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**CLUSTER ANALYSIS OF UPLAND
FARMING PRACTICES IN THE PHILIPPINES**

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INTRODUCTION

Between February 1986 to June 1988, a study was undertaken jointly by the staff of La Trobe University, Visayas State College of Agriculture (ViSCA) and the Victorian Department of Conservation, Forests and Lands. This research project was funded by the Australian Centre for International Agricultural Research (ACIAR). It was administered through La Trobe University and the research activity was conducted through ViSCA and Victorian Department of Conservation, Forests and Lands as collaborating agency.

The project attempted to investigate the socioeconomic aspects of the adoption or non-adoption of improved cropping methods, particularly soil conservation techniques by upland farmers in the island of Leyte, Philippines (See Figure 1). This project is intended to complement research being undertaken in Agronomy and Soil Science to provide a complete perspective of the problem. The study was conducted in four research sites namely : Tabing in Tabango, Canquiason in Villaba, Pomponan in Baybay and San Vicente in Bontoc (See Figure 2).

Cluster analysis was one of the important techniques used in analysing the data and was expected to show important groupings of the population. The derived groups or clusters could then be expected to assist in explaining the similarities or differences of the families, farms, farmers and farm household characteristics in relation to adoption of soil conservation practices in Leyte, Philippines.

Chi-square tests were also used to test the significance of the association between variables under consideration and to ascertain the extent to which the variables contributed to differentiating between the clusters.

The objective of this paper is to show that a multi-variate statistical procedure like cluster analysis when applied to agricultural data can provide an important input into of policy formulation and aid to hypothesis formation and normative judgements about optimal husbandry practices. This paper provides an entree into consideration of their usefulness in the context of agricultural practices in the upland areas of the Philippines.

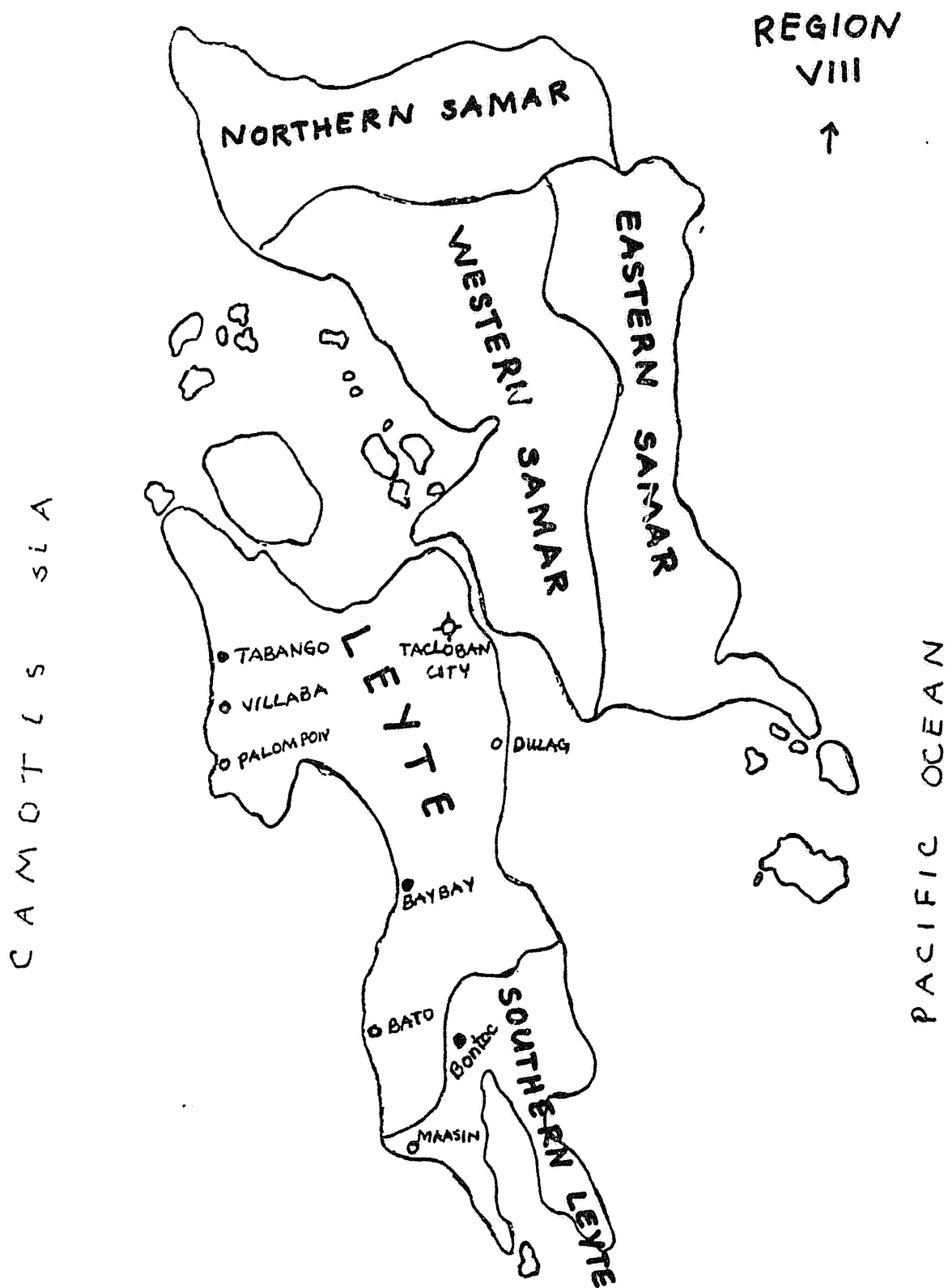


Figure 2. Map of Eastern Visayas Region showing the island of Leyte

THE SURVEY

The substantive nature of the survey to which the cluster analysis was applied, together with the survey methodology is fully described in the proceeding of the workshop on "Socioeconomic Constraints to the Adoption of Improved Cropping Methods by Upland Farmers in Leyte, Philippines: A Project in Progress (ACIAR PN 8541)" held in the Visayas State College of Agriculture, October 18-20, 1988. A copy of the proceedings is available at the Dean's Office, School of Economics and Commerce, La Trobe University.

This section presents a brief summary of the research methodology used. The sampling methods used in this study were complete enumeration and proportionate stratification. During the start of the project a complete enumeration survey was conducted to classify farm households in the four research sites selected. The farm households were classified according to farm size and according to whether or not they practice soil conservation in their upland farms. There were three strata considered in terms of farm size for each research site. They were small (1.0 and less), medium (1.01-3.0ha.) and large (>3.0 ha.). After identifying the strata, proportionate allocation of elements was carried out with 40 samples per research site. A total of 160 sample farm households for the whole study area.

The projects' interview schedule was designed in an iterative manner. The first-round survey was employed to gather basic demographic and socioeconomic data to classify farmers for sampling purposes. In the second and subsequent rounds, the information generated was used to develop further detailed questions. Questions were grouped according to the kind of survey conducted and types of respondents. For example, we used one set of schedules or forms when we conducted rapid rural appraisal and another set for a frequent interview survey. During the frequent interview survey, different sets of questions were designed for the farmer, for the housewife and the children. The interview schedule was pre-tested and pre-codified before being used.

The project used different methods of data collection depending on the type of information required, namely: formal and informal methods. The formal methods were single interview survey, frequent interview survey, monitoring, record keeping and direct measurement while the informal methods included reconnaissance survey, informal follow-up interviews, and participant observations.

The data collected was initially assembled in a conventional way, mainly cross-tabulations were produced to obtain an initial insight about the characteristics of the farm households and their farms in general. It also provided valuable information concerning upland farming practices and their reasons for adopting or not adopting soil conservation practices in their upland farms. Because of the voluminous data gathered; and the

univariate and bivariate analysis performed, it was argued here that a much simpler and more empirically meaningful analysis could have been achieved by producing 'significant' groupings of the sample farm households and then considering their differences, in terms of each group's distinguishing variables. Further analysis could then be made base on the differences in the behaviour of the individual group.

A clustering method is a multivariate statistical procedure that starts with a data set containing information about a sample of entities and attempts to reorganise these entities into relatively homogenous groups (Aldenderfer, M., 1984).

The remainder of this paper begins with the techniques used and presents the application of the clustering approach to the project data in the hope of getting clearer patterns and useful findings. It should be emphasised that the objective of this paper is to inquire whether an alternative way of analysing data might throw up fresh insights into the survey responses.

CLUSTER ANALYSIS - THE TECHNIQUE

Cluster analyses were run on a PC micro-computer using SPSS PC Version 2.0 . The project's raw data was originally coded in DBASE format. The preliminary data manipulations were accomplished using DBASE III + package. At the time data was in a form ready to be clustered, it was translated to SPSS PC format.

The entire data set was partitioned into the following subsets and cluster analysis performed on each family , farm, farmer and the farm households characteristics. The data sets analyzed presented the substantive picture of the similarities and differences among groups of farm households and their farming practices.

In each cluster analysis, an agglomeration schedule using complete linkages for the cases under study was produced. This matrix was then scanned to produce a hierarchical fusion of the individual cases into clusters. This fusion process was summarised for each cluster analysis by a "family tree" or dendrogram. The hierarchy fusion ceases when most similar entities are fused.

The number of clusters for each analysis was determined by inspecting the dendrogram and deciding when there was a discontinuity in the Euclidean distance between cluster and beyond which amalgamation of clusters would lead to an unacceptable loss of detail about each cluster.

Each subset of clusters was tested by a chi-square test to measure the significance of the association between the variables under consideration and ascertain to what extent the variables contributed to differentiating between the cluster.

ADOPTION OF SOIL CONSERVATION PRACTICES IN THE UPLAND AREAS

Data on upland farm profile was gathered to ascertain upland farmers' degree of adoption of the soil conservation practices. Farm maps and crop maps were made during the data monitoring process. Type of farms, whether upland or lowland; crop arrangement and sequence were specified in the map. Crops raised for each parcel cultivated was monitored including density, variety, yield and area.

The degree of adoption of the soil conservation practices was classified into fully adopted, highly adopted, rarely adopted and not adopted. Fully adopted means that upland farmers employed soil conservation practices on all parts of his upland farms. Highly adopted refers to the use of soil conservation practices for at least 50 per cent of his upland farms and rarely adopted if it was less than 50 per cent. On the other hand, not adopted means zero adoption or no soil conservation practices was employed. For the purposes of this analysis, degree of adoption was scaled as follows:

Fully adopted	=	100 per cent
Highly adopted	=	82 per cent
Rarely adopted	=	22 per cent
Not adopted	=	0 per cent

Cluster analysis of this information was carried out in relation to some of the family, farm, farmer and farm household characteristics. Family characteristics included net family income, wealth position, liquidity position, size of the family, proportion of family labour contributed to total on-farm labour requirements and proportion of family members aged 14 years and younger. The farm characteristics included net farm income, land productivity, land tenure, size of upland area cultivated and proportion of upland area cultivated to the total farm area while the farmer's characteristics were age, farming experience and educational attainment.

Table 1. Some characteristics of the sample farm households.

Variables	Mean	i.e 'p' Per cent of samples with values greater or equal to the mean
Net family income (pesos)	9,432.03	22.93
Net farm income (pesos)	9,990.92	24.20
Wealth position (pesos)	12,472.74	33.12
Liquidity position (pesos)	11,499.89	15.92
Land productivity (pesos)	4,175.75	26.11
Proportion of family labour contribution to on-farm labour requirements (%)	71.23	59.24
Proportion of family members with age 14 years old and below (%)	35.00	45.22
Farming experience (years)	23.47	49.00
Educational attainment (years)	4.43	52.00
Size of upland area cultivated (Ha)	1.27	31.21
Age (years)	47.00	51.59
Adoption Score (%)	50.68	48.41

1. Family characteristics

The survey information gathered in this section provided detail on the degree of adoption of soil conservation practices and family characteristics. The data allowed groupings of families with similar characteristics. The resulting pattern of characteristics is presented in Figure 3. The cluster groupings were labelled as Groups 1A, 1B, 1C, 1D and 1E. Table 2 was presented for purposes of comparison of characteristics between cluster groups.

Group 1A. Zero per cent adoption score and family characteristics

This group comprised 29 per cent of the sample families and consisted mainly of low net family income, wealth positions and liquidity positions. There was an over-representation of families (89%) in this group with net family income below the total sample mean (P 9,432.03). Sixty one per cent of the sample families in Tabing fell in this group.

There was a range of sources of family income, but an over-representation of families in this group (59%) whose income from off-farm source was more than from farm sources. The most common off-farm source was labouring on another farm and remittances

from older children working outside their own farm or village. Farm income was derived from both upland and lowland farms.

The mean wealth position of the representative families was P 3,492.85, well below the total sample mean of P 12,472.74. Seventy eight per cent of the families in this group had a wealth position less than the total sample mean. Only one sample family owned land, 92 per cent owned animals. However, all of them had tools and equipment for farm production purposes. Livestock were commonly pigs and chickens with few caribous, goats, dogs, and ducks while tools and equipment were bolos, ploughs, harvest tools and others.

The representative sample had a mean liquidity position of P5,853.29 per year, well below that of the total sample mean (P11,499.89). Liquidity positions vary between sites. In Tabing, all representative sample families fell under this group which mainly implies that in general, families were poor compared to that of the other sites.

This group of families was also characterised as having the highest mean proportion of family labour contribution to on-farm labour requirements in spite of the high proportion of family members who are aged 14 years and below. This finding can be supported by the fact that this group cultivated the lowest mean acreage of their farms.

The cropping type used by this group of upland families were monocropping of annual crops mostly corn; upland rice; and a few root crops and perennial crops.

Group 1B. Twenty two per cent adoption score and family characteristics

This group formed 22 per cent of the total sample families having rarely adopted the soil conservation practices in their upland farms. It was represented by 43 per cent of the families in Canquiason and 26 per cent in Tabing. It had a mean net family income of P7211.82 and liquidity positions of P7381.62 per year, lower than the mean of the total sample but had a greater wealth positions. Sixty seven per cent of the representative sample had net family incomes below the total sample mean.

Sources of family income included own-farm and off-farm activities. The same as the previous group, the most common off-farm activities are labouring on another farm and remittances from children who worked outside their own farm or outside the village. Older children who are not in school migrated to capital cities to look for better job to earn cash income which most of the time was used for family and farm expenses. Sixty three per cent of the representative sample were getting more income from farm sources (both upland and lowland) than from off-farm sources with a mean of P10,838.63 per year from farm sources (62%) and P6,677.69 per year from off-farm sources (38%).

Although this group achieved lower net family income and liquidity positions per year, they possessed more wealth than Group 1A and Group 1C (Table 2). Thirty five per cent of the representative sample owned the land they cultivated and 89 per cent of them owned animals, mostly pigs, chickens and dogs. All of them owned farm tools and equipment for farm production.

This group was also characterised by having a lower proportion of family labour contribution to the total on-farm labour requirements in spite of the higher proportion (69%) of family members whose age is greater than 14 years old. This finding can be explained by the fact that this group of families are better-off than Group 1A as reflected by a higher net family income, liquidity positions and wealth positions. They have a greater capacity to hire labourers to perform farm activities.

The cropping type of this group was annual crops together with few perennial crops in varying arrangements, sequences and densities. Perennial crops were planted randomly on the farm with low density or sometimes used as borders.

Group 1C. Eighty two per cent adoption score and family characteristics

This group made up 16 per cent of the total sample households mostly from Pomponan(44%) and San Vicente (28%). Representative families from San Vicente grew perennial crops like coconut and banana mixed with root crops and fruits in most of their upland farms while those from Pomponan used bench terraces for rice production in some of their upland farms, those farms that are accessible to spring water. Perennial crops like abacca, coconut and banana were also grown with or without annual crops in areas which are not accessible to irrigation water. Group 1C appeared to have a low net family income, wealth position and relatively low liquidity positions. The mean net family income was P7000.38 per year, a bit lower than that of Group 1B and 1E but higher than that of Group 1A. There was an over-representation (76%) of sample families in this group with net family income lower than the total sample mean.

Family income came from a range of activities but 58 per cent of the representative sample income came from on-farm sources rather than off-farm sources. The mean family income was P11,132.15 from farm source compared to P5,716.90 from off-farm source.

The farm households were also recorded to have the least wealth from among the cluster groups. Only 8 per cent of this group owned farms which they cultivated although all of them raised pigs and chickens and owned small farm tools and minor equipment for farm production.

This group was also characterised by having a higher proportion of family labour contribution to on-farm labour requirements and relatively higher proportion of family members who are in the off-farm labour force.

Group 1D. Eighty two per cent adoption score and family characteristics

It comprised of only one family (0.64%) which was characterised by having an extremely high net family income, wealth position and liquidity position compared to the other sample families. The yearly net family income was P442,525.52 ; wealth position of P202,212.58; and liquidity position of P542,610.15. It had a large farms owned and cultivated, of 13 parcels with an area of about 16 hectares. There were two parcels of upland farms and all the others were lowland farms. The upland parcels were planted with annual crops like upland rice and corn; and perennial crops such as coconut, abaca, banana, coffee and sugarcane. Likewise, lowland farms were devoted to sugarcane production (60%) and rice production (40%).

This sample family got 87 per cent of its family income from farm sources and 13 per cent from off-farm sources. The most important enterprises contributing to wealth were sugarcane and rice production. The family are also in business, running a public utility transport; farm machinery for hire such as hand tractors for cultivation and trucks for hauling farm products; lending cash and in-kind to neighbouring farmers and have other assets that will generate income.

The family also had a number of farm animals including caribou, cattle, pigs, dogs and chickens and possessed modern farm tools and equipment.

The family size of this group was 12, all except one being below 14 years of age. Most of the members were engaged in full-time farm and off-farm income generating activities but because of the bulk of farm activities, 72 per cent of the farm labour were supplied by hired labourer. In addition the wealth of the family permitted it to employ labourers to work on the farm.

Group 1E. One hundred per cent adoption score and family characteristics

This group contained 32 per cent of the total sample families predominantly from San Vicente, Bontoc (57%) and Pomponan, Baybay (39%). Representative families from San Vicente raised mostly coconuts and bananas mixed with annual crops while those from Pomponan used bench terraces for rice production in all their upland farms. Some others raised perennial crops with or without annual crops. Two (8%) of the representative families from San Vicente used hedgerows. They planted ipil-ipil (*Luecaena glauca*) and madre de cacao, a leguminous tree as hedges along the contour and annual crops like corn, legumes (peanut, mung bean) and root

crops in between hedgerows.

This group also appeared to be better-off than the other cluster groups except Group 1D. It had a mean net family income of P7,259.44, wealth positions of P13,780.55 and liquidity positions of P10,521.19 per year. Most of the income came from on-farm sources. Twenty seven per cent of them owned the land they cultivated and all of them raised animals and owned farm tools and equipment.

Group 1E was also characterised by having a relatively high proportion of family labour contribution to total on-farm labour and a higher proportion of the family members are in the labour force (Table 2).

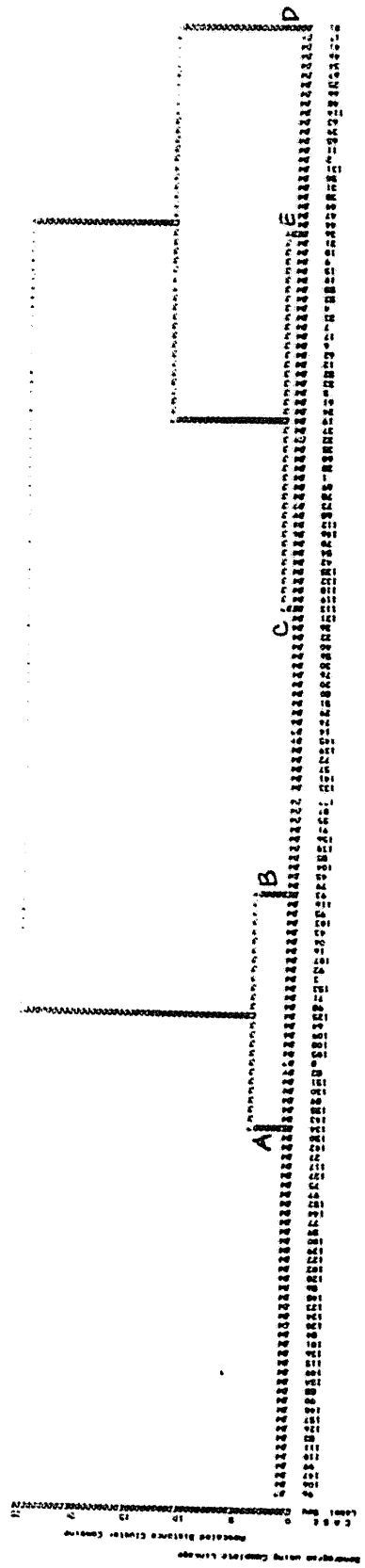
Table 2. Cluster groups according to the family characteristics and percentage adoption of the soil conservation practices in the upland areas of Leyte, Philippines.

Group	Characteristic*					
	1		2		3	
	(pesos)		(pesos)		4	
				(%)		(Hectare)
A	5,383.67	8,492.85	5,853.29	72.85	5.33	39.78
B	7,211.82	13,230.70	7,381.62	69.66	5.26	30.91
C	7,000.38	8,310.56	8,278.48	72.29	5.47	37.50
D	442,525.52	202,212.58	542,610.15	28.00	12.00	8.00
E	7,259.44	13,780.55	10,521.19	71.12	5.43	32.22

*

- | | |
|---|------------------------------------|
| 1 Net family income | 6 Proportion of the family members |
| 2 Wealth position | with age 14 years and younger |
| 3 Liquidity positions | |
| 4 Proportion of family labour contribution to the total on-farm labour requirements | |
| 5 Size of the family | |

Figure 3: Dendrogram for family characteristics and adoption of soil conservation practices



Conclusion :

There were five groupings revealed by the cluster analysis of family characteristics and adoption of soil conservation practices in the upland areas : one group of non-adaptors; one group of rare adaptors; two groups of high adaptors and one group of full adaptors. It is interesting to note that there were two groups of high adaptors. Group 1D consisted only of one sample family with very high net family income, wealth positions and liquidity positions. The income received by the family was more than 20 times as much as the mean of the other cluster groups. The inclusion of Group 1D may have some effects on the reliance of total sample mean in identifying a typical family in the upland areas in terms of the family characteristics.

Other findings revealed by cluster analysis concern the distribution of the sample farm households. The majority of the samples from Tabing fell within Group 1A, with very low net family income, low liquidity position, zero adoption score and possessed the least wealth.

It was also revealed that different soil conservation practices exhibited different effects on the proportion of family labour contribution to on-farm labour requirements. In San Vicente, agro-forestry systems were used. Farmers grew perennial crops such as coconut, banana, coffee and others in the upland farms. These kind of crops are not labour intensive thus on-farm labour requirements are minimal compared to monocropping of annual crops. So that the higher the adoption of the above-mentioned practices, the greater the proportion of family labour contributed to on-farm labour requirements - the amount of family labour being constant. In contrast, Pomponan farmers were using bench terraces to conserve soil resources. This practice is labour intensive as compared to the aforementioned practice. On-farm labour requirements per unit area increases as farmers use the practice because aside from the normal activities in rice production, they had to maintain the terraces, thus increasing labour requirements. Taking the amount of labour as constant, the proportion of the family labour contribution tended to decrease.

In general, family income and liquidity positions came from farm sources (upland farms, lowland farms and animal production) rather than from off-farm sources. It follows that the higher the net family income and liquidity position the greater the adoption of soil conservation practices.

2. Farm characteristics

The survey also attempted to measure how farm characteristics are associated with adoption of soil conservation practices in the upland areas. Information was obtained on net farm income, land productivity, size of upland farms cultivated, land tenure and proportion of the size of upland farms cultivated to the total farm area. Data on net farm income and land productivity were taken from many sources. Quantities and prices of farm products and inputs were monitored by enterprise and by parcel per unit of time for 18 months.

Cluster analysis of this set of characteristics together with the adoption score was performed, resulting in many clusters (See Figure 4). Four groups were chosen for further study and were labelled as Group 2A, 2B, 2C and 2D.

Group 2A. Zero adoption score and farm characteristics

This group had 29 per cent of the total sample farms predominantly with low land productivity and net farm income. Ninety one per cent and 83 per cent of them had land productivity and net farm income lower than the total sample mean, respectively. The findings can be explained by the fact that soil degradation in the farms of this group was very fast due to its limited vegetation; productivity was becoming very poor thus affected the net farm income.

Group 2A had the least acreage of farms cultivated but the proportion of upland farms to that of the total farms cultivated was high (82%).

Land tenure affected not only land productivity but also net farm income. Only one or 2 per cent of the farms were owned, 67 per cent were rented and the others were partly-owned. Farmers appeared to have no interest in developing the rented farms they cultivated, because the lack of assurance of long-term benefits. Also the farmer's net incomes received per year from the farms were affected by the amount of rental the farmers paid to the landlord.

Group 2B. Twenty two per cent adoption score and farm characteristics

This group had a relatively low land productivity, net farm income and size of upland farms but higher than that of Group 2A. The mean land productivity was P3,810.50 per hectare, a net farm income of P8,338.02 per year and a size of upland farms cultivated was 1.17 hectares. There was an under-representation (23%) of the sample farms with land productivity greater or equal to the total sample mean. Likewise, only 26 per cent received a net farm income greater or equal to the total sample mean.

Proportion of the upland farms cultivated to the total size of farms managed was quite high (74%) but most of it (86%) were tenanted or partly owned.

Group 2C. Eighty two per cent adoption score and farm characteristics

Group 2C contained only one sample farm which was characterised by a very high net income and high productivity. This representative sample was in Canquiason with net farm income of P392,755.86 per year and a land productivity of P40,601.50 per hectare. It was the largest farm owned and cultivated, comprising 13 parcels with an area of about 16 hectares. Only 22 per cent of the farm was upland and 78 per cent lowland. Lowland areas were more productive than the upland areas. Sugarcane and rice were the most important enterprises, grown in a semi-mechanised method. Hand tractors were used for cultivation; trucks hauled the farm products; mechanical rice threshers and blowers and other modern tools and equipment were used. Material inputs such as fertilisers and pesticides were used more for rice and sugarcane than for other crops. Crops raised in the uplands were coconut, corn, abaca, banana and coffee but the biggest source of net farm income were sugarcane and rice.

Group 2D. Eighty two per cent and one hundred per cent adoption score and farm characteristics

This group of farms was recorded to be more productive than Group 2A, 2B and the total sample mean with a land productivity of P4,655.97 per hectare. Net farm income was a bit high although a few (4%) got a negative income.

Group 2D was mostly (89%) from San Vicente and Pomponan where perennials are the most important crop in the uplands and bench-terrace techniques of raising rice were popular. Coconut mixed with banana and root crops had the highest productivity in San Vicente and Pomponan while growing rice after rice in terraces was predominant in Pomponan. This group had the highest proportion of upland land cultivated in relation to the total acreage per farm. Twenty one per cent of the farms were owned, 37 per cent were partly-owned, and the others were tenanted.

Figure 4: Dendrogram for farm characteristics and adoption of soil conservation practices

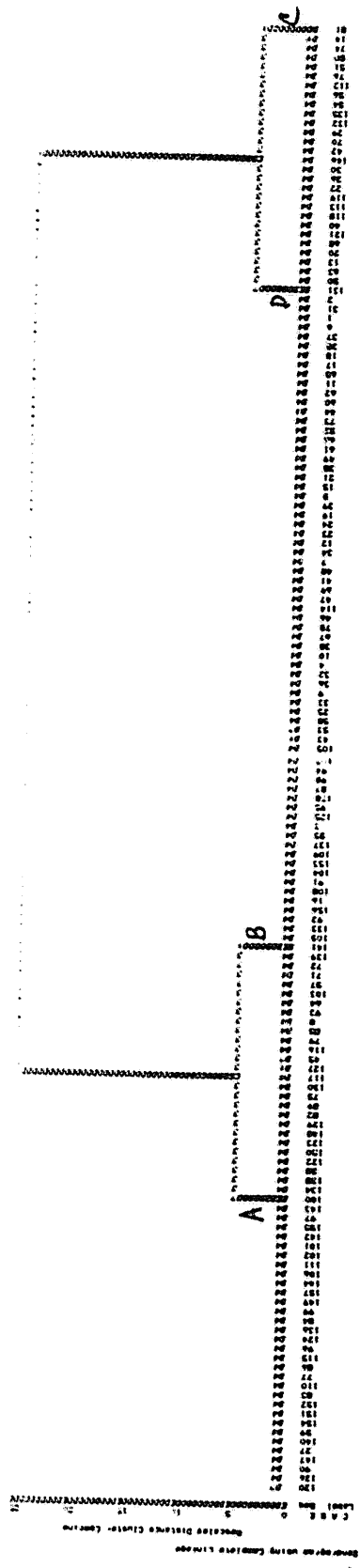


Table 3. Cluster groups according to farm characteristics and the percentage adoption of soil conservation practices in the upland areas of Leyte, Philippines.

Group	Characteristics*			
	1	2	3	4
	(pesos)	(pesos)	(%)	(Hectare)
A	2,878.80	5,175.67	82	0.95
B	3,810.50	8,338.02	74	1.17
C	40,601.50	392,755.86	22	3.50
D	4,655.97	8,612.10	83	1.48

- * 1 Land productivity
 2 Net farm income
 3 Proportion of upland area cultivated to the total farm managed
 4 Size of upland farm cultivated

Conclusion:

The patterning of data revealed by cluster analysis showed that farm characteristics influenced adoption of soil conservation practices in the upland areas. The larger the upland farms cultivated coupled with higher adoption of soil conservation practices, the higher the net farm income and the more productive the farm. This can be explained as follows. Small farm holders tend to use a bigger portion of their farms for annual crop production than perennial crops to sustain supply for food consumption.

As expected, cluster analysis also revealed that land tenure is an important determinant of adoption of soil conservation practices. Eleven per cent of the fully owned farms were highly conserved compared to 4 per cent which were rarely or not conserved. Farmers in upland areas do not want long-term investments. Firstly, present income does not suffice for present family requirements; secondly, most of the farms are not owned thus benefits from such long-term investments will not be received by farmers, part or most of it going to the landlord; thirdly, assurance of long-term utilization of the land resource is not guaranteed, at any time a landlord may eject the tenants if he wishes.

3. Farmer characteristics

The survey also collected data about farmers' demographic including characteristics age, educational attainment and farming experience. It attempted to test how farmer characteristics were influenced by or were associated with adoption of soil conservation practices in the upland areas.

Cluster analysis of this set of characteristics together with the farmers adoption score was carried out and three clusters (See Figure 5) were chosen for further analysis, labelled here as Groups 3A, 3B and 3C. Table 4 was also presented to indicate the main differences and similarities between groups.

Group 3A. Zero per cent adoption score and farmer characteristics

Group 3A consisted of farmers which were non-adaptors of soil conservation practices. They are younger and less experienced farmers compared with other cluster groups (See Table 4). There was an over-representation (67%) of farmers with age less than the total sample mean (47 years old). The mean educational attainment was 4 years. Eleven per cent of the representative farmers in this group did not have formal schooling but 35 per cent finished elementary grades and 9 per cent reached high school.

Group 3B. Twenty two per cent adoption score and farmers characteristics

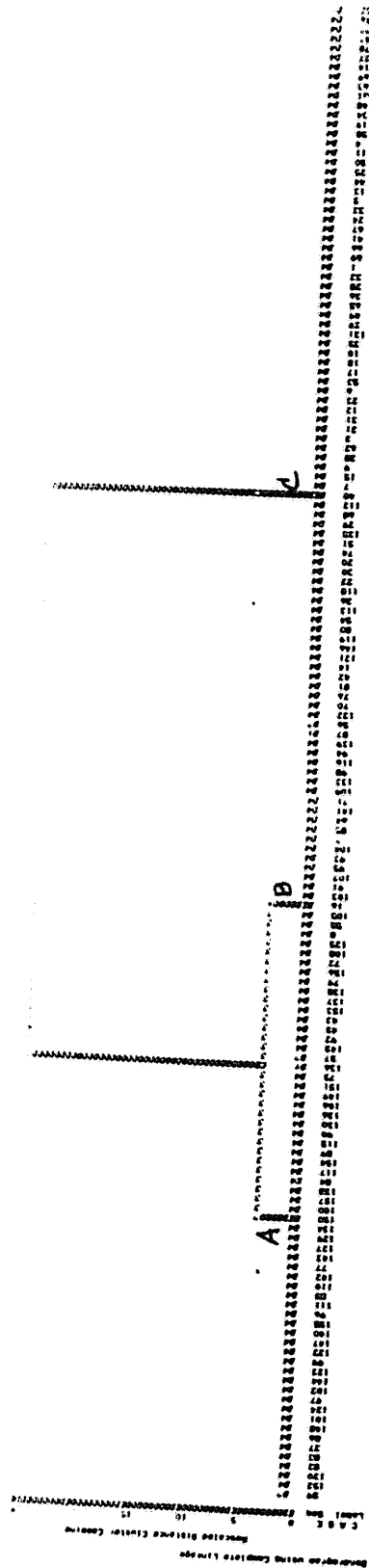
It comprised 22 per cent of the total sample farmers who rarely adopted soil conservation practices. This group appeared to be the most experienced and the oldest group of farmers. Sixty three per cent of them had an age greater than the total sample mean. Also, more than half (60 %) with age 50 years old and above. The eldest was found to be 75 years old.

The representative farmers had a relatively low educational attainment with a mean of 4 years. Fourteen per cent of them had no formal schooling and 46 per cent finished elementary grade. Only 6 per cent reached secondary level.

Group 3C. Eighty two per cent and one hundred per cent adoption score and farmers characteristics

This group consisted of farmers who are high adaptors of soil conservation practices. It represented 48 per cent of the total sample farmers. It appeared that they are more educated than the other cluster groups. The mean educational attainment was 5 years. Eight per cent of farmers had no formal schooling but eleven per cent reached high school. One farmer finished a degree.

Figure 5. Dendrogram for farmers characteristics and adoption of soil conservation practices



Farmers in this group was also characterised by being very experienced and with mean age greater than Group 3A but lower than Group 3B.

Table 4. Cluster groups according to farmer characteristics and percentage adoption of the soil conservation practices in the upland areas of Leyte, Philippines.

Group	Characteristics		
	Age	Farming Experience	Education
	(y e a r s)		
A	42	19	4
B	50	26	4
C	48	25	5

Conclusion :

Cluster analysis has shown that farmers' characteristics may be important determinants of the degree of adoption of soil conservation practices. Further analysis confirms that the greater the farming experience the higher the adoption of soil conservation practices. Group C farmers were mostly a representative from San Vicente and Pomponan which uses agro-forestry systems and bench terracing. The finding is supported by the fact that more experienced farmers tend to be more aware of the changes occurring in the farm like its productivity and other characteristics than those less experienced farmers. It was further concluded that in general, the older the farmer the more they are concerned about soil conservation in the upland areas. Older farmers are obviously more experienced.

4. Farm household characteristics

Cluster analysis was carried out using all the characteristics in section 1 - 3 to ascertain the patterns of characteristics of the farm households in the upland areas. It produced five clusters for further analysis (See Figure 6) which were very similar to the groupings of the family characteristics. It was labelled as Group 4A, 4B, 4C, 4D and 4E. For comparison purposes Table 5 has been prepared to show the distinguishing features of each cluster group.

Group 4A. Zero adoption score and farm household characteristics

This group comprised 29 per cent of the total sample farm households and had a zero adoption score. It contained samples having the lowest net family income and net farm income; and cultivated lands which are least productive. It was also recorded as having very low wealth positions and liquidity positions (Table 5).

There was a range of sources of family income and liquidity positions but most of them were getting more income from off-farm sources than from own-farm sources. Own farm sources included lowland and upland farms. Payments for working in another's farm and remittances from older children were the most important off-farm sources.

Group 4A was also characterised by having the least acreage of upland farms cultivated; although that size is already 82 per cent of the total land area cultivated per farm. Only two per cent of the representative sample fully owned the land they cultivated, 67 per cent tenants and the remainder were part-owners.

The representative farm households were also recorded to have the highest proportion of family labour contribution to total on-farm labour requirements although they have a relatively high proportion of family members who are 14 years old and younger. This finding can be explained by the fact that the total on-farm labour requirement was very low because they cultivated a small size of farm, family labour can still meet the farm's labour requirements. Besides, they are less able to hire labourers for farm activities compared with the other groups.

Farmers in this group tended to be less experienced and younger than in other groups. They finished 4 years of formal schooling.

Group 4B. Twenty two per cent adoption score and farm household characteristics

This category was represented by 22 per cent of the total sample households and have rarely adopted soil conservation practices. A number of these farm households were found in Canquiason (43 %) and Tabing (26 %). They had a low net family income and net farm income of P7,211.62 and P8,338.02 per year respectively compared with the total sample mean of P9,432.03 and P9,990 per year. They had more wealth than those in Group 4A.

Farmers in this group were cultivating on the average 2 parcels of land with a mean area of 1.58 hectares but only 74 per cent represent the upland area. The other 26 per cent are lowland areas. They grew both annual crops and perennial crops. Although perennial crops were grown, they were not planted in such fashion as to provide good protection from soil erosion. Few of these farmers planted perennial crops in a normal density. They

planted them randomly and sparsely on the farm. Besides, they tended to cultivate the area in between the perennial crops, sometimes perennials are only used as a boundary for their farms and they cultivate the entire inner portion for annual crops.

The proportion of on-farm labour contributed by the farm household members was 69.66 per cent, relatively low compared with the total sample mean of 71 per cent. The farm household contained five members, 69 per cent of which were aged more than 14 years. This implies that most of the family members are capable of carrying out farm and off-farm income generating activities.

It also appeared that the farmers in this group of farm households are a bit older than that of Groups 4A, 4C, and 4D; are highly experienced in farming. The group had a mean educational attainment of 4 years which ranged from 0 to 8 years. Eleven per cent of the farmers had no formal schooling but 57 per cent finished elementary grade.

Group 4C. Eighty two per cent adoption score and farm household characteristics

The group was comprised of farm households with high adoption scores and contained 15 per cent of the total sample households. They attained a lower mean net family income and wealth position than those in Group 4B but had higher net farm incomes, land productivity and liquidity positions (Table 5).

The farms of these representative households were owned by 21 per cent of farmers, partly owned by 37 per cent and the others were tenanted. Eighty eight per cent of the total size of farms cultivated was upland and only 12 per cent was lowland. The mean upland area cultivated was 1.44 hectares.

Group 4C was also recorded to have a very high family labour contribution to total on-farm labour with a mean of 72 per cent and a relatively high proportion of the family members in the labour force.

The farmers in this group of farm households had a mean age of 43 years and an educational attainment of 4 years but are more experienced in farming than Group 4A.

Group 4D. Eighty two per cent adoption score and farm household characteristics

This group consisted of one farm household (0.64%) having a unique characteristics compared to the other cluster groups. It had a very high net family income, net farm income and possessed plenty of wealth and cash money income per year. It cultivated and owned a very productive farm of about 13 parcels. The farm household grew highly expensive crops like sugarcane and coffee. Aside farm owning bigger size of farm, this farm household also

possessed high valued assets like farm tools and equipment.

The farm household consisted of 12 members; 92 per cent were older than 14 years . In spite of the highest percentage of the farm household members who are in the labour force, 72 per cent of the total on-farm labour was contributed by hired labourers. This finding can be explained by the fact that this farm household had a very high on-farm labour requirement compared with the other farm households because of the size of the farm. Besides, the farm household is capable of hiring labourers to do farm activities because it possessed plenty of wealth and received very high net earnings per year.

The age of the farmers in this group was 49 years. He finished 5 years of formal schooling. He is very innovative as shown in his farm practices. Aside from using modern farm tools and equipment, he was also using recommended inputs like fertilizer and pesticides in order that his farming business would be very productive.

Group 4E. One hundred per cent adoption score and farm household characteristics

This group of farm households fully adopted soil conservation practices in their upland farms and were found to have attained a higher net family income, wealth position and liquidity position than the other cluster groups except Group 4D (Table 5). Twenty seven per cent of them owned the land they cultivated, 37 per cent, partly-owned and the remaining others were tenants. The mean size of upland farms cultivated was 1.50 hectares, which is 81 per cent of the total area cultivated per farm.

The representative sample was also recorded to have a mean household size of 5 members, 32 per cent of which were 14 years old and younger. The proportion of family labour contributed to the total on-farm labour requirements was high with a mean of 71 per cent.

The farmers in this group appeared to be older and more experienced in the farming business than those in other groups, more educated than those in Groups 4A, 4B, and 4C. On the average, they finished 5 years of formal schooling.

Figure 6. Dendrogram for farm household characteristics and adoption of soil conservation practices

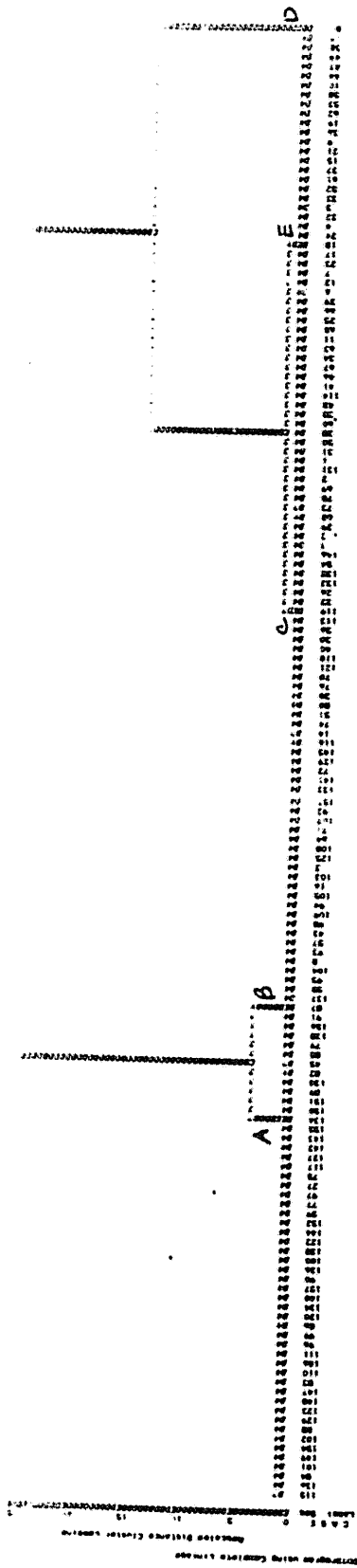


Table 5. Cluster groups according to farm household characteristics and percentage adoption of soil conservation practices in the upland areas of Leyte, Philippines.

Group	Characteristics*												
	1	2	3	4	5	6	7	8	9	10	11	12	13
	(pesos)	(pesos)	(pesos)	(pesos)	(pesos)	(%)	(No.)	(%)	(%)	(Ha)	(years)	(years)	(years)
A	5,383.67	5,175.67	2,878.80	8,492.85	5,853.29	72.85	5.33	39.78	82	0.95	42	19	
B	7,211.82	8,338.02	3,810.50	13,230.70	7,381.62	69.66	5.26	30.91	74	1.17	50	26	
C	7,000.38	8,663.76	4,239.08	8,310.56	8,278.48	72.29	5.47	37.50	88	1.44	43	21	
D	442,525.52	392,755.86	40,601.50	202,212.58	542,610.15	28.00	12.00	8.00	22	3.50	49	30	
E	7,259.44	8,587.79	4,852.15	13,780.55	10,521.19	71.12	5.43	32.22	81	1.50	51	27	

- * 1 Net family income
2 Net farm income
3 Land productivity
4 Wealth position
5 Liquidity position
6 Proportion of family labour contribution to total on-farm labour requirement
7. Size of the family
8. Proportion of family members whose age is 14 years and younger.
9 Proportion of upland farm cultivated to the total farm area managed
10 Size of upland farm cultivated
11 Age
12 Farming experience
13 Educational attainment

Conclusion:

Cluster analysis has shown that net farm income, liquidity positions, land tenure, age and farming experience of the farmer are not surprisingly, a significant determinant of the adoption of soil conservation practices in the upland areas. Thus the greater the adoption the better the farm household's earning capacity. Also, the older and more experienced farmer, the greater is the adoption of the soil conservation practices. Obviously, older and experience farmers tend to be more aware of the changes in the farm productivity and other characteristics compared to the younger and less experience farmer.

Other findings show that land productivity is positively related to adoption of soil conservation practices. Land tend to be more productive if soil degradation could be minimised. Farmers with highly productive farms and high adoption scores tend to have higher liquidity position and net farm earning.

Other dimensions of the data show that tenure status and size of the farms cultivated may have some influence on the amount of net farm income and net family income received by the farm households. Tenants and part-owners spend much for the rental to the land they cultivated thus affecting the net amount received in their farming business compared to owner farm households. Also, the larger the size of farm cultivated, the higher the net farm income, net family income, and liquidity position to the farm households.

Low net farm income households with low adoption scores tend to receive more off-farm income per year and higher proportion of the on-farm labour contributed by family members. This implies that non-adoptors with low net farm income tended to find job outside of their own farms to increase family income to meet the demands for family consumption. Because of this limitation, they can't afford to hire labourers to do farm activities so that the family members have to work harder to meet on-farm labour requirements.

FARMERS PERCEPTION TOWARDS SOIL CONSERVATION PRACTICES IN THE UPLAND AREAS

During the start of the data monitoring, farmers were asked whether or not they're practicing soil conservation in their upland parcels. At the same time their farming practices were monitored to prove whether their perception towards using soil conservation practices was true or not. Their answers were categorised as follows:

YY = for those farmers who said "yes" they practiced soil conservation and were found to have been practicing it;

YN = for those farmers who said "yes" but did not actually practice it;

NY = for those farmers who said "no" but they actually did it;

NN = for those farmers who said "no" and did not practice it.

For farmers who said "yes" they practiced, perceived that employing soil conservation makes land more productive. The methods used were planting perennial crops such as coconut, banana, coffee, abaca, ipil-ipil (*Leucaena glauca*), madre de cacao and others; bench terracing; and contour ploughing.

Farmers were asked how they came to know about the method. Findings showed that 59 per cent of those who practiced soil conservation said, they based it in their own experience about farming upland parcels. Some others learned it from their parents, from extension workers, in farmers meetings, seminars, and landlord suggestion.

Questions about whether they still have plans for improving the practice and their reasons for having or not were also asked. Twenty seven per cent of those who answered "yes" still have plans for improvement because erosion was still occurring. For farmers who said they don't have plans for improving the practice reasoned out that they can't afford further improvement because it is costly; already contented of the present practice; and few others said, they don't know of any other techniques to conserve the soil.

Farmers reasons for not doing soil conservation in the upland areas were lack of technical know-how (38%); advantages were not visible (20%); labourious (14%); and costly (8%). The remaining others said, it was not compatible with their beliefs and difficult to do.

Cluster analysis of farmers perception together with some of the family, farm, farmer and farm household characteristics was carried out. The groupings of characteristics were the same for each set. Thus, the results of clustering for family, farm and farmer characteristics were no longer presented. Description and presentation of results focused on the characteristics of the farm households as a whole. Figure 7 illustrates the groupings of farm households and Table 6 presents the characteristics in terms of similarities and/or differences between groups.

Group A. Perception YY and farm household characteristics

This group comprised 31.85 per cent of the total farm households and contained farmers who perceived that they were practicing soil conservation in their upland farms. The adoption of the practices vary between farmers. Fifty eight per cent of them fully adopted soil conservation practices, 16 per cent highly adopted and the other 26 per cent rarely adopted.

The representative farm households appeared to have higher net family income, net farm income, liquidity positions and wealth positions compared with other cluster groups except Group D. They tended to have a lower proportion of family labour contributed to total on-farm labour requirements. Sixty eight per cent of the family members were in the labour force .

The farmers in this group of farm households cultivated a relatively higher productivity farms compared with Groups B and E. The mean size of upland farm was 1.66 hectares, that is 82 per cent of the total acreage cultivated per farm. Twenty per cent of these households were owners, 44 per cent were part-owners and the remaining others were tenants. The cropping systems used were bench terracing in rice production and agro-forestry systems using perennial crops mixed with annual crops. This group was also recorded to be the oldest, most educated and experienced in farming business than those in other groups.

Group B. Perception YN and farm household characteristics

Group B consisted of 14.65 per cent of the total sample farm households and contained farmers who perceived they practiced soil conservation but were found that they did not actually do it. Most (87%) of them were representative from Tabing, Tabango. This group of farm households used mono-cropping of corn in their upland farms.

The representative farm households appeared to be the poorest among the cluster groups. It had a low net family income, net farm income and liquidity position (Table 6). It was also found that proportion of family members who are aged 14 years and younger was high. But in spite of that, the proportion of family labour contribution to on-farm labour was high (71%). This can be explained by the fact that these farm households cultivated a very small acreage of land thus total labour requirement was very low.

The farmer in this group cultivated the least acreage of upland farm with lower productivity. The majority (52%) were tenants and no single farm household fully owned the land. The remaining 48 per cent were part-owners. This group of farmers was also recorded to be the youngest among the cluster groups. They had more farming experience than those in Groups A and D.

Group C. Perception NY and farm household characteristics

This group made up 37.58 per cent of the total sample farm households and contained farmers who perceived they did not practice soil conservation in their upland farms. It was interesting to note that during the monitoring process, it was found out that farmers were actually doing it. Thirty seven per cent fully adopted the soil conservation practices, 29 per cent highly adopted and 34 per cent rarely adopted.

The representative farm households were also characterised by having a relatively lower net family income, liquidity position, wealth position and net farm income compared with that of Groups A and D but higher than that of Groups B and E. Only 27 per cent of them had net family income greater than that of the total sample mean. Family income were mostly (68%) taken from farm sources rather than from off-farm sources. The mean household size was 5, 66 per cent of which were members in the labour force. It had the highest family labour contributed to the total on-farm labour requirements.

The farmers in this group cultivated a highly productive farms with a mean acreage of 1.16 hectares. They grew coconut and banana as base crop and annual crops such as corn, rice, and rootcrops as intercrops. The farms cultivated were mostly (51%) tenanted. The farmers had lesser farming experience than those in Group A but more experience than those in Group D. It had a mean age of 48 years and as educated as the farmers in Groups B and D.

Group D. Perception NY and farm household characteristics.

Group D consisted of only one sample farm household (0.64%) and contained a farmer who perceived he did not practice soil conservation but were found to have been practicing it. Perennial crops were raised in normal density. There were two upland parcels planted with coconuts, abaca, banana, coffee and sugarcane. A little amount of corn and upland rice were also planted in patches in between coconut trees.

Surprisingly, this farm household was the wealthiest among the sample farm households. It had a family net income, net farm income and cash income per year more than 20 times as much as that of the other sample farm households. The family had 12 members, 8 per cent of which had an age 14 years and younger. This is the same household described in the preceeding section , Group 4D.

Group E. Perception NN and farm household characteristics

This group comprised 15.27 per cent of the total sample farm households having farmers who perceived they did not practice soil conservation and were found that they were not practicing it. They used mono-cropping of annual crops such as rice; corn; and few rootcrops and legumes.

These representative samples were also characterised by having a lower net family income, net farm income, liquidity position and wealth position (Table 6). Only 12 per cent of them had net family income greater than the total sample mean. It tended to have higher proportion of family labour contributed to on-farm labour than the other cluster groups except Group C. The mean family size was 5, 65 per cent of which were members in the labour force.

Figure 7. Dendrogram for farm household characteristics and perception

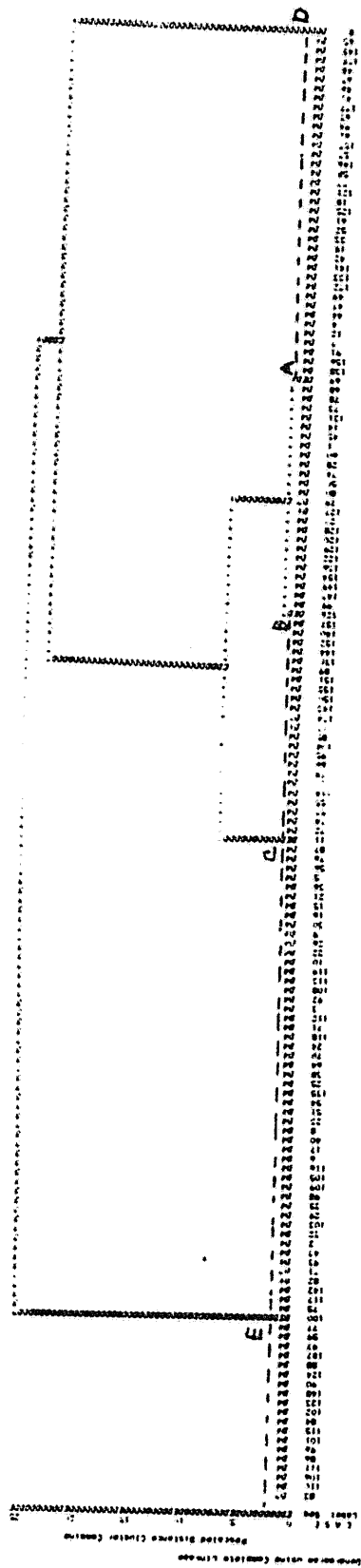


Table 6. Cluster groups according to farm household characteristics and farmer perception towards soil conservation practices in the upland areas of Leyte, Philippines.

Group	Characteristics*												
	1	2	3	4	5	6	7	8	9	10	11	12	13
	(pesos)	(pesos)	(pesos)	(pesos)	(pesos)	(%)	(No.)	(%)	(%)	(Ha)	(years)	(years)	(years)
A	7,363.47	10,074.96	3,845.96	14,398.69	9,155.87	66	6	32	82	1.66	49	29	5
B	3,616.49	5,565.60	3,076.50	10,075.24	5,334.09	71	6	44	82	0.75	42	22	4
C	7,145.90	7,243.36	4,908.32	10,855.35	9,012.62	75	5	34	79	1.16	48	22	4
D	442,525.52	392,755.86	40,601.50	202,212.58	542,610.15	28	12	8	22	3.50	49	30	5
E	6,889.28	4,862.66	2,597.59	6,828.16	6,277.08	74	5	35	80	1.12	43	16	4

- *

1

Net family income

2

Net farm income

3

Land productivity

4

Wealth position

5

Liquidity position

6

Proportion of family labour contribution to total on-farm labour requirement

7.

Size of the family

8.

Proportion of family members whose age is 14 years and younger.
- 9

Proportion of upland farm cultivated to the total farm area managed

10

Size of upland farm cultivated

11

Age

12

Farming experience

13

Educational attainment

Most (83%) of the farmers in this group were tenants. Only 4 per cent were full owners and the other 13 per cent were part-owners. The mean size of upland farms cultivated was 1.12 hectares, that is 80 per cent of the total acreage cultivated per farm. This group of farmers also recorded to be the least experience compared with other cluster groups. They are more younger than those in groups A, C, and D.

Conclusion :

The patterning of data revealed by the cluster analysis showed that some farm household characteristics such as net family income, liquidity positions, wealth positions, area of upland farm cultivated, land tenure, age and farming experience of the farmer are associated with farmers' perceptions towards soil conservation practices in the upland areas. It follows that positive farmers perception and adoption of soil conservation practices is greater if they have high net family income, high liquidity positions and wealth positions. This indicates that those farm households with more experienced farmers and have better earning capacity tended to perceive that practicing soil conservation is advantageous. Also, the larger the size of upland farms cultivated and owned, the better their adoption and perception towards soil conservation practices.

MAJOR CONCLUSIONS

Cluster analysis of upland farmers in the Philippines has been shown as a successful method in teasing out underlying patterns within the data, and providing an alternative way of looking at the data, to that provided by conventional descriptive analysis. It is considered that two major conclusions have emerged.

The first conclusion relates to the approaches in analysing the data. It should be remembered that cluster analysis is a mathematical approach (such as calculus) rather than a statistical approach, and is therefore not amenable to test its statistical significance. However it is suggested that when compared to the conventional descriptive way of analyzing the data, cluster analysis provides a more cost-effective way of reducing the data's complexity and presenting the initial important patterns in the survey data. It will also help in quickly deciding on important distinguishing variables suitable for further analysis, either relating to the socioeconomic variables or to the farm household characteristics differences where patterns in the data are unlikely to be known before-hand.

The problem of whether to use a single or multivariate approach in the analysis of large amounts of survey data depends upon whether it is desired to understand a lot about a little, or a little about a lot. Essentially they can be combined to advantage. Thus, after completing the cluster analysis, cross-tabulations were prepared using the variables identified in the cluster analysis and chi-square tests of association were carried out.

The final conclusion relates to the substantive nature of the results.

It should be remembered that the project gave more emphasis to identifying similarities and differences in the characteristics of the family, farm, farmer and the farm household as a whole between different levels of adoption of the upland farming practices. There was no study of this kind where government programs and projects has been implemented several years back. This is the reason why description of results in this analysis were focused on relating adoption of upland practices to the characteristics of the different entities. The findings and their implications for policy development are found in the conclusions of each section of this study. The substantive results are as follows:

1. That net farm income, liquidity positions, land tenure, age and farming experience of the farmer are associated with the adoption of soil conservation practices in the upland areas. The greater the adoption of improved upland practices the better the farm households' earning capacity. Also the older and more experienced the farmer, the greater is the adoption of soil conservation practices.
2. That land productivity is positively related to adoption of soil conservation practices. Land tends to be more productive if soil degradation could be minimised. Farmers with highly productive farms and high adoption scores tend to have higher liquidity positions and net farm earnings.
3. That tenure status and size of the farms cultivated may have some influence on the amount of net farm income and net family income received by the farm households per year.
4. That low net farm income households with low adoption scores tend to receive more off-farm income per year and higher proportions of the family labour contribution to total on-farm labour.

5. That farm households characteristics such as net family income, liquidity positions, wealth positions, area of upland farm cultivated, land tenure, age and farming experience are associated with farmers' perceptions of soil conservation practices. It follows that positive farmers' perception and adoption of soil conservation is greater if they have high net family income, high liquidity positions and wealth positions. This indicates that those farm households with experienced farmers and have better earning capacity tended to perceive that practicing soil conservation is advantageous. Also, the larger the size of upland farm cultivated and owned, the better their adoption and perception towards soil conservation.

6. That using the total sample mean of a certain characteristics in identifying a typical farm, or farm household may not always be practical or reasonable.

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