Figures

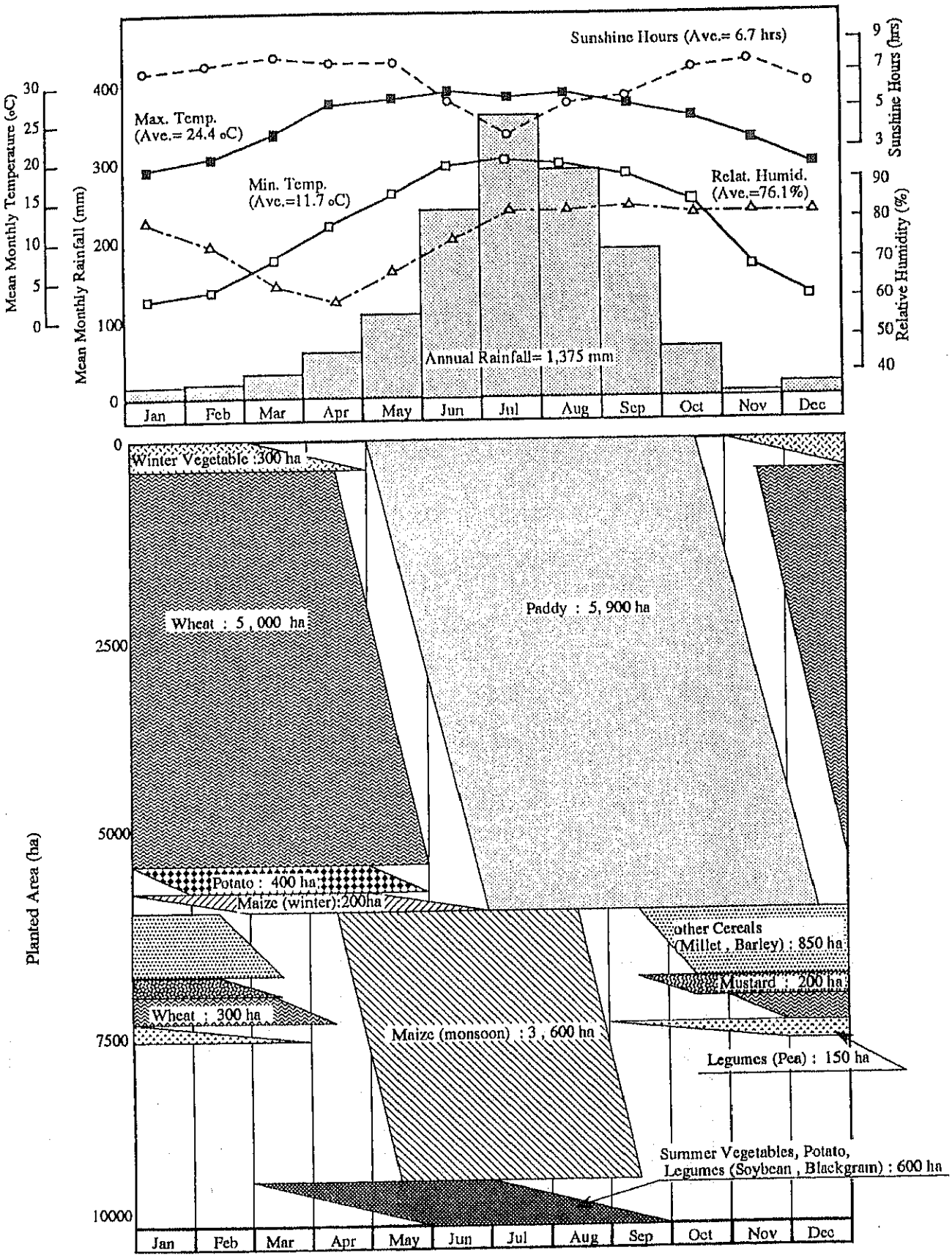


Figure 1 - 1 Present Cropping Pattern in the Study area

HIS MAJESTY'S GOVERNMENT OF NEPAL
THE STUDY ON THE REHABILITATION OF GOVERNMENT DEVELOPED IRRIGATION SCHEMES IN THE KATHMANDU VALLEY
JAPAN INTERNAIONAL COOPERATION AGENCY

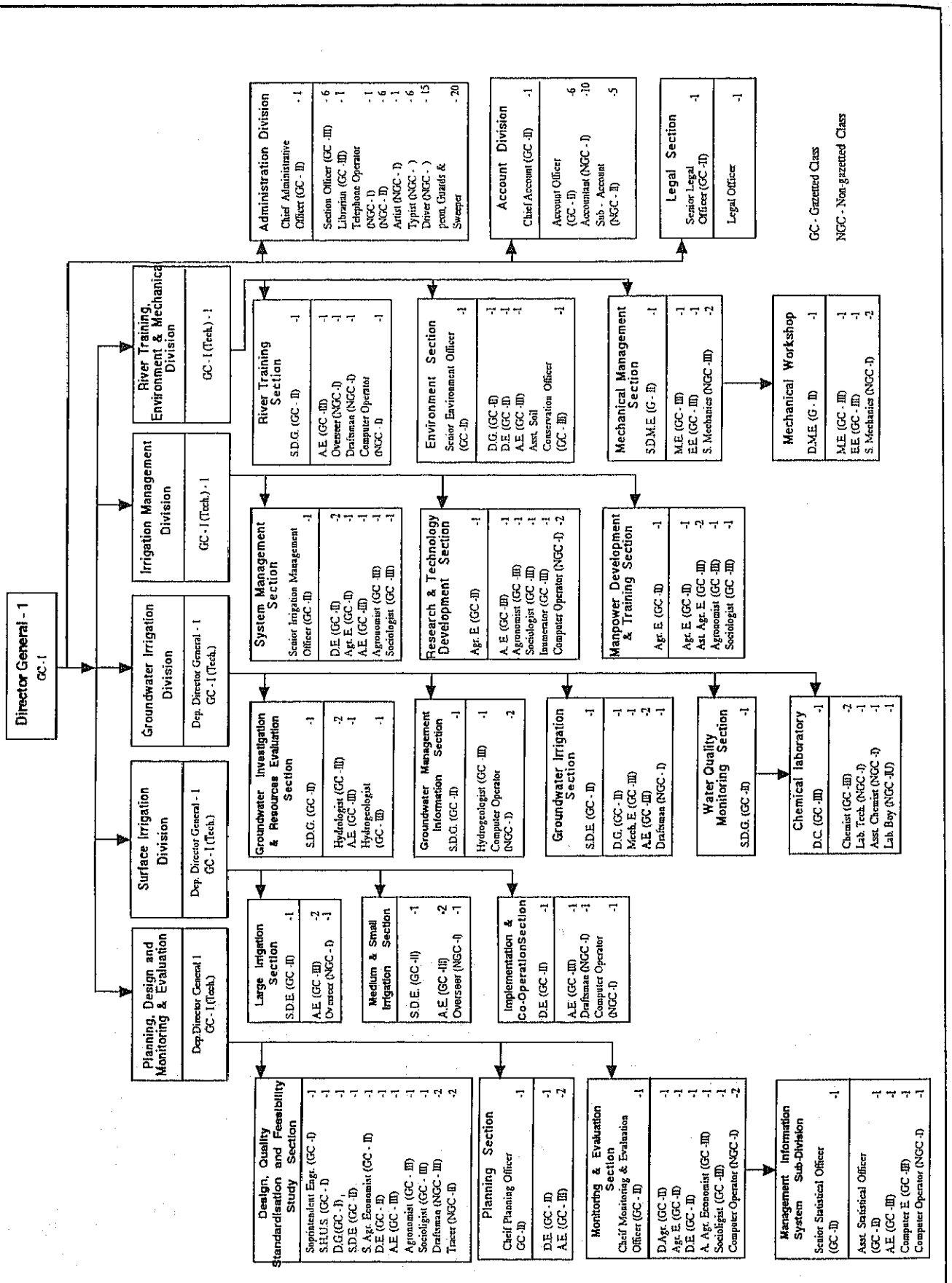


Figure 1 - 2 Organization Structure of the Department of Irrigation (DoI)

HIS MAJESTY'S GOVERNMENT OF NEPAL

THE STUDY ON
THE REHABILITATION OF GOVERNMENT DEVELOPED IRRIGATION SCHEMES IN THE KATHMANDU VALLEY

JAPAN INTERNAIONAL COOPERATION AGENCY

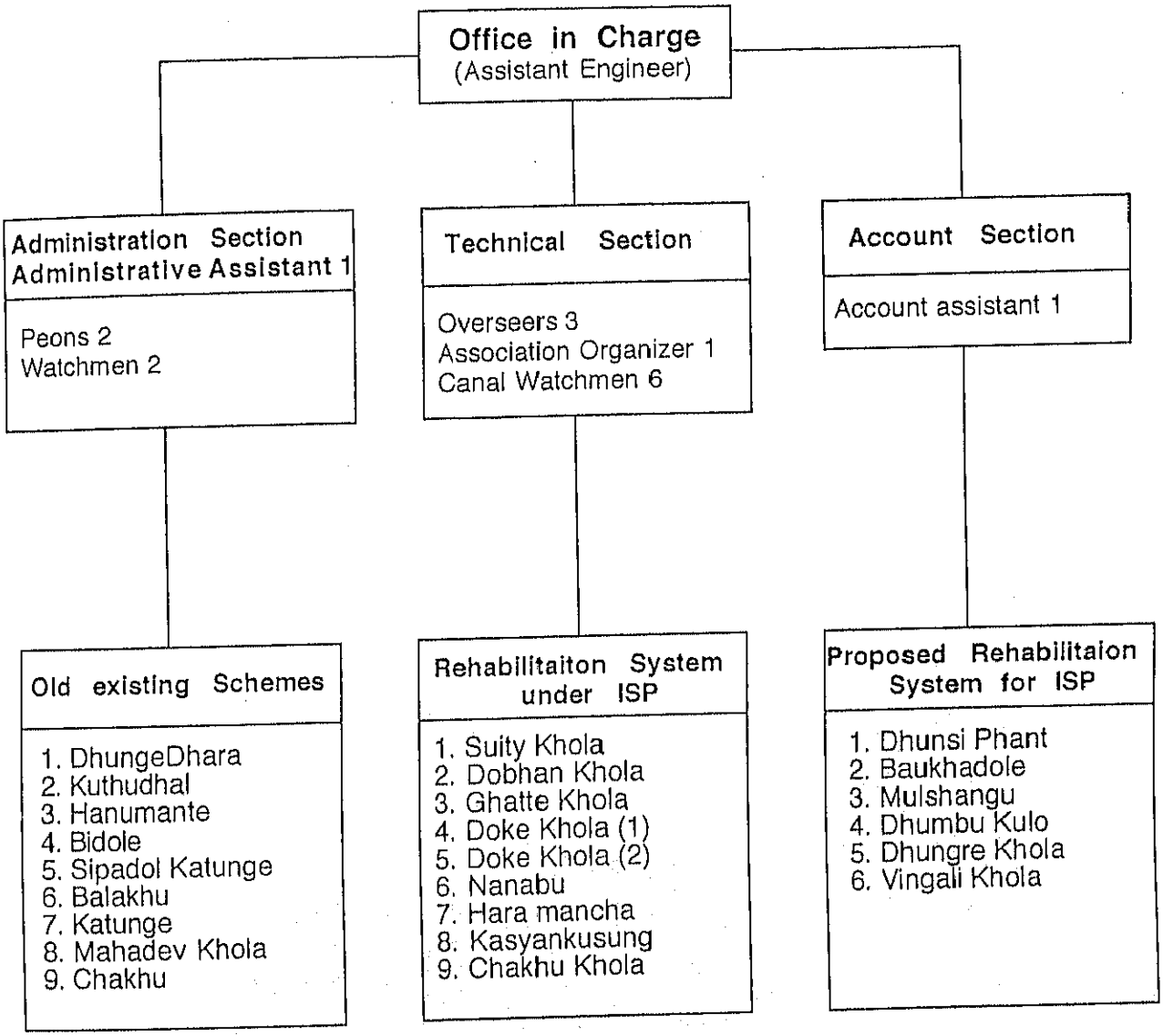


Figure 1 - 3 Organization Structure of the District Irrigation Office (DIO)

HIS MAJESTY'S GOVERNMENT OF NEPAL

THE STUDY ON
THE REHABILITATION OF GOVERNMENT DEVELOPED IRRIGATION SCHEMES IN THE KATHMANDU VALLEY

JAPAN INTERNAIONAL COOPERATION AGENCY

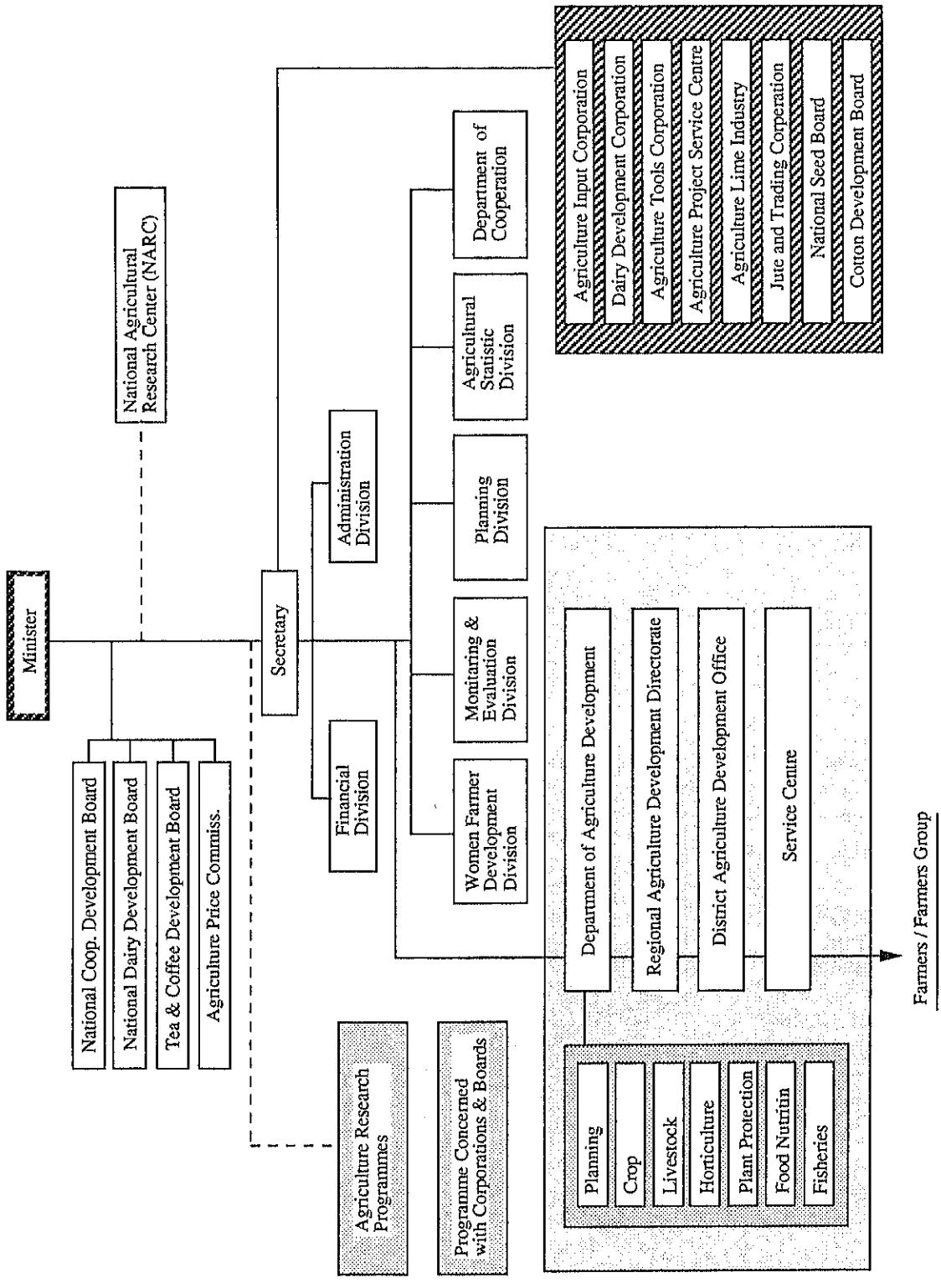


Figure 1 - 4 Organization Structure of the Ministry of Agriculture (MoA)

HIS MAJESTY'S GOVERNMENT OF NEPAL

THE STUDY ON
THE REHABILITATION OF GOVERNMENT DEVELOPED IRRIGATION SCHEMES IN THE KATHMANDU VALLEY

JAPAN INTERNAIONAL COOPERATION AGENCY

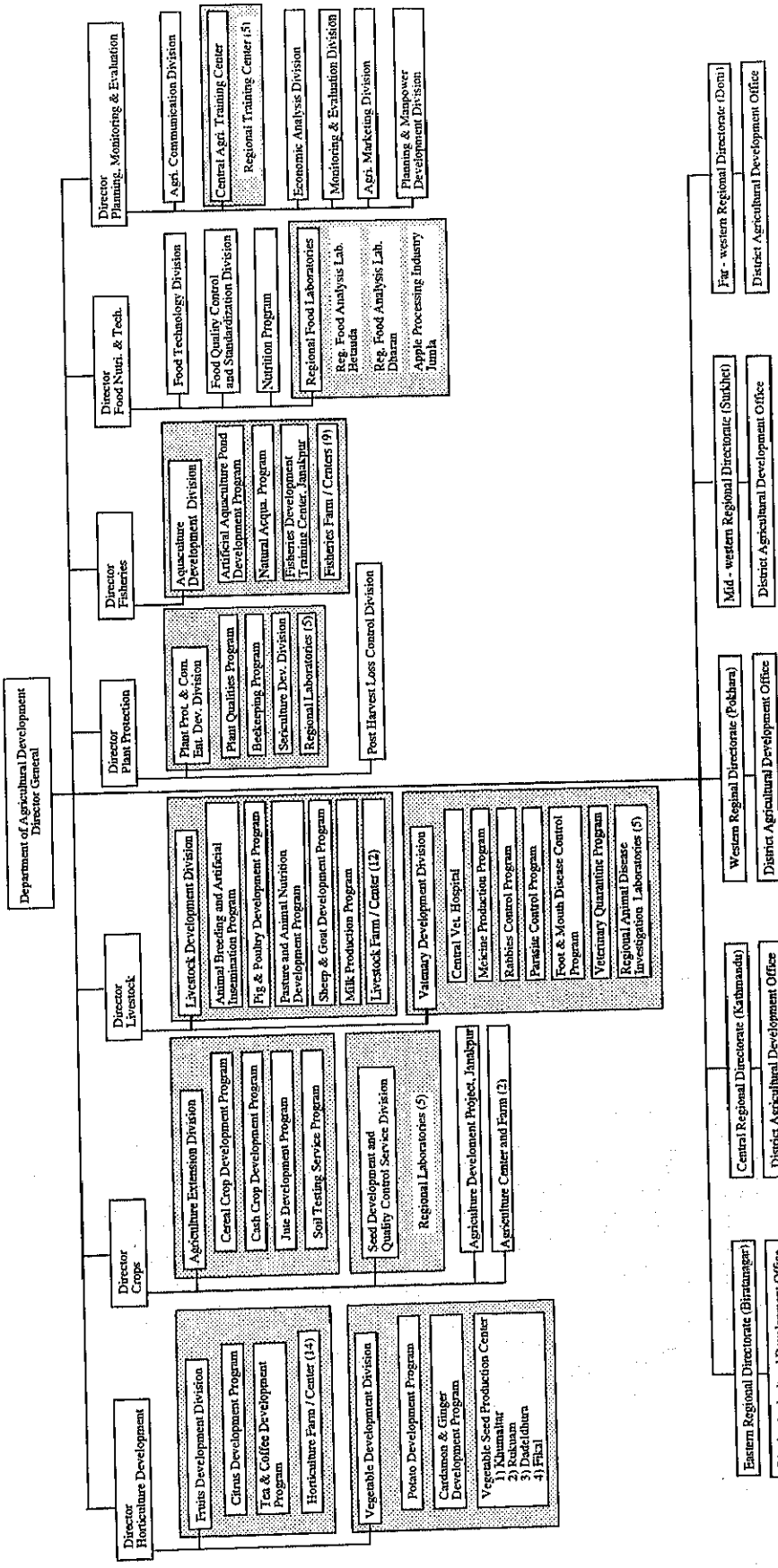


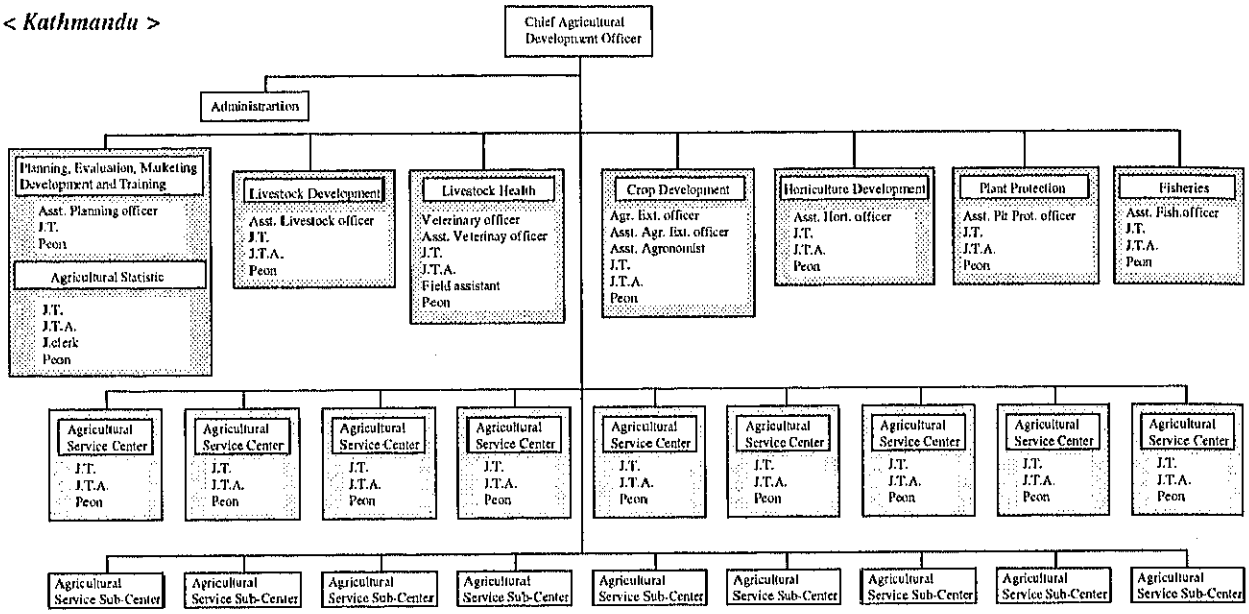
Figure 1 - 5
Organization Structure of the Department of Agricultural Development (DoAD)

HIS MAJESTY'S GOVERNMENT OF NEPAL

THE STUDY ON
THE REHABILITATION OF GOVERNMENT DEVELOPED IRRIGATION SCHEMES IN THE KATHMANDU VALLEY

JAPAN INTERNAIONAL COOPERATION AGENCY

< *Kathmandu* >



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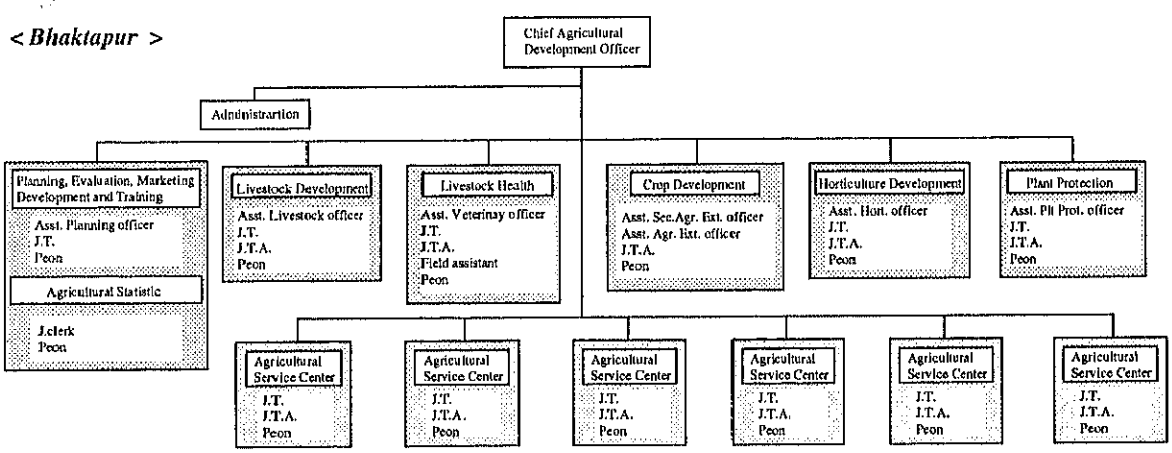

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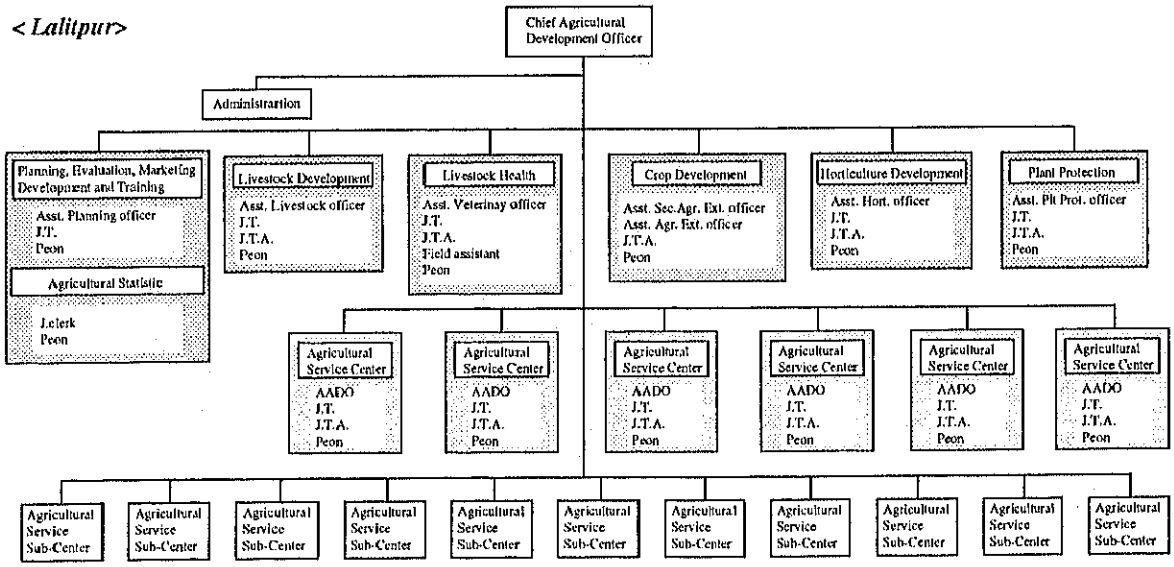

Figure 1 - 6
Organization Structure of the District Agricultural Development Office (DADO)
(Kathmandu , Lalitpur , Bhaktapur District)

HIS MAJESTY'S GOVERNMENT OF NEPAL
THE STUDY ON THE REHABILITATION OF GOVERNMENT DEVELOPED IRRIGATION SCHEMES IN THE KATHMANDU VALLEY
JAPAN INTERNAIONAL COOPERATION AGENCY

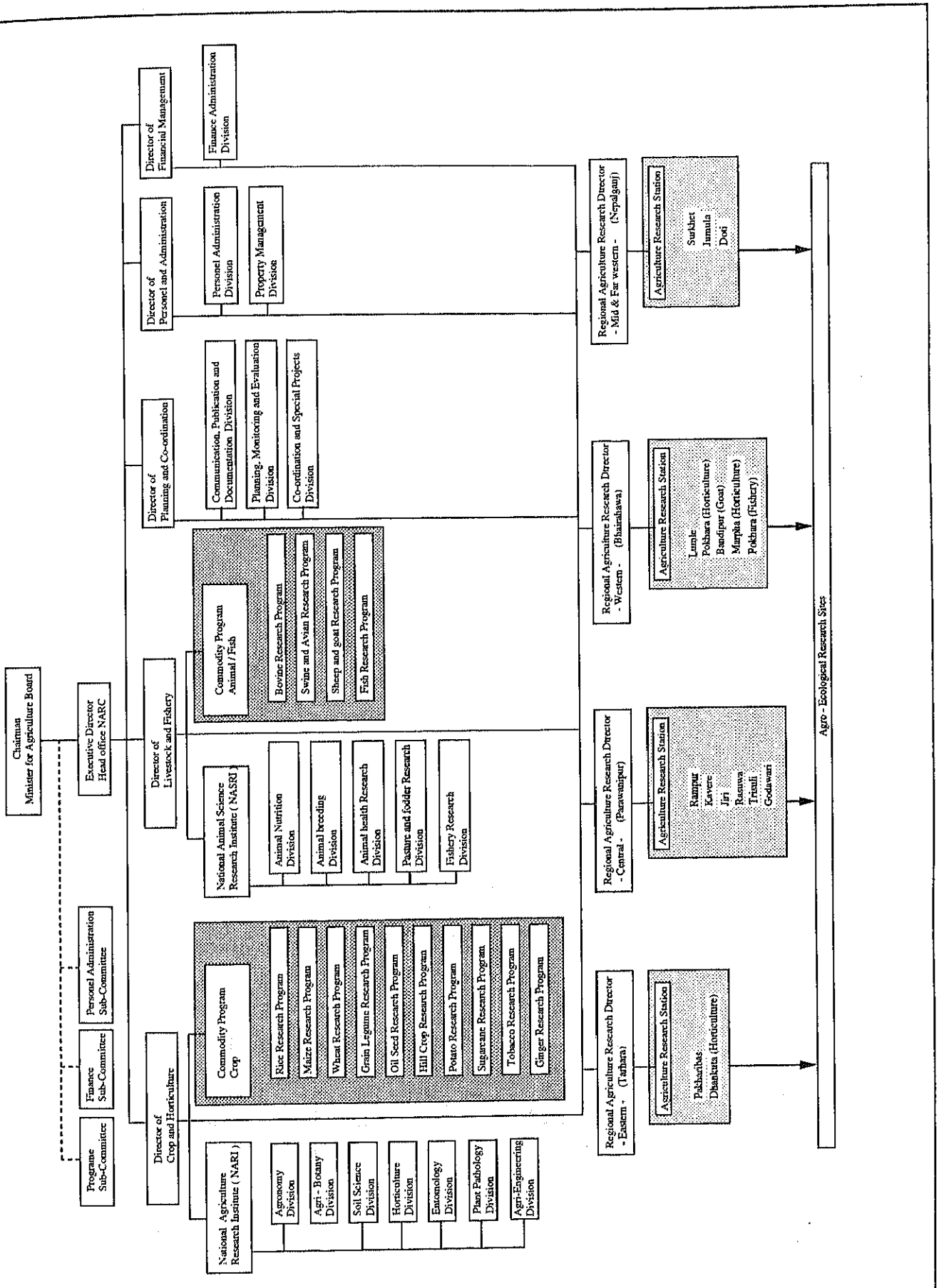

Figure 1-7 Organization Structure of National Agriculture Research Center (NARC)

HIS MAJESTY'S GOVERNMENT OF NEPAL
THE STUDY ON THE REHABILITATION OF GOVERNMENT DEVELOPED IRRIGATION SCHEMES IN THE KATHMANDU VALLEY
JAPAN INTERNAIONAL COOPERATION AGENCY

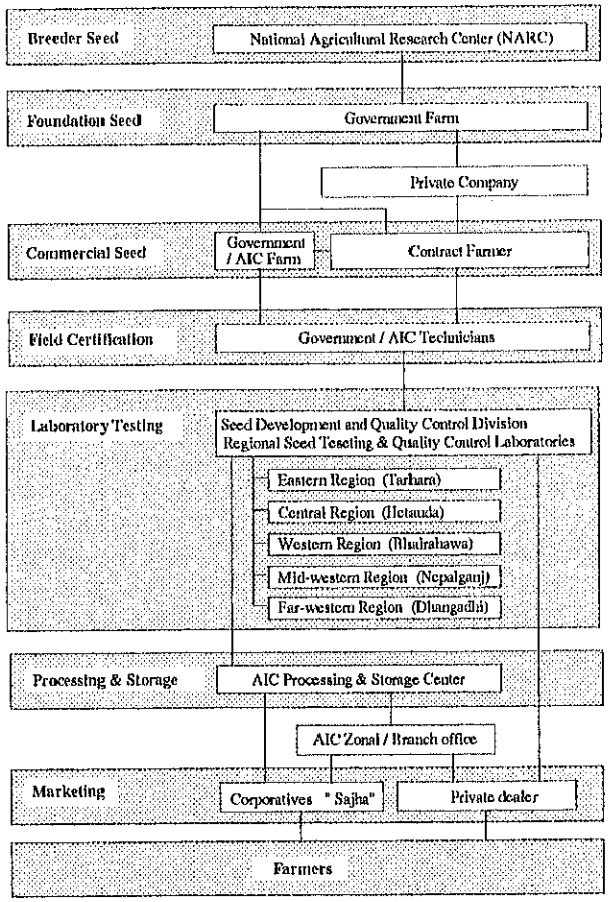

Figure 1 - 8 Seed Multiplication System in Nepal

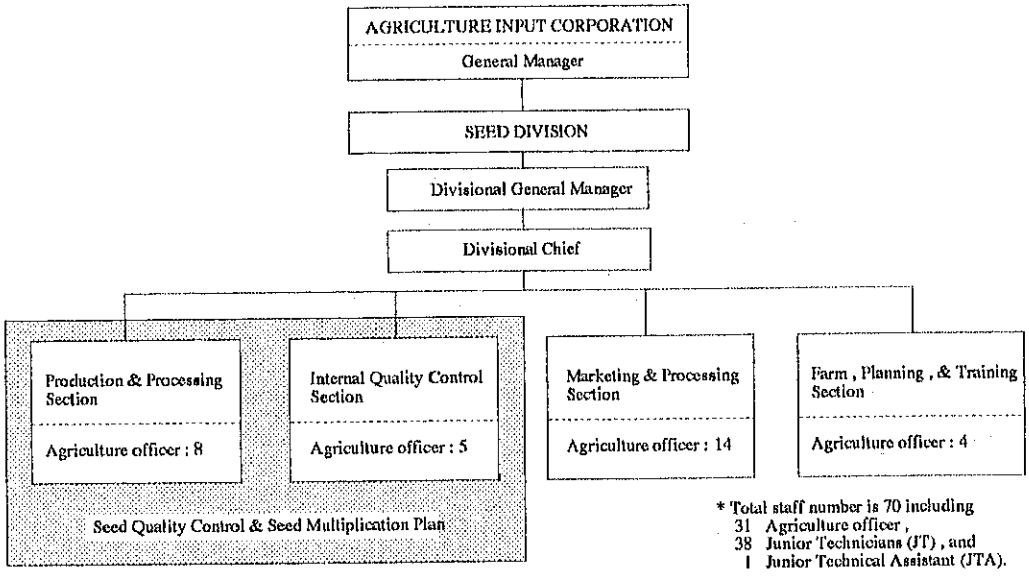

Figure 1 - 9 Organization Chart of Seed Division of AIC

HIS MAJESTY'S GOVERNMENT OF NEPAL
THE STUDY ON THE REHABILITATION OF GOVERNMENT DEVELOPED IRRIGATION SCHEMES IN THE KATHMANDU VALLEY
JAPAN INTERNAIONAL COOPERATION AGENCY

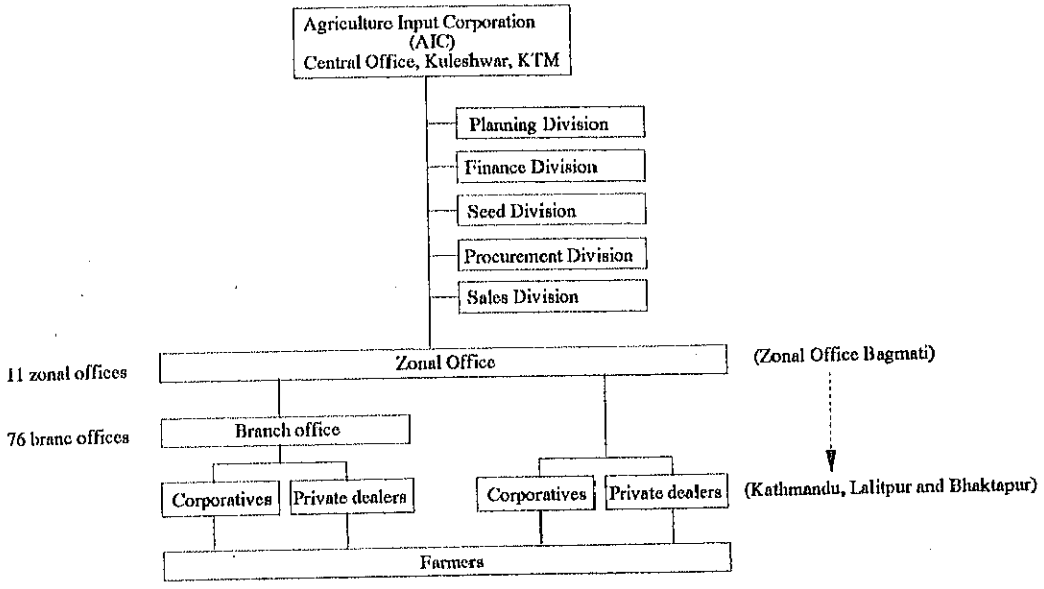

Figure 1 - 10 Organization Structure of Agricultural Input Corporation (AIC)

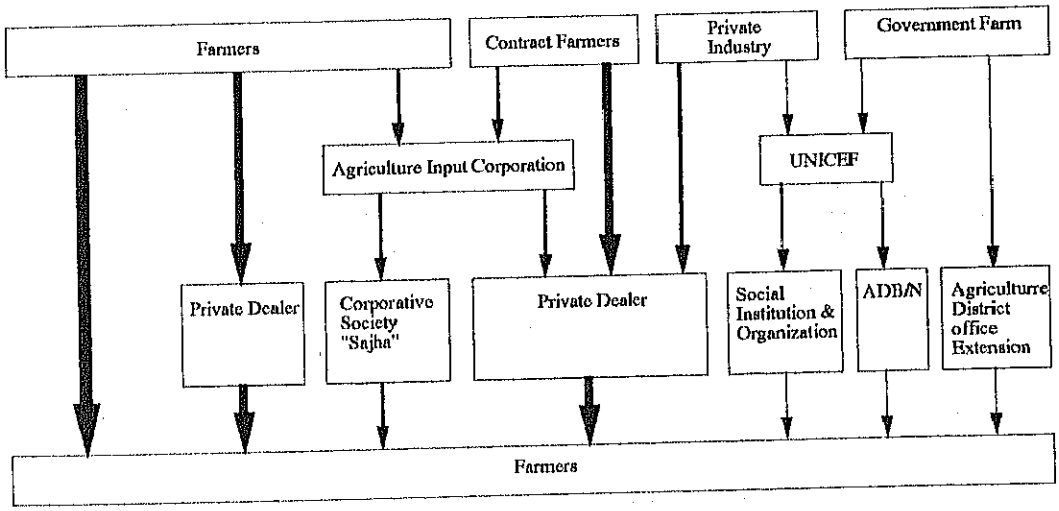

Figure 1 - 11 Seed Distribution System

HIS MAJESTY'S GOVERNMENT OF NEPAL
THE STUDY ON THE REHABILITATION OF GOVERNMENT DEVELOPED IRRIGATION SCHEMES IN THE KATHMANDU VALLEY
JAPAN INTERNAIONAL COOPERATION AGENCY

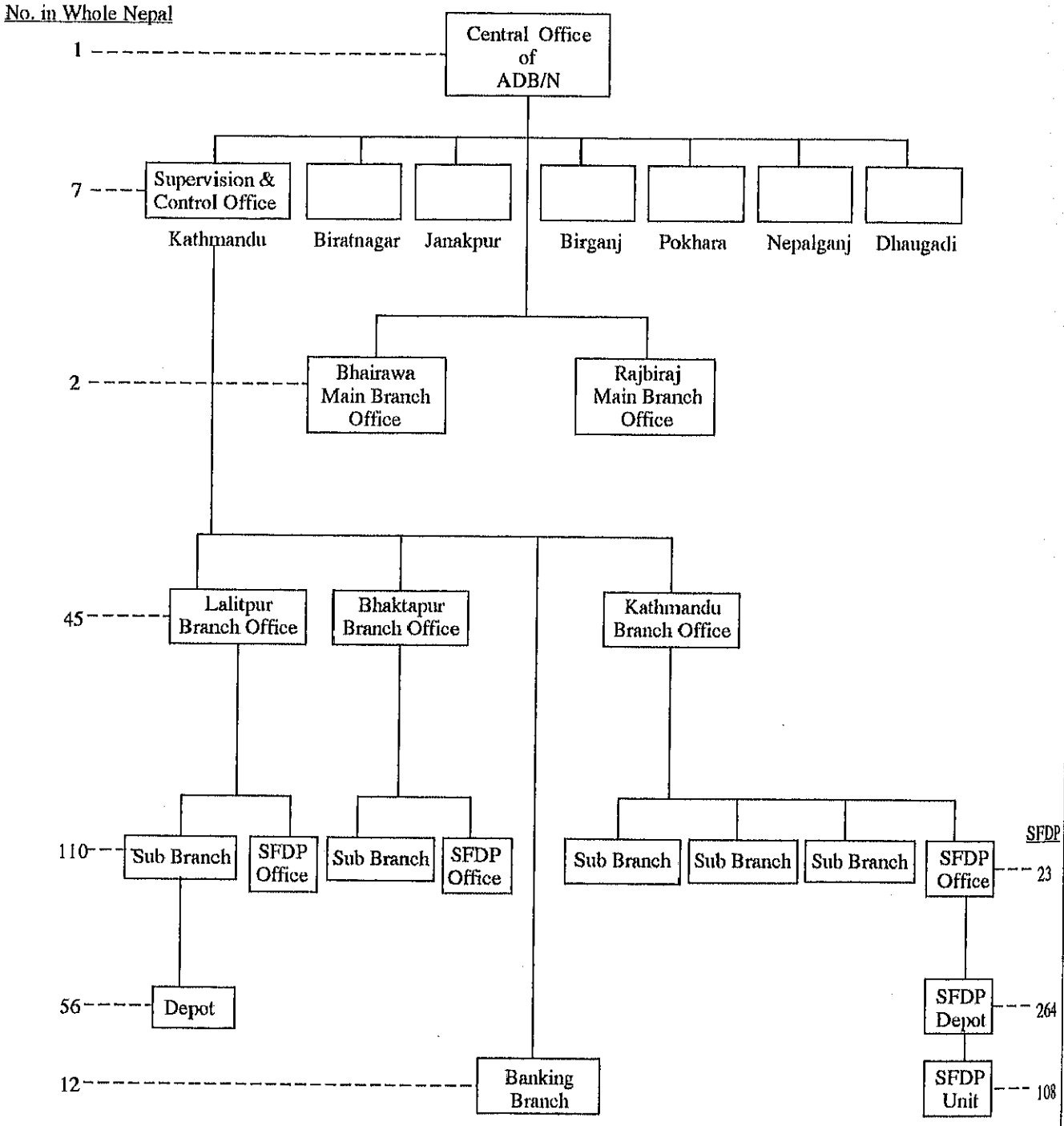

Figure 1 - 12 Organization Structure of ADB/N (1991/92)

HIS MAJESTY'S GOVERNMENT OF NEPAL
THE STUDY ON
THE REHABILITATION OF GOVERNMENT DEVELOPED IRRIGATION SCHEMES IN THE KATHMANDU VALLEY
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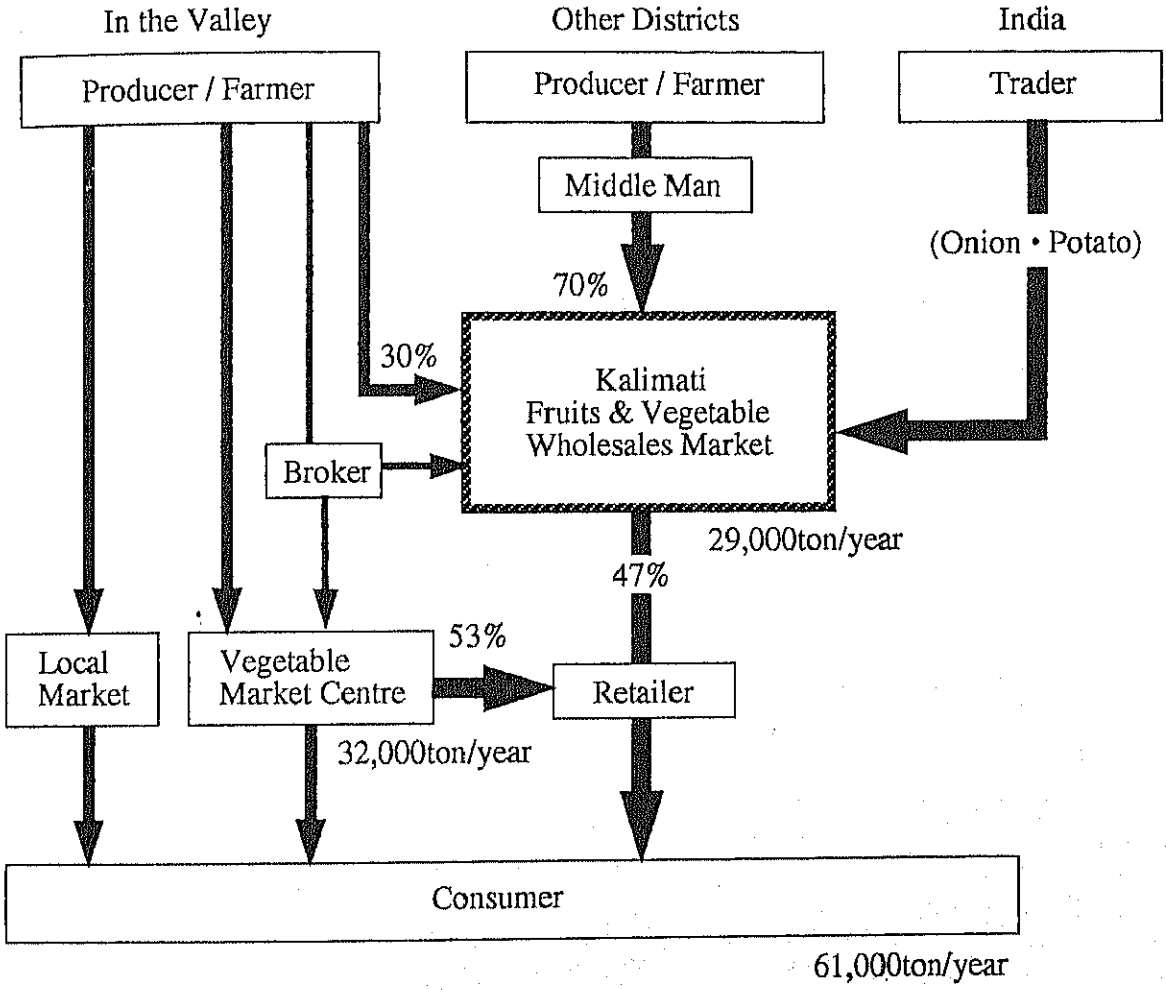
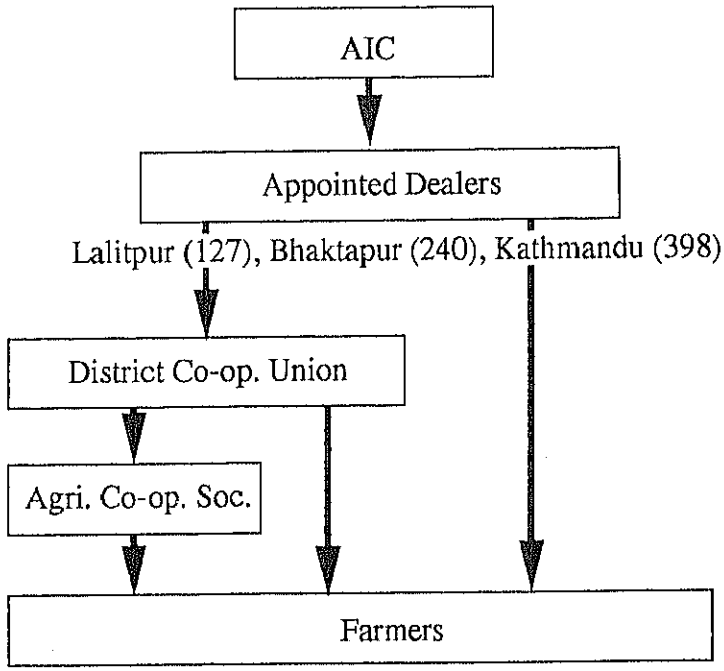


Note: other Districts are Dhading, Nuwakot, Makwanpur, and Kavre Districts in hilly region, Dhanukha, Sarlahi and Bara Districts in Terai region.
India is mainly Motihari, Ranchi, Sitamadi and Siligudi Districts.

Figure 1 - 13 Marketing Channels for Vegetables

HIS MAJESTY'S GOVERNMENT OF NEPAL
THE STUDY ON THE REHABILITATION OF GOVERNMENT DEVELOPED IRRIGATION SCHEMES IN THE KATHMANDU VALLEY
JAPAN INTERNAIONAL COOPERATION AGENCY

A : For Chemical Fertilizer, Seed and Agricultural Tools



B : For Agro Chemicals

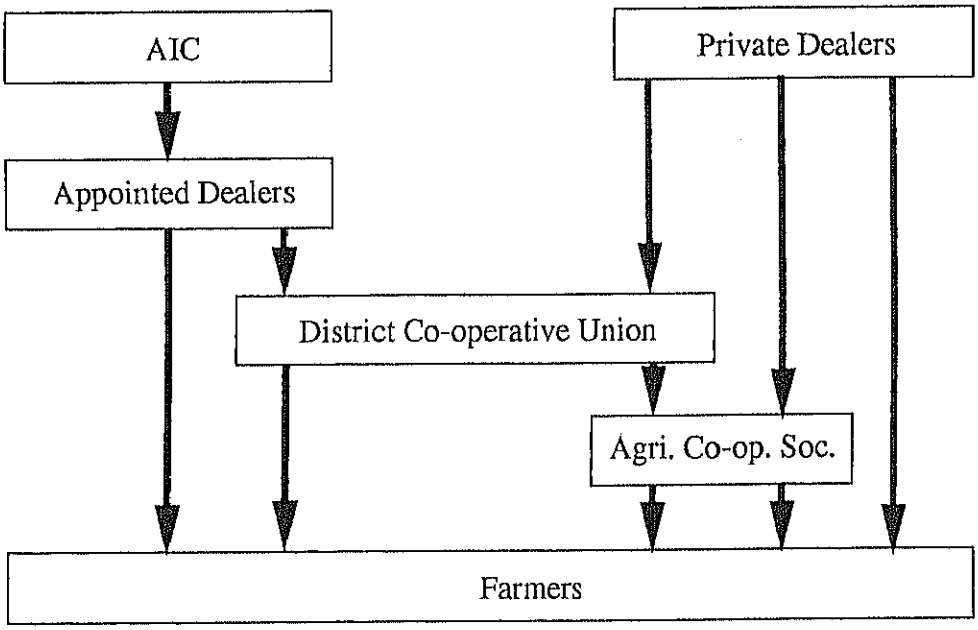
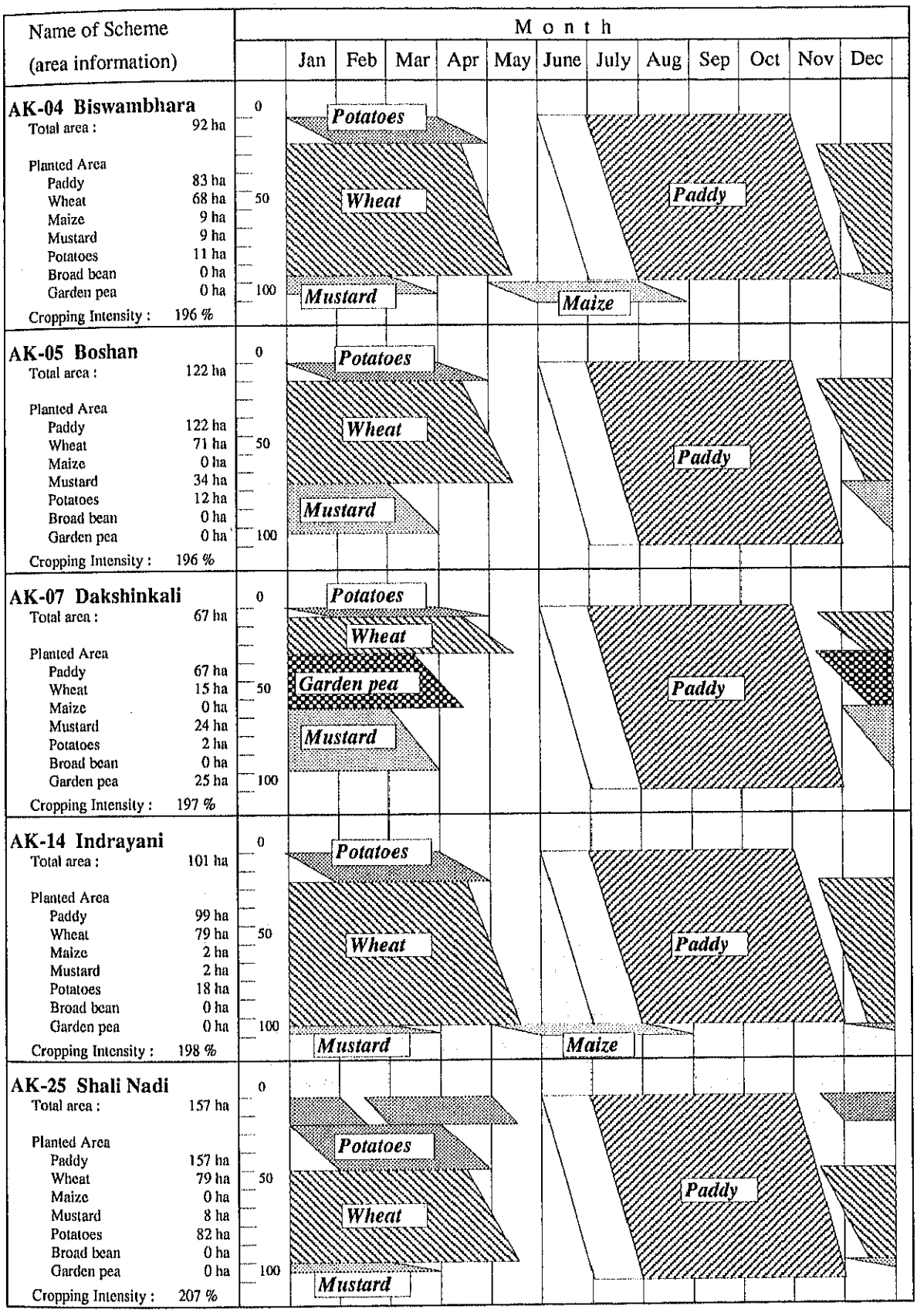


Figure 1 - 14 Major Supply Channels for Agricultural Inputs

HIS MAJESTY'S GOVERNMENT OF NEPAL
THE STUDY ON
THE REHABILITATION OF GOVERNMENT DEVELOPED IRRIGATION SCHEMES IN THE KATHMANDU VALLEY
JAPAN INTERNAIONAL COOPERATION AGENCY

Name of District *Kathmandu*



Source : Farm Survey , JICA Study Team , 1994

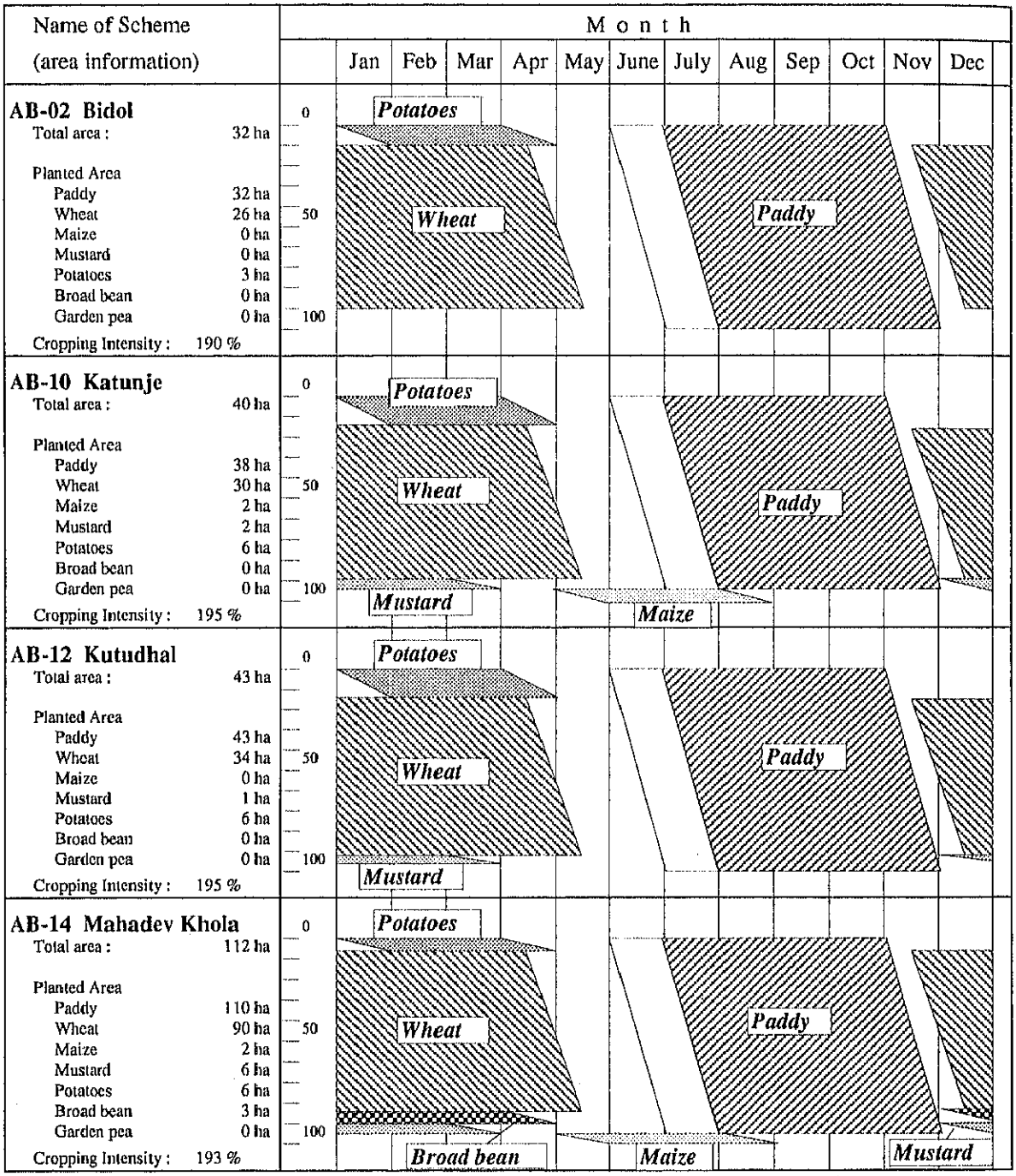
Figure 1 - 15 Present Cropping Pattern (1/3)

HIS MAJESTY'S GOVERNMENT OF NEPAL

THE STUDY ON
THE REHABILITATION OF GOVERNMENT DEVELOPED IRRIGATION SCHEMES IN THE KATHMANDU VALLEY

JAPAN INTERNAIONAL COOPERATION AGENCY

Name of District ***Bhaktapur***



Source : Farm Survey , JICA Study Team , 1994

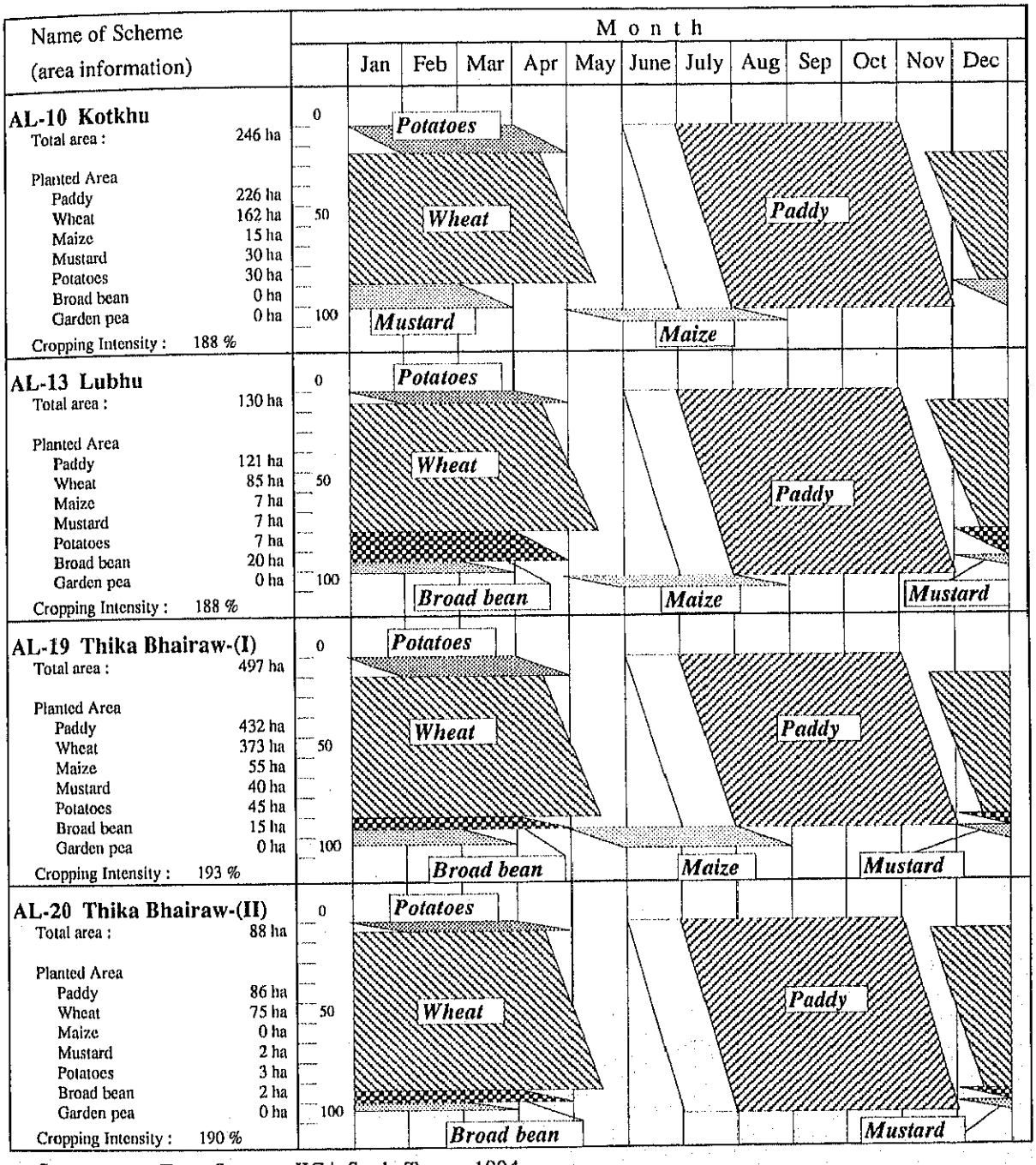
Figure 1 - 15 Present Cropping Pattern (2/3)

HIS MAJESTY'S GOVERNMENT OF NEPAL

THE STUDY ON
THE REHABILITATION OF GOVERNMENT DEVELOPED IRRIGATION SCHEMES IN THE KATHMANDU VALLEY

JAPAN INTERNAIONAL COOPERATION AGENCY

Name of District *Lalitpur*



Source : Farm Survey , JICA Study Team , 1994

Figure 1 - 15 Present Cropping Pattern (3/3)

HIS MAJESTY'S GOVERNMENT OF NEPAL
THE STUDY ON THE REHABILITATION OF GOVERNMENT DEVELOPED IRRIGATION SCHEMES IN THE KATHMANDU VALLEY
JAPAN INTERNAIONAL COOPERATION AGENCY

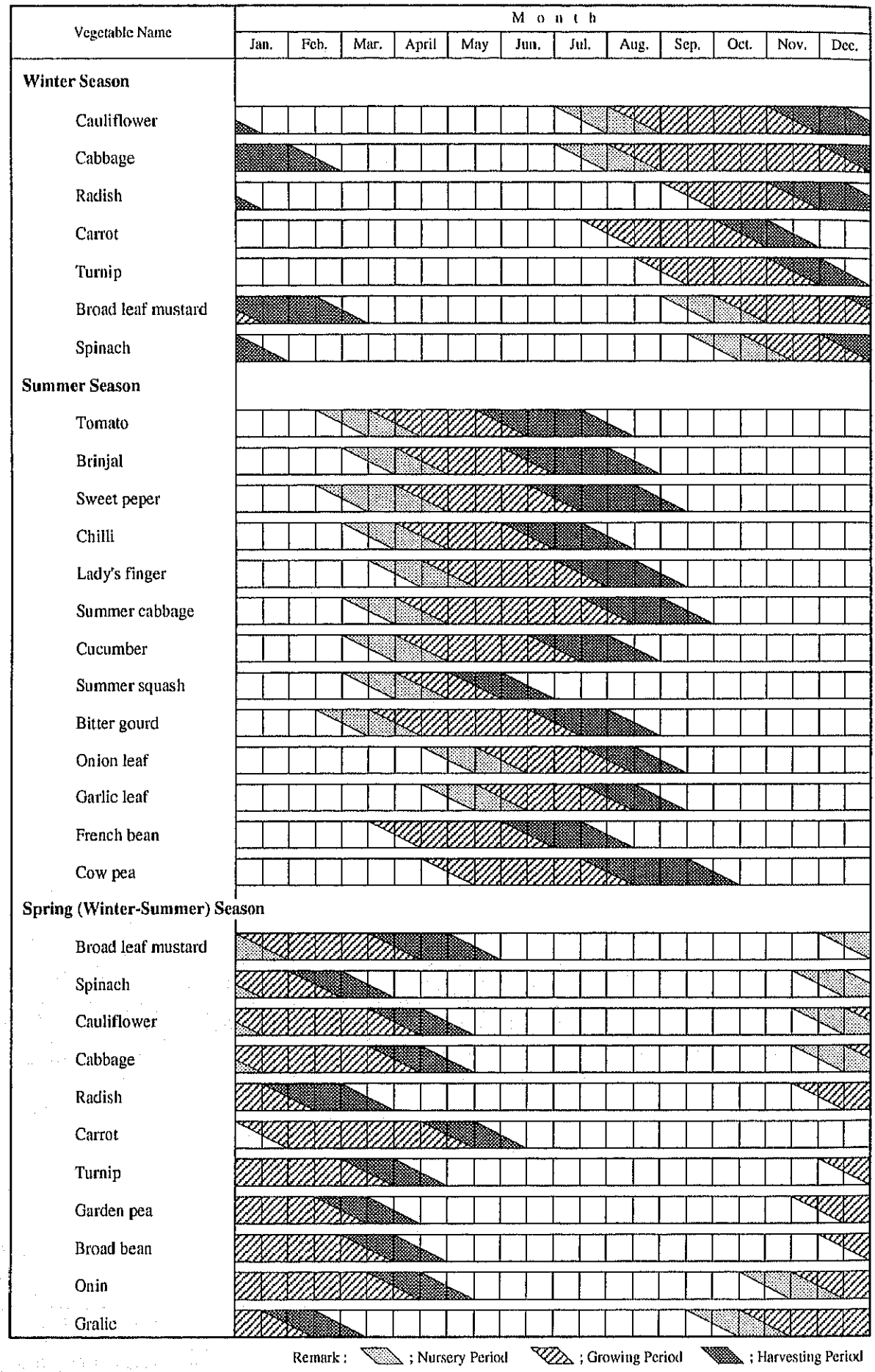


Figure 1 - 16 Present Vegetable Cropping Calendar

HIS MAJESTY'S GOVERNMENT OF NEPAL

THE STUDY ON
THE REHABILITATION OF GOVERNMENT DEVELOPED IRRIGATION SCHEMES IN THE KATHMANDU VALLEY

JAPAN INTERNAIONAL COOPERATION AGENCY

ANNEX - 2

SOIL AND LAND USE

ANNEX - 2

SOIL AND LAND USE

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ANNEX-2 Soil and Land Use

2.1 General

In order to grasp the features of soil in the study area, the soil survey was carried out. The survey components are as follows.

i) Collection and review of the existing data: reports and maps of Land Resource Mapping Project and aerial photographs;

ii) Test pit survey: investigation of soil profiles (65 points) and sampling for the analysis of physical-chemical properties at the 58 points in the study area; and

iii) Physical-chemical analysis: analysis of physical-chemical properties of surface and subsoil samples.

2.2 Soil Survey Procedure

(1) Desk Study

The soil survey was preceded by a study of available maps and literature on geology, geomorphology, climate, soil and land use of the study area. The following maps and reports were collected and reviewed.

i) Land Resource Mapping Project Reports, (1986)

- Land System Report
- Land Capability Report
- Land Utilization Report

ii) Land Resource Mapping Project Maps, (1986)

- Land System Maps at 1:50,000 scale
- Land Capability Maps at 1:50,000 scale

iii) Aerial photographs at 1:20,000 scale, (1989)

iv) Topographic maps at 1:10,000 scale

v) Other reports on geology, geomorphology, climate, soil, etc.

Among the above mentioned literatures LRMP provides preliminary information on the land and soils of the Kathmandu valley that has been used as a base for semi-detailed field soil survey. The other reports provided background information for the study area.

(2) Soil Survey Methods

By studying aerial photographs and topographic base maps geomorphological information of

the study area was obtained. A fairly high coincidence was recognized between physiography and soil formation. In other words each physiographic unit/land type implies a unique individual geology, topographic condition, soil characteristics, drainage condition and land use. Therefore, field soil survey was conducted by physiographic approach. In the first instance terrain or physiographic unit maps were prepared by aerial photo interpretation on the basis of relative height or position of unit with reference to stream bed including its tone, texture, colour, contrast as implied by soil difference with adjoining units and then the soil units were indentified and incorporated within those physiographic units.

Altogether sixty five (65) test pits were established in the study area to reveal soil profile. The distribution and location of test pits are given in **Fig.2-1.**

In each test pit, soil profile was described using Soil Survey Manual of USDA with reference to soil depth, horizon, colour, structure, consistency, physiography, parent material, drainage, permeability, land use, etc. Two to three representative soil samples were collected from each profile: one from surface soil for physical and chemical analysis for soil nutrient content and other at the rate of one or two samples from sub-horizons for physical analysis.

(3) Soil Laboratory Test

Laboratory tests aim at classification of the physical and chemical properties of the soils in the study area. Physical tests were performed on 116 surface and sub surface samples whereas chemical analysis of 58 surface samples were carried out to determine nutrient content of soils. The following tests were performed:

i) Physical analysis (on 116 samples)

- Particle size distribution
- pH
- EC

ii) Chemical analysis (on 58 samples)

- Nitrogen
- Total Carbon Content
- Available Phosphorus
- Cation Exchange Capacity
- Exchangeable Cations e.g., Na, K, Ca and Mg
- Soluble Cation and Anion Content e.g., Ca, Mg, Na and Cl

Following test methods and procedures were adopted according to standard text books on soil physical and chemical analysis :

Type of test	Method
Particle size distribution	Hydrometer method
pH	pH meter (on 1:2.5 soil water suspension)
EC	EC meter (on 1:2.5 soil water suspension)

Nitrogen	Kjeldhal digestion method
Total Carbon	Walkley and Black method
Available Phosphrous	Olsen P-method (pH>6) Bray P-method (pH<6)
Cation exchange capacity	Ammonium accelate extract method
Exchangeable Cations	EDTA titration method
Soluble Cations and Anions	EDTA titration on water extract

(4) Soil Classification and Mapping

Based on the field soil survey data and laboratory test results the soils were classified into soil units according to soil family group and subgroup level legend of Soil Taxonomy (USDA Soil Survey Staff 1975, Keys to Soil Taxonomy 1992).

The soil mapping units were set up for the systematic legend of soil map in accordance to physiographic mapping units carried out. The highest category of the legend is given by physiographic terms, ie, alluvial fan, recent alluvial plain, ancient lake and river terraces, sloping hill slopes, etc. The physiographic units were further subdivided into lower categories on the basis of relief, slope, drainage, and land use condition. These subdivisions represent mapping units on which one or more dominant soil units were identified. These soil units may be similar or contrasting (depending upon the composition of the physiographic unit) but occur together in a more or less regular pattern and are so intimately associated that they cannot be separated by boundaries at this survey level and may occur as inclusion along with major soil units.

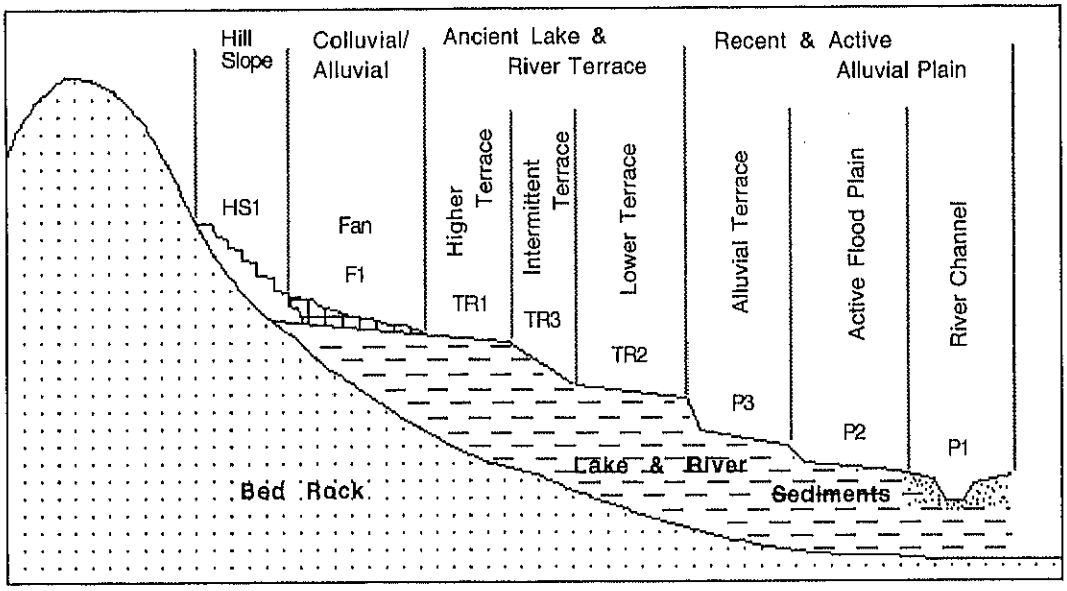
The soil mapping units of the study area are given in **Tables 2-1** and **2-2**, for irrigation schemes in the northern and southern sectors of Kathmandu valley respectively. Similarly, distribution and extent of these mapping units are given in soil maps (**Fig.2-2 1/3 - 3/3**) of the irrigation schmes.

The irrigation schemes categorized in nothern and southern sectors according to geomorphological and physiographic characteristics are :

On Northern Sector	On Southern Sector
Tokha	Boshan
Gokarna	Khokana
Indrayani	Thika Bhairaw - I
Shali Nadi	Thika Bhairaw - II
Biswambhara	Godawari
	Kotkhu
	Lubhu
	Mahadev Khola
	Katunje
	Dhunge Dhara

Kutudhal
Dhakshinkali
Bidol

The schematic cross section of the physiographic unit of the study area is given in the Figure below.



Soils are classified in Soil Taxonomy on the basis of measurable and or observable properties of soils particularly that of surface and subsurface horizons or layers in which genetic properties are implied.

Seven diagnostic surface horizons (Epipedons) are recognized in the Soil Taxonomy of which Mollic (soft, very dark, high fertile topsoil), Ochric (pale coloured less fertile topsoil), Plaggen (sod or man made surface layer 50cm or more thick with artefacts, spade marks and abundance of "kalimati" pieces) and Umbric (dark coloured like Mollic, but acid topsoil) are observed in the project area.

Similarly 19 diagnostic subsurface horizons (Endopedons), are recognized in the Soil Taxonomy. Of them, Argillic (alluvial clay accumulated horizon), Cambic (altered horizon with no dark colour, organic matter or structure development), and Agric (alluvial horizon formed under cultivation or plowpan) have been observed.

Among 17 other diagnostic soil properties abrupt textural change, aquic moisture regime, paralithic contact, sequum, bisequum and interfingering with albic materials were observed.

The aquic moisture condition has been divided into 3 substages (i) Endosaturation -fully saturated to a depth of 200 cm or more with grey color (color value 4 or more, chroma 2 or less) (ii) Episaturation - partially saturated with one or more layers unsaturated or mottled within 200 cm or more and (iii) Anthric saturation - a variant of episaturation associated with controlled flooding eg. rice cultivation (mottled surface + saturated subsoil).

Most of the soils observed and classified in the study area have Ochric surface horizons

followed by Cambic subsurface horizon with or without aquic soil moisture regimes and high or low base saturation in subsoil eg. Dystrochrepts in the northern sector vis-a-vis Eutrochrepts in the southern sector. A few have Plaggen epipedons and Cambic endopedons eg. Plaggepts and Ochric and Arigillic combination eg. Haplustalfs particularly in the fine loamy soils of the southern sector.

The subgroup level classification of Soil Taxonomy particularly for the soils of the study area are expressed by aquic moisture condition due to irrigation, partial irrigation and rainfed rice cultivation during summer eg. Ochric epipedons + Cambic endopedons. Soil profiles with endosaturation are classified as Typic or Aeric endoaquepts and with episaturation as Typic or Aeric Epiaquepts. Similar soils with high base saturation in B horizon and anthric saturation are classified as Anthraquic Eutrochrepts.

Similarly the soil family level classification in the Soil Taxonomy are expressed by the particle size group (texture) of the subsurface or B horizons below 25 cm depth to 50 or 100 cm depth. The soils of the irrigation schemes lying in the northern sector of Kathmandu valley are predominantly coarse loamy in texture followed by minor fine loamy and coarse loamy over sandy. Similarly, soils of irrigation schemes located in the southern sector are predominantly fine loamy textured followed by coarse loamy, fine clayey and coarse loamy over fine loamy.

2.3 Results of Soil Survey

The landscape of the study area is highly modified by cultivation, irrigation and terracing.

The construction of bench terrace create considerable soil variation within each terrace. In addition, the annual scrapping of the terrace walls, repair and maintenanceof terrace failures and flushing with irrigation and/or flood water create considerable mixture in the surface soils. With irrigation, soils even on topographically high positions have aquic characteristics eg. gleying and mottling. During winter, with less irrigation available, the soils dry out and produce sometimes completely oxidized unmottled profiles. These processes of reduction, oxidation as well as the mixture of the two are prevalent in the irrigation schemes. These water logged soils have been described using the existing Soil Taxonomy terms as Aquic (wet) and/or Aeric (airy, hence dry). In addition, a man made soil e.g. plaggen has been used to describe specific soil in Kathmandu valley formed by the addition of large amount of "kalimati" pieces (>50% or more) at surface or even to a depth of 50 or 100 cm in the profile.

On the basis of field soil survey records eg. typical soil profile descriptions and the results of soil analysis given in chapter 2.7 "Soil Profile and Physical - Chemical Analysis", soils of the irrigation schmes lying in the northern and southern sectors are classified, grouped and arranged according to soil family and subgroup level of the Soil Taxonomy in **Table 2-3** and **Table 2-4**, respectively.

The physiographic land units and their associated soil groups of the northern and southern sectors are presented in **Table 2-5** and **Table 2-6** respectively. These physiographic land units e.g. highest terrace, upper terrace, lower terrace, intermittent terrace, active flood plain, recent flood plain/basin, erosional fan and depressional fan form the basic mapping units of the irrigation scheme areas.

In addition, the abbreviations of these physiographic land units eg. TH1 (relic terrace), TR1

(upper terrace), TR2 (lower terrace), TR3 (intermittent terrace), P2 (active flood plain), P3 (recent flood plain/basin) and F1 (erosional fan) and F2 depressional fan) form the basis of the mapping legend. These mapping units with or without some modifications and/or subdivisions have been used to map the entire irrigation shceme areas. The soil maps are presented in figures as per below.

Northern Sector			Southern Sector		
Indrayani	**Fig.2-2**	**(3/3)**	Boshan	**Fig.2-2**	**(1/3)**
Shali Nadi	**Fig.2-2**	**(3/3)**	Dhakshinkali	**Fig.2-2**	**(1/3)**
Biswambhara	**Fig.2-2**	**(3/3)**	Thika Bhairaw (I)&(II)	**Fig.2-2**	**(1/3)**
			Kotkhu	**Fig.2-2**	**(2/3)**
			Lubhu	**Fig.2-2**	**(2/3)**
			Mahadev Khola	**Fig.2-2**	**(2/3)**
			Katunje	**Fig.2-2**	**(2/3)**
			Kutudhal	**Fig.2-2**	**(3/3)**
			Bidol	**Fig.2-2**	**(3/3)**

In the above soil maps, the legend has been given in terms of physiographic land units and corresponding dominant soil(s). The composition of dominant soil indicates approximately 80 - 85 % of the named soil with minor inclusion of about 15 to 20 % of other soils or miscellaneous land types on steep slopes, scarps, stream channels etc.

2.4 Legend Composition of Soil Map

The legend is based on land system mapping of Land Resource Mapping Project (LRMP), 198 6. Land systems are defined as "recurrent patterns of landforms, geology, slopes and arable agriculture limits". Each land system consists of one or more landform(s) which is/are divided into land units. Land units are characterized by landscape characteristics such as topographic positions, slope, surface dissection, flooding frequency and soil characteristics such as drainage depth, texture and profile development. These land units form the base of the soil map.

The following classes of slope have been used for mapping unit legend composition.

Description	Range	Class
Nearly level	0 - 2°	1
Gently sloping	2 - 7°	2
Moderately sloping	7 - 15°	3
Steeply sloping	15 - 30°	4
Very steeply slopping	>30°	5

The following classes of drainage and runoff have been used :

Description	Diagnostic Characteristics	Class
Poor	grey colours and prominent mottles	I

	within 0 - 50 cm depth	
Somewhat poor/Imperfect	distinct mottles within 0 - 50 cm or prominent mottles within 50 - 10 cm depth	II
Moderately well	only faint mottles present	III
Well	loamy soil with no mottles	IV
Rapid	sandy soil with no mottles	V

The mapping unit legend composition designed for this Soil Survey are essentially subdivision and/or isolation of parent land units from earlier land system mapping done at 1:50,000 scale using similar aerial photographs and topographic base maps. The finer details for land unit separations as TR1, TR2, TR3 (of LRMP land unit 10a); TE1, TE2/3 (of LRMP land unit 10b); P2, P3 (of LRMP land unit 9b) and F1, F2 (of LRMP land unit 9c) have been proved because of availability of large scale aerial photographs (at 1:20,000 scale) and topographic base map (1:10,000 scale) plus extensive aerial photo interpretations followed by field study and checking soils.

2.5 Mapping Unit Description

(1) Ancient Lake and River Terrace (T)

i) Terrace Remanant

This land unit represents upper level terrace of Kathmandu valley indicative of first lake level (approximately 1400 m elevation). The TR1 map unit is found at 1370 m (Tokha), 1390 m (Indrayani), 1390 m (Shali Nadi) and 1395 m (Biswambhara). Similar map units indicate variable elevations in the southern sector, eg. 1358 m (Boshan), and 1360m (Thika Bhairaw). The TR2 map unit indicates approximately second lake level (around 1320 m elevation). It is present at 1338 m (Tokha), 1328 m (Boshan), and 1322 m (Thika Bhairaw). The TR3 map unit occurs at various levels in between TR1 and TR2 map units.

The ancient lake and river terrace represent the former lake bed underlain by coarse loamy lacustrine sediment but sometimes overlain by fluvial sediment capping, eg. Bisequum profile (P9, P10, Shali Nadi; P51, Biswambhara). The dominant slopes are 0.5° to 2° sometimes even up to 5° (class 1 and 2); sandy loam/loam surface texture with moderately good and somewhat poor drainage (class II & III). The dominant land use is paddy followed by wheat/potato in winter.

Associated soil groups with this ancient lake and river terrace map unit are

(a) Aquic Dystochrepts in TR1
(b) Typic/Aeric Endoaquepts in TR2 and
(c) Aeric Endoaquepts and Fluventic Dystochrepts in TR3 (**Table 2-2**)

The ancient lake and river terrace in the southern sector are underlain by fine loamy or clayey lacustrine sediments with no perceptible fluvial capping (except AP1 and AP2 horizons which are always different than the rest of the soil profile). The dominant slope varies from 0.5° to 2° sometimes even up to 7° (class 1 & 2); loam/silt loam/clay loam/silty clay loam surface texture with moderately good and somewhat poor drainage (class II & III). The dominant land use is

paddy followed by wheat/mustard.

The associated soil groups with this map unit are :

(a) Typic/Aquic/Anthraquic Eutrochrepts in TR1
(b) Aquic Eutrochrepts + Oxyaquic Udorthents in TR1'
(c) (Aquic + Typic), Aquic/Typic Eutrochrepts,
(d) Plaggepts and Aeric/Typic Endoaquepts in TR2
(e) Aquic Eutrochrepts and Aquic Plaggepts in TR2'
(f) Aquic Eutrochrepts and Fluvaquentic Eutrochrepts in TR2" (brick making)
(g) Authraquic Eutrochrepts, Fluventic Eutrochrepts and Typic/Hapludolls in TR3 (**Table 2 -2**)

ii) Erosional Terrace

The erosional terraces TE1 and TE2/3 in both the northern and southern sectors have similar features in land units but only associated with different soils (**Tables 2-1** and **2-2**). Associated soil groups are Typic Dystochrepts in TE1 in the northern sector with Udorthents and Typic/Scalpic Dystochrepts in TE2/3 whereas Typic Eutrochrepts are dominant in TE1 of the southern sector with Aquic Udorthents in TE2/3 mapping unit.

iii) Relic Terrace

The relic terrace TH1 represent landscape formation of earlier age than that of Kathmandu valley lake formation. It has one of the oldest and most pedogenically developed soil Alfisol (Typic or Aquic Haplustalfs). The area is confined to the southern part of Thika Bhairaw, Godawari and Kotkhu.

The dominant slopes are 0.5 to 3° (Classes 1 & 2); clay loam surface soil with moderately well to well drained (Classes III & IV) land use mostly confined to maize - mustard with minor paddy - lablab bean. In Khokana there is one older but different soil, viz. Paralithic (Ruptic Alfic) Dystrochrepts.

(2) Alluvial Plains (P)

The alluvial plains of both the northern and southern sectors have similar land units with comparable soils. The river channels (P1) of both sectors have sand + silt bars, predominantly sandy in the northern sector. These are used for mud collection/mining for construction purposes. The active flood plain (P2) of both the sectors have Typic Fluvaquents and Aquic Ustifluvents with dominant slopes of 0.5° to 1° (Class 1); loam surface texture good to somewhat poorly drained (Class II to IV) with paddy-wheat or fallow land use.

Similarly, the recent flood plain/basin (P3) has Typic/Aeric Endoaquepts, Typic Fluvaquents and Typic Udifluvents with dominantly sandy loam, loam or silt loam surface soil moderately well to poorly drained (Class I to III). The only differences are in dominant slopes and land use as conditioned by longer stream profiles in the southern sector. The dominant slopes and land use of the northern sector are 0.5° to 2° (Class 1) and paddy-wheat/potato, respectively, compared with 1° to 3° (Class 1 and 2) and paddy-wheat/mustard in the southern sector.

(3) Alluvial Fans (F)

The alluvial fans of the southern sector have longer profiles, hence have different soils and slopes compared to the northern sector. The convex shaped erosional fans (F1) in the northern sector have predominantly Typic Dystrochrepts soils on 1° - 1.5° slopes (Class 1) with loam surface soil, moderately well drained (Class III) and paddy-wheat crop rotation compared to Anthraquic Eutrochrepts soils; 3° - 5° slopes (Class 2); silt loam surface soil; moderately well drained (Class III) and paddy-wheat/mustard landuse in the southern sector.

The concave shaped depressional fan (F2) has predominantly Typic and Typic Endoaquepts soils on 1° - 3° slopes (Class 1 and 2) with loam surface texture, moderately well to poorly drained (Class I to III) and paddy-potato/wheat crop rotation in the northern sector. The same land/mapping unit has predominantly Anthraquic Eutrochrepts and Typic Eutrochrepts soils on 2° - 4° or even 8° slopes (Classes 2 and 3) with silt loam or loam surface texture, moderately well to well drained (Class III to IV) and paddy-wheat/mustard land use in the southern sector.

(4) Hill Slope (HS)

The hill slope mapping units (HS1, HS2, HS3) are found in Biswambhara, Dhakshinkali and Katunje lying in the northern and southern sectors of the Kathmandu valley. The gently sloping terraces (HS1) of Biswambhara have predominantly Oxyaquic Dystrochrepts soils, 5° to 8° slopes (Class 2 and 3), loam surface texture; somewhat poorly drained (Class II) and paddy-wheat land use. On the other hand the moderately slopping fan (HS2) and moderately sloping ridge (HS3) have Aquic Dystrochrepts and Typic Dystrochrepts, respectively. Both of them occur on 5° to 15° slopes (Classes 2 and 3) with sandy loam/loam surface texture, moderately well drained (Class III) and paddy-wheat or maize-mustard land use.

The gently sloping ridges (HS1/3) of Katunje have Typic Haplustalfs soils with dominant slopes of 2° - 5° (Class 2), well drained (Class IV) and maize-millet crop rotations.

2.6 Soil Classification

Due to the complexity of parent material, topography, slope, drainage and soil moisture characteristics and the time since they were deposited the ancient lake and river terraces, alluvial plains, alluvial fans and hill slopes of the project area have many physiographic land units where diverse soil units are identified. The following are the major soil units classified in the study area.

Entisols

- Udfluvents (Typic)
- Ustifluvents (Aquic)
- Fluvaquents (Typic, Aeric, Umbric)
- Udorthents (Typic, Aeric, Aquic, Oxyaquic)

Inceptisols

- Dystrochrepts (Typic, Aquic, Fluventic, Ruptic Aeric, Ruptic, Paralithic [Ruptic Alfic], Fluvaquentic, Oxyaquic, Scalpic)
- Eutrochrepts (Typic, Aquic, Aquic [Ruptic Scalpic], Anthraquic, Fluvaquentic, Scalpic)

- Endoaquepts (Typic, Aeric, Fluvaquentic)
- Epiaquepts (Typic, Aeric)
- Plaggepts (Typic, Aquic)

Mollisolls

- Endoaquolls (Typic or Fluventic)
- Hapludolls (Typic)

Affisols

- Haplustalfs (Typic, Aquic)

The following are the basic features of the soil units identified and studied in the study area and some of their management implications.

(1) Entisols

Entisols (Udifluvents, Ustifluvents, Fluvaquents and Udorthents) represent alluvial soils and terrace slope or scarp soils. They are classified by absence of distinct pedogenic development in the soil profile. They are particularly common in areas adjacent to major rivers and stream channels (Udifluvents, Ustifluvents and Fluvaquents) and on steep slopes/scarps (Udorthents).

i) Udifluvent (Typic)

Common is map unit P3. Udifluvents comprise a small but significant proportion of recent flood plain/basin soils particularly in Thika Bhairaw. The distinguishing features of Udifluvents include :

- no significant pedogenic development;
- Udic moisture regime;
- stratified recent course textured alluvial deposit forming unrecognizable layers/horizons with variable organic carbon contents;
- Udifluvents are found in association with Ustifluvents, Fluvaquents, and Endoaquepts;
- monsoon flooding sometimes renew these deposits.

Example : P_{35}

ii) Ustifluvent (Aquic)

Common is map unit P2. Ustifluvent consists of a small but significant proportion of active flood plain soils particularly in Tokha and others in the northern sector. Ustifluvents have characteristics similar to Udifluvents except that they occur in Ustic moisture regime and more sandy in nature. The other diagonostic features include:

- surface textures of sandy loam to loamy sand are subjected to a considerable risk of wind erosion particularly from February to May when soils dry out and winds are generally very strong.
- severe monsoon flooding precludes investment in permanent irrigation;
- Ustifluvents are important source of sand for construction purposes;

- Ustifluvents are extensively used for cattle grazing and/or willow plantation.

iii) Fluvaquents (Typic, Aeric, Umbric)

Aeric Fluvaquents are common in map unit P2 whereas Typic and Umbric Fluvaquents occur extensively in map unit P3. The characteristics of Fluvaquents are similar to those of Udifluvents and Ustifluvents except that they are somewhat poor to poorly drained soils. The other characteristic of Fluvaquents include :

- Typic Fluvaquents have grey coloured surface and subsoils with chroma. 4 or more and colour value 2 or less, whereas Aeric subgroups have mottled surface and/or subsurface horizons. The Umbric subgroups have dark coloured surface soil, 18 cm or more thick with acidic reaction (pH<5.5);
- Aquic moisture regime either due to shallow ground water table or frequent flooding or flushing from shedding sites to recent alluvial plains/basins;
- Fluvaquents are confined to paddy cultivation in monsoon followed by sporadic cultivation of potato, onion, garlics and sometimes even wheat in winter;
- Fluvaquents are major components of mapping units P2 and P3; and also a main source of stream bed coaurse sand collection/mining for construction purposes.

iv) Udorthents (Typic, Aeric, Aquic, Oxaquic)

Udorthents are major components of sloping terrace/scarp (map unit TE2/3) and new and old brick excavation sites of Harisiddhi Brick and Tile Factory that falls within the command area of Kotkhu (map unit TR1'). They occur in all the irrigation schmes particularly on terrace side slopes whenever slopes are sufficiently steep (Classes 4 and 5) to promote significant colluvial action. Weathered soils are removed from the site as it develops. Udorthents occur on recent mud flows, slumps and slide scarps and on slopes steeper than 35° (Class 5). The diagnostic features of Udorthents include :

- no significant pedogenic development;
- Udic moisture regime;
- steep slopes with unstable surfaces;
- Udorthents are intimately associated with other soil types as well as exposed bedrock. They are found associated with Typic Dystrochrepts in the northern sector and with Typic Eutrochrepts in the southern sector;
- Udorthents are also used to describe sites where the diagnostic horizons have been removed by erosion or by deep excavation;
- Udorthents are associated with shruby forest, and grass vegetation on stable sites with predominantly *siris* and alnus on unstable wet sites. Bamboo are found on higher well drained sites particularly near house or kitchen gardens.

The management of Udorthents posses a major problem in all the irrigation scheme areas because of their unstable sites. Revegetation of badly eroded sites by suitable tree species like pine on droughty sites and alnus on wet sites could be beneficial. Diversion of water from slopes may be required for stabilization of slumps and slides which have been triggered by wetness of slopes. The establishment and maintenance of good vegetation together with fire wood, fodder and grass collection rather then grazing on the land are the management requirements for Udorthents.

(2) Inceptisols

The Inceptisols (Dystrochrepts, Eutrochrepts, Endoaquepts, Epiaquepts and Plaggepts) represent soils of humid and sub humid regions with altered horizons that have lost basis of iron and aluminum but retain weather resistant minerals. They are the single most common soil order found in all the ancient lake and river terraces of the irrigation scheme areas. They occupy slightly more stable landscape than Entisols and show distinct weathering in the subsoil. The diagnostic feature of the Inceptisols include a presence of a changed, Cambic B horizon in the subsoil with high or low base saturation and with or without presence of a mollic, plaggen or umbic surface A horizon. A greater variety of Inceptisols reflect differences in climate, slope, parent material and soil moisture regimes in the irrigation scheme areas.

i) Dystrochrepts (Typic, Aquic, Fluventic, Fluvaquentic, Oxaquic, Ruptic Alfic, Scalfic)

Dystrochrepts are common in map units TR1, TR3, TE1, TE2/3, F1, HS1, HS2 and HS3 of the northern sector and TH1 of Khokana in the southern sector. They are among the most common soil types found in the terrace remanant (TR), erosional terraces (TE1) of the ancient lake and river terraces; alluvial fans and hill slopes in the northern sector of Kathmandu valley. They are common on acidic or neutral bedrock (gneiss, mica schists, non calcareous sandstone) and on sediments derived from them where soils have a strong leaching regime. They occur on the classes of slopes 1 to 5.

The main diagnostic characteristics of Dystrochrepts include :

- well developed Bm (Cambic) horizon;
- base saturation less than 60 percent (or pH less than 5.5);
- Udic moisture regime;
- Dystrochrepts are associated with Aeric Epiaquepts, Aeric Endoaquepts and Udorthents.

Dystrochrepts are originally developed under forest vegetation which have been currently cleared for terraced cultivation or grazing. They are strongly acidic with pH below 5.5 and a low base saturation. The sandy loam or loamy surface soils on various slopes (particularly on Class 3, 4, and 5) are subjected to surface erosion.

The use of organic matter plays a crucial role in retaining soil nutrients and suppressing the potential toxicity of aluminium. Addition of chemical nitrogen may further acidify these soils requiring time to be used to optimize yield in the long run. But care should be taken not to overtime low CEC soils associated with Dystrochrepts. Erosion control is another aspect for sustained management of terrace slopes.

Examples : TR1 - P_1 , P_5 , P_9
TE1 - P_{26} , P_7
TE2/3 - P_{11}
HS1 - P_{52}

ii) Eutrochrepts (Typic, Aquic, Aquic [Ruptic Alfic], Anthraquic, Fluvaquentic, Scalpic)

Eutrochrepts are common in map units TR1, TR3, TE1, TR2", F1, F2 and partially in TR1', TR2 and TR2'. They are among the most common soils found in the terrace remanant (TR),

erosional terrace (TE) of the ancient lake and river terraces and alluvial fans in the southern sector of the Kathmandu valley. They are common in limestone bedrock areas of the south including some mixed soil types of the east and on sediments derived from them where soils are of fine loamy or fine clayey texture having strong weathering regime associated with high base saturation. They occur in milder classes of slopes (Class 1, 2, 3). The main diagnostic characteristics of Eutrochrepts are :

- well developed Bm (Cambic) horizon as in Dystrochrepts;
- base saturation more than 60 percent (pH greater than 5.5 approx.);
- Udic moisture regime;
- Eutrochrepts are associated with Typic/Aeric Endoaquepts; Typic/Aquic Plaggepts and Aquic/Oxyaquic Udorthents.

The main difference between Dystrochrepts and Eutrochrepts are that the latter occur on calcium rich parent material and, therefore, have high base saturation and low fertility compared to the former.

Eutrochrepts are generally non-calcareous at the surface and slightly calcareous at depth indicating a downward movement and reprecipitation of calcium carbonate. They are subjected to surface erosion where unvegetated and severe gully erosion on unattended water diversion. Proper erosion control and fertility management are mandatory for sustained yield of crops in these soils.

Examples : TR1 - P_{19} , P_{29} , P_{40} , P_{33} , P_{65} , P_{22} , P_{24} , P_{44} , P_{60} , P_{50} , P_{58}
TR3 - P_{36} , P_{59}
TE1 - P_{30}
TR2''- P_{42}
F1 - P_{20}
F2 - P_{25}
and partially
TR1'- P_{45}
TR2 - P_{31} , P_{41} , P_{37}
TR2'- P_{32}

iii) Endoaquepts (Typic, Aeric, Fluvaquentic)

Eudoaquepts are common in map units TR2, TR3, P3 in the northern sector and prevalent in map units TR2, TR3, P3 and F2 in the southern sector. They occur in alluvial terraces, intermittent terraces, recent alluvial plain/depressional fans wherever drainage is restricted regardless of parent material whether acidic as in Dystrochrepts or calcareous as in Eutrochrepts.

Endoaquepts are distinguished from other soils by the following features :

- some pedognic development in the B-horizon
- Aquic moisture regime, eg. gleying or mottling in the subsoil indicating reduction or partial oxidation under submerged condition for at least part of the year;
- they are associated with Epiaquepts, Dystrochrepts, Eutrochrepts, Udifluvents and Fluvaquents;

- they are somewhat poorly or poorly drained.

The main characteristic of Endoaquepts is the Aquic moisture regime which restricts winter cultivation of crops requiring an aerated root zone. The water tables can be regional, seasonal or perched on impervious layer. With cultivation of rice in these soils, the yearly puddling sometimes create substantial pans at 10 -20 cm depth below the surface. More pans are detrimental to crops like winter wheat requiring aerated subsoil.

Without extensive drainage Endoaquepts cannot support upland crops like maize during monsoon. Deep ploughing is needed to beak pans and/or deep trench drainage for winter wheat. This may be one of the reasons that wheat are generally cultivated in Kathmandu valley in marked flat beds with alternate furrows in order to provide better drainage in these soils.

Examples : Northern Sector

TR2 - P_4 ,P_{10}
TR3 - P_6
P - P_{53}

Southern Sector

TR2 - P_{23} , P_{16} , P_{17} , P_{18}
P3 - P_{40} , P_{21}

iv) Epiaquepts (Typic, Aeric)

Epiaquepts are found in map units TR1, TR2, TR3 of Tokha and Biswambhara of the northern sector and partially in map units TR2 and TR3 of Katunje of the southern sector.

They are similar to Endoaquepts in nature, but occur on sites which are slightly better drained than Endoaquepts. They show less pronounced glazing and have episaturation subdivision of Aquic moisture regime. Episaturation refers to a condition when soils are saturated with water in one or more layers within 200 cm of the mineral surface soil and also have one or more unsaturated layers. The zone of saturation eg. water table may be perched on top of relatively impermeable layer. Epiaquepts are associated with Endoaquepts, Dystrochrepts, Eutrochrepts and Plaggepts.

The management required for Epiaquepts are similar to that of Endoaquepts. For example proper drainage is needed both for summer and winter crops and other than rice. Soil fertility management is also crucial in these soils.

Examples : TR1 - P_{54}
TR3 - P_{27} , P_{51} , P_{12}

v) Plaggepts (Typic, Aquic)

Plaggepts are found in map units TR2, TR2' of Thika Bhairaw, Kotkhu, Lubhu and Mahadev Khola in the southern sector. They are characterized by the presence of "kalimati" pieces (50% or more) intermixed with in-situ soil to a depth of 50 to 100 cm or more. These "kalimati" have been added earlier by people while cultivating these soils (hence plaggen or sod or spade marks indicating human interference).

Plaggepts consist of 15 cm thick, dark greyish brown to dark brown (10 YR 4/2, 4/3 or 3/3) loam or silty clay loam surface soil underlain by similar coloured subsoil 90 - 100 cm thick and

brown to yellowish brown (10 YR 5/3 - 5/6) silty clay loam substances. The CEC of surface soil is greater than 20 me/100g with base saturation more than 60%. They are fertile soil and inter mixture of "kalimati" pieces provide better drainage eg. moderately well drained. They are associated with Eutrochrepts in better drained sites and Endoaquepts in poorly drained sites.

Soil fertility management including addition of organic manure together with chemical fertilizers are important for sustained yield of crops in these soils. Areas with Plaggepts are less enchroached by brick kilns or brick factories.

Examples : TR2 - P_{47} , P_{49} , P_{46} , P_{55}

(3) Alfisols

Alfisols are characterized by the presence of an alluvial B horizon in which layer lattice silicate clays have accumulated to a significant extent but still have high base saturation. They are found in the highest relic terrace (TH1) of Thika Bhairaw, Godawari and Kotkhu and on the hill slope ridge (HS1) of Katunje, all lying in the southern sector.

Alfisols are one of the oldest soils found in ancient relic terraces of the Kathmandu valley. Their presence, therefore, indicate a stable landscape and climatic conditions that permit development of more mature pedogenic horizons. Most of the soils mapped in other irrigation scheme areas, eg. Ruptic Alfic Dystrochrepts (TE1) of Tokha, Aquic (Ruptic Alfic) Eutrocherepts (TR1) of Boshan and Khokana and Paralithic (Ruptic Alfic) Dystrochrepts (TH1) of Khokana have fragments of Alfic B-horizons, but do not meet all the criteria for Alfisols. In other works, the presence of the juvenile Argillic (Btj) horizons indicate a fair stability of landscape or soils in question and hence could be called older soils.

i) Haplustalfs (Typic, Aquic)

Haplutalfs are common in map units TH1, TH1a, TH1b of Thika Bhairaw, Godawari and Kotkhu and map unit HS1 of Katunje of the southern sector.

The diagnostic features of Haplustalfs include :

- well expressed Bt (Argillic) horizon;
- soil matrix with hue of 5 YR or yellowish;
- Udic moisture regime;
- base saturation greater than 35 percent.

Haplustalfs developed on old relic alluvial terraces are often unirrigable because of high topographic positions and presence of sloping terraces where maize and millet are usually grown. Rice cultivation is restricted to depressional level terraces where Aquic Haplustalfs are found. Sheet and gully erosions are a constant hazard in these soils, if left bare. The deep weathering of these soils become hazardous once the run off channel concentrates on a site which turns into gully quickly and eventually into a ravine by gully head eating, side collapse and transportation of material in slurry.

Addition of organic matter is crucial for productive management of these soils.

Examples : TH1 - P_{43}

TH1a - P_{63}
TH1b - P_{34}
HS1 - P_{13}

(4) Mollisols

Mollisols are characterized by the presence of a thick, dark colour, high base saturated and humus rich surface soil about 18 to 25 cm thick. They are minor soils and occur in isolated areas of depressional fans of Shali Nadi and intermittent terraces of Mahadev Khola. These soils were originally formed under tropical hard wood forest and grass land vegetation which has since been cleared.

i) Endoaquolls (Typic or Fluventic)

Endoaquolls are found on map unit F2 of Shali Nadi in the northern sector. The distinguishing features of Endoaquolls include :

- Dark topsoil (Mollic and horizon);
- well developed Bm (Cambic) horizon;
- base saturation greater than 60 percent;
- Aquic moisture regime.

These Endoaquolls are developed on stratified but stable sediments with flushing of flood waters enriched with organic matter from the forested hills in upper catchment.

Soil fertility of these mollisols drops quickly after 4 or 5 years of cultivation without addition of organic manure. When Mollic Ah fails to meet the criteria of Endoaquolls the soils are then classified as Endoaquepts. Hence a need for regular soil fertility management by the addition of organic manure together with proper dosages of chemical fertilizers.

Example : F2 - P_8

ii) Hapludolls (Typic)

Hapludolls are found in map unit TR3 of Mahadev Khola. They are similar to Endoaquolls in diagnostic characteristics except that they occur on Udic moisture regime and hence better drained than Endoaquolls.

The usual soil fertility management practices also apply to Hapludolls.

Examples : TR3 - P_{57}

2.7 Soil Profiles and Physical-Chemical Analysis

Tokha Irrigation scheme

Coarse Loamy, mixed thermic Aquic Dystrochrepts

Test Pit No	:	P1
Location	:	Tokha Irrigation scheme
Physiography	:	Ancient lake and river terrace
Topography	:	Nearly level
Slope	:	1° ↑N 1° ↓S
Parent material	:	Old alluvium
Drainage	:	Moderately well drained
Ground Water	:	N. S. (not seen)
Permeability	:	Slow
Moisture	:	Slightly moist surface, slightly dry subsoil and wet at 100 cm
Present land use or vegetation	:	paddy-wheat, Alnus, Bamboo on edges

Horizon	Depth(cm)	Soil Description
Ap1	0-10	10YR 5/2 (brown); sandy loam; weak; medium subangular blocky; friable; common fine fibrous roots, pH 5.2; hardness 18 mm gradual smooth boundary.
Ap2	10-16	10YR 5/3 (brown); loam; few faint fine (10YR 4/6) mottles; weak medium subangular friable;few fine roots; pH 5.2; hardness 18mm; gradual smooth boundary.
B1g	19-34	2.5Y 5/2 (greyish brown); silt loam; many fine distinct (10YR 5/6) mottles; weak platy breaking into medium and course subangular blocky; friable to firm; very few fine roots; hardness 20 mm; clear smooth boundary.
B2	34-69	10Y 5/4 (yellowish brown); sandy clay loam; common fine faint (7.5YR 5/6) mottles; moderate to strong prismatic breaking into strong medium to coarse sub angular blocky; firm; pH 5.6; hardness 20 mm; clear smooth boundary.
B31g	69-100	7.5YR 4/4 (dark brown) clay; many medium faint (7.5 YR 5/6) mottles; weak prismatic breaking into coarse angular blocky; few Fe Mn concretions; gradual smooth boundary.
B32g	100-135	7.5YR 3/4 (dark brown); clay; massive and wet; saturated at bottom.

Pit No.: 1 Scheme: Tokha

Depth (cm)	pH (1:2.5)	E.C.. mS/cm (1:2.5)	Total CaCO3 %	Particle size distribution				O.C. %	Total N %	Av. P ppm
				Sand %	Silt %	Clay %	Texture Class			
0-19	5.2	0.033	Nil	41	45	14	L	1.46	0.14	4.2
34-69	5.6	0.033	-	55	29	16	SL	-	-	-

Depth (cm)	Exchangeable Cation me/100g				CEC me/100g	B/S %	Soluble Cation and Anions			
	Ca	Mg	K	Na			Ca me/l	Mg me/l	Na ppm	Cl me/l
0-19	2.58	1.03	0.21	0	7.25	49.9	0.22	0.08	0	4.22
34-69	-	-	-	-	-	-	-	-	-	-

Coarse loamy over sandy, mixed, thermic Ruptic Alfic Dystrochrepts/Aeric Dystrochrepts

Test Pit No	:	P26
Location	:	Tokha Irrigation scheme
Physiography	:	Ancient lake and river terrace ridge
Topography	:	Nearly level
Slope	:	0.5° ↑NW 2° ↓SE
Parent material	:	Old alluvium
Drainage	:	Somewhat poorly drained
Normal Water	:	N. S.
Permeability	:	moderate
Moisture	:	Slightly moist subsoil and dry sand at 125-130cm
Present land use or vegetation	:	upland paddy/ground nut/soyabean, Bamboo Bakena, Siris

Horizon	Depth(cm)	Soil Description
Ap1	0-15	10YR 4/3 (dark brown); sandy loam, weak medium subangular blocky; friable; many fine fibrous roots, pH 5.3; hardness 15 mm; abrupt irregular boundary.
B21(t)g	15-38	10YR 6/4 (light yellowish brown) + 10YR 4/6 (dark yellowish brown);silt loam; weak columnar breaking into moderate angular blocky,firm; many fine tubular pores; thin clay skins on ped faces; pH 6.0; hardness 24 mm; clear broken boundary.
B22	38-50	10YR 6/4 (light yellowish brown silty clay loam; many fine prominent (5YR 4/6) mottles; moderate medium subangular blocky; hard; many fine tabular pores; hardness 19 mm; abrupt smooth boundary.
BC	50-125	10Y 4/6 (light yellowish brown); coarse loamy; sand; compact; abrupt smooth boundary
C1g	125-130	2.5Y 7/2 (light grey); silt loam (gleyed layer)
C2	130+	2.5Y 6/4 (light yellowish brown); medium sand, single grained; loose.

Pit No.: 26 Scheme: Tokha

Depth (cm)	pH (1:2.5)	E.C. mS/cm (1:2.5)	Total CaCO3 %	Particle size distribution				O.C. %	Total N %	Av. P ppm
				%	Silt %	Clay %	Texture Class			
0-15	5.3	0.033	Nil	72	22	6	SL	0.66	0.06	16.3
15-38	6.0	0.055	-	37	52	11	SiL	-	-	-

Depth (cm)	Exchangeable Cation me/100g				CEC me/100g	B/S %	Soluble Cation and Anions			
	Ca	Mg	K	Na			Ca me/l	Mg me/l	Na ppm	Cl me/l
0-15	2.58	0.51	0.07	0	6.15	52.5	0.33	0.18	1	0.22
15-38	-	-	-	-	-	-	-	-	-	-

Fine loamy, mixed, thermic Aeric Epiaquepts

Test Pit No	:	P27
Location	:	Tokha Irrigation scheme
Physiography	:	Second level Tar of Ancient lake and river terraces
Topography	:	Nearly level
Slope	:	0.5° ↑NW 1.5° ↓SE
Parent material	:	Alluvium
Drainage	:	Somewhat poorly drained
Ground Water	:	N.S
Permability	:	Slow
Moisture	:	Moist surface and slighly moist subsoil and substratum
Present land use or vegetation	:	paddy-wheat, alnus bamboo, siris

Horizon	Depth(cm)	Soil Description
Apg	0-16	10YR4/2 (dark greyish brown): silt loam, few fine faint (10YR 4/4) mottles; weak fine subangular blocky; friable; many fine fibrous roots; pH 5.7; hardness 12mm; clear smooth boundary.
AB	16-30	10YR 4/2 (dark greyish brown); sandy clay loam; few fine faint (10YR 4/4) mottles; weak medium subanglar blocky; hard; many medium tubular pores; hardness 26mm; gradual smooth boundary.
B2	30-105	10YR 5/3 (brown); sandy clay loam, common fine faint (10YR 4/4) mottles; strong coarse angular blocky; hard compact but with many fine tubular vertical and horizontal pores; few brick and pottery pieces; pH 6.7; hardness 28 mm; gradual smooth boundary
BC	105-130	10YR 5/2 (greyish brown); sandy clay loam; friable.

Pit No.: 27 Scheme: Tokha

Depth (cm)	pH (1:2.5)	E.C. mS/cm (1:2.5)	Total CaCO3 %	Particle size distribution				O.C. %	Total N %	Av. P ppm
				Sand %	Silt %	Clay %	Texture Class			
0-16	5.7	0.033	Nil	37	52	11	SiL	1.27	0.11	3.1
30-105	6.7	0.07	-	65	12	23	SCL	-	-	-

Depth (cm)	Exchangeable Cation me/100g				CEC me/100g	B/S %	Soluble Cation and Anions			
	Ca	Mg	K	Na			Ca me/l	Mg me/l	Na ppm	Cl me/l
0-16	2.58	1.03	0.05	0.05	7.15	51.7	0.33	0.08	4.6	0
30-105	-	-	-	-	-	-	-	-	-	-

Coarse loamy, mixed, thermic Typic Fluvaquents

Test Pit No	:	P28
Location	:	Tokha Irrigation scheme
Physiography	:	Depressional flood plain
Topography	:	Nearly level
Slope	:	1° ↑NW 1° ↓SE
Parent material	:	Recent alluvium
Drainage	:	Somewhat poorly drained
Normal Water	:	Not seen
Permeability	:	Moderately slow
Moisture	:	Wet surface soil and moist substratum
Present land use or vegetation	:	Alnus, Paddy-wheat/potato

Horizon	Depth(cm)	Soil Description
Apg	0-16	10YR 4/1 (dark grey); silt loam; many fine distinct (7.5YR 3/4); mottles; weak medium subangular blocky; friable; many fine fibrous; roots; pH 5.8; hardness 14 mm; gradual smooth boundary
C1	16-40	10YR 4/2 (dark greyish brown); silt loam; massive; friable; pH 6.8; hardness 19 mm; gradual smooth boundary
C2/A1b	40-64	10YR 5/1 (grey); sandy loam; few fine faint (10YR 4/4) mottles; weak subangular blocky; friable

Pit No.: 28 Scheme: Tokha

Depth (cm)	pH (1:2.5)	E.C. mS/cm (1:2.5)	Total CaCO3 %	Particle size distribution				O.C. %	Total N %	Av. P ppm
				Sand %	Silt %	Clay %	Texture Class			
0-16	5.8	0.055	Nil	28	61	11	SiL	1.62	0.14	3.3
16-40	6.8	0.07	-	28	57	15	SiL	-	-	-

Depth (cm)	Exchangeable Cation me/100g				CEC me/100g	B/S %	Soluble Cation and Anions			
	Ca	Mg	K	Na			Ca me/l	Mg me/l	Na ppm	Cl me/l
0-16	5.15	1.55	0.14	0.05	12.25	55.5	0.66	0.15	4.5	0.11
16-40	-	-	-	-	-	-	-	-	-	-

Gokarna Irrigation scheme

Coarse Loamy over sandy, mixed, thermic cambic Fluvaquents

Test Pit No	:	P2
Location	:	Gokarna Irrigation scheme
Physiography	:	Stable flood plain terrace
Topography	:	Nearly level
Slope	:	0.5° ↑N 0.5° ↓S
Parent material	:	Recent alluvium
Drainage	:	Somewhat poorly drained
Normal Water	:	Within 3 m
Permeability	:	Moderate
Moisture	:	Moist topsoil and dry substratum
Present land use or vegetation	:	Paddy-wheat

Horizon	Depth(cm)	Soil Description
Ap1g	0-16	10YR 3/2 (very dark greyish brown); silt loam; common medium distinct mottles; moderate medium subangular blocky; friable; few fine fibrous roots; pH 5.0; gradual smooth boundary.
Ap2g	16-31	2.5YR 5/2 (greyish brown); loam; many medium prominent 5YR 4/6 mottles; weak fine subangular blocky; friable; few fine tubular pore; pH5.1; abrupt smoooth boundary.
C1	31-39	2.5YR 4/2 (dark greyish brown) medium sandy; single grained; loose, abrupt smooth boundary.
C2	39-43	10YR 7/2 (light grey); very fine sand + silt; platy; irregular smooth boundary
C3	43-95	2.5YR 7/2 (light grey); coarse sand, river bed load
C4	95+	very coarse sand + gravel bed

Pit No.: 2 Scheme: Gokarna

Depth (cm)	pH (1:2.5)	E.C. mS/cm (1:2.5)	Total CaCO3 %	Particle size distribution				O.C. %	Total N %	Av. P ppm
				Sand %	Silt %	Clay %	Texture Class			
0-16	5.0	0.033	Nil	33	55	12	SiL	1.39	0.13	16.2
16-39	5.1	0.103	-	34	48	18	L	-	-	-

Depth (cm)	Exchangeable Cation me/100g				CEC me/100g	B/S %	Soluble Cation and Anions			
	Ca	Mg	K	Na			Ca me/l	Mg me/l	Na ppm	Cl me/l
0-16	3.09	1.03	0.09	0	9.35	45.6	1.22	0.08	0	0.11
16-39	-	-	-	-	-	-	-	-	-	-

Coarse Loamy over sandy, mixed thermic, Aeric Fluvaquents

Test Pit No	:	P3
Location	:	Gokarna Irrigation scheme
Physiography	:	Active flood plain
Topography	:	Nearly level depression
Slope	:	2° ↑N 1° ↓S
Parent material	:	Recent alluvium
Drainage	:	Poorly drained
Ground Water	:	110 cm
Permeability	:	Moderate
Moisture	:	Slightly moist throughout the profile
Present land use or vegetation	:	Paddy - fallow

Horizon	Depth(cm)	Soil Description
Ap	0-15	10YR 4/2 (dark greyish brown); loam; many fine few (7.5YR 4/4) mottles; structure not defined; coarse; few fine roots; pH 5.6; abrupt wavy boundary
C	15-32	10R 5/3 (brown); coarse sand; single grained; loose; abrupt wavy boundary
A1bg	32-48	10YR 4/2 (dark greyish brown) ; silt loam; many coarse prominent (5YR 3/4) mottles; massive; friable; few fine tubular pores; pH 5.6; clear wavy boundary
IIBg	48-70	2.5YR 3/0 (very dark grey); loam; few fine prominent (5YR 3/4) mottles massive; friable; abrupt smooth boundary
IIC	70-90+	Very coarse sand + gravel single grained; loose river bed land

Pit No.: 3 Scheme: Gokarna

Depth (cm)	pH (1:2.5)	E.C. mS/cm (1:2.5)	Total CaCO3 %	Particle size distribution				O.C. %	Total N %	Av. P ppm
				Sand %	Silt %	Clay %	Texture Class			
0-15	5.6	0.046	Nil	46	38	16	L	1.27	0.12	8.1
32-48	5.6	0.059	-	30	62	8	SiL	-	-	-

Depth (cm)	Exchangeable Cation me/100g				CEC me/100g	B/S %	Soluble Cation and Anions			
	Ca	Mg	K	Na			Ca me/l	Mg me/l	Na ppm	Cl me/l
0-15	2.58	0.51	0.23	0.05	7.35	43.9	0.33	0.08	3.6	1.11
32-48	-	-	-	-	-	-	-	-	-	-

Fine loamy, mixed, thermic Typic Epiaquepts

Test Pit No	:	P4
Location	:	Gokarna Irrigation scheme
Physiography	:	Stable alluvial plain/terrace
Slope	:	Nearly level
Parent material	:	Subrecent alluvium
Drainage	:	Somewhat poorly drained
Ground Water	:	Not seen
Permeability	:	Slow
Moisture	:	Slightly moist through out the profile
Present land use or vegetation	:	Paddy-wheat

Horizon	Depth(cm)	Soil Description
Ap	0-18	2.5Y 5/2 (greyish brown); sandy loam; weak coarse clods; friable; few fine roots; pH 5.5; hardness 22 mm; gradual smooth boundary
Bpan	18-24	2.5Y 4/2 (greyish brown); sandy clay loam; common fine distinct (7.5YR 4/6) mottles; weak platy breaking into moderate subangular blocky; friable to firm; hardness 28 mm; clear smooth boundary
B	24-72	2.5Y 4/2 (greyish brown); sandy clay loam; common fine faint (10YR 4/6); mottles; weak columnar breaking into coarse angular blocky; friable to firm; pH 5.8; hardness 26 mm; clear wavy boundary
C	72-120	10YR 6/2 (light brownish grey); very fine sand; very frible; hardness 20 mm

Pit No.: 4 Scheme: Gokarna

Depth (cm)	pH (1:2.5)	E.C. mS/cm (1:2.5)	Total CaCO3 %	Particle size distribution				O.C. %	Total N %	Av. P ppm
				Sand %	Silt %	Clay %	Texture Class			
0-18	5.5	0.049	Nil	65	24	11	SL	1.65	0.14	32.2
24-72	5.8	0.069	-	59	21	20	SCL	-	-	-

Depth (cm)	Exchangeable Cation me/100g				CEC me/100g	B/S %	Soluble Cation and Anions			
	Ca	Mg	K	Na			Ca me/l	Mg me/l	Na ppm	Cl me/l
0-18	3.09	1.03	0.18	0.05	9.45	45.7	0.22	1.19	4.2	0
24-72	-	-	-	-	-	-	-	-	-	-

Indrayani Irrigation scheme

Fine loamy, mixed, thermic Aquic Dystrochrepts

Test Pit No	:	P5
Location	:	Indrayani Irrigation scheme
Physiography	:	Ancient lake and river terrace, irrigated
Topography	:	Nearly level
Slope	:	0.52° ↑ N 1° ↓ S
Parent material	:	Old alluvium
Drainage	:	Somewhat poorly drained
Ground Water	:	Not seen
Permeability	:	Moderate
Moisture	:	Slightly moist surface, moist subsoil and substratum
Present land use or vegetation	:	Paddy-wheat, mango, siris, bamboo

Horizon	Depth(cm)	Soil Description
Ap1g	0-12	2.5Y 4/2 (dark greyish brown); sandy loam; many medium distinct 10YR 4/4 mottles; weak medium subangular blocky; friable; many fine fibrous roots; pH 5.3; gradual smooth boundary
Ap2g	12-22	2.5Y 4/2 (dark greyish brown); loam; many medium and coarse prominent 7.5YR 4/4 mottles; moderate fine and medium subangular blocky; friable; many fine fibrous roots; pH 5.3; very porous; clear wavy boundary
Bg	22-29	10YR 5/3 (brown); sandy clay loam; many fine distinct 7.5YR 4/6 mottles; weak prismatic breaking to medium subangular blocky; firm; few fine roots; few fine tubular pores; hardness 12mm; gradual smooth boundary
B2	29-54	10YR 4/3 (dark brown) sandy clay loam; few fine faint 10YR 4/6 mottles; moderate prismatic breaking to coarse subangular blocky; firm; few fine tubular pores; thin clay skins on ped faces and root channels; Fe Mn concretions; pH 6.0; hardness 22 mm; gradual irregular boundary
B3	54-105	10YR 5/4 (yellowish brown) clay loam; common fine faint 10YR 4/6 mottles; moderate medium and coarse angular blocky; firm; few Fe Mn concretions; few pieces of quartz stones; very few roots; hardness 22mm.

Pit No.: 5 Scheme: Indrayani

Depth (cm)	pH (1:2.5)	E.C. mS/cm (1:2.5)	Total CaCO3 %	Particle size distribution				O.C. %	Total N %	Av. P ppm
				Sand %	Silt %	Clay %	Texture Class			
0-22	5.3	0.046	Nil	45	43	12	L	1.84	0.16	16.2
29-54	6.0	0.143	-	59	21	20	SCL	-	-	-

Depth (cm)	Exchangeable Cation me/100g				CEC me/100g	B/S %	Soluble Cation and Anions			
	Ca	Mg	K	Na			Ca me/l	Mg me/l	Na ppm	Cl me/l
0-22	4.12	1.55	0.09	0	10.31	55.4	0.89	0.33	1	0.11
29-54	-	-	-	-	-	-	-	-	-	-

Coarse loamy, mixed, thermic Aeric Endoaquepts

Test Pit No	:	P6
Location	:	Sanagaun, Indrayani Irrigation scheme
Physiography	:	Concave valley slope in tar, irrigatd
Topography	:	Gently sloping
Slope	:	3° ↑ NE 50° ↓ S
Parent material	:	Alluvium
Drainage	:	Somewhat poorly drained
Ground Water	:	Not seen
Permeability	:	Moderate
Moisture	:	Slightly moist throughout
Present land use or vegetation	:	Paddy-wheat, bamboo, alnus in side slopes

Horizon	Depth(cm)	Soil Description
Ap	0-12	2.5YR 4/2 (dark greyish brown); loam; few fine faint 10YR 4/6 mottles; clods breaking to weak subangular blocky; friable; many fine fibrous roots pH 5.2; hardness 19 mm; gradual smooth boundary
Ap2g	12-32	2.5Y 4/2 (dark greyish brown); loam; many coarse distint 10YR 4/6 mottles; weak coarse subangular blocky; friable; few fine fibrous roots; few fine vertical; pores; hardness 21 mm; gradual smooth boundary.
Bg	32-80	2.5Y 5/2 (greyish brown); loam; few fine distint 10YR 4/6 mottles; moderate medium subangular blocky; friable; very few fine roots; few tubular and vesicular pores; pH 6.0; hardness 25 mm.

Pit No.: 6 Scheme: Indrayani

Depth (cm)	pH (1:2.5)	E.C. mS/cm (1:2.5)	Total CaCO3 %	Particle size distribution				O.C. %	Total N %	Av. P ppm
				Sand %	Silt %	Clay %	Texture Class			
0-12	5.2	0.033	Nil	45	43	12	L	2.12	0.18	4.1
32-80	6.0	0.091		48	40	12	L	-	-	-

Depth (cm)	Exchangeable Cation me/100g				CEC me/100g	B/S %	Soluble Cation and Anions			
	Ca	Mg	K	Na			Ca me/l	Mg me/l	Na ppm	Cl me/l
0-12	3.61	1.03	0.09	0	9.25	51.1	0.44	0.17	1	0.22
32-80	-	-	-	-	-	-	-	-	-	-

Coarse loamy, over sandy, acid, mixed, thermic Typic Dystrochrepts

Test Pit No	:	P7
Location	:	Pasikhel, Indrayani Irrigation scheme
Physiography	:	Tar ridge, non-irrigated
Topography	:	Nearly level
Slope	:	1° ↑ W 1.5° ↓ S
Parent material	:	Old alluvium
Drainage	:	Moderately well drained
Ground Water	:	N.S.
Permeability	:	Moderate
Moisture	:	Slightly moist throughout
Present land use or vegetation	:	Maize-millet; alnus; bamboo; lapsi on sides

Horizon	Depth(cm)	Soil Description
Ap	0-12	10YR 4/4 (dark yellowish brown); loam; moderate medium subangular blocky; friable; few fine roots; few macro verticle pores; pH 5.4; hardness 22mm; broken boundary
B	12-36	7.5YR 4/4 (dark brown); sandy loam; weak columnar breaking to medium subangular breaking to medium subangular blocky; friable; very few roots; pH 5.5; hardness 25mm; clear wavy boundary
BC	36-76	10YR 6/4 (light yellowish brown); silt/silt loam; moderate platy; friable; silt flushings on few big pores insect burrows and cracks; roots nil; hardness 27 mm; clear smooth boundary
C	76-100	10YR 7/4 (very pale brown) medium sand; single grained; loose

Pit No.: 7 Scheme: Indrayani

Depth (cm)	pH (1:2.5)	E.C. mS/cm (1:2.5)	Total CaCO3 %	Particle size distribution				O.C. %	Total N %	Av. P ppm
				Sand %	Silt %	Clay %	Texture Class			
6-12	5.4	0.091	Nil	45	43	12	L	1.08	0.09	8.1
12-36	5.5	0.172	-	67	23	10	SL	-	-	-

Depth (cm)	Exchangeable Cation me/100g				CEC me/100g	B/S %	Soluble Cation and Anions			
	Ca	Mg	K	Na			Ca me/l	Mg me/l	Na ppm	Cl me/l
6-12	3.09	1.03	0.17	0.05	9.12	46.7	0.44	0.17	3	0.22
12-36	-	-	-	-	-	-	-	-	-	-

Shali Nadi Irrigation scheme

Coarse loamy, mixed, thermic Typic Endaquolls

Test Pit No	:	P8
Location	:	Damai Khola, Shali Nadi Irrigation scheme
Physiography	:	Alluvial terrace
Topography	:	Very gently sloping
Slope	:	3° ↑ N 1° ↓ S
Parent material	:	Alluvium
Drainage	:	Moderately well drained
Ground Water	:	N.S
Permeability	:	Moderately slow
Moisture	:	Moist throughout
Present land use or vegetation	:	Paddy-wheat/Potato

Horizon	Depth(cm)	Soil Description
Ap	0-18	10YR 3/2 (very dark greyish brown); loam; moderate fine and medium subangular blocky; friable; few fine fibrous roots; pH 6.0; hardness 10mm; clear smooth boundary
Bpan	18-29	10YR 4/2 (dark greyish brown); sandy loam/silt loam; common fine faint 10YR 3/4 mottles; weak coarse subangular + angular blocky friable; slightly porous; hardness 19mm; clear smooth boundary
B1	29-46	10YR 5/2 (greyish brown); sandy clay loam; weak prismatic breaking to medium subangular blocky; few medium subangular blocky; few medium Fe Mn concretion; hardness 15mm; clear wavy boundary
B2	46-66	10YR 4/2 (dark greyish brown); silt loam; massive; few brick pieces; pH 6.3; hardness 20mm; clear irregular boundary
C	66-86	10YR 5/2 (greyish brown) + 10YR 5/6 (yellowish brown); Coarse sandy loam; massive; hardness 21 mm; abrupt boundary
C+R	86-100+	10YR 5/3 (brown); stony coarse sany; (stone pavement at bottom); stones 50%

Pit No.: 8 Scheme: Shali Nadi

Depth (cm)	pH (1:2.5)	E.C. mS/cm (1:2.5)	Total CaCO3 %	Particle size distribution				O.C. %	Total N %	Av. P ppm
				Sand %	Silt %	Clay %	Texture Class			
0-18	6.0	0.042	0.07	45	43	12	L	2.23	0.19	32.1
46-66	6.3	0.042	-	30	62	8	SiL	-	-	-

Depth (cm)	Exchangeable Cation me/100g				CEC me/100g	B/S %	Soluble Cation and Anions			
	Ca	Mg	K	Na			Ca me/l	Mg me/l	Na ppm	Cl me/l
0-18	5.67	2.06	0.22	0.1	14.25	56.1	0.66	0.15	4.3	0.22
46-66	-	-	-	-	-	-	-	-	-	-

Coarse loamy, acid, mixed, thermic Fluvaquentic Dystrochrepts (Bisequum)

Test Pit No	:	P9
Location	:	Sakhu, Salinadi, Irrigation scheme
Physiography	:	Tar Summit
Topography	:	Very gently sloping
Slope	:	1° ↑ N 2° ↓ S
Parent material	:	Old Alluvium
Drainage	:	Somewhat poorly drained
Ground Water	:	Not seen
Permeability	:	Moderately slow
Moisture	:	Moist throughout the profile
Present land use or vegetation	:	Paddy-Potato

Horizon	Depth(cm)	Soil Description
Ap1	0-10	10YR 4/2 (dark greyish brown); loam; weak fine and medium subangular blocky; friable; many fine fibrous roots; pH 5.4; hardness 12mm; gradual smooth boundary
Ap2	10-19	10YR 4/3 (dark brown); loam; common coarse distinct 10YR 3/6 mottles; weak fine and medium subangular blocky; friable; many fine fibrous roots pH 5.4; hardness 12 mm; abrupts broken boundary
Bg pan	19-32	10YR 5/3 (brown); loam; many fine prominent 5YR 3/3 mottles at root channels and pores; weak prismatic breaking to medium subangular blocky + angular blocky; friable; few fine roots; few tubular verticle micropores; hardness 17 mm; clear smooth boundary
A1b	32-62	10YR 4/2 (dark greyish brown); sandy loam; few fine faint 7.5YR 3/4 mottles; moderate medium subangular blocky; friable; very few fine roots; slightly pores; pH 5.5; hardness 19 mm; few Fe Mn concretions; clear wavy boundary
IIB	62-84	7.5YR 5/4 (brown); very coarse sandy loam; massive; friable; very few roots; abrupt smooth boundary
IIC	84-90	7.5YR 6/4 (reddish yellow); very coarse sandy loam; single grained; loose quartz gravels 25%

Pit No.: 9 Scheme: Shali Nadi

Depth (cm)	pH (1:2.5)	E.C. mS/cm (1:2.5)	Total CaCO3 %	Particle size distribution				O.C. %	Total N %	Av. P ppm
				Sand %	Silt %	Clay %	Texture Class			
0-19	5.4	0.033	Nil	44	40	16	L	1.91	0.16	64.2
32-62	5.5	0.056	-	67	23	10	SL	-	-	-

Depth (cm)	Exchangeable Cation me/100g				CEC me/100g	B/S %	Soluble Cation and Anions			
	Ca	Mg	K	Na			Ca me/l	Mg me/l	Na ppm	Cl me/l
0-19	3.09	1.03	0.28	0	9.35	45	0.55	0.16	1.2	0.11
32-62	-	-	-	-	-	-	-	-	-	-

Coarse loamy, acid, mixed, thermic typic (Fluventic) Endoaquepts (Bisequum)

Test Pit No	:	P10
Location	:	Sankhu Suntol, Shali Nadi Irrigation scheme
Physiography	:	Tar
Topography	:	Nearly level
Slope	:	1° ↑ N 1° ↓ S
Parent material	:	Alluminum
Drainage	:	Somewhat poorly drained
Ground Water	:	110 cm perched; impermeable black grey layer to 125cm
Permeability	:	Moderate
Moisture	:	Slight moist throughout the profile but wet at 60-100cm
Present land use or vegetation	:	Paddy-potato/wheat

Horizon	Depth(cm)	Soil Description
Ap	0-12	10yR 3/3 (dark brown); loam; weak fine and medium subangular blocky; friable; many fine to fibrous roots; pH 5.2; hardness 14 mm; gradual smooth boundary
Ap2	12-22	10YR 4/2 (dark greyish brown); loam; few fine faint 7.5YR 3/4 mottles; weak fine and medium subangular blocky; friable; few fine roots pH 5.2; hardness 14mm; gradual smooth boundary
Bg pan	22-33	10YR 5/2 (greyish brown); loam; many fine distinct 7.5YR 4/4 mottles; weak coarse subangular blocky; firm; hardness 18 mm; few brick pieces; clear wavy boundary
A1b	33-45	7.5YR 3/2 (dark brown); gravelly sandy clay loam; firm; gravel pieces 60%; hardness 20mm; abrupt smooth boundary
IIB	45-60	5YR 2.5/2 (black); sandy loam; moderate medium subangular blocky; friable; pH 5.5; hardness 19 mm; abrupt smooth boundary
IIC	60-125	Stratified layer of yellow; brown and black loamy sand with abrupt boundaries
IIICg	125+	Impermeable black (5YR 2.5/2) clay

Pit No.: 10 Scheme: Shali Nadi

Depth (cm)	pH (1:2.5)	E.C. mS/cm (1:2.5)	Total CaCO3 %	Particle size distribution				O.C. %	Total N %	Av. P ppm
				Sand %	Silt %	Clay %	Texture Class			
0-22	5.2	0.033	Nil	45	43	12	L	1.54	0.14	64.2
22-33	5.5	0.059	-	45	43	12	L	-	-	-

Depth (cm)	Exchangeable Cation me/100g				CEC me/100g	B/S %	Soluble Cation and Anions			
	Ca	Mg	K	Na			Ca me/l	Mg me/l	Na ppm	Cl me/l
0-22	3.09	1.55	0.09	0	10.12	47.3	0.44	0.17	0	0.11
22-33	-	-	-	-	-	-	-	-	-	-

Coarse loamy, acid, mixed; thermic Typic (ammoniumic or scalpic) Dystrochrepts

Test Pit No	:	P11
Location	:	Sakhu, Forest, Shali Nadi Irrigation scheme
Physiography	:	Side slope of a tar ridge
Topography	:	Steep
Slope	:	28° ↑ S 25° ↓ N
Parent material	:	Alluvium
Drainage	:	Moderately well drained
Ground Water	:	N.S.
Permeability	:	Moderate
Moisture	:	Moist surface soil, slightly moist in rest of the profile
Present land use or vegetation	:	Forest

Horizon	Depth(cm)	Soil Description
A11 (overburcen)	0-10	10YR 4/3 (dark brown); loam; moderate fine subangular blocky + granular; friable; many fine and medium and a few coarse roots; pH 5.0; hardness 15 mm; gradual wavy boundary
Ap12	10-24	10YR 3/3 (dark brown); loam; moderate fine subangular blocky; friable; many fine and medium and a few coarse roots; pH 5.0; hardness 19 mm; clear wavy boundary
B	24-61	10YR 3/4 (dark yellowish brown); sandy loam; weak medium subangular blocky; friable; few medium roots; slightly porous; pH 5.1; hardness 18 mm; clear irregular boundary
BC	61-90	10YR 5/3 (brown); coarse sandy loam; structure not defined; friable; few chunks and 5% gravels; hardness 20 mm; abrupt irregular boundary
C	90-110	Coarse sand + gravel; single grained; few coarse roots; gravel 20%

Pit No.: 11 Scheme: Shali Nadi

Depth (cm)	pH (1:2.5)	E.C. mS/cm (1:2.5)	Total CaCO3 %	Particle size distribution				O.C. %	Total N %	Av. P ppm
				Sand %	Silt %	Clay %	Texture Class			
0-24	5.5	0.059	Nil	45	40	15	L	1.08	0.09	4.2
24-61	5.1	0.033	-	63	29	8	SL	-	-	-

Depth (cm)	Exchangeable Cation me/100g				CEC me/100g	B/S %	Soluble Cation and Anions			
	Ca	Mg	K	Na			Ca me/l	Mg me/l	Na ppm	Cl me/l
0-24	4.12	1.55	0.18	0	12.15	47.4	0.33	0.08	1	0.22
24-61	-	-	-	-	-	-	-	-	-	-

Biswambhara Irrigation scheme

Coarse Loamy, mixed, thermic Aeric Epiaquepts

Test Pit No	:	P51
Location	:	Biswambhara Irrigation scheme
Physiography	:	Ancient lake and river terrace
Topography	:	Very gently sloping
Slope	:	4° ↑NNE 2° ↓SSW
Parent material	:	Recent alluvium over old alluvium
Drainage	:	Somewhat poorly drained
Ground Water	:	N.S.
Permeability	:	Moderate
Moisture	:	Moist
Present land use or vegetation	:	Paddy-wheat

Horizon	Depth(cm)	Soil Description
Ap1	0-10	2.5Y 4/2 (dark greyish brown); loam; moderate medium subangular blocky; friable; many fine fibrous roots; pH 5.0; hardness 11mm; gradual smooth boundary
Ap2	10-19	2.5Y 4/2 (dark greyish brown); loam; many fine distinct 7.5YR 4/4 mottles; moderate medium subangular blocky; friable; many fine tubular verticle and horizontal pores; few fine fibrous roots; pH 5.6; hardness 11 mm; clear smooth boundary
B	19-39	2.5YR 4/4 (olive brown); loam; weak medium angular blocky; friable; many fine tubular verticle horizontal pores; hardness 17 mm; clear smooth boundary
A1b	39-56	2.5YR 4/2 (dark greyish brown); silt loam/loams; weak medium angular blocky; friable; very few fine roots
IIB21	56-115	10YR 5/4-4/4 (yellowish brown to dark yellowish brown); loam; medium fine subangular blocky; firm; hardness 22 mm; gradual smooth boundary
IIB22	115-135	10YR 5/6 (yellowish brown); silty clay loam; hard

Pit No.: 51 Scheme: Biswambhara

Depth (cm)	pH (1:2.5)	E.C. mS/cm (1:2.5)	Total CaCO3 %	Particle size distribution				O.C. %	Total N %	Av. P ppm
				Sand %	Silt %	Clay %	Texture Class			
6-19	5.0	0.103	Nil	45	43	12	L	1.11	0.09	16.1
19-39	5.6	0.07	-	45	40	15	L	-	-	-

Depth (cm)	Exchangeable Cation me/100g				CEC me/100g	B/S %	Soluble Cation and Anions			
	Ca	Mg	K	Na			Ca me/l	Mg me/l	Na ppm	Cl me/l
6-19	1.93	0.86	0.19	0	7.2	41.2	0.22	0.19	1.2	0
19-39	-	-	-	-	-	-	-	-	-	-

Fine Loamy, mixed, thermic, Oxyaquic Dystrochrepts

Test Pit No	:	P52
Location	:	Biswambhara Irrigation scheme
Physiography	:	Hill slope terraces
Topography	:	Gently sloping
Slope	:	5° ↑N 8° ↓S
Parent material	:	Fluvial capping over in situ weathered rock
Drainage	:	Somewhat poorly drained
Ground Water	:	N.S.
Permeability	:	Moderate
Moisture	:	Moist
Present land use or vegetation	:	Paddy-wheat

Horizon	Depth(cm)	Soil Description
Ap	0-8	2.5Y 5/2 (greyish brown); loam; slightly platy; friable; many fine fibrous roots; pH 5.2; hardness 11 mm; clear smooth boundary
B21	8-25	10YR 5/3 (brown); loam; many fine distinct 7.5YR 5/6 mottles; weak medium subangular blocky; friable; many fine tubular verticle and horizontal pores; few fine fibrous roots; hardness 18 mm; gradual smooth boundary
B22	25-54	10YR 5/3 (brown); sandy clay loam; many fine distinct 7.5YR 5/8 mottles; moderate medium subangular blocky; friable; very porous; few fine roots; pH 5.8; hardness 21 mm; clear smooth boundary
IIB2	54-125	10YR 5/4-4/6 (yellowish brown to dark yellowish brown); clay loam; moderate medium and coarse subangular blocky; firm; hardness 23 mm; clear smooth boundary
IIBC	125-160	10YR 4/6-5/6 (dark yellowish brown to yellowish brown); silty clay loam; massive; abrupt wavy boundary
C+R	160+	Stone + Rook layer

Pit No.: 52 Scheme: Biswambhara

Depth (cm)	pH (1:2.5)	E.C. mS/cm (1:2.5)	Total CaCO3 %	Particle size distribution				O.C. %	Total N %	Av. P ppm
				Sand %	Silt %	Clay %	Texture Class			
0-8	5.2	0.055	Nil	46	38	16	L	1.76	0.16	16.3
25-54	5.8	0.07	-	58	20	22	SCL	-	-	-

Depth (cm)	Exchangeable Cation me/100g				CEC me/100g	B/S %	Soluble Cation and Anions			
	Ca	Mg	K	Na			Ca me/l	Mg me/l	Na ppm	Cl me/l
0-8	2.76	0.79	0.15	0	8.5	43.9	0.22	0.08	1.2	0.11
25-54	-	-	-	-	-	-	-	-	-	-

Coarse Loamy, mixed, thermic Typic Endoaquepts

Test Pit No	:	P53
Location	:	Biswambhara Irrigation scheme
Physiographysic	:	Recent flood plain/basin
Topography	:	Nearly level
Slope	:	1° ↑N 2° ↓S
Parent material	:	Recent alluvium
Drainage	:	Poorly drained
Ground Water	:	N.S.
Permeability	:	slow
Moisture	:	moist and wet
Present land use or vegetation	:	paddy-wheat/potato

Horizon	Depth(cm)	Soil Description
Ap	0-12	2.5Y 5/2 (greyish brown); loam; many fine faint 10YR 4/4 mottles; weak fine subangular blocky; friable; many fine fibrous roots; pH 5.0; hardness 18 mm; gradual smooth boundary
B	12-42	2.5Y 6/2 (light brownish grey); loam; weak coarse subangular blocky; friable; many fine tubular verticle and horizontal pores; few fine roots; pH 5.8; hardness 17 mm; gradual smooth boundary
IIB21	42-100	2.5Y 4/2 (dark greyish brown); loam; massive; friable; few fine fibrous roots; hardness 12 mm; gradual smooth boundary
IIB22	100-165	10YR 5/2 (greyish brown); clay loam; massive; frable to firm; clear smooth boundary
IICg	165-180	5Y 5/1 (grey); loam; firm

Pit No.: 53 Scheme: Biswambhara

Depth (cm)	pH (1:2.5)	E.C. mS/cm (1:2.5)	Total CaCO3 %	Particle size distribution				O.C. %	Total N %	Av. P ppm
				Sand %	Silt %	Clay %	Texture Class			
0-12	5.0	0.05	Nil	46	38	16	L	1.69	0.15	8.2
12-42	5.8	0.056	-	45	43	12	L	-	-	-

Depth (cm)	Exchangeable Cation me/100g				CEC me/100g	B/S %	Soluble Cation and Anions			
	Ca	Mg	K	Na			Ca me/l	Mg me/l	Na ppm	Cl me/l
0-12	3.14	1.43	0.23	0	7.79	48.2	0.66	0.25	0	0.11
12-42	-	-	-	-	-	-	-	-	-	-

Coarse Loamy, mixed, thermic Aeric Epiaquepts

Test Pit No	:	P54
Location	:	Biswambhara Irrigation scheme
Physiography	:	Ancient lake and river terrace
Topography	:	Nearly level
Slope	:	1.5° ↑N 2° ↓S
Parent material	:	Old alluvium
Drainage	:	Somewhat poorly drained
Ground Water	:	N.S.
Permeability	:	Rapid
Moisture	:	Moist and wet throughout the profile
Present land use or vegetation	:	Paddy-wheat/potato

Horizon	Depth(cm)	Soil Description
Ap1	0-14	10Y 5/2 (greyish brown); sandy loam; weak fine subangular blocky; friable; many fine fibrous roots; pH 5.4; hardness 9 mm ; gradual smooth boundary
Ap2	14-28	2.5Y 5/2 (greyish brown); loam; many fine faint 10YR 4/4 mottles; weak medium angular blocky; friable; few fine roots; hardness 14 mm; clear smooth boundary
B21	28-90	10Y 6/3 (pale brown); loam; structure not defined; friable; very porous; pH 6.2; hardness 13 mm; gradual smooth boundary
B22	90-130	10YR 7/3 (very pale brown); loamy sand; single grained; friable; very porous; clear smooth boundary smooth boundary
C1	130-145	5YR 5/8 (yellowish red); coarse; sandy loam; single grained; friable; clear smooth boundary
C2	145-160	7.5YR 4/2 (dark brown); silty clay loam; massive; hard

Pit No.: 54 Scheme: Biswambhara

Depth (cm)	pH (1:2.5)	E.C. mS/cm (1:2.5)	Total CaCO3 %	Particle size distribution				O.C. %	Total N %	Av. P ppm
				Sand %	Silt %	Clay %	Texture Class			
0-14	5.4	0.058	Nil	58	30	12	SL	1.98	0.18	16.1
28-90	6.2	0.07	-	44	44	12	L	-	-	-

Depth (cm)	Exchangeable Cation me/100g				CEC me/100g	B/S %	Soluble Cation and Anions			
	Ca	Mg	K	Na			Ca me/l	Mg me/l	Na ppm	Cl me/l
0-14	2.49	1.06	0.31	0	8.23	45.4	0.33	0.18	1	0.22
28-90	-	-	-	-	-	-	-	-	-	-

Boshan Irrigation scheme

Fine Loamy, mixed, thermic Aquic (Raptic Alfic) Eutrochrepts

Test Pit No	:	P29
Location	:	Boshan Irrigation scheme
Physiography	:	Old meander plain
Topography	:	Nearly level
Slope	:	0.5° ↑ W 0.5° ↓ E
Parent material	:	Old alluvium
Drainage	:	poorly drained
Ground Water	:	at 175 cm
Permeability	:	Slow
Moisture	:	moist and wet
Present land use or vegetation	:	Paddy-wheat

Horizon	Depth(cm)	Soil Description
Ap1	0-10	10YR 5/3 (brown); loam; many fine distinct 10YR 4/6 mottles; weak fine subangular blocky; friable; many fine fibrous roots; pH 5.4; hardness 17 mm ; gradual smooth boundary
Ap2	10-18	10YR 5/2 (greyish brown); silt loam; many fine distinct 7.5YR 4/4 mottles; weak fine subangular blocky + angular blocky; friable; few friable roots; hardness 16 mm; clean smooth boundary
B21g	18-35	10YR 5/1 (grey); silty clay loam; common fine faint 7.5 YR 4/4 mottles; moderate columnar breaking into moderate medium sub-angular blocky; firm; few fine tubular verticle and horizontal pores; very few fine roots; pH 6.8; hardness 23 mm; gradual smooth b
B22g	35-100	10YR 6/1 (grey); silty clay coarse ; many fine faint 7.5YR 4/4 mottles; weak to moderate columnar breaking into medium sub-angular blocky + angular blocky; hardness 22 mm; gradual smooth boundary
BC	100-150	10YR 4/2 (dark greyish brown); silty clay; massive; hard; clear smooth boundary
C	150-175	10YR 6/1 (grey); loam; massive

Pit No.: 29 Scheme: Boshan

Depth (cm)	pH (1:2.5)	E.C. mS/cm (1:2.5)	Total CaCO3 %	Particle size distribution				O.C. %	Total N %	Av. P ppm
				Sand %	Silt %	Clay %	Texture Class			
0-10	6.2	0.055	0.07	42	45	13	L	1.35	0.13	48.2
18-35	6.8	0.055	-	18	52	30	SiCL	-	-	-

Depth (cm)	Exchangeable Cation me/100g				CEC me/100g	B/S %	Soluble Cation and Anions			
	Ca	Mg	K	Na			Ca me/l	Mg me/l	Na ppm	Cl me/l
0-10	11.05	2.91	0.35	0	21.35	66.4	0.33	0.28	1	0.22
18-35	-	-	-	-	-	-	-	-	-	-

Fine Loamy, mixed, thermic Typic Eutrochrepts

Test Pit No	:	P30
Location	:	Boshan Irrigation scheme
Physiography	:	Summit/ridge
Topography	:	Gently sloping
Slope	:	1° ↑W 2° ↓E
Parent material	:	Old alluvium
Drainage	:	Moderately well drained
Ground Water	:	N.S.
Permeability	:	Moderate
Moisture	:	Slightly moist
Present land use or vegetation	:	Maize + Soyabean-mustard

Horizon	Depth(cm)	Soil Description
Ap	0-15	10Y 3/3 (dark brown); loam; moderate fine subangular blocky + granular; friable; few fine roots; pH 6.4; hardness 14
B21	15-52	10YR 4/3 (dark brown); sandy clay loam; moderate medium subangular blocky; firm; many fine tubular verticle and horizontal pores; pH 6.4; hardness 24 mm;
B22	52-90	10YR 5/3 (grey); clay loam; moderate columnar breaking into medium sub-angular blocky; firm; few Fe Mn concretions; hardness 21 mm; clear smooth boundary
C	90-125	10YR 6/4 (light yellowish brown); sandy clay loam; frable;

Pit No.: 30 Scheme: Boshan

Depth (cm)	pH (1:2.5)	E.C. mS/cm (1:2.5)	Total CaCO3 %	Particle size distribution				O.C. %	Total N %	Av. P ppm
				Sand %	Silt %	Clay %	Texture Class			
0-15	6.4	0.056	0.07	44	46	10	L	1.5	0.15	80.4
15-52	6.4	0.055	-	59	18	23	SCL	-	-	-

Depth (cm)	Exchangeable Cation me/100g				CEC me/100g	B/S %	Soluble Cation and Anions			
	Ca	Mg	K	Na			Ca me/l	Mg me/l	Na ppm	Cl me/l
0-15	11.2	3.26	0.36	0.05	22.05	66.8	0.48	0.33	3.1	0.22
15-52	-	-	-	-	-	-	-	-	-	-

Fine Clayey, mixed, thermic Aquic Eutrochrepts

Test Pit No	:	P31
Location	:	Boshan Irrigation scheme
Physiography	:	Ancient lake and river terrace
Topography	:	Nearly level
Slope	:	1.5° ↑N 0.5° ↓S
Parent material	:	Alluvium over "Kalimati"
Drainage	:	Somewhat poorly drained
Ground Water	:	at 140 cm
Permeability	:	Slow
Moisture	:	Moist
Present land use or vegetation	:	Paddy-wheat/mustard

Horizon	Depth(cm)	Soil Description
Ap1+Ap2	0-17	10Y 4/2 (dark greyish brown); silty clay loam; many fine faint 10YR 5/4 mottles; weak coarse subangular blocky; hard; common fine fibrous roots; pH 6.4; hardness 26 mm; clear smooth boundary
B21	17-30	7.5YR 3/2 (dark brown); silty clay loam; mandy fine faint 7.5YR 4/6 mottles; moderate columnar breaking into moderate coarse sub-angular blocky; hard; many fine tubular verticle and horizontal pores; very few fine roots; a few Fe Mn concretions; hardness
B22	30-125	10Y 3/1 (very dark grey); silty clay; strong columnar breaking into strong fine and medium sub-angular blocky; hard; very porous; few insect burrwos; very few fine roots; isolated silt + old "kalimati" Pockets pH 6.8; hardness 23 mm; abrupt irregular and
C	125-165	10YR 4/1 (light grey); silt clay loam; massive (Kalimati layer)

Pit No.: 31 Scheme: Boshan

Depth (cm)	pH (1:2.5)	E.C. mS/cm (1:2.5)	Total CaCO3 %	Particle size distribution				O.C. %	Total N %	Av. P ppm
				Sand %	Silt %	Clay %	Texture Class			
0-17	6.4	0.055	0.28	18	54	28	SiCL	1.39	0.12	80.3
30-125	6.8	-	-	17	42	41	SiC	-	-	-

Depth (cm)	Exchangeable Cation me/100g				CEC me/100g	B/S %	Soluble Cation and Anions			
	Ca	Mg	K	Na			Ca me/l	Mg me/l	Na ppm	Cl me/l
0-17	17.48	4.34	0.34	0.05	28.52	77.5	0.53	0.26	3.2	0.22
30-125	-	-	-	-	-	-	-	-	-	-

Fine Clayey, mixed, thermic Aquic (Ruptic Alfic) Eutrochrepts

Test Pit No	:	P32
Location	:	Boshan Irrigation scheme
Physiography	:	Lower terrace
Topography	:	Nearly level
Slope	:	1° ↑W 1° ↓E
Parent material	:	Alluvium
Drainage	:	Poorly drained
Ground Water	:	at 100 cm
Permeability	:	Slow
Moisture	:	Moist
Present land use or vegetation	:	Paddy-lab lab bean/Wheat

Horizon	Depth(cm)	Soil Description
Ap1	0-14	10YR 3/3 (dark brown); silt loam; many fine faint 10YR 4/4 mottles; weak coarse sub-angular blocky; firm; few fine fibrous roots; pH 6.8; hardness 20 mm; gradual smooth boundary
Ap2	14-24	10YR 4/2 (dark greyish brown); many fine distinct 7.5YR 4/4 mottles; weak medium sub-angular blocky; firm; very few fibrous roots; hardness 23 mm; gradual smooth boundary
B21	24-45	10Y 4/2 (dark greyish brown); silty clay loam; many fine faint 7.5YR 3/4 mottles; moderate coarse sub-angular blocky; firm; many fine tubular verticle and horizontal pores; a few brick + stone pieces; pH 7.2; hardness 23 mm; clear smooth boundary
B22	45-100	10YR 4/1 (dark grey); silty clay loam; moderate columnar breaking; blocky; firm; few thin silt-coatings on faces; hardness 22 mm; clear smooth boundary
Cg	100-165	2.5Y 5/2 (greyish brown); silty clay; many fine distinct 7.5YR 4/6 mottles (grey layer)

Pit No.: 32 Scheme: Boshan

Depth (cm)	pH (1:2.5)	E.C. mS/cm (1:2.5)	Total CaCO3 %	Particle size distribution				O.C. %	Total N %	Av. P ppm
				Sand %	Silt %	Clay %	Texture Class			
0-14	6.8	0.21	0.35	0.36	54	10	SiL	2.62	0.19	82.2
24-45	7.2	-	-	18	45	37	SiCL	-	-	-

Depth (cm)	Exchangeable Cation me/100g				CEC me/100g	B/S %	Soluble Cation and Anions			
	Ca	Mg	K	Na			Ca me/l	Mg me/l	Na ppm	Cl me/l
0-14	19.6	4.7	0.15	0.05	31.15	78.9	1.33	0.7	3.5	0.11
24-45	-	-	-	-	-	-	-	-	-	-

Khokana Irrigation scheme

Coarse Loamy over fragmental pebbly, mixed, thermic Paralithic (Ruptic Alfic) Dystrochrepts

Test Pit No	:	P38
Location	:	Khokana Irrigation scheme
Physiography	:	Ancient glacio-Fluvial terrace
Topography	:	Nearly level
Slope	:	1° ↑S 1° ↓N, 12-20 on sides
Parent material	:	Old glacio-fluvial sediments
Drainage	:	Well drained
Ground Water	:	N.S.
Permeability	:	Rapid
Moisture	:	Dry surface; moist sub-soil and substratum
Present land use or vegetation	:	Maize-mustard

Horizon	Depth(cm)	Soil Description
Ap	0-11	10YR 4/3 (dark brown) moist; 10YR 6/3 (pale brown) dry; loam; strong fine sub-angular blocky; friable; few fine roots; pH 4.8; hardness 10; gradual smooth boundary
B21(tj)	11-30	10YR 3/3 (dark brown); loam; moderate columnar breaking into moderate sub-angular blocky; firm; massive coarse tubular verticle and horizontal pores; few centipeds; very few fine roots; thin clay cutans on ped faces; hardness 24 mm pebbles 5-10%; clear wa
B22(tj)	30-48	10YR 3/4 (dark yellowish brown); pebbly sandy loam; strong fine sub-angular blocky + granular; firm; thin to thick clay on pad faces; pH 5.2; hardness 16 mm; pebbles 40%
C+R	48-70+	10YR 3/6 (dark yellowish brown); pebbly and stony sandy loam; pebbles + stones 70%
Note	:	tj = initial argillic horizon

Pit No.: 38 Scheme: Khokana

Depth (cm)	pH (1:2.5)	E.C. mS/cm (1:2.5)	Total CaCO3 %	Particle size distribution				O.C. %	Total N %	Av. P ppm
				Sand %	Silt %	Clay %	Texture Class			
0-11	4.8	0.033	Nil	48	37	15	L	1.65	0.13	8.5
30-48	5.2	0.055	-	54	32	14	SL	-	-	-

Depth (cm)	Exchangeable Cation me/100g				CEC me/100g	B/S %	Soluble Cation and Anions			
	Ca	Mg	K	Na			Ca me/l	Mg me/l	Na ppm	Cl me/l
0-11	4.69	1.15	0.09	0	12.93	46.4	0.66	0.21	0	0
30-48	-	-	-	-	-	-	-	-	-	-

Coarse Loamy, mixed, thermic, Anthraquic Eutrochrepts

Test Pit No	:	P39
Location	:	Khokana Irrigation scheme
Physiography	:	Terrace side slope
Topography	:	Moderately sloping
Slope	:	10° ↑SE 12° ↓NW
Parent material	:	Old Alluvium
Drainage	:	Somewhat poorly drained
Ground Water	:	N.S
Permeability	:	Moderate
Moisture	:	moist
Present land use or vegetation	:	Paddy-wheat/mustard

Horizon	Depth(cm)	Soil Description
Ap1	0-12	10YR 5/3 (brown); silt loam; many fine faint 10YR 4/4 mottles; weak fine subangular blocky; friable; many fine fibrous roots; pH 5.6; hardness 21 mm; gradual smooth boundary
Ap2	12-22	10YR 5/3 (greyish brown); silt loam; many fine distinct 10YR 4/6 mottles; weak medium subangular blocky; friable; many fine tubular verticle and horizontal pores; few fine fibrous roots; pH 5.6; hardness 21 mm; clear smooth boundary
Bg	22-90	10YR 6/3 (pale brown); silt loam; many fine distinct 10YR 3/4 mottles; weak coarse sub-angular blocky; friable; few Fe Mn concretions; pH 6.2; hardness 15 mm; gradual smooth boundary
BCg	90-140	10YR 3/3 (dark brown); silt loam; many coarse distinct 7.5YR 4/6 mottles; massive; firm; many coarse Fe Mn concretions; clear smooth boundary
Cg	140-160	10YR 4/1 (dark grey); silt loam/loam; massive; firm; few Fe Mn concretions

Pit No.: 39 Scheme: Khokana

Depth (cm)	pH (1:2.5)	E.C. mS/cm (1:2.5)	Total CaCO3 %	Particle size distribution				O.C. %	Total N %	Av. P ppm
				Sand %	Silt %	Clay %	Texture Class			
0-22	5.6	0.055	Nil	33	55	12	SiL	1.01	0.07	8.1
22-90	6.2	0.056	-	27	61	12	SiL	-	-	-

Depth (cm)	Exchangeable Cation me/100g				CEC me/100g	B/S %	Soluble Cation and Anions			
	Ca	Mg	K	Na			Ca me/l	Mg me/l	Na ppm	Cl me/l
0-22	6.63	2.25	0.07	0.05	19.23	46.8	0.22	0.08	3.3	0.22
22-90	-	-	-	-	-	-	-	-	-	-

Fine Loamy, mixed, thermic Aquic (Ruptic Alfic) Eutrochrepts

Test Pit No	:	P40
Location	:	Khokana Irrigation scheme
Physiography	:	Upper Terrace
Topography	:	Nearly level
Slope	:	0.5° ↑E 0.5° ↓W
Parent material	:	Old Alluvium
Drainage	:	Somewhat poorly drained
Ground Water	:	N.S
Permeability	:	Slow
Moisture	:	Dry surface, moist subsoil and substratum
Present land use or vegetation	:	Paddy-Wheat

Horizon	Depth(cm)	Soil Description
Ap	0-11	10Y 6/2 (light brownish grey); clay loam; many fine distinct 7.5YR 5/6 mottles; moderate fine and medium subangular blocky; many fine fibrous roots; pH 6.0; hardness 15 mm; clear smooth boundary
B21	11-37	10YR 4/2 (dark greyish brown); clay loam; fine faint 7.5 YR 4/6 mottles; strong columnar breaking into coarse angular blocky; extremely hard; very few fine tubular pores; few fine roots; thin silt contains on ped faces; pH 6.2; hardness 23 mm; gradual smo
B22	37-100	10YR 5/2 (greyish brown); silt clay; many fine distinct 7.5YR 4/4 mottles; moderate columnar breaking into medium subangular blocky; extremely hard; few Fe Mn concretion; very thin silt cutans on ped faces; hardness 23 mm; clear smooth boundary
Cg	100-140	7.5YR 4/2 (dark brown); silt clay/clay (greyed layer); extremely hard; common fine Fe Mn concretions

Pit No.: 40 Scheme: Khokana

Depth (cm)	pH (1:2.5)	E.C. mS/cm (1:2.5)	Total CaCO3 %	Particle size distribution				O.C. %	Total N %	Av. P ppm
				Sand %	Silt %	Clay %	Texture Class			
0-11	6.0	0.055	0.14	40	31	29	CL	2.45	0.17	9.2
11-37	6.2	0.042	-	30	36	34	CL	-	-	-

Depth (cm)	Exchangeable Cation me/100g				CEC me/100g	B/S %	Soluble Cation and Anions			
	Ca	Mg	K	Na			Ca me/l	Mg me/l	Na ppm	Cl me/l
0-11	17.13	4.19	0.18	0.05	27.82	77.1	0.44	0.14	3.5	0.22
11-37	-	-	-	-	-	-	-	-	-	-

Fine loamy, mixed, thermic Typic Eutrochrepts

Test Pit No	:	P41
Location	:	Khokana Irrigation scheme
Physiography	:	Lower Terrace
Topography	:	Nearly level
Slope	:	1° ↑E 1° ↓W
Parent material	:	Recent Alluvium
Drainage	:	Somewhat poorly drained
Ground Water	:	at 100 mm
Permeability	:	Moderate
Moisture	:	Moist surface, wet subsoil and substratum
Present land use or vegetation	:	Paddy-wheat/mustard

Horizon	Depth(cm)	Soil Description
Ap1	0-11	10Y 5/3 (brown); loam; weak fine subangular blocky; friable; many fine fibrous roots; pH 5.4; hardness 13 mm; gradual smooth boundary
Ap2	11-22	10YR 5/3 (brown); silt loam/ clay loam; many fine faint 10YR 4/4 mottles; slightly platy + weak medium subangular blocky; friable; hardness 22 mm; clear wavy boundary
B	22-48	10YR 4/2 (dark greyish brown); clay loam; moderate columnar breaking into coarse subangular blocky; firm many fine tabular verticle and horizontal pores; thin silt cuntans on ped faces; pH 6.8; hardness 21 mm; clear wavy boundary
C	48-160	10YR 5/2 (greyish brown); silt loam; few fine faint 10YR 4/4 mottles; massive; friable; hardness 16 mm

Pit No.: 41 Scheme: Khokana

Depth (cm)	pH (1:2.5)	E.C. mS/cm (1:2.5)	Total CaCO3 %	Particle size distribution				O.C. %	Total N %	Av. P ppm
				Sand %	Silt %	Clay %	Texture Class			
0-11	5.4	0.046	0.14	32	44	24	L	1.91	0.16	16.5
22-48	6.8	0.055	-	35	35	30	CL	-	-	-

Depth (cm)	Exchangeable Cation me/100g				CEC me/100g	B/S %	Soluble Cation and Anions			
	Ca	Mg	K	Na			Ca me/l	Mg me/l	Na ppm	Cl me/l
0-11	11.88	2.09	0.29	0	24.61	61.5	0.55	0.16	1.1	0
22-48	-	-	-	-	-	-	-	-	-	-

Thika Bhairaw - I Irrigation scheme

Coarse Loamy over fine loamy, mixed, thermic Aquic Eutrochrepts

Test Pit No	:	P33
Location	:	Thika Bhairaw - I Irrigation scheme
Physiography	:	Lower Alluvial Terrace
Topography	:	Nearly level
Slope	:	1° ↑N 1° ↓S
Parent material	:	Alluvium
Drainage	:	Somewhat poorly drained
Ground Water	:	N.S.
Permeability	:	Moderate
Moisture	:	Slightly dry surface + subsoil; moist substratum
Present land use or vegetation	:	Paddy-Wheat

Horizon	Depth(cm)	Soil Description
Ap	0-14	10YR 5/3 (brown) loam; common fine faint 10YR 5/8 mottles; weak faint and medium subangular blocky; friable; pH 5.6; hardness 22 mm; abrupt smooth boundary
B pan	14-22	10YR 5/2 (greyish brown); silt loam; many fine prominent 5YR 4/6 mottles; moderate medium subangular blocky; slightly compact; firm; stone + gravel 5%; hardness 25 mm; abrupt wavy boundary
A1b	22-58	10YR 6/2 (light brownish grey); loam; many fine distinct 7.5YR 4/4 mottles; moderate columnar breaking into weak medium subangular blocky; firm; many fine tubular verticle and horizontal pores; pH 6.2; hardness 27 mm; clear smooth boundary
IIB	58-90	10YR 5/4-4/4 (yellowish brown to dark yellowish brown); clay loam; weak coarse angular blocky; firm; hardness 18 mm
IIIA1b	90-107	7.5YR 3/4 (dark brown); clay loam; (augered); firm; gradual smooth boundary
IIIB	107-135	7.5YR 5/4 (brown); clay loam; (augered); firm

Pit No.: 33 Scheme: Thika Bhairaw I

Depth (cm)	pH (1:2.5)	E.C. mS/cm (1:2.5)	Total CaCO3 %	Particle size distribution				O.C. %	Total N %	Av. P ppm
				Sand %	Silt %	Clay %	Texture Class			
0-14	5.6	0.033	0.07	46	42	12	L	2.09	0.19	17.1
22-58	6.2	0.055	-	44	40	16	L	-	-	-

Depth (cm)	Exchangeable Cation me/100g				CEC me/100g	B/S %	Soluble Cation and Anions			
	Ca	Mg	K	Na			Ca me/l	Mg me/l	Na ppm	Cl me/l
0-14	7.46	1.68	0.32	0.05	16.71	55.3	0.39	0.22	3.2	0.11
22-58	-	-	-	-	-	-	-	-	-	-

Fine Loamy, mixed, thermic Aquic Haplustalfs

Test Pit No	:	P34
Location	:	Thika Bhairaw - I Irrigation scheme
Physiography	:	Ancient Tar depression
Topography	:	Nearly level
Slope	:	0.5° ↑S 1.5° ↓N
Parent material	:	Old Alluvium
Drainage	:	Moderately well drained
Ground Water	:	N.S
Permeability	:	Slow
Moisture	:	Dry surface; moist subsoil
Present land use or vegetation	:	Paddy-lablab bean

Horizon	Depth(cm)	Soil Description
Ap	0-14	10YR 4/4 (dark yellowish brown); clay loam; few fine distinct 7.5YR 5/6 mottles; moderate medium sub-angular blocky; hard; many fine fibrous roots; pH 6.0; clear smooth boundary.
B21t	14-37	7.5YR 4/4 (dark brown); silty clay loam; common fine faint 7.5YR 4/6 mottles; moderate columnar breaking into fine subangular blocky; hard; few medium pores; few fine roots; thin clay skins on ped faces; gradual smooth boundary
B22t	37-90	5YR 4/6 (yellowish red); clay loam; common fine distinct 7.5YR 5/6 mottles; weak columnar breaking into fine angular + subangular blocky; firm; thin clay skins on ped faces; few rusty coloured Fe Mn concretions; pH 6.4; gradual smooth boundary
B23	90-120	5YR 5/6 (yellowish red); silty clay; massive; firm; gradual smooth boundary
B3	120-150	7.5YR 5/8 (strong brown); silty clay; massive; firm

Pit No.: 34 Scheme: Thika Bhairaw I

Depth (cm)	pH (1:2.5)	E.C. mS/cm (1:2.5)	Total CaCO3 %	Particle size distribution				O.C. %	Total N %	Av. P ppm
				Sand %	Silt %	Clay %	Texture Class			
0-14	6.0	0.055	0.07	35	37	28	CL	1.91	0.15	80.2
37-90	6.4	0.055	-	26	42	32	CL	-	-	-

Depth (cm)	Exchangeable Cation me/100g				CEC me/100g	B/S %	Soluble Cation and Anions			
	Ca	Mg	K	Na			Ca me/l	Mg me/l	Na ppm	Cl me/l
0-14	8.84	2.33	0.17	0.1	19.32	59.4	0.44	0.17	4.1	0.22
37-90	-	-	-	-	-	-	-	-	-	-

Coarse Loamy, mixed, thermic Typic Udifluvents

Test Pit No	:	P35
Location	:	Thika Bhairaw - I Irrigation scheme
Physiography	:	Recent flood plains/basin
Topography	:	Gently sloping
Slope	:	3° ↑S 2° ↓N
Parent material	:	Recent alluvium
Drainage	:	Moderately well drained
Ground Water	:	N.S
Permeability	:	Rapid
Moisture	:	Slightly dry surface and moist subsoil
Present land use or vegetation	:	Paddy-lablab bean/mustard

Horizon	Depth(cm)	Soil Description
Ap	0-15	10YR 5/4 (yellowish brown); silt loam; weak fine subangular blocky; friable; many fine fibrous roots; pH 6.4; hardness 23 mm; abrupt smooth boundary
C1	15-42	10R 5/3 (brown); silt loam; weak columnar breaking into medium subangular blocky; friable; few fine roots + fragments of A1bj; pH 6.4; hardness 26 mm; abrupt wavy boundary.
A1b	42-65	10YR(4/3-4/4) (dark brown to dark yellowish brown); silt loam; many fine faint 7.5YR 4/4 mottles; weak columnar breaking into medium subangular blocky; friable; very few fine roots; hardness 25 mm; clear smooth boundary
IIBC	65-90	7.5YR 5/4 (brown); loam; slightly compact; friable; gradual smooth boundary
IIC	90-140	7.5YR 5/4 (brown); silty clay; massive; firm

Pit No.: 35 Scheme: Thika Bhairaw I

Depth (cm)	pH (1:2.5)	E.C. mS/cm (1:2.5)	Total CaCO3 %	Particle size distribution				O.C. %	Total N %	Av. P ppm
				Sand %	Silt %	Clay %	Texture Class			
0-15	6.4	0.046	0.05	32	52	16	SiL	1.58	0.13	31.2
15-42	6.4	0.046	-	29	53	18	SiL	-	-	-

Depth (cm)	Exchangeable Cation me/100g				CEC me/100g	B/S %	Soluble Cation and Anions			
	Ca	Mg	K	Na			Ca me/l	Mg me/l	Na ppm	Cl me/l
0-15	6.33	1.94	0.06	0.05	15.52	54.7	0.66	0.28	4.1	0.22
15-42	-	-	-	-	-	-	-	-	-	-

Fine clayey, mixed, thermic Fluvaquentic Eutrochrepts

Test Pit No	:	P42
Location	:	Thika Bhairaw -I Irrigation scheme
Physiography	:	Lower alluvial Terrace
Topography	:	Gently sloping
Slope	:	4° ↑W 2° ↓E
Parent material	:	Old alluvium
Drainage	:	Somewhat poorly drained
Ground Water	:	N.S.
Permeability	:	Moderate slow
Moisture	:	Moist, wet subtratum
Present land use or vegetation	:	Paddy-Brick making (winter)

Horizon	Depth(cm)	Soil Description
Ap	0-10	10YR 5/3 (brown); clay loam; many fine distinct 7.5YR 5/6 mottles; weak medium subangular blocky; firm; few fine fibrous roots; pH 6.4; hardness 23 mm; gradual smooth boundary
B	10-46	10YR 5/3 (brown); silty clay; many fine distinct 10YR 4/4 mottles; weak coarse subangular blocky; firm; many fine pores and crevaces; few silt patches + few Fe Mn concretions; pH 6.5; hardness 22 mm; clear wavy boundary
C1	46-70	10YR 6/2 (light brownish grey); silty loam/loam; many coarse distinct 7.5YR 4/6 mottles; weak platy; firm; many silty patches + a few Fe Mn concretions; abrupt wavy boundary
C2g	70-150	2.5YR 2/0 (black); silt loam; silt massive; (gley layer)

Pit No.: 42 Scheme: Thika Bhairaw I

Depth (cm)	pH (1:2.5)	E.C. mS/cm (1:2.5)	Total CaCO3 %	Particle size distribution				O.C. %	Total N %	Av. P ppm
				Sand %	Silt %	Clay %	Texture Class			
0-10	6.4	0.055	0.07	25	40	35	CL	0.54	0.04	40.2
10-46	6.5	0.07	-	14	44	42	SiC	-	-	-

Depth (cm)	Exchangeable Cation me/100g				CEC me/100g	B/S %	Soluble Cation and Anions			
	Ca	Mg	K	Na			Ca me/l	Mg me/l	Na ppm	Cl me/l
0-10	8.56	2.35	0.24	0	18.6	59.5	66	0.35	1.2	0.2
10-46	-	-	-	-	-	-	-	-	-	-

Coarse Loamy, mixed, thermic Typic Fluvaquepts

Test Pit No	:	P62
Location	:	Thika Bhairaw - I Irrigation scheme
Physiography	:	Active flood plain
Topography	:	Nearly level
Slope	:	0.5° ↑ W 2° ↓ E
Parent material	:	Recent alluvium
Drainage	:	Somewhat poorly drained
Ground Water	:	at 50 cm
Permeability	:	Rapid
Moisture	:	Wet
Present land use or vegetation	:	Paddy-wheat

Horizon	Depth(cm)	Soil Description
Ap	0-10	10YR 5/3 (brown); silt loam; massive; friable; many fine fibrous roots; gradual smooth boundary
B	10-38	10YR 5/3 (brown); loam; distinct 7.5YR 4/4 mottles; massive; friable; very few verticle and horizontal pores; very few fine roots; clear wavy boundary
A1b	38-50	10YR 5/2 (greyish brown); loam/clay loam; many medium prominent 5YR 4/6 mottles; massive; friable; very porous; hardness 16 mm; clear wavy boundary
IIB	50-100	10YR 6/2 (light brownish grey); loam; common fine distinct 7.5YR 4/4 mottles; massive; abrupt smooth boundary
IIC	100-130	10YR 2/1 (black) + 10YR 6/3 (pale brown); silty clay loam; massive; firm; abrupt smooth boundary
IIIC	130 +	Gravel layer

Pit No.: 62 Scheme: Thika Bhairaw I

Depth (cm)	pH (1:2.5)	E.C. mS/cm (1:2.5)	Total CaCO3 %	Particle size distribution				O.C. %	Total N %	Av. P ppm
				Sand %	Silt %	Clay %	Texture Class			
0-17	5.8	0.033	0.07	29	52	19	SiL	1.65	0.12	14.5
29-65	6.2	0.056		30	39	31	CL	-	-	-

Depth (cm)	Exchangeable Cation me/100g				CEC me/100g	B/S %	Soluble Cation and Anions			
	Ca	Mg	K	Na			Ca me/l	Mg me/l	Na ppm	Cl me/l
0-17	4.97	1.12	0.19	0.05	10.12	63.1	0.44	0.17	3.5	0.11
29-65	-	-	-	-	-	-	-	-	-	-

Thika Bhairaw - II Irrigation scheme

Fine Loamy, mixed, thermic Anthraquic Eutrochrepts

Test Pit No	:	P36
Location	:	Thika Bhairaw - II Irrigation scheme
Physiography	:	Terrace side slope
Topography	:	Moderately sloping
Slope	:	20° ↑E 16° ↓W
Parent material	:	Old alluvium
Drainage	:	Moderately well drained
Ground Water	:	N.S.
Permeability	:	Moderate
Moisture	:	Moist
Present land use or vegetation	:	Paddy-Wheat

Horizon	Depth(cm)	Soil Description
Ap	0-10	10YR 5/4 (yellowish brown); loam; many fine faint 10YR 4/6 mottles; very weak medium subangular blocky; friable; common fine fibrous roots; pH 6.4; hardness 12 mm; clear smooth boundary.
B21	10-35	10R 6/3 (pale brown); silt loam; many fine distinct 7.5YR 4/4 mottles; weak medium subangular blocky; friable; highly porous; very few fine roots; few insect burrows; hardness 20 mm; gradual wavy boundary
B22	35-100	10YR 6/3 (pale brown); clay loam; common fine faint 7.5YR 5/6 mottles; moderate medium subangular blocky; friable; very few fine roots; few insect and rodent burrows; pH 6.6; hardness 21 mm; clear smooth boundary
C	100-135	2.5Y 6/2 (light brownish grey); silt loam/silt; many coarse distinct 7.5YR 4/6 mottles; massive; firm; many coarse Fe Mn concretions

Pit No.: 36 Scheme: Thika Bhairaw II

Depth (cm)	pH (1:2.5)	E.C. mS/cm (1:2.5)	Total CaCO3 %	Particle size distribution				O.C. %	Total N %	Av. P ppm
				Sand %	Silt %	Clay %	Texture Class			
0-10	6.4	0.055	Nil	46	38	16	L	0.58	0.06	4.1
35-100	6.6	0.07	-	40	30	30	CL	-	-	-

Depth (cm)	Exchangeable Cation me/100g				CEC me/100g	B/S %	Soluble Cation and Anions			
	Ca	Mg	K	Na			Ca me/l	Mg me/l	Na ppm	Cl me/l
0-10	3.87	1.21	0.11	0.05	10.24	52.8	0.44	0.17	4.1	0.22
35-100	-	-	-	-	-	-	-	-	-	-

Coarse Loamy over fine loamy, mixed, thermic Aquic Eutrochrepts

Test Pit No	:	P37
Location	:	Thika Bhairaw - II Irrigation scheme
Physiography	:	Lower alluvial terrace slope
Topography	:	Nearly level
Slope	:	10° ↑ SW 2° ↓ NE
Parent material	:	Old alluvium
Drainage	:	Somewhat poorly drained
Ground Water	:	N.S.
Permeability	:	Moderately slow
Moisture	:	Slightly moist
Present land use or vegetation	:	Paddy-wheat/mustard

Horizon	Depth(cm)	Soil Description
Ap	0-14	10YR 6/2 (light brownish grey); silt loam; many fine distinct 7.5YR 4/6 mottles; moderate coarse subangular blocky; friable; pH 5.6; clear smooth boundary
AB	14-58	10YR 4/3 (dark brown) + 10YR 5/4 (yellowish brown); silt loam; moderate columnar breaking into medium and coarse subangular blocky; firm; pH 6.3; abrupt smooth boundary.
B21	58-140	10YR 5/8 (yellowish brown); silty clay; massive; hard; few Fe Mn concretions; gradual smooth boundary.
B22	140-150	10YR 5/8 (yellowish brown); silty clay; massive; many Fe Mn concretions.

Pit No.: 37 Scheme: Thika Bhairaw II

Depth (cm)	pH (1:2.5)	E.C. mS/cm (1:2.5)	Total CaCO3 %	Particle size distribution				O.C. %	Total N %	Av. P ppm
				Sand %	Silt %	Clay %	Texture Class			
0-14	5.6	0.033	Nil	32	56	12	SiL	1.8	0.17	8.3
14-58	6.3	0.055	-	28	55	17	SiL	-	-	-

Depth (cm)	Exchangeable Cation me/100g				CEC me/100g	B/S %	Soluble Cation and Anions			
	Ca	Mg	K	Na			Ca me/l	Mg me/l	Na ppm	Cl me/l
0-14	7.74	1.9	0.11	0	16.82	57.8	0.66	0.36	1.2	0.11
14-58	-	-	-	-	-	-	-	-	-	-