HOUSEHOLD LABOUR ALLOCATION ON SMALL DAIRY FARMS IN EASTERN JAVA, INDONESIA:

Implications for Gender Roles

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ABSTRACT

The study was carried out in Andonosari village, East Java, Indonesia to investigate the household labour pattern of small-scale dairy farmers. The objectives were to: (a) investigate the pattern of the household labour allocation; (b) examine the earning contribution of dairy farming to the total of household income; and (c) quantify the role of gender in dairy farming activities. Time use patterns for household labour were computed as the time spent on work (dairy farming and non-dairy farming, including on- and off-farm activities). Interviews were conducted separately with the husband, wife, and family members aged 15-64 years for 50 households. Households were classified into three strata based on the number of dairy cattle farmed: strata 1 (with fewer than 3 animal units (AUs)), n=16; strata 2 (with 3 to 5 AUs, n=18); and strata 3 (with more than 5 AUs, n=16). Descriptive, univariate, bivariate and multivariate analyses were performed using SAS package.

Results showed that household labour for income generating activities was allocated more to dairy farming compared to the farm and non-farm work. Females allocated one third of total time to income generating activities, with most of the time devoted to dairy farming activities, while males tended to allocate more time to non-dairy farming activities. The household labour requirement in dairy farming per animal unit decreased as herd size increased, thereby allowing more time for non-dairy activities. Female participation was most evident in feed preparation and feeding, whereas the predominant male activity was forage collection for the dairy cattle. The size of the landholding had no impact on household labour allocation to dairy farming activities. An increase in household income and dependency ratio had a minor impact on household labour requirement in dairy farming. Non-dairy farming activities contributed about two-thirds to household income, the majority from apple farming. The income of household labour per animal unit tended to decrease with an increase in herd size. Variable costs accounted for 74% of the total expenditure in dairy farming, with majority purchases being concentrates. Fixed costs were 26% of total costs, and the major item was depreciation (8%).

It is suggested that farmers, including both men and women, should be trained to be more efficient in allocating household labour to dairy farming activities, and in managing the feeding of dairy cattle to achieve high productivity and income. There is substantial scope to increase herd size and increase labour efficiency in dairy farming.

Key words : Household labour, gender, dairy farming, non-dairy farming.

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CHAPTER 1 INTRODUCTION

1.1 Introduction

Indonesia is the fourth most populous country in the world, with 193 million people living in 27 provinces. The total labour force is 120 million, of which 40% are women. The agricultural sector alone accounts for 57% of the total labour force, and industries absorb another 14%. The national gross domestic product (GDP) of Indonesia is US$198,079 million (World Development Report, 1997). Livestock contributed 6.05% of total GDP in 1996 and dairy farming employs 32,5000 people (Wiryosuhanto, 1997). Indonesian dairy farms cannot produce enough milk and dairy product for domestic markets and thus imports these from overseas countries.

The government has taken new initiatives to improve the dairy production system and boost milk production. Internal initiatives aim to increase the quality and the number of dairy cattle owned by farmers. These efforts are not only to increase milk production, but also to generate income and employment opportunities, thereby raising the living standards of marginal communities in rural areas. External initiatives have been developed by agribusiness through milk co-operatives and development milk processing industries.

East Java is an important province for dairy farm development. The region accounts for 31% of the total dairy cow numbers in Indonesia, as East Java has a suitable climate for dairying. In addition, dairy farming has tremendous potential to employ a large number of rural people in the region.

East Java agriculture is largely based on a subsistence farming system, whereby the rural population derives income mostly from the primary sector which is dominated by crops, livestock and fisheries. Large numbers of people are involved also in non-farm activities such as trading, public service, and labour employment. However, due to low levels of education and lack of skills, non-farm income opportunities are very limited.

1.2 Background and Problem Statement

Farming accounts for the primary source of income for households in rural East Java. Among farm enterprises, crops dominate farm income, but provide employment only on a seasonal basis. The surplus labour from cropping is largely unutilised in the province, leading to high underemployment and unemployment. Furthermore, incomes generated from cropping are necessary to sustain household demand for necessities including food. If rural residents of East Java could find alternative sources of income, it would improve their food intake (both in quality and in amount) and ultimately provide a healthy work force. Dairy farming is one of few options available to rural residents.

The development of dairy farming in Indonesia has shown a positive impact on rural development (Prawirokusuma, *et al.*, 1983; Nugroho and Utami, 1988). Dairy farming can provide steady cash income and employment for rural labour throughout the year, and can also assist in stabilising household income. In addition, the absorption of under-utilised labour in dairy farming has the potential to slow the rate of migration from rural to urban areas and, over time, it may lessen the degree of urbanisation.

Dairy farm households allocate their labour to economic and non-economic activities, including dairy farming. Activities in dairy farming are commonly operated by family labour, including women. Women are largely involved in milking, rearing calves and other activities associated with raising dairy cattle - activities which are operated from home, with skill they already have. Dairy farm activities can thus increase women's participation in productive work. The participation of women in dairying becomes important because it provides supplementary household income on a regular basis, improves nutrition for their family members, increases self-reliance and self-confidence among women, and decreases their dependency on local moneylenders.

Utami (1992) examined the household labour allocation on Eastern Java dairy farms, but the gender role, and contribution of time allocation and income from dairy farming in alleviating poverty have not been studied. Thus, this research examines gender roles in dairy farming and their impact on household sustainability. The findings from

this study are expected to be of importance to the government in designing rural development strategies in East Java.

1.3 Objectives of the Study

The overall objectives of the research are to examine the performance of smallholder dairy farms in East Java. The specific objectives are to: (a) investigate the pattern of household labour allocation; (b) examine the contribution of the small dairy farm to the total of household income; and (c) quantify the role of gender in dairy farming activities.

1.4 Trends in Dairy Cattle Number and Productivity

The population of dairy cattle in Tutur (Nongkojajar) Sub-district steadily increased from 1981 to 1987 (Table 1.1). However, in 1988 and 1989, the number of dairy cattle decreased by 636 heads or 5.04%. Similarly, the number of dairy cattle owned by co-operatives' members declined by 66.67% (from 5.70 head in 1981 to only 1.90 head in 1990). The decrease in the number of dairy cattle was associated with calf sales - as farmers required cash to purchase farm inputs. Others used the money generated from sales to provide household needs, such as paying for children's education. Selling calves was seen as being a reasonable method by which to obtain alternative to obtain cash. By 1990, dairy cattle numbers started to increase to about 13,352 head. Farmers had realised the advantages, while dairying, of routine cash obtained from marketing milk, and annual manure.

Milk production followed an increasing trend to 1989, and then declined slightly in 1990. Likewise, milk production per cow exhibited an increase by 66.67% between 1981 to 1989 and then decreased to 16.87% in 1990. Inefficiency in managing dairy cattle was the main reason for this decreased milk production, together with the fall of per cow milk production in 1990, which was caused by the increasing age of dairy cows with declining milk production (Anonymous, 1991).

Table 1.1 The composition and development of dairy cattle, milk production and the milk co-operatives of dairy farmers (1981-1990).

Year	Number of Dairy cattle (head)	Annual milk Production (litre)	Number of dairy farmers in milk co-operatives (person)	Milk production Per dairy cattle Per year (litre)	Dairy cattle per farmer (head)
1981	8,463	3,485,404	1,485	411.84	5.70
1982	11,070	8,577,716	2,524	774.86	4.39
1983	12,085	12,144,974	2,589	1004.96	4.67
1984	12,797	12,980,369	3,645	1014.33	3.51
1985	12,806	13,848,862	4,069	1081.44	3.15
1986	13,227	14,721,791	5,042	1113.01	2.62
1987	13,574	15,825,857	5,660	1165.89	2.40
1988	12,624	17,569,775	6,151	1391.78	2.05
1989	11,988	20,552,921	6,328	1714.46	1.89
1990	13,352	19,030,547	7,044	1425.30	1.90

Source: Statistics data of milk co-operatives "KUD Setia Kawan", 1991.

The number of dairy farmers tended to increase in the sub-district of Tutur (Nongkojajar) from 1981 to 1990. All of the farmers were involved in "KUD Setia Kawan" (milk co-operatives) which provide some facilities, such as dairy farming inputs and the marketing of milk. The increase in the number of dairy farmers indicated that farmers realised the benefits of undertaking dairy farming rather than other jobs available in the village.

The number of dairy cattle, number of lactating cows, milk production per day and number of dairy farmers in Andonosari village are presented in Table 1.2. The trends in Andonosari village followed those observed in the sub-district of Tutur – which showed increases in both the dairy cattle population and the number of dairy farmers. Andonosari accounted for about 14.33% of total dairy cattle in sub-districts Tutur, including about 11.40% of the lactating cows, and 11.31 % of the total production.

Table 1.2 Dairy farming performance in Andonosari village.

Variables	Sub-district of Tutur	Andonosari village
Number of dairy cattle (head)	13,353	1,913
Number of lactating cows (AU)	6,038	683
Milk production per day (litre)	52,138	5,944
Number of dairy farmers (person)	7,044	627

Source: Statistics data of milk co-operatives "KUD Setia Kawan", 1991.

Note: AU= Animal Unit is defined using Brown's (1979) criteria: cows aged more than 2 years = 1 AU; cows aged 1-2 years = 2/3 AU; cows aged less than 1 year = 1/3 AU.

1.5 Importance of the Study

Relevance to On-Farm Needs

The findings from this study will provide input into government formulation of rural economic development programmes, especially those for developing dairy farming in East Java. Dairy farmers will ultimately benefit from this government strategy in terms of better access to employment and increased income opportunities.

Relevance to future research

The data from this research will provide benchmark information, which can be used for follow-up studies. In addition, the information will be valuable as a reference comparison for other researchers who wish to extend the study into other regions, and to other economic enterprises.

1.6 Limitation of the Study

The study of household labour allocation of small dairy farms was conducted in East-Java, Indonesia, and was limited to small-scale dairy farmers in Andonosari village. Economic activities of household labour, the contribution of these activities to household income and factors which influence family members' allocation of time to

dairy farming were investigated. The study reflected the household labour pattern particularly of small-scale dairy farmer households.

1.7 Thesis Outline

Chapter 2 provides a review of literature in relation to household labour allocation. In chapter 3, methodology including conceptual framework, study area, data collection and analytical tools used are discussed. Chapter 4 is devoted to results and discussion. The summary, conclusions and recommendations are in chapter 5.

CHAPTER 2 LITERATURE REVIEW

Dairy farming as a part of a farming system has become increasingly important as an aspect of labour and income generating activities of farm households. Households, as noted by Doss (1996), have a function as producers, investors in human and physical capital, managers of risk, and as consumers. Smallholder dairy farms typically produce farm commodities such as crops, livestock and livestock products, controlling household labour and consumption goods. Although cropping is the principal source of household income, many households are unable to survive on this income alone, and therefore seek other opportunities to supplement farm income by allocating family labour (both male and female) to on-farm (including dairy farming) as well as off- and non-farm activities in order to fulfil household needs.

Household labour allocation decisions can be based on the theory of time allocation (Becker, 1965). The theory of time allocation of household labour on dairy farms is reviewed in section 2.1, and limitations of the time allocation model are discussed in section 2.2. Section 2.3 summarises empirical studies focussing on the relevance of the theory of time allocation. The determinants of household labour allocation are presented in section 2.4, while the advantages of time allocation on small dairy farms are discussed in section 2.5. Finally, section 2.6 presents a summary of the literature on the theory of time allocation on smallholder dairy farms.

2. 1 Theory of Time Allocation in the Household

The theory of household time allocation as proposed by Becker (1965) stated that "households maximise utility derived from the consumption of goods and services subject to their time and income constraints". The theory confirms that the utility of households depends on their income, and time allocation pattern. Households seek to maximise the cumulative utility of all family members - household utility is a function of both consumption goods and leisure time. The theory has been applied extensively in economics literature, particularly in modelling household economic

decision-making where a household allocates labour between market and non-market activities.

Gronau (1977) elaborated the theory by allocating household time (labour) to three activities: (i) labour market; (ii) home activities; and (iii) leisure time. In this framework, market-purchased and household-produced commodities are perfect substitutes in consumption. The former applies to the commodities purchased at market, while the latter are the commodities produced using household labour and purchased inputs.

However, Sumner (1982) had a slightly different perspective from Gronau's model. The distinction is seen when the model is applied to farm families in which the income constraint includes farm production. Thus, household utility is subject to both time, income and farm production constraints. The farm household time allocation is assumed as a unit of production function of farm and household commodities. The joint household production is represented by a farm commodity which is sold to the market and a household commodity which is consumed by the family. Labour is sold on the market, but only market purchases are for production function. However, if agricultural households have separate production functions, then the fixed inputs are permitted to one enterprise only, and the model will be recursive production function between farm and the household commodities.

Other researchers have extended Gronau's model, and such approaches assume that family utility function involves the constraint of time allocation between various members of the household, a specification of farm income sources, and household characteristics. Studies of household time allocation do not concentrate on the farm operator only (Huffman, 1980; Robinson, *et al.*, 1982; Simpson and Kapitany, 1983; Van Kooten and Arthur, 1985; Gunter and McNamara, 1990), but examine both the farm operator and his/her spouse (Furtan, *et al.*, 1985). Other studies have included other members of the household (Schmitt, 1989) as well as emphasising on gender roles (Olfert, 1993).

Sicular (1986) added another dimension of the farm household time allocation when he examined the collective farm-household model representing Chinese farms in which a single decision is used in both production and consumption. The production decisions are derived demands for labour and seasonal distribution of labour use. The consumption side, collective farms are determined by the levels of collective income, both in kind and in cash, and distribution of income among members.

The studies mentioned above infer that households allocate their time in the market as a labour force. Household labour, together with purchased goods in a household production function, combines to produce commodities, which are sources of household utility. Therefore, household utility is derived from household labour activities in which the household allocation of time should be observable. The question arises amongst household labour ("male", "female" or "both") as to how households allocate their time (labour) on those activities, and by members of which gender those activities are – or should be - performed.

Answering the question "who does what?" in farm households can be traced by a time budget. Time budgets are useful in describing the division of labour by age and sex, and analysing socio-economic variables which influence the time-use pattern (Dixon-Muller, 1985). However, asking questions about time use is a very broad and complex process, particularly in work and leisure on a daily, weekly and seasonal basis. The household labour (time) allocation requires to be categorised to simplify data collection. Furthermore, Anker (1983) recommended the specification of questions relating to labour force activities to provide accurate labour force data.

Ehrenberg and Smith (1994), for instance, classified three alternative uses of time – namely, working for pay, working at home, and consuming leisure time. Subsequently, Fratkin (1989) provided a starting point with which to determine the time allocation of household activities into (i) household task; (ii) livestock task; (iii) manufacturing task; (iv) the performance of essential social activities; (v) and rest and leisure. In addition, stratifying the time-allocation survey was considered a useful approach to identifying the factors affecting the organisation of labour and production. Although the authors provide a good work model specification of time-use pattern

within a household, it is unclear whether "work" is defined as "work for pay" or "non-work activities" such as "household chores".

Similarly, Malathy (1994) examined the determinants of work activities differentiating between paid work and household tasks. Traditionally, female activities are regarded as non-labour force activities. This ignoring of the contribution of activities undertaken by women can seriously distort the measurement of their productive roles. This view is supported by Rosenfield and Tigges (1988) who point out that, in reality, women's contributions to farm productivity are likely to be underestimated by conventional measures.

Tomoda (1985) has attempted to overcome both the ambiguous nature of productive activities and the disregard, in the evaluation, of women's economic contribution. In reviewing studies of female labour activities in Asian developing countries using the time allocation approach, the author finds variations in terms of the activity pattern among population subgroups-even within the same area. "Work activities" are argued to include not only work in economic activities (e.g. work for wages), but also non-economic work, such as providing household needs and tasks to produce a fairer evaluation of women's economic contribution, and hence a better recognition of their true role in society. This will avoid the biased perception of women in the labour force. Anker (1983) pointed out that the statistical invisibility of the economic contribution and labour force activity of women can be eliminated by improving fieldwork techniques and questionnaire design. Skoufias's (1994) study is consistent with the concept suggested by Tomoda (1985) that productive time includes working on the farm, cooking and cleaning, and other housework. However, Tomoda fails to provide methods of valuing household chores, such as cooking, cleaning and childcare.

Ehrenberg and Smith (1994) attempted to overcome Tomoda's limitation and used three methods in valuing household work. First, *market price* is applied to place a value on the homemaker's services similar to what they would cost if purchased in the marketplace. For example, the value of services performed by a full-time homemaker, in a two-adult family with two children under age 6, was US$18,780 in 1992 dollars.

Second, *opportunity costs* are calculated to measure the homemaker's services as having the same salary as work for pay. An estimate of the value of a typical housemaker's services using this approach came to about $10,630 per year in 1992 (after taxes and work-related expenses). Third, the *self-employment* approach estimates the homemaker's services as for self-employed individuals - in which the value of their marginal productivity at home is equal to their net market wage. It has been estimated that the typical homemaker, working exclusively in the home, produces services worth $24,530 to the family (in 1992 terms).

The approach of Ehrenberg and Smith in valuing household tasks may answer the measurement problems in developed countries. However, these methods are unlikely to be applied in developing countries such as Indonesia. For instance, the social-economic condition is markedly different between developed and developing countries. In addition, the criterion for valuing earnings or taxes is not the same. Furthermore, there is no standardisation in measuring household work.

Dixon-Mueller (1985) excluded household tasks from work activities. She divided time use into three comprehensive categories - namely, economic activities, housework and childcare, and leisure time. Economic activities are sometimes called "market work", "market production", "economic production", "exchange value" or "direct productive work" whereas housework and childcare involve home production, use value, household maintenance and reproduction. In addition, "leisure" is defined as "non-work activities", such as eating, resting and visiting. Fratkin (1989) further explained that "rest and leisure" consist of sleeping, visiting and socialising, playing games, and secular singing and dancing in non-ritual contexts.

In another study, ILO (1982) cited by Anker (1983), household activities are grouped into economic and non-economic activities. "economic activities" imply work for pay or profit during a specified period. United Nations recommend that these activities' result in goods or services, as defined by national accounts statistics, such as wages or salaries employment or entrepreneurial profit are considered to be economic or labour force activities; all other activities are considered to be non-economic or non-labour force. In principle, however, both the United Nations and the ILO study emphasise

that activities oriented to household consumption, such as subsistence agriculture, home consumption and improvement, milking animals and processing food, should also be considered as labour force activities. However, a general-purpose time allocation inventory developed by the FAO divides time spent in agriculture only into work on family holdings in cash crops, food crops, livestock, home garden and small animals or poultry, wage employment, and exchange labour.

The literature suggests that introducing new agricultural technology can involve usually an unequal division of household labour especially with regard to one gender (Palmer, 1976; Heyzer, 1986; Boserup, 1990). This is because women have more responsibilities in domestic work, whereas men are less involved in household work. This, in turn, affects the decision about the hours worked in labour markets by men and women. Consequently, women are deprived of opportunities in labour participation. Unlike other farm enterprises, a dairy enterprise tends to enhance the participation of family labour, particularly that of women and children.

Household incomes are derived from both work activities (labour engagement) and non-work activities (e.g. remittance, rent and interest). Huffman (1980) stated that household income can come from on-farm, non-farm activities, and non-wage labour. Also, the study by Furtan, *et al.* (1985) further postulated that total household income is a function of the time allocated to work for earnings between female and male, farm production, household characteristics and unearned income less fixed costs (asset income). This concept in which the household income includes other income, such as savings is supported by Van Kooten and Arthur (1985). In addition, Olfert (1993) added family income from various other sources, such as government transfer and investment income.

The relationship between household income and household labour allocation to maximise household utility can be explained by the theory of income effects. Ehrenberg and Smith (1994) discussed the trade-off between utility and budget constraint (with an increase in non-labour income). If the income effect is negative, then the household utility can be obtained in two ways. First, as income increases (holding wages constant) hours of work decrease and, as a consequence, a leisure time

increases; second, as income decreases (holding wages constant) hours of work increase and, therefore, leisure time decreases.

The theory of income effect of Ehrenberg and Smith may be interpreted in dairy farmer households. Household income can be generated by employing the household labour, thereby increasing their work-time and consequently decreasing leisure-time. The pattern of that time use is addressed to maximise the household utility of the dairy farmer. The utility of the dairy farmer household is represented in different ways: to fulfil consumption goods; status; and non-economic utility (satisfaction).

2.2 The Weaknesses of the Time Allocation Model

The time allocation model has some limitations, which largely stem from constraints in applying such models in a real context. Olfert (1993) contended that the theory of household time allocation is a static model, therefore the model is restricted when explaining long run changes such as technical changes, preferences, changing labour force participation rates, and changing the structure of the non-agricultural sectors. Pollak and Wachter (1975), on the other hand, criticised applications of household production function in explaining time allocation. Constant returns to scale and joint production were cited as limiting factors.

Several difficulties are also faced when the methods are applied in empirical modelling. Robinson, *et al.* (1982), for instance, noted that calculating time allocation in hours is difficult because many statistics are available only at the aggregate level (for example, hours per week, per year). Another difficulty is that the model does not capture personal preference. Dixon-Mueller (1985) further explained that difficulties in collecting data on time allocation include: (i) predicting the number of hours of household labour activities in which farmers usually lack awareness of time on the clock; (ii) estimating and recalling every activity; (iii) deciding when one activity ends and another activity begins; and (iv) estimating time for two simultaneous activities.

Although there are some weaknesses in theoretical use of the household time allocation model, the theory is appropriate when viewing utility (Pollak and Watcher,

1975). Moreover, Schmitt (1989) argued that the theories of farm households' time allocation are much more flexible in adjustment to changing social and economic conditions. In addition, a complete agricultural household time allocation model requires extensive data such as labour supply by sex, farm and non-farm outputs, fixed farm assets, and prices, for both consumption and production inputs, including wages (Singh, *et al.*, 1986). Researchers perceive the theory of household time allocation as a valid framework for explaining time-allocation patterns within farm households; the theory needs therefore, to be viewed in the context of these findings.

2.3 Empirical Studies on Farm Household Time Allocation

2.3.1 Household Labour Allocation

Household labour allocation can be classified into two main groups: economic and non-economic activities. The former activities for instance on farm, including dairy farming, off- and non-farm, benefit in cash or in kind, whereas the latter (for example, household tasks, social activities and leisure time) do not provide such tangible benefits.

Non-economic Activities

The non-economic activities, such as household tasks, can vary between countries. A study in India, for example, indicated that the level of rural development, caste, per capita income, socio-economic status and level of household technology are all found to be positively and significantly related to the time spent in household chores (Kaur and Punia, 1988).

Religion also plays an important role in determining who is responsible for household chores. For instance in South Asian societies, and particularly amongst the Moslem communities, women are generally confined to household chores and to the home and its vicinity, while field and outdoor tasks are undertaken by men (Wimaladharma, 1985).

In addition, the studies from Sri Lanka, Philippines and Indonesia showed that about 90% of women have responsibility for food preparation, while only 5% of men are engaged in such activity. Attendance at social activities - especially extension service and attending meetings - is biased usually towards men, while women are mostly involved in marriage or circumcision activities (90%) (Palawija News, June 1995).

Literature portrays substantial evidence that women are likely to be involved in labour-intensive activities (housework), while men have the responsibility for the financial support of their family. However, situations may change (if women are given an opportunity to be involved in economic activities) so that there may be a more equitable sharing of household tasks between women and men. For example, the introduction and expansion of dairy farming may modify the behaviour within the household by improving women's ability to earn income from the dairy farming operation.

Economic Activities

Evidence suggests that women spend more time on economic activities compared to men. This is consistent with the study of Fratkin (1989) in Ariaal of Northern Kenya that women allocate more time in labour tasks than do men, and have only two-thirds of the rest and leisure time compared with men. Heyzer (1986) provided a similar finding, in many case studies of South-East Asian societies, that women - particularly from low income strata tend to work longer hours and have less leisure than do men. Thus, women are involved in activities which allow less leisure time. Whereas, the condition of men in poverty groups is different from the condition of women, because the increasing household burdens and pressures to obtain income tend not to change either men's use of time, or their work burden. However, women in the poorest rural strata not only contribute more time but also generate more income than men within the agricultural household economy.

The study of upland agriculture in Sri Lanka, Philippines and Indonesia confirmed the involvement of men (15-64 years), women (15-64 years), and children-male (8-14 years) or female (8-14 years) on- and off-farm. Men are mostly engaged in on-farm

work, the majority in land preparation and use of animal power (100%), while women are employed in planting seeds (85%)(Palawija News, June 1995). However, only 5% of both males and females have taken part in planting seeds. Also, there were 50%, 10% and 40% of men, women and male children respectively involved in livestock raising. Off-farm work, particularly craftsmanship, is dominated by men (100%), whereas women engaged more in mat weaving and petty trading (90%).

The results of a study of the status of rural women in Bangladesh indicated that the women's working day is typically long, and extends between nine and thirteen hours (Akhter, *et al.*, 1995). However, economic activities such as livestock raising and kitchen gardening occupy minimal time due to lack of technical knowledge. The authors concluded that if women from small, marginal and landless farm households were trained in improved techniques, they could raise their income levels. Furthermore, the study of Singh and Riyazuddin (1996) found that in India, women did 60% of the livestock rearing tasks, and provided 50% of the labour associated with crop farming.

Thus many authors conclude that economic activities are more beneficial for men than for women. This indicates that women work for a longer period, but, in contrast gain less income than men do. One could ask the question if this situation is also valid for the dairy farming household?

The study by Lalwani (1990) concluded that labour use in the crossbred cattle farming system is excessive in landless and medium farm sized households, but deficient when the farming system uses buffaloes and indigenous cattle. These finding are in agreement with Singh, *et al.* (1993) that dairy farming sub-systems provide more employment than crop farming sub-systems, and that the inclusion of a dairy component into mixed crop farming systems has the potential to provide extra employment for rural smallholders.

Mullins, *et al.* (1996) examined the impacts of intensive dairy production on smallholder farm women in coastal Kenya. Their findings showed that women perform half of all dairy-related activities. Similarly, a study in Nepal (Chitwan

district) showed that women participate equally with, or sometimes even more often than men in different rice farming and livestock production activities (Timsina, et *al.*, 1996).

Other studies consider the contribution of family members to dairy farming. The various contributions of women, and male and female children in livestock activities - particularly for beef production and draft animals in Indonesia-are 82.1%, 60.3%, and 50.4%, respectively (Asian Development Bank, 1991).

2.3.2 The Division of Labour in Dairy Farming Activities by Gender

A trend in most developing countries is that women and children are displaced from the fields by men and tractors. They are, therefore, likely to turn towards the homestead and engage in vegetable gardening, animal husbandry tasks and cottage industries. Animal husbandry tasks done by women could help strengthen the traditional household labour division. For example, in Indonesia, milking and marketing of milk are usually done by the men, while women are involved only marginally with the household dairy enterprise (Wimaladharma, 1985). Whereas, in India, within a household, it is the women and the older children who look after the dairy cattle (Wimaladharma, 1985).

The labour divisions in South Asian societies are influenced also by religion, particularly among the Moslem communities, and this has implications for gender division of labour activities. For example, grazing the cattle away from home is usually the task of men or adolescent male children, but feeding and tending within the home yard, and milking are almost exclusively the task of women. Selling milk is also the responsibility of men (Wimaladharma, 1985).

The involvement of males and females in dairy farming activities are further explained by Tripathi and Kunzru (1995) in a study on the dynamics of employment of rural women in dairying. They report that about two-thirds of rural women are employed in dairying, and that approximately 100-400 minutes per day are spent in dairying-related

activities. The activities carried out by females included mostly feeding and management of livestock, and the processing of livestock products.

On the other hand, the data for Java tends to contradict the assertion that animal husbandry is largely within the women's sphere of work. Adult women (15 years and over) devoted only 1.3% and men 15.2% of their total working time to animal care and feeding. However, another set of data indicates that, in animal husbandry, the greater part of labour is contributed by children (both boys and girls) 6 to 11 years of age. In the youngest group, the proportion of labour spent is about equal among both boys and girls. Similarly, dairy cattle activities are tasks largely of women (wives) and children in Sri Lanka and Bangladesh (Wimaladharma, 1985).

Similarly, Singh (1995) investigated the participation of rural women in concentrate feeding and watering of animals and in the washing of utensils in two villages of West Bengal India: Nadia and South 24 Parganas. The findings showed that the family size and labour force were significantly higher in Nadia compared to South 24 Parganas. In terms of dairy farming activities, more than 50% of women participated in concentrate feeding of animals (58% and 54% in Nadia and South 24 Parganas, respectively), watering animals (56 and 55%, respectively) and washing utensils (85 and 88%, respectively).

Another study reported that the daily labour requirement per lactating cow was higher than that for rearing dry animals and heifers (43.63 man-minutes including 13 minutes for milking vs. 18 man-minutes per day). For instance, feeding and cleaning took 19.3% and 24.1% of total requirements in the care of a lactating cow; 21.6% and 41.3% for dry animals; and 21.7 and 40.2% for heifers. A minimum of 7.77 man-hours were required to produce 100 kg of milk and 152 man-hours per year are needed in raising one animal (Devarajulu and Naldu, 1989).

Several studies reviewed above indicated that women have more participation in dairy farming than do men, particularly in specific activities such as milking, feeding and watering, which are home-based. In contrast, men are involved more in the activities outside the home, such as cutting and gathering grass and selling milk.

2.4 Determinants of Household Labour Allocation

It has been recognised that farm families, including women, manage most of the dairy farms in developing countries. However, even on these family farms, the labour force participation between men and women in dairy farming works may vary between, and within, households in the villages. The differences may be caused by several determinants which can influence either the presence, or the absence, of women in dairy farming activities - and lead to division of labour between genders. The activities of household labour in farming activities were influenced by several factors associated with the division of labour between genders. In this review of the literature on the labour requirements for dairy farming activities, three areas were specifically addressed: human capital, household characteristics and labour market characteristics.

2.4.1 Human Capital

Education

Education can influence dairy farming activities by improving farm production and labour efficiency. Increasing education seems to enhance the capability for solving problems which are faced by farmers, such as taking a rational approach to the issues confronting the farmer, and in even allocation of human resources (Stevens and Jabara, 1988).

Feder, *et al.* (1985) and Rauniyar and Goode (1996) reported that education could influence the adoption of modern technology by farmers. Evidence has been presented for Punjab that adoption of technology in agriculture (e.g. high-yield grain) is positively related to education (Rosenzweig, 1978 cited by Feder, *et al.*, 1985).

There are two effects of education on agriculture, involving allocation and worker effects (Huffman, 1974 cited by Steven and Jabara, 1988). The first one is referred to as the "cost perspective" in which education can improve the farmer's ability to access markets, and technical and institutional information. The second relates to resources

in that farmers have ability to produce more with a given quantity of resources. Huffman (1980) indicated that education can influence the time allocation at work.

Age and Gender

The age of the household labour force is related to productivity, whereby as the age of a household member increases, productivity improves by allocating more time to economic and less to non-economic activities. Increasing age can make the labour force more productive although, after a certain age, this diminishes. Age is positively related to economic activities up to a certain age level, and thereafter it is negatively related to work for pay. This is supported by the finding of Gunter and McNamara (1990) that the participation in work activities, particularly off-farm jobs increases with age, and then ultimately starts to decline. The time of the highest potential for engaging in income-earning work is predicted to occur at the age of 40. Likewise Thurmeier (1981) showed that group of age 40s held the highest potential for work activities. However, the productivity effects of the household labour's age may differ between the genders.

Huffman (1980) used the theory of time allocation to describe the labour supply decision model. The results show that age has a negative impact on the time household members devoted to farm work, off-farm work and leisure. The finding is consistent with that of Huffman and Lange (1989) that the work participation of the husband is negatively influenced by life cycle, while that of wife is positively influenced by life cycle. In the dairy farming sector, however, women are the major performers of tasks related to the dairy sectors, and the time spent in these activities is negatively and significantly related to the age of the respondent (Kaur and Punia, 1988). Furthermore, Roberts (1996) studied dairy production in Kenya and found that age and gender are important factors to consider when examining livestock production among African smallholder farmers. Women, young males between ages of 6-15 and persons of both sexes aged 65 and over spend a considerable amount of time engaged in livestock-related activities. This happens especially when males are away from home earning extra income as hired labourers.

2.4.2 Health

Health is one of the important constraints to the availability of family labour. It can affect the quality of the labour input supplied by the farmer and household members, and has both a direct and an indirect effect on farm production and the efficiency of both farm inputs and farm outputs.

Pitt and Rosenzweig (1986) developed the conventional one-person farm household work model of Barnum and Squire (1979) by examining the interaction between prices, health and profits in the context of an agricultural household model. The findings indicate that changes in health on labour supply are not influenced by household labour activities in the labour market. The advantages of health improvement influence households through increased labour market supply.

Age and health status were the principal determinants of work absenteeism. Health status consideration rather than economic variables ultimately affected the job loss rates for both male and female workers. In addition, age has a markedly greater impact on work loss for men than for women. Women have a lower work absence rate and a longer life expectancy because they make greater use of medical care and respond early to illness (Paringer, 1983).

2.4.3 Household Characteristics

Family labour allocation in income generating activities can be influenced by household characteristics. Gunter and McNamara (1990) presented two impacts of farm characteristics on economic activities within a farmer's household. First, income effects, in which household labour is a trade-off between the marginal utilities of time spent on work activities (e.g. off-farm work) and leisure. Second, farm characteristics influencing time allocation of family labour are their relative hours spent between on- and off-farm tasks. In terms of household characteristics, these can be classified into seven factors: non-labour income, household income, household size, dependency ratio, household assets and land holding.

Non-labour Income

Household income can measure the level of a household's well being. Income does not arise solely from work activities, but can originate also from non-wage labour, such as remittances, rent and interest. Raising non-labour income can improve the relative income position of households. It can also affect household labour patterns by allowing the purchase of labour-saving technologies, or by expanding enterprises such as livestock or cash crops. Lopez (1986) showed that non-work sources of income have an effect on the total labour supply. Similar findings were reported by Sumner (1982) whereby non-wage income was negatively related to the possibility of a farmer's access to work opportunities, especially off-farm jobs.

Household Income

Household income plays an important role in allocating household labour in economic activities. As mentioned by Gunter and McNamara (1990), family income can determine the hours of labour allocated to work activities and leisure. Higher household income tends to reduce marginal utility for the farmer in work activities and, as consequence, it will increase leisure time, and vice versa.

Rosenzweig (1986) elaborates a prototypical economic model of the household incorporating multiple family members with differing characteristics, household production, labour market relations, time, and income constraints. The study stressed the effect of household resources allocation, particularly time and food, on households' outcomes - which include the schooling, earnings, and health status of individuals. The empirical data set from the Philippines, India and Indonesia showed that food-intervention, female-employment schemes and price-altering policies do affect a household's outcomes. Household utility is maximised by intra-household allocation of goods between individuals and household activities.

Household Size

The number of family members should be taken into account when deciding household labour allocation to income-generating activities, as this can affect the ability of the household to supply labour to work-earning activities. As unit decision making, the labour supplied by farmers will be initially devoted to work-earning activities to meet the household's needs. This leads to achievement of the household utility.

Huffman (1980), using the theory of time allocation to describe the labour supply decision model, found that household size is an important factor which influences the time spent by household members between farm work, off-farm work and leisure. Similarly, Pitt and Rosenzweig (1986) emphasised that household composition is an important factor to consider in household production activities. Furthermore, Singh and Riyazuddin (1996) found that the larger-sized household were engaged in livestock farming as a secondary source of livelihood.

However, a study in Northern Kenya found that household composition tended not to vary in respect to labour demand perspective. The intensity of work performance in this area was not affected by the composition of the household labour force (Fratkin, 1989).

Dependency Ratio

The dependency ratio is the number of children under 14 and the number of adults over 65 divided by the population aged between 14 and 65 (Due, *et al.*, 1997). It is an important factor in determining the household burden, particularly in work activities. As the number of non-productive household members' increases, working members tend to work longer to meet household requirements (Chayanov (1966) cited by Fratkin (1989).

However, Fratkin (1989) in a Northern of Kenya study showed that the dependency ratios do not have a significant effect on the intensity of work performance by either

men's or women's labour. The finding was contrary to Caryanov's rule, in which people from larger households with lower dependency ratios should work less intensively than those were with higher dependency ratio.

Household Assets

Household assets - including wealth, stock, and land - can affect the work hour allocation between members of the household as well as by gender. Fratkin (1989) reported that wealth and livestock have a strong influence on labour participation in work activities. The level of wealth affected labour allocation equally between males and females, while it had a different influence between poor and rich households, as less time was spent in income generating activities in affluent households compared with poor households. Huffman and Lange (1989) also noted that the asset income had a negative impact on the husband's, but a positive impact on the wife's, labour participation (Huffman and Lange, 1989).

Land Holding

The farm size cultivated by farmers influences the amount of time allocated by households to economic and non-economic activities. Heyzer (1986) investigated how the size of land holding can affect income-generating activity and lead to the sexual division of labour in farming sectors in which women may either engage side by side with men, or may work separately in farm cultivation. Dixon-Mueller (1985) noted that landless females spent more hours than males on other owners' farm (157 hours for males vs. 93 hours for females per year). In contrast, larger landowners devoted less time to farming activities in the peak season, and women contributed more than men (24 hours vs. 11 hours).

Research on three agro-ecological zones in South Africa: Burkina Faso-Sahelian, Sudanese, and Guenian examined the determinants and effects of household income diversification. Land constraint did not appear to be driving income diversification in any zone. This is one of the strong differences from the Asian findings of Reardon, *et al.* (1992). In addition, the increase in land size does not influence the level of non-

farm employment income, suggesting that an increase in land base alone will not necessarily reduce non-farm employment (Olfert, 1992). On the other hand, women are the major performers of tasks on dairy farms, and the time spent in dairy activities are negatively and significantly related to the size of the land holding in India (Kaur and Punia, 1988).

2.4.4 Labour Market Characteristics

Wage Rates

Behrman and Deolalikar (1993) developed a model of intra-household distribution of market work which focuses on two dimensions of household preference for leisure based on International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) survey data. The results indicate that households balance their preference equality of labour supply or leisure among their members against the trade-off represented by relative wage rates. However, there is some evidence of unequal concern, with the leisure of males being given higher preference weighting in household work distribution decisions than the leisure of females. This latter result conforms to evidence accumulating from a number of other studies in South Asia that households discriminate heavily against their female members in virtually every area - namely the allocation of food, nutrition and medical care.

The study of Malathy (1994) showed that the husband's wage affects the substitutability between the roles of spouses in all activities. The accruing women's wage and the higher education of females reduce the amount of time spent in home production, and increase the time allocated to teaching their children. The reviews of the determinants of labour force participation showed that personal, farm and labour characteristics all contribute to determining household labour participation in work/earning activities.

2.5 The Advantages of Dairy Farming

Although dairy farming is not a principal livelihood of farmers, it can be a viable alternative job in rural areas. Dairy farming has enormous potential for increasing economic activities in rural areas, such as improving human resources - particularly through increasing household members' work activities, thereby increasing livestock production.

2.5.1 Household Income and Employment

Studies on livestock farming indicated that livestock can provide additional income and employment to households, especially in developing countries (Sansoucy, 1995; Sansoucy, *et al.*, 1995; Piraux, *et al.*, 1996). Diversification of farming into livestock rearing provides an opportunity to augment farm income and to reduce income risk, particularly in dryland areas where income from crop husbandry is unstable. Farming of dairy animals not only increases the level of expected income but also reduces the magnitude of income risk (Bhende and Venkataram, 1994). For instance, the dairy cattle in Bangladesh are proposed as a supplementary income source for smallholders (Wimaladharma, 1995). Similarly, dairy farming is found beneficial in terms of increasing income (Mergos and Slade, 1987; Bhople, *et al.*, 1992; Mullins, *et al.*, 1996) and generating employment (Ravindra and Veerabhadraiah, 1991). Furthermore, Kanvinde (1988) found that not only do the borrowers (mostly poor and landless people) in Maharashtra-India earn substantial additional income from milk animals, but also that the share from dairying can increase the net family income by approximately 68.3% in the post-loan reference year.

Moreover, Muljadi and Saleh (1995) studied the production factors of small-scale dairy farming in West Java, Indonesia which influence farmers' income from the sale of milk. Labour returns from dairy farming are also high. The production factors positively affecting farmers' incomes from selling milk were barn costs, concentrate feed, animal health care and artificial insemination, labour, and the number of lactating cows.

2.5.2 Poverty Alleviation

Dairy farming activities generate income for farmer households, which can be used to: (a) improve nutritional status; (b) enhance children's education; and (c) improve standard of living. Therefore, dairy farming can be used as a tool in alleviating poverty, particularly in rural areas.

A study in North West India, with 700 respondents representing various categories of the rural poor in India, shows that the majority of poor prefer dairying, whereas the emphasis in development budgets has always been in favour of crop enterprises. Although agriculture is the main source of livelihood for the rural poor, the income derived from crop enterprises is not enough to fulfil family needs. The productive employment typically includes a considerable proportion of household time in crop enterprises, while additional labour is required to generate sufficient household income. Efforts should be made to promote dairying as a subsidiary occupation to move the rural poor above the poverty line (Verma and Malik, 1991).

However, Escher (1986) investigated "Integrated Rural Development" (IRD) in India, and showed that investments in dairy farming can not raise the goal of IRD in terms of the poverty eradication strategy because poor farmers benefit only marginally. On the other hand, the investments benefit dairy farmers who have sufficient resources to maintain their cattle. Verhagen (1986) obtained similar results in investigating Operation Flood which seek to produce greater income for the rural poor in India through dairying. The results indicated that statements made by the dairy authorities regarding the potential of the programme to combat rural poverty are exaggerated. Operation Flood can have only a limited impact in terms of income and employment generation among the poor. In particular, landless labourers, who constitute the bottom 25% of the rural population, are largely excluded from the benefits of the programme.

There are several conditions which must be met for livestock to be used to combat poverty. First, the right market conditions must be made available. Second, the returns to labour must be made remunerative. Third, the input and output must be fairly

priced. For example, small farm incomes in the dairy sector in Indonesia which average Rp 2500/day/cow have made a significant contribution in combating poverty among rural producers (Asian Development Bank, 1991).

2.5.3 Nutritional Status

Income generated from dairy farming can provide additional advantages for small households. Incremental income can be spent on increasing the amount and quality of household food. Either the household members can consume milk, or it can constitute surplus production and be sold in the market. Thus, dairy farming can improve the quality of nutrition within the household.

Mullins, *et al.* (1996) found that there is broad consensus among the women interviewed in Kenya that intensive dairying had led to improved household welfare, primarily through milk consumption. Women 'contact farmers' are observed to be spending dairy income on food items more often than their counterparts on male contact farms. Mergos and Slade (1987) reported that milk producers increase their consumption of milk slightly, about 2% on average (8% amongst the poorest producers) as well as consume higher levels of calories and protein. The extra income accrued from the sale of milk is used to purchase other foods not produced by the farmer (Shah, 1992).

Another benefit of the husbandry knowledge gained by women from certain livestock-related activities in dairying is that it enhances childcare, particularly health and nutrition (Asian Development Bank, 1991). Although the impact of changing livestock production system on household nutrition in Kenya may alter both the food intake and the intra-household control of nutritional resources, it has decreased control over milk disposal (Huss, 1996).

2.5.4 Children's Education

Income from the sale of livestock products is usually used to pay for the children's food, clothing and education (Asian Development Bank, 1991). The contribution of

livestock's income to children's education highlights the importance of the livestock to farmer households, particularly in developing countries.

Dairy development in India was proposed for increasing rural household income as well as for meeting national requirements for milk and dairy products. Income from milk is a daily cash income, which is spent on children, food and other household needs. In addition, in Kenya, women spend dairy income on children's education (Mullins, *et al.*, 1996). In Sri Lanka, women spend income from dairying on children's schooling, food and clothes (Wimaladharma, 1985).

2.5.5 Farming Sector

Chabayanzara and Breth (1994) found that smallholder irrigation development had a positive impact on productivity, food production, income and employment. The results indicated that cash crop income was dominant compared to other income sources (e.g. livestock). Whereas Kalyankar and Potekar (1994) noted that, in the assured rainfall zone of Marathwada (India), with the present level of technology and input-output price ratios, returns from farming on 28% of farms were not sufficient to meet cash expenses. Farm business income was not sufficient to cover full costs (including imputed value of family labour) on 65% of farms. Net returns per ha were higher for the small farm size group (1-2 ha). In these situations, livestock may act as a supplier of inputs and services for crop production (Sansoucy, *et al.*, 1995).

Mixed farming systems and landless households (though leasing land) can use livestock rearing to provide supplementary food supplies, optimise land use and increase their income through multiple cropping (Asian Development Bank, 1991). Furthermore, Devasenapathy, *et al.*, (1995) found that integrated farming systems combining groundnut-black gram-maize with livestock (poultry, fish, dairy farming) can result in higher net returns and provide additional employment opportunities to those offered by the conventional groundnut-cotton or sorghum-cotton system.

2.5.6 Other Advantages

The Environment

Animals benefit the ecosystem, as animal manure in its fresh or dried form has been a traditional source of fertiliser for crops (Asian Development Bank, 1991). Similarly, Sansoucy (1995) examined the role of livestock as a source of fertiliser and soil conditioner. Livestock can ensure the better management of soil fertility (Piraux, *et al.*, 1996) as well as take part in resource management and reduce environmental degradation (Sansoucy, *et al.*, 1995).

Source of Energy

Animal manure is used for fuel in South Asia, thus mitigating the damage to the ecosystems caused by cutting down trees for fuel (Asian Development Bank, 1991). It is used in biogas production, and even as source of energy - including draught animal power (Sansoucy, 1995).

Marginal Lands and Crops Residues

Sansoucy (1995) states that one of the roles of livestock is the utilisation of marginal lands and crop residues. For example, farmers can allow livestock to convert the waste vegetation (i.e., straw) to valuable products rather than burning these crop residues, creating pollution and contributing to global warming.

2.6 Summary

The review of several studies above indicates that the theory of time allocation pioneered by Becker (1965) was expanded and developed by some authors. The theory is a suitable framework for explaining the pattern of time allocation within farm households, although there is some debate as to the grouping of economic and non-economic activities of household labour allocation. Some researchers included household chores in economic activities; others recognised those as being non-economic activities. Others recommended that economic activities include the activities in work for pay in either farm or non-farm activities. Non-economic activities, including household chores - on the other hand, were considered activities without refunds. This classification attempts to trace the hours spent by households in income acquisition. However, the income of households does not come only from economic or work activities, but also from non-work incomes, such as remittances, rent, and interest on assets.

Labour households (including male and female) play an enormous role in their contribution to income generating activities. Considerable hours available from both males and females were devoted to participation in dairy farming tasks and non-dairy activities, including on-farm and non-farm works. The daily economic activities are usually operated by family labour, both male and female, particularly dairy farming activities. The gender division of labour may explain the extent of dairy farming activities.

Division by gender was analysed to examine the contribution of male and female, in economic and non-economic activities, to household income. The appropriate tool used is the theory of time allocation of Becker (1965) which determines how economic activities are performed separately or equally between men and women. Men and women can either work side by side, or perform different tasks. However, some studies found that men receive more advantages than women in economic activities.

The theory of household time allocations as postulated by Becker (1965) is limited, but it can explain the family labour allocations of dairy farmer households and the relationships between time-use and income generation in order to achieve utility. According to the many studies reviewed above, the findings reveal that dairy farming plays a valuable role in generating income and enhancing employment for both males and females, and can lead to socio-economic sustainability in the rural sector.

The empirical studies of time allocation indicated that different time allocation to both economic and non-economic activities exists between genders due to religion, culture and tradition. Particularly with regard to dairy farming activities, women allocated more time than did men although the decision to operate a dairy farming system is decided within the household. Studies in India, Indonesia, and Kenya found that women took a major role in operating dairy farming systems. Meanwhile, the time allocated to dairy farming was restricted by several determinants, namely, human capital, household characteristics and labour market characteristics. Human capital, including education, age and gender, and health, resulted in the variation of time devoted by household labour to work-earning activities involved in dairy farming. Similarly, the pattern of time allocation between males and females in work activities varied by household characteristics (i.e. non-labour income, household income, household size, dependency ratio, household assets and land holding). In addition, labour market characteristics, such as wage rates, influenced the time allocation between males and females in work for pay.

Many studies have investigated the advantages of dairy farming. These advantages include household income generation, enhancing work opportunities, alleviating poverty, increasing nutritional status, improving children's education, helping farming sectors' development, environmental improvement, producing of energy and the utilisation of marginal lands and crop residues. Therefore, dairy farming can provide benefits for rural people as well as for the environment.

CHAPTER 3 METHODOLOGY

This chapter outlines the methodology used to research time allocation in small-scale dairy farming households. The methodology is classified into five sections.

3.1 Theoretical Framework

The theoretical framework for the research is based on the Becker Model (1965) and is presented in Figure 3.1. The theory was applied to explain the time allocation pattern within farm households, and attempts to assess the extent to which the time and budget constraints account for gender differences in the available time of households in order to achieve utility. Utility of the household depends on household income and time allocation patterns. Households aim to maximise the cumulative utility of all family members. The household utility is a function of commodities, which involve both consumption goods and leisure time. The utility (U) of the household is derived from home-produced goods (Q_h), market goods (Q_m), the leisure time of both female (T_{fl}) and male (T_{ml}), and household characteristics (Z). The household is assumed to maximise utility subject to constraints. The household utility is formulated as:

$$U = f(Q_h, Q_m, T_{fl}, T_{ml}, Z) \quad \text{.....(1)}$$

$$Q_{h1} = f(Q_{m1}, T_{fl1}, T_{ml1}, Z_1)$$

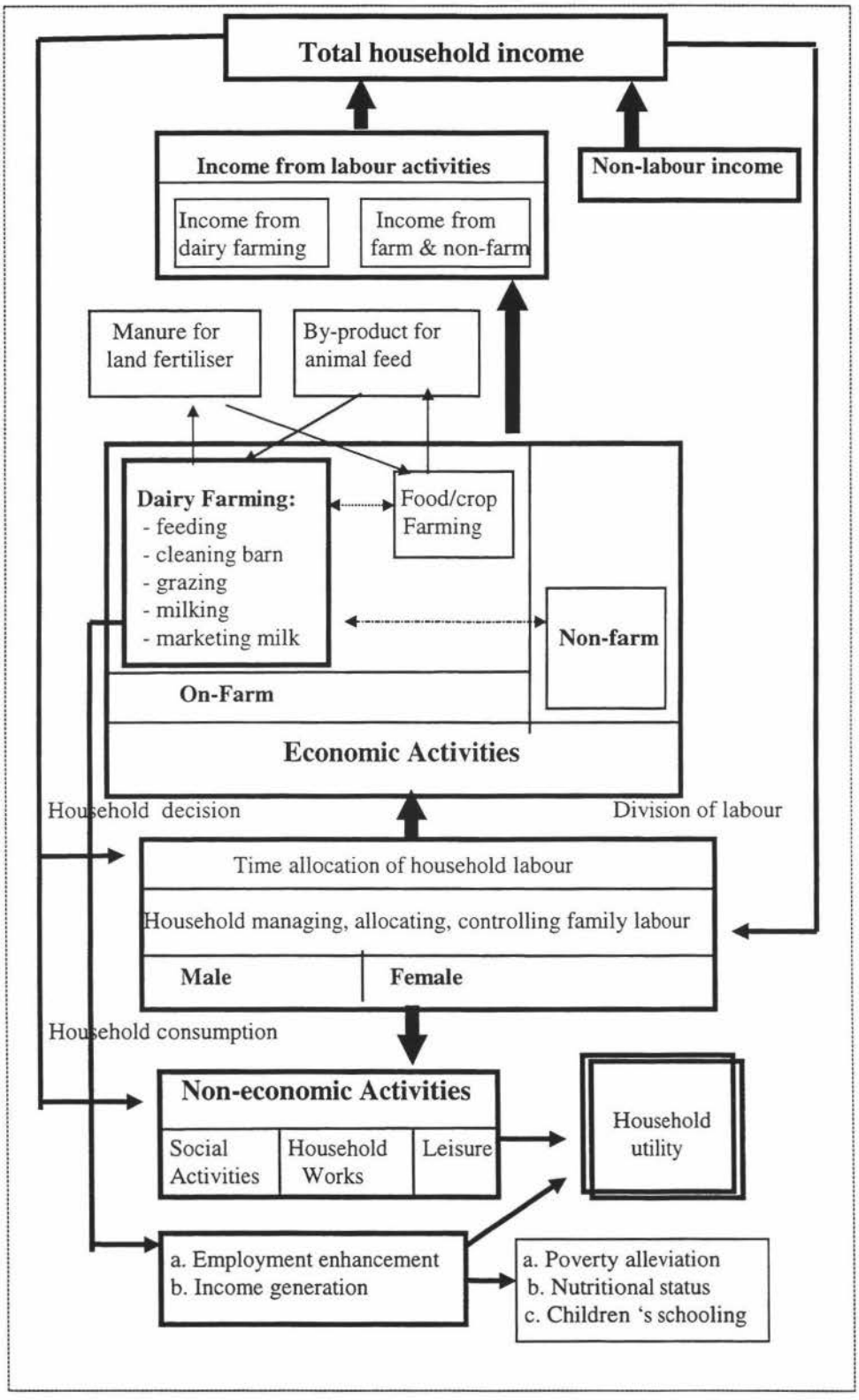
$$Q_{h2} = f(Q_{m2}, T_{fl2}, T_{ml2}, Z_2)$$

. .
. .
. .

$$Q_{hn} = f(Q_{mn}, T_{fln}, T_{mln}, Z_n)$$

Where:
U : utility,
Q_h : the set of consumption goods purchased at home,
Q_m : the set of consumption goods purchases in the market,
T_{fl} : leisure hours of female,
T_{ml} : leisure hours of male, and
Z : a set of household's characteristics, such as age, education, family size, geographic location, dependency ratio, herd size, and landholding size.

Figure 3.1 Conceptual model of time allocation amongst household labour in small scale dairy farming.



Legend:

⇢ : indicate slight importance

→ : indicate moderate importance.

➡ : indicate strong importance.

Dairy farm households allocate time to three daily activities: (a) in the labour market; (b) in home activities; and (c) leisure time. Household activities involve caring for the elderly and children, cleaning the house, preparing meals, washing clothes, gathering firewood and fetching water. Leisure includes personal activities such as sleeping, taking rest, games and other individual activities. The labour market activities include work both on their own farms (including dairy farming), and off-farm. In this study, work activities comprise all productive activities, on- and non- dairy farming yielding income in cash or in kind. The relationship of time constraint can be stated as Gronau's model:

$$T = \sum_{i=1}^{n} T_{si} = T_{wi} + T_{hi} + T_{li} \quad \text{..... (2)}$$

where:

T : total time available to the i^{th} dairy farmer household,
T_{wi} : time allocated to market work in the i^{th} household,
T_{hi} : time allocated to home production in the i^{th} household and
T_{li} : time allocated to leisure in the i^{th} household.

The work activities include time-use by all household members: male and female in income-generating activities. The household's time spent on three separate activities can be viewed as:

$$T_{wi} = \sum_{i=1}^{n} T_i = \sum_{i=1}^{n} \sum_{j=1}^{3} \sum_{k=1}^{2} T_{ijk} \quad \text{..... (3)}$$

where:

T_{wi} : total time allocated to market work,
i : i^{th} member of the household (n-members),
j : j^{th} activity (1= market work; 2= household activities; and 3= leisure time),
k : gender of the household labour (1=male; 2=female).

Household income is used to fulfil the consumption good of households in maximising utility. Income is an endogenous factor of a household since labour allocation decisions are made within the household. Time-allocation decisions labours within the household on work activities regarding certain task, either wage labour or household production or resources are allocated based on marginal

productivity. The higher levels of household earning should reduce the marginal utility of family income, *ceteris paribus*, and consequently this will diminish the time allocation of labour within the household to work relative to time spent in leisure. The household income is derived from the time used by family members in work activities, and from non-labour income. The income constraint can be formulated as:

$$Y = \sum_{i=1}^{n} Y_i$$

$$= \sum_{i=1}^{n} \sum_{j=1}^{m} W_{ij} T_{ij} + \sum_{i=1}^{n} V_i \quad \ldots\ldots (4)$$

where:
i^{th} : individual,
j^{th} : activity (i=dairy farm, 2= farm and non-farm),
W_j : wage rate for j^{th} activity,
T_j : time units allocated by i^{th} individual in j^{th} activity,
V_i : non-wage income generated by i^{th} individual.

From equations (1) to (4) it can be formulated that the consumption of market goods (Q_m) is a function of the total time of the household (T) and the total income of the household (Y). If income is a constraint in utility maximisation, the expenditure on market goods cannot exceed the family income. It can be couched:

$$V_i + \Sigma W_i . T_{wi} = \Sigma P_i . Q_{mi} \quad \ldots\ldots (5)$$

$$T_w = T_s - T_h - T_l$$

$$V_i + \Sigma W_i (T_s - T_h - T_l) = \Sigma P_i . Q_{mi}$$

$$V_i + \Sigma W_i . T_w = \Sigma P_i . Q_{mi} + \Sigma W_i . T_h + \Sigma W_i . T_l \quad \ldots\ldots (6)$$

where:
W_i : wage rate for i^{th} activity,
T_{wi} : time units allocated by i^{th} activity,
P_i : the price for i^{th} market goods, and
Q_{mi} : the consumption for i^{th} market goods.

The equation (6) means that non-labour income and the earning from productive activities equal the value of market goods, of home production and of leisure.

Family income can be acquired by employing the household labour which is influenced by exogenous and endogenous factors. Exogenous factors include non-labour income, wage rate or labour productivity, household consumption, and factors within the household such as skill, capital and the level of technology used by the household. In an equilibrium condition, the exogenous factor is affected by endogenous factors which include demand for market goods, market goods purchased and household's time availability.

This study will investigate exogenous factors, which influence household labour allocation in dairy farming with the addition of other factors, and will be expressed as an influence variable. The following predictors were household characteristics, which were used to explain the variation of household labour allocation in dairy farming activities.

A lactating cow requires special attention, and more time devoted by household labour, than activities such as milking a cow, selling milk, and preparing a qualified feed. The number of lactating cows variable can reflect the variation of time allocated by the household labour in dairy farming.

The income of dairy farming can influence decision-making in allocating household labour time to dairy farming activities. Theoretically, higher earning can attract household labour to allocate more time to those activities. Therefore, income from dairy farming can determine whether household labour should be devoted more ,or less, to dairy farming activities.

Non-labour income, such as remittances, rent and interest, may decrease the time allocated to work activities, including dairy farming. Household labour tends to be lessen the time in work for pay and increase leisure because of the accruing non-labour income. The household labour spent their time in dairy farming activities may influence by non-work activities.

Income from outside dairy farming, for instance from crop farming and non-farm work can determine whether the household labour should be devoted either to dairy farming or outside dairy farming. The high wage rates are hypothesised to use more household labour. It is important to know the relationship between income from outside dairy farming and time allocation by household labour in dairying works.

The more of family members, there are, the higher is the household labour time available. It is hypothesised that the more family members, the higher household labour time devoted to dairy farming activities. This is possible because most family members are employed in their own farming, including dairy farming. Therefore, family size is important in determining the variation in dairy farming activities by household labour.

Dependency ratio can also determine the time devoted by household labour to dairy farming activities. According to the theory, a higher dependency ratio can increase the number of household members who labour in work for pay, such as dairy farming. Time allocation in dairy farming may vary according to the dependency ratios of households.

The number of dairy owning farmers can influence the time allocated by household labour. As the number of dairy cattle increases, the decision in allocating time in dairy farming may be different among farmers. Some farmers may tend to allocate more household labour to rearing their dairy cattle. Others prefer a decrease in time allocated to dairy activities because of hired external labour. The number of dairy cattle owned by the farmer can determine the variation of the household labour pattern in dairy farming activities.

The size of land holding may influence time allocated by household labour in dairy farming activities. Farmers who access the higher size of land holding may tend to decrease their time allocated in dairy farming instead of cultivating their land. The variance of household labour allocation in dairy farming can be obtained from landholding size predictors.

The time allocation in dairy farming is a function of the postulated exogenous variables (household characteristics) of the model:

$$N = \alpha o + \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + \alpha_4 X_4 + \alpha_5 X_5 + \alpha_6 X_6 + \alpha_7 X_7 + \alpha_8 X_8 + \varepsilon \ldots\ldots (7)$$

Where :

N : time allocated by household labour in dairy farming (hours/year),
X_1 : the number of lactating cows (animal units),
X_2 : the income of dairy farming (Rp/year),
X_3 : non-labour income (Rp /year),
X_4 : income from outside dairy farming (including both farm and non-farm) (Rp/year),
X_5 : the number of family members (persons),
X_6 : dependency ratio,
X_7 : the number of dairy cattle (animal units),
X_8 : the size of land holding (ha),
ε : the error or residual,
αo : intercept, and
$\alpha_1, \alpha_2, \ldots\ldots, \alpha_8$: regression coefficients associated with $X_1, X_2, \ldots\ldots, X_8$ respectively.

Dairy farming income is derived from milk and non-milk production, including calves (6 month and under) either sold or non-sold during the year, culled calves (6-12 months), culled mature dairy cows (1-2 years) and imputed change in value of stock. The income of dairy farming is primarily influenced by total costs, which comprise variable and fixed costs. The net income from dairy farming is the difference between income and total costs. The per animal unit net income is derived by dividing total farm net income by the number of dairy cattle. Several variables as follows influence net income from dairy farming per AU.

Variable costs per AU of forage consumption, concentrate consumption, transportation, total animal feeding, herbal medicine, artificial insemination, and other farming purchases were estimated to exhibit the variation in net-income of dairy farming.

The number of family labourers is hypothesised to affect the net-income of dairy farming. As the number of household labourers increase, a greater amount of time may be devoted in dairy farming to acquiring more income from dairy farming. The difference in number of household labour hours can represent the variation in net income of dairy farming per AU.

The dependency ratio reflects the responsibility to provide for household needs by allocating household labour to work activities, including dairy farming tasks. The variation in net-income of dairy farming can be reflected by the dependency ratio.

The time allocation in dairy farming is a function of the postulated exogenous variables (household characteristics) of the model:

$$Y_1 = \alpha o + \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + \alpha_4 X_4 + \alpha_5 X_5 + \alpha_6 X_6 + \alpha_7 X_7 + \alpha_8 X_8 + \alpha_9 X_9 + \varepsilon \quad \text{.......} \quad (8)$$

where:

Y_1 : net-income in dairy farming per AU (Rp /year),
X_1 : variable cost of forage consumption per AU (Rp / year),
X_2 : variable cost of concentrate consumption per AU (Rp / year),
X_3 : variable cost of transportation per AU (Rp / year),
X_4 : variable cost of total cost animal feed per AU (Rp / year),
X_5 : variable cost of herbal medicine per AU (Rp / year),
X_6 : variable cost of artificial insemination per AU (Rp / year),
X_7 : variable cost of other dairy farming purchasing per AU (Rp / year),
X_8 : the number of family labourers (persons),
X_9 : dependency ratio,
ε : the error or residual,
αo : intercept,
$\alpha_1, \alpha_2, \ldots, \alpha_9$: regression coefficients associated with $X_1, X_2, \ldots X_9$ respectively.

3.2 Area Selection

The research was conducted in the selected rural area by a purposive sampling approach (Miah, 1993) based on two criteria: (a) the dairy cattle development area in East Java; and (b) the higher dependency of communities on dairy farming whether dairying was the main, or secondary, work earning. Andonosari village was selected for the research because of its proportionately greater number of dairy cows, and greater number of dairy farmers in its villages compared to other regions.

3.2.1 Study Area

Population and Employment

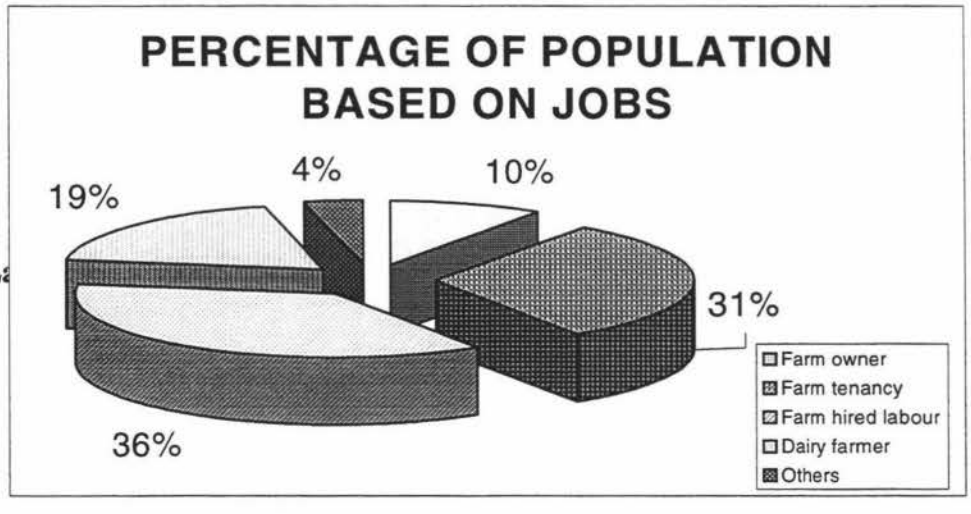
The total population of Andonosari village in 1991 was 4316 persons and its area was 5.06 km^2. The population density was about 450 person per Km^2, which considerably higher than other villages in the sub-district of Tutur. Men marginally outnumbered women in the village (sex ratio = 1.026). The village had about 10% of the Tutur sub-districts' population.

The labour force, according to the Centre of Statistics Office, is defined as a population aged more than 14 years, and less than 65 years. Population aged less than 14 years and more than 65 years was categorised as non-labour force. The labour force accounted for 69% of the total population (34% male and 35% female), whereas 31% of the population in these villages was classified as non-labour force (17% male and 14% female).

Source of Household Income

Several jobs, including farm, non-farm and off-farm were performed by society in Andonosari village and were presented in Figure 3.2.

Figure 3.2 Population distribution based on work.

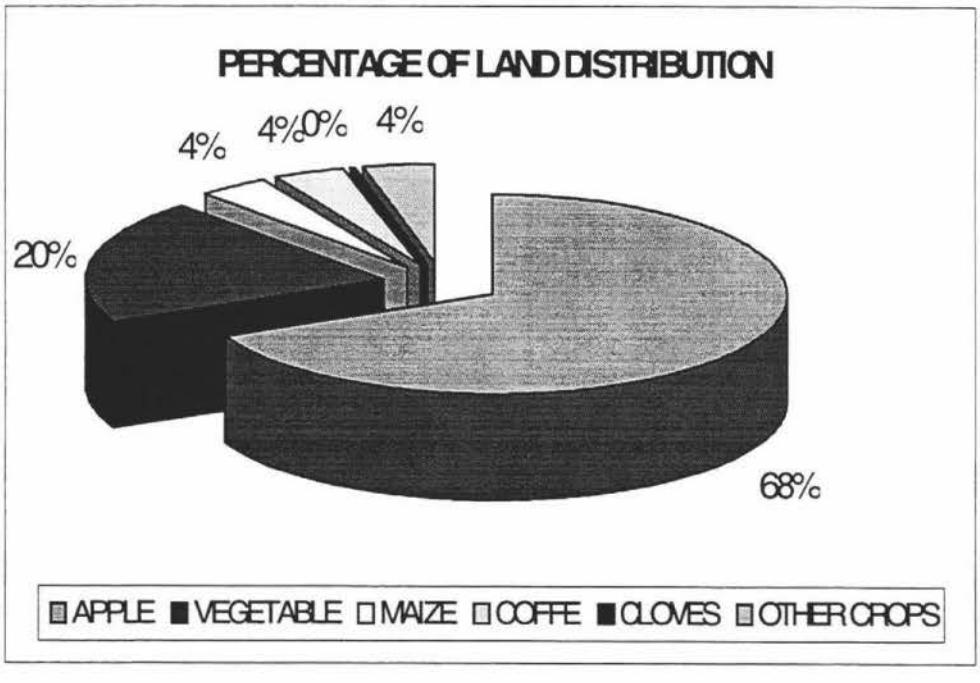


The main sources of income of the people of Andonosari village come from "farm ownership" (31%), with about 19% of population specifying their main job as "dairy farmer". Some farmers are "tenants" (10%), "hired labourers "(36%), while only 4% were accounted as "government officer", "co-operatives worker", "trader", "services", "non-farm hired labour" and "pensioners".

Land Distribution

The land uses in Andonosari village are classified as dry lands which were planted in vegetables, fruit and cash crops. The distribution of crop area can be viewed in Figure 3.3.

Figure 3.3 Land distribution based on crops planted.



The main crop in Andonosari village is apples (68%). Vegetables accounted for 20%, whereas 4% of the land area was planted in both maize and other crops. Coffee was cultivated on almost 4%, whereas less than 1% of land was planted in cloves.

3.3 Selection of Respondents

A multistage random sampling technique (Dane, 1990) was used to determine respondents. First, dairy farmers were selected according to two criteria (a) land holdings and (b) ownership of at least one lactating cow. From a list of 627 dairy farmers, only 150 dairy farmers had the criteria recommended. Subsequently, the number of sample size in the case of random sampling was estimated based on the concept presented by Miah (1993). The equation of determining sample size can be couched as:

$$n = \frac{N.\,p.q.z^2}{Nd^2 + p.q.z^2} \quad \text{..... (9)}$$

where:
n : sample size,
N : population,
z : interval confidence level,
d : precision,
p : probability of right (the proportion of successes),
q : probability of error (the proportion of failures).

Sample size based on population (150 selected farmers), proportion (α = 5%), precision (d= 9%), probability right (p=80%), and probability error (q= 20%), is about 50.39.

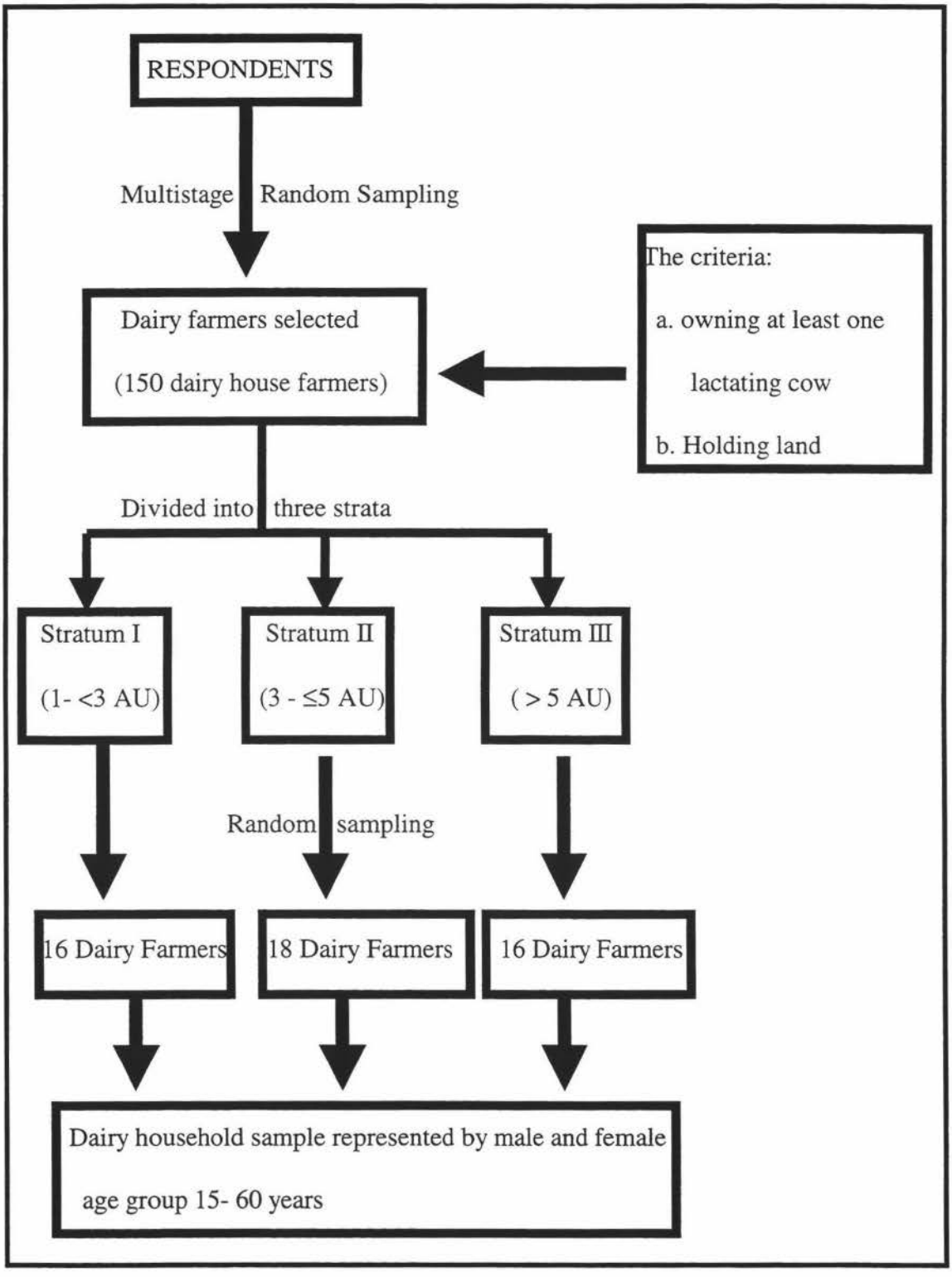
Second, the dairy farmers in the sampling frame (N=150) were classified into three strata, stratum I included households owning fewer than 3 Animal Units (AU) and consisted of 48 dairy farmers; Stratum II comprised 55 dairy households owning 3 to less and equal to 5 AU, and Stratum III had 47 households owning more than 5 AU. Because the strata differ in size, proportional allocation is used to maintain a steady sampling fraction throughout the population as recommended by Miah (1993). Each stratum is calculated with the following equation.

$$n_h = \frac{n\,N_h}{N} \quad \text{..... (10)}$$

where:
n_h : sample size of each stratum,
N : total population,
N_h : total population of each stratum,
n : total sample size of all strata.

Third, according to the equation, in each stratum 16, 18, and 16 households were randomly selected for the study. The respondents of the nominated dairy farm households were represented by respective family members, including husband, wife and other adults, particularly in the age group 15-60, (productive age) in order to ensure adequate numbers of sample. A questionnaire was developed and used to gather information from dairy farm household members. In all, 50 dairy farm households were interviewed. In addition, direct observations of activities undertaken by household members were also made (Figure 3.4).

Figure 3.4 Selection of respondents.



3.4 Data Collection

The data collection on time allocation of household labour for each activity became a complex procedure because the diversity of activities undertaken by family members posed a major challenge. The time use of family members was computed as time spent on work (dairy farming and non-dairy farming, including on- and non-farm), household tasks, social activities, and leisure time. Time allocation by gender was collected. Additional information on household income from other sources was gathered from the interviews. A discussion of procedure follows.

There are many ways to collect the data of household time allocation. Tomoda (1985) mentions three data collection methods, namely interviewing, direct observation and self-recording. All approaches have some benefits: (i) the data collection methods can minimise sex bias and simply describe all activities in hours spent by the person; (ii) the data can contain the variation of seasonal work pattern, since the survey is conducted over a long period of time; (iii) more detailed information can be obtained on labour allocation than that from the Census.

In contrast, the disadvantage is that errors can arise in the interview method based on recall if the respondents are not familiar with clock time. Moreover, the lack of quantitative data will arise if the traditional Census and the data are not representative of the country as a whole, since samples are small. Furthermore, data collection needs more time and money. Anker (1983) explains the difficulties in collecting data of time allocation via interviews. These include (i) respondents usually tend to answer questions in the way they believe the interviewer would like. This biases answers towards socially-accepted norms; (ii) proxy respondents may not possess detailed knowledge on the activities of other household members. A common procedure in large surveys and Census is to interview the head of the household, usually assumed to be the male, if present; (iii) response relates specifically to the sex of the respondent. It is generally believed that, in developing countries, male respondents are more likely than females to understate the labour force activity of female household members; and (iv) interviews are often conducted in the presence of other persons (besides the respondent and interviewer), which undoubtedly affects results.

Katz (1995), however, demonstrates the benefits of the direct observation approach in studying the allocation of household income. The advantages of the direct observation method are: (i) the intra-household processes are empirically traceable; and (ii) the direct measurement of intra-household resource allocation offers richness to the prediction and interpretation of micro-level policy impacts.

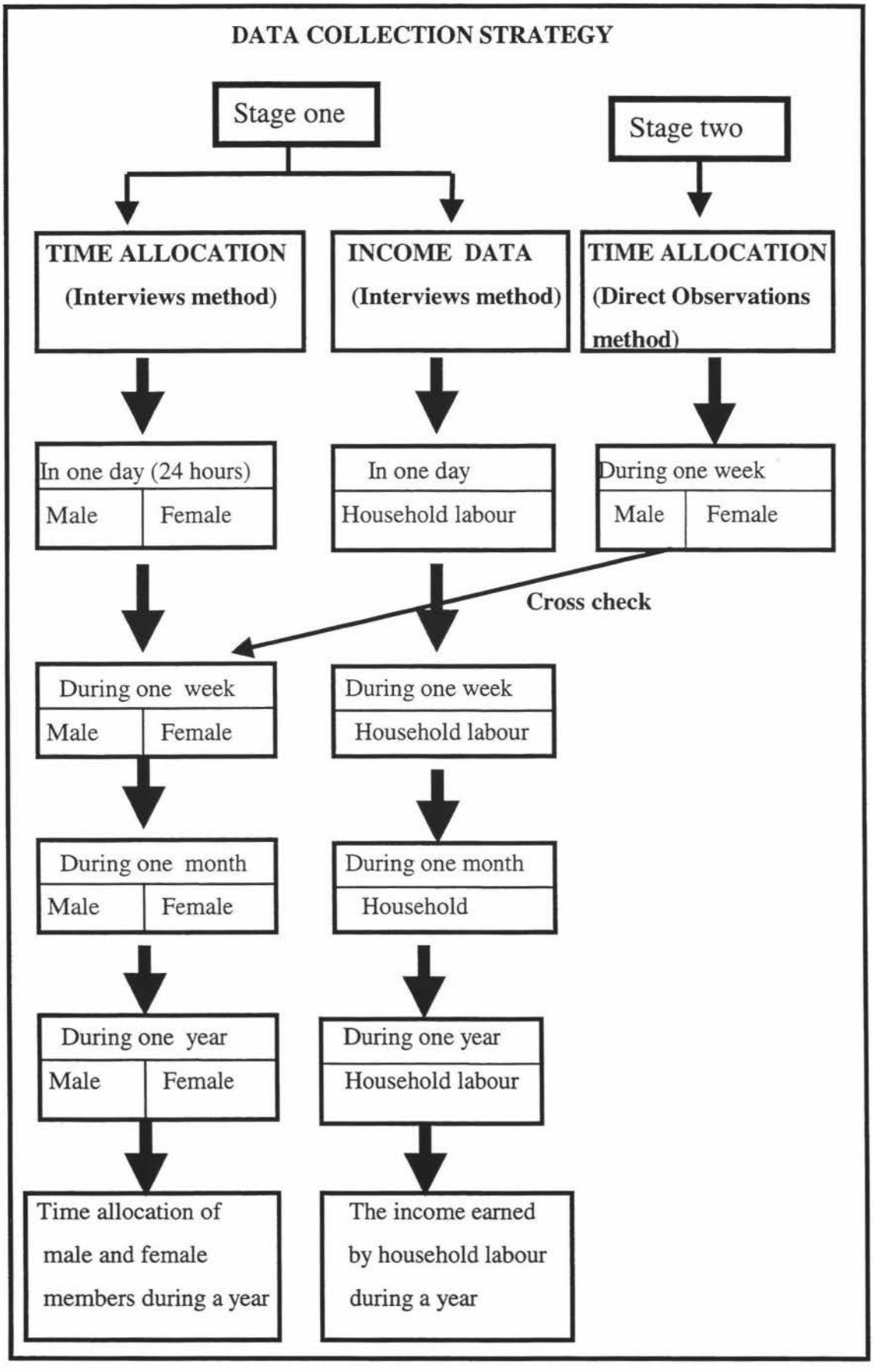
Tripp (1982) attempted to develop direct observation by creating the random visit method of recording time allocation. The strength of the method is that it requires less time and fewer personnel. The researcher could directly observe all of the activities, and provide data for all household members. On the other hand, the disadvantage of the method is that the investigators must be present throughout the study period. Also, the method provides only general categories of activities and the data are collected on direct observation only so some information may be missed out. For example, in the casual occupation, or the job which lasts for a short period of time, and the adults who work outside the home are difficult to investigate.

The self-recording approach, however, has a limitation - and is not appropriate - especially when respondents have a low degree of literacy.

However, in this study, a method using a combination of interviews and direct observations was used. This was conducted intensively over a one month period because of the time and research budget limitations. Interviews were conducted separately with the husband, wife, and family members aged 15-64 years of 50 households, while direct observation was implemented on two representative respondents of each stratum.

To obtain reliable labour allocation data, the time use of each activity was scheduled, respondents being questioned on the specific activities they performed. The activities of household labour, with interviews scheduled through a four-way strategy: by time activities of day, by day of week, by a day of month and a day of year to guide respondents' recalling their activities for hours over the past 12 months (Figure 3.5 and Tables 3.1-3.4). The activities of the day were purported to record the daily work activities, household and social activities, and leisure time.

Figure 3.5 Data collection strategy.



3.4.1 Data Collected from Earlier Research

The data used in this study of "Household Labour Allocation in Small Scale Dairy Farming" had been collected during 1991-1992 from Andonosari village, Pasuruan, East Java, Indonesia (Utami, 1992). The primary data covered quantitative and qualitative data. The quantitative data covered household labour activities, household incomes, and factors influencing dairy farming activities, while the qualitative data presented the farmers' perception of dairying. The secondary data showed the socio-economic condition of the village, the number of dairy farmers, the number and production of dairy cattle.

Table 3.1 Household labour allocation.

Subject/ Variables	Purpose	Approach
I. Household time allocation	Viewing the time allocation between household's members (aged 15-64)	Interviews Direct Observations
1. In dairy farming	Describing the time allocated to dairy activities by males and females, including feeding, cleaning barn, washing utensils, watering, milking, collecting milk, and other activities (e.g. preparing traditional medicine for their cattle)	Interviews Direct observations
2. Outside Dairy farming	Describing the time allocated to activities excluding dairy farming by males and females	Interviews Direct observations
a. On farm	Describing time spent in farming activities as self employed	Interviews Direct observations
b. Off- farm	Describing time spent in farming activities as hired labour	Interviews Direct observations
c. Non- farm	Describing time spent in non-farming activities whether self employed or hired labour, including trading, service sectors, public service	Interviews Direct observations
II. Household Tasks	Showing the activities done by family members in household's work, including preparing meals, washing, gathering fuel, cleaning house	Interviews Direct observations
III. Social Activities	Representing the household's time spent in social activities, such as ceremonial, communal activities, religious activities	Interviews
IV. Leisure time	Showing the time of family members spent in individual activities, such as sleeping, eating, taking a rest	Interviews

Table 3.2 Household income.

Subject/ Variables	Purpose	Approach
I. Wage income	Showing the income gained by household's members in work activities	Interviews
1. From dairy farming	Describing the income from dairying activities, including selling milk, calves, culled cow, and manure and estimating live-weight gains after reduction in dairying expenses	Interviews
2. Outside Dairy farming	Describes the income gathered from outside dairy farming by males and females	Interviews
a. On farm	Describing income from selling farm products after reduced by farm expenses	Interviews
b. Off- farm	Describes income from farming activities as hired labour after reduced by expenses	Interviews
c. Non- farm	Describes income from non-farming activities whether self employed or hired labour after reduced by the expenses	Interviews
II.Non-labour income	Shows the income obtained from household's assets such as, rent, interest, or from remittances	Interviews

Table 3.3 Factors influencing household labour allocation in dairying.

Subject/ Variables	Purpose	Approach
1. The number of lactating cows	Viewing the number of lactating cows owned by dairy farmers	Interviews
2. The productivity of dairy farming	Calculating the wages for dairy farming activities by dividing the earning of dairy farming by time allocated of family members in dairying	Interviews
3. Non-labour income	Describing the income from non work activities	Interviews
4. Household income	Describing the income from outside dairy farming, including income from on-, off- and non-farm activities	Interviews
5. The number of family members	Describing the family members of dairy farmer	Interviews
6. Dependency ratio	Describing the burden of household's labour by dividing the family members who have not worked by the number of household members employed	Interviews
7. The number of dairy cattle	Showing the total number of dairy cattle owned by dairy farmer	Interviews
8.The size of land	Representing the asset of dairy farmer's household	Interviews

Table 3.4 The perceptions of dairy farmers.

Subject/ Variables	Purpose	Approach
1. Increase income	Showing the opportunity cost of household's member in dairy farming	Interviews
2. Generating work	Describing the work opportunities of dairy farming	Interviews
3. Farming supplier and substitution	Describing the role of dairy farming in substitution and supply of farming's inputs	Interviews
4. Other opinion	Describing the general opinion of farmers on dairy farming	Interviews

3.5 Analytical Methods

Data entry was accomplished using Excel Software and analysis was performed using SAS package (DiIorio and Hardy, 1996). Descriptive, univariate, bivariate and multivariate analyses were performed. Descriptive analysis was used to exhibit the social economic condition of the village and dairy farmers' households as well as the perceptions of farmers on dairying. Univariate analysis such as frequency tabulation was used to represent the time allocation and income of household labour of dairy farmers based on gender. Bivariate analysis (correlation analysis) was applied to understand the association between relevant pairs of variables. Multiple regression analysis was used to identify the determinants of households in allocating their labour in dairy farming activities.

CHAPTER 4 RESULTS AND DISCUSSION

This chapter is divided into five sections. Section 1 shows the characteristics of respondents. The second section deals with results and discussion of the contribution of household labour allocation by strata and farm size (per animal unit basis) to economic activities of dairy farming and non-dairy farming (both on- and non-farm). The third section describes the source of household income by strata and gender based on per farm and animal unit basis. The fourth section represents the interrelationships amongst factors associated with household labour allocation in dairy farming work, and provides sensitivity analysis predicting labour requirements in dairying due to the change of predictor variables. Finally, the fourth section presents the factors influencing gross income from dairy farming activities as well as predictions of how income might change by varying the level of key determinants.

4.1 Characteristics of Respondents

The level of success of dairy farmers in operating dairy farms depends on many factors, which can be traced through age, education and experience in rearing animal husbandry.

Farmers' Age

Most dairy farmers (36%) were aged 41-50 years old, while only 4% of farmers were aged 60-70 years. About 26% and 23% of farmers were aged 31-40 years and 51-60 years respectively. A few of the farmers (11%) were aged 27-30 years. This indicated that the majority of farmer were aged between 27-60 years.

Farmers' Education

The level of education can determine the farmers' capability in dealing with problems, adoption of new technology, and how they manage their dairy farms. The level of farmer education in Andonosari village was mostly that they had completed primary

school (77%), whereas only 13% had not completed. 11% of the farmers were illiterate.

Farmers' Experience

Experience in dairying is a valuable asset in improving dairy farming. Farmers with more experience can more easily overcome problems facing them in dairy farming. The majority of dairy farmers (66%) in Andonosari village have more than 10 years experience in operating dairy farms. About 28% and 6% of farmers have had experience in operating dairy cattle for 6-10 years, and fewer then 5 years respectively.

4.2 Household Labour Allocation to Economic Activities per Farm Size

Household labour time allocation (51% of total time available) to dairy farming was slightly more than to non-dairy farming activities (49%)(Table 4.2). Tables 4.1 indicate that households with larger numbers of animal units (AUs) had substantially more time allocated to both dairy and non-dairy activities. However, the difference in time allocation was not significant between stratum 2 (3- $\leq$ 5 AU) and stratum 3 (> 5 AU). One interesting fact which emerges from household labour in stratum 2 is that the higher labour requirement is concentrated in non-dairy, rather than in dairy activities. Households in stratum 2 showed a different trend from that of strata 1 and 3 in which the amount of family labour time spent in animal husbandry activities appeared lowest in comparison with both farm and non-farm activities (49 % and 51% respectively). This is because some of the dairy farmers in stratum 2 use hired labour for dairy farming activities, such as collection of forage, milking cows and marketing milk. On the other hand, non-dairy tasks are performed only by family labour.

However, focusing on gender, women's labour contribution in income generating activities (dairy farming as well as non-dairy farming) accounted for 28% of the total hours allocated by the households. Women in strata 2 and 3 spent relatively fewer hours in both dairy and non-dairy activities compared to women in stratum 1 (1- <3 AU). Income from work outside dairying was earned significantly more ($P<0.001$)

often by men than women while most of women's time was devoted to animal husbandry as opposed to on- and non-farm works. Unlike men in stratum 1, most of the time of males of stratum 3 is devoted to non-dairy works rather than to dairying activities. Male labour is concentrated in non-dairy works, while female labour was represented more in dairy farm activities.

The findings show that both strata and gender are associated with household labour time in income generating activities. Generally, the contribution of household labour to dairy farming activities was higher than to non-farm work. This is because dairy farm activities, such as feed preparation and feeding, forage collection, milking, and marketing milk should be done continually and routinely on a daily basis in order to maintains continuity of milk production. This results in more time being consumed in dairying tasks, in contrast to situation where household labour requirement in farm activities is only occasional, for instance in planting, weeding and harvesting. Likewise, non-farm works, such as hired labour, service, trade happen only at certain times of the year. Unlike dairy farming activities, farm and non-farm works needed fewer household labour hours throughout the year.

The participation of women in economic activities should be taken into account since more female hours were contributed in those activities. For example, dairy farming tasks which were assigned to family labour usually involved women. Also, women may be more suitable for certain dairy farm activities (e.g. feed preparation and feeding, cleaning milking and feeding equipment, cleaning barn) (Tables 4.4 and 4.5) because these activities were carried out close to the house where women were engaged routinely in household chores. Moreover, those activities can be carried out with no skill requirement and, as such, provide work opportunities for women.

Table 4.1 Household labour allocation to economic activities by stratum (farm size) and gender for small dairy farms at Andonosari village, Pasuruan, East Java, Indonesia (hours/year).

Economic Activities	Household labour time allocation (hours/year)											
	Stratum 1 1- < 3 AU[2] n=16			Stratum 2 3- ≤5 AU n=18			Stratum 3 > 5AU n=16			Overall n=50		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Household
1. In Dairy Farming	1787	1051**[4]	2838	3472	906***	4378***[5]	3067	1403***	4470	2803	1112***	3914
	(757)[1]	(526)	(922)	(1020)	(486)	(1288)	(1691)	(470)	(1846)	(1392)	(528)	(1561)
2. Outside Dairy Farming[3]	1302	743*[6]	2045	3375	1184***	4560***	3330	1062***	4393	2697	1004***	3701
	(845)	(528)	(1082)	(1654)	(787)	(1769)	(2161)	(823)	(2812)	(1880)	(737)	(2278)
Total	3088	1794***	4883	6847	2090***	8937***	6397	2465***	8863	5500	2116***	7616
	(1083)	(647)	(1447)	(2090)	(850)	(2192)	(3135)	(904)	(3806)	(2760)	(838)	(3214)

Note:

[1] Figures in the parentheses are standard deviation.

[2] Animal Unit (AU) is defined using Brown's (1979) criteria: cows aged more than 2 years = one AU; cows aged 1-2 years = 2/3 AU; cows aged less than 1 years = 1/3 AU.

[3] Outside dairy farming includes both on-farm and non-farm activities.

[4] *, **, *** indicate the statistical difference in means between male and female.

[5] Indicates the difference between stratum 1 and stratum 2.

[6] *, **, *** indicate $P< 0.05$, $P< 0.01$, and $P<0.001$, respectively.

Table 4.2. Household labour allocation to economic activities by stratum (farm size) and gender for small dairy farms at Andonosari village, Pasuruan, East Java, Indonesia (percentage).

Economic Activities	Household labour time allocation (%)											
	Stratum 1 1-< 3 AU[2] n=16			Stratum 2 3- ≤5 AU n=18			Stratum 3 > 5 AU n=16			Overall n=50		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
1. In Dairy Farming	58	59	58	51	43	49	48	45	50	51	53	51
	(63)	(37)	(100)[7]	(79)	(21)	(100)	(69)	(31)	(100)	(72)	(28)	(100)
2. Outside Dairy Farming[3]	42	41	42	49	57	51	52	34	50	49	47	49
	(64)	(36)	(100)	74	(26)	(100)	(76)	(24)	(100)	(73)	(27)	(100)
Total	100	100	100	100	100	100	100	100	100	100	100	100
	(63)	(37)	(100)	(77)	(23)	(100)	(72)	(35)	(100)	(72)	(28)	(100)

Note:
[2),3)] See Table 4.1.
[7)] The figures in parentheses indicate the percentage distribution between male and female.

4.2.1 Household Labour Allocation to Economic Activities per Animal Unit

The trend of household labour allocation to economic activities on a per animal unit (AU) basis remains the same as when allocated on a per farm basis (Table 4.3). Approximately 52% of total hours of household labour were spent in dairy farming activities, whereas 48% of their hours were devoted to non-dairy activities, including both farm and non-farm activities (Table 4.3).

Increasing farm size (using AUs) was associated with fewer hours per animal unit of family labour being required. Hours per animal unit in income generating activities of stratum 3 were fewer than those of stratum 2. It seems, therefore, that the greater the number of dairy cattle owned by farmers the fewer were the hours of household labour utilised in both farm and non-farm works.

In stratum 1, the labour requirement per animal unit was greater compared to those of strata 2 and 3. However, the opposite appeared in stratum 2, in which the hours needed in dairy farming per animal unit were higher than in stratum 3 (Table 4.3). This may have reflected the location of stratum 2 dairy farms. Location can determine the number of hours spent in operating dairy farming. For example, more time is required if the site of forage collection is located far from the house, or the water sources for cows is not available near the house, or the place to market milk is not close to the farmer's house. This leads to more hours being allocated to dairy farming tasks.

Female labour spent 29% ($P<0.001$), whereas men accounted for about 71% of the total work paid hours. Women allocated less time (42-56%) than men (50-59%) on dairy farming, except for households in stratum 3 where females performed more work on dairy farms than in non-dairy activities. In contrast, female labour devoted more time to tasks outside dairy farming (44-57%) in comparison with male labour (41-50%). Whereas, in stratum 3, females are less involved in these activities than are men (43% vs. 50%).

Table 4.3 Household labour allocation to economic activities by stratum (farm size) and gender for small dairy farms at Andonosari village, Pasuruan, East Java, Indonesia per animal unit (hours/year).

Economic Activities	Household labour time allocation (hours/year/animal unit)											
	Stratum 1 1- < 3AU[2)] n = 16			Stratum 2 3- ≤ 5 AU n = 18			Stratum 3 > 5 AU n = 16			Overall n = 50		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Household
1. In Dairy Farming	893	485***[4)]	1379	913	233***	1146	463	205**	669***[8)]	763	305***	1068
	(417)[1)]	(257)	(471)	(244)	(106)	(277)	(283)	(84)	(330)	(376)	(205)	(462)
2. Outside Dairy Farming[3)]	609	386	994	918	316***	1234	492	153**	645**	683	286***	969
	(328)	(354)	(530)	(477)	(226)	(528)	(333)	(118)	(424)	(424)	(264)	(546)
Total	1502	871***	2373	1831	550***	2381	955	359***	1314	1446	591***	2037
	(539)	(380)	(783)	(573)	(213)	(612)	(520)	(150)	(641)	(648)	(332)	(834)

Note:

[1), 2), 3), 4)] See Table 4.1.

[8)] Indicates statistically significant difference between stratum 2 and stratum 3.

4.2.2 Household Labour Allocation to Dairy Farming Tasks

Household labour requirements in dairy farming were classified into nine tasks. These were collecting water for cows, forage collection, feed preparation and feeding, cleaning the barn, cleaning milking and feeding equipment, washing dairy cows, milking cows, marketing milk to "KUD Setia Kawan" (milk co-operatives), and other activities (including calf rearing, taking care of unhealthy cows or calving cows). The totals of family labour hours required for each of these activities are presented on a per farm basis (Table 4.4) and on an animal units basis (Table 4.5).

Feed preparation, and feeding and forage collection activities were assigned the highest percentage (55%) of household labour for both men and women (Table 4.6). Household labour in all strata allocated approximately 54% to feed preparation, feeding, and forage collection activities.

Females allocated consistently higher numbers of hours to giving feed to animals, and washing feeding and milking equipment activities, while male labour dominated in giving feed to animals and grazing activities. Irrespective of strata, men were an important source of labour in the forage collection activity (29-42%), while women (34-55%) dominated feed preparation and feeding to animals. Generally, males spent more time in animal husbandry activities, while the reverse was true for female labour. Men's hours were more strongly tied to the type of work which was more time consuming, such as forage collection. On average, up to three hours per day were required to collect forage for the cows. This time could be longer during the dry season when feed supply was limited and the dairy farmers needed to travel greater distances to the forestry areas to find sufficient fodder. In contrast, some of the women's tasks such as feed preparation and feeding, cleaning the barn and cleaning milking and feeding equipment activities required fewer hours per day, or were relatively small in their demand for time.

Table 4.4 Annual time allocation of household labour to dairy farming tasks by stratum and gender at Andonosari village, Pasuruan, East Java, Indonesia (hours/year).

Dairy Farming activities	Annual household labour allocation (hours/year)											
	Stratum 1 1-<3 AU n = 16			Stratum 2 3- ≤ 5 AU n = 18			Stratum 3 >5 AU n = 16			Overall n = 50		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
1. Feed preparation and feeding	320 (108)	357 (163)	677 (181)	680 (279)	370*** (191)	1050*** (348)	657 (366)	771 (335)	1427* (589)	557 (314)	494 (303)	1051 (500)
2. Cleaning barn	71 (45)	107 (57)	179 (78)	124 (54)	140 (76)	264** (99)	111 (105)	149 (65)	260 (84)	103 (74)	132* (68)	235 (95)
3. Cleaning milking and Feeding equipment	52 (39)	169*** (60)	221 (63)	101 (55)	132 (64)	233 (62)	55 (62)	189*** (32)	244 (73)	71 (57)	162*** (58)	233 (65)
4. Washing dairy cows	62 (39)	15*** (29)	77 (53)	171 (132)	6 (18)	177*** (134)	130 (1132)	7** (19)	137 (130)	123 (118)	9*** (22)	132 (118)
5. Collecting water for cows	217 (191)	53*** (67)	270 (201)	335 (351)	47** (91)	383 (369)	184 (231)	17* (50)	202 (241)	249 (274)	39*** (73)	289 (288)
6. Forage collection	754 (444)	106*** (246)	861 (573)	1165 (522)	138*** (203)	1302* (601)	901 (764)	163*** (221)	1064 (905)	949 (603)	136*** (220)	1085 (714)
7. Milking cows	144 (143)	29** (68)	174 (159)	355 (187)	33*** (94)	388** (238)	612 (312)	27*** (92)	639* (310)	370 (290)	30*** (84)	400 (304)
8. Marketing milk[a)]	162 (197)	189 (230)	351 (252)	533 (376)	10*** (43)	543 (373)	411 (454)	54** (107)	465 (458)	375 (385)	81*** (162)	456 (372)
9. Other activities[b)]	3 (1)	26*** (8)	29 (9)	8 (10)	30*** (7)	38* (14)	6 (17)	26*** (10)	32 (14)	6 (11)	27* (9)	33 (13)
Total	1787 (757)	1051** (526)	2838 (922)	3472 (1020)	906*** (486)	4378*** (1288)	3067 (1691)	1403** (470)	4470 (1846)	2803 (1392)	1112*** (528)	3914 (1561)

Note:

[a)] Marketing milk through collecting milk and transporting it to milk co-operatives.

[b)] Including rearing calves and taking care of unhealthy cows or calving cows.

Table 4.5 Annual time allocation of household labour to dairy farming tasks by stratum and gender at Andonosari village, Pasuruan, East Java, Indonesia per animal unit (hours/year).

Dairy farming activities	Annual household labour allocation (hours/year/animal unit)											
	Stratum 1 1- < 3 AU n = 16			Stratum 2 3- ≤ 5 AU n = 18			Stratum 3 >5 AU n = 16			Overall n = 50		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
1. Feed preparation and Feeding	162 (76) [1]	164 (85)	326 (108)	178 (71)	96*** (44)	274 (79)	96 (62)	110 (52)	206* (97)	147 (77)	122 (68)	269 (105)
2. Cleaning barn	34 (20)	50 (32)	84 (35)	33 (15)	37 (17)	70 (23)	17 (16)	20 (9)	37*** (13)	28 (19)	36 (24)	64 (31)
3. Cleaning milking and Feeding equipment	26 (21)	82***[2] (34)	108 (40)	27 (14)	34 (14)	61 (9)	8 (10)	28*** (8)	36*** (15)	21 (17)	47*** (32)	68 (38)
4. Washing dairy cows	30 (16)	7 (14)	37 (23)	45 (34)	1*** (4)	46 (34)	20 (21)	1*** (3)	21* (21)	32 (27)	3*** (9)	35 (29)
5. Collecting water for cows	110*** (93)	25 (36)	136 (99)	85 (86)	12** (23)	97 (90)	30 (39)	3* (9)	33* (41)	76 (82)	13*** (26)	89 (90)
6. Forage collection	374*** (202)	43 (99)	417 (234)	308 (133)	35*** (53)	343 (153)	140 (122)	26*** (34)	166** (145)	275 (181)	35*** (66)	310 (205)
7. Milking cows	76 (75)	18* (45)	93**[3] (100)	90 (40)	7*** (20)	97 (48)	90 (48)	4*** (14)	94 (48)	85 (55)	10*** (29)	95 (68)
8. Marketing milk	80 (98)	83 (101)	163 (107)	145 (106)	2*** (9)	148 (105)	61 (71)	9* (18)	70 (73)	97 (99)	30*** (68)	128 (103)
9. Other activities	2 (1)	13*** (5)	14 (5)	2 (3)	8*** (2)	10 (4)	1 (3)	4*** (2)	5**** (2)	2 (2)	8*** (5)	10 (6)
Total	893 (417)	485*** (257)	1379 (471)	913 (244)	233*** (106)	1146 (277)	463 (283)	205*** (84)	669*** (330)	763*** (376)	305*** (205)	1068 (462)

Note:

[1] Figures in the parentheses are standard deviation.

[2] *,**,*** Indicate the statistical difference in means between male and female.

[3] *, **, *** Indicate the statistical difference in means between strata 1 and 2.

Table 4.6 Annual household labour allocation by stratum and gender to small dairy farm activities at Andonosari village, Pasuruan, East Java, Indonesia (percentage).

Dairy Farming activities	Annual household labour allocation (%)											
	Stratum 1 1- < 3 AU n= 16			Stratum 2 3- ≤5 AU n=18			Stratum 3 >5 AU n=16			Overall n=50		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
1. Feed preparation and feeding	18	34	24	20	41	24	21	55	32	20	44	27
2. Cleaning barn	4	10	6	4	15	6	4	11	6	4	12	6
3. cleaning milking and feeding equipment	3	16	8	3	15	5	2	13	5	3	15	6
4. Washing dairy cows	3	1	3	5	1	4	4	1	3	4	1	3
5. Collecting water for cows	12	5	10	10	5	9	6	1	5	9	4	7
6. Forage collection	42	10	30	34	15	30	29	12	24	34	12	28
7. Milking cows	8	3	6	10	4	9	20	2	14	13	3	10
8. Marketing milk	9	18	12	15	1	12	13	4	10	13	7	12
9. Other activities	0.2	2	1	0	3	1	0	2	1	0	2	1
Total	100	100	100	100	100	100	100	100	100	100	100	100

4.3 The Source of Household Income

The sources of income of small dairy farmers were categorised into dairy farming and non-dairy sources, including on- and non-farm activities. Two-thirds of household income was contributed by non-dairy farming activities but 62% of household income originated from on-farm activities (Table 4.7 and Table 4.8).

Income from non-dairy farming sources was higher than that from of dairy farming irrespective of stratum, with the majority of this income arising from apple growing. Interestingly, farmers continued with dairying although the return was less than that from apple farming. The main reasons for this were: (a) the environment (i.e. climate) was suitable for raising dairy cattle, and the availability of fodder; (b) the farmers received consistent cash when marketing milk, usually once every ten days, and this supplied or improved the farmers' day-to-day cash situation; (c) dairy farming activities supported, or were substituted for farming activities, by providing farming input or even manure to fertilise land; and (d) the existence of "KUD Setia Kawan" (milk co-operatives) offered additional facilities to farmers, such as farm inputs (e.g. concentrate, cattle, seed, fertiliser, pesticide), household needs (food, clothes), capital to improve farming activities, extension services, and - most importantly in the marketing of milk. In addition, the forestry office provided land where dairy farmers were allowed to plant grass for feed. In these cases, farmers did not pay rent for the land, but provided labour for tapping pine trees and, in return, received nominal compensation for this job. Finally, apple farming was difficult to establish because of the limitations of land size and a higher investment requirement.

As the number of cows increased, from stratum 1 (18%) to stratum 2 (41%) income from dairy farming increased, but as herds got larger (stratum 3) income from dairy farming started to decline (29%). A contrasting trend appeared in non-dairy farming: about 76% of those in stratum 1 showed a decrease in income, and approximately 59% in stratum 2. Stratum 3 indicated an inconsistent trend compared with the other strata, in which income from outside dairy farming increased to 68%.

In households of stratum 1, income from non-dairy farming contributed four times the income received from dairy farming activities. Similarly, income from dairy farming activities in households in stratum 3 was about one-third of the income from farm and non-farm activities. In households of stratum 2, meanwhile, there was no different between income from dairy farming and non-dairy income.

The total farm income of stratum 2 appeared lower than those of stratum 1. This is probably because the number of dairy cattle owned by farmers does not directly influence dairy farming incomes. Earnings outside dairying - for example from apples - depends on the size of the landholding and, importantly, the maturity of apple trees - in that apple trees more than 5 years old have higher productivity than in previous years.

The non-farm incomes tend to increase with strata, the highest income coming from stratum 3. Household in stratum 3 were able to engage in and choose non-farm activities, which needed more capital and promised higher returns. For instance, some of the farmers in stratum 3 sold farm inputs which were needed by farmers in strata 1 and 2.

Total household income came not only from household labour activities, but also from non-labour work. Non-wage income for stratum 2 was lowest compared to strata 1 and 3. Non-wage income comprised income from remittances, rent and interest. The lack of a family member working outside rural areas, lower size of landholding, and limited capital available as savings contributed to lower non-wage income in stratum 2.

Table 4.7 Sources of annual household income by stratum of small scale dairy farming at Andonosari village, Pasuruan, East Java, Indonesia ('000 Rp/year).

Source of income	Household income ('000 Rp /year)			
	Stratum 1 (1- <3 AU) n = 16	Stratum 2 (3- ≤5 AU) n = 18	Stratum 3 (> 5 AU) n = 16	Overall n = 50
I. Work activities				
1. Dairy farming	1,230	2,444** [2)]	3,761* [3)]	2,477
	(631) [1)]	(1,548)	(2,026)	(1,805)
2. Outside dairy farming				
a. On–farm	4,901	3,312	7,979	5,314
	(10,889)	(2,943)	(12,675)	(9,609)
b. Non-farm	178	211	888	417
	(318)	(566)	(2,050)	(1,239)
Sub-total outside dairy	5,080	3,523	8,867	5,731
	(10,881)	(2,887)	(13,129)	(9,851)
Total work income	6,309	5,967	12,628	8,208
	(10,954)	(3,994)	(13,488)	(10,361)
II.Non-work activities	386	37	506*	299
	(878)	(114)	(864)	(715)
Total household income	6,696	6,004	13,134	8,507
	(11,729)	(4,007)	(14,062)	(10,890)

Note:
[1)] Figures in the parentheses are standard deviation.
[2)] *, **, *** indicate the statistical difference in means between stratum.
[3)] *, ** indicate P<0.05, and P<0.01, respectively.

Table 4.8 **Sources of annual household income by stratum of small scale dairy farming at Andonosari village, Pasuruan, East Java, Indonesia (%).**

Source of income	Household income (%)			
	Stratum 1 (1- <3 AU) n=16	Stratum 2 (3- ≤5 AU) n=18	Stratum 3 (> 5 AU) n=16	Overall n=50
I. Work activities				
1. Dairy farming	18	41	29	29
	(19)[1)]	(41)	(30)	(30)
2. Outside dairy farming				
a. On–farm	73	55	61	62
	(78)	(56)	(63)	(65)
b. Non-farm	3	4	7	5
	(3)	(4)	(7)	(5)
Sub-total outside dairy	76	59	68	67
	(81)	(59)	(70)	(70)
Total work income	94	99	96	96
	(100)	(100)	(100)	(100)
II.Non-work activities	6	1	4	4
Total household income	100	100	100	100

Note:
[1)] The figures in parentheses indicate the percentage of the total work income.

4.3.1 The Source of Household Income per Animal Unit

The return to household labour per animal unit decreased as the number of animal units increased (Tables 4.9 and 4.10). In households of stratum 1, returns for household labour were almost twice as high as for those in stratum 2, while, in stratum 3, they were slightly higher than in stratum 2. This trend was noticeable also for non-dairy farming income. Whereas, in terms of dairy farming activities, the more dairy cattle households had, the more income they received. The returns from dairy farming per animal unit in stratum 2 were relatively higher than in stratum 1 (39% and 20% of total household income, respectively). On the other hand, the income per animal unit of dairy farming was lower for stratum 3 than for stratum 2 (28% vs. 39%).

Table 4.9 Sources of annual household income by stratum per animal unit of small dairy farming at Andonosari village, Pasuruan, East Java ('000 Rp/year).

Source of income	Total household income ('000 Rp./Animal Unit/year)			
	Stratum 1 (1- <3 AU) n=16	Stratum 2 (3- ≤ 5 AU) n=18	Stratum 3 (> 5 AU) n=16	Overall n=50
I. Work activities				
1. In Dairy farming	567	626	517	572
	(224)[1)]	(353)	(209)	(272)
2. Outside dairy farming				
a. On–farm	2,059	912	1,105	1,341
	(4,045)	(839)	(1,911)	(2,574)
b. Non-farm	97	52	143	95
	(162)	(124)	(357)	(232)
Sub-total outside dairy	2,157	964	1,248	1,436
	(4,040)	(822)	(1,992)	(2,590)
Total work income	2,723	1,590	1,766	2,009
	(4,031)	(1,061)	(2,018)	(2,620)
II.Non-work activities	152 (329)	9 (29)	78 (135)	77 (206)
Total household income	2,875	1,599	1,844	2,086
	(4,317)	(1,065)	(2,109)	(2,787)

Note:
[1)] The figures in parentheses are standard deviation.

Table 4.10 Sources of annual household income by stratum per animal unit of small dairy farming at Andonosari village, Pasuruan, East Java (%).

Source of income	Total household income (%)			
	Stratum 1 (1- <3AU) n=16	Stratum 2 (3- ≤5 AU) n=18	Stratum 3 (> 5 AU) n=16	Overall n=50
I. Work activities				
1. In Dairy farming	20	39	28	27
	(21)[1)]	(39)	(29)	(28)
2. Outside dairy farming				
a. On–farm	72	57	60	64
	(76)	(57)	(63)	(67)
b. Non-farm	3	3	8	5
	(4)	(3)	(8)	(5)
Sub-total outside dairy	75	60	68	69
	(79)	(61)	(71)	(71)
Total work income	95	99	96	96
	(100)	(100)	(100)	(100)
II.Non-work activities	5	1	4	4
Total household income	100	100	100	100

Note:
[1)] The figures in parentheses indicate the percentage of the total work income.

4.3.2 Household Income Generated from Dairy Farming

Income from dairy farming was classified into two groups: milk income sold, and income from non-milk related activities. The latter involved calves (6 months and under) either sold or not sold during the year, culled calves (6-12 months), culled mature dairy cows (1-2 years) and imputed change in the value of livestock.

Income from dairy farming arises primarily from milk (68%) (Table 4.11 and 4.12). However, the herd size (reflected in AUs) was positively associated with income from dairy farming. However, the milk return of stratum 1 was marginally higher (69%) than that from stratum 2 (64%). Likewise, income from non-milk sources was less in stratum 3 (32%) compared to stratum 2 (36%). Meanwhile, non-milk return in stratum 2 indicated a slightly higher level (36%) than that in stratum 1 (31%).

The differences in contribution of milk to farm income can be traced to different levels of inputs and outputs. The use of hired labour was one example of the difference, whereas all activities are carried out by family labour in stratum 1, in stratum 2 hired labour may be used. On the output side, the ratio of lactating to non-lactating cows was higher in stratum 1 than in stratum 2.

One of the interesting findings was that the income from non-milk sources in stratum 2 households was higher compared to other strata. This was associated with the sale of more calves aged 6-12 months. This income from selling livestock was used to purchase farming inputs, although some farmers allocated non-milk income to pay for the education of their children in tertiary institutions. Few farmers spent the income to buy furniture and television sets.

Table 4.11 Sources of annual household income from dairy farming by stratum at Andonosari village, Pasuruan, East Java, Indonesia ('000Rp/year).

Variables	Household income from dairy farming ('000Rp/year)			
	Stratum 1 1- <3 AU n = 16	Stratum 2 3- ≤5 AU n = 18	Stratum 3 >5AU n = 16	Overall n = 50
A. Income from milk	1,420 (574)[1)]	2,417***[2)] (1,050)	4,613**[3)] (2,676)	2,801 (2,103)
B. Income from non-milk				
a. Calves (6 months and under)	269 (174)	301 (279)	353 (297)	307 (254)
b. Culled calves (6-12 months)	88 (181)	464** (474)	504 (661)	356 (506)
c. Culled mature dairy cows (1-2 years)	0 0	36 (153)	25 (100)	21 (107)
d. Culled cows (more than 2 years)	0 0	36 (105)	48 (194)	29 (125)
e. Value added[a)]	241 (128)	431*** (114)	663 * (336)	444 (271)
f. Manure	55 (181)	90 *** (22)	145*** (41)	96 (46)
Income from non-milk	652 (336)	1,357*** (592)	1,737 (785)	1,253 (737)
Total income from dairy	2,071 (793)	3,774*** (1,492)	6,350 ** (3,230)	4,201 (2,846)
Expenses				
Total variable costs	624 (191)	1,092*** (367)	2,123** (1,330)	1,272 (992)
Total fixed costs	212 (579)	431** (247)	710* (424)	450 (349)
Total costs	835 (255)	1,523** (465)	2,833** (1,624)	1,722 (1,255)
Net income from dairy Farming	1,230 (631)	2,444** (1,548)	3,761* (2,026)	2,477 (1,805)

Note:

[a)] Imputed value of change in livestock

[1)] Figures in the parentheses are standard deviation.

[2)] *, **, *** indicate the statistical difference in means between stratum.

[3)] *, **, *** indicate P<0.05, P<0.01, and P<0.001 respectively.

Table 4.12 Sources of annual income from dairy farming by stratum at Andonosari village, Pasuruan, East Java, Indonesia (%).

Variables	Household income from dairy farming (%)			
	Stratum 1 1- <3 AU n=16	Stratum 2 3- ≤5 AU n=18	Stratum 3 >5 AU n=16	Overall N=50
A. Income from milk	70	64	72	68
B. Income from non-milk				
a. Calves (6 months and under)	13	8	6	9
b. Culled calves (6-12 months)	4	12	8	8
c. Culling mature dairy cows (1-2 years)	0	0.9	0.4	0.5
d. Culled cows (more than 2 years)	0	0.9	1	0.7
e. Value added	12	11	10	11
f. Manure	3	2	2	2 .4
Total income from non-milk sources	31	36	27	32
Total income from dairy farming	100	100	100	100

4.3.3 The Annual Expenditure Incurred in Dairy Farming Activities

Table 4.14 reveals that variable costs were the highest costs (74%) with the greatest single purchase being concentrates (63%). In contrast, fixed costs accounted for only 26% of total costs, and were dominated by 8% the total expenditure in animal depreciation.

Purchases of animal feeds varied between strata (about 67% of stratum 1 and 65% of stratum 2 and 64% of stratum 3). It indicated that the efficiency of animal feeding appears to increase with respect to strata whereby stratum 3 was more efficient than the other strata. It is likely that the price of feed was cheaper because the farmers in stratum 3 purchased large quantities of both forage and concentrate. Since more than 60% of total expenditure is allocated to feed, stratum 3 farms can minimise costs in this area. This means that, for the same expenses, the farmers in stratum 3 can produce more milk and non-milk income.

Likewise, other purchases in stratum 1 were higher than in strata 2 and 3. Stratum 1 farms may purchase more in vitamins, artificial milk for calves and eggs for cows compared to other strata. Strata 2 and 3 farms return the calf to the lactating cow after the cow has been milked instead of using artificial milk, and never give either vitamins or eggs to cows.

Similarly, stratum 2 farms forage purchasing was lower compared to both strata 1 and 3 because, presumably farmers planted more forage. Therefore, they did not need to purchase forage during the dry season. The lower cost of forage in stratum 2 only slightly affected cash expenditure, because it contributed a minimal (2%) amount to the total costs.

On the other hand, herbal medicine expenditure increased significantly with increasing strata. The purchasing of herbal medicine in stratum 3 was highest compared to other strata. This is because stratum 3 owned more cows, which required more purchases of herbal medicine. The composition and price of herbal medicine

used varied considerably among the farmers. Herbal medicine did not significantly influence expenditure, because it accounted for only 3-6% of total expenditure.

As animal units increased, there was a significant increase in fixed costs. The higher expenditure in stratum 2 was associated with external hired labour in operating the dairy farms. Farmers in stratum 2 preferred to hire external labour because these farmers perceived that greater benefits could be acquired from either crop-farming or non-farm work. Thus, the higher fixed costs in stratum 2 were associated with higher permanent hired labour costs.

In contrast, purchased external hired labour in stratum 3 was lower than in stratum 2. The main reason for this may come from the difference in wage rates of hired labour. Wage rates depend on a commitment between the farmer and the permanent labourer. The salary of hired labour was normally paid monthly, however some farmers give a calf to external hired labour which has been employed for a year. Therefore, the accruing of animal units did not ensure an increase in expenditure on permanent labour.

Levy costs were similar in all strata. Although the levy on dairy cows has a certain cost (Rp 500 per head per year) based on each village's rule, some farmers tended to pay as they wished regardless of the number of the dairy cattle which they owned. Therefore, the fact that farmers owned more dairy cattle did not necessarily ensure that the cost of levies would be greater.

In addition, housing depreciation showed inconsistencies with increasing strata. Stratum 3 had a lower housing depreciation compared to other strata. The differences were a result of the type and condition of the housing. Farmers in stratum 3 do not always have permanent housing and may locate cows in housing made from bamboo, or in non-permanent barns. On the other hand, the farmers in strata 1 and 2, sometimes have permanent housing, although they owned fewer than 5 AU dairy cows. Likewise, for equipment depreciation, there were fewer costs in stratum 3 than in strata 1 and 2. The type and condition of equipment determined the different depreciation costs among strata. For example, stratum 3 farmers used cheaper

artificial milk cans, while other farmers used stainless steel milk cans. Since depreciation accounts for more than half (47-59%) of the fixed costs, they then had lower costs in this area.

Table 4.13 The annual expenditure incurred in dairy farming activities by stratum at Andonosari village, Pasuruan, East Java, Indonesia ('000 Rp/year).

Expenses	The expenses of dairy farming ('000Rp/year)			
	Stratum 1 (1- <3 AU) n=16	Stratum 2 (3- ≤5 AU) n=18	Stratum 3 (> 5 AU) n=16	Overall n = 50
Variable costs				
Forage	13	22***[2)]	69	35
	(4) [1)]	(7)	(164)	(94)
Concentrate	546	960*** [3)]	1,766*	1,086
	(178)	(319)	(1,122)	(826)
Total animal feed	560	983***	1,836*	1,120
	(79)	(320)	(1,272)	(904)
Transportation	20	23	71*	37
	(7)	(9)	(67)	(44)
Herbal medicine	22	64**	169	85
	(12)	(60)	(198)	(130)
Artificial insemination	10	19 ***	36***	22
	(4)	(6)	(12)	(13)
Other purchases[a)]	12	2	11*	8
	(26)	(7)	(15)	(18)
Total variable cost	624	1,092 ***	2,123**	1,272
	(191)	(367)	(1,330)	(992)
Fixed costs				
Housing depreciation	30	46***	49	42
	(14)	(11)	(195)	(15)
Animal depreciation	65	114***	232*	136
	(16)	(18)	(198)	(131)
Equipment depreciation	31	43**	69***	48
	(29)	(12)	(19)	(21)
Total depreciation	126	203***	350**	225
	(29)	(28)	(195)	(144)
Land rent	16	24*	45*	28
	(4)	(12)	(36)	(25)
Permanent labour	68	203	312	195
	(111)	(252)	(374)	(280)
Levies	1	2***	3***	2
	(0)	(0)	(1)	(1)
Total fixed costs	212	431**	710 *	450
	(578)	(247)	(424)	349
Total costs	835	1,523***	2,833**	1,722
	(255)	(465)	(1,624)	(1,255)

Note:

[a)] Includes expenses incurred in buying vitamins, artificial milk for calf and eggs for cows.

[1)] The figures in parentheses are standard deviation.

[2)] *, **, *** indicate the statistical difference between stratum.

[3)] *, **, *** indicate P<0.05, P<0.01, and P<0.001, respectively.

Table 4.14 The annual expenditure incurred in dairy farming activities by stratum at Andonosari village, Pasuruan, East Java, Indonesia (%).

Expenses	The expenses of dairy farming (%)			
	Stratum 1 (1- <3 AU) n=16	Stratum 2 (3- ≤5 AU) n=18	Stratum 3 (> 5 AU) n=16	Overall N=50
Variable costs				
Forage	2	1	2	2
	(2)[1)]	(2)	(3)	(3)
Concentrate	65	63	62	63
	(88)	(88)	(88)	(85)
Total animal feed	67	65	64	65
	(90)	(90)	(86)	(88)
Transportation	2	2	2	2
	(3)	(2)	(3)	(3)
Herbal medicine	3	4	6	5
	(4)	(6)	(8)	(7)
Artificial insemination	1	1	1	1
	(2)	(2)	(2)	(2)
Other purchases	1	0.2	0.4	0.5
	(2)	(0.2)	(1)	(1)
Total variable costs	75	72	75	74
	(100)	(100)	(100)	(100)
Fixed costs				
Housing depreciation	4	3	2	2
	(14) [2)]	(11)	(7)	(9)
Animal depreciation	8	7	8	8
	(31)	(26)	(33)	(30)
Equipment depreciation	4	3	2	3
	(15)	(10)	(10)	(11)
Total depreciation	15	13	12	13
	(59)	(47)	(49)	(50)
Land rent	2	2	2	2
	(8)	(5)	(6)	(6)
Permanent labour	8	13	11	11
	(32)	(47)	(44)	(43)
Levies	0.1	0.1	0.1	0.1
	(0.4)	(0.4)	(0.4)	(0.4)
Total fixed costs	25	28	25	26
	(100)	(100)	(100)	(100)
Total costs	100	100	100	100

Note:

[1)] The figures in parentheses before total variable costs indicates the percentage out of total variable costs.

[2)] The figures in parentheses after total variable costs indicates the percentage out of total fixed costs.

4.3.4 The Annual Expenditure Incurred in Dairy Farming Activities per AU

Total expenditure in dairy farming per animal unit showed a similar trend to that for farm size (stratum) basis (Table 4.15). Variable costs were estimated at about 65% of total costs, with the majority of costs being associated with purchasing concentrates. Animal depreciation was the highest expenditure item (8%) of fixed costs (Table 4.16).

The total variable costs decreased as the number of animal units increased. There were marginally fewer purchases (71%) in stratum 2 than in stratum 1 (75%). Expenditure was higher in stratum 3 compared to stratum 2 and equal with stratum 1. Similarity, total fixed costs were the same proportion (25%) in both strata 1 and 3. On the other hand, as strata increased, fixed costs increased on a per animal unit basis. There were more fixed costs per animal unit in stratum 2 (29%) in comparison with stratum 1 (25%).

Table 4.15 The annual expenses incurred in dairy farming activities by stratum at Andonosari village Pasuruan, East Java, Indonesia per animal unit ('000Rp/year).

Expenses	The expenses of dairy farming ('000 Rp /Animal Unit/year)			
	Stratum 1 1- < 3 AU n = 16	Stratum 2 3- ≤5 AU n = 18	Stratum 3 >5AU n =16	Overall n =50
Variable costs				
Forage	7	6	8	7
	(3) [1)]	(2)	(14)	(8)
Concentrate	259	249	245	251
	(70)	(57)	(110)	(80)
Total animal feed	265	255	253	258
	(71)	(57)	(119)	(84)
Transportation	10	6*[2)]	9	8
	(5)	(2)	(7)	(5)
Herbal medicine	12	16	24	17
	(8)	(12)	(28)	(18)
Artificial insemination	5	5	5	5
	(2)	(1)	(1)	(2)
Other purchases[a)]	5	1	1	2
	(10)	(2)	(2)	(6)
Total variable costs	297	283	292**[3)]	290
	(76)	(62)	(122)	(88)
Fixed costs				
Housing depreciation	14	12	7***	11
	(7)	(4)	(3)	(5)
Animal depreciation	30	30	32	31
	(0)	0	26	15
Equipment depreciation	15	11*	10	12
	(6)	(3)	(2)	(5)
Total depreciation	59	54*	50	54
	(9)	(5)	(26)	(16)
Land rent	8	6	7	7
	(3)	(3)	(7)	(5)
Permanent labour	30	56	41	43
	(45)	(72)	(47)	(57)
Levies	0.04	0.04	0.04*	0.04
	(0)	(0)	(0)	(0)
Total fixed costs	98	116	97	104
	(49)	(71)	(51)	(58)
Total costs	395	399	390	395
	(90)	(99)	(141)	(109)

Note:

a) Includes expenses incurred in buying vitamins, artificial milk for calf and eggs for cows.

1) The figures in parentheses are standard deviation.

2) *, **, *** indicate the statistical difference between stratum.

3) *, **, *** indicate P<0.05, P<0.01, and P<0.001, respectively.

Table 4.16 The annual expenses incurred in dairy farming activities by stratum at Andonosari village Pasuruan, East Java, Indonesia per animal unit (%).

Expenses	The expenses of dairy farming (%)			
	Stratum 1 1- < 3 AU n =16	Stratum 2 3- ≤ 5 AU n =18	Stratum 3 >5AU n =16	Overall n =50
Variable costs				
Forage	2 (2) [1)]	2 (2)	2 (3)	2 (2)
concentrate	65 (87)	62 (88)	63 (84)	63 (86)
Total animal feed	67 (89)	64 (90)	65 (87)	65 (89)
Transportation	2 (3)	2 (2)	2 (3)	2 (3)
Herbal medicine	3 (4)	4 (6)	6 (8)	4 (6)
Artificial insemination	1 (2)	1 (2)	1 (2)	1 (2)
Other purchases	1 (2)	0.1 (0.2)	0.4 (0.5)	1 (1)
Total variable costs	75 (100)	71 (100)	75 (100)	73 (100)
Fixed costs				
Housing depreciation	4 (14) [2)]	3 (11)	2 (8)	3 (11)
Animal depreciation	8 (31)	8 (26)	8 (33)	8 (30)
Equipment depreciation	4 (16)	3 (10)	2 (10)	3 (12)
Total depreciation	15 (61)	13 (46)	13 (51)	14 (52)
Land rent	2 (8)	2 (5)	2 (7)	2 (7)
Permanent labour	8 (31)	14 (48)	10 (42)	11 (41)
Levies	0.1 (0.4)	0.1 (0.4)	0.1 (0.4)	0.1 (0.4)
Total fixed costs	25 (100)	29 (100)	25 (100)	26 (100)
Total costs	100	100	100	100

Note:

[1)] The figures in parentheses before total variable costs indicate the percentage of the total variable costs.

[2)] The figures in parentheses after total variable costs indicate the percentage of the total fixed costs.

4.4 Interrelationships between Factors Affecting Household Labour Allocation to Dairy Farming

4.4.1 Bivariate Analysis

The bivariate analysis is quite useful to measure any correlation between variables through correlation coefficients. Then, uncorrelated explanatory variables were used in the regression analysis.

The correlation between variables in respect of the household labour requirement in dairy farming showed mostly a weak association (Table 4.17). However, some variables indicated a significantly ($P<0.01$) strong association with respect to the labour requirement in dairy farming. These variables such as the number of dairy cattle owned and the number of lactating cows, the total household income and non-wage income, were both significantly ($P<0.001$)) and positively correlated. The strong association between those variables indicated that the more dairy cattle owned by farmers, the more lactating cows were present on farms. This is consistent with the expectation that dairy farmers with higher dairy cattle numbers should have more lactating cows. Similarly, more non-labour income can reflect the higher total household income. This is because remittances, rent and interest from assets can accrue to the total household income. Other correlation appeared moderate, and positively significant ($P< 0.01$), for instance, the land owned and both the number of lactating cows and the number of dairy cattle owned.

Table 4.17 Bivariate analysis of household labour allocation variables in dairying.

VARIABLE	TDAIRY	CATLSIZE	NLACC	TNONDR	VRGMB	VRGLON	FAMINCO	NONLBIC
TDAIRY	1							
CATLSIZE	O.28*	1						
NLACC	0.1	0.86***	1					
TNONDR	O.38**	0.28	0.18	1				
VRGMB	0.23	0.04	0.06	0.44**	1			
VRGLON	0.03	0.55**	0.54***	0.09	0.16	1		
FAMINCO	-0.14	0.31*	0.37**	-0.09	-0.09	0.21	1	
NONLBIC	0.01	0.08	0.08	-0.04	-0.07	-0.0001	0.75***	1

Note:
*, **, *** indicate P<0.05, P<0.01, P<0.001, respectively.
TDAIRY : total time allocation of household in dairy farming activities (hours/year),
CATLSIZE: the total dairy cattle owned by farmers (animal units),
NLACC : the number of lactating cows (animal units),
TNONDR : total time allocation of household labour in farm and non-farm (hour/year),
VRGFMB : the number of family labourers (persons),
VRGLON : the land owned by farmers (ha),
FAMINCO: total household income (Rp /year),
NONLBIC: non-labour income (remittances, interest, rent from assets)(Rp /year).

However, land ownership by farmers is not associated with the household labour allocation to dairy farming. This relates to the theory of "product-product relationship" which indicates the relationship between crop-farming and dairy farming. Not all of the household labour potential was devoted to crop farming. Household labour allocated to crop farming does not influence dairy farming activities. Also, the activities involved in dairy farming such as milking and marketing for milk in the morning and afternoon have a certain time limit so that these activities do not disturb farmers cultivating their land. Moreover, dairy farming is usually a family enterprise, however, some of the activities were carried out by external labour. Therefore, the allocation of time in dairy farming does not influence crop farming.

4.4.2 Determinants of Household Labour Allocation to Dairy Farming Activities

Uncorrelated variables were used to build regression analysis. The regression analysis was applied to obtain insight into how household labour allocation in dairy farming differs according to household characteristics: the number of dairy cattle owned by the farmer, the number of family members and the total household income.

Regression analysis reveals that the number of dairy cattle owned by the farmer and the total household income are the strongest predictors of the household labour allocation in dairy farming (R^2 = 0.4273 and F=8.394). This indicates that only about 43% of the variation of household labour allocation in dairy farming activities can be explained by (i) number of lactating cows; (ii) income from dairy farming; (iii) non-labour income; (iv) income from outside dairy farming (including both farm and non-farm); (v) number of family members (persons); (vi) dependency ratio; (vii) number of dairy cattle owned; (viii) and the size of land holding. It is likely that variables are not formulated into the model in the best way, as such models included only household characteristics. The model does not include an adequate number of predictor variables related to household labour allocation to dairy farming activities, such as human capital: education, experience in dairying, age, and health. The regression model shows that both the numbers of dairy cattle owned by farmers and the size of family positively influenced household labour allocation in dairy farming.

Regression model of household labour allocation in dairy farming:

$$Y = 6.27 + 1453.77\ CATLSIZE - 105.59\ SQCASIZE^2 + 109.63\ FAMEMB - 0.000036\ FAMINCO$$
$$\quad (0.01)\quad (5.09)\qquad\qquad (-4.48)\qquad\qquad (1.02)\qquad\qquad (-2.13)$$

Where:
Y : the number of household labour allocation on dairy farming (hours/year),
CATLSIZE : the number of dairy cattle owned by farmers (animal units),
FAMEMB : the number of family members (persons),
FAMINCO : total household income (Rp/year).
Figure in parentheses is student's t-values.

The regression analysis indicated that the household labour requirement in dairy farming is positively influenced by the number of dairy cattle owned. This indicated that increasing the number of dairy cows would increase the number of hours spent by

family labour in operating dairy farming activities. More time is devoted to feeding cows, milking and collecting water.

Total household income, meanwhile, negatively affected the households' hours devoted to dairy farming. An increase in family income decreased the household requirement in dairy farming. This is reasonable because, as income increases, household labour tends to spend more time in leisure or non-dairy activities. As result the farmer may employ external labour to undertake some of the dairying activities, such as the collection of forage.

4.4.3 Impact of Changes in Dairy Cattle Numbers and Total Household Income on Labour Requirements in Dairy Farming

Table 4.18 provides the changes in household labour requirements in dairy farming when the number of dairy cattle owned increases by 10%, 25%, 50%, 75%, and 100%. As the number of dairy cattle doubles, the household labour requirement increases by about only 6%. Similarly, the household labour participation in dairy farming is expected to increase by 5% and 10% when dairy cattle increase by 10% and 25% respectively. Likewise, an increase of 50% in the number of dairy cattle will have 14% incremental demand for household labour in dairy farming. This suggests that an increase of 50% of herd size provides ample scope to improve labour productivity.

A change in total household income showed little change in household labour allocation in dairy farming. This indicated that although dairy farming is a second income source, the dairy enterprise was the best alternative to which to allocate household labour. This is because not all potential household labour is allocated to farm or non-farm activities, therefore the rest of the unused time can be devoted to dairy farming. Moreover, female labour can be employed more easily, and dairy farming provides a steady source of income on a regular basis, which provides an incentive to stay in dairy farming.

Table 4.18 The impact of a change in cattle number and in total household income on household labour requirements in dairy farming activities.

Variable[1)]	Percentage of change					
	0%	10%	25%	50%	75%	100%
1. Impact of change in dairy herd size on labour requirement in dairying						
a. Household labour in dairy farming	4527	4738	4979	5178	5124	4817
b. Percentage increase in allocation of hours to dairy farming		5	10	14	13	6
2. Impact of change in Household income on labour requirement in dairying						
a. Household labour on dairy farming	4527	4496	4449	4372	4294	4217
b. Percentage decrease in hours allocated to dairy farming		1	2	3	5	7

Note:
[1)] Base herd size 4.38 AU and base household income Rp 8,506,982.

4.4.4 Interrelationships between Factors Affecting Household Labour Allocation in Dairy Farming on a per AU Basis

Regression Analysis

The regression model indicated that both the numbers of dairy cattle owned by farmers and the household income variables were negatively associated with the total number of hours allocated per AU in dairy farming ($P<0.01$ and $P<0.05$ respectively). The household size, although was positively associated with labour requirement, was not statistically significant. The model explained 54% of the variation in the household labour requirement per AU basis.

$$Y = 1582.32 - 118.45\ CATLSIZE + 19.77\ FAMEMB - 0.0000098\ FAMINCO$$
$$(10.17)\quad (-5.88)\quad (0.76)\quad (-2.18)$$

Where:
Y : the number of household labour allocation on dairy farming per animal unit (hours/year),
CATLSIZE : the number of dairy cattle owned by farmers (animal units),
FAMEMB : the number of family members (persons),
FAMINCO : total household income (Rp/year).
Figure in parentheses is student's t-values.

The result of regression analysis of household labour requirement per animal units is consistent to farm size basis. An increase in the number in dairy cattle owned would decrease hours of household labour per animal unit spent on animal husbandry tasks - whereas family labour per animal unit in a dairy enterprise shows the reverse trend with the accruing total household income.

4.4.5 The Impact of Changes in Dairy Cattle Numbers and Total Household Income on Labour Requirements in Dairy Farming per AU Basis

A 100% increase in cattle numbers is expected to decrease 49% of the time spent by family labour in dairy farming per animal unit basis (Table 4.19). Similarly, increasing the number of dairy cattle by 25% and 50% will decrease household labour in dairy farming by 12% and 24% respectively. The time devoted to dairy farming decreases by approximately 36% when the farmers increase the number of dairy cattle 75%.

As household income doubles, household labour requirement per animal unit decreases by about 8%. Household labour spent in dairy farming declines by only 2-8% when family income increases 25%-100%. This means that the accruing household income can not influence the labour requirement used in dairy farming.

Table 4.19 The impact of a change in cattle numbers and in total household income on household labour requirements in dairy farming activities per animal unit basis.

Variable	Percentage of change					
	0%	10%	25%	50%	75%	100%
1. Impact of change in dairy herd size						
a. Household labour on dairy farming	1068	1016	938	808	679	549
b. Percentage decrease in allocation of hours to dairy farming per AU		5	12	24	36	49
2. Impact of change in household income						
a. On household labour in dairy farming	1068	1060	1047	1026	1005	984
b. Percentage decrease in hours allocated to dairy farming per AU		1	2	4	6	8

Note:
Base herd size 4.38 Animal Unit and base household income Rp 8,506,982.

4.5 Interrelationships between Factors Affecting Dairy Farming Net Income per AU Basis

4.5.1 Bivariate Analysis

Most of the associations between variables studied in respect of the net income of dairy farming were weak (Table 4.20). However, some variables were positively and significantly correlated ($P<0.01$), for instance, the purchases of concentrate and total feed cost appeared almost perfectly correlated. Also, the net income from dairy farming on a per animal unit basis is positively and strongly associated with the purchase of concentrate, and the total animal feed costs. Forage costs are correlated moderately and positively with both concentrate cost and total animal feed costs.

Table 4.20 Correlation analysis of net income on dairy farms per animal unit.

Variables	ATTLDR	AVCFDR	AVCFDC	AVCFTT	AVCTRN	AVCMED	AVCAI	AVCOT	VRGFMB	VRGDR
ATTLDR	1									
AVCFDR	0.36*	1								
AVCFDC	0.62***	0.48***	1							
AVCFTT	0.62***	0.55***	0.996***	1						
AVCTRN	0.01	0.27	0.14	0.16	1					
AVCMED	-0.15	-0.06	-0.02	-0.02	0.1	1				
AVCAI	0.32*	0.18	0.44**	0.43**	-0.14	-0.13	1			
AVCOT	0.21	-0.06	0.09	0.08	0.02	0.01	-0.1	1		
VRFFMB	0.04	0.03	0.14	0.13	0.05	-0.29*	0.01	-0.18	1	
VRGDR	0.27	-0.02	0.06	0.05	-0.03	-0.03	-0.03	-0.03	-0.24	1

Where:
ATTLDR : net income of dairy farming work per AU (Rp /year),
AVCFDR : variable cost of forage consumption per AU (Rp /year),
AVCFDC : variable cost of concentrate consumption per AU (Rp /year),
AVCTRN : variable cost of transportation per AU (Rp /year),
AVCFTT : total cost of animal feeding per AU (Rp /year),
AVCMED : variable cost of herbal medicine per AU (Rp /year),
AVCAI : variable cost of artificial insemination per AU (Rp /year),
AVCOT : variable cost of other dairy farming purchasing per AU (Rp /year),
VRGFMB : the number of family labourers (persons),
VRGDR : dependency ratio.

4.5.2 Factors Explaining Net Income per AU

The regression analysis showed that about 50% of the annual net income of dairy farming per animal units was explained by (i) variable cost of forage consumption per AU; (ii) variable cost of concentrate consumption per AU; (iii) variable cost of transportation per AU; (iv) variable cost of total animal feed per AU; (v) variable cost of herbal medicine per AU; (vi) variable cost of artificial insemination per AU; (vii) dependency ratio; (viii) variable cost of other dairy farm purchasing per AU; and (ix) the number of family members (persons) (R^2= 0.5060, F= 6.145). The estimated coefficients of variable costs in animal feed and dependency ratio are positive and significant (P<0.05).

Regression model of net income from dairy farming per animal unit:

$$Y = 309477 + 1.864\ AVCFTT - 2.697\ AVCTRN - 1.699\ AVCMED + 14.465\ AVCAI$$
$$(176166)\quad (0.43)\quad (6170)\quad (1.774)\quad (22.861)$$

$$+ 8.934\ AVCOT + 5403.902\ VRGFMB + 159052\ VRGDR$$
$$(5.210)\quad (20547)\quad (71292)$$

Where:

Y	: net income per AU from dairy farming (Rp/year),
AVCFTT	: total cost of animal feeding per AU (Rp/year),
AVCTRN	: variable cost of transportation per AU (Rp/year),
AVCMED	: variable cost of herbal medicine per AU (Rp/year),
AVCAI	: variable cost of artificial insemination per AU (Rp/year),
AVCOT	: variable cost of other purchasing in dairy farming per AU (Rp/year),
VRGFMB	: the number of family labourers (persons),
VRGDR	: dependency ratio.

4.5.3 Prediction of Change in Total Costs of Animal Feeding and Dependency Ratio on Net Income of Dairy Farming per Animal Unit

The Increasing Total Costs of Animal Feeding and Dependency Ratio

As the total livestock feed costs increase, so also the net income of dairy farming per animal unit tends to increase (Table 4.21). However, generating net income was lower than the accruing cost of livestock feed. As animal feed costs double, net income from dairy farming per AU increases by half (51%). Likewise, the addition of livestock feed costs of 75% and 100% can increase net income of dairy farming by 38% and 51% respectively.

Also, as the dependency ratio increases by 100%, surplus net income from dairy farming activities per AU increases by less than 10%. An additional 50% of dependency ratio can acquire 5% of surplus net income of dairy farming per animal unit. The dependency ratio, therefore, did not influence the net income of dairy farming per animal unit.

Table 4.21 The impact of increasing total costs of animal feeding, and dependency ratio on net income from dairy farming per AU.

Variable	Percentage of increasing					
	0%	10%	25%	50%	75%	100%
1.Impact of change in total costs of feed						
a.Total costs/AU	257596	283356	321995	386394	450793	515192
b.Dairy income/AU	941917	989932	1061956	1181996	1302036	1422075
c.Percentage increase		5	13	25	38	51
In dairy income per AU						
2. Impact of change in dependency ratio						
a. Dependency ratio	0.54	0.59	0.68	0.81	0.95	1.08
b.Dairy income/AU	941917	950505	963389	984861	1006333	1027805
c.Percentage increase		1	2	5	7	9
in dairy income per AU						

The Decreasing Total Costs of Animal Feeding and Dependency Ratio

As the feed costs per AU decrease, the net income of dairy farming per AU tends to decrease (Table 4.22). Net income from dairy farming per AU will fall by 5% when the cost of animal feed per AU decreases by 10%. However, a 25%, 50% and 75% decline in the cost of livestock feed resulted in a change of net income in dairy farming of 13%, 25%, and 38% respectively. Therefore, a decrease in animal feed costs will influence the net income of dairy farming per animal unit.

Decreasing the dependency ratio had a small influence on the net income of dairy farming per animal unit (Table 4.22). A 10%, 25% and 50% decrease in the dependency ratio resulted in a decline in net income of dairy farming of only 1%, 2% and 5% respectively. Similarly, as the animal feeding costs decrease by 75%, a decrease in net income of dairy farming of 7% occurred. Therefore, the net income from dairy farming on a per animal unit basis was not influenced by the dependency ratio.

Table 4.22 The impact of decreasing total costs of animal feeding ,and dependency ratio on net income from dairy farming per AU.

Variable	Percentage reduction				
	0%	10%	25%	50%	75%
1. Impact of change in total costs of feed					
a. Total costs/AU	257596	231836	193197	128798	64399
b. Dairy income/AU	941917	893901	821877	701837	581797
c. Percentage decrease in dairy income per AU		5	13	25	38
2. Impact of change in dependency ratio					
a. Dependency ratio	0.54	0.49	0.41	0.27	0.14
b. Dairy income/AU	941917	933328	920444	898972	877500
c. Percentage decrease in dairy income per AU		1	2	5	7

CHAPTER 5 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

As a part of a subsistence farming system, dairy farming in Indonesia provides milk for consumers and to rural households. Domestic supply alone cannot meet consumption demand, and thus Indonesia imports from overseas countries. The government of Indonesia has taken new initiatives to improve the dairy production system, and boost milk-production by improving the quality of dairy cattle, which in turn will provide higher incomes for dairy farmers.

East Java is an important province for dairy farm development. The region accounts for about one-third of the total dairy cows in Indonesia, and dairying constitutes an important source of income for rural households. Dairy farming in East Java commonly involves family labour, including women. Women are largely involved in milking, rearing calves and other activities contributing to the raising of dairy cattle.

Utami (1992) examined the household labour allocation on East Java dairy farms, however the gender role, and contribution of time allocation and income generated from dairy farming and its role in alleviating poverty have not been studied. This study examined the household labour allocation and gender roles in dairy farming.

The overall objective of the research was to examine the performance of smallholder dairy farms in East Java. The study was limited to small-scale dairy farmers in Andonosari village. The specific objectives were to: (a) investigate the pattern of household labour allocation; (b) examine the contribution of the small dairy farm to the total household income; and (c) quantify the role of gender in dairy farming activities.

A review of several studies indicated that the theory of time allocation proposed by Becker (1965) was a suitable framework for explaining the pattern of time allocation within farm households. Its purpose was to maximise household utility through time allocation by the household, and it was restricted by time, income and farm production. Separation of time allocation was used to determine household labour allocation either in economic or non-economic activities.

Economic activities included the activities undertaken for payment, either on the farm and/or off-farm. Non-economic activities, on the other hand, were considered activities including household chores without any monetary payments. The classification attempted to trace the hours spent, and the income acquired, by households. The income of a household included income from economic activities, as well as income from remittances, rent, and interest payments.

Household labour (including both male and female) was assumed to play an important role in income generating activities. Both male and female members of households devote considerable hours to dairy farming and non-dairy activities, including on-farm and non-farm. The gender division of labour was used to explain gender roles in dairy farming.

The time allocation in dairy farming was restricted by several determinants. In this study the predictors of household labour requirements in dairy farming, included (i) the number of lactating cows; (ii) income from dairy farming; (iii) non-labour income; (iv) income from outside dairy farming (including both farm and non-farm); (v) the number of family members (persons); (vi) dependency ratio; (vii) the number of dairy cattle owned; (viii) and the size of land holding, were regressed. Also, net-farm income from dairy farming per animal unit (AU) was predicted by the following variable costs: (i) forage consumption; (ii) concentrate consumption per AU; (iii) transportation per AU; (iv) cost of total animal feed per AU; (v) herbal medicine per AU; (vi) artificial insemination per AU; (vii) other dairy farming purchases per AU; and other two variables: (viii) dependency ratio; and (ix) the number of family members (persons).

The data collection on time allocation of household labour for each activity became a complex procedure because of the diversity of activities undertaken by family members. The time use of family members was computed as time spent on work (dairy farming and non-dairy farming, including on- and non-farm), household tasks, social activities, and leisure time. Time allocations by gender were recorded. Additional information on household income from other sources was gathered from face-to-face interviews.

A combination of interviews and direct observations was employed in this study. These were conducted intensively over a one-month period. Interviews were conducted separately with the husband, wife, and family members aged 15-64 years of 50 households (16 households in both strata 1 and 3, and 18 households in stratum 2), while direct observation were implemented on two representative respondents of each strata. Strata were classified on the basis of the number of dairy cattle owned: stratum 1(fewer than 3 AUs; stratum 2 (3 to fewer or equal 5 AUs); and strata 3 (more than 5 AUs).

To obtain reliable labour allocation data, respondents were questioned on the specific activities they performed. The household labour activities were scheduled through a four-way strategy: by time activities of day; by day of week; by a day of a month; and by a day of a year to guide respondents' recollecting their involvement in hours over the past 12 months.

Data entry was accomplished using Excel Software, and analysis was performed using SAS package. Descriptive, univariate, bivariate and multivariate analyses were performed.

Household Labour Allocation in Economic Activities

Household labour allocation to economic activities exhibited similar trends both on a per farm, and on a per AU basis. In income-generating activities, household labour allocation suggested that dairy farming activities were equally important as on-farm and non-farm work (51% vs. 49%). Most dairy farming tasks continually and routinely demanded time

on a daily basis in order to maintain continuity of milk production, feed preparation and feeding, forage collection, milking, and marketing of milk. In contrast, the household labour requirements in cropping activities were seasonal only (for example, planting, weeding and harvesting). Likewise, non-farm activities, such as hired labour, service, trade were required only during specific time periods. Unlike dairy farming activities, farm and non-farm activities required fewer household labour hours during the year.

As the number of dairy cattle increased, the households allocated more labour to both dairy and non-dairy activities. However, in stratum 2 (3-≤5AUs), the higher labour requirement was concentrated equally in non-dairy and dairy activities (51% and 49 % respectively). Stratum 2 farmers spent less time in dairy farming activities because they employed hired labour for jobs such as collection of forage, milking cows and marketing milk. On the other hand, only family members performed non-dairy tasks within stratum 2.

Time allocated per AU by family labour in dairy farming activities was inversely proportional to the number of cattle owned. However, in stratum 2, the hours devoted to dairy farming per AU were higher than in stratum 3. This was explained by the location of stratum 2 dairy farms, which required forage and water collection from far-away places, or required longer commuting time to market milk.

The participation of women in economic activities was visible. Women in stratum 1 spent a greater number of hours in both dairy and non-dairy activities than in other strata. Men dominated work outside dairying, while the majority of women's time was devoted to animal husbandry as opposed to on- and non-farm activities. A similar trend was observed in stratum 3, where male labour was concentrated in non-dairy activities, while female labour was represented more in dairy farm related activities.

Of the dairy farming tasks, feed preparation and feeding and forage collection activities absorbed 55% of household labour for both men and women. Females consistently allocated a higher number of hours per AU in giving feed to dairy cattle and washing

feeding and milking equipment activities, while male labour dominated in milking cows, grazing activities and marketing milk. Irrespective of strata, men were an important source of labour in forage collection activity (29-42%), while women dominated feed preparation and feeding to dairy cattle (34-55%).

The Source of Income

Two-thirds of household income was contributed by non-dairy farming activities, with the majority of this income arising from apple growing. Interestingly, farmers continued with dairying although the income was less than that from apple farming. The main reasons were: (a) the farmers received consistent cash flow from marketing milk, usually every ten days; (b) dairying activities supported or complemented farming activities, by providing farming input such as manure to fertilise land; and (c) the existence of "KUD Setia Kawan" (milk co-operatives) offered additional facilities to farmers, such as farming input. Whereas, apple farming was difficult to establish because of the limitations of land size and the higher investment requirement.

Income from dairy farming increased with an increase in the number of cows, while non-dairy farming income decreased as cow numbers increased. In households of stratum 1, income from non-dairy farming contributed four times the income earned from dairy farming. Similarly, the income of dairy farming households in stratum 3 was about one-third of the income from farm and non-farm. The increasing herd size appeared inconsistent with non-dairy farming income. This is because the number of dairy cattle owned by a farmer does not directly influence apple farming incomes. Earning from apple planting depended on the size of landholding and, importantly, the maturity of the apple trees. Apple trees more than 5 years old had higher productivity than the younger ones.

Income from dairy farming was primarily derived from milk (68%). However, the milk income per AU of stratum 1 was marginally higher (69%) than those from stratum 2

(64%). Meanwhile, non-milk income in stratum 2 was slightly higher compared to that in stratum 1 (36% vs. 31%).

Another interesting finding was that the income per AU from non-milk sources in stratum 2 households was higher compared to those of other strata. This was associated with the sale of a greater number of calves aged 6-12 months. The income from selling livestock was used to purchase farming inputs, to pay for the education of their children in tertiary institutions and to buy furniture and television sets.

Total household income did not come only from household labour activities but also from non-labour work. Non-wage income for stratum 2 was the lowest compared to strata 1 and 3. Lack of a family member working outside rural areas, the lower size of landholding, and limited capital available as savings contributed to the lower non-wage income in stratum 2 (3-≤5AU).

The Expenditure in Dairy Farming

Variable costs accounted for 74% of the total costs - and concentrate purchase alone required 63% of expenditure. In contrast, the fixed costs accounted for only 26%, which included 8% as depreciation. As expected, the variable costs per AU decreased as the herd size increased.

The efficiency of animal feeding increased with respect to strata. This is probably due to efficiency in purchasing concentrate as well as an adequate feed formulation.

Purchasing forage - and other purchases, including buying vitamins, artificial milk for calves and eggs (for feeding to cows) followed a similar trend. Herbal medicine expenditure decreased significantly by increased strata.

There were marginally fewer purchased inputs in stratum 2 than stratum 1 (71% vs. 75%). On the other hand, fixed costs per AU in stratum 2 was somewhat higher than in stratum 1 (29% vs. 25%). Strata 1 and 3 had similar variable costs as well as fixed costs.

Determinants of Household Labour Allocation in Dairy Farming

Interrelationships amongst factors associated with household labour allocation in dairy farming work revealed mostly a weak association. However, some variables indicated a strong association which was positively significant ($P<0.001$), such as the number of dairy cattle owned and the number of lactating cows, the total household income and non-wage income. Other correlations appeared moderate and positively significant ($P< 0.01$), for instance the land owned, with the number of lactation cows and the number of dairy cattle owned.

However, the land owned by farmers is not associated with the household labour allocation in dairy farming. Presumably, not all household labour was devoted to cropping. Some of the dairy farming activities did not conflict with cropping.

Nearly 43% of the variation in household labour allocation in dairy farming on a per farm basis was explained by (i) the number of lactating cows; (ii) income generated from dairy farming; (iii) non-labour income; (iv) income from outside dairy farming (including both farm and non-farm); (v) the number of family members (persons); (vi) dependency ratio; (vii) the number of dairy cattle owned; and (viii) the size of land holding. The regression analysis indicated that the household labour requirement in dairy farming was positively influenced by the number of dairy cattle owned and was negatively associated with the total household income. The effect of the family size was positive, but not statistically significant in explaining hours devoted to dairy farming activities.

The Impact of the Change in Herd Size and Total Household Income on Household Labour Requirement in Dairy Farming

Doubling the number of dairy cows would have little impact on the additional labour requirement on a per farm basis. As herd size increases by 50%, about 14% of household labour would be required. On the other hand, the change in total household income showed a small impact in household labour allocation to dairy farming. This indicated that, although dairy farming is a second income source, it was the reasonable alternative to allocate household labour. This is because not all of potential household labour is allocated to farm or non-farm activities, so the surplus labour can be devoted to dairy farming. Moreover, it can absorb female labour. In addition, an attraction which dairy farming provides is a steady source of income on a regular basis – which is an incentive to continuing dairying.

On the other hand, doubling dairy cattle numbers would reduce the labour requirement by 49% per AU. As the household income increased by 100%, the household labour requirement per AU would decrease by only 8%. This means that higher household income has only a marginal influence on the labour requirement in dairy farming.

Determinants of Annual Net Income from Dairy Farming

Most interrelationships amongst variables associated with the annual net income of dairy farming per AU indicated a weak correlation. However, some variables were positively correlation ($P<0.01$). For instance, the purchase of concentrates and total feed costs were almost perfectly correlated.

Fifty percent of the variation of annual net income in dairy farming was explained by (i) variable cost of forage consumption per AU; (ii) variable cost of concentrate consumption per AU; (iii) variable cost of transportation per AU; (iv) variable cost of total cost animal feed per AU; (v) variable cost of herbal medicine per AU; (vi) variable cost of artificial insemination per AU; (vii) dependency ratio; (viii) variable cost of other dairy farming purchasing per AU; and (ix) the number of family members (persons). The

estimated coefficient of variable cost in animal feeding and dependency ratios were also positive ($P<0.05$).

The Impact of the Change in Feed Cost and Dependency Ratio on the Annual Net Income from Dairy Farming

An increase in animal feeding costs had a negative impact on net income from dairy farming. As animal feed costs doubled, net-income from dairy farming per AU increased by 51%. The share of livestock feed cost in total costs is important in increasing the net income from dairy farming. In contrast, the dependency ratio had little impact on the net income of dairy farming. As the dependency ratio doubled, the surplus net income of dairy farming per AU decreased by 10%.

5.2 Conclusions

An investigation of "Household Labour Allocation in Small Scale Dairy Farming" in Indonesia indicated the following conclusions.

1. Household labour was allocated to income generating activities more than to dairy farming compared to farm and non-farm work. Dairy farming tasks were performed on a routinely daily basis, whereas both farm and non-farm work occurred periodically.

2. Strata and gender were associated with household labour allocation to income generating activities. With increasing dairy cattle numbers, the household labour requirements increased marginally in dairy farming activities, and decreased in farm and non-farm works. Females allocated one third of total time to income generating activities, most of which were devoted to dairy farming activities. Males tended to allocate more time to non-dairy farming activities, while women engaged, most of the time, in dairy farming activities.

3. The household labour requirement in dairy farming per animal unit decreased as herd size increased, allowing more time for non-dairy activities.

4. Feed preparation, feeding and forage collection for dairy farming absorbed the most household labour. Strong female participation was evident in feed preparation and feeding, whereas male participation was higher in forage collection.

5. The efficiency in allocating household labour in dairy farming tasks increased with herd size. However, in general, farmers were inefficient in allocating household labour to dairy farming activities, since family members devoted more hours in particular to fodder collection tasks.

6. Non-dairy farming contributed about two-thirds of household income, with the majority arising from apple farming. The higher income from apple farming was due to larger land size and matured apple trees. However, households with a large number of animal units derived more income from dairying.

7. The income of household labour per animal unit tended to decrease with an increase in herd size. Farmers in stratum 1 (1- <3 AU) realised a higher income from non-dairy farming (i.e. apple trees), whereas farmers in stratum 3 (> 5 AU), received more income in dairy farming per AU.

8. The expenditure in dairy farming comprised 74% variable costs, with the major cost being that of purchasing concentrates. Depreciation (8%) was the largest fixed cost. Housing and equipment depreciation were inconsistent with herd size due to age, type and condition of equipment and capital items where - the number of dairy cattle was more than 5 AU the dairy farms appeared more efficient in terms of annual expenditure.

9. The size of landholding had no impact on household labour allocation in dairy farming activities.

10. An increase in household income and dependency ratio resulted in a small change in the household labour requirement for dairy farming. Therefore, the dairy enterprise was still considered as a secondary income-generating activity within farming households. Farmers continued dairy farming because it (i) provided a regular daily cash income; (ii) allowed easy access to credit; (iii) was located close to the homestead; and (iv) it provided for participation by females. Therefore, dairy farming is a reasonable alternative in allocating family labour, both male and female. This ultimately leads to enhanced work opportunities and generating of income to deal with poverty alleviation.

5.3 Recommendations

In order to enhance dairy farming in East Java, it is suggested:

1. Farmers should be trained to be more efficient in allocating household labour to dairy farming activities to achieve high productivity and therefore greater income. The additional income from dairy farming is worthwhile, particularly for smallholder farmers to improve their living standard, and to alleviate poverty - particularly in rural areas.

2. Efficiency in operating dairy farms can be achieved by providing improved livestock feeding. A cost-effective method of feeding dairy cattle should be investigated.

3. Dairy farming activities can be increased in this region as well as in other provinces which have a suitable environment for their development. The addition of an extra 50% of dairy cows would increase the household labour requirement by 14%. Likewise, doubling the herd size can save about 50 % of the household labour requirement per animal unit. Providing credit either in cash or in dairy cattle breeding for farmers would be necessary to develop dairy farming.

4. Dairy farming extension programmes would be important in improving farmers' skill in operating dairy enterprises to increase milk productivity. Women should be involved in this extension, based on their high participation in dairy farming activities.

5. A study of dairy farming activities which focuses on poverty alleviation, gender analysis and the role of women's decision making should be explored as the basis of future studies.

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