercrop

Table 5.26. Land use in optimal solution by gotong-royong repayment period practices with available cash fixed at 100% of gross farm income (GFI) and at present level of cash in Bandar Agung and Komering Putih villages, Lampung, 1975-1976

Gotong-royong repayment period	At 100% of cash available		At present level of cash used	
	Land (Ha.)	Percentage of total available	Land (Ha.)	Percentage of total available
	---------- Bandar Agung ----------			
0	0.9615	59	0.54616	33
2	1.39839	85	0.84379	51
4	1.5744	96	1.00617	61
6	1.6400	100	1.06017	65
8	1.6400	100	1.11416	68
	---------- Komering Putih ----------			
0	1.3327	81	0.68367	42
2	1.54277	94	0.88014	54
4	1.6400	100	0.93056	57
6	1.6400	100	0.98054	60
8	1.6400	100	1.03053	63

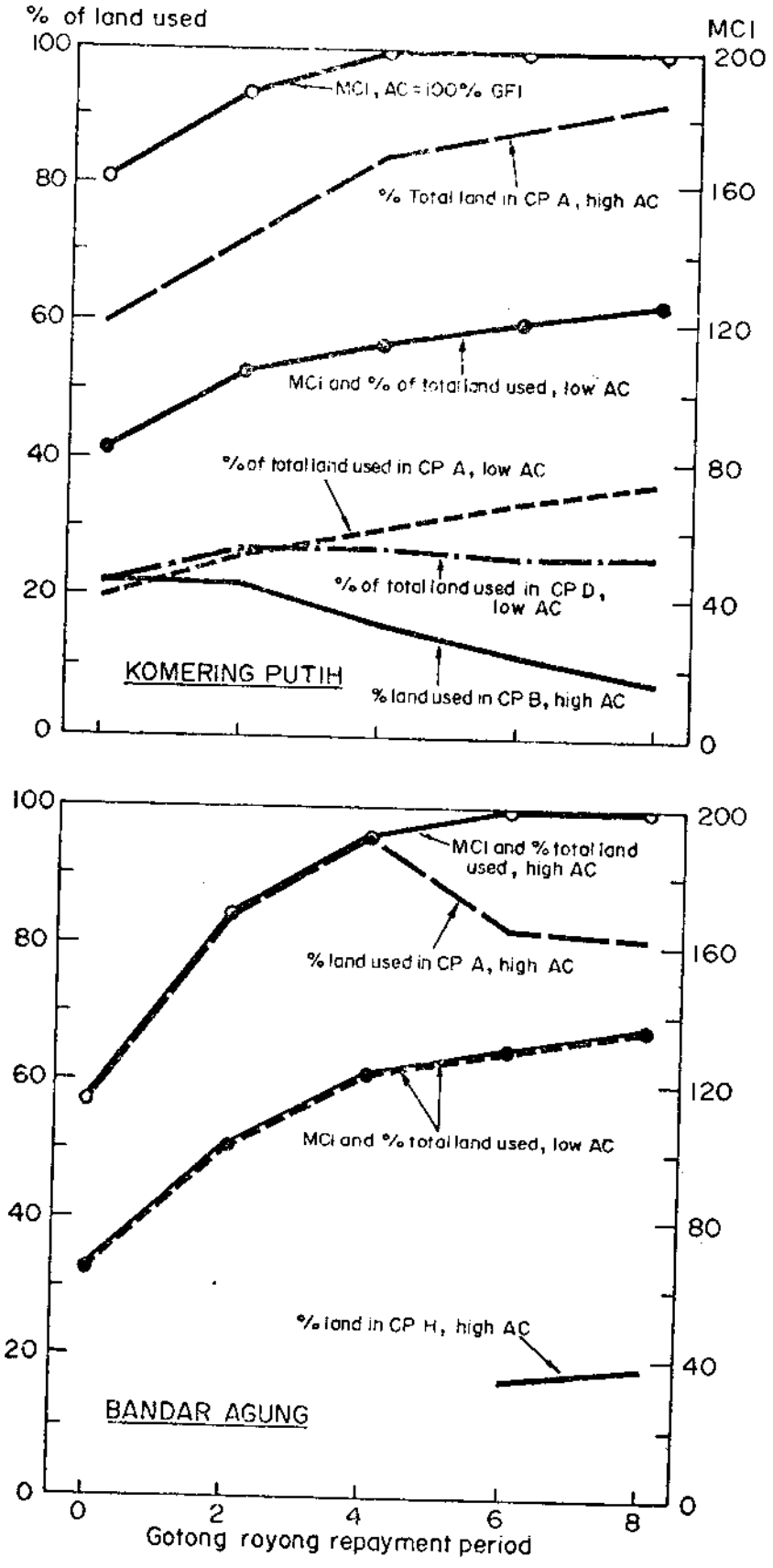
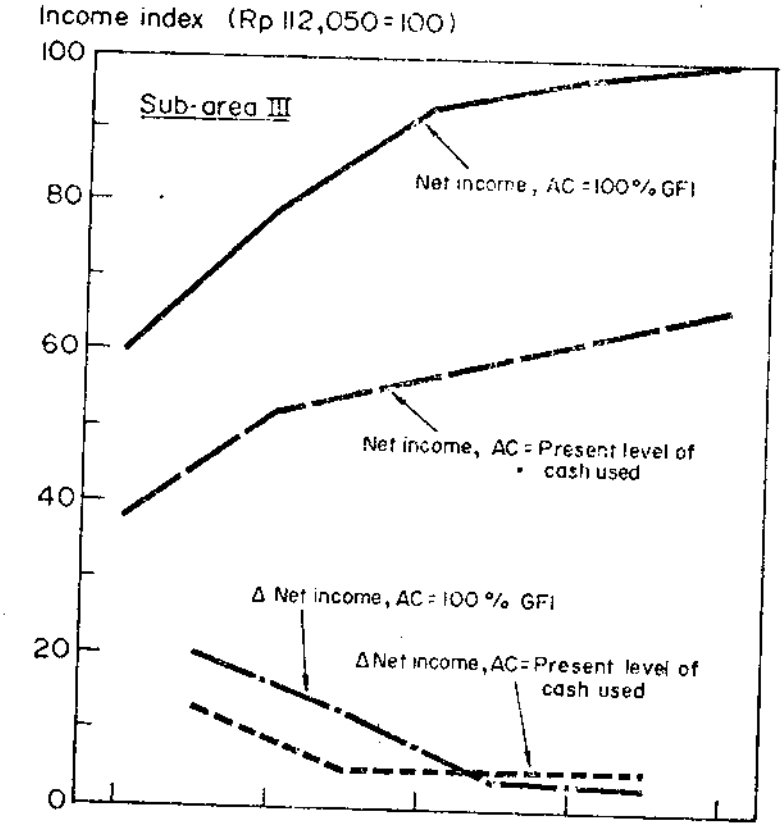


Fig. 5.11. Percentage of total land planted to alternative cropping patterns (CP), total land used and multiple cropping index (MCI) by gotong royong repayment period and when available cash (AC) is fixed at present level of cash used (low) and when fixed at 100% GFI (high), Bandar Agung and Komering Putih, 1975 - 1976.

Table 5.27. Net income in optimal solution by length of gotong-royong repayment period, with available cash fixed at 100% of gross farm income (GFI) and at the present level of cash used in Bandar, Agung and Komering Putih villages, Lampung, 1975-1976

Gotong-royong repayment period (weeks)	At 100% of GFI level of cash used			At present level of cash used		
	Net income (Rp)	Δ Net income (Rp)	e *	Net income (Rp)	Δ Net income (Rp)	e*
	---------- Bandar Agung ----------					
0	56911			40066		
		30640	0		27033	0
2	87551			67099		
		15860	0.70		14748	0.11
4	103411			81847		
		10237	0.20		4905	0.12
6	113648			86752		
		2906	0.0		4904	0.17
8	116554			91656		
	---------- Komering Putih ----------					
0	67307			43250		
		22171	0		15107	0
2	89478			58357		
		15191	0.17		5735	0.10
4	104669			64092		
		4398	0.08		5718	0.18
6	109067			69810		
		3883	0.11		5718	0.25
8	112950			75529		



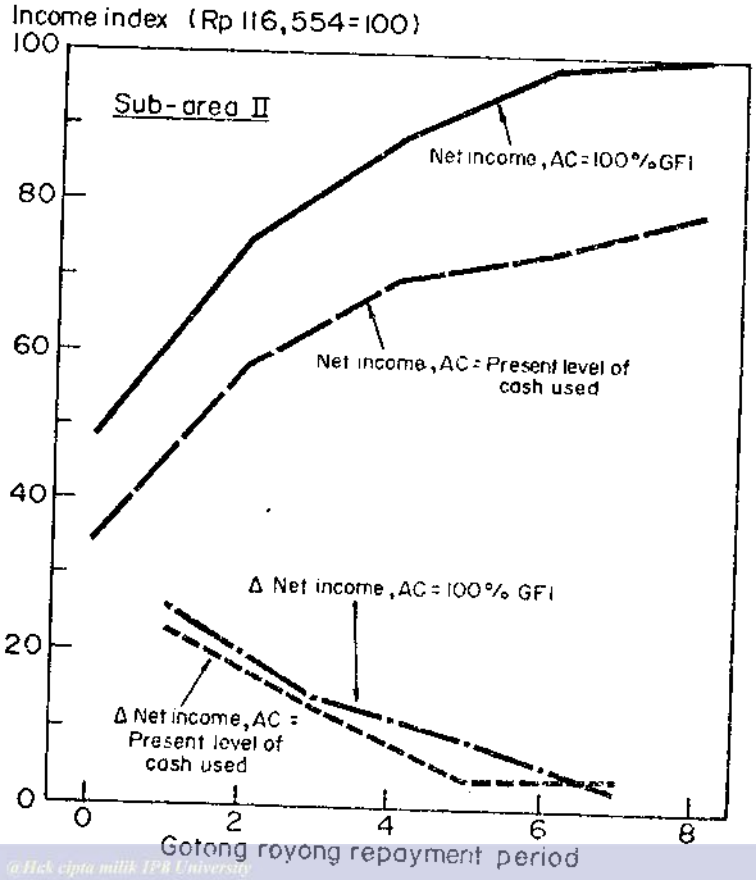


Fig. 5.12. Net income and increments in net income by gotong royong repayment period and level of available cash (AC), sub-areas II and III, Lampung, 1975-1976.

nation either at the present level of available cash or at 100% of GFI, with the present practice of gotong-royong (4 weeks). The multiple cropping index is 113 for at the present level of cash availability, and 200 for 100% of GFI. It ranged from 83 (without gotong-royong) up to 126 with 8 weeks of gotong-royong, with the present level of cash use; while with cash available at 100% of GFI, the multiple cropping index ranged from 163 (without gotong-royong) up to 200 with 8 weeks of gotong-royong.

Land use increased with the increase in number of weeks for gotong-royong practices, with the present level of use. WIthout gotong-royong 42 percent of land was cultivated, but it increased up to 63 percent when gotong-royong was extended to 8 weeks.

5.3.2. The effect of gotong-royong on the use of cash

Nambahdadi Village (Sub-area I). The optimal solution indicates as use all the presently available cash in both the first and second crop seasons. When the time span of gotong-royong was varied, all cash remained in use, except at 8 weeks of gotong-royong when use of cash II decreased by 3 percent.

When the available cash was increased up to 100% of GFI, the optimal solution did not use all the cash available. The highest cash use was far 2 weeks of gotong-royong, and upon extending the time for gotong royong, total cash used decreased. The ratio of cash I used to cash II used was about 9, that is, the use of cash during the first season was 9 times that of the second crop season.

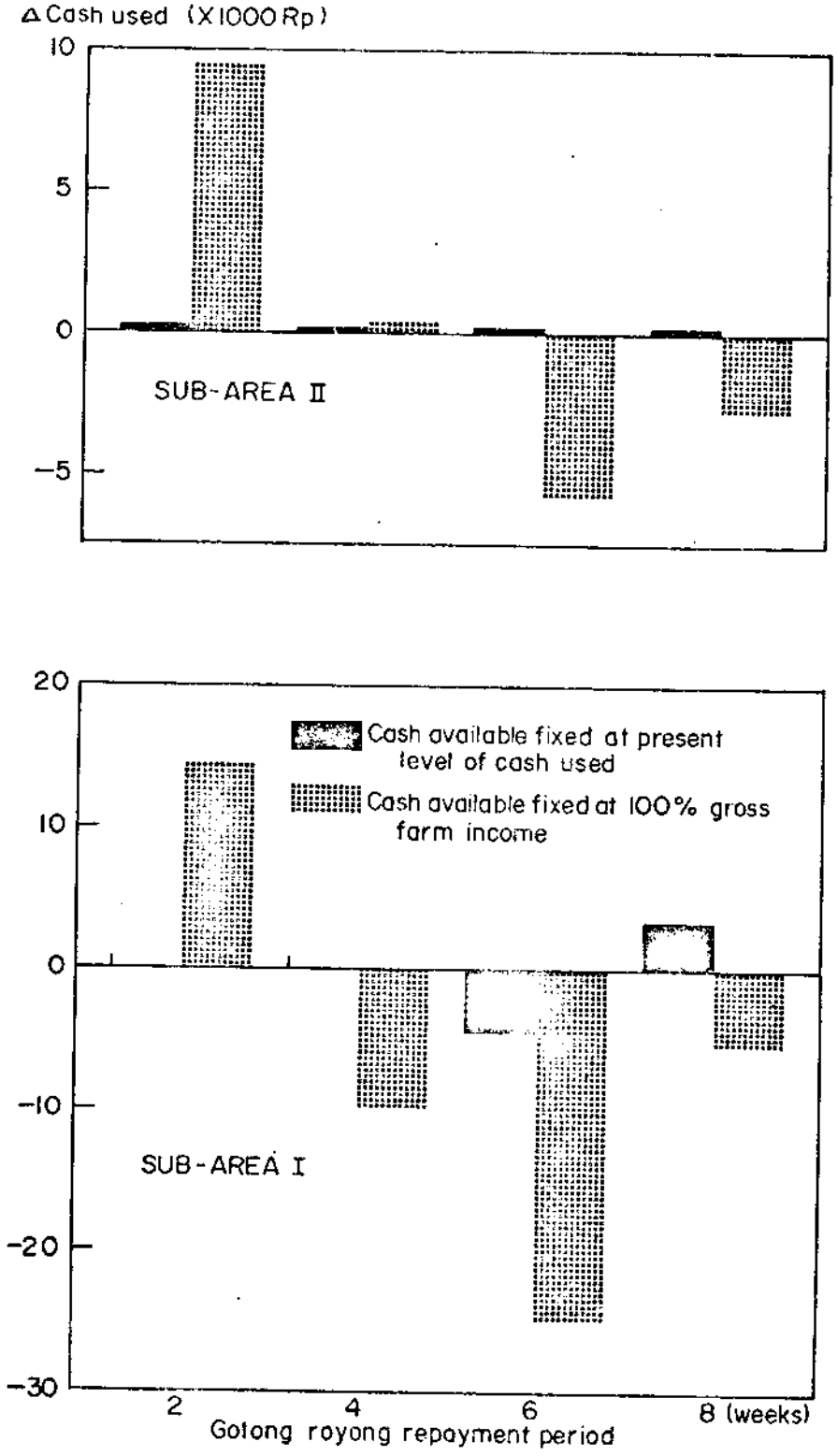


Fig. 5.13 Changes in the amount of cash used on farms as gotong royong repayment period increases, by level of available cash, sub-areas I and II, Lampung, 1975 - 1976.

Bandar Agung Village (Sub-area II). The optimal soulution uses all the cash I when the maximum was set at the level presently available cash, while only 10% cash of II was used. Varying the time of gotong-royong did not affect the use of cash I but slightly affected the use of cash II. Increasing the available cash up to 100% of the GFI 4 and 2 weeks of gotong-royong caused all the cash to be used, but only 13% of cash II. Without gotong-royong, only 75 percent of cash I, and 16% of cash II were used. Extending the time of gotong-royong to 6 and 8 weeks decreased the use of cash I, but slightly increased the use of cash II.

Komering Putih Village (Sub-area III). The optimal solution shows that varying the length of time for gotong-royong does not affect the use of either cash I or cash II. The cash needed was only from cash II, both when the maximum was set at present level of cash use, and even set at 100% of GFI. The exception was when there was no gotong-royong, when small additional amount of cash II was used.

5.3.3. The effect of gotong-royong on labor utilization

At the present level of cash use, the solution indicates the use of more family and gotong-royong labor than hired labor. Increasing the span of gotong-royong increased the use of this labor source. In the optimal solution, the increase in the proportion of gotong-royong labor was compensated by a reduction in use of direct family labor and hired labor. It is more profitable to use gotong-royong labor. Total labor use slightly increased and decreased depending upon the

Table 5.28. Total cash used in the optimal solution by length of gotong-royong repayment period with available cash fixed at 100% of gross farm income (GFI) and at the present level of cash used, Nambahdadi, Lampung, 1975-1976

Gotong-royong repayment period (weeks)	At 100% of GFI level			At present level of cash used		
	Cash I used (Rp)	Cash II used (Rp)	Total (Rp)	Cash I used (Rp)	Cash II used (Rp)	Total (Rp)
0	67626 (86)	31223 (12)	98849	20308 (100)	20308 (100)	40616
2	78221 (100)	34829 (13)	113050	20308 (100)	20308 (100)	40616
4	73648 (94)	29104 (11)	102752	20308 (100)	20380 (100)	40616
6	56186 (72)	20707 (8)	76893	20308 (100)	15996 (79)	36304
8	52484 (67)	18989 (7)	71473	20308 (100)	19699 (97)	40007

Inside the bracket is shown the percentage of total cash available.

[illegible] used in optimal solution by length of gotong-royong [illegible] period with available cash fixed at 100% of gross [illegible] (GFI) and at the present level of cash used, [illegible]ung, Lampung, 1975-1976

[illegible]	At 100% of GFI			At present of cash used		
	Cash I used (Rp)	Cash II used (Rp)	Total (Rp)	Cash I used (Rp)	Cash II used (Rp)	Total (Rp)
[illegible]	[illegible]683 [illegible]75)	1702 (16)	31385	9540 (100)	546 (5)	10086
[illegible]	[illegible]60 [illegible]00)	1398 (13)	40858	9540 (100)	844 (8)	10384
[illegible]	[illegible]460 [illegible]00)	1610 (13)	41070	9540 (100)	1006 (9)	10546
[illegible]	[illegible]146 [illegible])	1502 (14)	34648	9540 (100)	1060 (10)	10600
[illegible]	[illegible]384 [illegible])	1502 (14)	31886	9540 (100)	1114 (10)	10654

[illegible] is shown the percentage of total cash available.

Table 5.30. Total cash used in optimal solution by length of gotong-royong repayment period with available cash fixed at 100% gross farm income (GFI) and at the present level of cash used available, Komering Putih, Lampung, 1975-1976

Gotong-royong repayment period (weeks)	At 100% of GFI level			At present level of cash used		
	Cash I used(Rp)	Cash II used(Rp)	Total (Rp)	Cash I used(Rp)	Cash II used(Rp)	Total used(Rp)
0	50537 (100)	240 (0.20)	50777	6950 (100)	86.73	7036.73
2	50537 (100)	0	50537	6950 (100)	0	6950
4	50537 (100)	0	50537	6950 (100)	0	6950
6	50537 (100)	0	50537	6950 (100)	0	6950
8	50537 (100)	0	50537	6950 (100)	0	6950

Inside the bracket is shown the percentage of total cash available.

Table 5.31. Labor used by source in optimal solution by length of gotong-royong repayment period with available cash fixed at 100% gross farm income (GFI) and present level of cash used, Nambahdadi, Lampung, 1975-1976

Gotong-royong repayment period (Wks.)	At 100% of GFI cash level				At present level of cash used			
	Family labor	Hired labor	Gotong royong labor	Total	Family labor	Hired labor	Gotong royong labor	Total
	-- manours --							
0	1420 (52)	1317 (48)	0	2737 (100)	1119 (72)	430 (28)	0	1549 (100)
2	872 (26)	1597 (47)	907 (277)	3376 (100)	974 (53)	306 (16)	568 (31)	1848 (100)
4	808 (23)	1390 (40)	1270 (37)	3468 (100)	687 (36)	244 (13)	974 (51)	1905 (100)
6	634 (21)	875 (29)	1556 (51)	3065 (100)	694 (34)	161 (8)	1205 (58)	2060 (100)
8	717 (23)	767 (25)	1568 (51)	3052 (100)	643 (29)	144 (6)	1464 (65)	2251 (100)

Inside bracket is shown the percentage of total labor used.

Table 5.32. Labor used by source, by length of gotong royong repayment period, with available cash fixed at 100% of gross farm income (GFI) and at the present level of cash used, Bandar Agung, Lampung, 1975-76

Gotong-royong repayment period (weeks)	Family labor	Hired labor	Gotong-royong labor	Total	Family labor	Hired labor	Gotong-royong labor	Total
	manhours							
0	1079 (58)	792 (42)	0	1871 (100)	834 (78)	229 (22)	0	1063 (100)
2	767 (28)	1016 (37)	938 (35)	2721 (100)	685 (42)	205 (12)	752 (96)	1642 (100)
4	662 (21)	1057 (34)	1397 (45)	3116 (100)	810 (42)	192 (10)	921 (48)	1923 (100)
6	777 (25)	780 (25)	1571 (50)	3128 (100)	919 (45)	188 (9)	956 (46)	2063 (100)
8	941 (30)	685 (22)	1501 (48)	3127 (100)	950 (44)	183 (8)	1034 (48)	2167 (100)

Inside the bracket is shown the percentage of total labor.

Table 5.33. Labor used by source in optimal solution by length of gotong-royong repayment period with available cash fixed at 100% of gross farm income (GFI) and at the present level of cash used, Komering Putih, Lampung, 1975-1976

Gotong-royong repayment period (weeks)	At 100% of GFI				At present level of cash used			
	Family labor	Hired labor	Gotong-royong labor	Total	Family labor	Hired labor	Gotong-royong labor	Total
	manhours							
0	1672 (55)	1342 (45)	0	3014 (100)	1514 (90)	177 (10)	0	1691 (100)
2	1136 (33)	1321 (38)	985 (29)	3442 (100)	1383 (64)	167 (8)	620 (28)	2170 (100)
4	871 (24)	1345 (38)	1351 (38)	3567 (100)	1301 (57)	163 (7)	802 (36)	2266 (100)
6	699 (20)	1298 (38)	1459 (42)	3451 (100)	945 (40)	159 (8)	1257 (52)	2361 (100)
8	795 (23)	1303 (37)	1409 (40)	3507 (100)	1204 (49)	155 (6)	1097 (45)	2456 (100)

Inside the brackets is shown the percentage of total labor used.

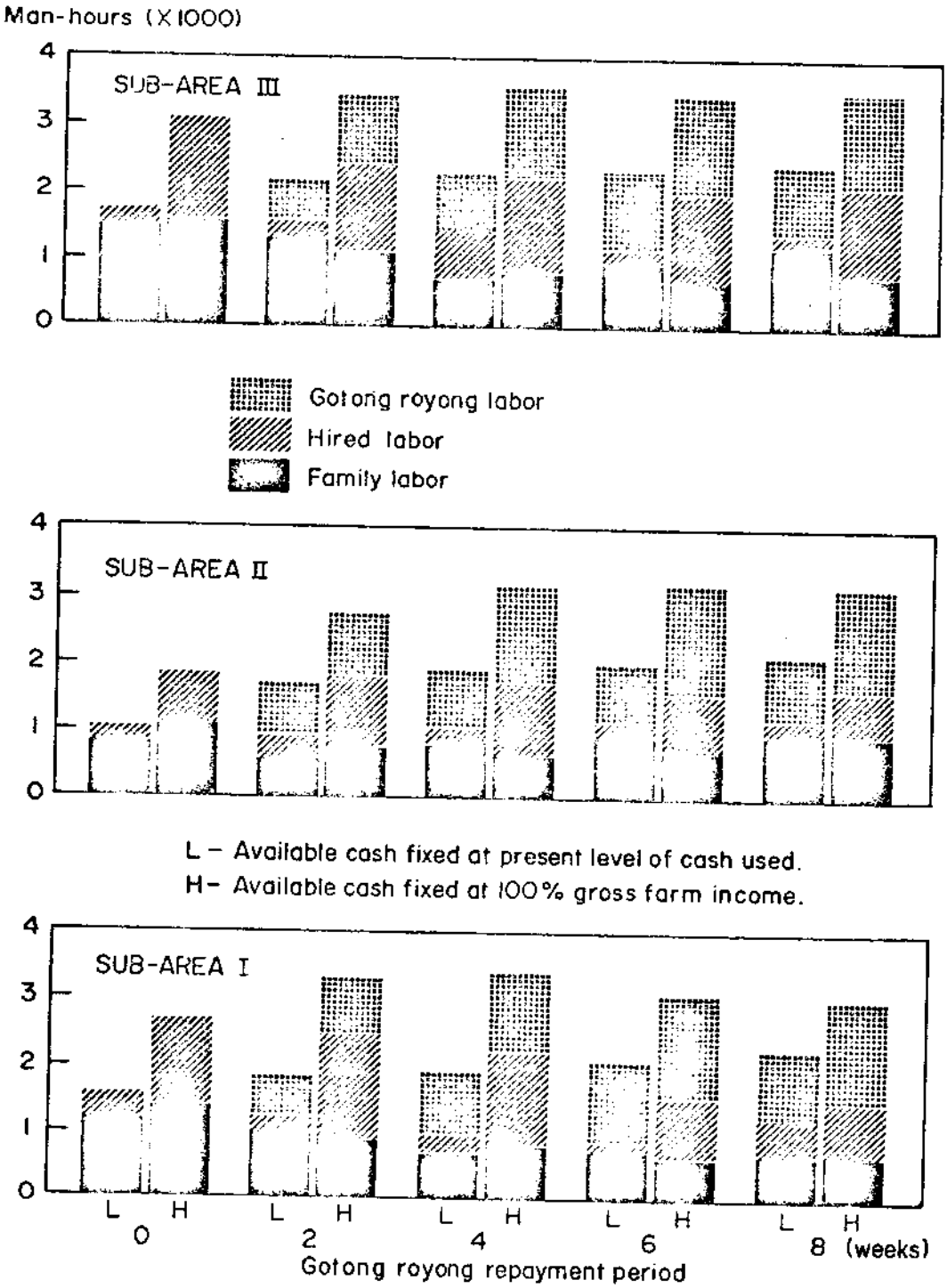


Fig.5.14. Amount of labor used on farms representative of three sub-areas in Lampung, by gotong royong repayment period, source of labor and level of available cash.

gotong-royong repayment span. Increasing the cash available, up to 100% of GFI increased the total labor use and the proportion of hired labor. In Nambahdadi village, extending gotong-royong labor from 4 to 6 weeks decreased total labor use. Figure 5 shows the optimal total labor use and the composition of the labor force in three sub-areas.

5.4. Summary Evaluation of Major Objectives and Hypothesis

The main objective of the study was to determine the feasibility of experimental cropping pattern with respect to labor supply in selected upland and lowland rice growing villages in the Lampung resettlement area. Also, it examines the role of family, hired and exchange labor in increasing cropping intensity particularly to achieve the socio-economic objectives of the farmers.

The results of finding in this study show that the most profitable combination of cropping patterns grown under present conditions of cash, labor and market wages in lowland area, is the combination of an improved experimental cropping pattern (lowland rice-corn-rice bean) and a farmer's cropping pattern (upland rice-corn as managed by themselves. The improved cropping pattern that was tested in 1975-1976 was indicated to be a profitable use of all lowland available on a typical farm. This pattern was designed to replace the present one crop system in lowland fields. The farmers present patterns as managed by themselves, appeared to be a profitable alternative for one quarter up to half of the estimated upland area. The rest of upland was profitably left idle under present conditions.

For upland areas, farmers cropping pattern as grown by when supervised by researchers with farmer input levels, remained the best alternative on upland that had been opened for a long-time. On newly opened upland, the most profitable alternative also included such as supervised farmer's pattern, but it was best combined with a farmers' cropping pattern managed by themselves, planted on one-fourth of the total area. The abnormally long dry season in 1975-1976 was the most probable reason why the improved cropping patterns that were tried were not included in the optimal solution. This unusual climatic condition particularly affected the second crop season.

The lowland farm indicates acceptance of the hypotheses that new multiple cropping technology will increase net income, and increase the average productivity of land and labor. Moreover, the new technology increases the requirements for labor, thereby increasing employment opportunity as the technology is adopted. Analysis of the economic performance of upland cropping pattenrs based data from 1975-1976, an abnormally dry years did not indicate the acceptance of this hypothesis.

The second objective was to examine labor utilization in increasing cropping intensity particularly in relation to farm cash flow, the role of family labor, hired labor and gotong-royong labor. Related to this objective, the following hypotheses were constructed: Labor practices vary among regions as a result of agro-economic environmental factors;

they vary among farms due to varying farm characteristics, and vary within the year because of seasonal factors; and increasing cash flow will shift labor utilization from gotong-royong to hired labor.

The finding of this study show tha if farmers' maximize profit in the manner simulated by the linear programming model constructed, those hypotheses can be accepted. The most profitable labor utilization differs between each sub-area because of agroeconomic environmental factors. Farmers in the lowland area profitably used more gotong-royong labor than in upland areas, amounting one-half of the total labor used. In upland areas, only about one-third of the total labor was used. In upland area, opened more than 20 years, gotong-royong use was higher by about 10% than in the area newly opened. Older transmigrants, utilize technology that spreads the use of family labor through gotong-royong arrangements.

In lowland areas, the hired labor source constituted about twenty percent of the total labor used, while in upland areas, opened for a long time only about 10 percent was used. In newly opened upland less than 10 percent of the total labor was hired under present conditions. More cash is available in lowland area, and more in the long-settled upland than in the newly settled. This difference in cash availability appeared related to the differences in the amount of hired labor.

When cash available to the farm increased, the LP model indicated a shift labor utilization from the gotong-royong to the hired labor source, as hypothesised. But still about one-third of total labor comprised gotong-royong. The projected shift from gotong-royong labor to hired labor was sharpest in the newly opened upland area.

Direct use of family labor constituted one-third of the total labor used in lowland areas, and close to one-half in upland area. When available cash was increased, it was profitable to use more hired labor than family labor, especially in newly opened upland areas. It is better for family members to work occasionally outside the farm, for example in the agricultural company operated near the resettlement scheme. This result closely coincides with actual conditions in the area.

The comparison of labor utilization due to varying specific farm characteristics, i.e. farm size, cropping pattern, income and others could not be done in this study due to unsufficient time and available data, even though the typical farms in each sub-area demonstrated variation of labor utilization as stated in the hypothesis due to different general farm characteristics.

The optimal solution of LP model with the objective function maximizing net income under present conditions facing the farmers' gave results very close to the existing activities. This was especially true in terms of land and labor utilization, except for the high levels of gotong-royong labor used. The latter resulted because the model was constructed with the assumption that whenever farmers need gotong-royong it was always available. Actually, in some cases, when farmers need gotong-royong, it may be restricted because others also need it.

We can conclude from the findings of this study of the existing system that the farmers objective of maximizing profit is constrained by cash availability. Because of the lack of cash, they stop using

hired labor before reaching the point where the marginal value product of labor is equal to the nominal wage. It is quite profitable to apply additional cash to the hiring of labor. The implication is that credit facilities are a very important factor to transmigration farmers. Credit would permit more labor to be hired which in turn would increase net income and employment.

5.5. Areas for Further Study

Based of the results of this study, it can be concluded that cash availability is a very important factor to farmers. Increased cash availability will increase net income and employment. A study of farm cash flow in relation to credit needs of farmers would be very useful step for both the farmers and policy makers. Under conditions presently facing farmers, they cannot cultivate all of their land.

A large amount of labor on the typical farms studied is used for hand tillage and this links the problem of cash liquidity and labor to the potential for inducting more animal or mechanical draft power. Possibly more land can be utilized by introducing credit for farmers to buy animals, or for farmers cooperatives to provide small tractors. This needs to be studied more carefully, because the introduction of animals or tractors will require additional skills and expenses. Also, the overal employment effects of such a move should be examined.

The wage-rate may be a more important factor in farm operations than this study indicated. A constant, but actually, it may vary from time to time and from one activity to another activities on the farm. It is common for farmers to pay the same amount of cash wage but in certain cases they have to give additional pay in kind, or provide food. If non-cash payments to workers are considered, it may turn out that imputed waged vary substantially from time to time, or activity to activity. Knowledge of imported wage rate, or the real amounts of wages paid, by farmers, would also very useful in determining the optimum cropping patterns.

Increasing time span for repayment of gotong-royong increases thenet income of the farmers. The practice of gotong-royong spreads the utilization of family labor over time by reducing fluctuation in the use of labor. This can reduce the cost of production by employing slack of family labor when the opportunity cost is low, or by reducing family labor needs in a period of peak use, when the opportunity cost is relatively high. The study of specific labor distributions of present technology would give valuable information for designing new patterns more suitable to each area.

Finally, as mentioned below, in the limitations, part of this study, the number of improved patterns examined was relatively small. It would be better to include more of the experimental pattern in further study, including more variation in the farm management practices applied to such activities.

5.6. Limitations of the Study

The data used in this study came mostly from the multiple cropping project of the Central Research Institute for Agriculture, Indonesia.

The data were from the first year of the project when weather was particularly dry; therefore the data need to be improved by including more recent information on cropping pattern performance. Farm records for additional years and additional farmers need to be added to more adequately represent typical farmers.

The number of cropping patterns, or real activities, both experimental cropping patterns and the patterns presently grown by farmers in each area should be increased to better represent new experimental work, and reflect more of the variation between villages.

LITERATURE CITED

ACHARYA, S. S. 1973. Green revolution and farm employment. Indian Journal of Agricultural Economics, Vol. 28(3).

BANTA, G. R. and RICHARD HARWOOD. 1975. The multiple cropping program at IRRI. The Philippine Economic Journal, Vol. XIV, No. 1 and 2, pp. 300-307.

BARKER, R. 1964. Use of linear programming in making farm management decision. Bulletin 993. Cornell University Agricultural Experiment Station, and Economic Research Service, USDA, Ithaca.

_____. 1966. Linear programming in agricultural development. Economic Research Journal, Vol. XIII, No. 3, University of the East, Manila.

_____ and V. CORDOVA. 1976. Labor utilization in rice production. Resource paper No. 5. Conference on Economic Consequences of New Rice Technology, IRRI, Los Baños (Mimeo).

BAUMOL, W. G. Economic theory and operation analysis. Fourth Edition. Prentice-Hall, Inc. Englewood Cliffs, New Jersey 08632. 692 p.

BUREAU OF STATISTICS. 1975. Indonesian Statistical Pocketbook. Jakarta, Republic of Indonesia. 375 p.

CENTRAL RESEARCH INSTITUTE FOR AGRICULTURE. 1977. Cropping System Research and Implementation. Bogor, Indonesia (Mimeo). 21 p.

CENTRAL RESEARCH INSTITUTE FOR AGRICULTURE. 1976. Annual Report 1975-1976. Cropping System Research, Cooperative CRIA-IRRI Program, Bogor, Indonesia. 188 p.

CHIANG, A. C. 1967. Fundamental Methods of Mathematical Economics. McGraw-Hill Inc., New York. 784 p.

COLLIER, W. L. and SAYOGO. 1972. Village employment source of income use of HYV and farm labor in major rice producing region of Indonesia. Research note no. 11, Agroeconomic Survey Indonesia. (Mimeo).

_____. 1972. Employment opportunities created by the HYV rice in several areas in Java. Research note no. 8. Agroeconomic Survey, Indonesia (Mimeo). 8p.

CRISOSTOMO, C. M., et al., 1971. The New Rice Technology and Labor Absorption in Philippine Agriculture. The Malayan Economic Review, Vol. XVI No. 2 pp. 117-158.

DALRYMPLE, D. G. 1971. Survey of multiple cropping in less developed nations. U.S. Department of Agriculture and U.S. Agency for International Development, Washington, D. C.

DJAUHARI, A. 1976. Employment aspect of multiple cropping, a case in Indramayu. Paper presented in Cropping System Workshop Central Research Institute for Agriculture, Bogor, Indonesia (Mimeo) 17 p.

_____. 1977. Cropping pattern in Indramayu and Central Lampung areas; results of a baseline survey. Bagian Social Ebonomi Pertanian. Lembaga Pusat Penelitian Pertanian, Bogor, Indonesia. 83 p.

DORMAN, R., PAUL A. SAMUELSON and ROBERT M. SOLOW. 1958. Linear Programming and Economic Analysis. McGraw-Hill Book Company, Inc. 525 p.

ELTONBARY, A. A., A. A. GUBELI and N. T. HABASHY. 1975. Some models for determining the optimum cropping system in A.R.E., agriculture under certain environmental and organizational conditions. University of Oxford Institute of Agricultural Economics for the International Association of Agricultural Economists. pp. 131-146.

GARRITY, D. et al. 1975. Evaluating alternative field crop pattern for upland rice areas. IRRI Saturday Seminar, Los Baños, (Mimeo). 46 p.

HARWOOD, R. R. and EDWIN C. PRICE. 1975. Multiple cropping in tropical Asia. Paper presented at the 1975 meeting of the American Society of Agronomy as part of the Symposium on Multiple Cropping, Knoxville, Tennessee (Miemeo). 30p.

HAYAMI, Y., et al. 1975. Agricultural growth against land resource constraint, the Philippine experience. Paper No. 75-14. Agricultural Economics Department, IRRI (Miemo). 34p.

HENDERSON, J. R. and R. E. QUANDT. 1971. Microeconomic Theory: A Mathematical Approach. Tokyo, McGraw-Hill, Kogabusha Ltd. 431p.

IHALAUW, J. and WIDYA UTAMI. 1975. Central Java in changes in rice farming in selected areas of Asia. IRRI, Los Baños (Mimeo). 29p.

ILAG, L.M. 1977. Multiple Cropping, Its Relevance to Population Problem. Journal of Agricultural Economic and Development, Vol. VII, No. 1, pp. 22-32.

_____, E. D. GOMEZ and L. L. VEGA. 1975. Communication, Media and the Buying and Selling Practices of Some Farmers in Laguna and Batangas. Some Preliminary Findings. Journal of Agricultural Economics and Development, Vol. 1. pp. 1-11.

IMTIAS, B., W. SUDANA and ASDIRMAN ARIEF. 1976. Cropping pattern research in farmers field in Lampung upland area. Paper presented at the Cropping System Workshop, Bogor, Indonesia. 48p.

KAHLON, A. S. and S. S. JOHL. 1973. Application of linear programming to rational planning. Indonesian Journal of Agricultural Economics, pp. 45-53.

KANBUR, M. G. and V. MUKERJI. 1973. Productivities of farm family labor and hired labor. Indian Journal of Agricultural Economics, pp. 255-260.

LEE, T. H. 1973. Agricultural diversification and development. Agricultural mechanization in Asia. Spring, 1973. pp. 43-53.

LEFTWICH, R. R. 1973. The price system and resource allocation, Fifth edition. Oklahoma State University, The Dryden Press, Hindale, Illinois 60521. 433 p.

LEVIN, R. A. and MAX R. LANGHAM. 1975. Chrysanthemum production planning under time-to-harvest uncertainty. Journal of Agricultural Economics. July, 1975, pp. 97-103.

LIH YUH SHY TSAI. 1976. Production cost and return for rice farms in CentralTaiwan 1895-1976, Analysis of Structural Changes. (Unpublished M.A. Thesis, School of Economics, University of the Philippines, Diliman, Quezon City, Philippines). 234 p.

MCINTOSH, J. L. , SURYATNA EFFENDI and A. SYARI FUDIN. 1976. Testing cropping pattern for upland condition. Paper presented at the Symposium on Cropping System Research and Development for the Asian Rice Farmer. IRRI, Los Baños, Philippines (Mimeo). 26 p.

OSHIMA, H. T. 1975. Multiple cropping in Asia development, Summary and Further Research. The Philippine Econic Journal Vol: XIV, No. 1 & 2, pp. 7-25.

PRICE, E. C. 1976. Design of cropping pattern for economic criteria. Paper presented at symposium on Cropping System Research and Development for the Asian Rice Farmer. IRRI, Los Baños (Mimeo). 13 p.

REPUBLIC OF INDONESIA. 1974. National Development Plan, 1974-1979. Jakarta, 4 volumes.

SARDIDO, M. L. 1974. Analysis of income and resource productivity of alternative rice farm cropping patterns in Bicol. Unpublished M.S. Thesis, University of the Philippines, Los Baños, 137 p.

SURYATNA, E. S. and J. L. MCINTOSH. 1976. Food crops production and control of Imperata Cylindrica on small farm. Presented on the workshop on Alang-alang (Imperata cylindrica). Bogor, Indonesia (Mimeo), 13 p.

_____, et al. 1976. Cropping system research in Indramayu and Lampung, Indonesia (Mimeo), 28 p.

SYARIFUDDIN, A., SEHARSONO and J. L. MCINTOSH. 1975. Paper presented at the workshop for the Southeast Asia Cropping System Network, IRRI Los Baños, Philippines (Mimeo), 20 p.

_____, and J. J. MCINTOSH. 1975. Cropping systems for transmigration areas in Lampung on upland, red yellow podzolic soils. Paper submitted to symposium, Pencegahan dan Pernulihan tamah-tarah britis. Jakarta, Indonesia (Mimeo.), 12 p.

TAKASHI, S., et al. 1974. Agricultural sector survey Indonesia. Report prepared by World Bank staff at the request of the Government of Indonesia. 4 volumes.

THODEY, A. R. and RAPEEPUN SELETHEERA. 1974. Optimal multiple cropping system for the Chiang Mai Valley, a linear programming approach. Faculty of Agriculture, Chiang Mei University, Chiang Mei, Thailand. 80 p.

Table A.1. Harvest share of males less than 15 years old, Nambahdadi, Lampung, Indonesia, 1977

No.	No. of hours	Share (kg)	Share/day Total (kg)	Share/day Value * (Rp)	Share/hour Total (kg)	Share/hour Value (Rp)
1	3:30	5	10.2	510	1.4	70
2	4:30	8	14.4	720	1.8	90
3	5:00	8	12.8	640	1.6	80
4	5:00	3	4.8	240	0.6	80
5	5:30	8	12.0	600	1.5	75
6	6:00	8	10.4	520	1.3	65
7	6:00	4	5.6	280	0.7	35
8	6:00	12	16.0	800	2.0	100
9	6:30	11	13.6	680	1.7	85
10	6:30	7	8.8	440	1.1	55
11	7:00	9	10.4	520	1.3	65
12	7:00	5	5.6	280	0.7	35
13	7:30	10	10.4	520	1.3	65
14	7:30	4	4.0	200	0.5	25
15	8:00	14	14.4	720	1.8	90
16	10:00	7	5.6	280	0.7	35
17	10:00	15	12.0	600	1.5	75
Total	110.10		171.0	8550	21.4	1125
Av.	6.48		10.1	502.9	1.3	66.2

Source: Recorded at harvesting eimt, Nambahdadi, 1977.

* Price of rough rice during harvesting time was Rp 50/kg.

APPENDIX A

Harvest share, Nambahdadi

Table A.2 Harvest share of females less than 15 years old, Nambahdadi, Lampung, Indonesia, 1977

No.	No. of hours	Share (kg)	Share/day		Share/hour	
			Total (kg)	Value (Rp)	Total (kg)	Value (Rp)
1	3:30	4	8.8	440	1.1	55
2	3:30	6	13.6	680	1.7	85
3	3:30	4	8.8	440	1.1	55
4	3:30	4	8.8	440	1.1	55
5	4:00	5	10.4	520	1.3	65
6	4:30	4	7.2	360	0.9	45
7	7:00	5	5.6	280	0.7	35
8	7:00	5	5.6	560	1.4	70
9	8:00	11	11.2	320	0.8	40
Total	53:50		86.4	4320	10.8	540
Av	5.35		8.6	432	1.1	54

Source: Recorded at harvesting time, Nambahdadi, 1977.
*Price of rough rice during harvesting time was Rp 50/kg.

Table A.3. Harvest share of males of age 15-30 years, Nambahdadi, Lampung, Indonesia, 1977

No.	No. of hour	Share (kg)	Total/day		Share/hour	
			Total (kg)	Value (Rp)	Total (kg)	Value (Rp)
1	2:30	2.0	6.40	302	0.8	40
2	3:00	10.0	26.0	1300	3.2	160
3	4:00	13.0	26.0	1300	3.3	165
4	4:00	15.0	30	1500	3.8	190
5	4:00	5.0	10.0	500	1.3	65
6	4:30	11.0	19.6	980	2.5	125
7	4:30	12.0	21.3	1065	2.7	135
8	5:00	15.0	24.0	1200	3.0	150
9	5:00	5.0	8.0	400	1.0	50
10	5:00	5.0	8.0	400	1.0	50
11	5:00	10.0	16.0	800	2.0	100
12	5:30	8.0	12.0	600	1.5	75
13	6:00	12.0	16.0	800	2.0	100
14	6:00	13.0	17.3	865	2.2	110
15	6:00	12.0	16.0	800	2.0	100
16	6:30	19.0	23.4	1170	2.9	145
17	6:30	20.0	24.6	1230	3.0	155
18	7:00	10.0	11.4	750	1.4	70
19	7:00	10.0	11.4	570	1.4	70
20	7:00	7.0	8.0	400	1.0	50
21	7:00	13.0	13.9	745	1.9	95
22	7:30	13.0	13.9	695	1.7	85
23	9:00	11.0	9.6	480	1.2	60
24	9:30	17.0	14.4	720	1.8	90
25	10:00	12.0	9.6	480	1.2	60
26	10:00	20.0	16.0	800	2.0	100
27	10:00	20.0	15.2	760	1.9	95
Total	165.7		429.0	21450	53.6	2690
Av.	6.14		15.9	794.4	2.0	99.6

Source: Recorded at harvesting time, Nambahdadi, 1977.

Table A.4. Harvest share of females on age 15-30 years old, Nambahdadi, Lampung, Indonesia, 1977

No.	No. of hour	Share (kg)	Share/day		Share/hour	
			Total (kg)	Value (Rp)	Total (kg)	Value (Rp)
1	3:30	2.5	5.7	285	0.7	35
2	3:30	4.0	9.1	455	1.1	55
3	3:30	6.0	13.6	680	1.7	85
4	4:30	5.0	8.8	440	1.1	55
5	5:00	6.5	10.4	520	1.3	65
6	5:00	5.0	8.0	400	1.0	50
7	5:00	7.0	11.2	560	1.4	70
8	6:00	18.0	24.0	1200	3.0	150
9	8:00	16.0	16.0	800	2.0	100
10	9:00	20.0	17.8	890	2.2	110
11	9:00	12.0	10.7	535	1.3	65
12	10:00	10.0	8.0	400	1.0	50
13	10:00	10.0	8.0	400	1.0	50
14	10:00	10.0	8.0	400	1.0	50
15	10:00	10.0	8.0	400	1.0	50
16	10:00	15.0	12.0	600	1.5	75
17	10:50	7.0	5.6	280	0.7	35
Total	121.70		188.9	9445	23.6	1175
Average	7.16		11.1	555.6	1.4	69.1

Source: Recorded at harvesting time, Nambahdadi, 1977.

Table A.5. Harvest share at male and females of age 30-60 years old, Nambahdadi, Lampung, Indonesia, 1977

Age	No. of hours	Share (Kg)	Share/day			Share/hour		
			Male (Kg)	Female (Kg)	Value (Kg)	Male (Kg)	Female (Kg)	Value (Kg)
Male 1	3:00	6.0	16.0	-	800	2.0	-	100
2	5:00	5.0	8.0	-	400	1.0	-	50
3	5:00	20.0	32.0	-	1600	4.0	-	250
4	5:30	7.0	10.4	-	520	1.3	-	65
5	8:00	20.0	20.0	-	1000	2.5	-	125
6	8:00	15.0	15.2	-	760	1.9	-	95
7	10:00	13.0	10.4	-	520	1.3	-	65
Total	44.3		112.0		5600	14.0	-	700
Av.	6.33		16.0		400	2.0	-	100
Female								
1	3:30	5.0	-	11.2	560	-	1.4	70
2	3:30	7.0	-	16.0	800	-	2.0	100
3	4:30	5.0	-	8.8	440	-	1.1	55
4	5:00	5.0	-	8.0	400	-	1.0	50
5	5:00	10.0	-	16.0	800	-	2.0	100
6	7:30	8.0	-	8.8	440	-	1.1	55
7	8:00	6.0	-	6.0	300	-	0.8	40
8	8:00	7.5	-	7.2	360	-	0.9	45
9	10:00	10.0	-	8.0	400	-	1.0	50
Total	54.2			90.0	4500	-	11.25	565
Av.	6.02			10.0	500	-	1.1	62.7

Source: Recorded at harvesting time, Nambahdadi, 1977.

Table B.1. Activities creating gotong-royong labor in week t from family labor week t

		CGF 1-2	CGF 1-3	CGF 2-1	CGF 2-3	CGF 2-4	CGF t-2	CGF t-1	CGF t	CGF t+1	CGF t+2	CGF 5-1	CGF 5-1	CGF 5-1	CGF 5-2	CGF 5-2
PROFIT	N															
AVGR 1	L	-1	-1													
AVGR 2	L			-1	-1	-1										
.	.															
.	.															
.	.															
AVGR t	L						1	-1	-1	-1						
.	.															
.	.															
.	.															
AVGR 51	L											-1	-1	-1		
AVGR 52	L														-1	-1
. . . . .																
AVFL 1	L			1												
AVFL 2	L	1														
AVFL 3	L		1		1											
AVFL 4						1										
.	.															
.	.															
.	.															
AVFL t-2	L						1									
AVFL t-1	L							1								
AVFL t	L															
AVFL t+1	L									1						
AVFL t+2	L										1					
.	.															
.	.															
.	.															
AVFL 49	L											1				
AVFL 50	L												1			
AVFL 51	L													1		
AVFL 52	L														1	1

CGF t-(t-1) = Create gotong-royong week t from family labor week t-1
AVGR-t = Available gotong-royong labor week t
AVFL-t = Available family labor week t

Table B.2. Activities for creating available labor in week t from available gotong royong labor week t

		CLG-1-1	CLG-2-2	CLG-3-3	CLG-t-t	CLG-50-50	CLG-51-51	CLG-52-52
PROFIT	N							
AVL 1	L	-1						
AVL 2	L		-1					
AVL 3	L			-1				
.	.							
.	.							
.	.							
AVL t	L				-1			
.	.							
.	.							
.	.							
AVL 50	L					-1		
AVL 51	L						-1	
AVL 52	L							-1
. . . . .								
AVGR 1	L	1						
AVGR 2	L		1					
AVGR 3	L			1				
.	.							
.	.							
.	.							
AVGR t	L				1			
.	.							
.	.							
.	.							
AVGR 50	L					1		
AVGR 51	L						1	
AVGR 52	L							1

CLG-t-t = Create available labor week t from gotong royong labor week t
AVL-t = Available labor week
AVGR-t = Available gotong royong labor week t

Table B.3. Activities for creating available labor in week t from available family labor by week t

			CLF11	CLF12	CLF13	CLFt1	CLF501	CLF512	CLF502
PROFIT		N							
AVL	1	L	-1						
AVL	2	L		-1					
AVL	3	L			-1				
.		.							
.		.							
.		.							
AVL	t	L				-1			
.		.							
.		.							
.		.							
AVL	50	L					-1		
AVL	51	L						-1	
AVL	52	L							-1
. . . . .									
AVFL	1	L	1						
AVFL	2	L		1					
AVFL	3	L			1				
.		.							
.		.							
.		.							
AVFL	t	L				1			
.		.							
.		.							
.		.							
AVFL	50	L					1		
AVFL	51	L						1	
AVFL	52	L							1

CLF-t-t = Created available labor week t from family labor week t
AVL-t = Available labor week t
AVFL-t = Available family labor week t

Table B.4. Activities for creating available cash week t from cash balance.

			C C C C B 1	C C C C B 2	C C C C B 3	C C C C B 4	C C C C B 5	C C C C B 6	C C C C B 7	C C C C B 8	C C C C B 50	C C C C B 51	C C C C B 52
PROFIT	N		-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
AVCH 1	L		-1											
AVCH 2	L			-1										
AVCH 3	L				-1									
.	.													
.	.													
.	.													
.	.													
.	.													
AVCH 23	L					-1								
AVCH 24	L						-1							
AVCH 25	L							-1						
AVCH 26	L								-1					
AVCH 27	L									-1				
AVCH 28	L										-1			
.	.													
.	.													
.	.													
.	.													
.	.													
AVCH 50	L											-1		
AVCH 51	L												-1	
AVCH 52	L													-1
CHBL 1	L		1	1	1	1	1	1						
CHBL 2	L								1	1	1	1	1	1

CCB -t = Created available cash in week t from cash balance
AVCH -t = Available cash week t
CHBL 1 = Cash balance at end of first crop season

Table B.5. Activities for creating available labor in week from available cash in week

		CLC1 1	CLC2 2	CLC3 3	... CLCt t	... CLC50 50	CLC51 51	CLC52 52
PROFIT	N							
AVL 1	L	-1						
AVL 2	L		-1					
AVL 3	L			-1				
AVL t	L				-1			
AVL 50	L					-1		
AVL 51	L						-1	
AVL 52	L							-1
AVCH 1	L	B						
AVCH 2	L		B					
AVCH 3	L			B				
AVCH t	L				B			
AVCH 50	L					B		
AVCH 51	L						B	
AVCH 52	L							B

CLC-t-t = Created available labor week t from available cash week
AVL-t = Available labor week t
AVCH-t = Available cash week t
B = Average wage rate per hour in respective villages

Table B.6. Net Income and Available Land, Nambahdadi, Lampung 1975-1976

	Cropping Pattern A	Cropping pattern B	Cropping pattern C	Cropping pattern D	Cropping pattern E	Cropping pattern F	Cropping pattern G	Cropping pattern H
Net Income:	203025	226935	258860	52130	90177	41228	151916	80991
AVL 1	-	-	-	-	-	76	83	156
AVL 2	51	76	102	37	23	76	83	156
AVL 3	146	120	130	37	23	76	83	156
AVL 4	18	18	36	37	23	76	83	156
AVL 5	25	25	27	37	23	76	83	279
AVL 6	45	45	50	73	74	107	158	610
AVL 7	168	161	112	65	74	107	158	479
AVL 8	154	91	161	36	54	107	158	383
AVL 9	210	224	364	34		32	75	32
AVL 10	-	-	-	42	19		75	22
AVL 11	-	-	64	38	23	55	123	22
AVL 12	33	33	-		22	55	123	352
AVL 13	110	106	10	34	-	55	123	374
AVL 14	-	-	100	34	-	55	123	22
AVL 15	-	-	-	-	22	-	-	22
AVL 16	30	30	10	41	19	-	-	-
AVL 17	10	10	-	37	-	-	-	22
AVL 18	103	100	10	-	22	-	-	-
AVL 19	-	15	-	-	19	-	-	-
AVL 20	-	-	23	-	-	-	-	-
AVL 21	-	-	-	404	408	-	113	408
AVL 22	-	-	-	-	408	-	113	408
AVL 23	-	-	-	-	-	-	-	408
AVL 24	-	-	-	-	4	73	123	-
AVL 25	-	-	-	-	23	73	123	-
AVL 26	896	-	651	-	23	73	123	-
AVL 27	-	-	-	-	19	-	123	137
AVL 28	-	903	-	408	19	-	123	137
AVL 29	-	-	-	-	19	-	-	137
AVL 30	-	-	-	-	74	-	-	148
AVL 31	-	-	-	-	54	-	-	127

Table B.6.(cont'd.)

	Cropping pattern A	Cropping pattern B	Cropping pattern C	Cropping pattern D	Cropping pattern E	Cropping pattern F	Cropping pattern G	Cropping pattern H
AVL 32	-	-	-	54	-	-	-	-
AVL 33	-	-	-	19	-	-	-	-
AVL 34	34	-	70	19	-	-	-	373
AVL 35	50	-	74	23	-	-	-	352
AVL 36	188	-	147	3	-	-	-	352
AVL 37	47	-	-	22	-	-	-	-
AVL 38	-	-	-	19	-	-	-	-
AVL 39	-	-	60	-	-	-	-	22
AVL 40	39	40	66	-	-	-	-	-
AVL 41	40	46	101	22	-	-	-	-
AVL 42	-	-	-	19	-	-	-	352
AVL 43	-	-	-	-	-	-	-	352
AVL 44	-	-	19	-	-	-	-	-
AVL 45	-	-	-	-	-	-	-	-
AVL 46	-	-	-	-	-	-	-	-
AVL 47	-	-	20	-	-	-	-	-
AVL 48	-	-	-	-	-	204	274	-
AVL 49	-	-	-	408	-	204	271	-
AVL 50	-	-	-	408	-	204	274	-
AVL 51	-	-	-	-	-	-	-	-
AVL 52	-	-	-	-	-	-	-	-
AVCH 1	-	-	-	1013	743	-	1040	1570
AVCH 2	1050	1050	1750	-	-	-	-	-
AVCH 3	-	-	-	-	-	-	-	-
AVCH 4				1696				
AVCH 5				1696				4200
AVCH 6					1118	255		
AVCH 7					1118			
AVCH 8					1118			
AVCH 9		8000	10400	1696				4200
AVCH 10	675	1080	3465			255		
AVCH 11	9308			336	1118			550
AVCH 12		3158	6000		198	255		

	Cropping pattern A	Cropping pattern B	Cropping pattern C	Cropping pattern D	Cropping pattern E	Cropping pattern F	Cropping pattern G	Cropping pattern H
AVCH 13	1408					53		
AVCH 14								
AVCH 15				336	198			
AVCH 16		3158	3600					
AVCH 17	1408							550
AVCH 18					198			
AVCH 19								
AVCH 20								
AVCH 21								
AVCH 22				593	406			
AVCH 23								
AVCH 24								
AVCH 25								
AVCH 26							72	775
AVCH 27								
AVCH 28					743			
AVCH 29					1118			1570
AVCH 30					1118			4200
AVCH 31					1118			
AVCH 32								
AVCH 33								
AVCH 34		21376	1375					550
AVCH 35	21375	7895	19000		1118			4200
AVCH 36	8238	3465	3465		198			
AVCH 37	675							
AVCH 38					198			550
AVCH 39		8000	8000					
AVCH 40	2517							
AVCH 41								
AVCH 42					198			
AVCH 43								
AVCH 44								

Table B.6. (cont'd.)

	Cropping pattern A	Cropping pattern B	Cropping pattern C	Cropping pattern D	Cropping pattern E	Cropping pattern F	Cropping pattern G	Cropping pattern H
AVCH 45								
AVCH 46								
AVCH 47								
AVCH 48								
AVCH 49								
AVCH 50					406			775
AVCH 51								
AVCH 52								
L N D 1	1	1	1	1	1			
L N D 2						1	1	1

Source: Daily farm records 1975-1976, and baseline survey 1974, by Multiple Cropping Project, Central Research Institute of Agriculture (CRIA), Bogor, Indonesia.

Note for abbreviations:

AVL 1 - Available labor week 1, and so on.
AVCH 1 - Available cash week, and so on.
LND 1 - Lowland field
LND 2 - Upland field

Table B.7. Net income and coefficient matrix of crop activities, by weekly available labor, cash, and land, Bandar Agung, Lampung 1975-1976

	Cropping pattern A	Cropping pattern B	Cropping pattern C	Cropping pattern D	Cropping pattern E	Cropping pattern F	Cropping pattern G	Cropping pattern H
Net Income:	91827	77565	147703	37852	16237	15883	84331	27427
AVL 1				259	250	63	80	233
AVL 2				259	250	63	80	233
AVL 3	80	100	92	259	250	63	55	233
AVL 4	81	103	90	259	286	63	55	233
AVL 5	200	98	376	259	286	63	55	233
AVL 6	200	300	166	259	286	63	55	233
AVL 7	230	400	175	56	36	44	12	31
AVL 8	140	434		56	127	44	12	31
AVL 9				56	128	44	12	31
AVL 10				183	127	44		31
AVL 11	78	55	273	183	128	90	200	31
AVL 12	100	55	110	183	127		47	
AVL 13	200		229		0		47	
AVL 14		20	92			90	14	201
AVL 15			100				41	201
AVL 16		66					55	
AVL 17		100	20	183				
AVL 18		15	56					
AVL 19			23				82	249
AVL 20					91			
AVL 21			49		91	90	408	
AVL 22	56	28			91	90		
AVL 23	273		343			90	408	
AVL 24		287			91			48
AVL 25				94	91			48
AVL 26				94				48
AVL 27				94				
AVL 28						60		

Table B.7 (cont'd.)

		Cropping pattern A	Cropping pattern B	Cropping pattern C	Cropping pattern D	Cropping pattern E	Cropping pattern F	Cropping pattern G	Cropping pattern H
AVL	29								
AVL	30						60		
AVL	31						60		
AVL	32								
AVL	33								
AVL	34								
AVL	35								
AVL	36	75	99						
AVL	37	100	90						
AVL	38	42	49						
AVL	39								
AVL	40								
AVL	41	7	7			145			
AVL	42	20	20			145			
AVL	43	29	22			145			
AVL	44					145			
AVL	45					145			
AVL	46					145			
AVL	47								
AVL	48								
AVL	49								
AVL	50								
AVL	51			49					
AVL	52	35	42						
AVCH	1								
AVCH	2								
AVCH	3								
AVCH	4								
AVCH	5								
AVCH	6		1947						

Table B. 7.(cont'd.)

	Cropping pattern A	Cropping pattern B	Cropping pattern C	Cropping pattern D	Cropping pattern E	Cropping pattern F	Cropping pattern G	Cropping pattern H
AVCH 7	1000		13673	1445	933	948	4633	4341
AVCH 8	1800	16718	18248					
AVCH 9								
AVCH 10			3200				94	
AVCH 11			12311			22	3081	
AVCH 12								
AVCH 13			8000				94	
AVCH 14								
AVCH 15								
AVCH 16							94	
AVCH 17			5333					
AVCH 18								
AVCH 19								
AVCH 20			9564					
AVCH 21								
AVCH 22								
AVCH 23								
AVCH 24								
AVCH 25			39145					
AVCH 26			1800					
AVCH 27								
AVCH 28				101	65	68	646	304
AVCH 29								
AVCH 30								
AVCH 31								
AVCH 32								
AVCH 33								
AVCH 34								
AVCH 35								
AVCH 36								
AVCH 37								
AVCH 38	1000	11180						

Table B.7. (cont'd.)

	Cropping pattern A	Cropping pattern B	Cropping pattern C	Cropping pattern D	Cropping pattern E	Cropping pattern F	Cropping pattern G	Cropping pattern H
AVCH 39								
AVCH 40								
AVCH 41		3505						
AVCH 42								
AVCH 43								
AVCH 44								
AVCH 45								
AVCH 46								
AVCH 47								
AVCH 48								
AVCH 49								
AVCH 50								
AVCH 51								
AVCH 52								
L N D	1	1	1	1	1	1	1	1

Source: Daily farm records 1975-1976, and baseline survey 1974, by Multiple Cropping Project, Central Research Institute of Agriculture (CRIA), Bogor, Indonesia.

Abbreviations:

AVL 1 = Available labor week 1, and so on.
AVCH 1 = Availble cash week 1, and so on.
LND = Land

Table B.8. Coefficient Matrix of Crop Activities, Komering Putih, Lampung, 1975-1976.

		Cropping pattern A	Cropping pattern B	Cropping pattern C	Cropping pattern D
Net Income		106160	104444	162189	44783
AVL	1	175	168	27	18
AVL	2	300	354	497	11
AVL	3	300	506	400	21
AVL	4	366	554	559	31
AVL	5	182	248	714	93
AVL	6	.	.	.	105
AVL	7	.	.	.	130
AVL	8	90	.	42	168
AVL	9	.	.	200	226
AVL	10	.	.	220	180
AVL	11	.	103	100	30
AVL	12	.	.	.	16
AVL	13	.	.	.	9
AVL	14	92	.	.	41
AVL	15	98	98	280	53
AVL	16	.	.	.	56
AVL	17	.	.	.	27
AVL	18	70	21	42	19
AVL	19	.	.	.	51
AVL	20	.	.	.	88
AVL	21	308	238	735	96
AVL	22	.	.	.	66
AVL	23	.	100	196	28
AVL	24	.	.	322	97

Table B.8. (Cont'd)

	Cropping pattern A	Cropping pattern B	Cropping pattern C	Cropping pattern D
AVL 25	-	-	-	61
AVL 26	-	-	-	34
AVL 27	-	-	7	6
AVL 28	-	-	60	41
AVL 29	-	-	-	50
AVL 30	-	-	7	-
AVL 31	-	-	62	-
AVL 32	-	-	-	59
AVL 33	-	-	-	233
AVL 34	-	-	-	180
AVL 35	-	-	-	78
AVL 36	-	-	126	51
AVL 37	-	-	126	96
AVL 38	-	-	-	20
AVL 39	-	-	-	13
AVL 40	-	-	-	24
AVL 41	-	-	-	31
AVL 42	-	-	-	7
AVL 43	-	-	-	49
AVL 44	-	-	-	35
AVL 45	-	-	-	17
AVL 46	-	-	-	-
AVL 47	-	-	-	-
AVL 48	-	-	-	-
AVL 49	-	-	-	-
AVL 50	-	-	-	19
AVL 51	56	56	42	83
AVL 52	-	-	-	45

Table B. 8. (Cont'd)

		Cropping pattern A	Cropping pattern B	Cropping pattern C	Cropping pattern D
AVCH	1				
AVCH	2				
AVCH	3			14967	
AVCH	4			-	
AVCH	5	2520	13360	17350	5754
AVCH	6			2430	
AVCH	7			-	
AVCH	8			3200	
AVCH	9			533	
AVCH	10				
AVCH	11		10000	8000	
AVCH	12				
AVCH	13			7625	
AVCH	14			-	
AVCH	15			5333	
AVCH	16			-	
AVCH	17			-	
AVCH	18			-	
AVCH	19			-	
AVCH	20			-	
AVCH	21			46117	
AVCH	22			2430	
AVCH	23			11250	
AVCH	24				
AVCH	25				
AVCH	26				

Table B.8. (Cont'd)

		Cropping pattern A	Cropping pattern B	Cropping pattern C	Cropping pattern D
AVCH	24	-	-	-	-
.	.				
.	.				
.	.				
.	.				
.	.				
AVCH	54	-	-	-	-
LND		1	1	1	1

Source: Daily farm records, 1975-1976, and baseline survey, 1974 by Multiple Cropping Project, Central Research Institute of Agriculture (CRIA), Bogor, Indonesia.

Abbreviations:
AVL 1 = Available week 1 (and so on)
AVCH 1 = Available cash week 1 (and so on)
LND = Land

APPENDIX C

Cost and Return Analysis of Crop Activites

Table C.1. Cultural practices for 3 cropping patterns in 6 month irrigation area, Sub-area I, Nambah Dadi, Lampung, 1975-1976

Activity	CP IA	CP IB	CP IC
First Crop			
Land preparation	LLR	LLR	LLR
Planting	Full tillage	Full tillage	Full tillage
Fertilization	Rows	Rows	Rows
0 DAP	$NP_2O_5K_2O$	$NP_2O_5K_2O$	$NP_2O_5K_2O$
14 DAP	33% 100% -	- 100% -	20% 100% -
21 DAP	33% - -	50% - -	50% - -
50 DAP	33% - -	50% - -	50% - -
Pest management			30% - -
Insecticide	Spray 2 x	Spray 2 x	Furadan seed treatment
Weeded	2 x	3 x	Spray 6 x
Harvesting	Ani-ani	Ani-ani	6 x
			Sickle
Second Crops			
Land preparation	Full tillage	Full tillage	Strip tillage
Planting	Same time	Same time	Corn alone
Fertilization[1]	N P_2O_5 K_2O	N P_2O_5 K_2O	N P_2O_5 K_2O
0 DAP	33% 100% -	33% 100% -	33% 100% 100%
30 DAP	67% - -	67% - -	67% - -
			(Banded)
Pest management			
Insecticide	-	-	Spray 6 x
Weeded	2 x	2 x	2 x
Mill-up	-	-	-

[1]Broadcast unless otherwise indicated.

Table C.2. Time and labor cost by activities for 3 cropping patterns in 5 months irrigation area, Sub-area I, Nambahdadi, Lampung, 1975-1976

Activities	Cropping pattern A		Cropping pattern B		Cropping pattern C	
	Manhour	Cost (Rp)	Manhour	Cost (Rp)	Manhour	Cost (Rp)
Lowland rice						
Plowing (2x)	70	10,000	70	10,000	77	10,000
Seedbed preparation	77	3,800	77	3,800	91	4,500
Sowing	7	300	7	300	14	750
Cleaning dike and bedding	63	3,000	35	1,750	49	2,420
Repair of bund (2x)	105	6,000	126	6,400	63	3,170
Leveling and harrowing	154	10,000	91	7,830	161	12,120
Transplanting	210	8,000	224	9,830	364	13,380
Weeding	203	10,000	196	9,430	224	10,630
Fertilizing	63	2,200	63	3,195	14	670
Spraying	21	1,150	35	1,740	63	3,010
Harvesting	869	35,069	903	42,920	651	48,951
Corn and Peanut						
Plowing	84	12,000	84	12,000	140	6,000
Strip tillage	-	-	-	-	-	-
Planting	189	8,100	28	8,400	147	6,300
Weeding	119	5,100	18	5,400	126	5,400
Fertilizing	7	300	1	300	91	3,900
Spraying	-	-	-	-	49	2,100
Harvesting	-	-	-	-	77	3,300

Table C.3. Material cost for cropping patterns, Sub-area I, Nambahdadi, Lampung, 1975-1976

Material	Cropping pattern A		Cropping pattern B		Cropping pattern C	
	Amount kg/ha	Value (Rp)	Amount kg/ha	Value (Rp)	Amount kg/ha)	Value (Rp)
Seed: Corn	25	1,375	25	1,375	25	1,375
Upland rice	15	1,050	15	1,050	25	1,750
Corn						
Peanut	80	20,000	80	20,000		
Fertilizer:						
Urea	100	8,000	150	12,000	400	32,000
TSP	75	6,000	175	14,000	200	16,000
Zk					100	14,500
DAP	111	8,880				
Pesticide:						
Thiodan	1.5 lt	1,350	2.4 lt	2,160	2.2 lt	1,980
Suricide					5.5 lt	4,50
Total		46,655		50,585		72,555

Table C.4. Average yield and cost and return analysis for 3 cropping patterns in 6 months irrigation areas, Sub-area I/Nambah Dadi, Lampung, 1975-1976

Cropping pattern	Variety	Yield I	Yield II	Yield III	Yield Average	Gross return (Rp)	Labor cost (Rp)	Material cost (Rp)	Net return (Rp)
		(kg/ha)[1]							
IA-									
LLR -	Pelita I/1	3,151	4,427	3,906	3,828	229,680	92,269	19,605	117,806
Corn +	DMR -5	-	-	-	-)				
Peanut[2]	Kidang	-	-	-	-)	20,000	25,500	27,050	-32,550
						249,680	117,769	46,655	85,256
IB-									
LLR -	Pelita I/1	4,064	4,508	4,305	4,292	257,520	97,195	23,571	136,754
Corn +	DMR - 5	-	-	-	-)				
Peanut[2]	Kidang	-	-	-	-)	20,000	26,100	27,014	-33,114
						277,520	123,295	50,585	103,640
IC -									
LLR -	Pelita I/1	4,929	5,350	4,407	4,895	293,520	109,600	37,710	146,210
Corn	DMR - 5	613	877	576	689	37,895	27,000	34,845	-23,950
						331,415	136,600	72,555	122,260

[1] No rain throughout entire month of May.

[2] No grain yield but sold fodder for feed.

Table C.5. Material costs for cropping patterns in old alang-alang fields, Sub-area II/Bandar Agung, Lampung, 1975-1976

Item	CP IIA		CP IIB		CP IIC	
	Amount (Kg/ha)	Value (Rp/ha)	Amount (Kg/ha)	Value (Rp/ha)	Amount (Kg/ha)	Value (Rp/ha)
Seed						
Corn	18	720	18	720	15	2,050
U. rice	30	1,800	25	2,100	30	2,100
Corn	25	1,000	25	1,000	-	-
Peanut	-	-	-	-	100	2,500
Pesticide						
Thiodan	-	-	2.35 lt	2,115	3 lt	2,700
Surecide	-	-	-	-	1 lt.	900
Fertilizer						
Urea	-	-	6	480	100	8,000
TSP	-	-	7	560	50	4,000
Z K	-	-	-	-	50	7,250
Upland Rice						
Urea	-	-	144	11,520	200	16,000
TSP	-	-	93	7,440	100	8,000
ZK	-	-	-	-	50	7,250
Cassava						
Urea	-	-	-	-	75	6,000
TSP	-	-	-	-	25	2,000
ZK	-	-	-	-	75	10,875
Corn						
Urea	67	5,333	135	10,800	-	-
TSP	54	4,320	75	6,000	-	-
ZP	-	-	-	-	-	-
Peanut						
Urea	-	-	-	-	40	3,200
TSP	-	-	-	-	80	8,400
ZK	-	-	-	-	40	5,800
Total		13,173		42,735		116,525

Table C.6. Time and labor cost by activities for 3 cropping pattern in old alang-alang fields, Sub-area II/Bandar Agung, Lampung, 1975-1976

Activity	Cropping pattern A		Cropping pattern B		Cropping pattern C	
	Manhours	Cost (Rp)	Manhours	Cost (Rp)	Manhours	Cost (Rp)
Corn + ULR						
Cutting alang-alang	161	5,635	203	7,105	182	6,370
Full cultivation for upland rice + corn	630	22,050	798	27,930	-	-
Strip cultivation for corn (25 cm width)	-	-	-	-	476	16,660
Strip cultivation for upland rice (175 cm width)	-	-	-	-	966	33,310
Corn planting	140	4,900	42	1,470	175	6,125
Upland rice planting	-	-	392	13,720	231	8,085
Weeding for corn & upland rice (2 x)	378	13,281	266	9,310	329	11,575
Upland rice fertilizing	-	-	-	-	182	6,370
Corn fertilizing	-	-	-	-	42	1,470
Spraying	-	-	35	1,225	63	2,205
Corn harvesting	56	1,960	28	980	49	1,715
Upland rice harvesting	273	9,555	287	10,045	343	12,005
Sub-total	1638	57,381	2051	71,783	3038	106,390
Peanut:						
Strip cultivation	-	-	-	-	189	6,750
Planting	-	-	-	-	315	11,250
Weeding	-	-	-	-	105	3,750
Spraying	-	-	-	-	14	500
Harvesting	-	-	-	-	49	1,750
Sub-total	-	-	-	-	672	24,000
Cassava:						
Planting	-	-	-	-	56	2,000
Fertilizing	-	-	-	-	21	750
Harvesting	-	-	-	-	49	1,750
Sub-total	-	-	-	-	126	4,500
Corn:						
Strip tillage in hill	175	6,250	189	6,750	-	-
Planting	42	1,500	49	1,750	-	-
Fertilizing	7	250	7	250	-	-
Weeding	49	1,750	42	1,500	-	-
Harvesting	35	1,250	42	1,500	-	-
Sub-total	308	11,000	329	11,750	-	-
TOTAL	1946	68.381	2380	83,533	3836	13,4890

Table C.7. Average yield and cost and return analysis for 3 cropping patterns in old alang-alang fields, Sub-area II/Bandar Agung, Lampung, 1976-1976

Cropping pattern	Variety	Yield by plot and av.[1] I	II	III	Av.	Gross return (Rp/ha)	Labor cost (Rp/ha)	Material cost (Rp/ha)	Net return (Rp/ha)
		(Kg/ha)							
IIA									
Corn +	Local	228	241	2)	235	14,100)	57,381	2,520	-2,481
U. Rice -	Local	247	874	1,045	722	43,320)			
Corn	Local	714	606	1,059	793	47,580	11,000	10,653	25,927
						105,000	68,381	13,173	23,446
IIB.									
Corn +	DMR -5	359	460	805	541	32,460)	71,785	24,935	-5,700
U. Rice -	Bicol	924	907	1,096	976	58,560)			
Corn	DMR-5	490	483	490	488	29,280	11,750	17,800	- 270
						120,300	83,535	42,735	5,970
IIC.									
Corn +	DMR-5	2,208	1,465	1,722	1,798	107,880)	106,390	56,440	10,690
U. Rice -	Bicol	504	1,078	1,110	1,094	65,640)			
Cassava -	547	12,500	10,000	10,954	11,151	89,208	4,500	18,875	65,833
						262,728	110,890	75,315	76,523
Peanut	Gajah	8	5	6	6	1,500	24,000	41,210	-63,710
						274,228	134,890	116,525	12,813

[1] No rain throughout the entire month of May.

[2] Destroyed by pigs and chickens.

Table C.8. Material costs for 3 cropping patterns on newly opened fields, Sub-area III/Komering Putih, Lampung, 1975-1976

Item	CP IIIA		CP IIIB		CP III C	
	Amount	Value	Amount	Value	Amount	Value
	(kg/ha)	(Rp/ha)	(kg/ha)	(Rp/ha)	(kg/ha)	(Rp/ha)
Seed						
Corn	18	720	18	1,260	15	1,000
U. Rice	30	1,800	35	2,100	30	2,100
Peanut	-	-	-	-	125	31,250
Pesticide						
Thiodan	-	-	-	-	4 lt.	3,600
Surecide	-	-	-	-	1.4 1s.	1,260
Fertilizer						
Corn						
Urea	-	-	150	12,000	100	8,000
TSP	-	-	100	8,000	50	4,000
ZK	-	-	-	-	50	7,250
Upland RIce						
Urea	-	-	-	-	200	16,000
TSP	-	-	-	-	100	8,000
ZK	-	-	-	-	50	7,250
Cassava						
Urea	-	-	-	-	75	6,000
TSP	-	-	-	-	25	2,000
ZK	-	-	-	-	75	10,875
Peanut						
Urea	-	-	-	-	40	3,200
TSP	-	-	-	-	80	6,400
ZK	-	-	-	-	40	5,800
Total	-	2,520	-	23,360	-	124,035

able C.9. Cultural practices for 3 cropping patterns in newly opened fields, Sub-area III/Komering Putih, Lampung, 1975-1976

ctivity	CP III A	CP III B	CP IIIC
IRST CROPS	Corn+ULR/Cassava	Corn+ULR/Cassava	Corn+ULR/Cassava
nd preparation	Cut alang-alang Full tillage	Cut alang-alang Full tillage	Cut alang-alang Strip tillage
lanting	Corn+ULR Same time	Corn+ULR Same time	UPR - 15 DAP corn Cassava 70 DAP corn
rtilization[1]	N P_2O_5 K_2O	N P_2O_5 K_2O	N P_2O_5 K_2O
0 DAP	-	-	Corn 33% 100% 100% ULR - 100% 100% Cassava 33% 100% 33% (per hill)
15 DAP	-	-	ULR 20% - -
21 DAP	-	100% - - (broadcast)	- - -
30 DAP	-		Corn 67% - -
40 DAP	-	-	ULR 50% - -
42 DAP	-	100% - (broadcast)	
60 DAP	-		Cassava 67% - 67% (per hill)
70 DAP	-		ULR 30% - -
st Management			
Insecticide	-	As necessary	Furadan seed treatment and spray as necessary
Weeded	21 and 42 DAP	21 and 42 DAP	14 DAP
COND CROPS			Peanut
Land preparation	-	-	
Planting	-	-	After ULR
Fertilization			100% at planting

Table C.10. Time and labor cost by activities for 3 cropping patterns in newly opened areas, Sub-area III/Komering Putih, Lampung, 1975-1976

Activity	Cropping pattern A		Cropping pattern B		Cropping pattern C	
	Manhours	Cost (Rp)	Manhours	Cost (Rp)	Manhours	Cost (Rp)
Corn + ULR						
Cutting alang-alang	175	6,250	168	6,000	217	7,750
Full cultivation for UPL and corn	966	34,500	1,414	50,500		
Strip cultivation for corn	-	-	-	-	497	17,737
Strip cultivation for rice (175 cm width)	-	-	-	-	959	34,250
Corn planting	182	6,500	49	1,750	231	8,322
U. rice planting	-	-	189	6,785	483	17,262
Weeding for corn & rice	182	6,500	203	7,263	420	15,000
Corn fertilizing	-	-	-	-	42	1,500
Spraying	-	-	-	-	70	2,500
U. rice harvesting	308	11,000	238	8,452	735	25,725
Sub-total	1883	67,250	2,282	81,500	3,913	139,306
Cassava						
Planting	98	3,500	98	3,500	63	2,250
Fertilizing	-	-	-	-	21	750
Harvesting	56	2,000	56	2,000	42	1,500
Sub-total	154	5,500	154	5,500	126	4,500
Peanut						
Strip cultivation for peanut (350 cm width)	-	-	-	-	196	7,000
Planting and fertilizing	-	-	-	-	322	11,500
Weeding	-	-	-	-	126	4,500
Spraying	-	-	-	-	14	500
Harvesting	-	-	-	-	126	4,500
Sub-total					112	28,500
Total	2037	72,750	2436	87,000	4823	171,806

Table C.11. Average yield and cost and return analysis for 3 cropping patterns in newly opened areas, Sub-area III/Komering Putih, Lampung, 1975-1976.

Cropping pattern	Variety	Yield by plot and av[1] I	II	II	Av.	Gross return	Labor cost	Material cost	Net return
		--kg/ha--				Rp/ha	Rp/ha	Rp/ha	Rp/ha
IIIA.									
Corn +	Local	200	140	520	287	17,220)	67,250	2,520	-24,890
U. Rice +	Local	433	398	552	461	27,660)			
Cassava	Local	7,736	8,416	7,774	7,975	63,800	5,500	-	58,300
						108,680	72,750	2,520	33,410
IIIB.									
Corn +	DMR - 5	158	168	911	412	24,720)	81,500	23,360	-41,440
U. Rice +	Local	900	564	470	645	38,700)			
Cassava	Local	7,280	7,813	9,050	8,048	64,384	5,500	-	58,884
						127,804	87,000	23,360	17,444
IIIC.									
Corn +	DMR-5	1,825	2,451	2,143	2,140	128,400)	139,306	57,700	5,254
U. Rice +	Bicol	748	1,349	1,596	1,231	73,860)			
Cassava +	Gading	10,575	9,275	9,950	9,933	79,464	4,500	18,875	56,089
						281,724	143,806	76,575	61,343
Peanut[2]	Gajah	17	18	20	18	4,500	28,000	47,460	-70,960
						286,224	171,806	124,035	- 9,617

[1]No rain throughout the month of May.

[2]Peanut vegetative growth good but seed destroyed by pod borers.