

Research paper

Survey and Analysis of Agroforestry's Technical System in Taiwan¹

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【Abstract】 The main purposes of this study are to comprehend leased land of national forest's current agroforestry's situation, factors which influence agroforesters' decision making in agroforestry management and evaluation of agroforestry's technical system. We surveyed 12 counties in whole island from October to December in 2001, 400 agroforesters were interviewed personally. The results of evaluation of agroforestry's systems are: (1)pessimistic to crops' benefit and sale channel. (2)optimistic to agroforestry's functions in watershed conservation and environment amenity. (3)very pessimistic to forest product's benefit and sale channel. (4)pessimistic to agroforestry's contribution to community development. (5)dissatisfy with current forest policy and law. If ideal mix patterns of trees and crops were be chosen by agroforesters, in tree species, they favored of *Calocedrus formosana*, *Zelkova formosana*, *Michelia formosana* and *Cinnamomum camphora*, in bamboo species, they favored of *Dendrocalamus latiflorus*, *Phyllostachys makinoi* and *Phyllostachys edulis*, and in crop species, they favored of *Camellia sinensis* (tea), *Areca catechu*, *Prunus mume* and *Diospyros oldhamii*. Among several mix arrangement patterns, they favored of separate plantation between trees (or bamboos) and crops. However, if the forest law set an act as follows : "Under principles of water and soil conservation, national land conservation and ecological conservation, owners of private forestland or managers of national leased forestland could carry out agroforestry in which forest play as a major role. Central government will set management conditions, restricted methods, crops species and other acts which should be obligated." Most of agroforesters didn't approve this act temporarily. If the government patiently promote the design of this act not only emphasis on water and soil conservation but also pay attention to agroforesters' living, perhaps the act will earn agroforesters' trust.

【Key words】 Agroforestry, Agroforestry's technical system.

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研究報告

臺灣地區混農林作業技術體系調查與分析¹

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【摘要】本研究的主要目的在瞭解現階段臺灣地區國有林班租地造林地實施混農林作業現況、探討影響混農林主經營混農林作業決策的因素與對混農林作業體系進行評估。本研究訪問了全省八個林管處的 400 戶混農林戶，贊成實施混農林業的百分比佔 71.5 %，主要誘因是農作物有收入、林木保育水土、維持土地肥力。而對混農林業的總體評估的結果顯示：1.對農作物的收益與銷售管道抱持著悲觀的看法。2.對混農林業在保育水土、美化環境與農林作物的生長抱持著審慎樂觀的看法。3.林產品收益與銷售管道抱持著很悲觀的看法。4.混農林業對社區產業的發展與本身未來的發展不表樂觀。5.林農對現有的政策、法令與政府的輔導感到不滿意。若依據各地區林農所選擇心目中最理想的林木和農作物當成適當的組合方式，林木類受歡迎的包括肖楠、臺灣檫、烏心石與樟樹；竹類受歡迎的包括麻竹、桂竹與孟宗竹；作物類則包括茶、檳榔、梅、柿子等，配置方式仍以分開栽植最受青睞。如在森林法中訂定：「私有林或國有林事業區出租造林地得視其環境，在不影響水土保持、國土保安、生態保育之情形下，實施以林為主之混農作業，其許可經營之條件、限制方式、作物種類及其他應遵行事項之辦法，由中央主管機關定之」的規定暫時無法獲得百姓的認同，但是執法機關本著誠意施政，以委婉的態度向林農宣導該項政策是為兼顧水土保持與林農生計而設計的，終究是會得到百姓的信任。

【關鍵詞】混農林業、混農林作業技術體系

I. Introduction

Leasing land from national forest is a very special system in Taiwan, and part of leaseholders (here we call agroforester) adopt agroforestry to manage their land for many years. But till now, agroforestry's scale and mix pattern are still neglected by government. Owing to the tilt topography of Taiwan, water and soil conservation is the most important principle of forest management. Agroforestry is thought to be a disadvantageous system to water and soil conservation. Many successful experiences from other countries showed that defects of agroforestry didn't origin from the system itself, but it all depended on how to implement properly

and how to fit for the environment. The main purposes of this study are to comprehend the current agroforestry's situation of leased land of national forest and factors will influence agroforesters' decision making in agroforestry management and evaluation of agroforestry's technical system.

II. Method

We used questionnaire to acquire agroforesters' opinions in the study. The design of questionnaire was based on survey table of Agroforestry Systems Inventory proposed by ICRAF (International Council for Research in Agroforestry) and made some revision in order to

suit for Taiwan's environment. Under condition of confidence level 95% and error 5%, we personally interviewed 400 agroforesters to ask them about their opinions. The study area distributed in 12 counties (administrated by 8 forest district administration offices) throughout the island from October to December in 2001.

The statistical package "SPSS for windows" is utilized to sort and analyze data. To analyze all basic data we used descriptive statistical method. Factor analysis was used to explain the recognition of agroforesters' opinions. The first step, the data were test by Kaiser-Meyer-Olkin (KOM) and Bartlett's test of sphericity (BTS) to show that opinions were fit for test by factor analysis or not. The second step, principal component analysis choose factors and then rotate factors by oblique rotation. The third step, reject the eigenvalues which are smaller than 1(Kaiser, 1960). The last step, according to rule of thumb, we adopt absolute value of factor loading which are superior to 0.4.

III. Result and Discussion

(I) Basic data

The results showed that agroforesters are male(88.0%) mainly with 57.3 years old in average. Nearly 63% of their education background are primary school or lower. Most of their income (about 40.8%) get from agricultural activities. According to our investigation of agroforesters in 1992, there has been an average age of 54.3 or 3 years younger than this research. This phenomenon indicates that aging tendency is more serious than ten years ago. As for current situation of agroforesters' leased land, table 1 shows that each agroforester owns average 2.75

parcels of land, average area of their land is 2.71 ha and average altitude is 600 meters, most of their land slope are over 55% and majority of aspect of slope are eastern side, most of soil fertility of land is evaluated as "good" by themselves, average distance to source of water is 1273m.

In addition to descriptive analysis of basic data, we further use factor analysis to classify importance degree of leased land condition in agroforestry management into several factors which were shown in table 2. After analyzing of factor analysis, there are five eigenvalues superior to 1. Therefore the leased land condition can be classified into five categories which were named as follows :

- a. Factor 1 gets 23.7% of total variation. There are 3 factor loadings superior to 0.4 , they are "water abundant or not", "distance to water source" and "amount of rainfall". Since all factors relate to water, we name the factors as "**water condition**".
- b. Factor 2 interprets 11.8% of total variation. There are 5 factor loadings superior to 0.4 , they are "soil fertility", "slope", "aspect of slope", "pH value of soil" and "soil thickness". Since all factors relate to soil, we name the factors as "**soil condition**".
- c. Factor 3 accounts for 10.8% of total variation. There are 2 factor loadings superior to 0.4 , they are "temperature" and "altitude". Since all factors relate to temperature, we name the factors as "**temperature condition**".
- d. Factor 4 gets 9.0% of total variation. There are 3 factor loadings superior to 0.4 , they are "distance to market" , "distance to residence" and "road situation". Since all factors relate to

Table 1. Current situation of agroforesters' lease land in different districts.

District		Hsing- chu	Dung- shi	Nan-tou	Chia-yi	Ping-dung	Lo-dung	Hwa-lian	Tai-dung	average
Current situation										
No. of parcel	mode	1	3	1	1	2	1	2	1	
	mean	2.59	3.38	2.33	2.83	3.02	3.33	3.55	1.45	2.75
Area (ha)	mode	under0.9	2-2.9	1-1.9	1-1.9	1-1.9	under 0.9	1-1.9	under 0.9	
	mean	1.0	4.40	3.30	2.64	2.43	3.31	2.14	1.92	2.71
Altitude (meters)	mode	200-399	800-999	400-599	above1000	200-399	200-399	200-399	400-599	
	mean	378	820	605	988	383	359	408	370	600.0
Slope	mode	40-55%	5-15%	over55%	40-55%	over55%	over55%	over55%	15-30%	
Direction of slope	mode	east	west	east	east	east	west	east	west	
Depth of soil (cm)	mode	over 90	over 90	over 90	20-50	over 90	50-90	over 90	over 90	
Soil Fertility	mode	general	good	good	good	good	general	general	good	
Distance to source of water (km)	mode	0-0.9	0-0.9	0-0.9	0-0.9	0-0.9	0-0.9	0-0.9	0-0.9	
	mean	0.73	1.40	1.79	1.88	0.80	0.37	1.28	0.18	1.273
Distance to residence (km)	mode	0-0.9	0-0.9	over 5	over 5	over 5	0-0.9	over 5	3-3.9	
	mean	10.7	3.39	14.2	11.79	26.62	1.62	3.75	3.25	11.86

traffic, we name the factors as "**traffic condition**".

- e. Factor 5 interprets 7.2% of total variation. There are 2 factor loadings superior to 0.4 , they are "hire labor easily or not" and "own labor". Since all factors relate to labor, we name the factors as "**labor condition**".

(II) Agroforesters' intention analysis

Did agroforesters really approve agroforestry's management on their leased land ? The results of questionnaire showed that the management acquire 71.5% agroforesters' approval and 28.5% disapproval. We use factor analysis to analyze the

reason of approval and disapproval are shown as follows :

The factors which agroforesters approve agroforestry's management :

- a. Factor 1 gets 24.0% of total variation. There are 4 factor loadings superior to 0.4 , they are "soil and water conservation", "cover land well" and "maintain soil fertility" and "windbreak". Since all factors relate to environmental conservation, we name the factors as "**environmental conservation**".
- b. Factor 2 interprets 14.0% of total variation. There are 2 factor loadings superior to 0.4 , they are "risk aversion" and "increase

Table 2. Factor analysis of leased land condition in agroforestry management.

factor	1	2	3	4	5
water abundant or not	.976	-.172	6.874E-02	-.153	6.082E-02
distance to water source	.865	-.178	5.174E-02	5.629E-02	2.895E-02
amount of rainfall	.490	.115	.394	2.374E-02	-.262
soil fertility	.374	.484	-.191	.131	5.717E-02
slope	-.204	.858	.134	-5.837E-03	-.136
aspect of slope	-.204	.815	.180	-4.621E-02	1.401E-02
pH value of soil	.107	.552	-3.654E-02	-7.546E-02	.373
soil thickness	.267	.502	-.119	.198	6.101E-02
temperature	5.544E-02	.156	.809	-2.543E-02	3.197E-02
altitude	1.970E-02	7.106E-02	.783	-4.084E-02	2.775E-02
distance to market	-.138	-.200	.399	.410	.381
distance to residence	-2.106E-02	5.187E-02	-.143	.871	-.109
road situation	-3.655E-02	-4.988E-02	.109	.851	3.078E-02
hire labor easily or not	4.524E-03	6.666E-02	3.700E-02	-.171	.837
own labor	.115	-2.045E-02	-4.332E-02	.122	.539
eigenvalue	3.554	1.776	1.624	1.355	1.085
% on total variation	23.7%	11.8%	10.8%	9.0%	7.2%
% on cumulative variation	23.9%	35.5%	46.3%	55.3%	62.5%

biodiversity". We name these factor loadings as "**risk aversion**".

- c. Factor 3 accounts for 10.3% of total variation. There is 1 factor loading superior to 0.4 , that is "to get income every year". We name the factor loading as "**getting income every year**".

The factors which agroforesters disapprove agroforestry's management :

- a. Factor 1 gets 27.2% of total variation. There are 4 factor loadings superior to 0.4 , they are "uncertainty of agroforestry policy", "no relate law acts", "no subsidiary system" and "lack of technology and fund". Since all factors relate to policy, we name these factor loadings as

"**uncertainty of agroforestry policy**".

- b. Factor 2 interprets 18.8% of total variation. There are 2 factor loadings superior to 0.4 , they are "tree will shelter the sunshine" and "root competition between trees and crops". We name these factor loadings as "**competition between trees and crops**".
- c. Factor 3 gets 10.9% of total variation. There is 1 factor loading superior to 0.4 , that is "**lack of labor**".
- d. Factor 4 accounts for 10.1% of total variation. There is 1 factor loading superior to 0.4 , that is "**uninteresting**".

(III)**Past, now and ideal mix of trees and crops**

According to our survey, there are 196 agroforesters (49.0%) have ever changed their planting of crops or trees. Among them, there are 127 agroforesters (31.8%) have changed planting of crops, 28 agroforesters (7.0%) have changed planting of trees and 41 agroforesters (10.2%)

have changed planting both of them. What kinds of crops have been changed? According to table 3, they are orange, ginger, sweet potato and cassava. The main reasons of changing consist of economic consideration (66%) and choose labor saving crops (19.0%). What kinds of trees (or bamboos)

Table 3. Past \ present and ideal of trees and crops

District	Time	Past	Present	Ideal
Hsing- chu	Crops	Orange, banana, Peanut, sweet potato	Orange, tea, pear, Vegetable, <i>Areca catechu</i>	Pear, tea, Chinese medicine herb <i>Areca catechu</i>
	Trees	<i>Acacia confosa</i> <i>Phyllostachys makinoi</i>	<i>Phyllostachys makinoi</i> <i>Bambusa oldhamii</i> <i>Acacia confusa</i> <i>Cunninghamia lanceolata</i> <i>Dendrocalamus latiflorus</i>	<i>Cinnamomum camphora</i> <i>Calocedrus formosana</i>
	Mix pattern		Mix plantation (26.6%) Neighboring plantation (26.6%)	
Dung- shi	Crops	Orange, plum	Japanese persimmon Orange, peach, pear plum	Japanese persimmon
	Trees	<i>Phyllostachys makinoi</i>	<i>Phyllostachys makinoi</i> <i>Phyllostachys edulis</i> <i>Cunninghamia lanceolata</i> <i>Dendrocalamus latiflorus</i> <i>Pinus taiwanensis</i>	<i>Cunninghamia lanceolata</i> <i>Zelkova serrulata</i>
	Mix pattern		Plant on different piece of land (87.5%) Neighboring plantation (12.5%)	
Nan-tou	Crops	Orange, banana, rice Cassava	<i>Areca catechu</i> , mume, Tea, banana, orange	<i>Areca catechu</i> , mume, Tea
	Trees	<i>Phyllostachys makinoi</i> <i>Cunninghamia lanceolata</i> <i>Dendrocalamus latiflorus</i>	<i>Phyllostachys makinoi</i> <i>Phyllostachys edulis</i> <i>Cunninghamia lanceolata</i> <i>Dendrocalamus latiflorus</i> <i>Calocedrus formosana</i> <i>Pachira macrocarpa</i>	<i>Calocedrus formosana</i> <i>Michelia formosana</i> <i>Phyllostachys edulis</i> <i>Cunninghamia lanceolata</i> <i>Dendrocalamus latiflorus</i>

	Mix pattern		Mix plantation (30.4%) Plant on different piece of land (20.7%)	
Chia-yi	Crops	Ginger, tea, orange, rice	Japanese persimmon <i>Areca catechu</i> , tea Dragon eye, wasabi	Japanese persimmon <i>Areca catechu</i> , tea
	Trees	<i>Phyllostachys makinoi</i> <i>Cunninghamia lanceolata</i> <i>Dendrocalamus latiflorus</i>	<i>Phyllostachys makinoi</i> <i>Cunninghamia lanceolata</i> <i>Dendrocalamus latiflorus</i> <i>Phyllostachys lithophila</i> <i>Phyllostachys lithophila</i>	<i>Phyllostachys makinoi</i> <i>Cunninghamia lanceolata</i> <i>Dendrocalamus latiflorus</i> <i>Chamaecyparis formosensis</i> <i>Phyllostachys lithophila</i>
	Mix pattern		Mix plantation (33.3%) Plant on different piece of land (39.3%)	
Ping-dung	Crops	Cassava, ginger	Dragon eye, mango Litchi nut, mume Coconut tree	Dragon eye, mango Litchi nut, mume
	Trees	<i>Bambusa stenostachya</i>	<i>Dendrocalamus latiflorus</i> <i>Bambusa stenostachya</i> <i>Zelkova serrulata</i> <i>Acacia confusa</i>	<i>Swentenia macrophylla</i> <i>Cinnamomum camphora</i> <i>Dendrocalamus latiflorus</i> <i>Michellia formosana</i>
	Mix pattern		Mix plantation (24.0%) Plant on different piece of land (56.0%)	
Lo-dung	Crops	Round kumquat, rice Tea, ginger	Tea, shaddock, plum Vegetable, orange	Tea, orange, guava tree
	Trees	<i>Pinus luchuensis</i>	<i>Bambusa oldhamii</i> <i>Michellia formosana</i> <i>Phyllostachys makinoi</i> <i>Liquidambar formosana</i>	<i>Calocedrus formosana</i> <i>Michellia formosana</i> <i>Bambusa oldhamii</i> <i>Phyllostachys makinoi</i>
	Mix pattern		Plant on different piece of land (54.2%) Neighboring plantation (33.3%)	
Hwa-lian	Crops	Sugar cane, maize Sweet potato, orange	Rice, oil vegetable Mume, <i>Areca catechu</i> , shaddock	Rice, orange, mume, <i>Areca catechu</i> , shaddock
	Trees	<i>Paulownia fortunei</i> <i>Tectona grandis</i>	<i>Phyllostachys makinoi</i> <i>Acacia confusa</i> <i>Cinnamomum camphora</i> <i>Calocedrus formosana</i> <i>Zelkova serrulata</i>	<i>Phyllostachys makinoi</i> <i>Acacia confusa</i> <i>Cinnamomum camphora</i> <i>Zelkova serrulata</i>

	Time	Past	Present	Ideal
District				
			Mix plantation (22.5%)	
			Plant on different piece of land (57.5%)	
Tai-dung	Crops	Orange, <i>Areca catechu</i>	Mume, <i>Areca catechu</i> , shaddock, orange, vegetable	<i>Areca catechu</i> , mume, orange, Sugar apple
	Trees		<i>Zelkova serrulata</i> , <i>Cinnamomum camphora</i> , <i>Dendrocalamus latiflorus</i> <i>Acacia confusa</i>	<i>Zelkova serrulata</i> , <i>Cinnamomum camphora</i>
	Mix pattern		Mix plantation (30.0%)	
			Plant on different piece of land (35.0%)	

have been changed? *Phyllostachys makinoi* and *Cunninghamia lanceolata* are the main tree species which have been changed. Their changing reasons are economic consideration(58%), government promote another tree species (26%), choose labor saving species (23.2%). What kind of trees and crops are ideal species on agroforesters' mind? The ideal species are shown in table 3 .As for crops species, there is not much difference between present and ideal. Tea, *Areca catechu*, Japanese persimmon, mume are always favored by agroforesters. But to our amazing that Chinese medicine herb are the first time list in ideal category. It means that Chinese medicine herb is gradually favored by agroforesters. But there is some difference in tree species between present and ideal category. *Calocedrus formosana*, *Michelia formosana*, *Zelkova serrulata* and *Swietenia macrophylla* are newly list in ideal category. Because these tree species own both timber and scenic usage. In addition to above discription, we use factor analysis to analyze factors that influence ideal

mix of crops and trees as follows:

- Factor 1 gets 32.9% of total variation. There are 3 factor loadings superior to 0.4 , they are "crop growth", "tree growth" and "decrease damage of forest insects and diseases" . We name these factor loadings as "**Both crop and tree growth and decrease their damage from insects and diseases**".
- Factor 2 interprets 17.4% of total variation. There are 2 factor loadings superior to 0.4 , they are "decrease space competition between trees and crops" and "decrease root competition between trees and crops". We name these factor loadings as "**decrease competition between trees and crops**".
- Factor 3 accounts for 10.9% of total variation. There are 2 factor loadings superior to 0.4 , they are "higher economic value" and "mutual complement between trees and crops in income". We call these factor loadings as "**economic consideration**".
- Factor 4 interprets 8.8% of total variation. There are 2 factor loadings superior to 0.4 ,

they are "labor saving" and "maintain soil fertility". We call these factor loadings as **"labor saving and maintain soil fertility"**.

e. Factor 5 gets 7.0% of total variation. There are 2 factor loadings superior to 0.4 , they are "environmental amenity" and "water and soil conservation" . We call these factor loadings as **"environmental consideration"**.

According to the results of above factor analysis, we find that agroforesters care about both growth of crops and trees on their land and avoid their space and root competition. Therefore most of their arrangement of crops and trees' mix pattern belong to plant crops and trees on different piece of land (50%). The second is mix plantation (20.9%). Alley cropping only get 4.3%.

(IV) Feasibility of joining agroforestry in forest law

According to factor analysis of disapproval of agroforestry, "the uncertainty of agroforestry policy" is an important factor. In other words, there are no related agroforest policy or acts in forest law. This paper entrusted by Taiwan Forest Bureau to set a question among questionnaire as

follows : If forest law set an act— **"Under unharmed principles of water and soil conservation, national land conservation and ecological conservation, owners of private forestland or managers of national leased forestland can carry out agroforestry in which forest plays as a major role. Central government will set Management conditions, restricted methods, crops species and other acts which should be obligated."** We separate this hypothetical act into several questions as shown in table 4. Generally speaking, agroforesters positively agree with "unharmful principles of water and soil conservation" (75.2%) and "emphasis on ecological principle" (64.6).But they hold negative attitude towards "forest plays as a major role"(24.0%), "government set management restrictions" (21.2%) and "crops' species are determined by government (15.1%). Beside these, most of agroforesters didn't agree joining this act in forest law (17.6%). Although there are many disagreements from them, but government patiently promote the design of this act not only emphasis on water and soil conservation but also pay attention to agroforesters' living, perhaps the

Table 4. The approval percentage of several questions among hypothetical act.

Content of question	% of approval
Adapt for private forest land	28.9%
Adapt for lease forest land	53.9%
principles of water and soil conservation	75.2%
Emphasis on ecological principle	64.6%
Forest plays as a major role	24.0%
Approve "Government set Management restrictions"	21.2%
Crops' species are regulated by government	15.1%
This act will encourage behavior of land over utilization	22.6%
Suit for joining this act in forest law	17.6%

Table 5. Application of factor analysis on evaluating performance of agroforestry.

Factor	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Average Score
Crop market	0.832	-0.033	0.123	0.158	-0.009	2.50
Crop benefit	0.758	0.033	0.260	0.327	-0.058	2.26
Labor adjustment	0.518	0.186	-0.321	0.083	0.338	2.94
Environment amenity	-0.089	0.808	0.138	0.087	-0.054	3.48
Influence of water and soil conservation	0.012	0.751	-0.123	0.049	0.089	3.78
Growth of crops and trees	0.417	0.640	-0.011	0.123	0.081	3.23
Maintain fertility	0.438	0.525	-0.226	0.026	0.204	3.44
Forest product benefit	0.042	0.059	0.883	0.081	0.071	1.53
Forest product market	0.085	-0.075	0.850	-0.124	0.109	1.54
Future development	0.075	0.090	0.036	0.892	0.162	1.60
Development of other sectors	0.239	0.069	-0.107	0.836	0.206	1.96
Government assistance	0.091	0.085	0.171	0.103	0.833	1.87
Support to agroforestry policy and law	-0.065	-0.026	0.021	0.244	0.832	1.78
eigenvalue	2.091	1.969	1.815	1.752	1.648	
% on total variation	16.1%	15.2%	14.0%	13.5%	12.7%	
% on cumulative variation	16.1%	31.3%	45.3%	58.8%	58.8%	

act will earn agroforesters' trust.

(V) Total evaluation to agroforest performance

We also use factor analysis to evaluate performance of agroforestry and acquire several components (table 5) as follows :

Table 5 shows that evaluating performance of agroforestry can divide into 5 factors as follows :

a. Factor 1 gets 16.1% of total variation. There are 3 factor loadings superior to 0.4 , they are "crop market", "crop benefit", and "labor adjustment" . Since all factors relate to crop and all their score lie between "common" and "not good " .Therefore we name the factors as "**worry about crops' benefit and their sale**

channel ".

b. Factor 2 interprets 15.2% of total variation.

There are 4 factor loadings superior to 0.4 , they are "environment amenity", "influence of water and soil conservation", "growth of crops and trees" and "maintain fertility". Since all factors relate to water and soil conservation and all their score lie between "common" and "good", we name the factors as "**satisfy with agroforestry's functions in watershed conservation and environment amenity**".

c. Factor 3 accounts for 14.0% of total variation.

There are 2 factor loadings superior to 0.4 , they are "forest product benefit" and "forest product market" . Since all factors relate to forest product and all their average score lie

between "not good" and "not very good", we name the factors as **"dissatisfy with forest product's benefit and sale channel"**.

- d. Factor 4 interprets 13.5% of total variation. There are 2 factor loadings superior to 0.4 , they are "future development" and "development of other sectors". Since all factors relate to community development and all their average score lie between "not good" and "not very good", we name the factors as **"dissatisfy with agroforestry's contribution to community development"**.
- e. Factor 5 gets 12.7% of total variation. There are 2 factor loadings superior to 0.4 , they are "government assistance" and "support to agroforestry policy and law". Since all factors relate to forest policy and law and their average score lie between "not good" and "not very good", we name the factors as **"dissatisfy with current forest policy and law."**

IV. Conclusion

(I) Conclusion

- a. The attributes of agroforesters are male(88.0%) with 57.3 years old in average, 62.8% of their education degree are primary school or lower, most of their income (about 40.8%) come from management of agriculture.
- b. Leased land conditions that will influence agroforest management can be classified into five factors : water ,soil, temperature, traffic and labor .
- c. The factors which agroforesters agree with agroforestry's management consist of : environmental conservation, risk aversion and having income every year.
- d. The factors which agroforesters disagree with agroforestry's management : uncertainty of

agroforestry policy, competition between trees and crops, lack of laborers, and uninteresting.

- e. The factors that influence ideal mix of crops and trees as follows : Both crop and tree growth and decrease their damage from insects and diseases, decrease competition between trees and crops, economic consideration, labor saving, maintain soil fertility, and environmental consideration.
- f. Most of mix pattern between trees and crops belong to plantation on different land parcel, the next is mix plantation and the last is alley cropping .
- g. Performance evaluation of agroforestry can be divided into 5 factors : worry about crops' benefit and their sale channel, satisfy with agroforestry's functions in watershed conservation and environment amenity, dissatisfy with forest product's benefit and sale channel, dissatisfy with agroforestry's contribution to community development and dissatisfy with current forest policy and law.

(II) Perspectives

- a. *Areca catechu* is a very popular in Taiwan and which is planted widespread in whole island. But betel nut of *Areca catechu* injures people catch mouth disease easily, and its shallow root system has weakness on water and soil protection. Therefore the felling of *Areca catechu* and planting other tree species instead is a very important leased land policy currently. We suggest that adoption of Taungya system is an appropriate method, that is before felling of *Areca catechu* we plant tree species which crown shape like tower, such as *Calocedrus formosana*, *Swientenia macrophylla*. And then we fell *Areca catechu* until tree crown close

gradually.

- b. The mix of tree and medicine herb are worthy of trying plantation. Because it is not difficult in administration and has fewer pollution of pesticides. Beside medicine herb, odorous herbs (such as *Lavandula*, *mentha*, *Rosmarinus*, etc) are also popular in recent years. The mix of tree and odorous herb are worthy of planting too.
- c. Home garden is one pattern of agroforestry. This pattern develop gradually in Taiwan in recent years. The agroforesters plant vegetable, plum, mume, cherry and coffee tree around their house. And near by the house, they plant trees such as *Taiwania cryptomerioides*, *Zelkova serrulata* and *Michellia formosana* etc. Home garden is in accordance with conception of biodiversity. May be this pattern won't bring much money , but they enjoy their planting and think about land ethics.

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