

## 2. Targets and Basic Considerations in Planning

As described in previous paragraphs, 98% of population of working persons engages in agriculture in the objective areas in two districts and, thus, it may be said that the agriculture is a sole existing industry at present time.

Under such circumstances, the self-supporting force in these areas is insufficient. There is some surplus rice in part of area of Sindhuli District where the natural conditions are favourable but most of the surplus rice is said to be flowing to Terai area because of shortage in buying power of farmers in the areas and lack of distributing roads.

Thus, the first target of planning of the agricultural development in mountainous area is the improvement of the self-supporting force by increasing the force of agricultural production and, if self-supporting is satisfied, next target will be the securing of cash incomes by the introduction of commercial crops to improve the living standard of farmers.

As measures for increasing the agricultural production, the following four methods can be considered: (1) Improvement and adjustment of arable land (including securing of irrigation water); (2) improvement of farming skills; (3) improvement of factor of utilization of the arable land; and (4) new land reclamation by developing forests and fields.

However, as described before, topographic conditions in these areas are generally disadvantageous, and adjustment of the arable lands is extremely difficult to make. In addition, land has been already cultivated to a maximum degree, and factor of utilization of land already reached to a high value at present. Water is one of the important factors of the agricultural production force, but it is considered that there is no room for developing new water sources. In addition, there is almost no room for making agricultural land reclamation.

The effective measures for increasing the agricultural production force under such circumstances shall consist of the following four items: Firstly, increasing yield by improvement and promotion of the agricultural technique; secondly, achieving the self-supporting and introducing commercial crops; thirdly, developing agricultural water as much as possible and improving method of water utilization; and fourthly, promoting development and adjustment of roads, readjusting marketing conditions and improving the living environment.

According to this survey, the realization of four items stated above are established as targets for planning, and it was determined to proceed the survey and planning in the following procedures to achieve these targets:

(1) Analysis of Actual Conditions of Agriculture:

Particularly, the agricultural types will be classified by focussing the attention on the fact that agricultural types differ depending upon the altitudes. Then, actual farming conditions will be surveyed and analyzed by type, and problems in improvement will be clarified.

(2) Determining the Improving Measures for Farming:

Measures for solving the problems clarified by the survey will be established, and the farming improvement measures will be established by introducing the improving techniques as much as possible.

(3) Making Agricultural Land Improvement Plan:

For the areas where the water sources can be developed, the water development plan will be established. In this case, the possibility of securing of agricultural water as well as water for drinking and domestic use and of constructing small-scale power plants will be pursued while improving the agricultural environment.

(4) Determining Outline of Regional Development Road Plan:

Scheme for development trunk roads required for bringing in the agricultural materials and commodities and for shipping the agricultural products will be prepared for improving the basic living environment.

The items (2) to (4) stated above will be the contents of development plan in future, but execution of Item (2) is relatively easy so that it may widely affect the farmers in the areas. The execution of Item (3) will be limited to the areas where the development of water sources is possible but steady effects will be expected.

Since Items (2) and (3) seem to be carried out relatively easily, these will be used as first stage plan, but Item (4) will be considered as long-range second stage plan since it requires a large investment and includes several construction technical problems to be solved such as bringing in the necessary materials.

### 3. Survey and Analysis of Typical Sections

#### (1) Classification of Type of Farming and Selection of Survey Sections

For finding actual conditions of agriculture by the survey and for making the improvement plan, the difference of types of the farming in the objective areas must be carefully taken into consideration. That is, depending upon the differences of topography or altitude, water resources conditions and marketing conditions, the constitution of land categories and selection of crops vary, and the form of agriculture itself is affected. Thus, it is determined that classification of types of farming in the objective areas is to be made in this survey and typical section for each type is to be selected for investigating actual conditions.

For types of farming, discussions were made basing upon the survey results by each specialist of JADP and particularly in reference to "Preliminary Survey Report on Actual Conditions of Agriculture in Mountainous Areas for Agricultural Development Programme - Survey Records by Japanese Specialists" (Norin: 50-101) which was prepared in 1976, and the results of the discussion were compiled and the following classification was made and indicated in the table:

Table 19 Classification of Types of Farming and Selection of Objective Areas of Survey (proposed)

Type of farming	Altitude of area	Features	Objective area of survey
Paddy in low land	700 m max.	Paddy in low land along rivers is dominant.	(S) Khurkot (S) Nepaltok
Miscellaneous grains in midland areas	1,500 ~ 700 m	Production of miscellaneous grain crops and livestock as well as fruit trees, vegetables and paddy mixed in farming.	(S) Nakajoli (S) Chapouli (S) Ambot
Paddy and other grains in mountainous areas	2,500 ~ 1,500 m	Production of grains such as corns and barnyard millet, and raising of livestock.	(R) Vicinity of Ramechhap
Potatoes and livestock in high-mountainous areas	3,000 ~ 2,500 m	Combination of production of potatoes for self-support and seeds, and livestock.	(R) Rasnal
Livestock in high-mountainous areas	3,000 m min.	Specialized livestock in high-mountainous areas	(Excluded from objective areas.)

Note: (R) shown in objective area column indicates Ramechhap District and (S) indicates Sindhuli District.

The classification of the types of farming will be used as a basis of the survey and will be explained hereafter.

High-mountainous areas higher than about 3,000 meters are located in the Himalaya mountain region and they belong to the sub-frigid zones as far as the climate is concerned. These areas are actually pasture type livestock zone for high-cold land type goats and oxen (yak) but are not included in the objective areas of this survey.

Next altitude zone covering from 2,500 m to 3,000 m in the northern section of Ramechhap District is within the cold temperature zone where livestock such as high-cold land type goats and oxen and production of potatoes are being performed in addition to raising of miscellaneous grains such as barnyard millet. However, technical level of raising potatoes is generally low so that maintaining of land is difficult and productivity is said to be extremely low.

Next altitude zone covering from 1,500 to 2,000 m in mountainous areas is within the Temperate Zones where miscellaneous grains such as maize, millet and barnyard millet are raised partly in association with livestock (water buffaloes for milk, work cattles, goats and chickens). In this case, type of livestock will vary depending upon tribes and religions.

Next altitude zone covering from 1,500 to 700 m in middle mountain areas is within the warm Temperate Zones where miscellaneous grains described above are mainly raised but fruit trees and vegetables are partially included in farming while paddy rice is also being grown where water resources are available. Particularly, the altitude of about 1,000 m functions as a boundary in terms of fruit production since deciduous fruit trees are grown in land above this boundary and tree distribution changes to citrus fruits and tropical fruit trees in land below this boundary.

Next altitude zone covering from 700 m to 500 m in low land is located at the bottom of valley along the rivers where rice is dominant. However, areas below the altitude of 500 m are located within the subtropical rice zones which have a washtub shape so that these areas are excluded from the category of mountainous agriculture.

Also, when difference in elevations is large within the same agricultural land block, vertical distribution of crops considerably varies depending upon the elevation.

In selecting the survey areas, the typical sections of each type of farming described in the previous table will be considered and special precautions will be taken so as to survey the whole locality as wide as possible. Thus, in addition to each typical section in central area of each district, Nepartok in the western area and Ambot in the eastern area are specially added though traffic is extremely inconvenient in these areas.

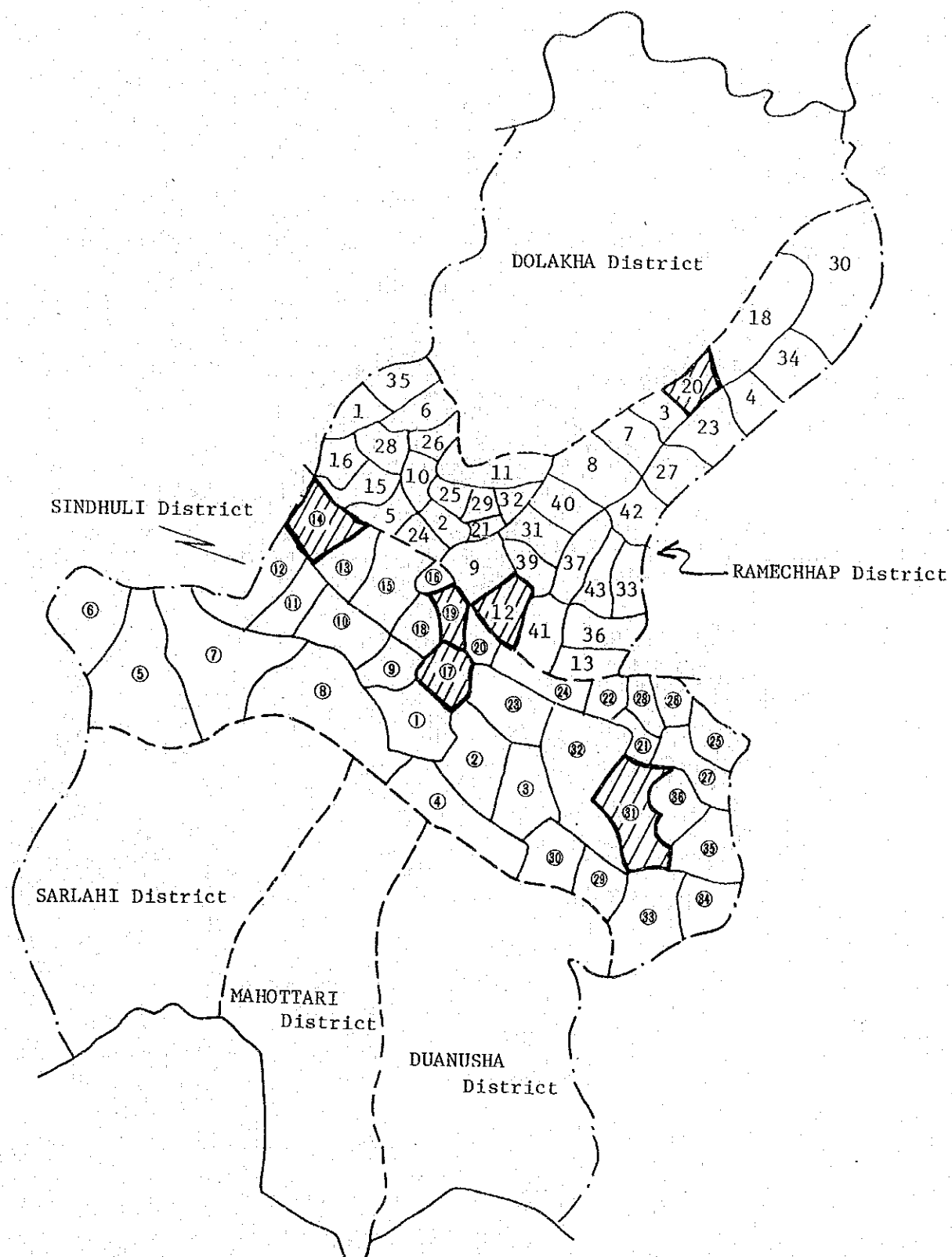
The survey was conducted by the cooperation between the specialists of both Japan and Nepal with schedule and organization indicated at the end of this report.

The survey was conducted by the following procedure:  
(1) Correction of relevant data at the ADOs; (2) gathering information on the present conditions of agriculture within the survey sections from the representatives of Panchayat; (3) selection of farmers to be surveyed; and (4) surveying on and hearing from farmers by using farming survey table and supplemental survey table. (Farming survey table and supplemental survey table will be shown later.)

However, because of the tight survey schedule, the survey for Chapouli and Rasnal was conducted by simplifying the method of hearing in Panchayat.



Table 20 List of Panchayat by District



1. (NOTE): From ADO survey data.

Fig. 7 Location of Survey Sections

District No.	Sindhuli District	District No.	Ramechhap District
①	Sidheshwar	1	Gunsi Bhadoure
②	Ramchuri	2	Pakarbas
③	Patandeir	3	Betali
④	Ranibar	4	Priti
⑤	Mahendra Jhyadi	5	Rahathum
⑥	Hariharpur Gadhi	6	Tokarpur
⑦	Kapila Kot	7	Namadi
⑧	Dadi Curasa	8	Khimti Nagasthali
⑨	Bhadra Kali	9	Bhaluwajor
⑩	Amle Bastipur	10	Choparang
⑪	Nepaltali	11	Phalasi
⑫	Rampur	12	Bhangeri
⑬	Thangajholi	13	Rampur
⑭	Kusheshwar Dumja	14	Nagdaha
⑮	Ratornate Jhagajholi	15	Khaniyapani
⑯	Sitalpati	16	Bethan
⑰	Ratenchure	17	Majhuwe
⑱	Majhuwa	18	Thasebazar
⑲	Bhimeshar	19	Chuchure
⑳	Baseshwar	20	Rasnalu
㉑	Tripureshwar	21	Chisapani
㉒	Dudu Bhanjyang	22	Bekukasthali
㉓	Tinkanya	23	Bhuju
㉔	Bhuaneshwari	24	Bhirpani
㉕	Solpathana	25	Gagal Tar
㉖	Khang Sayg	26	Daramba
㉗	Mahader Dada	27	Saipu
㉘	Pukhari	28	Dimipokhari
㉙	Dakaha	29	Puranagaun
㉚	Kurtharli	30	Gumdel
㉛	Tribuwar Ambote	31	Kathajor
㉜	Balajor	32	Gelu
㉝	Tandi	33	Mugitar
㉞	Mabendra Ladabh	34	Bamitibhandar
㉟	Arun Thakur	35	Lokhanpur Rilthe
㊱	Jinkbu	36	Chilaune Kmarka
		37	Saluseti Devi
		38	Bankimeri
		39	Sunarpani
		40	Katahare
		41	Sukajor Sailsikha
		42	Sailsikhar
		43	Bijuli Kat
			Sirubari





(2) Present Conditions of Survey Sections

1) Khurkot: "Paddy in low land" type

Name of Panchayat: Bhimeshwar

This Panchayat has a total area of 977 ha. with altitudes varying from 1,400 m at the ridge line of the Mahabharat Mountain System to 430 m at alluvial fan in the Sunkosi River. Its percentage of arable land is 66% and this area has 150 ha. of irrigated paddy fields which utilizes as water sources the Adheri, Bhatauti and Khimti Rivers, the tributaries of the Sunkosi River. Its percentage of the paddy field is 39%, and this area has water reserve property which gives good soil fertility to the area since it is located on the north slope of the Mahabharat Mountain System.

Number of households of farmers is 581 and head of village told that about 60% of farmers produces sufficient foods and 20% of these farmers has surplus to sell their foods.

On the other hand, 40% of all farmers has no sufficient foods since they have no irrigated arable land and, thus, they generally work for rich farmers as agricultural daylabourers and get paid by grains as wage for making their living. There are also few people who go out to Katmandu and India for work.

Area of arable land per farmer is 1.03 ha. which is larger than the mean area of 0.8 ha. in Sindhuli District. But it is said that the dry field farmers have no sufficient foods in many cases even if they have 50 Ropani (about 2.5 ha.) but, in case of irrigated arable land, it is said that 10 Ropani (0.5 ha.) is sufficient for a farmer.

In this Panchayat, four persons per farmer's household work in agricultural work on the average but it is said that labour force relying only on the family labour force is insufficient as a whole.

For this reason, not only the workers from farm households who have no sufficient foods but also the workers from Ramachhap come to work for the rich farmers during busy farming season.

The wage is 7 RP in cash or 1 Pathi (3.4 kg) of maize for payment by allowance in kind.

The cropping system of Panchayat consists of combinations of paddy, wheat, maize, millet, soybean, cowpea, etc. as indicated in the table below.

Table 21 Cropping System of Irrigated Arable Land and Percentage of Distribution

Cropping system	Percentage of distribution
Paddy + wheat	25%
Paddy + maize	30%
Paddy + soybean	10%
Paddy + paddy	15%
Paddy + wheat + paddy (early ripening)	20%

Table 22 Cropping System of Non-irrigated Arable Land

Cropping system	Place of distribution
Maize + peanut	Low land
Maize + horse bean (gahat)	Low land
Maize + soybean	Low land
Maize + cowpea	High land

In areas other than main grain cropping areas, few fruit trees such as pineapples, bananas, etc. are raised and some of fruits are sold. As far as vegetables are concerned, potatoes are being sold in these areas.

Agricultural products are sold in Sindhuli and Ramechhap markets but the latter is functioning as marketing economic zone since unit prices are higher than in Sinduhuli market because of inconvenience of traffic.

Nextly, actual conditions of cultivating technique are that the compost of 120 to 150 kg per Ropani (0.5 ha.) is being used as basal application of fertilizer and many farmers are increasingly using chemical fertilizer as additional application. The kinds of the chemical fertilizer widely being used are mixed fertilizer, urea, potassium chloride and ammonium sulfate. For plant control, many farmers use miticide to prevent damages by stink bugs and Mei bugs during milk-ripe stage of paddy, and about 10% of farmers use BHC and miticide for preventing insect damages of maize.

Farmers are making efforts for increasing the agricultural productivity in this Panchayat but there is almost no room for enlarging the farming scale. There are only few examples of sales of lands, and price of land is about 5,000 to 10,000 RS/Ropani for irrigated arable land and 500 to 1,000 RS/Ropani for un-irrigated field.

## 2) Nepartok: "Paddy in low land" type

Name of Panchayat: Kusheswar Dumju

This section is located in the western area of Sindhuli District in adjacent to Bagmati District in the next zone. Therefore, this section is greatly affected by Bagmati economic zone since bus route between Katmandu and Bagmati is extended up to a point about 20 km away to the west of this section.

This section is located between the altitudes from 1,759 m to 534 m and has a relatively large paddy field zone in alluvial fan at the confluence between the Sunkosi River and the Rosi River.

Its total land area is 1,440 ha., percentage of arable land is 67%, and percentage of paddy field is 18%. According to the report by the head of village, this Panchayat will be able to make self-supporting if proper amount of rainfall is available at proper time.

Total population is 3,637, number of households is 588, and the mean arable land area is 1.64 ha. per household (from results of survey by ADO in 1978/79), which are relatively large. These indicate that a farmer will be able to make living if he has paddy fields of about 0.5 ha. with irrigation facilities in this area which is almost the same as that of Khurkot section described before.

Cropping in this section is "paddy + paddy + wheat" and "paddy + maize" for paddy field and also typified by "maize + horse bean or mustard" for dry field. In recent years, revetment work has been developed so that it is said that even three crops a year are possible as long as serious problems soil fertility are solved. It is also told that deteriorating soil fertility and unstable cropping of maize are creating special problems for upland field cropping.

The people in this village are greatly interested in manuring practice and plant control for paddy, and they use BHC and metasistorux for preventing it from damages by leaf rorrers and stemrot.

Busy farming seasons in this village are from April to May for harvesting wheat, from June to July for rice planting, and rice harvesting from November to December, and most of persons having no land work within Panchayat and their wages are 5 RS plus lunch per day.

Generally, in year when there is a surplus in the production of grains in this village, rice, maize and wheat are shipped to Ramechhap but people go out to Katmandu and other areas for work in year when the main grains are in shortage.

Flow of lands is relatively high and it is told that about 10 to 15 households left the village for last 4 to 5 years and moved to Bagmati and other areas (told by the head of village).

3) Nakajori: "Paddy and other grains in middle mountain areas" type

Name of Panchayat: Patanchura

This section is located at a point about 12 km northeast of Sindhulimali at the center of Sindhuli District. The altitude of this section ranges from 1,260 m to 1,000 m on the north slope, covering both warm Temperate Zone and Subtropical Zone.

The total land area of this Panchayat is 944 ha., percentage of arable land is 53%, and percentage of paddy field is 23%, and relatively good cultivating conditions are available within the survey areas.

Average area of arable land per household of farmer is 1.07 ha. which is about 1.3 times bigger of that of Sindhuli District but the distribution of farmers by scale of arable land ranges between 0.1 ha. and 5.0 ha.

Current cropping conditions are that paddy, maize and wheat are raised in irrigable land, that is, the paddy field, but maize is mainly raised in non-irrigable land together with other cropping system of soybean, small red beans, horse beans, millet, cowpeas, etc. However, yield from dry field without water is extremely unstable, and many farmers have difficulties in securing drinking and domestic water. For securing irrigation water, small rivers within the area have been used as water sources for the irrigation. In 1974, national budget of 13,000 RS and investment of 17,000 RS by Panchayat were added together to make a total of 30,000 RS as fund for the canal construction work for 40 to 50 ha. of arable land and the work was completed,

but this canal is now unable to supply water because of breaking by sediment during rainy season. It is told that many people go out to India or other areas for work for 3 to 6 months during dry season because of such unstable situation in farm production.

Characteristics of agriculture in this section are that Suntara and Jiknar of citrus fruit trees which have been the traditional trees in this section are still being raised, and each farmer raises about 6 mature trees of this kinds on the average. A total of 2,430 Jiknar is presently being raised in this section. It is told that the fruits are shipped to Bazar and other areas and an income of about 150 RS is possible per tree. The people in this section are very enthusiastic for newly planting these trees of Jiknar and buy young trees from adjacent orchard area.

For buying materials needed for agricultural production, farmers customarily borrow money from leaders in the village and buy them in Sindhuli. Presently they seem to be not using AIC. Users of chemical fertilizer are mostly rich farmers, and the fertilizer is occasionally not available when it is really needed.

Agricultural chemicals are not being used well since people frequently think that they are not effective. Main reason is that farmers have not been well informed of using method of such chemicals. Head of village points out that the residents of the village are hoping to have new roads developed first since they have to walk to Sindhuli for buying commodities at present. Secondly, they want to construct irrigation facilities and it is told that they may be able to increase their annual production several times more if irrigation is provided. Thirdly, they want to have animal hospital, market facilities for selling livestock, and enrichment of surger Sunstar.

4) Ambot: "Paddy and other grains in middle mountain areas" type

Name of Panchayat: Tribhowar

This village is about 39 km away to the east, in a straight distance, from Sindhulimari, the center of Sindhuli District and located on the south slope of Mahabharat Mountain System. This section is in low valley with an altitude of about 1,200 m, and most of arable land has been completely cultivated. Its percentage of arable land is 40% and percentage of paddy field is 35% (results of the ADO Survey). Total number of households is 819 and about 10% of them has no arable land. The mean area of arable land of each household is 1.35 ha. which is 1.7 times of the mean area (0.8 ha.) in Sindhuli District so that this village is relatively in good conditions compared to other villages. However, it is said that the production of grains is generally insufficient and they buy main grains such as paddy, maize, millet, wheat, etc. from Kamala Belt where surplus of such grains exist.

The cropping system in this valley varies considerably from "paddy + wheat", "paddy + maize" to "paddy + mustard" for paddy field, and "maize + millet" for dry field. However, it is said that yield of maize in dry field is greatly depending upon the rainfall at right time and thus it is so unstable. Use of improved varieties of maize or chemical fertilizer is not effective in the year of drought. Though the main grains are in shortage, sufficient potatoes and dairy products are available in this village.

With cooperation with other 9 nearby Panchayat, this village has carried out new road construction project and road is already constructed up to Sindhuli.

Sufficient farm workers are available within the Panchayat, and wage of worker usually consists of "3 meals + allowance in kind (grains)". Since there is no room to expand the arable land within the Panchayat, the price of land is 3,000 RS per 1 Ropani (0.5 ha.) for irrigated paddy field and 200 RS for arable land without irrigation facilities. Head of village indicates that farmers want to have the propagation of technique for increasing and stabilizing crops, installation of pilot farm for verification, and improvement of living environment such as electric power generation.

5) Ramechhap: "Miscellaneous grains in mountainous areas" type

Name of Panchayat: Bhangeri

This section is located at far south portion of Ramechhap District which is about 4 km away, if the straight distance is measured, from Sunkoshi River running along border between Sindhuli and Ramechhap Districts.

This section is on the sloped land facing the south with steep topography that ranges from the altitude of about 430 m along the bank of Sunkoshi River to the altitude of about 1,260 to 1,400 m.

This section is the economic center of Ramechhap District where district office of government and agricultural organs such as agricultural promotion center are located.

Total area of the Panchayat is 2,052 ha., total number of households is 761 and its population is 4,119.

Its climate is that of Subtropical Zone and Temperate Zone, soil is mainly red soil, rainfall is relatively low because of blocking by Mahabharat Mountain System, but north wind from mountain area is strong.

Percentage of arable land is 53% but agricultural productivity in sloped land facing the south along the ridge is generally low because of drying and northern slope has a high productivity because of its excellent water reserve property.

Main crops are maize, millet, wheat, horse beans, black chick pea and small red beans in the order of yield, and paddy cropping is being performed in the area along the Sunkoshi River for rice and there are also some rain-fed paddy fields. These rain-fed paddy fields are located in relatively flat area with good water reserve property but its yield is low and unstable compared to irrigated paddy fields. Most of cash income of farmers in this section is made by the citrus fruits. Particularly, Jiknar trees are widely raised and new trees are increasing since nursery stocks are produced in 3 nurseries in the district and being distributed to farmers. Since most of lands in this village are located on steep slope in the valley, even the drinking water is insufficient and there is almost no irrigable land. Therefore, the representative of Panchayat indicates that self-supporting foods are available only for 6 months.

In many cases, income of farmer's household consists of wages obtained from farming labour, work of porter and work in other areas in the country.

Since a unit of army permanently stays in this valley, there are many work of periodic transporting of army materials and work of transporting of commodities from Sindhuli District so that chances of employment other than farming are considered to be relatively high.

### (3) Survey and Analysis of Farming

Actual situations of farmers engaged in farming in mountainous areas have been already studied and surveyed by "Preliminary Survey for Farming in Valley" from 1974 to 1976, and by the survey for 5 districts within the project area conducted by the staff of APRSC (Agricultural Project Services Centre) in 1977. By using the results of such previous surveys as reference, our survey was conducted by focussing our efforts on analysis of farming situations in order to establish the improved plan.

As already described before, only roads available in this section run between Janakpur and Sindhuli and between Sindhuli and Ambot but automobiles can travel these roads only during dry season. Only traffic means other than these roads are horse riding and walking through steep mountains. For this reasons, it was impossible to perform complete survey for all of survey sections shown in Table 19 within limited period of survey time by the specialists who visited there just for a short time. For this reason, Rasnal which is a typical land of "potatoes and livestock in high-mountainous areas" type was surveyed only by the separate team consisting of only Nepari staff.



### 1) Selection of Farmers' Households to be Surveyed

The purposes of this farmers' survey are to find out the basic conditions of farming (scale of arable land and land conditions, families and labour forces, livestock raising conditions, etc.), and actual situations of hill agriculture including cropping system and level of farming techniques, to analyze the factors which are obstructing the development of farming, and to establish the improvement and development plan for hill agriculture. For these purposes, standard farmers of each type of farming were selected, questions were asked concerning farming conditions stated above to each farmer, and actual farming was observed and surveyed. In addition, it was determined to survey the progressive farmers in order to utilize the results in preparation of improved plan.

In this case, if statistical data are fully available, farmers to be surveyed may be selected basing upon such data. However, survey and statistical data that can be used for such purposes are not available and number of farmers who are able to respond to such survey is extremely small. Thus, sampling by class is impossible in selecting the farmers so that we had no choice but to rely upon the recommendations made by head of each Panchayat after explaining the purposes of the survey. As a result, characteristics of farmers selected and surveyed are tabulated in Table 23. Actual number of households of farmers surveyed is more than 30 but only 16 households who were fully capable to respond to our survey are tabulated in this table.

Table 23 Results of Selection of Farmer Households Surveyed and Percentages of Farmers by Scale of Arable Land for Farming

Description	Name of district	Scale of arable land for farming (ha.)							
		0.2 max.	0.2~0.5	0.5~1.0	1.0~2.0	2.0~3.0	3.0~5.0	5.0 min.	Total
Percentage of farmers	Sindhuli	35	34	18	9	2	1	1	100
by scale (%)	Ramechhap	38	38	17	5	1	1	-	100
Number of farmer households	Sindhuli	0	0	4	2	3	1	0	10
	Ramechhap	0	0	1	2	2	-	1	6

## 2) Result of Survey

### (1) Basic Conditions of Farming Management

Present situations of land ownerships are tabulated in Table 21. It is clear that most of arable lands owned by the farmers are the paddy fields in cases of "paddy in low land" type and "miscellaneous grains in mountainous areas" type including partial rain-fed paddy fields. However, in cases of "miscellaneous grains in mountainous areas" type and "potatoes and livestock in high-mountainous areas" type, farmers own the paddy fields but the areas are smaller than 30% of total arable land for farming.

On the other hand, number of places of scattered fields owned is 7 at maximum for a some farmer but its average is about 4 per household. Generally, the farmer who owns large scale arable land also own a land of sizable area with good land conditions in the vicinity of his house.

Concerning slope and soil conditions of the fields, it is found out that most of land is terraced fields on the steeply sloped land since this is topographically a hill area and many farmers indicate that soil conditions are normal except that some farmers of "miscellaneous grains in mountainous areas" type have poor lands with many gravel.

Table 24 Basic Farm Management Conditions of Farmers Surveyed

Type of farming	Name of Panchayat	Farmer's No.	Area of farming land (ha.)					Land conditions (number of places of fields)										Present of irrigation facilities	
			Arable land					Conditions of scattering of field					Slope & soil conditions						
			Paddy field	Dry field	Land for fruit trees	Total	Forest & plain	Paddy field		Dry field		Flat land	Gentle slope	Steep slope	Soil				
								Less than 1 km	Greater than 1 km	Less than 1 km	Greater than 1 km								
"Paddy in low land" type	Khurkot	1	0.5	0.3		0.8						1	2	2		1	Normal	Yes	
	Nepalpok	2	0.6	1.2		1.8	0.1			1			2	1	1	2	Normal	Yes	
	"	3	1.7	1.0		2.7						3	1	2	3	4	Good	Yes	
"Paddy and misc. grains in middle mountain areas" type	Ambot	4	1.3	0.6	0.2	2.1				2	1			1		4	Poor	None	
	"	5	4.6			4.6				1	1			1		1	Normal	Yes	
	Nakajoli	6		0.8		0.8										1	2	Good	-
	"	7	0.9			0.9				2							2	Good	Yes
	"	8	1.8			1.8	0.5		1						3		Normal	Yes	
	Chapouli	9		0.7		0.7										2	2	Normal	-
	"	10	1.5	1.4		2.9				5						2	6	Normal	Yes
	Ramechhap	11		0.6		0.6										1	1	Poor	-
	"	12	0.1	1.8		1.9					1	1					2	Poor	None
"	13	0.5	6.7		7.2					1	2					3	1	Good	Yes
"Potatoes and live-stock in mountainous areas" type	Rasnal	14	0.4	0.8		1.2				1	1			1		2	Normal	None	
	"	15	0.2	1.3		2.0				1	2	1				5	Normal	Yes	
	"	16	0.6	2.1		2.7				2	4					2	5	Normal	Yes

It is also found out that all irrigation facilities are taking water from mountain streams.

All farmers surveyed of each type of farming are doing owner-farming. Some middle-scale farmers of "miscellaneous grain in mountain areas" type are doing farming work by contract to secure self-supporting foods. In addition, some large-scale farmers in "potatoes and livestock in high-mountainous areas" are lending their lands. However, representatives of Panchayats indicate that tenant farming is not being practiced at present. Survey for farming conditions conducted in 1976 analyzed that some middle-scale or smaller farmers were doing farming on leased land but the majority of farmers were doing owner-farming, which will substantiate the presence of tenant farming practice.

## (2) Land Use and Cropping Pattern

Farmers' arable land use situations show that the presence of the water reserve property will allow easier selection of kinds of second crops and assure higher stability of yield not only for irrigated fields in low land but also for terraced paddy fields utilizing water from mountain streams in valley during rainy season. Thus, whether a farmer will have paddy field or not will greatly affect the economic potential of this farmer.

According to the total planted area used for computation of the cropping rate of farm, it is found out that the width of line planting of both companion cropping and second cropping is wider than that of single cropping, and actual planting density of such companion and second cropping is lower. For instance, the results of hearing from farmers of Nakajoli indicate that the spacing between the rows of maize is 0.6 to 0.45 m for single cropping but is 1.0 to 0.6 m for companion and second cropping, which means that the latter has about 30 to 40% wider spacing between the rows. Though there are some problems stated above, a cropping rate of farm of 100% will be assumed for both companion cropping and second cropping in this paragraph. Basing upon this assumption and number of cropping of the arable lands, the cropping rate of farm will become 150 to 200% for "paddy in low land", 160 to 210% for "paddy & miscellaneous grains in valley areas", 190 to 300% for "miscellaneous grains in mountainous areas", and 100 to 170% for "potatoes in high-mountainous areas".

As far as paddy fields in "paddy in low land" are concerned, "paddy + wheat + paddy" or "paddy + wheat" is the most dominant.

In the "paddy and miscellaneous grains in middle mountain areas", "paddy + wheat" and "paddy + maize" are dominant. On the contrary, of the upland field cropping in "miscellaneous grains in mountainous area" and "potatoes and livestock in high-mountainous areas" where the area of paddy fields is very small, miscellaneous grains are being raised mainly by two crops a year but some farmers are producing three crops a year. Also, it is found out that the cropping rate of farm of small-scale farmers is larger than that of large-scale farmers. The cropping pattern of farmers surveyed is shown in Table 25.

Table 25. Type-of-agriculture-wise Cropping Pattern  
 (x:seeding, o:transplanting, ww :harvest, —:period in field)

Type of agri.wise	Village panchayat	Low land field (international months)					Upland field (international months)					
		4	6	9	12	3	4	6	9	12	3	
Low land paddy type	Khurkot	1 Paddy + wheat + maize						1 Soybean + maize				
		2 Paddy + paddy + wheat										
	Nepaltok	1 Paddy + paddy + wheat						2 + potato & garlic				
		2 Paddy + maize										
Mid-Hill cerials type	Ambot	1 Paddy + wheat						1 Maize + horsegram, mustard				
		2 Paddy + mustard, chana										
		3 Paddy + maize						2 Maize + mustard				
	Nepaltok	1 Maize + horsegram, mustard						3 Maize + horsegram				
2 Maize + mustard												

Type of agri.wise	Village panchayat	Low land field (international months)	Upland field (international months)
		4   6   9   12   3	4   6   9   12   3
Mid-hill cereals type	Nakajoli	1 Paddy + maize paddy x-o-----ww ww maize x	1 Maize + millet maize-----ww x millet x-o-----ww
		2 Paddy + wheat paddy x-o-----ww ww wheat x	2 Maize + soybean maize-----ww x soybean x-----ww
		3 Paddy ... (fallow)	
		4 Millet + maize millet x-o-----ww ww maize x	
		5 Vegetable	
	Chapouli	1 Paddy + wheat paddy x-o-----ww(local) x-o-----ww(improvement) ww wheat x	1 Soybean, maize + backwheat maize-----ww x soybean-----ww } (catch crop) backwheat x-----ww
		2 Paddy + maize	2 Maize + millet, soybean maize-----ww x millet x-o-----ww soybean x-----ww
			3 Fruit + vegetable, etc.
Hill cereals type	Ramechhap	1 Paddy ... (fallow) x-o-----ww	1 Maize + horsegram
		2 Paddy + wheat + maize paddy x-o-----ww ww wheat x maize-----ww	2 Maize+horsegram, backwheat soybean, mustard maize-----ww x horsegram x-----ww backwheat x-----ww mustard x-----ww soybean

Type of agri.wise	Village panchayat	Low land field (international months)	Upland field (international months)
		4   6   9   12   3	4   6   9   12   3
Sub-high land potato and stock raising type	Rasnal	1 Paddy ... (fallow) paddy x—o—w	1 Maize + millet maize x—w
		2 Paddy + potato paddy —o—w x potato	2 Wheat + potato wheat x—w x potato
		3 Paddy + wheat x—o—w w wheat x	3 Potato w potato x



The results indicate that farmers of each type of farming are making efforts for increasing the cropping rate of farm as high as possible. Therefore, there is no quite possibility of consolidation of cropping pattern in future so that it is considered that more efforts should be made in improving varieties and cultivation techniques. However, in some sections where new water intake is possible and new paddy can be cultivated, the top priority shall be naturally given to land reclaiming to paddy fields.

(3) Varieties and Yields of Main Crops

Table 26 Introduced Varieties of Main Grains

Type of farming	Paddy			Maize			Wheat	
	Improved varieties	Local varieties	Local varieties	Improved varieties	Local varieties	Local varieties	Improved varieties	Local varieties
"Paddy in low land" type	MASULI	MARSI		KHUMALTAR YELLOW	SATIYA		RR-21	
	TAICHING							
	CH-45							
"Paddy and misc. grains in valley areas" type	MASULI	THAPACHINIYA		KHUMALTAR YELLOW	SATIYA		RR-21	
	TAICHING	MARSI		RAMPUL YELLOW	HETAUDA			
	IR-8	POKHARELI MASINO						
		MANSORI						
"Misc. grains in mountainous areas" type		MARSI		KHUMALTAR YELLOW			RR-21	
		RAMBILAS			SATIYA			
"Potatoes and livestock in high-mountainous areas" type		MARSI						BIRE
		SETO						

Note: There are other conventional varieties not shown in this Table which are called by dialect names and unclear.

It is found out that the improved varieties of paddy are widely used in the region of "paddy in low land, type" and "paddy and misc. grains in middle mountain areas" type where percentage of paddy area is high. On the other hand, in the region of "misc. grains in mountain areas" type and "potatoes and livestock in high-mountainous areas" type where the rate of paddy cultivation is low, conventional varieties are mostly used and improved varieties are rarely raised.

An improved variety of maize called "Khumaltar yellow" has been partially introduced but conventional varieties having short cropping period and good quality are still being raised widely.

As far as wheat is concerned, an improved variety called "RR-21" is widely being raised except the region of "potatoes and livestock in high-mountainous areas" type.

Results of case study for farmers show that the yield is 1.7 to 4.2 Muri\*/Ropani for paddy fields of "paddy in low land", 0.9 to 3.2 Muri/Ropani for "paddy and misc. grains in valley areas" type, and 0.3 to 1.7 Muri/Ropani for "grains in mountainous areas" type and "potatoes and livestock in high-mountainous areas" type. These values are generally lower than the yields per unit area which were told by heads of Panchayat, ADO and JTA. Improved varieties of paddy show a tendency of higher yields.

Note\*: One Muri of paddy is equal to 48.77 kg.

Table 27 Yield per Unit Area by Type of Main Grain  
(from Farmers' Management Survey)

(Unit in Muri/Ropani)

Class	Low land field			Upland field		
	E-paddy	L-paddy	Wheat	Maize	Maize	Millet
"Paddy in low land" type	1.7	1.0~4.2	0.8~2.0	-	0.8~1.0	-
"Paddy and misc. grains in middle mountain areas" type	-	0.9~3.2	0.5~0.7	0.9	0.4~0.8	0.5~1.0
"Misc. grains in mountainous areas" type	-	1.7	0.4	-	0.9	-
"Potatoes and livestock in high-mountainous areas" type	-	0.3~0.5	0.4	-	0.4~0.6	-

(4) Manuring and Management Practice and Protection of Disease and Insect

According to ordinary practice of fertilizer application in hill land, the compost produced by farmers is all used for basal application. Amount of compost used is about 10 dokko (about 250 to 300 kg) per 1 Ropani for paddy cropping. The farmers using cropping pattern of "paddy + wheat" in region of "paddy in low land" type and "paddy and misc. grains in middle mountain areas" type widely use chemical fertilizer but use less compost compared to upland field region. Also, it is found that there is a tendency of using less compost in irrigated paddy field than rain-fed paddy field even though the same paddy is raised. This is possible probably because the irrigation water contains some natural supply of nutrient so that high yield is obtained without using a large amount of compost and because the yield is stable due to the supply of water.

For raising maize in upland fields in the region of "misc. grains in middle mountain areas" type and "misc. grains in mountainous areas" type, farmers are using compost which is about 1.4 to 3.0 times of that used for paddy cropping. Also, additional application of fertilizer for upland field cropping is rarely made and chemical fertilizer is rarely used.

When applying the compost, all farmers surveyed apply it to the fields by the method of broadcasting.

For plant control, only method being used is screening and removal of seeds damaged by insects for maize, and only very few farmers spray the agricultural chemicals for paddy cropping.

#### (5) Cultivation of Fruit Trees

About 60% of farmers' households surveyed are raising some fruit trees. Except apple, lemon and peach trees being raised in Tabe Danda in Pansal Panchayat, most of these farmers raise mainly jiknar and suntara, the citrus fruits. However, only few farmers raise them in orchards and most of farmers generally raise only several trees within and around their lots.

Some farmers in Ramechhap and Nakajoli are strongly hoping to plant and raise fruit trees as sources of cash incomes since the areas of arable lands are small and thus grain production is limited. Many of these farmers who raise the fruits trees are selling jiknar and suntara.

#### (6) Stock Keeping Situations

Stock keeping situations of the farmers surveyed are indicated in Table 28. Buffaloes are raised for the purposes of milking, production of ghee and increasing of baby buffaloes and are their important cash income sources. Cattle is raised for the both purposes of work cattle and breeding cattle but the latter is also used for milking.

Generally, number of livestock including only large animals such as buffaloes and cattle is very large and is about 8 in average per each farmer's household surveyed.

Table 28 Stock Keeping Situations

Type of farming	Name of Panchayat	Farmer's No.	Farming area (ha.)		Number of livestock raised										
			Total	Forest and plain	Buffaloes		Breeding cattle		Work cattle		Goats	Chickens			
					Adults	Infants	Adults	Infants	Adults	Infants					
"Paddy in low land" type	Khurkot	1	0.8				4			2					
	Nepalpok	2	1.8	0.1			2			2		2		2	4
	"	3	2.7				2			4					1
	Ambot	4	2.1				4			3		2		3	4
	"	5	4.6			6	3	10			6			12	
"Paddy and misc. grains in middle mountain areas" type	Nakajoli	6	0.8		1									3	4
	"	7	0.9				5			2		1			6
	"	8	1.8	0.5		4		4			3				11
	Chapouli	9	0.7			2								5	60
"Misc. grains in mountainous areas" type	"	10	2.9			5	3	2			4			8	5
	Ramechhap	11	0.6			1		1			2			6	4
	"	12	1.9			1								3	15
"Potatoes and live-stock in high-mountainous areas" type	"	13	7.2			3	1	2			4			6	10
	Rasnal	14	1.2			1					2			2	
	"	15	2.0			2		2						1	15
	"	16	2.7			3		7			2			8	22

Method of stock keeping is open-yard feeding associated with drylot feeding as indicated in Table 29. And main feeds are straws, millet grass, wild grass, forage plants and so forth. Since number of livestock raised is large, feeds are generally insufficient particularly in dry season so that farmers are greatly depending upon the forage plant and spend many time and labor in collecting the feeds in many cases. Thus, most forests are losing their trees and, therefore, many problems exist in view of protection of erosion and securing of water sources.

Due to lack of improved breeds for large livestock and shortage of feeds described above, the milk performance is extremely in low level. It was difficult to accurately grasp the amount of milk through the hearing survey but it is assumed that mean amount of milking per day per cattle is about 1/10 (about 1.5 to 2.0 kg) of that of developed countries.

Of the use of work cattle in agriculture, it is told that an arable land of 2 ha. will be fully processed by a work method using two cattle as a pair. Mr. K.K. Panday also says that even 3 ha. can be done by a pair of cattle. The results of survey for farmers show that a total of 13 households of farmers raise work cattle and a total of 43 cattle is being used to process a total arable land of 30.1 ha. This means that an area of 0.7 ha. is being processed by each cattle. In addition, it is considered that cows presently being raised particularly for breeding can be also used as work cattle so that big problems of excessive number of cattle being raised and low efficiency exist there presently.

In addition to the large livestock described above, many goats and chickens are raised for producing meat products, and this makes the feed shortage problem more serious particularly in dry season.

Table 29 Large Stock Keeping Method

Type of farming	Name of Panchayat	Farmer's No.	Stock keeping method	Style of barn yard	Place of open yard	Kinds of feeds					Method of production or securing of feeds	Characteristics of feeding and management	Utilization of dung	What the farmers are thinking
						Stems of maize	Millet grass	Wild grass	Forage plants	Bamboo				
"Paddy in low land" type	Khurkot	1	Drylot & open-yard feeding	Open type	River land	0	0	0	0	0	0	Returned to arable land.	Diseases of livestock.	
	Nepalok	2	Drylot feeding	With roof	"	0	0	0	0	0	0	- do -		
	"	3	"	"	"	0	0	0	0	0	0	- do -		
	Anbot	4	Drylot & open-yard feeding	"	Within field	0	0	0	0	0	0	- do -	Improvement of breeds of livestock and of technique for pasture.	
	"	5	"	"	"	0	0	0	0	0	0	- do -		
"Paddy and misc. grains in valley areas" type	Nakajoli	6	Drylot feeding	"	"	0	0	0	0	0	0	Returned to arable land (220 baskets).	Veterinarians are needed. Insufficient feeds.	
	"	7	Drylot & open-yard feeding	"	Field & river land	0	0	0	0	0	0	- do -		
	"	8	"	"	Owed plain	0	0	0	0	0	0	- do -	Insufficient feeds.	
	Chapouli	9	Drylot feeding	"	"	0	0	0	0	0	0	- do -	Diseases of livestock.	
"Misc. grains in mountain-cus areas" type	"	10	Drylot & open-yard feeding	"	Forest and prao	0	0	0	0	0	0	- do -		
	Ramechhap	11	Drylot feeding	"	"	0	0	0	0	0	0	- do -	Insufficient feeds.	
	"	12	"	"	"	0	0	0	0	0	0	- do -	Diseases of livestock	
	"	13	"	"	"	0	0	0	0	0	0	Returned to arable land (460 baskets).		
	Rasol	14	Drylot & open-yard feeding	"	Within field	0	0	0	0	0	0			
	"	15	"	"	"	0	0	0	0	0	0			
	"	16	"	"	"	0	0	0	0	0	0			



(7) Family Members and Their Working Situations

It is commonly seen in many areas that the families with large-scale arable land for farming have also large family members. Also, generally there are more members in families in valley areas than in region of "paddy in low land" type. About 1/2 of members of each family are working in agriculture.

Of the percentage of working of family members within their own farm lands, only about 10% of them are working for more than 50% of days of the year in their own farming. This means that labor peak of owner-farming occurs during busy farming season of tilling, seeding and harvesting but farming management is generally poorly performed in other seasons of the year. This indicates that the productivity can be considerably increased in future by systematizing cultivation techniques and improving the cropping rate of farm. Agricultural labor described above does not include the labor required for the management of livestock.

Table 30 Family Members and Their Working Situations

Type of farming	Name of Panchayat	Farmer's No.	Number of family by age (No. of persons)										Working situations (persons)						
			Male					Female					Working in agriculture			Working in other than agriculture			
			Age 15-16	17-30	31-50	51-15	16-30	31-50	51-15	16-30	31-50	51-15	Total of male & female	Number of persons	Rated of working in owner-farming	Less than 30%	50-70	Greater than 70%	Number of persons
"Paddy in low land" type	Khurkot	1	2	1	1			2	1	2									
	Nepeltok	2	1	1		1		4	1								1	1	Porter
	"	3	2	1		1		1		1					3			1	Porter
	Ambot	4	1	1				3	2		1				3			2	Daylaborer
	"	5	1	2		1		3	2		1				3				
"Paddy and misc. grains in middle mountain areas" type	Nakajoli	6	4			1		1											
	"	7	2			1		4			1				4				
	"	8	4	2			1	2	3	2					9				
	Chapouli	9	1			1		2	1						2			1	Daylaborer
	"	10	3	2		2		4	3	2					6			2	Teacher, porter
"Misc. grains in mountainous areas" type	Ramechhap	11	1	1				1	1	1					3			1	Cultivation by contract
	"	12	1				1	2	1		1				2				
	"	13	1	3			1	2	2	1					3			1	Permanent worker
	Rasnal	14		1	1					1								2	Work away from home
	"	15	3	1				1	2									3	
"Potatoes and live-stock in high-mountainous areas" type	"	16	4			1		3			1							3	

(8) Farm Income and Budget

15 households of farmers out of 16 households actually surveyed have the cash incomes from agricultural and livestock products within the fiscal year of survey and have sales records in some forms.

Concerning the sales of agricultural and livestock products, five farming families of them sell the main grains, but paddy is sold by 4 families, maize and wheat are sold by 2 families and millet is sold by one family.

They are all paddy cropping families living in the regions of "paddy in low land" type and "paddy and misc. grains in middle mountain areas" type and this indicates that low land cropping is able to assure higher and more stable production than upland cropping.

Other products being sold are jiknar and suntara in Nakajoli and Ramechhap; potatoes in Tabe Danda (Rasnal); garlic and Indian mustard by paddy farming households in regions of "paddy in low land" type and "paddy & misc. grains in valley areas" type; and ghee, goats, buffaloes, work cattle, and eggs by stock keeping farmers in all regions.

Results of hearing on budgets of farmers indicate that many farmers have to spend cash of about 400 to 500 RS per each member of family annually, and the ratio of food expense to the total cash expense is high particularly for small-scale and large-scale farmers and is greater than 60%.

#### 4. Improvement Measures

##### (1) Improvement of Farming Techniques

The improvement measures described in this section have been prepared and presented here basing upon the opinions of specialists of JADP on the basis of survey results and upon the data supplied. However, most of the improvement techniques shown here are based upon the knowledge and experiences of specialists, and the tests for justification within the object areas which have complicated conditions have been hardly started at this stage. Thus, it is required to carry out these measures for propagation after performing thorough tests and studies from now on.

As far as management for potatoes is concerned, we could not make thorough survey for the potatoes this time so that only the recognition of present potato conditions will be made but improvement measures for potatoes will not be considered this time.

##### 1) Paddy

###### (1) Outline of Cultivation

The cultivation of paddy rice is seen mainly in alluvial fan formed by rivers and along the rivers that are capable to supply the irrigation water. However, paddy rice is also raised in terraced fields on sloped land with high altitude by taking water from usable water sources if they exist. On the other hand, paddy rice is also being raised in the rain-fed paddy field but its production is extremely unstable.

At present time, the varieties of paddy rice are being selected by considering the following factors:

- a. Growing period in relation with cropping pattern.
- b. Varieties which are able to assure stable yield without applying a large amount of fertilizer and/or chemicals.
- c. Large amount of straws as well as large yield should be expected. (Straws are important as feed.)
- d. Drought resistance should be expected (particularly for rain-fed paddy fields and for paddy fields with insufficient water).

The varieties used for cropping are indicated below.

° Early varieties of rice (Planted from late in March to early in April):

Kind	Name of varieties	Remarks
Improved varieties	Taichung N-1, CH-45, 1R-8, Parwanipur-1, Chandina.	Taichung N-1 is most widely used.
Local varieties	Tapatinia	

° Ordinary varieties of rice (Planted from July to August):

Kind	Name of varieties	Remarks
Improved varieties	Masuli, 1R-8, CH-45	Masuli is widely used.
Local varieties	Rambilas, Dallemasino, Bhotenge, Chatemorsi, Achami, Tenpani, Trarneri, Masimo.	

In case of three crops a year with the pattern of "paddy + paddy + wheat" or "maize + paddy + wheat", the short growing period will become important factor in selecting the varieties and, thus, Masuli and 1R-8 shown in the varieties of the above table are not included in this pattern.

In case of two crops a year within the irrigable fields, the cropping pattern of "paddy + wheat" or "paddy + maize" is used. In this case, the yield will be the most important factor in selection so that Masuli is very widely being used as ordinary variety of paddy rice.

Native varieties are mainly being used in rain-fed paddy fields.

According to the present method of field husbandry, wet seed bed is generally used, in which field surface is first tilled, massive earth is crashed then seeds are sowed at a rate of 200 to 300 g/m<sup>2</sup>.

Wet seed bed is maintained for 30 to 35 days for early varieties of paddy rice (transplanted from late in March to early in April) and for 20 to 30 days approximately for ordinary paddy rice (transplanted from July to August).

In preparing paddy field, the field is tilled twice by the cattle then the seedlings are transplanted after puddling. Seedlings are generally transplanted densely at a rate of about 50 to 75 stumps per square meter. Regular planting is not ordinarily performed and random planting is more popular in most of areas. After transplanting to the paddy field, weeding is made once or twice by hand and some farmers will do the additional application of urea.

Main diseases are blast and white leaf withering, and main insect damages are caused by stink bugs, stem-borer, planthoppers and leafhoppers. Particularly, the damages by stink bugs are widely seen and yield is reduced by 10 to 40% depending on the degree of the damage. It is also said that yield is reduced by 10 to 20% by stem-borer, depending upon the season when damage is made.

Harvesting is done by cutting the stems near the ground surface with sickle, and threshing is made by hitting rice to stone or by kicking and treading by cattle.

## (2) Problems and Countermeasures

Though wet seed bed is prepared by tilling of field surface, by crashing of massive earth then by seeding, the seeds are unevenly sowed and growth of seedlings is generally irregular because of insufficient levelling. In addition, seeding density is very high with a rate of 200 to 300 g/m<sup>2</sup> and area of wet seed bed is very small, which is about 2 to 3% of area of paddy field.

As a result, extremely thin seedlings are raised and, thus, tillering is very poor after transplanting to paddy field. Also in the paddy field, seedlings are planted at random and densely at a rate of 50 to 75 stumps per square meter.

Only few farmers are using fertilizer, and particularly additional manure is rarely used. The lack of plant control is the main cause of damages and reduced yield but only few farmers perform the plant control.

As far as cropping pattern is concerned, the pattern mainly using paddy, wheat and maize in irrigated paddy field has been deeply rooted as system 2 or 3 crops a year. However, if all these grains are introduced to the pattern of three crops a year, seeding and harvesting periods as well as growing period and varieties will be overlapped resulting in extremely high peak of labour. Also, when making crop rotation for cereal cropping only, maintaining of soil fertility is very difficult to achieve and this will in turn create the problem of insufficient growth of yield.

According to National Program, it recommends the following improved varieties of paddy rice as shown in the table below:

Table 31 Recommended Varieties of Rice

Region	Improved varieties	Remarks
River Basins	*CH-45, *Parmaripur-1	Growing period of varieties marked with * is within 120 days.
Inner Tarai	*1R-24, 1R-1561	
Hill Area	Taichung-176, Chainung-242 Chainan-2, Tainan-1	Growing period is within 145 days (for 4 varieties).

The varieties shown above have been accepted by part of farmers in the district and planted. However, it is very important to confirm the adaptability of varieties to specific area by the cultivation tests since land conditions and meteorological conditions of the mountains will vary depending upon the location.

Main cropping pattern of the paddy rice in hill area is "paddy + wheat" and "paddy + maize" for two crops a year and "paddy + wheat + early paddy" for three crops a year, and it is required to establish the advantageous cropping pattern which highly utilizes the characteristics of varieties.

In regard to the improvement of wet seed bed and planting density, dense planting generally causes thin seedlings and weak tillering capacity. Therefore, it is considered that the seedlings which have much higher yielding ability than present ones can be obtained if planting density of about 100 g/m<sup>2</sup> is maintained and if area of wet seed bed becomes almost equal to 5% of area of paddy field (50 kg/ha. will provide 5%).

If growing of healthy seedlings is achieved, it will be possible to reduce the planting density of the paddy field to 25 to 50 stumps, and amount of seeds can be also saved.

At present time, wet seed bed is generally used in the district but its field surface is not level. Therefore, there is another possibility of improving the seedlings by only sowing after levelling the paddy surface without making so-called "bed".

In regard to seed pretreatment, this is rarely being performed in hill area. This is an artificial process to treat the seeds prior to sowing for obtaining better consequence in cultivation. This pretreatment will greatly contribute to the promotion of germination or rooting, acceleration of growth, plant control and increase of yield.

In regard to improvement of fertilizer application techniques, the use of chemical fertilizer in irrigated land has greatly attracted farmers' attention in recent years and this fertilizer is now rapidly winning the popularity among farmers.

However, chemical fertilizer is not widely being used in hill area now because of topographic, transporting and other restrictions. Therefore, it will be necessary to aggressively promote the use of chemical fertilizer by properly informing the proper amount and method of application from now on.

The standards of application for each district in Janakpur are indicated in Table 32. The standards for two districts shown in the table have values lower than that of national optimum standards probably because of transportation problem.



Table 32. Recommended Amount of Fertilizer Application per ha, for Each District (for irrigated land)

District	Improved varieties			Native varieties		
	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
Sindhuli	75kg	20	20	30	15	15
Ramechhap	75	20	20	30	15	15
Optimum amount of application recommended by government	110	30	30	40	20	20

In regard to measures for plant control (for disease and pest), it is required to promote protection against insect damages by using chemicals since, as described before, specially the insect damages are considered to be the main cause of extremely reduced yield. However, since new diseases frequently tend to begin as a result of introduction of improved techniques related to fertilizer application and improved varieties, it is required to make efforts at the same time for growing resistant varieties.

## 2) Wheat

In mountainous areas, wheat is mainly cultivated in irrigated land (including partially irrigated land), as same as plain section of Tarai, after harvesting of paddy rice. Sowing season of wheat is generally from November to December after harvesting ordinary paddy rice.

Cultivation of wheat was previously being performed in small scale but the planted area of wheat suddenly increased after propagation of the high yield variety "RR-21". After this, this variety is considered to be the major winter crop.

RR-21 is now considered to be the main variety in hill area. S-331 and Lerma Roho-64 are also recommended by government as varieties suited to the hill area but they are rarely seen.

Generally speaking, seeds are sowed without making ridges between fields to tilling after harvesting ordinary paddy rice. Amount of sowing per ha, is about 100 kg. According to the present management method, field work is not performed after sowing until harvesting except supplying irrigation water 2 to 3 times.

Effect of fertilizer application to wheat is more outstanding than paddy and maize so that it is considered that amount of application of chemical fertilizer for wheat is larger than that for other crops but accurate amount of application is not known.

Problem in cultivation of wheat is that sowing season of wheat as winter crop is limited to the optimum period from middle of November to 1st week of December and yield is greatly reduced if not sowed during this period. Thus, this optimum sowing must be maintained also for rotation with other crops.

As described before, the most widely used variety is RR-21 at present stage and farmers also highly evaluate this variety. Other varieties recommended are NL-30 and HD-1982 for low land and S-331 and Lerma Koho-64 for hill. In making improvement for new varieties under present conditions, it will be needed to make verification tests for their adaptability to particular areas. The necessity of the seed pretreatment is the same as paddy rice.

Table 33. Recommended Amount of Fertilizer Application for Wheat for Each District (for irrigated land)

District	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	Remarks
Sindhuli	75	25	15	
Ramechhap	75	25	15	

In regard to the fertilizer application, amount of basal fertilizer for wheat is small in many farm lands, and additional fertilizer is rarely applied. This is possible because effect of first crop remains since wheat is planted after the first crop of paddy rice and probably because its yield is stable to a certain degree by irrigation.

However, fertilizer application must be performed in conformity with the recommended standards for increasing the incomes.

In addition, in view of cultivation, the yield of wheat is greatly affected by the sowing period. Of the most widely used varieties, the optimum sowing period is 2nd week of November for RR-21 and also for NL-30 and HD-1982. If wheat is sowed after 3rd week in December, its yield will be drastically reduced. Thus, a cropping pattern which allows the work during the optimum period must be established.

### 3) Maize

Maize is an important crop which is the most widely cultivated in mountainous areas and is used as main food for residents in these areas. In irrigated land, maize is combined to the cropping pattern together with paddy rice and wheat. In non-irrigated land, maize is planted as a basic crop widely from low land to upland in form of single cropping, or relay crop, companion crop or mixed crop with millet, buck wheat, potato, mustard and various beans.

In regard to the varieties of maize, the improved varieties of maize are widely being used in recent years. However, a native variety called "Sateya" has a short growing period (90 to 100 days) and good quality and is still raised widely by farmers. Particularly, the cropping pattern of 3 crops a year can be possible by combining this variety. It is told that when chemical fertilizer is used in field with good natural conditions, the yield of improved variety is greater than that of native variety but, if natural conditions are poor and no fertilizer is applied, the yield of native variety will become greater than that of improved variety.

Table 34 Names of Maize Varieties

Kind of maize	Names of varieties	Remarks
Improved varieties	*Khumatar yellow, *Rampur yellow Hetauda, Composite, Kokoni yellow	* indicates varieties raised more widely.
Native varieties	Sateya	

In regard to the cultivation method, the maize is combined with cropping pattern together with paddy rice and wheat in irrigable fields and, in many cases, is sowed as spring crop from late February to March as first crop before ordinary paddy rice.

In non-irrigated fields, maize is sowed as basic crop after rain in late April since it depends on the rainfall and raised as companion crop or mixed crop with beans or as relay crop with millet.

Normally, the period between December and March is an off season as far as agriculture is concerned since no rainfall is expected and ground is extremely dried.

Generally, if there is no previous crop, cropping pattern of maize is that first tilling is made from December to January and second tilling is made during sowing (from late February to March in irrigated land, and late in April in rain-fed paddy field) by using cattle. Cattle is also used for tilling work in terraced upland field with a small area. Amount of seeds per ha. is about 40 to 50 kg, and cultivation density is 25 cm for rows and 45 to 50 cm for stumps. This density is higher than 75x25 cm of Tarai plain area.

Main work required as part of management after sowing is weeding by hand associated with earthing (weed height: 20 to 25 cm), thinning (about 40 days after sowing) and second weeding and earthing (about 50 days after sowing). Then, generally no work is performed until harvesting season. When harvesting, ears are harvested first and then stems are cut near the ground surface and used as feed for livestock.

Maize is planted to the area which is approximately equivalent to 62% of total arable land in hill area and is an important crop that is used as main food for the residents in mountain areas.

According to the results of agricultural field tests conducted under NMDP (National Maize Development Programme), yields of recommended improved varieties of maize are 40 to 50% higher than those of native varieties under the same management and environmental conditions (from summary of Maize Coordinator Report).

On the other hand, the native variety of Sateya is, as stated before, still being used widely by farmers since it is better than the improved varieties because it has a short growing period and good quality as food without fertilizer. A comparison test to compare the local varieties to improved varieties should be considered in future. Recommended standards established for the fertilizer application are indicated in the following table:

Table 35 Recommended Amount of Fertilizer per ha. (for irrigated land)

Districts	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
Sindhuli	90	30	30
Ramechhap	90	30	30

As indicated in the table, amounts of fertilizer are the same for both districts. And tests and studies for determining appropriate amount of application in which difference of conditions between both districts will be necessary basing upon the recommended amount of fertilizer.

Farmers in the areas know the effects of compost very well and it is produced in farmers' houses. All compost produced is applied to the arable lands. However, since raw materials for the compost are extremely in short supply, it is considered to use fallen leaves in mountains and stems of forest killers (or Bam Mara) which densely grow in forests for solving this shortage problem.

In addition, since the compost is absolutely in short supply, an application method which is able to reduce the loss of fertilizer components must be found and utilized. For instance, compost must be applied without drying since nitric acid is produced and nitrogen is lost if fully ripened compost is dried. However, loss will be reduced if present practice of stacking fully ripened compost on arable land is abolished and, instead, if compost is brought to the field during sowing period.

As another desirable improvement, fully ripened compost for maize should be applied in such a manner that it will closely contacts seeds during sowing instead of complete broadcasting in order to improve the effects of compost.

The functions of the compost are to let the plants directly absorb the fertilizer components, to maintain fertility of soil by storing humus in soil, to improve physical and microbiological properties of the soil, and to improve the water reserve property.

For this purpose, not only for maize but also for upland crops during dry season, sowing should be made by line planting as much as possible and compost should be buried beneath the seeds particularly for maintaining the moisture of soil.

#### 4) Other Grains

Main crops in the irrigated land consist of three main grains of paddy rice, wheat and maize, and other crops are very few.

On the other hand, crops in the rain-fed paddy field vary considerably and their cropping pattern is complicated. Generally, millet is planted as relay crop before the harvesting of maize, and peanuts are sowed as companion crop at the same time with maize in many cases. Beans such as soybean and horsegram are planted between rows during the growing period of maize, and horsegram is mixed and raised with maize.

Mustard for harvesting seeds is normally planted after maize. Though exact methods of cultivation of such miscellaneous grains cannot be easily found, the management after sowing (after transplanting for millet) seems to be extremely poor since no fertilizer is applied and no work is performed until harvesting. This management is probably basing upon the wisdom obtained through experience of farmers themselves since they have found out that investing of labor and money is risky to the farmers who do unstable agriculture which rely upon the rain water.

#### 5) Vegetables

Since main targets of hill agriculture are grains and livestock, farmers show almost no interest in vegetables. It is considered that they are relying on milk for vitamins and minerals, and only 8.5% of upland fields in Sindhuli District, 1% of upland fields in Ramechhap District, and less than 1% of irrigated arable lands in both districts are used for cropping of vegetables.

Generally, only vegetables raised are pumpkin and white gourd planted along hedge around house, and eggplant, tomato and broad-leaf Indian mustard planted near the hedge. Few farmers are raising onion in fields during rainy season. Main problems in cultivation of vegetables at present are lack of interest by farmers, improper organizations of seed production and marketing, lack of vegetable production techniques and short supply of production materials.

As described above, kinds of vegetables being raised are now limited by the tests of farmers. However, it is required to promote and increase the cultivation of green vegetables by systematic utilization of land near the houses in order to improve the food life. In addition, for promoting the vegetable cultivation, it is particularly important (1) to establish the seed-producing organizations and (2) to arrange the seed-distributing organizations.

At present time, seeds are being produced by government-owned farms and there are almost no seeds-producing and marketing organizations owned by private firms. Therefore, the government must take some measures to promote and assist the private firms for establishing such organizations. It is more desirable that the government farms specialize in correcting and classifying good local varieties and producing foundation seeds and stock seeds and that the government will establish private organizations for producing ordinary seeds and ADO will guide and instruct the production of seeds by these private organizations.

Distribution of seeds and materials are now being made by farmers' co-operative but farmers' needs are not fully satisfied as yet. It is particularly important to distribute the seeds to the farmers before sowing.

However, since there are few difficult problems such as transportation in actual distribution of seeds, one alternative will be to establish model villages for promoting vegetable production for a time being instead of making distribution plan for all areas. Then, seeds, production materials and chemicals should be supplied to these model villages at the beginning and this should be extended and propagated gradually to wider areas.

## 6) Fruit Trees

### (1) Outline of Fruit Tree Cultivation

The major fruit trees in the hill areas are jiknar (one kind of sweet orange) and suntara (one kind of mandarin orange) mainly raised in Ratanchura Panchayat in Sindhuli District (Nakajoli, Ratanchura, Kannyakharka, Nannyakharka, Nigale), and other fruit trees are raised just for home consuming and only the surplus fruits are sold in bazaar.

Kinds of fruits in the area are varied considerably and these fruits are classified by approximate altitude and zone as indicated below.

Higher than 1,800 m: Cold Temperature Zone:

Apple, walnut, chestnut

1,800 to 1,300 m: Temperate Zone:

Chestnut, walnut, persimmon,  
peach, plum, pear

1,300 to 800 m: Warm Temperate Zone:

jiknar, suntara, lemon

Lower than 800 m: Subtropical Zone:

Banana, Guava, carica papaya L.,  
mango, shaddock, jackfruit,  
pineapple

Number of farmer's households that engage in cultivation of fruit trees is about equal to 35% of total farmer's households in Sindhuli District and to 13% in Ramechhap District. But most farmers raise only 2 to 3 trees around house in average except citrus fruits zone in part of Sindhuli District. In addition, fruit trees are being raised without management and control, and not only training, pruning and fruit thinning but also plant control and management practices are hardly being performed. Except few farmers engaged in producing fruits, most of farmers perform work during spare time only since most of their time must be spent for raising miscellaneous grains and livestock.

(2) Problems

a. Characteristics of Land Location

Since location of land ranges from Sub-tropical Zone with 400 to 500 m altitude to cold zone with altitude exceeding 3,000 m, so that many factors must be taken into consideration in selecting kinds and varieties of fruit trees. Some of these factors to be considered are effects of temperature difference imposed meteorologically, severe monsoon that occurs from June to end of September, dry season from October to May, soil property in the area in which granite is contained as parent material, and laterite soil that exists in some part of area. However, present conditions for coping with such problems are considered to be inadequate particularly in selecting optimum fruit trees and varieties and in teaching cultivation techniques. Because of this, most of fruit trees including jiknar and suntara are being raised by suckening and not from nursery stock. Grafting techniques have never been introduced before and quality of fruits widely varies for each tree.

b. Problems in Cultivation Techniques

Basic work required for raising fruit trees such as training, pruning, cutting of dead branches caused by disease, pest and wind damages, and other cares is rarely performed, and they are almost left alone. Except trees raised by some diligent farmers, phenomena of alternate bearing are clearly seen.



Only compost is used and no chemical fertilizer is used. In addition, surface soil is subject to erosion during rainy season and soil in the field remains not fertile so that trees get old earlier and get weaker than expected and have a short life. Also, there is no knowledge about plant control and chemicals are rarely applied.

### (3) Improvement Measures

It is very desirable to promote and propagate the cultivation of jiknar and suntara which have been specially increased in the fruit production in the areas. Since scheme of national level for the citrus fruit along belt zone coincides with the scheme of pocket area by JADP, it is considered to be adequate to promote formation of production center mainly in Ratanchura Panchayat.

Since orchards have been maintained without using nursery stock, the quality of fruits, harvesting season and yield, shape of trees, and ages of trees greatly vary. Thus, as improvement measures, the following points must be promoted and carried out:

#### a. Selection of Excellent Systems

JADP has already started the selection in Sindhuli and Ramechhap Districts. The excellent systems must be promoted by utilizing the results of competitive fruits exhibition, field exhibition and on-site survey. At the same time, management and assistance must be considered as part of the improvement plan in order to secure scions and scion buds on mother trees and original mother trees of excellent systems.

#### b. Improvement of Techniques for Raising Seedlings:

Promotion of raising of stocks, and propagation of grafting techniques including veneer-grafting and budding are required. On the other hand, Center Farm and Sindhuli Farm should be established or defined as central bases for raising seedlings, and private farmers or private companies who specialize in raising the seedlings should be encouraged and strengthened.

c. Improvement of Cultivation Techniques

(a) Planting Time

Planting in the field where irrigation is available shall be made between late in December and middle in January or between June and July. In area where irrigation is inconvenient, planting shall be made between middle in June to middle in July.

(b) Conditions of Gardening

Fields with a gradient less than 15° shall be reclaimed by following natural slope, and fields that exceeds 16° shall be reclaimed as terraced fields. However, minimum width of terrace shall be 4 meters.

(c) Spacing in the Row

Spacing shall be 4m x 4m, 4m x 6m or 6m x 6m. However, if other crops are being considered as companion crops, such crops can be planted for about 3 to 4 years after planting of trees. But the area within one meter from tree stumps shall not be cultivated during this period of 3 to 4 years.

(d) Planting Holes

Size of planting hole shall have a diameter of 1 meter and a depth of 1 meter approximately. Not only the fully ripened compost but also large organic matters such as branches shall be placed into the hole and well compacted. For forming top layer of bed, mix well fully ripened compost together with chemical fertilizer and matured soil and place the mixture into hole. Then, plant the nursery stock, compact the soil above roots, apply sufficient water, insert a support at center of hole and tie the tree to the support.

(e) Techniques of Pruning and Training

In regard to the shape of trees, main stem was conventionally grown straight upward. But this practice must be discontinued. Instead, modified leader type training by which main stem is divided into 3 to 4 stems, or open-center training with slightly large height shall be employed.

Upright branches that battle with main stem for power must be pruned in early stage, and secondary scaffold branches and lateral branches shall be generated at outer side but crowded branches are not desirable. Pruning shall be kept to a minimum when a tree is young and it should be pruned to basic pattern of training when it approaches to an adult tree. Dead branches caused by diseases and pest, storm, and excessive fruits shall be cut and removed.

(f) Protection of Disease and Insect

Main diseases are gray mold *Botrytis cinerea* PERSOON, virus, potato-scab, sooty-disease, bacterial canker, etc., and main pests are aphids, white fly, ticks, scales and smaller citrus dogs.

All of these must be controlled by using chemicals at right time.

(g) Soil Control

When three years pass after planting, companion crops should be discontinued and garden should be well maintained completed as much as possible. In addition, pruned branches and grass corrected from forests should be plowed under to improve the soil and to increase the water reserve property.

(h) Prevention of Alternate Bearing

By performing fruit thinning, fruit setting corresponding to the tree vigor should be maintained to prevent alternate bearing.

(i) Improvement of Existing Garden

Poor quality trees in the existing gardens shall be gradually removed, replaced with good nursery stocks, or improved by top-working to improve the quality of fruits and to unify the fruits. It is desirable to plant forest trees or forge plants suited to the particular land as windbreak forest surrounding the garden or orchard.

(j) Storages

The busiest harvesting season occurs between middle in November and late in December. But shipping must be controlled in accordance with schedule in order to prevent sudden fall of fruit prices during harvesting season. For this purpose, horizontal wells for storage of fruits shall be made into the side of mountain and simple method of temperature and humidity control should be instructed to farmers in order to extend the period of time of shipping and transportation.

d. Other Items of Improvement

(a) For improving farmers' knowledge on plant control, exhibition fields for confirmation should be provided and techniques for fruit trees should be propagated and promoted by JTA and leading farmers.

(b) For thoroughly carrying out the plant control, knapsack sprayers or D-ring type sprayers shall be made available through JTA and leading farmers.

(c) Since harvesting and shipping period of present varieties is mostly concentrated on middle in November to late in December, it is required to introduce and test other varieties that can be harvested before or after this period.

(d) For selling harvested fruits advantageously for the farmers, it is required to establish the system of joint collection and shipping in future.