CHAPTER 4

FARMING SYSTEMS AND BIO-PHYSICAL AND SOCIO-ECONOMIC CHARACTERISTICS

This chapter mainly deals with the characteristics of the study area and surveyed coconut smallholder farmers. Further, this shows the characteristics of the surveyed coconut based farming systems with comparisons to study the similarities and differences among them.

4.1 Land characteristics and bio-physical conditions of the study area

Gampaha district is located in western province of Sri Lanka close to the sea. Total land area is 1,387 square kilometers and that is 38 percent and 2.1 percent of the land area belong to western province and Sri Lanka respectively. Gampaha district is situated between the north latitude 6° 54 and 7° 20 and 79° 48, and 80° 13 east longitude. Due to the location of this district close to the capital city Colombo and location of International Airport and two major Free Trade Zones within this district and other infrastructure facilities this has become more populated. This district consists of 18 coconut development officer (CDO) divisions under 13 divisional secretariats (Statistics Division of Divisional Secretariat, 2010).

4.2 Climatic and soil condition

Relative humidity of the area is 76 percent and day and night temperature fluctuate 37 ºC-21.6 ºC with an average of 29.3 ºC per year. The soil groups are red and podzolic soils, which increase the potential for agriculture.

Average annual rainfall is 1,700-2,400 mm, contributes enormously in agriculture of the area. The highest rainfall is received during the South West monsoonal period. There are two peak periods of rainfall during May and October.

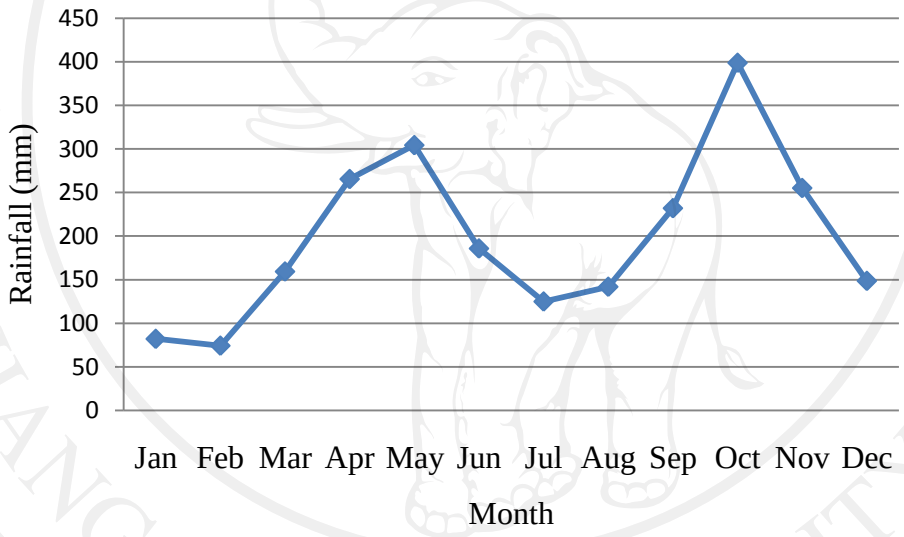

Figure 4.1 Average monthly rainfalls from 2000 to 2010 of Gampaha district

Source: Meteorological station data, 2010.

4. 3 Land cover and land utilization

The landscape of Gampaha district is characteristic by mostly flat or gently sloping low plains. Paddy is the main lowland cultivated crop and coconut and rubber are the common plantation crops grown. Since this is one of the most populated areas, home gardens have occupied much of the land area (56 percent) and fallow fields

and bare lands area is only 0.4 percent. Due to having rainfall throughout the year with only a few dry months most of the crops can be grown without irrigation facilities. Most of the people grow different types of crops in their home gardens and paddy is grown seasonally during monsoonal rainy period in "Maha" (October to January) and "Yala"(April to August) seasons.

Table 4.1 Land utilization of Gampaha district

Nature of the land	Area (ha)	Percentage
Lowland agricultural land area (Paddy)	18,439	13.0
Upland agricultural land area	24,843	18.0
Home gardens	78,022	56.0
Forest area	2,279	2.0
Reservoirs	4,736	3.4
Fallow fields and bare land	509	0.4
Buildings, roads and grounds	8,293	6.0
Others	1,600	1.2
Total	138,721	100

Source: Statistics Division of Divisional Secretariat, 2010

4.4 Cropping systems and main crops grown

Rice is the staple crop of Sri Lankans and the cultivation period is determined by the climatic condition. Since the study area is located in the low-country wet zone the amount of flooding or water logging determined the cropping calendar of many crops whether to plant once or twice. Most of the annuals are cultivated in the "Maha"

season (greater monsoon) and crops are sown between August and October and harvested five or six months later according to the growth cycle while in the "Yala" season (lesser monsoon) crops sown between April and May and harvested about four or five months later. The mainly cultivated annuals are paddy, low country vegetables (gaurds, long bean, brinjal and okra), root crops (cassava, sweet potatoes), and field crops (chillies). Among the perennials, plantation crops (coconut, rubber), fruit crops (pineapple, banana, rambutan), export agricultural crops (pepper, cinnamon) are prominent. Monocropping paddy cultivation, home gardening with multiple crops and coconut based monocropping and intercropping systems are the common systems in the area (Figure 4.2). (Provincial Agriculture Directorate, Western province, Sri Lanka, 2011)

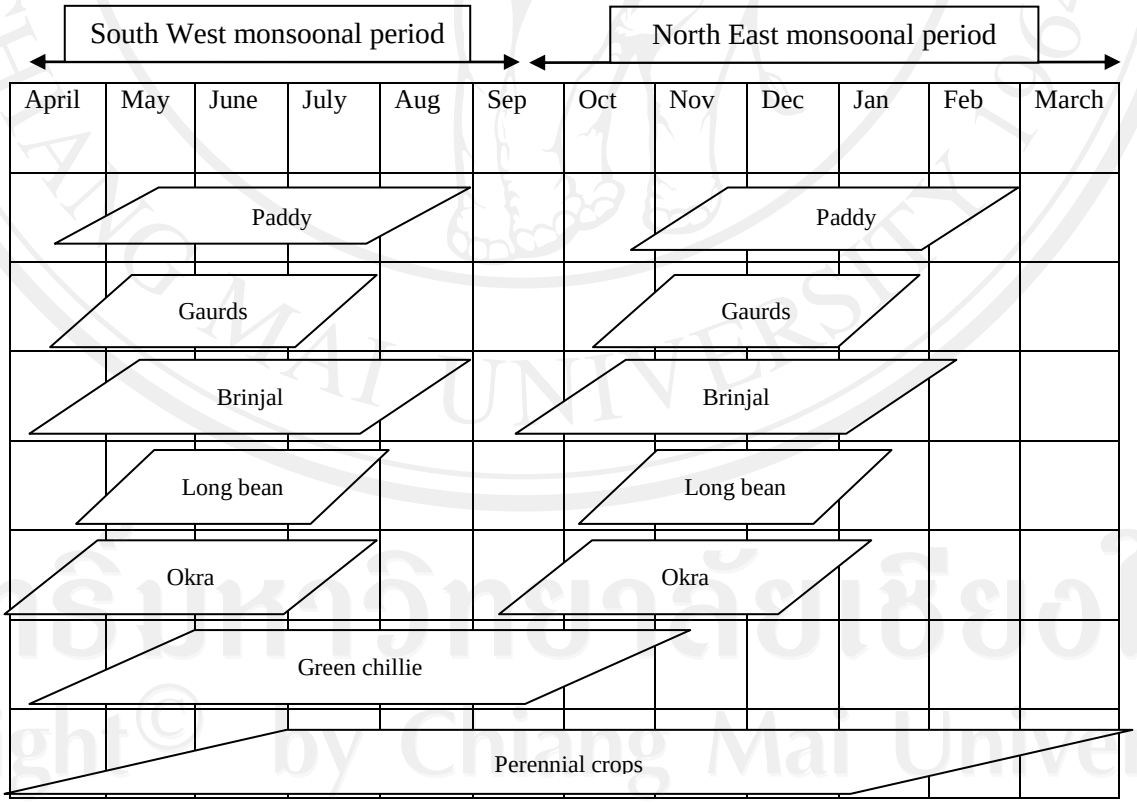

Figure 4.2 Seasonal cropping calendar of main crops grown in the study area

Source: Survey, 2011

4.5 Socio-economic conditions of the study area

The total population of Gampaha district is 21,65,000 and out of that 10, 57,175 are males and 11,07,825 are females. This district has recorded the second highest population density of the country of 1,614 persons per square kilometer. The urban and rural population is 390,235 and 1,774,008 respectively. The literacy rate is 95 percent and it is only second to the district located the capital city (Colombo district) and 7.2 percent of the population is poor. It has been reported that to obtain basic minimum requirements the amount of 3,117 rupees (28 US dollars) is required monthly per person in the study area. (Statistics division of Divisional Secretariat, 2010).

4.6 The characteristics of the sampled households

4.6.1 Demographic characteristics of coconut smallholder farmers

Among the respondents, the majority were male whereas only small numbers were female. The percentage of male was 90.3 while the female percentage was 9.7. The decision on coconut farming was taken by 80 percent of male and 15.4 percent of female alone in the family. Both female and male members (husband and wife) involved in decision making were 4.6 percent (8 families out of 175).

The average age of the coconut smallholder farmer was 54.28 years while the average house hold size was 3.54. Most of the farmers were well educated completing 11(average was 11.34 years) years of schooling. Out of the respondents, most were well experienced in farming with an average of 29.61 years. Out of the total respondents only 57 were full time farmers (32.6 percent) while majority (118) was

part time farmers (67.4 percent). All the respondents were owners of the land and they can do coconut farming as they wish without any external influence (Table 4.2).

Table 4.2 Demographic characteristics of coconut smallholder farmers (n=175)

Characteristics	Unit	Mean	Minimum	Maximum	SD
Age of farmer	year	54.28	27	88	11.15
Education level	year	11.34	5	16	2.26
Experience in coconut farming	year	29.61	4	52	10.83
Sex (Male)	%	90.3	-	-	-
Household size	no.	3.54	1	6	1.04
Fulltime farming	%	32.6	-	-	-

Source: Survey, 2011
Note: SD= Standard deviation

4.6.2 Socio-economic characteristics of coconut smallholder farmers

According to the results related with socio-economic characteristics, which are illustrated in Table 4.3, the mean value of annual farm income was 409,700 rupees (3,625 US dollars) with a minimum of 25,000 rupees (221 US dollars) and maximum of 5,480,000 rupees (48,495 US dollars). The standard deviation was 637,918 rupees (5,645 US dollars) and this value was higher than mean. The reason for this condition may be the higher variability of cultivation practices, types of crops grown, labour and input usage among the different coconut based farming systems. Annual off-farm income of the farmers ranged from a minimum value of 0 to a maximum value of 1,500,000 rupees (13,274 US dollars) with a mean of 401,971 rupees (3,557 US

dollars). Out of the total 175 farmers only 24 percent (42 farmers) had accessed to subsidy and only three farmers (1.77 percent) had gained credit. There was a higher variation of receiving extension contacts and the mean is 2.55 with minimum and maximum value of 0 and 11 respectively. Only a few trainings obtained by the farmers for 3 years and only 33 percent had received trainings on coconut cultivation practices. The mean value of that was 0.35 with a minimum of 0 and maximum of two. The officers told that most of the smallholder farmers are reluctant to participate for trainings and they have not applied for those. But farmers told that they were not invited for trainings by officers and there was a conflict on that. The location of the farm ranged from one to 18 km with a mean of 5 km (Table 4.3).

Table 4.3 Socio-economic characteristics of smallholder farmers (n=175)

Characteristics	Unit	Mean	Minimum	Maximum	SD
Farm income	10^3Rs	410	25	5480	638
Farm income/ac	10^3Rs	132.6	18	2090.7	176
Off farm income	10^3Rs	402	0	1500	318
Subsidy	%	24			
Credit	%	1.77			
Extension contacts	no.	2.55	0	11	2.32
Trainings received	no.	0.35	0	2	0.53
Distance from city	km	5	1	18	3

Source: Survey, 2011
Note: SD= Standard deviation

4.6.3 Bio-physical characteristics of coconut smallholder farmers

Coconut land area owned by smallholder farmers ranged from 0.5 to 12 acres. The average size of the field was 3 acres. Among the respondents, 116 households owned less than 3 acres, 34 households owned 3 to 6 acres, 15 households had 7 to 9 acres and 10 households owned more than 9 acres. Although according to the classification the farms less than 8 ha (20 acres) belong to coconut smallholding sector, at present the field size is very small due to blocking and fragmented of coconut cultivations in order to provide the space for houses, industries and other needs of the rapidly increasing population**.**

According to the farmer's view the drainage condition of fields varied from good to poor. The majority of the fields (69.9 percent) were having good drainage condition while 25 percent and 5.1 percent were having medium and poor drainage condition respectively. When the fertility condition of the coconut fields was considered, most of the fields were medium (70 percent). 21 percent and 9 percent of the observed fields were good and poor in fertility respectively.

4.7 Description of coconut cultivation

In the study area coconut cultivation can mainly be categorized into three systems named monocropping (coconut alone), intercropping (coconut with other types of crops such as fruit crops, spice crops etc.) and livestock integration (coconut with livestock (cattle and poultry) and with or without other types of crops such as fruit crops, spice crops etc.). Out of the randomly selected 175 smallholders, 82 (46.85 percent) were monocropping coconut smallholder farmers and 69 (39.43 percent) and

24 (13.72 percent) were intercropping and livestock integration smallholder farmers respectively (Figure 4.3).

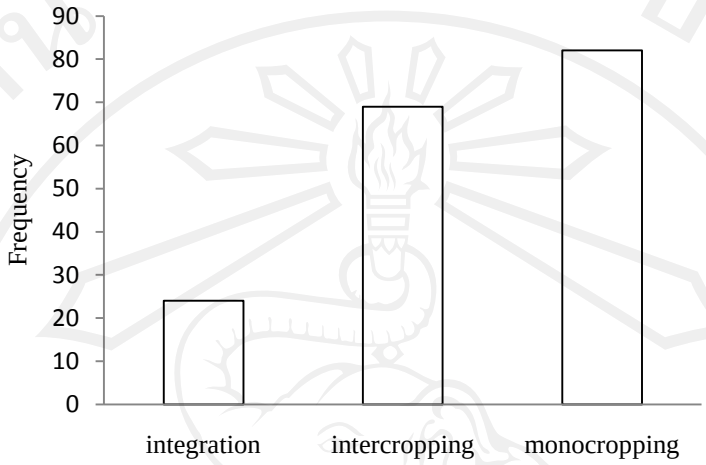

Figure 4.3 Type of coconut farming systems adopted by smallholder farmers

Most of the observed characteristics had higher variability not only between but also within each farming system. All the interviewed farmers owned the coconut land from their early generation since coconut is a perennial plant with 60 years or more of life span. Therefore majority of the smallholder farmers carried out the cultivation practices with slight or without any modifications. Due to this condition most of them did not aware of the initial steps or applications used in cultivation. But some farmers were able to recall their memory of what their parents practiced and most of the farmers were able to explain the present practices done by them after they became the owners of the land.

Out of the 175 respondents, 40.6 percent of the farmers obtained planting material from a reliable source (nurseries of CCB) while 14.9 percent had obtained the

seedlings from germinated seed nuts from their own field. Rests of the farmers were not aware of the place exactly.

The most popular recommended coconut variety among the farmers was CRIC 60. Among the surveyed smallholder farmers 36 percent used that variety in their field and 25.1 percent used local varieties while 0.6 percent used Moorock tall variety. Both CRIC 60 and CRIC 65 varieties were used by 1.7 percent of farmers and CRIC 60 and Moorock tall were used by 0.6 percent. Thirty six percent of the smallholder farmers were not aware of the varieties used.

Most of the coconut smallholder farmers (65 out of 175) applied only chemical fertilizer recommended and some farmers (51 out of 175) did not fertilize their fields. Organic alone and chemical and organic fertilizer together had been applied by 23 farmers and 36 farmers respectively (Figure 4.4).

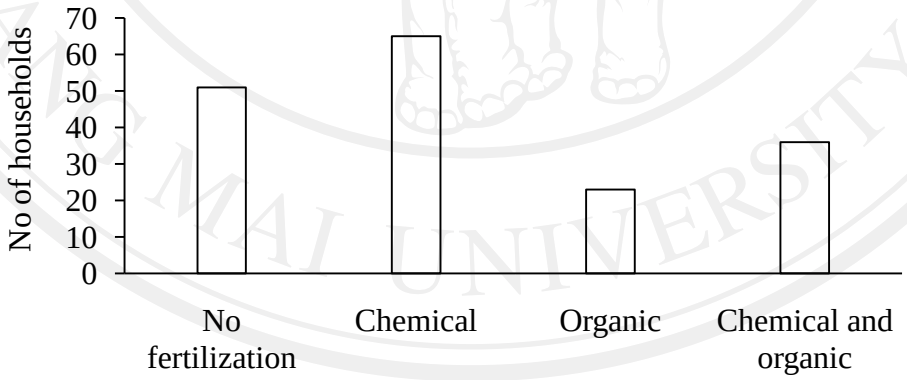

Figure 4.4 Type of fertilizer used by smallholder farmers

Out of smallholder farmers who applied organic fertilizer, chicken manure and cow dung were the common ones. Some farmers applied more than one type of organic matter (Table 4.4).

Table 4.4 Type of organic fertilizer applied by smallholder farmers

Type of organic fertilizer	Farmer percentage
cowdung	10.28
cowdung + chicken manure	1.14
chicken manure	10.89
compost	4.00
green manure	5.14
straw + husk pieces	0.57
cowdung +compost+green manure	1.17
no application	66.28

According to the Figure 4.5 out of the smallholder farmers surveyed, vacancy filling had been practiced by 73.7 percent (129 farmers). Due to this many fields were having the required plant density of 60-70 palms per acre. Other than that new planting and underplanting were practiced by 6.9 and 19.4 percent of the smallholder farmers. According to that only 6.9 percent of the studied fields were extended. Majority of the farmers (64.6 percent) told that the age of their plantation has not reached above 55 years for underplanting. Some farmers (2.2 percent) were reluctant to do that due to labour requirement and time limitation. Some fields (8 percent) were not systematic to carry out replanting recommended way. Out of all 6.9 percent of the smallholder farmers told that they did not need to do so although the palms became aged.

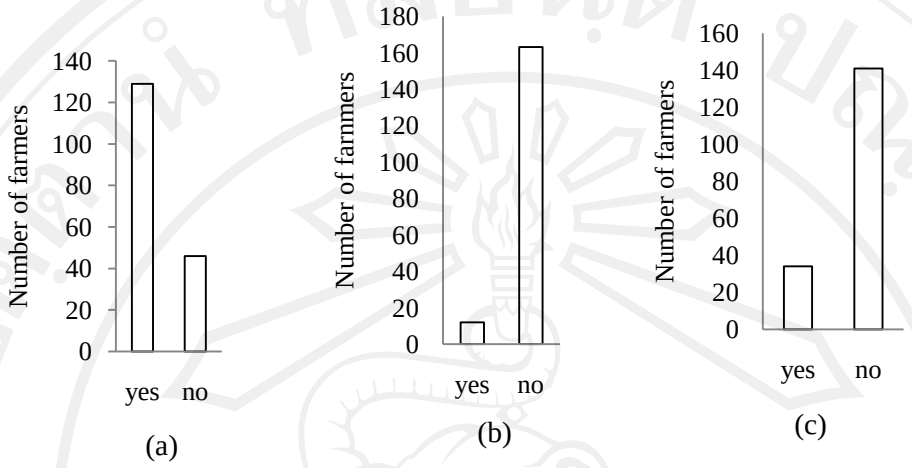

Figure 4.5 Vacancy filling (a), New planting (b) and Underplanting (c) practices followed by smallholder farmers

Moisture conservation is the most important practice in coconut farming since the yield is mainly depended on available soil moisture. Different types of moisture conservation methods have been introduced to farmers to improve their land productivity. Out of 175 smallholder farmers 61.1 percent applied at least one method in their field. According to the Figure 4.6, 42 farmers (24 percent) introduced mulching alone in their fields using coconut husks, Gliricedia leaves and coconut fronds. Some farmers applied the methods such as husk burial and contour drains and covercropping. Thirty eight farmers used only husk burial while 10 farmers established contour drains. Some farmers (10.3 percent) had applied more than single method of moisture conservation. Mulching and husk burial both were practiced by 14 farmers (8 percent) while three farmers used husk burial and contour drains for moisture conservation. One farmer used three methods such as mulching, covercropping and husk burial.

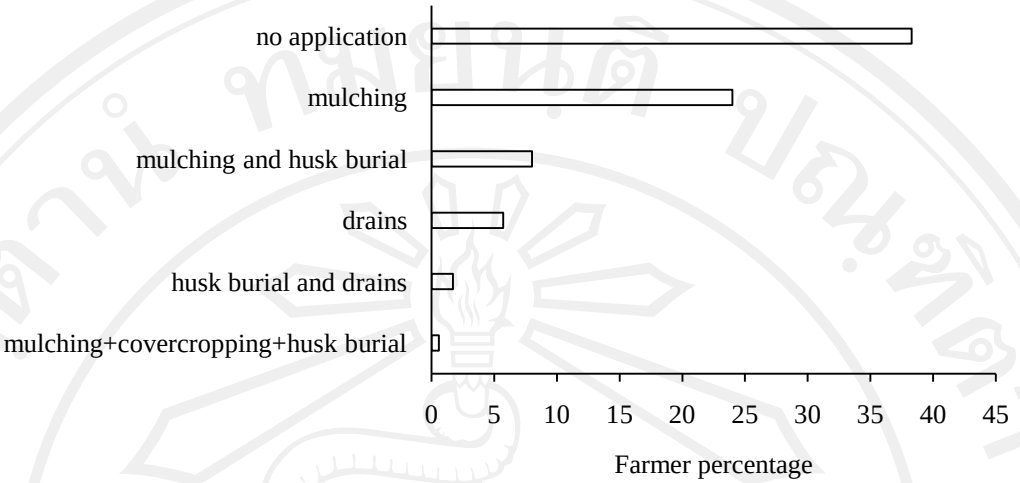

Figure 4.6 Method of moisture conservation employed by smallholder farmers

Like other crops pests and diseases problems are considerable factors influencing coconut yield. According to the data obtained (Figure 4.7), red weevil damage was the prominent problem in 24.6 percent of fields. Beside that mite, black beetle and premature decline disease were the other considerable pest problems in the study area.

In 58.9 percent of studied farmer fields there was not a severe problem and 30.3 percent of the farmers applied control measures. Some farmers (10.9 percent) told that there are no successful methods to control mite damage and premature decline disease. Most of the farmers (20.6 percent) applied non chemical control measures such as application of coal tar to repel red weevil and burning of debris to control black beetle. Monocrotophos was the main chemical pesticide applied by 6.3 percent of the farmers to control red weevil. Some farmers (3.4 percent) had used both chemical and non chemical measures to manage pests. Most of the farmers (69.7 percent) did not use any management strategies since there was no severe problem.

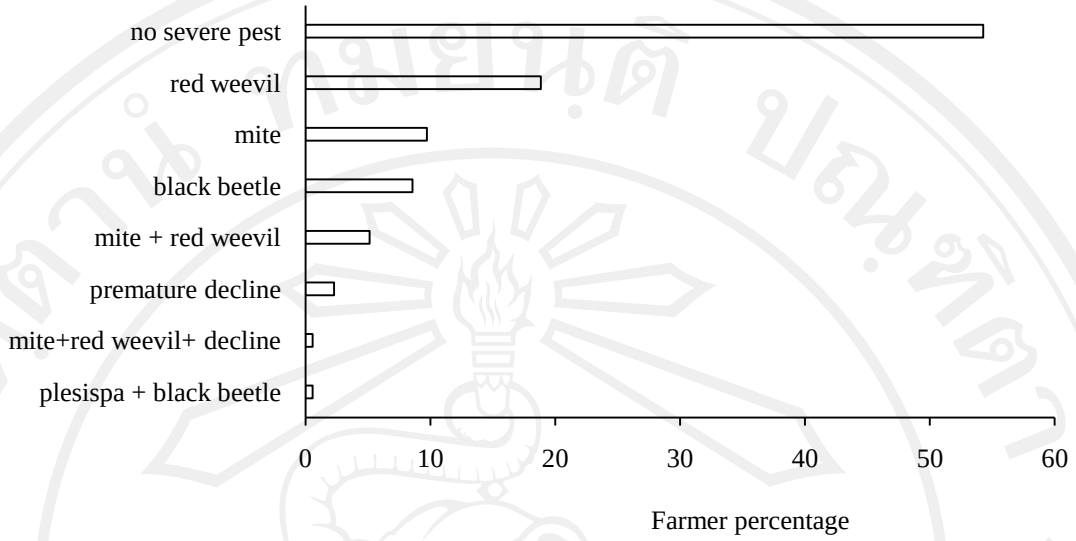

Figure 4.7 Percentage of pest problems appeared in coconut plantations

Coconut related organizations are not functioning well in the district and most of the smallholders were not aware of these. Some farmers were benefitted by other farmer organizations not directly related with coconut to obtain their fertilizer and seedlings requirements. Out of the respondents 66.9 percent told that they did not involve in coconut related farmer organization while 19.4 percent had taken the benefit from other farmer organizations and 13.7 percent did not aware of any organization.

The coconut smallholder farmers in the study area had obtained information on coconut farming in many ways. Extension service and media have played a main role on providing information. There are 18 CDO officer divisions in the Gampaha district under the regional CCB office and village level extension officers are there to provide the extension service. CCB and CRI have published leaflets and booklets related with coconut cultivation (printed media) and those are available for coconut growers for a low price. 27.4 percent of the farmers gained information from extension and written

media. Other than that their own experience had been useful for them to do farming without any external information. Out of all 22.9 percent of the farmers used their own experience for coconut cultivation. Obtaining information from neighbors was not an important source comparatively with others. Beside that 14.9 and 12.6 percent of the farmers had gained information from extension and experience both ways and extension alone respectively (Figure 4.8).

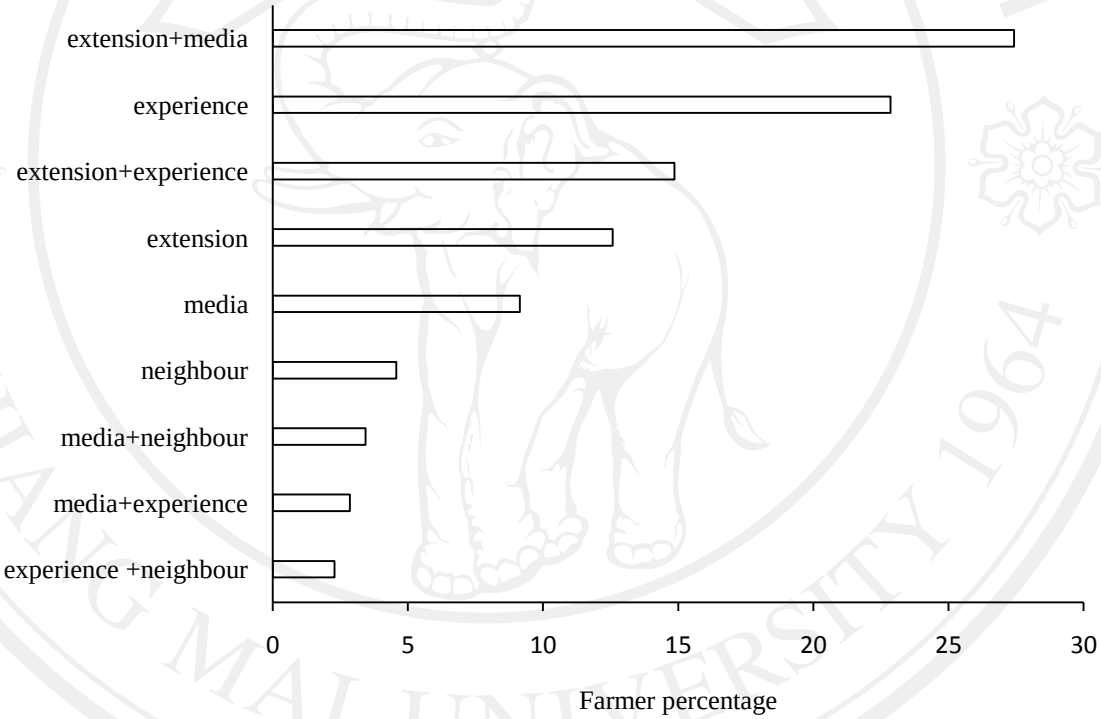

Figure 4.8 The ways of obtaining information by smallholder farmers

Only 32.57 percent of the farmers received trainings in coconut cultivation. The trainings were mainly based on fertilizer application and pest control. Out of the surveyed farmers 64 percent told that they need trainings in new techniques of coconut cultivation. Thirty six percent were reluctant to participate in trainings since their existing knowledge and experience is sufficient to maintain coconut cultivation.

Extension service is doing a great role in introducing different technologies of coconut cultivation. According to the information from CCB regional office of Gampaha district, Assisistant Regional Managers and Coconut Development Officers under the Regional Manager are mainly responsible to carry out field level extension service. The number of present officers are not sufficient to observe each and every field. Therefore Agricultural Production and Research Assistants from Department of Agriculture have been allocated to inspect the field problems in village level. Out of the surveyed households 62.86 and 8.57 percent received upto five and more than five extension contacts respectively within 2010. But 28.57 percent did not receive extension contacts because they did not informed their ploblems and some of the fields were not having considerable problems. Some farmers told that the officers visit only to the subsidized fields.

Majority of the smallholder farmers did not take credit facilities although ("Kapruka Ayojana" credit scheme) that is a concessionary financial assistant service conducted by CCB in collaboration with participatory financial institutions (Banks) in order to provide investment capital for the development of coconut lands. Only three farmers (1.7 percent) out of 175 accessed credit for intercropping and fertilization. Many reasons were dealing with not obtaining credit facilities. According to the surveyed results, majority of the farmers (49.7 percent) were able to manage the cultivation without credit. Most of the farmers employed in diversified technologies mentioned that their income is sufficient to manage cultivation without credit. About 29.1 percent thought of taking credit as a burden and responsibility. Some farmers (8.6 percent) had not accessed to credit due to inability to repay. Besides that, problem

of deed (4.6 percent), need of collateral (3.4 percent) and having small size of land (2.9 percent) were among the other reasons.

Coconut land improvement subsidy schemes are available for coconut growers. But majority of the smallholder farmers had not been benefitted by that. Out of the studied farmers only 24 percent had taken subsidies. Most of them had taken subsidy for replanting (24 percent). Beside that some had used the subsidy for moisture conservation, fertilization, intercropping, livestock integration and new planting. According to the surveyed results there were many reasons for not taking subsidy. Some of the farmers (13 percent and most of them belonged to monocropping system) told that they could manage without subsidy while others told reasons such as more documentation (need to fill many applications), no proper land right and small land size. Out of the total 20 percent of the farmers were not aware of the subsidy scheme and about 3 percent have recently applied for that (Figure 4.9).

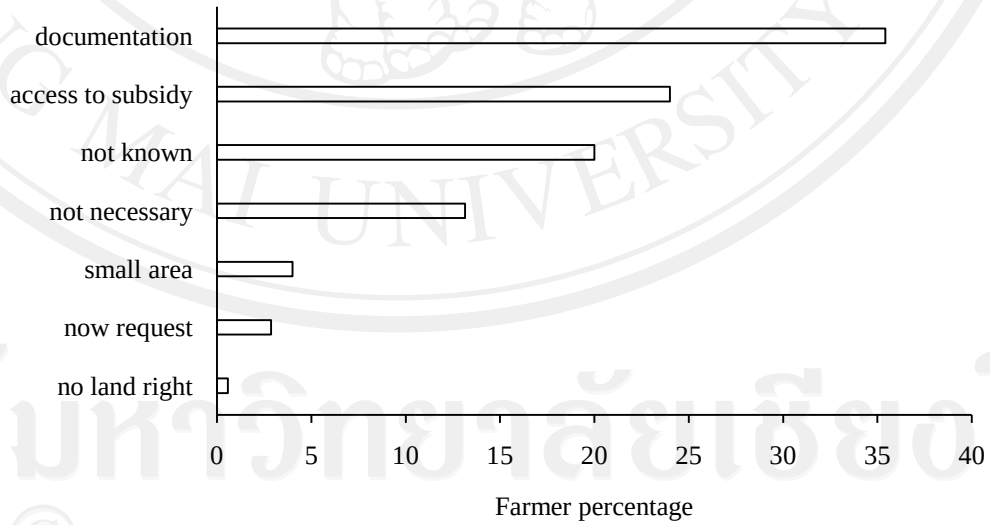

Figure 4.9 Reasons given by smallholder farmers for not accessing to subsidy

4.8 Comparison of different coconut-based farming systems

The main coconut based production systems of the area are intercropping, monocropping. The majority of coconut smallholder cultivations in the study area maintained as monocropping plantations while the second place had been taken by intercropping plantations. Beside that a few farmers employed in livestock integration coconut based farming system. Out of the randomly selected 175 smallholders, 82 (46.85 percent) were monocropping coconut smallholder farmers and 69 (39.43 percent) and 24 (13.72 percent) were intercropping and livestock integration smallholder farmers respectively. The intercropping and livestock integration systems are diversified sustainable systems than monocropping system. Coconut monocropping has been identified as an inefficient land management system of low productivity and poor economic returns comparatively with other systems.

4.8.1 Comparison of demographic characteristics of three farming systems

According to the survey results age of smallholder farmer in monocropping system was comparatively lower (53years) than other two systems but the difference was less (2-3 years). Out of the total farmers, 71 and 61 percent of the farmers in integaration and intercropping systems respectively belonged to older range of age (more than 50 years) while that was 51percent in monocropping system.

Comparatively, size of the household was smaller in monocropping system (3.3) than other two diversified systems (3.71 and 3.77). There was not a vast difference in full and part time farmers percentages among all three systems. But part time farmer percentage was slightly higher in intercropping system (70 percent).

Table 4.5 Demographic characteristics of farmers in three farming systems

Demographic characteristics	Monocropping n= 82		Livestock integration n= 24		Intercropping n= 69	
	no.	%	no.	%	no.	%
Farmer's age range (years)						
< 30 years	4	5	-	-	1	1
31-50	36	44	7	29	26	38
51-70	40	49	16	67	40	58
>70	2	2	1	4	*2*	3
Age (mean)		53		56		55
Size of the household (mean)		3.30		3.71		3.77
Occupation						
-full	28	34	8	33	21	30
-part	54	66	16	64	48	70
Education level						
Primary level	-	-	-	-	1	1
Secondary level	14	17	1	5	8	12
Higher secondary	58	71	20	83	45	65
Higher	10	12	3	12	15	22
Years of education (Mean)		10.95		11.08		11.90
Experience range (years)						
<15	13	16	2	8	2	3
15-30	42	51	15	63	35	51
>30	27	33	7	29	32	46
Experience (mean)		27.54		29.08		32.25

Source: Survey, 2011

All most all the farmers were well educated completing 10 years of schooling. In all three systems majority of the farmers belonged to higher secondary education

level. Smallholder farmers in monocropping system had the least coconut farming experience (27.54 years) than other farmers in diversified systems and that was highest in intercropping system (32.25 years). Majority of the fermers in all three systems belonged to 15-30 years of experience range. Higher persentage of farmers in intercropping system had more than 30 years of experience (46 percent) than other two systems (Table 4.5).

4.8.2 Comparison of bio-physical characteristics of three farming systems

According to Table 4.6, the smallholder farmers belonged to livestock integration system owned the largest land size (4.24 acres) than other two systems while the monocropping farmers owned the smallest land area (2.41 acres). Coconut yield per acre of monocropping system was lower than other 2 systems. The yield incensement in livestock integration and intercropping system was 5.8 and 6.6 percent than monocropping. Higher percent (28 percent) of the smallholder farmers of intercropping system had obtained more than 3,500 nuts per acre while that was only 21 percent and 17 percent in livestock integration and monocropping systems respectively.

According to farmer view, all the farmers in livestock integration system owned fields having at least medium soil fertility while this was lowest in monocropping system (85 percent). All the farmers in livestock integration system applied organic fertilizer since livestock was associated with the system. Out of all 48 percent of farmers belonged to monocropping system did not apply any fertilizer and that may be one reason to have 15 percent of poor fertility fields (Table 4.6).

Table 4.6. Bio-physical characteristics of farmers in three farming systems

Bio-physical factors	Monocropping n= 82		Livestock integration n= 24		Intercropping n= 69	
	no.	%	no.	%	no.	%
Land size range (acres)						
< 3	62	76	13	54	41	59
3-6	12	14	5	21	17	25
7-9	5	6	2	8	8	12
>9	3	4	4	17	3	4
Land size (mean)		2.41		4.24		3.43
Coconut yield range (nuts/acre)						
<2000	21	26	5	21	20	29
2000-3500	47	57	14	58	30	43
3501-5000	12	15	3	13	15	22
>5000	2	2	2	8	4	6
Yield (mean)		2,467		2,611		2,631
Soil fertility condition						
-good	11	13	11	46	15	22
-medium	59	72	13	54	50	72
-poor	12	15	0	0	4	6
Fertilizer used						
-chemical and organic	2	2	16	67	18	26
-organic only	10	12	8	33	6	9
-chemical only	31	38	0	0	34	49
-none	39	48	0	0	11	16

Source: Survey, 2011

4.8.3 Comparison of socio-economic characteristics of three farming systems

Most of the surveyed smallholders (33 percent) in monocropping system had not contacted with extension officer in the last year. On the other hand, 75 percent of the farmers in livestock integration system and 74 percent in intercropping system contacted with extension. Moreover, 17 percent of the farmers in the livestock integration system received more than 5 extension contact and that was 9 and 10 percent in monocropping and intercropping system respectively. Further, one farmer in intercropping system received 11 times extension visits. Majority of the farmers (33 percent) in the livestock integration system had taken subsidy than other two systems and that was minimum (16 percent) in monocropping system (Figure 4.10).

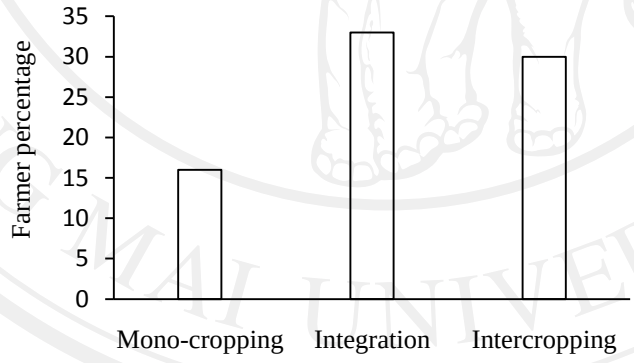

Figure 4. 10 Subsidy taken by farmers in three farming systems

Some farmers told that the extension officers frequently visit to subsidized fields than others to monitor the field work operated under subsidy. Therefore that may be the reason for the livestock integration system having maximum values for all the two characteristics. The trainings had also been received by the majority of

farmers (50 percent) in the livestock integration system than other two systems (Table 4.7).

According to the results hired labour utilization was highest in livestock integration system than other two systems. The mean of labour used was 94 units per year. That was 62 percent and 37 percent in intercropping and monocropping systems respectively. For the rearing of livestock it needs more labour continuously than growing crops. Coconut is a perennial crop and when it is grown alone that need less labour comparatively. In all the systems hired labour used was higher than family labour used (Figure 4.11).

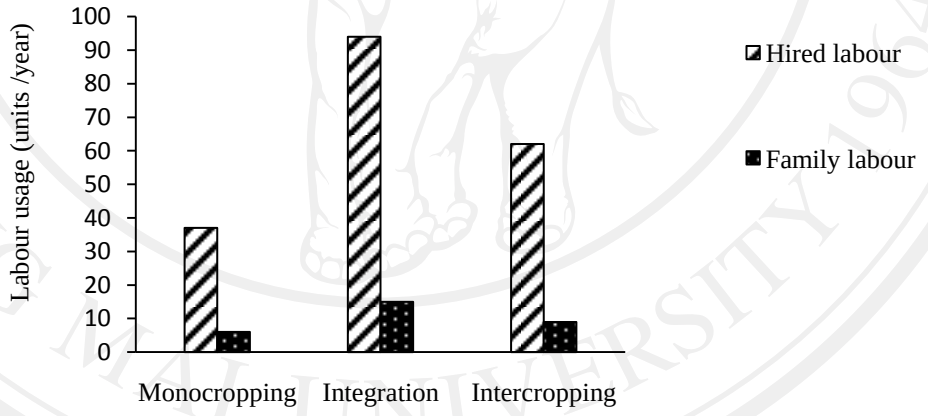

Figure 4.11 Labour utilization of three farming systems

Table 4.7 further illustrates that smallholder farmers obtained farm income from coconut based cultivation as well as off-farm income from other occupations. The farmers in the livestock integration system obtained the highest off-farm income (4,24,875 rupees) annually while that was lowest in intercropping system. As well as

total farm income per acre per year was also the highest in livestock integration system (2,22,406 rupees) than other two systems and that was lowest (73,570 rupees) in monocropping system. When the income from coconut is considered, that was also the highest (89,858 rupees/ac/year) in livestock integration system than other too systems. The main reason for this may be due to the adoption of integrated nutrient management resulted in high soil fertility had increased the coconut production since all the 24 farmers in this system had fertilized their fields.

Both climbers and pole harvesters harvest the coconut and it takes about 2500 to 3500 rupees to pluck the coconut per acre. Coconut fertilizing, harvesting (plucking) and collecting are the most labour consuming field operations. Smallholder farmers have to face difficulties to find out a knowledgeable person for harvesting.

There was no marketing problem for selling of coconut because intermediate traders come to the field with vehicles to collect nuts. If the nuts are too small two nuts are considered as one and barren and deformed nuts are rejected. Those are used mainly for home consumption. The price of a nut ranged from 21 rupees to 32 rupees in 2010. Smallholder farmers sell the nuts as two forms such as husked nuts (with husk) and de-husked nuts (without husk) for different prices. The price difference between those two types is around 2-3 rupees per nut and husked nuts are more valued than de-husked nuts. The reason for this is that the farmers who apply moisture conservation measures need husks for mulching and husk burial and they prefer to sell the product as de-husked nuts for a lower price but to increase the productivity and fertility by those practices which compensate the loss. This situation may create price variability among farmers and buyers too.

Table 4.7 Socio-economic characteristics of farmers in three farming systems

Socio-economic factors	Monocropping n= 82		Livestock integration n= 24		Intercropping n= 69	
	no.	%	no.	%	no.	%
Extension visits						
0	27	33	6	25	18	26
1-5	52	63	14	58	44	64
6-10	3	4	4	17	6	9
>10	-	-	-	-	1	1
Extension visits (mean)		1.87		3.46		3.06
Trainings received						
0	58	71	12	50	48	70
1	23	28	9	38	20	29
2	1	1	3	12	1	1
Off-farm income range (rupees)						
<500000	60	73	14	58	51	74
500001-800000	13	16	6	25	11	16
800001-1100000	3	4	3	13	6	9
>1100000	6	7	1	4	1	1
Off-farm income (10^3)/year		410		425		385
Coconut income (rupees)						
Income (10^3)/year		182		381		271
Income(10^3)/ac/ year		75.5		89.8		79.0
Total Farm income (rupees)						
<100000	50	61	-	-	10	14
100000-500000	25	30	12	50	37	54
500001-1000000	5	6	7	29	13	19
>1000000	2	3	5	21	9	13
Total farm income (10^3)/year		182		943		495
Total farm Income (10^3)/ac/year		73.6		222.4		144.3

Source: Survey, 2011
Note: I US dollar = 113 Sri Lankan rupees

4.9 Description of coconut-based farming systems

4.9.1 Monocropping system

Although coconut is grown alone in monocropping systems the sustainable practices practiced by farmers differ in several ways within the system. Application of fertilizer, applying moisture conservation practices and vacancy filing to replace the destroyed palms were the three common practices among them. According to the number of these common practices carried out in the field the smallholder farmers belong to this system further can be grouped into sub systems to observe some of the characteristics features which were obvious among them. Results are listed in Table 4.8.

Subsystems
1. No any application (8 farmers -10%)
2. Application of one of the practices out of three (22 farmers-27%)
3. Application of 2 practices (27 farmers- 33%)
4. Application of all 3 practices (25 farmers- 30%)

Out of the characteristics mentioned in Table 4.8 mean values of coconut yield per acre, farm income per acre and cost of cultivation per acre were different among sub groups. According to that it can be observed that higher the number of sustainable farming practices applied better the yield and income of coconut per unit land area. It was observed that the farmers belonged to subsystem 2, 3 and 4 had obtained 56 percent coconut yield increasement than the farmers belonged to subsystem 1. On the other hand, when more soil fertility improvement practices are carried out it needs more labour and cost of cultivation can be increased too. Although the means of net farm income had not been significant it was increased comparatively with the

increasing of applied practices. According to the farmer view, soil fertility condition of the field was increased with the application of the practices.

Table 4.8 Characteristics of monocropping subsystems

Characteristics	Mean (Sub system)			
	1	2	3	4
Coconut yield per ac (nuts)	1634	2194	2416	3029
Farm income per ac (10^3 rupees)	50.4	65.0	71.7	90.6
Net profit per ac (10^3 rupees)	30.6	40.5	44.1	53.3
Cost of cultivation/ac (10^3 rupees)	19.7	24.5	27.5	37.3
Soil fertility condition (good or medium (%))	50	77	85	92
Family labour used per ac (units)	4	6	8	8
Hired labour used per ac (units)	10	13	14	15

Source: Survey, 2011

According to the above results farmers who were unable to adopt sustainable technologies such as livestock integration and intercropping due to many reasons have been able to improve coconut productivity and soil fetility by applying farming practices such as fertilization, moisture conservation and vacancy filling. Therefore these result prove that if a farmer can spend financial resources and more labour in monocropping system he or she will be able to obtain economic and bio-physical sustainability more than the farmers who do pure monocropping (without application of any practices).

Out of the surveyed farmers, 48 percent did not apply any type of fertilizer for coconut plantations. Chemical only, organic only and both chemical and organic

fertilizer applied by 38 percent, 12 percent and 2 percent of the smallholders in monocropping system respectively (Figure 4.12).

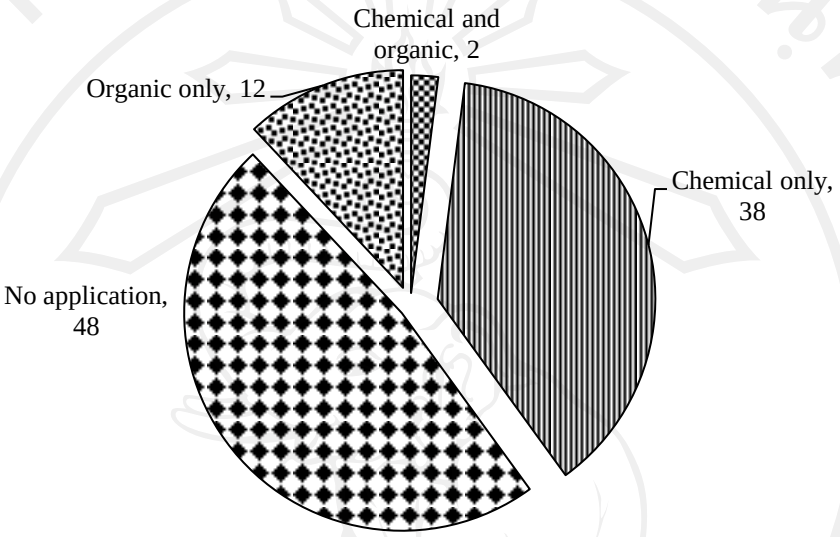

Figure 4.12 Type of fertilizer applied by smallholder farmers (with percentage) in monocropping system

The farmers in the monocropping system gave different reasons for not adopting of diversification systems. Most of them (39 percent) told that the limitation of space among palms due to small land size, unsystematic coconut planting and higher density than the recommended density in the fields was the barrier to adopt diversification. Secondly viewed problem by 29 percent of the monocropping farmers was the labour scarcity and high labour cost. Thirdly important reasons were the financial difficulties and time limitation. Beside those 7 percent of the farmers mentioned that they would like to do diversification in the near future. Due to the

insecurity of land ownership 5 percent of the farmers were not willing to adopt diversified systems (Figure 4.13).

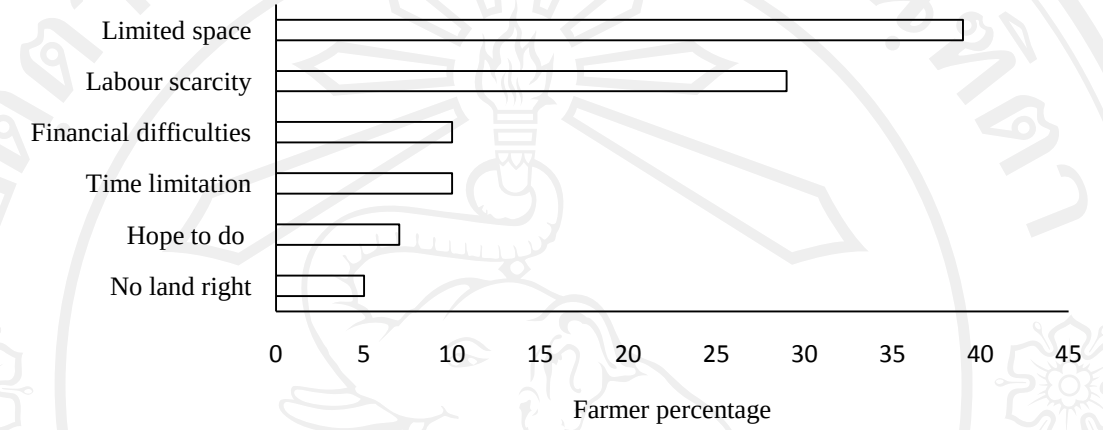

Figure 4.13 Reasons given by monocropping farmers for not employed in diversification

4.9.2 Intercropping system

The smallholder farmers belong to the intercropping system had diversified the system from 11 years in average and minimum and maximum years of adoption were one and 40 years respectively. Majority of the farmers (49 percent) practiced intercropping for less than 10 years and 39 percent of the farmers changed the system from monocropping to intercropping within 10 to 25 years. Only 12 percent diverted their system from more than 25 years. In average 55 percent of the total plantation had allocated for intercropping. This figure changed from 6 percent minimum to 100 percent maximum. Out of the 69 farmers 32 percent had allocated 26 to 50 percent of the coconut plantation for intercropping while 24 percent and 22 percent of farmers

had introduced intercrops for more than 75 percent and less than 25 percent of the total area under coconut respectively.

The smallholder farmers of intercropping system grew different types of perennials and annuals with coconut to obtain efficient land usage and production to reduce risk. The aim of intercropping of almost all farmers was to maximize profit to improve their financial status.

Table 4.9 Number of intercrops grown and farmer percentage

No. of intercrops	No. of farmers	Farmer %
1	31	45
2	25	36
3	9	13
4	3	4
5	1	2
Total	69	100

Source: Survey, 2011

It was visible that this system was not homogenous since the number and type of intercrops grown by the farmers differed in many fields. Among the crops grown fruit crops (banana, pineapple, cashew, rambutan, durian), export agricultural crops (pepper, clove, cinnamon, arecanut, betel, ginger), tuber crops (cassava, yams) and tea were observed since this area is rich with favourable climatic factors for different types of crops. Altogether 15 types of intercrops were observed in the intercropping coconut based system. Most of the fields (31) or 45 percent had only one intercrop. Majority of smallholders (59 percent) grew banana since this is the most popular fruit crop among Sri Lankans. Pepper was taken the second place (32 percent) due to

higher market demand with better farm gate price (400-500 rupees/kg). Beside that pineapple (20 percent) and rambutan (30 percent) were the other popular intercrops grown which give higher income and higher demand in local and foreign market (Figure 4.14 and Table 4.9).

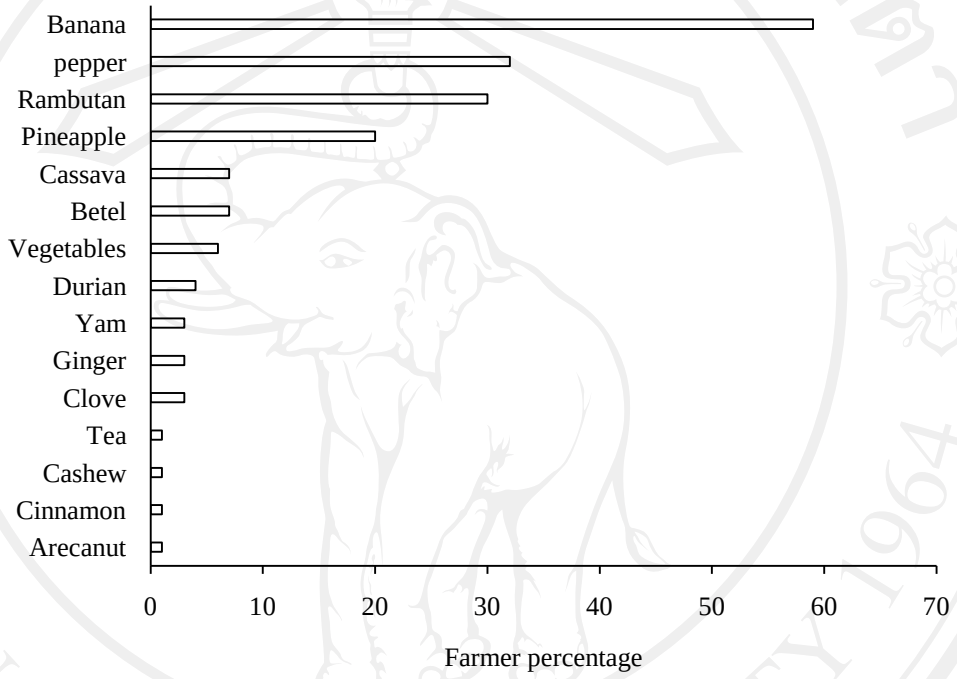

Figure 4.14 Types of intercrops grown and farmer percentage

The effect of intercropping on coconut cultivation viewed by the smallholder farmers can be shown in Figure 4.15. According to that, out of the total intercropping farmers 78 percent positively viewed the system providing with their ideas and experiences. Sixty nine percent told after introducing intercrops moisture retention ability and soil fertility had been increased. They further explained intercropping helps to control weeds and finally all these conditions have become favourable to increase the coconut yield. Some farmers (9 percent) viewed this system is not a lazy

man system as monocropping and frequent visits to the field are necessary to manage properly with intercrops. Due to that attention can be paid more towards coconut too and that is useful to identify pest problems or any other field problems without getting delay. Some of them told that if any tree can hear human voices, that produces more fruits. Therefore frequent farmer and labour visits help to increase productivity of both intercrops and coconuts. Some of the smallholder farmers (19 percent) mentioned that intercropping does not have any advantages or disadvantages on coconut. A few farmers (3 percent) mentioned that they experienced of decrease of coconut production due to competition after intercrop establishment.

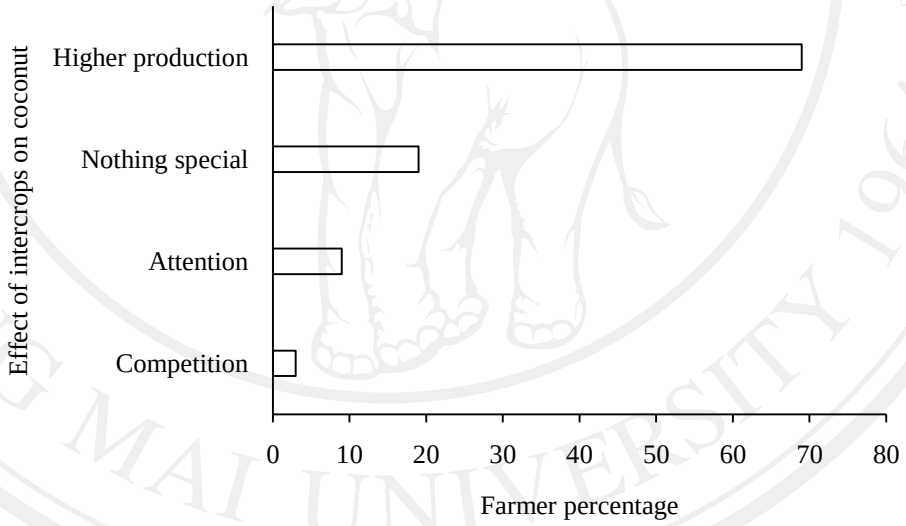

Figure 4.15 Farmer views on the effect of intercrops on coconut

4.9.3 Livestock integration system

Most of the smallholder farmers belonged to the livestock integration system had diversified the system with the minimum of one year to maximum of 25 years. Majority of the farmers (54 percent) had practiced livestock integration from five to 15 years and 33 percent of the farmers changed the system from monocropping to

livestock integration within 5 years. Only 13 percent had diverted their system from more than 15 years.

In livestock integration system farmers rear livestock with coconut and with or without other crops. Common livestock rearing in the studied system were cattle and poultry. Majority of the farmers (63 percent) reared only cattle and 29 percent reared only poultry. Out of the total smallholder farmers included in the system, 8 percent reared both poultry and cattle (Figure 4.16 and Table 4.10)

Table 4.10 Number of farmers and type of livestock reared

Livestock species reared	No of farmers	Farmer %
Poultry and Cattle	2	8
Cattle only	15	63
Poultry only	7	29
Total	24	100

Source: Survey, 2011

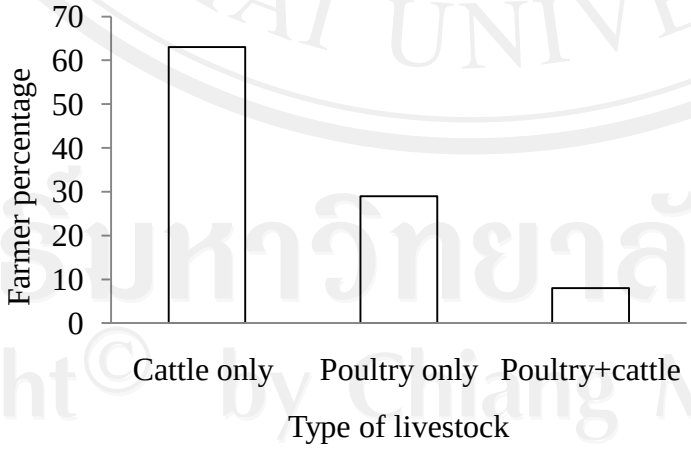

Figure 4. 16 Types of livestock reared with farmer percentage (integration system)

In this system 11 types of crops were observed except coconut. Like the intercropping system most of the farmers (42 percent each) grow banana and pepper. Beside that they had cultivated mainly other types of perennials and low country vegetables (Figure 4.17).

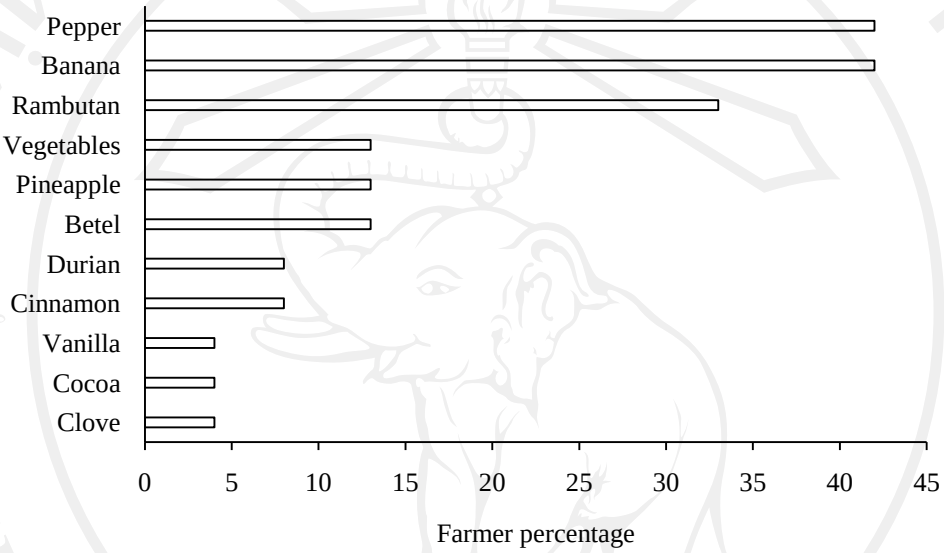

Figure 4.17 Types of crops grown and farmer percentage (livestock integration system)

One of the important features of this system was that no one complained about poor soil fertility. The main reason for this may be the adoption of integrated nutrient management by 67 percent of the farmers and further all the farmers used organic fertilizer gained from livestock (cow dung, poultry manure and compost) to fertilize their fields. All the smallholder farmers of this system mentioned that the main advantage of this to coconut production was the enhancing the addition of livestock manure to coconut and weed control by cattle. Main products gained by the farmer from this system were milk and eggs since the cattle and poultry were reared as dairy

cattle and layers and only one farmer had employed in broiler production within the field intensively. Other farmers were rearing livestock under semi intensively.

4.10 Problems faced in coconut farming

According to the surveyed smallholders, the problems faced in coconut cultivation can be given as fallows in Table 4.11.

Out of the respondents 18.28 percent told that they did not face any problem in coconut cultivation. Labour scarcity and high labour cost were the main constraints faced by the majority of the farmers having problems. Since the study area is semi urban most of the people are employed in industrial sector. There is an acute shortage for skilled labour necessary for harvesting of coconut (both climbers and pole harvesters). A reason for this may be the new generation is unwilling to take up this job due to social stigma. In Gampaha district, high wage rates (700-800 rupees per day) are observed than other regions.

Table 4.11 Problems faced by the coconut smallholder farmers

Problem	Number of households	Percentage of householders
No considerable problem	32	18.28
No stable price	33	18.85
No labour and high cost	37	21.14
No money	22	12.57
Pests	15	8.57
No quality seedlings	30	17.14
High fertilizer cost	20	11.43
Less yield	5	2.85
Theft	16	9.14

Source: Survey, 2011

There is no stable farm gate price for coconut and it fluctuates within and between years (Figure 4.18). This was the second major problem of the farmers. Out of all 18.85 percent mentioned this as their major problem. The price varies with the pick wise variation of coconut production. During low production periods usually price is becoming higher. Income status of the farmer had influenced on coconut farming. Out of all 12.57 percent of the farmers mentioned that financial problem had made them difficult to manage the coconut cultivation successfully. The cost of fertilization has been a great barrier and fertilizer subsidy has been given to encourage farmer to fertilize their fields recommended. According to the results in Table 4.11, 11.43 percent of the farmers considered high fertilizer cost as a problem in cultivation. The price of 50kg bag of fertilizer varies from 2500-3000 rupees in the market. Adult coconut palm requires 3-5kg of fertilizer yearly. According to the subsidy scheme the farmer can buy a bag for 1300 rupees. When the time of surveyed most of the farmers had applied for fertilizer subsidy to get that benefit. Pests and theft problems, low quality planting material and fewer yields were among the other problems faced by smallholder farmers in the study area.

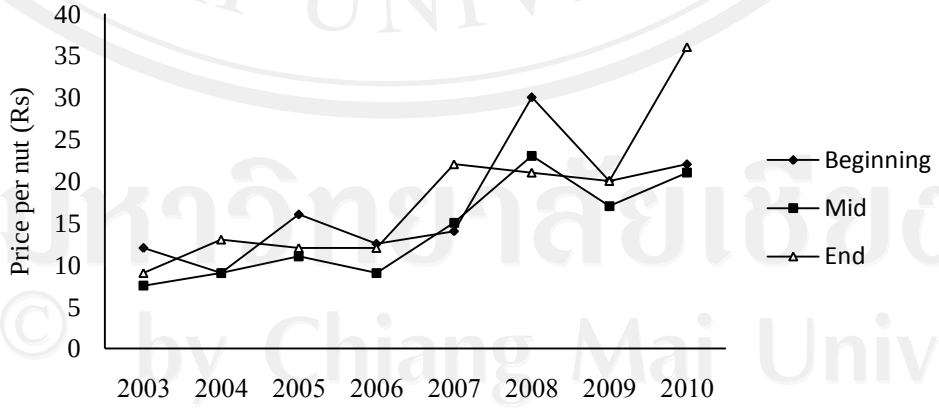

Figure 4. 18 Farm gate price of coconut from year 2003-2010