His Majesty's Government of Nepal
Ministry of Water Resources
Department of Irrigation

Planning and Design Strengthening Project

United Nations Development Programme
(NEP/85/013)/World Bank

MASTER PLAN
FOR
IRRIGATION DEVELOPMENT
IN
NEPAL

CYCLE 2

Annexes - Volume 1

Canadian International Water and Energy Consultants
in association with
East Consult (P) Ltd.

February 1990

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MASTER PLAN FOR IRRIGATION DEVELOPMENT IN NEPAL

MASTER PLAN SECOND CYCLE REPORT

ANNEX A

LAND RESOURCE DATA

Canadian International Water and Energy Consultants
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A1-1 - INTRODUCTION

A1-1.1 - Objectives

Annex A1 has four objectives :

1. To define the details of all irrigation developments by district, and by individual project where possible and appropriate

2. To identify or estimate the planned, developed and irrigated command areas of present irrigation developments, together with their irrigation capability and development intensity

3. To identify and account for the duplications and overlaps which exist in the various different records of irrigation areas

4. To ensure by proper referencing and explanation that the information can be readily revised and updated

A1-1.2 - Scope and Outline

This annex provides a summary of the present level of irrigation development in Nepal, based on the most reliable data now available. It contributes to definition of the potential and scope for improvements to the present irrigation developments, and for implementation of new irrigation developments.

Following this introductory section, in Section A1-2, the data sources which provided basic data on present irrigation development are identified and discussed. The methodologies applied to compile and analyse the data are then described in Section A1-3. Section A1-4 is concerned with a comprehensive presentation of the results of the work, while Section A1-5 presents an overview of the present level of irrigation development in the country.

A1-2 - DATA SOURCES

A1-2.1 - Water Use Inventories

Water Use Inventories (WUIs), prepared for the Water and Energy Commission Secretariat (WECS) by several consultants, were available for a total of 31* of the 75 districts of Nepal. Preparation of WUIs for further districts is under way, and measures are in hand for undertaking WUIs in the remaining districts. The WUIs provide an account of existing irrigation schemes in each district, defining them as either Department of Irrigation (DOI) schemes or farmer managed irrigation schemes (FMIS). Information on surface water sources is also provided. Irrigation developments based on groundwater sources are generally not accounted for in the WUIs.

The WUIs are largely based on aerial photography dating from 1978 and 1979. For this reason, more recent DOI sources of data are generally preferred for defining the DOI schemes. However, the WUIs remain the best data source for defining farmer managed surface water schemes. They are also useful for defining overlaps between DOI schemes and farmer managed schemes.

The WUIs are prepared according to common terms of reference. However, because of the many consulting firms involved, their quality varies from district to district. This applies both to the data inventories and to the mapping that is presented. The data include mapped or gross developed command areas; information on actual irrigated areas, irrigation capabilities and development intensities is not normally given.

A1-2.2 - Irrigation Agencies

DOI sources of data on the present status of DOI projects comprise project inventories**, individual project reports, official progress reports to the National Planning Commission (NPC), and the recollections and experience of many engineers who serve on, and have contributed to, the planning, implementation and management of the various projects. The available information extends, with less detail, to the numerous farmer managed schemes assisted by DOI with regard to their construction, upgrading, rehabilitation or maintenance. It is noted that these FMIS represent only a small

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* All 20 of the Terai districts, plus 11 of the 39 Hill districts, and none of the 16 Mountain districts.

** The principal source of basic data on DOI projects has been the project inventory included in Reference 1.

proportion of the total number of farmer managed schemes. They include the schemes that were associated with the Farm Irrigation and Water Utilization Division (FIWUD) of the Ministry of Agriculture, and with the irrigation section of the Ministry of Panchayat and Local Development (MPLD), prior to their incorporation into DOI as the Small Irrigation Division (SID).

Command area is an important indicator in the monitoring of progress of DOI, including SID (FIWUD and MPLD), irrigation development programs. For this reason it is not surprising that reported command areas often exceed the real command areas. The same command areas can be reported more than once (duplication or double counting), and existing FMIS can be reported as new DOI schemes (overlap). In addition, command areas can be reported which are unrelated to any defined project ("undefined" project command areas). Accounting for these reporting features is a major difficulty in the use of the DOI data sources.

The only government agency outside of DOI that has recognized major responsibilities for irrigation development is the Agricultural Development Bank of Nepal (ADBN). The primary area of direct involvement of ADBN in irrigation is in shallow tubewell (STW) development, with assistance provided to individual farmers. The involvement is financial rather than technical. Records indicate the numbers of STWs financed by district; a standard value of served area per tubewell is used to estimate command area, and no other technical details are available. ADBN is also involved in development and assistance related to farmer managed surface water irrigation schemes, primarily in cooperation with CARE Nepal.

Irrigation development responsibilities of the Department of Agriculture (DOA) have largely been taken over by DOI. The only current irrigation development program that is associated with DOA is the Agriculture Development Program Janakpur (ADPJ), which was undertaken with Japanese aid. The program involves development of groundwater resources for irrigation by installation of STWs and deep tubewells (DTWs); there is also some involvement with farmer managed surface water schemes.

Inventories of projects associated with the many international and foreign agencies and their aid or development programs are available. Each project is reported by the government agency associated with it.

A1-2.3 - Land Resources Mapping Project

The Land Resources Mapping Project (LRMP) (Ref 2), which was completed in 1986, comprehensively mapped and analysed the land resources of Nepal. The project undertook aerial photography of the country in 1978 and 1979 and prepared land resources maps and databases from this photography. The project included a land utilization component, which comprehensively classified agricultural, grazing and forest lands; however, irrigation systems, or a land use classification covering irrigation status, were not included. The WUIs, discussed in Section A1-2.1 above, identify irrigation systems from the LRMP photography and topographic maps. However, as noted above, the inventories are now available only for one third of the country's districts.

The LRMP land use mapping and database does identify and fully describe agricultural land in terms of cultivation types and cropping sequences. From this, by means of some generalized assumptions, an indication of irrigation status can be obtained. This is the only detailed data source and consistent method available at present for estimating the overall extent of irrigation development on a country-wide basis. An extension of the method can also provide an estimate of irrigable agricultural land.

Two separate components of the LRMP cover land systems and land capability. The land capability component provides an irrigation suitability classification, from which irrigable areas can be quantified independently from land use. These irrigable area estimates need to be expanded to account for irrigable terraced lands, which are not covered by the suitability classification. The division of irrigable lands into present land use categories (agricultural, grazing and forest lands) would best be obtained by physically superimposing the two map sets to delineate and measure the area subdivisions, but this is a lengthy procedure that cannot be undertaken at present. The definition and detailing of irrigable areas from both land capability and land use databases, using simplified methods, is reported in Annex A2. For the purposes of the present compilation, irrigable agricultural land areas are estimated from the LRMP land use database, and hence the land capability mapping and database are not used.*

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* The basic assumption made is that presently irrigated lands are also irrigable (i.e. suitable for irrigation). To these lands are added those presently unirrigated agricultural lands that are judged to be irrigable by virtue of their cultivation types and cropping sequences.

A1-2.4 - Project Appraisal Reports

A few assessments of individual existing irrigation systems have been documented, and accounts of present status are included in the corresponding reports. "Rapid appraisal" reports prepared by WECS for six DOI projects are available, and somewhat less structured assessments of other DOI projects appear in various reports. The details of DOI projects required for present purposes are available from the DOI sources of information discussed in Section A1-2.2 above; the project appraisals will therefore be of most value in the definition of potential improvements to the existing projects. However, there have been some "rapid appraisals" of individual farmer managed schemes (Ref 3); some case studies of farmer managed schemes have also been reported (Ref 4). These provide indications of system status for such schemes that are unavailable from other documented sources.

A1-2.5 - Field Observations and Appraisals

A small number of DOI projects and FMIS were visited during the initial preparation of this annex. The resulting observations supplemented the documented information where this was very limited on some aspects of the present status of irrigation development. However, the present final version of the annex generally incorporates the findings of the more extensive field programs and appraisals carried out subsequently. The exception to this relates to command area data for the larger DOI projects. In this case, the officially declared and currently accepted values to mid 1988 have been retained; it is recommended for the future that annual updates of these values be carried out which both accurately reflect current progress and incorporate improved estimates of previous progress. The current best estimates of large DOI project command areas are reported in Annex C2.

A1-3 - METHODOLOGY

A1-3.1 - Individual Project Details

From the DOI data sources discussed in Section A1-2.2 above, all DOI implemented and managed projects were identified and their details documented on an individual project basis. Available individual project data were also documented for the defined Agency Assisted FMIS, together with the "undefined" project command area data. The WUI lists of FMIS were reviewed to identify and correct for overlaps with DOI projects. They represent an incomplete inventory for the country; preparation of a complete database of individual farmer managed schemes is recommended.

A1-3.2 - Data Compilation by District

The political subdivisions of Nepal (wards, panchayats, districts, zones and regions) do not coincide with the physical and physiographic subdivisions (catchments and land systems) which are usually more appropriate for analysing irrigation and agriculture data. However, the districts in particular are the geographic units most often used for the reporting, compiling and analysis of statistical data, and they also represent the smallest subdivision suitable for master planning from a national perspective.

The aggregation of districts into manageable units for master planning purposes has been arranged to reflect the regional (east-west) and physiographic (north-south) variations which are important in the formulation of development strategies. The regional variation is provided by use of the five development regions (Eastern, Central, Western, Mid Western and Far Western), which are fully recognized aggregations of districts. The physiographic variation is approximated by use of the three ecological belts (Terai, Hill and Mountain), which are also recognized aggregations of districts used in several previous studies. A summary of the overall correspondence between ecological belts and major physiographic divisions, obtained from the LRMP database, is given below.

Ecological Belt	Land Area (ha x 10^6)	Major Physiographic Division (%)				
		Terai	Siwalik	Middle Mountain	High Mountain	High Himal
Terai	3.41	61.9	34.2	3.9	0.0	0.0
Hill	6.15	0.2	11.6	62.7	17.4	8.1
Mountain	5.19	0.0	0.0	6.9	35.3	57.8
Total	14.75	14.4	12.7	29.5	19.7	23.7

Table A1-1, from which the above summary is derived, presents a full listing of the districts, their land areas, their aggregations into development regions and ecological belts, and their breakdown in terms of the physiographic divisions being used for master planning purposes. The information was obtained by processing of the LRMP land systems database. The table forms the basis for all subsequent presentation of data on irrigation development compiled by district.

A1-3.3 - Identified Irrigation

Identified irrigation development in Nepal is defined herein as corresponding to those irrigation projects explicitly defined in the DOI and agency inventories or derived from the WUIs. The available WUIs cover all 20 of the Terai districts (which contain the major proportion of the command area in the country) and 11 Hill districts. The inventories of DOI implemented and managed projects naturally cover the entire country. These inventories were checked against the corresponding DOI project listings in the WUIs for omissions and major command area differences. Problems of this nature were resolved through discussions with DOI personnel; the DOI data sources, corrected as appropriate, were used to define these projects.

The DOI reported project command areas include any incorporated FMIS, even though these schemes often continue to function independently. Since all identified FMIS are accounted for separately in the WUIs, this resulted in a need to identify and adjust for such overlaps. It was established that almost all FMIS located within DOI project boundaries could be served by the projects' irrigation systems. These schemes were then not considered to fall within the category of FMIS. All major cases of overlap occur in the Terai districts, for which WUIs are available, hence this overlap problem is considered to be largely resolved.

The problems of duplication and double counting of reported command areas arise from the use of official progress reports and data aggregations submitted to the NPC, as opposed to project-specific inventories. Interventions in the same project at different times may result in multiple reporting and addition of the same command area; in addition, different project inventories, for separate development programs or agencies, may be treated as additive when reporting total command areas yet may in part contain the same projects. Investigations within DOI, including SID, resulted in some reconciliations and updated project-specific inventories.

The remaining differences between the officially reported command areas and those defined on a project-specific basis in the agency inventories have been separately recorded as corresponding to "undefined" projects. These project areas do not fall into the category of identified irrigation for the purposes of master planning analyses. Note must also be made of indications that specific projects which are included in the agency inventories sometimes do not exist, or were implemented or assisted to a negligible degree.

A special overlap problem arises in the accounting of command areas served by STWs. This applies primarily to the ADBN development program. Data are not available on the locations of developed tubewells, and hence it is not known what number, if any, are located inside the command areas of surface irrigation projects. Some farmers nominally served by surface irrigation systems may install STWs under the ADBN program to supplement unreliable or non-existing supplies from the system. However, it is considered that STWs would normally be installed in areas otherwise unserved by irrigation schemes. For present purposes therefore the estimated STW command areas are added to the identified surface irrigation system command areas to give the estimated total command areas under farmer managed irrigation.

After applying the appropriate corrections, available WUI estimates for farmer managed surface irrigation system command areas by district were adopted. It was then necessary to estimate these areas for those Hill and Mountain districts for which WUIs were not available. For this purpose it was assumed that the 11 Hill districts for which WUIs had been prepared were representative of all Hill and Mountain districts with respect to present level of irrigation development. Their total identified developed command areas were expressed as a fraction of their irrigable agricultural land areas, estimated from the LRMP database (see Section A1-3.4), giving values between 0.36 and 0.58 for net areas. The overall weighted average value of 0.49 was applied to the irrigable agricultural land areas of the remaining districts, to give their estimated identified developed command areas. The corresponding estimated farmer managed surface irrigation system command areas were then obtained from these by subtracting the identified commanded DOI system and farmer managed groundwater system areas. The procedure is described symbolically as follows

a) For 11 Hill districts with WUIs:

$$T_I = DOI_{SW} + DOI_{GW} + FM_{SW} + FM_{GW}$$

and

$$R_D = T_I / T_{IAL}$$

where

T_I	=	Total identified irrigation schemes
DOI_{SW}	=	DOI surface water schemes
DOI_{GW}	=	DOI groundwater schemes
FM_{SW}	=	Farmer managed surface water schemes
FM_{GW}	=	Farmer managed groundwater schemes
R_D	=	Irrigation development ratio (range 0.36 to 0.58 with weighted average 0.49, for net areas)
T_{IAL}	=	Total irrigable agricultural land (see Section A1-3.4)

b) For remaining Hill and Mountain districts, without WUIs:

$$T_I = R_{DA} \cdot T_{IAL}$$

and

$$FM_{SW} = T_I - DOI_{SW} - DOI_{GW} - FM_{GW}$$

where

R_{DA} = Weighted average irrigation development ratio for 11 Hill districts with WUIs (value 0.49)

The resulting estimates should naturally be replaced by those which will emerge from the WUIs still to be compiled.

A1-3.4 - Unidentified Irrigation

The LRMP land utilization database was analysed to provide an overall indication of the irrigation status of agricultural land in Nepal, and by extension, as explained in Section A1-2.3, an indication of the irrigable agricultural areas. The evaluation was undertaken as part of the process of establishing the interim estimate of irrigation areas in those districts for which WUIs were not available (see Section A1-3.3). However, it also led to additional insights and information regarding irrigation areas in districts for which WUIs had been prepared, with implications concerning irrigation area estimates for all districts. In particular, the existence of "unidentified" irrigation practices, in areas which the WUIs show to be unirrigated, seems to be indicated.

In the absence of land use information directly related to irrigation systems, the analysis was concerned with assessing the available cultivation type and cropping sequence information. Local knowledge and judgement was used to allocate each combination of cultivation type and cropping sequence to an irrigation status category. To characterize irrigation developments for master planning purposes, three irrigation capability status categories were formulated -- unirrigated (rainfed), monsoon season irrigated, and year round irrigated. Table A1-2 shows the assumptions applied in this allocation. It also shows the additional assumptions made concerning the irrigability of unirrigated agricultural land. The analysis itself provides the breakdown of agricultural land by district into the three categories, and the estimates of irrigated and irrigable agricultural land by district. The following general definitions of irrigated and irrigable agricultural lands apply in this analysis

- Irrigated agricultural lands -- agricultural lands with cropping sequence and cultivation type associations which would be expected to be either monsoon season or year round irrigated

- Irrigable agricultural lands -- agricultural lands (i.e. excluding forest, grazing and other non-agricultural lands) which are irrigated or which are unirrigated but with irrigable cropping sequence and cultivation type associations.

Table A1-2 indicates that the irrigation status analysis treats the important rice/fallow cropping sequence as unirrigated. This is because any irrigation system would provide some potential for winter cropping. However, it is known that social and other factors sometimes result in only single-season cropping within irrigation schemes, particularly in Terai areas. This implies that the analysis is underestimating the irrigated areas.

Subtracting the identified irrigation areas (see Section A1-3.3) from the LRMP derived irrigated areas gave an estimate of "unidentified" irrigation areas by district. When this estimate was negative, which occurred most often for Terai districts, it was set to zero*. For most Hill districts, however, including 10 of the 11 districts with WUIs available and hence with comprehensive accounts of irrigation development, the estimates show significant areas under "unidentified" irrigation.

A field visit was made to such an area in Bhaktapur district, and discussions were held with farmers. This visit confirmed that the cultivation types and cropping sequences were essentially as mapped

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* This is because greater reliability is placed on the estimates of identified irrigation areas derived from the WUIs and agency inventories than on those of total irrigated areas derived from the LRMP database.

by the LRMP. It also showed that the upper part of the area (valley tar) was farmed year round under rainfed conditions, apparently successfully. The lower part (valley floor) received runoff from the upper part and was also occasionally but judiciously irrigated by pumping from a stream, resulting in successful year round cropping of both grain crops and vegetables. There is no formal irrigation distribution system in the area; irrigation occurs as gravity flood flow from field to field. If representative, this observation would imply that the LRMP database analysis overestimates the irrigated areas, contrary to the previous assessment above*.

The foregoing indicates that a conclusive generalized statement regarding "unidentified" irrigation areas and practices cannot be made at present. The manipulation of the LRMP land use database, applying the assumptions of Table A1-2 to give a breakdown by irrigation status, is not fully satisfactory. The estimates of "unidentified" irrigation, all of which are considered to correspond to farmer managed schemes, can serve as an indication of the apparent existence and scale of such irrigation, but it is proposed at present to use only the identified irrigation areas for master planning assessments of irrigated agriculture. The remaining agricultural lands will be treated as unirrigated (rainfed or uncultivated) lands.

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* Irrigated agriculture in Bhaktapur district, and in the Kathmandu valley in general, should probably not be regarded as representative from the country-wide viewpoint.

A1-4 - RESULTS

A1-4.1 - Present Level of Development of DOI Projects

A1-4.1.1 - Details by Project

Table A1-3 presents the collected and compiled information on completed and ongoing DOI managed and implemented projects. Section A of the table gives the details by project with a breakdown by district. The information includes planned and developed command areas, both gross and net, as well as estimated net irrigated areas in summer and winter. From these data, ongoing gross and net development areas, defined as the difference between planned and developed areas, are derived, and the year of planned completion is shown. Also derived are the net underused command areas in summer and winter, defined as the difference between developed and irrigated areas. DOI data sources normally report command areas as net areas. Following the normal practice, a factor of 1/0.8 is applied to these to obtain the gross command areas, except where these are explicitly reported.

Two further items of project-specific information are given in the table. These are the irrigation capability status and the development intensity status. The first of these provides an indication of the designed capability of the irrigation scheme, related to the reliability of supply of irrigation water. The second describes the assumed present intensity of the distribution system, related to the reliability of delivery of irrigation water. Together with the information on underused command areas, and on agricultural performance, these data formed the basis for assessing the need and potential for structural and non-structural improvements within presently developed irrigation project areas.

The large number of existing projects, both DOI and farmer managed, precluded an assessment of potential improvements by individual project, except for the larger DOI projects. Examination of the project details reveals that a natural division between larger and smaller projects occurs at a planned net command area value of 2,500 ha; however, a value of 2,000 ha was subsequently used as a division, to conform with previously established DOI criteria. This division has been used in the presentation of project details in Section A of Table A1-3. Table A1-3 shows that the larger DOI projects represent 80% of the total planned net command area.

Some of the DOI projects detailed in Table A1-3 are in fact development programs which comprise several component subprojects. For completeness, the details of these subprojects are presented in Table A1-4, as a supplement to Table A1-3.

It is noted that, except for the Bhairawa-Lumbini DTW project, groundwater development projects comprise installation of individual wells at non-contiguous locations rather than in wellfields. Since individual wells are not described as individual projects, the presented project details represent aggregations by district.

A1-4.1.2 - Details by District

The details of existing DOI projects given in Section A of Table A1-3 are presented again in Section B of the same table. This section of the table is arranged to give an account of the projects by district, and by the aggregations of districts into the planning units (development regions and ecological belts) discussed in Section A1-3.2; a geographical perspective of the DOI irrigation developments is therefore provided. The distribution of DOI developed net command areas by region and belt is shown graphically in Figure A1-1.

The developed gross and net command areas of DOI schemes by district and planning unit, divided into surface water and groundwater scheme totals, are carried forward from Table A1-3 to form part of an overall summary of present irrigation development areas (Table A1-7).

A1-4.2 - Identified Farmer Managed Irrigation Schemes

A1-4.2.1 - Agency Assisted Schemes

The developed net command areas corresponding to Agency Assisted FMIS are summarized by district and planning unit in Table A1-5. Data are presented for each of the 5 implementing agencies: DOI, SID(FIWUD), SID(MPLD), ADBN and DOA. A further breakdown is made to identify the contributions of the major development programs. The data have been extracted from individual agency and development program inventories, corrected and reconciled as discussed in Section A1-3.3; details are given in a set of supporting tables, Tables A1-A1 to A1-A9, as indicated in Table A1-5. It is noted that there are several additional development programs, not explicitly referenced, whose contributions are aggregated and shown as corresponding directly to their associated implementing agencies.

As noted in Section A1-2.2, not all of the developed command areas reported by the agencies can be related to specific projects. The reported command areas corresponding to these "undefined" projects, obtained as described in Section A1-3.3, are summarized separately in Table A1-5. The distribution of net command areas of the

defined Agency Assisted FMIS by region and belt is shown graphically in Figure A1-2.

A1-4.2.2 - Reconciliation with WUIs by Project

The very large numbers of FMIS have precluded for the present a detailed project-by-project comparison and reconciliation of the agency inventories and the available WUIs. An initial review showed that such a task will be complicated by the use of different names of projects and water sources, and by inconsistencies in reporting of areas.

A1-4.2.3 - Reconciliation with WUIs by District

The defined Agency Assisted FMIS in most districts represent only a small fraction of the overall command area under farmer managed schemes. This observation results from a comparison of the total command areas of farmer managed surface water schemes defined in the agency inventories with those identified in the WUIs for the 20 Terai districts and 11 Hill districts. In only 2 districts with WUIs, one Terai (Rautahat) and one Hill (Bhaktapur), does it appear that agency intervention has extended essentially to all the schemes.

In view of this observation, the WUIs were generally adopted as the source of data by district on identified command areas of farmer managed surface water schemes, after applying the adjustments discussed in Section A1-3.3. The extrapolation of command area data for Hill districts with WUIs to Hill and Mountain districts without WUIs is described in Section A1-3.3, as is the subsequent estimation of the identified farmer managed surface water scheme command areas. The WUIs generally report command areas as gross areas, and a factor of 0.8 is applied to them to obtain the estimated net command areas, except where these are given directly.

Identified command areas by district of farmer managed groundwater schemes were taken from the ADBN/STW and DOA/ADPJ groundwater project inventories as presented in Table A1-5, since there are few indications of separate independent tubewell developments. A factor of 1/0.8 is applied to obtain gross command areas from net command areas. As noted in Section A1-2.1, the WUIs do not generally account for groundwater projects.

The resulting estimates of identified developed gross and net command areas of farmer managed schemes by district and planning unit, divided into surface water and groundwater scheme totals, are presented as part of the overall summary of present irrigation development command areas (Table A1-7).

A1-4.3 - Unidentified Farmer Managed Irrigation

A1-4.3.1 - Irrigation Status of Agricultural Land

Table A1-6 shows the results of the LRMP land use database analysis to estimate the irrigation status of agricultural lands. The analysis was carried out by applying the assumptions of Table A1-2, as described in Section A1-3.4. In Table A1-6, the overall total net agricultural area* for each district and planning unit is shown, together with its division into unirrigated, monsoon season irrigated and year round irrigated areas as provided by the analysis. The sum of the monsoon season and year round irrigated areas gives the total irrigated areas, and the further addition of unirrigated but irrigable areas gives the total irrigable areas. The application of these results to obtain estimates for both identified and "unidentified" farmer managed irrigation areas is discussed in Sections A1-3.3 and A1-3.4.

A1-4.3.2 - Unidentified Irrigation by District

The estimates of "unidentified" irrigation areas, obtained as described in Section A1-3.4, are shown by district and planning unit in Table A1-7. The gross areas are obtained from the net areas by applying the ratios of net to gross areas corresponding to identified irrigation areas. The estimates supplement those for the identified DOI and farmer managed command areas also shown in Table A1-7, thus completing the overall summary of present irrigation development command areas. As mentioned in Section A1-3.4, "unidentified" irrigation areas are considered to correspond only to farmer managed schemes. It was also noted that these estimates have not been used for master planning assessments of irrigated agriculture; the areas are treated as unirrigated agricultural areas in this report.

A1-4.4 - Present Status of Farmer Managed Irrigation Schemes

In the case of the DOI implemented and managed schemes, project-by-project estimates of actually irrigated areas in summer and winter, and of irrigation capabilities and development intensities, have been compiled, with the results given in Table A1-3. In the case of identified FMIS, similar estimates cannot be made with the level of information available at present. Only highly generalized and tentative indications can be made, based on the few available

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* Excludes grazing, forest and other non-productive land areas

relevant studies and on limited local knowledge and experience of FMIS. Such indications are required to allow some master planning assessment to be made with respect to potential improvements to farmer managed irrigation. The following sections present these tentative indications, which should naturally be improved as available knowledge increases.

A1-4.4.1 - Irrigated Area

From a review of the compiled information on DOI schemes given in Tables A1-3 and A1-4, it was found that the overall net irrigated areas in summer and winter at present are about 60% and 25% respectively of the developed net command areas of these schemes. These same values apply to Terai areas; in Hill and Mountain areas, net irrigated areas in summer are close to 70% of the net command areas. Observations indicate that a greater utilization is achieved in areas commanded by FMIS. The values given below provide an estimate of effective use of command areas on farmer managed schemes*

Ecological Belt	Identified Farmer Managed Irrigation Schemes		
	Developed Net Command Area (ha)	Net Irrigated Area (% of NCA)	
		Summer	Winter
Terai	475,010	70	40
Hill/Mountain	193,215	80	40

A1-4.4.2 - Irrigation Capability

The review of DOI scheme data indicated that almost 50% of the overall developed net command areas are served by systems capable of providing reliable year round (YR) irrigation, with the remaining 50% being served reliably during the monsoon season (MS) only. In Hill areas, these values are 25% and 75% for YR and MS irrigation capabilities respectively. However, generalizing from interpretations of the few available studies of individual farmer managed schemes, the indicated values are 60% and 40% in Terai areas, and 50% and 50% in Hill areas. From this information, the distribution of irrigation capability status of FMIS is estimated as follows :

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* Annex B2 provides a more detailed account of effective use of command areas on both DOI and Farmer Managed schemes.

Ecological Belt	Identified Farmer Managed Irrigation Schemes		
	Developed Net Command Area (ha)	Irrigation Capability Status Distribution (% of NCA)	
		MS	YR
Terai	475,010	50	50
Hill/Mountain	193,215	50	50

A1-4.4.3 - Development Intensity

The DOI scheme data review indicated that 36% of the overall developed net command areas have been designated as under extensive development (ED), with a further 42% under intensive development (ID) and the remaining 22% under command area development (CAD). For master planning purposes, these development intensity categories were used to provide an indication of the achievable degree of equitable water distribution, and hence of the achievable improvements in utilization of developed command areas. Service block sizes are used as the basis for definition of development intensity as shown below

Development Intensity	Service Block Size (ha)	Canal/Drain Systems
ED	300 to 500	Primary and Secondary
ID	30 to 50	As ED plus Tertiary
CAD	3 to 5	As ID plus Quaternary

Some of the DOI schemes with an ED status designation, especially the smaller ones, are in practice ID schemes. Although the DOI development of these schemes reached only the ED level, farmers have provided water distribution networks which, while perhaps not fully satisfactory from the technical viewpoint, have nevertheless effectively raised the status of the schemes to approximately the ID level. In the case of FMIS, all available project-specific studies and recent field observations indicated development intensities of at least ID level. For master planning purposes, a development intensity status of ID has been assumed for all Terai and Hill farmer managed schemes.

A1-5 - OVERVIEW OF PRESENT LEVEL OF IRRIGATION DEVELOPMENT

As indicated in Section A1-4, Table A1-7 presents a summary of the present irrigation development command areas which have resulted from the work for this annex. Developed command areas, both gross and net, for both identified and "unidentified" irrigation, are given as aggregates by district and planning unit. Identified DOI and FMIS areas are shown separately, each divided into surface water and groundwater scheme areas.

Drawing on the information in Tables A1-3, A1-6 and A1-7, a more general overview of the present level of irrigation in the country is given in Table A1-8. This presents an account by planning units (combinations of development regions and ecological belts) of the present status of agricultural land with regard to irrigation development. The table provides a perspective of the level of development of DOI projects and FMIS with respect to each other and also in the context of total irrigable agricultural areas.

Some visual indications of the overall distribution of identified irrigation development command areas are given in the two graphs of Figure A1-3, which is derived from Table A1-8. Both graphs present developed command area values by development region. The first graph, Figure A1-3a, shows the split between Terai and Hill/Mountain ecological belts, while the second graph, Figure A1-3b, shows the split between DOI schemes and FMIS. The graphs demonstrate the relative importance of Terai as opposed to Hill/Mountain irrigation development, and of farmer managed as opposed to DOI irrigation schemes.

By expressing developed command area as a percentage of irrigable agricultural area, a visual perception of the present level of irrigation development compared to the potential irrigation development of present agricultural lands is obtained. Figures A1-4, A1-5 and A1-6 present this information by development region for the Terai belt, for the Hill/Mountain belt, and for all the belts together, respectively. The division between DOI and farmer schemes is also shown in each figure.

Figure A1-4 is of particular relevance since command area data availability and reliability has been greatest for the Terai districts, and because of the dominant position of Terai irrigated agriculture from the national viewpoint. It shows that the Eastern and Far Western regions have the highest overall present levels of Terai irrigation development (60%), while the Mid Western region has the lowest (46%). The Eastern region also has the highest level of Terai DOI scheme development (30%), with the Mid Western region having the lowest (3%). Conversely, the Far and Mid Western regions have the highest levels of Terai FMIS development (44%), while the Eastern region has the lowest (31%).

Because of the absence of comprehensive inventories of irrigation developments in most Hill and Mountain districts, and because of the methodology consequently needed to derive estimates of irrigation development areas for these districts, the information on present level of irrigation presented in Figure A1-5 is obviously less revealing and relevant than that of Figure A1-4. As expected from the estimating methodology, Figure A1-5 shows all regions as having approximately the same overall present level of Hill/Mountain irrigation development (47% to 51%). It also shows that the Western and Central regions have the highest levels of Hill/Mountain DOI scheme development (6%), with the remaining regions having a lower level (1%).

The above comments on the relevance of information in Figure A1-5 apply by extension to the information on all the belts combined, presented in Figure A1-6. In this case, however, the dominance of Terai irrigation would probably be strongly reflected regardless of the true situation of Hill/Mountain irrigation. The analysis of Terai irrigation development levels presented above for Figure A1-4 applies also to the overall regional irrigation development levels shown in Figure A1-6 but with minor differences in the actual numerical values.

Table A1-1

DISTRICTS OF NEPAL

District	Zone	Development Region	Ecological Belt	Land Area (ha)	Physiographic Division (% of area)							
					Terai	Siwalik Valley	Siwalik Slope	Middle Mountain Valley	Middle Mountain Slope	High Mountain Valley	High Mountain Slope	High Himal
Jhapa	Mechi	Eastern	Terai	156891	93.5	6.2	0.2	0.1	0.1	0.0	0.0	0.0
Morang	Koshi	Eastern	Terai	184680	82.4	0.6	8.3	0.0	8.7	0.0	0.0	0.0
Sunsari	Koshi	Eastern	Terai	127076	91.2	0.6	5.8	0.0	2.5	0.0	0.0	0.0
Saptari	Sagarmatha	Eastern	Terai	135929	76.7	1.2	22.1	0.0	0.0	0.0	0.0	0.0
Siraha	Sagarmatha	Eastern	Terai	122797	77.3	2.7	20.0	0.0	0.0	0.0	0.0	0.0
TOTAL FOR EASTERN TERAI DISTRICTS				727374	84.4	2.3	10.6	0.0	2.7	0.0	0.0	0.0
Ilam	Mechi	Eastern	Hill	171725	1.5	3.9	22.5	2.3	66.6	0.0	3.2	0.0
Panchthar	Mechi	Eastern	Hill	124589	0.0	0.0	0.0	1.9	84.4	0.0	13.1	0.6
Terhathum	Koshi	Eastern	Hill	67163	0.0	0.0	0.0	1.2	98.2	0.0	0.6	0.0
Dhankuta	Koshi	Eastern	Hill	90020	0.0	0.0	0.1	5.4	94.5	0.0	0.0	0.0
Bhojpur	Koshi	Eastern	Hill	150994	0.0	0.0	0.0	3.0	85.1	0.0	11.8	0.0
Udayapur	Sagarmatha	Eastern	Hill	203169	3.6	18.0	34.8	1.7	41.9	0.0	0.0	0.0
Khotang	Sagarmatha	Eastern	Hill	160864	0.0	0.0	0.0	2.6	81.4	0.1	15.9	0.0
Okhaldhunga	Sagarmatha	Eastern	Hill	108503	0.0	0.0	0.0	2.8	74.4	0.0	22.8	0.0
TOTAL FOR EASTERN HILL DISTRICTS				1077026	0.9	4.0	10.2	2.5	73.9	0.0	8.4	0.1
Taplejung	Mechi	Eastern	Mountain	364221	0.0	0.0	0.0	0.0	12.6	0.1	38.2	49.1
Sankhuwasawa	Koshi	Eastern	Mountain	345729	0.0	0.0	0.0	0.9	23.4	0.2	42.6	32.9
Solukhumbu	Sagarmatha	Eastern	Mountain	339776	0.0	0.0	0.0	0.0	0.8	0.1	40.3	58.7
TOTAL FOR EASTERN MOUNTAIN DISTRICTS				1049725	0.0	0.0	0.0	0.3	12.3	0.1	40.4	46.9
Dhanusha	Janakpur	Central	Terai	121746	75.0	3.6	21.4	0.0	0.0	0.0	0.0	0.0
Mahottari	Janakpur	Central	Terai	98745	83.1	2.8	14.2	0.0	0.0	0.0	0.0	0.0
Sarlahi	Janakpur	Central	Terai	126327	84.6	1.9	13.4	0.0	0.0	0.0	0.0	0.0
Rautahat	Narayani	Central	Terai	103709	92.5	0.1	7.4	0.0	0.0	0.0	0.0	0.0
Bara	Narayani	Central	Terai	129564	87.2	0.8	12.0	0.0	0.0	0.0	0.0	0.0
Parsa	Narayani	Central	Terai	138943	65.1	14.1	20.9	0.0	0.0	0.0	0.0	0.0
Chitwan	Narayani	Central	Terai	219454	0.0	52.8	33.6	0.3	13.3	0.0	0.0	0.0
TOTAL FOR CENTRAL TERAI DISTRICTS				938488	61.7	15.6	19.5	0.1	3.1	0.0	0.0	0.0
Sindhuli	Janakpur	Central	Hill	247709	0.0	14.4	47.8	1.3	36.5	0.0	0.0	0.0
Ramechhap	Janakpur	Central	Hill	150194	0.0	0.0	0.0	2.1	69.4	0.3	12.0	16.3
Makawanpur	Narayani	Central	Hill	239076	0.0	16.6	42.7	2.5	38.2	0.0	0.0	0.1
Kabhre Palanchowk	Bagmati	Central	Hill	140485	0.0	0.3	2.7	6.0	91.0	0.0	0.0	0.0
Lalitpur	Bagmati	Central	Hill	39267	0.0	0.8	0.7	24.1	74.5	0.0	0.0	0.0
Bhaktapur	Bagmati	Central	Hill	12017	0.0	0.0	0.0	60.2	39.8	0.0	0.0	0.0
Kathmandu	Bagmati	Central	Hill	41202	0.0	0.0	0.0	47.4	52.6	0.0	0.0	0.0
Nuwakot	Bagmati	Central	Hill	119649	0.0	0.0	0.0	8.3	76.0	0.0	13.5	2.2
Dhading	Bagmati	Central	Hill	192487	0.0	0.0	0.0	4.8	66.3	0.0	21.5	7.4
TOTAL FOR CENTRAL HILL DISTRICTS				1182087	0.0	6.4	19.0	6.4	58.2	0.0	6.4	3.5
Dolakha	Janakpur	Central	Mountain	214278	0.0	0.0	0.0	0.3	24.4	0.2	38.1	37.0
Sindhupalchowk	Bagmati	Central	Mountain	248096	0.0	0.0	0.0	1.2	32.9	0.2	45.2	20.5
Rasuwa	Bagmati	Central	Mountain	151179	0.0	0.0	0.0	0.1	2.7	0.4	45.5	51.4
TOTAL FOR CENTRAL MOUNTAIN DISTRICTS				613553	0.0	0.0	0.0	0.6	22.5	0.2	42.8	33.9

Table A1-1 (continued)

DISTRICTS OF NEPAL

District	Zone	Region	Ecological Belt	Land Area (ha)	Physiographic Division (%)							
					Terai	Siwalik Valley	Siwalik Slope	Middle Mountain Valley	Middle Mountain Slope	High Mountain Valley	High Mountain Slope	High Himal
Nawalparasi	Lumbini	Western	Terai	201613	27.5	24.6	32.5	1.9	13.5	0.0	0.0	0.0
Rupandehi	Lumbini	Western	Terai	141351	85.0	0.0	14.5	0.0	0.5	0.0	0.0	0.0
Kapilbastu	Lumbini	Western	Terai	175694	83.8	0.0	16.2	0.0	0.0	0.0	0.0	0.0
TOTAL FOR WESTERN TERAI DISTRICTS				518658	62.2	9.6	22.1	0.7	5.4	0.0	0.0	0.0
Palpa	Lumbini	Western	Hill	136595	0.0	0.9	18.4	6.7	73.9	0.0	0.0	0.0
Arghakhanchi	Lumbini	Western	Hill	123272	0.0	2.6	31.5	2.7	63.2	0.0	0.0	0.0
Gulmi	Lumbini	Western	Hill	107918	0.0	0.0	0.0	5.0	95.0	0.0	0.0	0.0
Tanahun	Gandaki	Western	Hill	156878	0.0	1.1	0.7	13.9	84.3	0.0	0.0	0.0
Syangja	Gandaki	Western	Hill	103555	0.0	0.0	0.0	8.4	91.6	0.0	0.0	0.0
Gorkha	Gandaki	Western	Hill	361469	0.0	0.0	0.0	5.1	24.0	0.2	24.7	45.9
Lamjung	Gandaki	Western	Hill	170871	0.0	0.0	0.0	5.4	37.2	0.5	38.2	18.7
Kaski	Gandaki	Western	Hill	213167	0.0	0.0	0.0	8.8	29.7	0.4	30.4	30.7
Parbat	Dhawalagiri	Western	Hill	54931	0.0	0.0	0.0	7.6	76.6	0.2	15.6	0.0
Baglung	Dhawalagiri	Western	Hill	182745	0.0	0.0	0.0	1.5	35.7	2.2	53.5	7.2
Myagdi	Dhawalagiri	Western	Hill	230007	0.0	0.0	0.0	0.2	2.4	0.7	54.5	42.2
TOTAL FOR WESTERN HILL DISTRICTS				1841408	0.0	0.3	3.5	5.6	45.3	0.4	24.5	20.3
Manang	Gandaki	Western	Mountain	219625	0.0	0.0	0.0	0.0	0.0	0.1	5.2	94.8
Mustang	Dhawalagiri	Western	Mountain	355951	0.0	0.0	0.0	0.0	0.0	0.1	1.2	98.8
TOTAL FOR WESTERN MOUNTAIN DISTRICTS				575576	0.0	0.0	0.0	0.0	0.0	0.1	2.7	97.2
Dangdeukhuri	Rapti	Mid Western	Terai	297339	0.1	38.5	45.8	0.2	15.3	0.0	0.0	0.0
Banke	Bheri	Mid Western	Terai	235983	49.5	9.9	38.0	0.0	2.6	0.0	0.0	0.0
Bardiya	Bheri	Mid Western	Terai	203553	69.3	4.8	25.9	0.0	0.0	0.0	0.0	0.0
TOTAL FOR MID WESTERN TERAI DISTRICTS				736875	35.0	20.0	37.8	0.1	7.0	0.0	0.0	0.0
Pyuthan	Rapti	Mid Western	Hill	129521	0.0	1.0	2.8	4.9	83.8	0.0	7.5	0.0
Rolpa	Rapti	Mid Western	Hill	187149	0.0	0.0	0.0	0.7	73.3	0.0	25.9	0.0
Salyan	Rapti	Mid Western	Hill	150102	0.0	0.0	0.0	3.6	96.4	0.0	0.0	0.0
Rukum	Rapti	Mid Western	Hill	290675	0.0	0.0	0.0	0.8	9.5	1.0	67.1	21.6
Surkhet	Bheri	Mid Western	Hill	249017	0.0	12.5	42.9	1.1	43.5	0.0	0.0	0.0
Jajarkot	Bheri	Mid Western	Hill	222183	0.0	0.0	0.0	1.0	27.9	0.4	60.8	9.9
Dailekh	Bheri	Mid Western	Hill	150054	0.0	0.0	0.0	2.0	81.4	0.0	16.6	0.0
TOTAL FOR MID WESTERN HILL DISTRICTS				1378700	0.0	2.3	8.0	1.7	51.5	0.3	30.0	6.2
Dolpa	Karnali	Mid Western	Mountain	793230	0.0	0.0	0.0	0.2	0.0	0.1	12.3	87.3
Jumla	Karnali	Mid Western	Mountain	254365	0.0	0.0	0.0	0.0	0.0	2.3	63.7	34.1
Kalikot	Karnali	Mid Western	Mountain	174927	0.0	0.0	0.0	0.0	0.0	0.3	99.7	0.0
Mugu	Karnali	Mid Western	Mountain	358282	0.0	0.0	0.0	0.0	0.0	0.2	47.4	52.4
Humla	Karnali	Mid Western	Mountain	583826	0.0	0.0	0.0	0.0	0.3	0.5	17.0	82.2
TOTAL FOR MID WESTERN MOUNTAIN DISTRICTS				2164630	0.0	0.0	0.0	0.1	0.1	0.5	32.5	66.9

Table A1-1 (continued)

DISTRICTS OF NEPAL

District	Zone	Region	Ecological Belt	Land Area (ha)	Physiographic Division (%)							
					Terai	Siwalik Valley	Siwalik Slope	Middle Mountain Valley	Middle Mountain Slope	High Mountain Valley	High Mountain Slope	High Himal
Kailali	Seti	Far Western	Terai	324791	59.8	1.4	38.6	0.1	0.1	0.0	0.0	0.0
Kanchanpur	Mahakali	Far Western	Terai	163678	87.5	0.0	12.5	0.0	0.0	0.0	0.0	0.0
TOTAL FOR FAR WESTERN TERAI DISTRICTS				488469	69.1	0.9	29.9	0.1	0.1	0.0	0.0	0.0
Achhan	Seti	Far Western	Hill	169224	0.0	0.0	0.0	1.8	87.3	0.0	10.9	0.0
Doti	Seti	Far Western	Hill	205704	0.0	0.3	3.9	1.8	90.5	0.0	3.5	0.0
Dadeldhura	Mahakali	Far Western	Hill	149525	0.1	4.6	21.5	1.1	72.7	0.0	0.0	0.0
Baitadi	Mahakali	Far Western	Hill	148678	0.0	0.0	0.0	1.1	98.0	0.1	0.8	0.0
TOTAL FOR FAR WESTERN HILL DISTRICTS				673132	0.0	1.1	6.0	1.5	87.4	0.0	4.0	0.0
Bajura	Seti	Far Western	Mountain	202177	0.0	0.0	0.0	0.0	1.7	1.0	80.0	17.3
Bajhang	Seti	Far Western	Mountain	347560	0.0	0.0	0.0	1.7	10.0	0.8	42.7	44.9
Darchula	Mahakali	Far Western	Mountain	232960	0.0	0.0	0.0	0.5	15.9	0.3	40.9	42.3
TOTAL FOR FAR WESTERN MOUNTAIN DISTRICTS				782696	0.0	0.0	0.0	0.9	9.6	0.7	51.8	37.0
TOTALS BY DEVELOPMENT REGION												
EASTERN DISTRICTS				2854125	21.9	2.1	6.5	1.1	33.1	0.1	18.0	17.3
CENTRAL DISTRICTS				2734128	21.2	8.1	14.9	2.9	31.3	0.1	12.4	9.1
WESTERN DISTRICTS				2935642	11.0	1.9	6.1	3.6	29.4	0.3	15.9	31.8
MID WESTERN DISTRICTS				4280205	6.0	4.2	9.1	0.6	17.8	0.3	26.1	35.8
FAR WESTERN DISTRICTS				1944297	17.4	0.6	9.6	0.9	34.1	0.3	22.2	14.9
TOTALS BY ECOLOGICAL BELT												
TERAI DISTRICTS				3409863	61.9	10.7	23.5	0.2	3.8	0.0	0.0	0.0
HILL DISTRICTS				6152354	0.2	2.7	8.9	3.9	58.8	0.2	17.2	8.1
MOUNTAIN DISTRICTS				5186180	0.0	0.0	0.0	0.3	6.6	0.4	34.9	57.8
TOTAL FOR ALL DISTRICTS				14748397	14.4	3.6	9.1	1.8	27.7	0.2	19.4	23.7

ASSUMED IRRIGATION STATUS OF LRMP AGRICULTURAL LAND CATEGORIES

LRMP CROPPING SEQUENCES	LRMP CULTIVATION TYPES W	UW	D	M	VF	VT	LT	ST
a	U*	U*	U*	U*	U*	U*	U	U
a1	YR	YR	YR	YR	YR	YR	YR	U
b	MS	MS	MS	MS	MS	MS	MS	U
b1	YR	YR	YR	YR	YR	YR	YR	U
b2	MS	MS	MS	MS	MS	MS	MS	U
b3	YR	YR	YR	YR	YR	YR	YR	U
c	MS	MS	MS	MS	MS	MS	MS	U
c1	YR	YR	YR	YR	YR	YR	YR	U
c2	MS	MS	MS	MS	MS	MS	MS	U
c24	U*	U*	U*	U*	U*	U*	U	U
c3	YR	YR	YR	YR	YR	YR	YR	U
d	MS	MS	MS	MS	MS	MS	MS	U
d1	YR	YR	YR	YR	YR	YR	YR	U
d2	MS	MS	MS	MS	MS	MS	MS	U
d4	U*	U*	U*	U*	U*	U*	U	U
e (50%)	MS	MS	MS	MS	MS	MS	MS	U
e (50%)	YR	YR	YR	YR	YR	YR	YR	U
e1	YR	YR	YR	YR	YR	YR	YR	U
e4	U*	U*	U*	U*	U*	U*	U	U
f	MS	MS	MS	MS	MS	MS	MS	U
g	MS	MS	MS	MS	MS	MS	MS	U
g2	MS	MS	MS	MS	MS	MS	MS	U
h	MS	MS	MS	MS	MS	MS	MS	U
i	U*	U*	U*	U*	U*	U*	U	U
j	U*	U*	U*	U*	U*	U*	U	U
j1	U*	U*	U*	U*	U*	U*	U	U
k	U*	U*	U*	U*	U*	U*	U	U
k1	MS	MS	MS	MS	MS	MS	MS	U
l	U*	U*	U*	U*	U*	U*	U	U
l1	MS	MS	MS	MS	MS	MS	MS	U
m	U*	U*	U*	U*	U*	U*	U	U
n	U*	U*	U*	U*	U*	U*	U	U
o	U*	U*	U*	U*	U*	U*	U	U
p	U*	U*	U*	U*	U*	U*	U	U
q	U*	U*	U*	U*	U*	U*	U	U
r	YR	YR	YR	YR	YR	YR	YR	U
r2	MS	MS	MS	MS	MS	MS	MS	U
s (20%)	MS	MS	MS	MS	MS	MS	MS	U
s (80%)	YR	YR	YR	YR	YR	YR	YR	U
t	U*	U*	U*	U*	U*	U*	U	U
u	MS	MS	MS	MS	MS	MS	MS	U
v	U*	U*	U*	U*	U*	U*	U	U
w	U*	U*	U*	U*	U*	U*	U	U
x	U*	U*	U*	U*	U*	U*	U	U
x1	MS	MS	MS	MS	MS	MS	MS	U
x2	U*	U*	U*	U*	U*	U*	U	U
y	U*	U*	U*	U*	U*	U*	U	U
z	U*	U*	U*	U*	U*	U*	U	U
z1	U*	U*	U*	U*	U*	U*	U	U

ASSUMED IRRIGATION STATUS OF LRMP AGRICULTURAL LAND CATEGORIES

Legends

1) Assumed Irrigation Status

U	Unirrigated	U*	Unirrigated Irrigable
MS	Monsoon Season Irrigated		
YR	Year Round Irrigated		

2) Cultivation Types

Terai		Hill Valley		Hill Slope	
W	Wetlands	VF	Valley Floors	LT	Level Terraces
UW	Upper Wetlands	VT	Valley Tars	ST	Sloping Terraces
D	Drylands				
M	Mixed Lands				

3) Cropping Sequences (Monsoon / Winter)

a	Rice / Fallow	n	Cereal / Fallow
b	Rice / Oilseed	o	Maize / Tobacco
c	Rice / Mixed Winter Crop	p	Pigeon Pea
d	Rice / Pulses	q	Cereal/Fallow / Fallow
e	Rice / Cereal	r	Maize/Rice / Winter Crop
f	Jute/Rice / Fallow	s	Sugarcane
g	Jute/Rice / Winter Crop	t	Tobacco / Fallow
h	Rice-Maize / Winter Crop	u	Maize/Rice / Fallow
i	Rice Seedlings / Mustard	v	Other
j	Maize-Millet / Fallow	w	Maize / Pulses
k	Maize / Mustard	x	Maize / Potato
l	Maize / Cereal	y	Maize-Potato / Winter Crop
m	Mixed	z	Potato / Fallow

1	Double Monsoon Crop (Spring/Summer)
2	Relayed Winter Crop
3	Double Monsoon Crop (Spring/Summer) and Relayed Winter Crop
4	Upland Rice Monsoon Crop

/	Sequential Cropping
-	Parallel Cropping

Table A1-3

PRESENT STATUS OF COMPLETED OR ONGOING DOI PROJECTS

A. DETAILS BY PROJECT

Project (1)	District (Proportion of Project)	Planned Completion (Year)	Irrigation Capability Status (2)	Development Intensity Status (6)	Planned Gross	Planned Net	Developed (9) Gross	Developed (9) Net	Command Areas (ha) Irrigated (10) Net Summer	Net Winter	Net Spring	Ongoing (Plan - Dev) Gross	Ongoing (Plan - Dev) Net	Underused (Net Dev - Net Irr) Summer	Underused (Net Dev - Net Irr) Winter	Underused (Net Dev - Net Irr) Spring	Comments on Area, Handovers and Assistance to Farmers (11)
PROJECTS WITH N.C.A. GREATER THAN 2,000 HA																	
Kankai	Jhapa(100%)	1989	YR	ID	9600	8000	7200	6000	4000	1200	3000	2400	2000	2000	4800	3000	See Note 9
Sunsari-Morang	Morang(48%)	COMPLETE	MS	ED	52100	33000	52100	33000	16000	3400	3400	0	0	17000	29600	29600	
	Sunsari(52%)	COMPLETE	MS	ED/ID(7)	52100	33000	52100	33000	14000	3000	3000	0	0	19000	30000	30000	See Note 9
	Total				104200	66000	104200	66000	30000	6400	6400	0	0	36000	59600	59600	See Note 9
Kosi	Saptari(100%)	1990	MS/YR(3)	ID	43125	34500	38750	31000	20000	14000	0	4375	3500	11000	17000	31000	
Kamala	Siraha(50%)	COMPLETE	MS	ED	15625	12500	15625	12500	5000	2000	0	0	0	7500	10500	12500	
	Dhanusha(50%)	COMPLETE	MS	ED	15625	12500	15625	12500	5000	2000	0	0	0	7500	10500	12500	
	Total				31250	25000	31250	25000	10000	4000	0	0	0	15000	21000	25000	
Manusmara	Sarlahi(100%)	COMPLETE	YR	ID	6000	5800	6000	5800	5000	1000	0	0	0	800	4800	5800	See Note 9
Narayani	Rauthat(21%)	1993	YR	ID	9770	8700	3390	3000	1800	1000	0	6380	5700	1200	2000	3000	See Note 9
	Bara(32%)	COMPLETE	YR	ID	14610	12700	14610	12700	8600	4600	0	0	0	4100	8100	12700	
	Bara(DTW)(7%)	COMPLETE	YR	ID	3105	2700	3105	2700	1600	1200	0	0	0	1100	1500	2700	
	Parsa(40%)	COMPLETE	YR	ID	17970	16000	17970	16000	10600	6000	0	0	0	5400	10000	16000	
	Total				45455	40100	39075	34400	22600	12800	0	6380	5700	11800	21600	34400	See Note 9
Chitwan	Chitwan(100%)	COMPLETE	YR	ID	14435	11200	13400	10400	9600	800	500	1035	800	800	9600	9900	See Note 9
West Gandak	Nawalparasi(100%)	COMPLETE	YR	ID	16300	13400	16300	13400	6000	3500	900	0	0	7400	9900	12500	See Note 9
Bhairawa-Lumbini-1	Rupendehi(100%)	COMPLETE	YR	CAD	9500	7600	9500	7600	7400	4500	2200	0	0	200	3100	5400	
Bhairawa-Lumbini-2 (DTW)	Rupendehi(100%)	1990	YR	CAD	5500	4400	625	500	450	300	150	4875	3900	50	200	350	See Note 9
	Total				15000	12000	10125	8100	7850	4800	2350	4875	3900	250	3300	5750	See Note 9
Banganga	Kapilvastu(100%)	COMPLETE	MS	ID	8125	6500	7500	6000	5000	1300	0	625	500	1000	4700	6000	See Note 9
Pathraiya	Kailali(100%)	COMPLETE	MS	ID	2700	2133	2700	2133	1300	200	0	0	0	833	1933	2133	
Mohana	Kailali(100%)	COMPLETE	MS	ED	5670	3500	5670	3500	1500	500	0	0	0	2000	3000	3500	See Note 9
Mahakali - Phase I	Kanchanpur(100%)	COMPLETE	YR	CAD	5520	5000	5520	5000	4000	3000	0	0	0	1000	2000	5000	
TOTAL OF PROJECTS WITH N.C.A. GREATER THAN 2,000 HA					307380	233133	287690	216733	126850	53500	13150	19690	16400	89883	163233	203583	

Table A1-3 (continued)

PRESENT STATUS OF COMPLETED OR ONGOING DOI PROJECTS

A. DETAILS BY PROJECT (Continued)

Project (1)	District (Proportion of Project)	Planned Completion (Year)	Irrigation Capability Status (2)	Development Intensity Status (6)	Planned Gross	Planned Net	Developed (9) Gross	Developed (9) Net	Command Areas (ha) Irrigated (10) Net Summer	Net Winter	Net Spring	Ongoing (Plan - Dev) Gross	Ongoing (Plan - Dev) Net	Underused (Net Dev - Net Irr) Summer	Underused (Net Dev - Net Irr) Winter	Underused (Net Dev - Net Irr) Spring	Comments on Area, Handovers and Assistance to Farmers (11)
PROJECTS WITH N.C.A. OF 2,000 HA OR LESS																	
SIRDP (1)	Saptari(50%)	1989	MS/YR(4)	ED/ID/CAD(8)	12375	9900	8762	7010	3520	2400		3613	2890	3490	4610		
	Siraha(44%)	1989	MS/YR(4)	ED/ID/CAD(8)	10890	8712	7937	6350	3265	2250		2953	2362	3085	4100		
	Udayapur(6%)	1989	MS/YR(4)	ED/ID/CAD(8)	1485	1188	1131	905	452	350		354	283	453	555		
	Total				24750	19800	17830	14265	7237	5000		6920	5535	7028	9265		
Groundwater(DTW)	Siraha(10%)	COMPLETE	YR	ID	250	200	250	200	0	0		0	0	200	200		} To farmers,
	Dhanusha(5%)	COMPLETE	YR	ID	125	100	125	100	100	100		0	0	0	0		} under DOI
	Mahottari(10%)	COMPLETE	YR	ID	256	205	256	205	205	205		0	0	0	0		} and/or
	Sarlahi(19%)	COMPLETE	YR	ID	500	400	500	400	400	400		0	0	0	0		} SID (FIWUD)
	Bara(10%)	COMPLETE	YR	ID	250	200	250	200	200	100		0	0	0	100		} assistance
	Rupendehi(24%)	COMPLETE	YR	ID	600	500	600	500	300	300		0	0	200	200		} programmes
	Kapilvastu(22%)	COMPLETE	YR	ID	575	460	575	460	460	230		0	0	0	230		}
	Total				2556	2065	2556	2065	1665	1335		0	0	400	730		
Nerpa	Khotang(100%)	COMPLETE	MS	ED	250	200	250	200	100	50		0	0	100	150		
Rampurtar	Okhaldunga(100%)	COMPLETE	MS	ED	300	240	300	240	0	0		0	0	240	240		
Hardinath	Dhanusha(100%)	COMPLETE	MS	ED	2400	2000	2400	2000	1000	500		0	0	1000	1500		
Jhaj	Rauthat(100%)	COMPLETE	MS	ED	1875	1500	1875	1500	1500	600		0	0	0	900		
Sirsia-Dudhora	Bara(85%)	COMPLETE	MS	ED	1275	1020	1275	1020	850	170		0	0	170	850		
	Parsa(15%)	COMPLETE	MS	ED	225	180	225	180	150	30		0	0	30	150		
	Total				1500	1200	1500	1200	1000	200		0	0	200	1000		
Pithuwa	Chitwan(100%)	COMPLETE	MS	ED	600	500	600	500	500	100		0	0	0	400		
Gwang Khola	Sindhuli(100%)	COMPLETE	MS	ED	75	60	75	60	60	60		0	0	0	0		To farmers
Khimti	Ramechhap(100%)	COMPLETE	MS	ED	50	40	50	40	40	20		0	0	0	20		To farmers
Tika Bhairab - 1	Lalitpur(100%)	COMPLETE	MS	ED	500	400	500	400	400	250		0	0	0	150		
Tika Bhairab - 2	Lalitpur(100%)	COMPLETE	MS	ED	375	300	375	300	300	150		0	0	0	150		
Godavari	Lalitpur(100%)	COMPLETE	MS	ED	125	100	125	100	100	100		0	0	0	0		
Kotkhu	Lalitpur(100%)	COMPLETE	MS	ED	450	360	450	360	275	140		0	0	85	220		
Kumbheshwar	Lalitpur(100%)	COMPLETE	MS	ED	62	50	62	50	30	10		0	0	20	40		To farmers
Lumbhu	Lalitpur(100%)	COMPLETE	MS	ED	188	150	188	150	150	90		0	0	0	60		
Bhorlekulu	Lalitpur(100%)	COMPLETE	MS	ED	62	50	62	50	0	0		0	0	50	50		To farmers
Dhungedhara	Bhaktapur(100%)	COMPLETE	MS	ED	338	270	338	270	80	80		0	0	190	190		
Katunje	Bhaktapur(100%)	COMPLETE	MS	ED	56	45	56	45	30	10		0	0	15	35		

Table A1-3 (continued)

PRESENT STATUS OF COMPLETED OR ONGOING DOI PROJECTS

A. DETAILS BY PROJECT (Continued)

Project (1)	District (Proportion of Project)	Planned Completion (Year)	Irrigation Capability Status (2)	Development Intensity Status (6)	Planned		Developed (9)		Command Areas (ha) Irrigated (10)			Ongoing (Plan - Dev)		Underused (Net Dev - Net Irr)			Comments on Area, Handovers and Assistance to Farmers (11)
					Gross	Net	Gross	Net	Net Summer	Net Winter	Net Spring	Gross	Net	Summer	Winter	Spring	
Bidoul	Bhaktapur(100%)	COMPLETE	MS	ED	81	65	81	65	40	20		0	0	25	45		
Ghattekulo	Bhaktapur(100%)	COMPLETE	MS	ED	437	350	437	350	150	50		0	0	200	300		
Mahadev Khola	Bhaktapur(100%)	COMPLETE	MS	ED	468	375	468	375	210	80		0	0	165	295		
Chakhukhu	Bhaktapur(100%)	COMPLETE	MS	ED	125	100	125	100	60	20		0	0	40	80		
Hanumante	Bhaktapur(100%)	COMPLETE	MS	ED	125	100	125	100	60	60		0	0	40	40		
Dakshinkali	Kathmandu(100%)	COMPLETE	MS	ED	125	100	125	100	70	35		0	0	30	65		
Chaitya Kola	Kathmandu(100%)	COMPLETE	MS	ID	12	10	12	10	10	0		0	0	0	10		
Bosan	Kathmandu(100%)	COMPLETE	MS	ED	325	260	325	260	100	50		0	0	160	210		
Pharping Dhungedhara	Kathmandu(100%)	COMPLETE	MS	ED	250	200	250	200	100	50		0	0	100	150		
Kudali Kulo	Kathmandu(100%)	COMPLETE	MS	ID	12	10	12	10	10	0		0	0	0	10		
Ichadol	Kathmandu(100%)	COMPLETE	MS	ED	90	70	90	70	55	25		0	0	15	45		
Sokarna	Kathmandu(100%)	COMPLETE	MS	ED	470	375	470	375	150	75		0	0	225	300		
Pashupati	Kathmandu(100%)	COMPLETE	MS	ED	94	75	94	75	20	20		0	0	55	55		
Bishambara	Kathmandu(100%)	COMPLETE	MS	ED	250	200	250	200	200	120		0	0	0	80		
Budanilkantha	Kathmandu(100%)	COMPLETE	MS	ED	250	200	250	200	120	60		0	0	80	140		
Balaju	Kathmandu(100%)	COMPLETE	MS	ED	75	60	75	60	50	25		0	0	10	35		
Tokha	Kathmandu(100%)	COMPLETE	MS	ED	250	200	250	200	150	75		0	0	50	125		
Indrayani	Kathmandu(100%)	COMPLETE	MS	ED	180	145	180	145	100	50		0	0	45	95		
Balkhu	Kathmandu(100%)	COMPLETE	MS	ID	30	25	30	25	25	15		0	0	0	10		To farmers
Panchamane Balaju	Kathmandu(100%)	COMPLETE	MS	ED	75	60	75	60	50	25		0	0	10	35		To farmers
Sankhu	Kathmandu(100%)	COMPLETE	MS	ED	250	200	250	200	100	50		0	0	100	150		To farmers
Battar Lift	Nuwakot(100%)	COMPLETE	YR	ED	530	424	530	424	0	0		0	0	424	424		
Gadkhar	Nuwakot(100%)	COMPLETE	YR	ID	125	100	125	100	100	100		0	0	0	0		
Labdhu-Dhikuree-Sera	Nuwakot(100%)	COMPLETE	YR	ID	310	248	310	248	180	100		0	0	68	148		
Gajuritar	Dhading(100%)	COMPLETE	MS	ED	125	100	125	100	100	60		0	0	0	40		
Kalleritar	Dhading(100%)	COMPLETE	MS	ED	250	200	250	200	200	0		0	0	0	200		

Table A1-3 (continued)

PRESENT STATUS OF COMPLETED OR ONGOING DOI PROJECTS

A. DETAILS BY PROJECT (Continued)

Project (1)	District (Proportion of Project)	Planned Completion (Year)	Irrigation Capability Status (2)	Development Intensity Status (6)	Planned		Developed (9)		Command Areas (ha) Irrigated (10)			Ongoing (Plan - Dev)		Underused (Net Dev - Net Irr)			Comments on Area, Handovers and Assistance to Farmers (11)
					Gross	Net	Gross	Net	Net Summer	Net Winter	Net Spring	Gross	Net	Summer	Winter	Spring	
Pipaltar	Dhading(100%)	COMPLETE	MS	ED	75	60	75	60	30	30		0	0	30	30		
Ratomatotar	Dhading(100%)	COMPLETE	MS	ID	18	15	18	15	15	10		0	0	0	5		To farmers
Majhitar	Dhading(100%)	COMPLETE	MS	ID	12	10	12	10	10	5		0	0	0	5		To farmers
Ghyangkhola	Dolkha(100%)	COMPLETE	MS	ED	200	175	200	175	175	100		0	0	0	75		
Pushaha	Nawalparasi(100%)	COMPLETE	MS	ED	400	300	400	300	40	0		0	0	260	300		
Dergaon	Nawalparasi(100%)	COMPLETE	MS	ED	240	150	240	150	150	50		0	0	0	100		
Bulingtar	Nawalparasi(100%)	COMPLETE	MS	ID	305	240	305	240	180	90		0	0	60	150		
Siyari	Rupendehi(100%)	COMPLETE	MS	ED	600	500	600	500	100	100		0	0	400	400		
Surahi	Kapilvastu(100%)	COMPLETE	MS	ED	500	400	500	400	300	0		0	0	100	400		
Jabai	Kapilvastu(100%)	COMPLETE	MS	ED	500	400	500	400	300	0		0	0	100	400		
Rampurphat	Palpa(100%)	1990	MS	ID	950	760	0	0	0	0		950	760	0	0		Part existing FMS
Kachalphant	Palpa(100%)	1990	MS	ED	310	248	0	0	0	0		310	248	0	0		
Argentichap	Gulmi(100%)	COMPLETE	MS	ED	75	60	75	60	60	30		0	0	0	30		
Sajhatar	Tanahun(100%)	COMPLETE	MS	ID	50	40	50	40	40	20		0	0	0	20		
Sanghe Patyani	Tanahun(100%)	COMPLETE	MS	ED	375	300	375	300	100	50		0	0	200	250		
GADP (1)	Tanahun(8%)	COMPLETE	MS	ID	12	10	12	10	10	0		0	0	0	10		To DOA
	Syangja(13%)	COMPLETE	MS	ID	19	15	19	15	15	0		0	0	0	15		To DOA
	Lamjung(79%)	COMPLETE	MS	ED/ID(8	119	95	119	95	95	0		0	0	0	95		To DOA
	Total				150	120	150	120	120	0		0	0	0	120		
Chepetar	Gorkha(100%)	COMPLETE	MS	ED	75	60	75	60	25	10		0	0	35	50		
Chorkatetar	Gorkha(100%)	COMPLETE	MS	ED	137	110	137	110	60	20		0	0	50	90		
Bhimsenkulo	Gorkha(100%)	COMPLETE	MS	ED	94	75	94	75	40	25		0	0	35	50		
Mallatar	Gorkha(100%)	COMPLETE	MS	ED	125	100	125	100	50	30		0	0	50	70		
Dhuwakot	Gorkha(100%)	COMPLETE	MS	ED	55	44	55	44	44	44		0	0	0	0		
Arutar	Gorkha(100%)	COMPLETE	MS	ED	125	100	125	100	100	50		0	0	0	50		

Table A1-3 (continued)

PRESENT STATUS OF COMPLETED OR ONGOING DOI PROJECTS

A. DETAILS BY PROJECT (Continued)

Project (1)	District (Proportion of Project)	Planned Completion (Year)	Irrigation Capability Status (2)	Development Intensity Status (6)	Planned Gross	Planned Net	Developed (9) Gross	Developed (9) Net	Command Areas (ha) Irrigated (10) Net Summer	Net Winter	Net Spring	Ongoing (Plan - Dev) Gross	Ongoing (Plan - Dev) Net	Underused (Net Dev - Net Irr) Summer	Underused (Net Dev - Net Irr) Winter	Underused (Net Dev - Net Irr) Spring	Comments on Area, Handovers and Assistance to Farmers (11)
Ranghatar	Lamjung(100%)	COMPLETE	MS	ED	305	244	305	244	100	50		0	0	144	194		
Handetar	Lamjung(100%)	COMPLETE	MS	ED	337	270	337	270	140	70		0	0	130	200		
Bhorletar	Lamjung(100%)	COMPLETE	YR	ID	250	200	250	200	200	100		0	0	0	100		
Pokhara Water Cons.	Kaski(100%)	COMPLETE	YR	ID	1275	1030	1275	1030	1030	0		0	0	0	1030		
Phewatal	Kaski(100%)	COMPLETE	YR	ED	400	320	400	320	320	0		0	0	0	320		
Vijaypur	Kaski(100%)	COMPLETE	MS	ID	1600	1280	1600	1280	1025	300		0	0	255	980		
Begnastal	Kaski(100%)	1988	YR	ID	725	580	725	580	150	0		0	0	430	580		
Hyanga	Kaski(100%)	COMPLETE	MS	ID	412	330	412	330	330	165		0	0	0	165		
Gyandi	Parbat(100%)	COMPLETE	MS	ED	125	100	125	100	60	30		0	0	40	70		
Phalebas	Parbat(100%)	COMPLETE	MS	ID	406	325	406	325	325	75		0	0	0	250		
Jahare	Parbat(100%)	COMPLETE	MS	ED	94	75	94	75	40	20		0	0	35	55		
Dhami	Mustang(100%)	COMPLETE	MS(5)	ED	70	56	70	56	56	0		0	0	0	56		
Chhonup	Mustang(100%)	COMPLETE	MS(5)	ED	64	51	64	51	51	0		0	0	0	51		
Lomandhang	Mustang(100%)	COMPLETE	MS(5)	ED	64	51	64	51	51	0		0	0	0	51		
Gwar	Dang(100%)	COMPLETE	MS	ED	1000	800	1000	800	400	100		0	0	400	700		
HIRDP (1)	Dang(77%)	COMPLETE	MS	ED	1407	1125	1407	1125	635	0		0	0	490	1125		
	Pyuthan(23%)	COMPLETE	MS	ED	425	340	425	340	340	0		0	0	0	340		
	Total				1832	1465	1832	1465	975	0		0	0	490	1465		
Dughare	Dang(100%)	COMPLETE	MS	ED	200	160	200	160	160	100		0	0	0	60		
Dunduwa	Banke(100%)	COMPLETE	MS	ED	1560	1250	1560	1250	500	100		0	0	750	1150		
Chapala Tal	Bardiya(100%)	COMPLETE	MS	ED	600	480	600	480	480	50		0	0	0	430		To farmers
Badaiya Tal	Bardiya(100%)	COMPLETE	MS	ED	600	480	600	480	480	50		0	0	0	430		To farmers
Chaurjahari	Rukum(100%)	COMPLETE	MS	ED	750	600	750	600	300	300		0	0	300	300		
Khutia - Phase 1	Kailali(100%)	COMPLETE	MS	ED	1875	1500	1875	1500	1500	0		0	0	0	1500		
Kailali STW	Kailali(100%)	1989	YR	CAD	3255	2604	2017	1614	807	400		1238	990	807	1214		
Kailali DTW	Kailali(100%)	1989	YR	ID	2060	1648	1935	1548	1238	600		125	100	310	948		
Kanchanpur STW	Kanchanpur(100%)	1989	YR	CAD	2937	2350	1812	1450	725	360		1125	900	725	1090		
Kanchanpur DTW	Kanchanpur(100%)	1989	YR	ID	622	498	622	498	398	200		0	0	100	298		
	Total				8874	7100	6386	5110	3168	1560		2488	1990	1942	3550		

PRESENT STATUS OF COMPLETED OR ONGOING DOI PROJECTS

A. DETAILS BY PROJECT (Continued)

Project (1)	District (Proportion of Project)	Planned Completion (Year)	Irrigation Capability Status (2)	Development Intensity Status (6)	Planned		Developed (9)		Command Areas (ha) Irrigated (10)			Ongoing (Plan - Dev)		Underused (Net Dev - Net Irr)			Comments on Area, Handovers and Assistance to Farmers (11)
					Gross	Net	Gross	Net	Net Summer	Net Winter	Net Spring	Gross	Net	Summer	Winter	Spring	
MIRDP (1)	Dadeldhura(46%)	COMPLETE	MS	ED	150	120	150	120	120	0		0	0	0	120		
	Baitadi(54%)	COMPLETE	MS	ED/ID(8)	175	140	175	140	140	0		0	0	0	140		
	Total				325	260	325	260	260	0		0	0	0	260		
Surnaiyagad	Baitadi(100%)	COMPLETE	MS	ED	244	195	244	195	195	100		0	0	0	95		
Agadegad	Baitadi(100%)	COMPLETE	MS	ED	75	60	75	60	60	30		0	0	0	30		
TOTAL OF PROJECTS WITH N.C.A. OF 2,000 HA OR LESS					71259	57111	60591	48578	31172	13724	0	10668	8533	17406	34854	0	
TOTAL OF ALL PROJECTS					378639	290244	348281	265311	158022	67224	13150	30358	24933	107289	198087	203583	

Table AI-3 (continued)

PRESENT STATUS OF COMPLETED OR ONGOING DOI PROJECTS

B. DETAILS BY DISTRICT

District	Project (Proportion by District) (1)	Planned Completion (Year)	Irrigation Capability Status (2)	Development Intensity Status (6)	Planned		Developed (9)		Command Areas (ha) Irrigated (10)			Ongoing (Plan - Dev)		Underused (Net Dev - Net Irr)			Comments on Area, Handovers and Assistance to Farmers (11)
					Gross	Net	Gross	Net	Net Summer	Net Winter	Net Spring	Gross	Net	Summer	Winter	Spring	
EASTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT																	
Jhapa	Kankai(100%)	1989	YR	ID	9600	8000	7200	6000	4000	1200	3000	2400	2000	2000	4800	3000	See Note 9
Morang	Sunsari-Morang(48%)	COMPLETE	MS	ED	52100	33000	52100	33000	16000	3400	3400	0	0	17000	29600	29600	
Sunsari	Sunsari-Morang(52%)	COMPLETE	MS	ED/ID(7)	52100	33000	52100	33000	14000	3000	3000	0	0	19000	30000	30000	See Note 9
Saptari	Kosi(100%)	1990	MS/YR(3)	ID	43125	34500	38750	31000	20000	14000	0	4375	3500	11000	17000	31000	
	SIRDP(50%) (1)	1989	MS/YR(4)	ED/ID/CAD(8)	12375	9900	8762	7010	3520	2400		3613	2890	3490	4610		
	Total				55500	44400	47512	38010	23520	16400		7988	6390	14490	21610		
Siraha	SIRDP(44%) (1)	1989	MS/YR(4)	ED/ID/CAD(8)	10890	8712	7937	6350	3265	2250		2953	2362	3085	4100		
	Kamala(50%)	COMPLETE	MS	ED	15625	12500	15625	12500	5000	2000	0	0	0	7500	10500	12500	
	Groundwater(DTW)(10%)	COMPLETE	YR	ID	250	200	250	200	0	0		0	0	200	200		See Section A
	Total				26765	21412	23812	19050	8265	4250		2953	2362	10785	14800		
TOTAL FOR EASTERN TERAI DISTRICTS					196065	139812	182724	129060	65785	28250	9400	13341	10752	63275	100810	106100	
EASTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT																	
Ilam																	
Panchthar																	
Terhathum																	
Dhankuta																	
Bhojpur																	
Udayapur	SIRDP(6%) (1)	1989	MS/YR(4)	ED/ID/CAD(8)	1485	1188	1131	905	452	350		354	283	453	555		
Khotang	Nerpa(100%)	COMPLETE	MS	ED	250	200	250	200	100	50		0	0	100	150		
Okhaldhunga	Ranpurtar(100%)	COMPLETE	MS	ED	300	240	300	240	0	0		0	0	240	240		
TOTAL FOR EASTERN HILL DISTRICTS					2035	1628	1681	1345	552	400		354	283	793	945		
EASTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT																	
Taplejung																	
Sankhuwasawa																	
Solukhumbu																	
TOTAL FOR EASTERN MOUNTAIN DISTRICTS					0	0	0	0	0	0		0	0	0	0		

Table A1-3 (continued)

PRESENT STATUS OF COMPLETED OR ONGOING DOI PROJECTS

B. DETAILS BY DISTRICT (Continued)

District	Project (Proportion by District) (1)	Planned Completion (Year)	Irrigation Capability Status (2)	Development Intensity Status (6)	Planned Gross	Planned Net	Developed (9) Gross	Developed (9) Net	Command Areas (ha) Irrigated (10) Net Summer	Net Winter	Net Spring	Ongoing (Plan - Dev) Gross	Ongoing (Plan - Dev) Net	Underused (Net Dev - Net Irr) Summer	Underused (Net Dev - Net Irr) Winter	Underused (Net Dev - Net Irr) Spring	Comments on Area, Handovers and Assistance to Farmers (11)
CENTRAL DEVELOPMENT REGION - TERAI ECOLOGICAL BELT																	
Dhanusha	Kanala(50%)	COMPLETE	MS	ED	15625	12500	15625	12500	5000	2000	0	0	0	7500	10500	12500	
	Hardinath(100%)	COMPLETE	MS	ED	2400	2000	2400	2000	1000	500		0	0	1000	1500		
	Groundwater(DTW)(5%)	COMPLETE	YR	ID	125	100	125	100	100	100		0	0	0	0		See Section A
	Total				18150	14600	18150	14600	6100	2600		0	0	8500	12000		
Mahottari	Groundwater(DTW)(10%)	COMPLETE	YR	ID	256	205	256	205	205	205		0	0	0	0		See Section A
Sarlahi	Manusmara(100%)	COMPLETE	YR	ID	6000	5800	6000	5800	5000	1000	0	0	0	800	4800	5800	See Note 9
	Groundwater(DTW)(19%)	COMPLETE	YR	ID	500	400	500	400	400	400		0	0	0	0		See Section A
	Total				6500	6200	6500	6200	5400	1400		0	0	800	4800		
Rautahat	Narayani(21%)	1993	YR	ID	9770	8700	3390	3000	1800	1060	0	6380	5700	1200	2000	3000	See Note 9
	Jhaj(100%)	COMPLETE	MS	ED	1875	1500	1875	1500	1500	600		0	0	0	900		
	Total				11645	10200	5265	4500	3300	1600		6380	5700	1200	2900		
Bara	Narayani(32%)	COMPLETE	YR	ID	14610	12700	14610	12700	8600	4600	0	0	0	4100	8100	12700	
	Narayani(DTW)(7%)	COMPLETE	YR	ID	3105	2700	3105	2700	1600	1200	0	0	0	1100	1500	2700	
	Sirsia-Dudhora(85%)	COMPLETE	MS	ED	1275	1020	1275	1020	850	170		0	0	170	850		
	Groundwater(DTW)(10%)	COMPLETE	YR	ID	250	200	250	200	200	100		0	0	0	100		See Section A
	Total				19240	16620	19240	16620	11250	6070		0	0	5370	10550		
Parsa	Narayani(40%)	COMPLETE	YR	ID	17970	16000	17970	16000	10600	6000	0	0	0	5400	10000	16000	
	Sirsia-Dudhora(15%)	COMPLETE	MS	ED	225	180	225	180	150	30		0	0	30	150		
	Total				18195	16180	18195	16180	10750	6030		0	0	5430	10150		
Chitwan	Chitwan(100%)	COMPLETE	YR	ID	14435	11200	13400	10400	9600	800	500	1035	800	800	9600	9900	See Note 9
	Pithuwa(100%)	COMPLETE	MS	ED	600	500	600	500	500	100		0	0	0	400		
	Total				15035	11700	14000	10900	10100	900		1035	800	800	10000		
TOTAL FOR CENTRAL TERAI DISTRICTS					89021	75705	91605	69205	47105	18805	500	7415	6500	22100	50400	62600	
CENTRAL DEVELOPMENT REGION - HILL ECOLOGICAL BELT																	
Sindhuli	Gwang Khola(100%)	COMPLETE	MS	ED	75	60	75	60	60	60		0	0	0	0		To farmers
Ramechhap	Khimti(100%)	COMPLETE	MS	ID	50	40	50	40	40	20		0	0	0	20		To farmers
Makawanpur																	
Kabhre																	
Lalitpur	Tika Bhairab-1(100%)	COMPLETE	MS	ED	500	400	500	400	400	250		0	0	0	150		
	Tika Bhairab-2(100%)	COMPLETE	MS	ED	375	300	375	300	300	150		0	0	0	150		
	Godavari(100%)	COMPLETE	MS	ED	125	100	125	100	100	100		0	0	0	0		
	Kothku(100%)	COMPLETE	MS	ED	450	360	450	360	275	140		0	0	85	220		
	Kumbheshwar(100%)	COMPLETE	MS	ED	62	50	62	50	30	10		0	0	20	40		To farmers
	Lumbhu(100%)	COMPLETE	MS	ED	188	150	188	150	150	90		0	0	0	60		
	Bhorlekulu(100%)	COMPLETE	MS	ED	62	50	62	50	0	0		0	0	50	50		To farmers
	Total				1762	1410	1762	1410	1255	740		0	0	155	670		

Table A1-3 (continued)

PRESENT STATUS OF COMPLETED OR ONGOING DOI PROJECTS

B. DETAILS BY DISTRICT (Continued)

District	Project (Proportion by District) (1)	Planned Completion (Year)	Irrigation Capability Status (2)	Development Intensity Status (6)	Planned		Developed (9)		Command Areas (ha) Irrigated (10)			Ongoing (Plan - Dev)		Underused (Net Dev - Net Irr)			Comments on Area, Handovers and Assistance to Farmers (11)
					Gross	Net	Gross	Net	Net Summer	Net Winter	Net Spring	Gross	Net	Summer	Winter	Spring	
Bhaktapur	Dhungedhara(100%)	COMPLETE	MS	ED	338	270	338	270	80	80		0	0	190	190		
	Kutunje(100%)	COMPLETE	MS	ED	56	45	56	45	30	10		0	0	15	35		
	Bidoul(100%)	COMPLETE	MS	ED	81	65	81	65	40	20		0	0	25	45		
	Ghattekulo(100%)	COMPLETE	MS	ED	437	350	437	350	150	50		0	0	200	300		
	Mahadev Khola(100%)	COMPLETE	MS	ED	468	375	468	375	210	80		0	0	165	295		
	Chakhukhu(100%)	COMPLETE	MS	ED	125	100	125	100	60	20		0	0	40	80		
	Hanumante(100%)	COMPLETE	MS	ED	125	100	125	100	60	60		0	0	40	40		
	Total				1630	1305	1630	1305	630	320		0	0	675	985		
Kathmandu	Dakshinkali(100%)	COMPLETE	MS	ED	125	100	125	100	70	35		0	0	30	65		
	Chaitya Kola(100%)	COMPLETE	MS	ID	12	10	12	10	10	0		0	0	0	10		
	Bosan(100%)	COMPLETE	MS	ED	325	260	325	260	100	50		0	0	160	210		
	Pharping Dhungedhara(100%)	COMPLETE	MS	ED	250	200	250	200	100	50		0	0	100	150		
	Kudali Kulo(100%)	COMPLETE	MS	ID	12	10	12	10	10	0		0	0	0	10		
	Ichadol(100%)	COMPLETE	MS	ED	90	70	90	70	55	25		0	0	15	45		
	Gokarna(100%)	COMPLETE	MS	ED	470	375	470	375	150	75		0	0	225	300		
	Pashupati(100%)	COMPLETE	MS	ED	94	75	94	75	20	20		0	0	55	55		
	Bishambara(100%)	COMPLETE	MS	ED	250	200	250	200	200	120		0	0	0	80		
	Budhanilkantha(100%)	COMPLETE	MS	ED	250	200	250	200	120	60		0	0	80	140		
	Balaju(100%)	COMPLETE	MS	ED	75	60	75	60	50	25		0	0	10	35		
	Tokha(100%)	COMPLETE	MS	ED	250	200	250	200	150	75		0	0	50	125		
	Indrayani(100%)	COMPLETE	MS	ED	180	145	180	145	100	50		0	0	45	95		
	Balkhu(100%)	COMPLETE	MS	ID	30	25	30	25	25	15		0	0	0	10		To farmers
	Panchamane Balaju(100%)	COMPLETE	MS	ED	75	60	75	60	50	25		0	0	10	35		To farmers
	Sankhu(100%)	COMPLETE	MS	ED	250	200	250	200	100	50		0	0	100	150		To farmers
	Total				2738	2190	2738	2190	1310	675		0	0	880	1515		
Nuwakot	Battar Lift(100%)	COMPLETE	YR	ED	530	424	530	424	0	0		0	0	424	424		
	Gadkhar(100%)	COMPLETE	YR	ID	125	100	125	100	100	100		0	0	0	0		
	Labdhu-Dhikuree-Sera(100%)	COMPLETE	YR	IP	310	248	310	248	180	100		0	0	68	148		
	Total				965	772	965	772	280	200		0	0	492	572		
Dhading	Gajuritar(100%)	COMPLETE	MS	ED	125	100	125	100	120	60		0	0	0	40		
	Kalleritar(100%)	COMPLETE	MS	ED	250	200	250	200	200	0		0	0	0	200		
	Pipaltar(100%)	COMPLETE	MS	ED	75	60	75	60	20	30		0	0	30	30		
	Ratomatotar(100%)	COMPLETE	MS	ID	18	15	18	15	15	10		0	0	0	5		To farmers
	Majhitar(100%)	COMPLETE	MS	ID	12	10	12	10	10	5		0	0	0	5		To farmers
	Total				480	385	480	385	355	105		0	0	30	280		
TOTAL FOR CENTRAL HILL DISTRICTS					7700	6162	7700	6162	3930	2120		0	0	2232	4042		
CENTRAL DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT																	
Dolakha	Ghyangkhola(100%)	COMPLETE	MS	ED	200	175	200	175	175	100		0	0	0	75		
Sindhupalchowk																	
Rasuwa																	
TOTAL FOR CENTRAL MOUNTAIN DISTRICTS					200	175	200	175	175	100		0	0	0	75		

Table A1-3 (continued)

PRESENT STATUS OF COMPLETED OR ONGOING DOI PROJECTS

B. DETAILS BY DISTRICT (Continued)

District	Project (Proportion by District) (1)	Planned Completion (Year)	Irrigation Capability Status (2)	Development Intensity Status (6)	Planned Gross	Planned Net	Developed (9) Gross	Developed (9) Net	Command Areas (ha) Irrigated (10) Net Summer	Net Winter	Net Spring	Ongoing (Plan - Dev) Gross	Ongoing (Plan - Dev) Net	Underused (Net Dev - Net Irr) Summer	Winter	Spring	Comments on Area, Handovers and Assistance to Farmers (11)
WESTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT																	
Nawalparasi	West Gandak(100%)	COMPLETE	YR	ID	16300	13400	16300	13400	6000	3500	900	0	0	7400	9900	12500	See Note 9
	Pushaha(100%)	COMPLETE	MS	ED	400	300	400	300	40	0		0	0	260	300		
	Dergaon(100%)	COMPLETE	MS	ED	240	150	240	150	150	50		0	0	0	100		
	Bulingtar(100%)	COMPLETE	MS	ID	305	240	305	240	180	90		0	0	60	150		
	Total				17245	14090	17245	14090	6370	3640		0	0	7720	10450		
Rupandehi	Bhairawa-Lumbini-1(100%)	COMPLETE	YR	CAD	9500	7600	9500	7600	7400	4500	2200	0	0	200	3100	5400	
	Bhairawa-Lumbini-2(100%)	1990	YR	CAD	5500	4400	625	500	450	300	150	4875	3900	50	200	350	See Note 9
	Groundwater(DTW)(24%)	COMPLETE	YR	ID	600	500	600	500	300	300		0	0	200	200		See Section A
	Siyari(100%)	COMPLETE	MS	ED	600	500	600	500	100	100		0	0	400	400		
	Total				16200	13000	11325	9100	8250	5200		4875	3900	850	3900		
Kapilbastu	Banganga(100%)	COMPLETE	MS	ID	8125	6500	7500	6000	5000	1300	0	625	500	1000	4700	6000	See Note 9
	Groundwater(DTW)(22%)	COMPLETE	YR	ID	575	460	575	460	460	230		0	0	0	230		See Section A
	Surahi(100%)	COMPLETE	MS	ED	500	400	500	400	300	0		0	0	100	400		
	Jabai(100%)	COMPLETE	MS	ED	500	400	500	400	300	0		0	0	100	400		
	Total				9700	7760	9075	7260	6060	1530		625	500	1200	5730		
TOTAL FOR WESTERN TERAI DISTRICTS					43145	34850	37645	30450	20680	10370	3250	5500	4400	9770	20080	24250	
WESTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT																	
Palpa	Rampurphat(100%)	1990	MS	ID	950	760	0	0	0	0		950	760	0	0		Part existing FMS
	Kachalphat(100%)	1990	MS	ED	310	248	0	0	0	0		310	248	0	0		
	Total				1260	1008	0	0	0	0		1260	1008	0	0		
Arghakhanchi																	
Gulmi	Argentichap(100%)	COMPLETE	MS	ED	75	60	75	60	60	30		0	0	0	30		
Tanahun	Sajhatar(100%)	COMPLETE	MS	ID	50	40	50	40	40	20		0	0	0	20		
	Sanghe Patyani(100%)	COMPLETE	MS	ED	375	300	375	300	100	50		0	0	200	250		
	GADP(8%) (1)	COMPLETE	MS	ID	12	10	12	10	10	0		0	0	0	10		To DOA
	Total				437	350	437	350	150	70		0	0	200	280		
Syangja	GADP(13%) (1)	COMPLETE	MS	ID	19	15	19	15	15	0		0	0	0	15		To DOA
Gorkha	Chepetar(100%)	COMPLETE	MS	ED	75	60	75	60	25	10		0	0	35	50		
	Chorkatetar(100%)	COMPLETE	MS	ED	137	110	137	110	60	20		0	0	50	90		
	Bhimsenkulo(100%)	COMPLETE	MS	ED	94	75	94	75	40	25		0	0	35	50		
	Mallatar(100%)	COMPLETE	MS	ED	125	100	125	100	50	30		0	0	50	70		
	Dhuwakot(100%)	COMPLETE	MS	ED	55	44	55	44	44	44		0	0	0	0		
	Arutar(100%)	COMPLETE	MS	ED	125	100	125	100	100	50		0	0	0	50		
	Total				611	489	611	489	319	179		0	0	170	310		
Lamjung	Ranghstar(100%)	COMPLETE	MS	ED	305	244	305	244	100	50		0	0	144	194		
	Handetar(100%)	COMPLETE	MS	ED	337	270	337	270	140	70		0	0	130	200		
	Bhorletar(100%)	COMPLETE	YR	ID	250	200	250	200	200	100		0	0	0	100		
	GADP(19%) (1)	COMPLETE	MS	ED/ID(8)	119	95	119	95	95	0		0	0	0	95		To DOA
	Total				1011	809	1011	809	535	220		0	0	274	589		

Table A1-3 (continued)

PRESENT STATUS OF COMPLETED OR ONGOING DOI PROJECTS

B. DETAILS BY DISTRICT (Continued)

District	Project (Proportion by District) (1)	Planned Completion (Year)	Irrigation Capability Status (2)	Development Intensity Status (6)	Planned Gross	Planned Net	Developed (9) Gross	Developed (9) Net	Command Areas (ha) Irrigated (10) Net Summer	Net Winter	Net Spring	Ongoing (Plan - Dev) Gross	Ongoing (Plan - Dev) Net	Underused (Net Dev - Net Irr) Summer	Underused (Net Dev - Net Irr) Winter	Underused (Net Dev - Net Irr) Spring	Comments on Area, Handovers and Assistance to Farmers (11)
Kaski	Pokhara Water Cons.(100%)	COMPLETE	YR	ID	1275	1030	1275	1030	1030	0		0	0	0	1030		
	Phewatal(100%)	COMPLETE	YR	ED	400	320	400	320	320	0		0	0	0	320		
	Vijaypur(100%)	COMPLETE	MS	ID	1600	1280	1600	1280	1025	300		0	0	255	980		
	Begnastal(100%)	1988	YR	ID	725	580	725	580	150	0		0	0	430	580		
	Hyanga(100%)	COMPLETE	MS	ID	412	330	412	330	330	165		0	0	0	165		
	Total				4412	3540	4412	3540	2855	465		0	0	685	3075		
Parbat	Gyandi(100%)	COMPLETE	MS	ED	125	100	125	100	60	30		0	0	40	70		
	Phalebas(100%)	COMPLETE	MS	ID	406	325	406	325	325	75		0	0	0	250		
	Jabare(100%)	COMPLETE	MS	ED	94	75	94	75	40	20		0	0	35	55		
	Total				625	500	625	500	425	125		0	0	75	375		
Baglung																	
Myagdi																	
TOTAL FOR WESTERN HILL DISTRICTS					8450	6771	7190	5763	4359	1089		1260	1008	1404	4674		
WESTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT																	
Manang																	
Mustang	Dhami(100%)	COMPLETE	MS(5)	ED	70	56	70	56	56	0		0	0	0	56		
	Chhonup(100%)	COMPLETE	MS(5)	ED	64	51	64	51	51	0		0	0	0	51		
	Lomandang(100%)	COMPLETE	MS(5)	ED	64	51	64	51	51	0		0	0	0	51		
	Total				198	158	198	158	158	0		0	0	0	158		
TOTAL FOR WESTERN MOUNTAIN DISTRICTS					198	158	198	158	158	0		0	0	0	158		
MID WESTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT																	
Dangdeukhuri	Gwar(100%)	COMPLETE	MS	ED	1000	800	1000	800	400	100		0	0	400	700		
	RIRDP(77%) (1)	COMPLETE	MS	ED	1407	1125	1407	1125	635	0		0	0	490	1125		
	Dughare(100%)	COMPLETE	MS	ED	200	160	200	160	160	105		0	0	0	60		
	Total				2607	2085	2607	2085	1195	205		0	0	890	1885		
Banke	Dunduwa(100%)	COMPLETE	MS	ED	1560	1250	1560	1250	500	100		0	0	750	1150		
Bardiya	Chapala Tal(100%)	COMPLETE	MS	ED	600	480	600	480	480	50		0	0	0	430		To farmers
	Badaiya Tal(100%)	COMPLETE	MS	ED	600	480	600	480	480	50		0	0	0	430		To farmers
	Total				1200	960	1200	960	960	100		0	0	0	860		
TOTAL FOR MID WESTERN TERAI DISTRICTS					5367	4295	5367	4295	2655	400		0	0	1640	3895		
MID WESTERN REGION - HILL ECOLOGICAL BELT																	
Pyuthan	RIRDP(23%) (1)	COMPLETE	MS	ED	425	340	425	340	340	0		0	0	0	340		
Rolpa																	
Salyan																	

Table A1-3 (continued)

PRESENT STATUS OF COMPLETED OR ONGOING DOI PROJECTS

B. DETAILS BY DISTRICT (Continued)

District	Project (Proportion by District) (1)	Planned Completion (Year)	Irrigation Capability Status (2)	Development Intensity Status (6)	Planned Gross	Planned Net	Developed (9) Gross	Developed (9) Net	Command Areas (ha) Irrigated (10) Net Summer	Net Winter	Net Spring	Ongoing (Plan - Dev) Gross	Ongoing (Plan - Dev) Net	Underused (Net Dev - Net Irr) Summer	Winter	Spring	Comments on Area, Handovers and Assistance to Farmers (11)
Rukum	Chaurjahari(100%)	COMPLETE	MS	ED	750	600	750	600	300	300		0	0	300	300		
Surkhet																	
Jajarkot																	
Dailekh																	
TOTAL FOR MID WESTERN HILL DISTRICTS					1175	940	1175	940	640	300		0	0	300	640		
MID WESTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT																	
Dolpa																	
Jumla																	
Kalikot																	
Mugu																	
Humla																	
TOTAL FOR MID WESTERN MOUNTAIN DISTRICTS					0	0	0	0	0	0		0	0	0	0		
FAR WESTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT																	
Kailali	Mohana(100%)	COMPLETE	MS	ED	5670	3500	5670	3500	1500	500	0	0	0	2000	3000	3500	See Note 9
	Kailali STW(100%)	1989	YR	CAD	3255	2604	2017	1614	807	400		1238	990	807	1214		
	Kailali DTW(100%)	1989	YR	ID	2060	1648	1935	1548	1238	600		125	100	310	948		
	Pathraiya(100%)	COMPLETE	MS	ID	2700	2133	2700	2133	1300	200	0	0	0	833	1933	2133	
	Khutia Phase I(100%)	COMPLETE	MS	ED	1875	1500	1875	1500	1500	0		0	0	0	1500		
	Total				15560	11385	14197	10295	6345	1700		1363	1090	3950	8595		
Kanchanpur	Kanchanpur STW(100%)	1989	YR	CAD	2937	2350	1812	1450	725	360		1125	900	725	1090		
	Kanchanpur DTW(100%)	1989	YR	ID	622	498	622	498	398	200		0	0	100	298		
	Mahakali - Phase I(100%)	COMPLETE	YR	CAD	5520	5000	5520	5000	4000	3000	0	0	0	1000	2000	5000	
	Total				9079	7848	7954	6948	5123	3560		1125	900	1825	3388		
TOTAL FOR FAR WESTERN TERAI DISTRICTS					24639	19233	22151	17243	11468	5260	0	2488	1990	5775	11983	10633	
FAR WESTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT																	
Achham																	
Doti																	
Dadeldhura	MIRDP(46%) (1)	COMPLETE	MS	ED	150	120	150	120	120	0		0	0	0	120		

PRESENT STATUS OF COMPLETED OR ONGOING DOI PROJECTS

B. DETAILS BY DISTRICT (Continued)

District	Project (Proportion by District) (1)	Planned Completion (Year)	Irrigation Development Capability Status (2)	Intensity Status (6)	Planned Gross	Planned Net	Developed (9) Gross	Developed (9) Net	Command Areas (ha) Irrigated (10) Net Summer	Net Winter	Net Spring	Ongoing (Plan - Dev) Gross	Ongoing (Plan - Dev) Net	Underused (Net Dev - Net Irr) Summer	Underused (Net Dev - Net Irr) Winter	Underused (Net Dev - Net Irr) Spring	Comments on Area, Handovers and Assistance to Farmers (11)
Baitadi	MIRDP(54%) (1)	COMPLETE	MS	ED/ID(8)	175	140	175	140	140	0		0	0	0	140		
	Surnaiyagad(100%)	COMPLETE	MS	ED	244	195	244	195	195	100		0	0	0	95		
	Agedegad(100%)	COMPLETE	MS	ED	75	60	75	60	60	30		0	0	0	30		
	Total				494	395	494	395	395	130		0	0	0	265		
TOTAL FOR FAR WESTERN HILL DISTRICTS					644	515	644	515	515	130		0	0	0	385		
FAR WESTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT																	
Bajura																	
Bajhang																	
Darchula																	
TOTAL FOR FAR WESTERN MOUNTAIN DISTRICTS					0	0	0	0	0	0		0	0	0	0		
TOTALS BY DEVELOPMENT REGION																	
EASTERN DISTRICTS					198100	141440	184405	130405	66337	28650	9400	13695	11035	64068	101755	106100	
CENTRAL DISTRICTS					96921	82042	89506	75542	51210	21025	500	7415	6500	24332	54517	62600	
WESTERN DISTRICTS					51793	41779	45033	36371	25197	11459	3250	6760	5408	11174	24912	24250	
MID WESTERN DISTRICTS					6542	5235	6542	5235	3295	700	0	0	0	1940	4535	0	
FAR WESTERN DISTRICTS					25283	19748	22795	17758	11983	5390	0	2488	1990	5775	12368	10633	
TOTALS BY ECOLOGICAL BELT																	
TERAI DISTRICTS					358237	273895	329493	250253	147693	63085	13150	28744	23642	102560	187168	203583	
HILL DISTRICTS					20004	16016	18390	14725	9996	4039	0	1614	1291	4729	10686	0	
MOUNTAIN DISTRICTS					398	333	398	333	333	100	0	0	0	0	233	0	
TOTAL FOR ALL DISTRICTS					378639	290244	348281	265311	158022	67224	13150	30358	24933	107289	198087	203583	

Notes

(1) STW = Shallow Tube Wells; DTW = Deep Tube Wells; see Table A1-4 for details of component subprojects of the SIRDP, GADP, KIRDP and MIRDP
(2) MS = Monsoon Season; YR = Year Round
(3) MS for Chandra system (Developed N.C.A. 10,000 ha); YR for Western Kosi and pumped systems (Developed N.C.A. 21,000 ha)
(4) MS for surface irrigation; YR for tubewell irrigation
(5) Winter cropping climatically not possible
(6) ED = Extensive Development (Service Block 300-500 ha); ID = Intensive Development (Service Block 30-50 ha); CAD = Command Area Development (Service Block 3-5 ha)
(7) ID for Phase I (9,750 ha N.C.A. complete) and Phase II (16,700 ha N.C.A. ongoing); ED for rest
(8) ED for surface irrigation; ID for DTW irrigation and very small surface irrigation; CAD for STW irrigation
(9) Developed command areas shown for the larger projects are as declared by DOI; see Annex C2 for improved command area estimates
(10) Area estimates relating to spring season irrigation are currently available for the larger projects only
(11) DOI = Department of Irrigation; SID = Small Irrigation Division of DOI; FIWUD = Farm Irrigation and Water Utilization Division of DOA (incorporated into SID); DOA = Department of Agriculture; FMS = Farmer Managed Scheme

Table A1-4

PRESENT STATUS OF COMPLETED OR ONGOING DOI SUBPROJECTS

Project (1)	District (Proportion of Project)	Planned Completion (Year)	Irrigation Capability Status (2)	Development Intensity Status (3)	Planned		Developed		Command Areas (ha) Irrigated Net Summer	Irrigated Net Winter	Irrigated Net Spring	Ongoing (Plan - Dev) Gross	Ongoing (Plan - Dev) Net	Underused (Net Dev - Net Irr) Summer	Underused (Net Dev - Net Irr) Winter	Underused (Net Dev - Net Irr) Spring
					Gross	Net	Gross	Net								
SAGARMATHA INTEGRATED RURAL DEVELOPMENT PROJECT (SIRDP)																
Saptari STW	Saptari	1989	YR	CAD	8775	7020	7125	5700	2850	1995		1650	1320	2850	3705	
Saptari DTW	Saptari	1989	YR	ID	188	150	62	50	40	30		126	100	10	20	
Deodhar MIP	Saptari	Complete	MS	ED	500	400	500	400	200	120		0	0	200	280	
Chapin MIP	Saptari	Complete	MS	ED	375	300	375	300	150	90		0	0	150	210	
Jhoradah MIP	Saptari	Complete	MS	ED	75	60	75	60	30	15		0	0	30	45	
Bamana MIP	Saptari	Complete	MS	ED	500	400	500	400	200	120		0	0	200	280	
Laxmipurdah MIP	Saptari	1989	MS	ED	500	400	125	100	50	30		375	300	50	70	
Kuraha MIP	Saptari	1989	MS	ED	87	70	0	0	0	0		87	70	0	0	
Lohjara MIP	Saptari	1989	MS	ED	125	100	0	0	0	0		125	100	0	0	
Amsot MIP	Saptari	1989	MS	ED	500	400	0	0	0	0		500	400	0	0	
Karaj MIP	Saptari	1989	MS	ED	500	400	0	0	0	0		500	400	0	0	
Baragidhar MIP	Saptari	1989	MS	ED	250	200	0	0	0	0		250	200	0	0	
Total Saptari					12375	9900	8762	7010	3520	2400		3613	2890	3490	4610	
Siraha STW	Siraha	1989	YR	CAD	6796	5437	6593	5275	2638	1845		203	162	2637	3430	
Siraha DTW	Siraha	1989	YR	ID	500	400	375	300	240	180		125	100	60	120	
Khutti MIP	Siraha	Complete	MS	ED	375	300	375	300	150	88		0	0	150	212	
Sarswati MIP	Siraha	Complete	MS	ED	94	75	94	75	37	22		0	0	38	53	
Betaha MIP	Siraha	Complete	MS	ED	125	100	125	100	50	29		0	0	50	71	
Mutanidah MIP	Siraha	Complete	MS	ED	100	80	100	80	40	23		0	0	40	57	
Bhawaradah MIP	Siraha	Complete	MS	ED	250	200	250	200	100	58		0	0	100	142	
Jaruwa MIP	Siraha	Complete	MS	ID	25	20	25	20	10	5		0	0	10	15	
Jiwakhola MIP	Siraha	1989	MS	ED	500	400	0	0	0	0		500	400	0	0	
Lohjore MIP	Siraha	1989	MS	ED	500	400	0	0	0	0		500	400	0	0	
Katniya MIP	Siraha	1989	MS	ED	500	400	0	0	0	0		500	400	0	0	
Mainawati MIP	Siraha	1989	MS	ED	500	400	0	0	0	0		500	400	0	0	
Bano MIP	Siraha	1989	MS	ED	500	400	0	0	0	0		500	400	0	0	
Jhirjhire MIP	Siraha	1989	MS	ED	125	100	0	0	0	0		125	100	0	0	
Total Siraha					10890	8712	7937	6350	3265	2250		2953	2362	3085	4100	
Udayapur STW	Udayapur	1989	YR	CAD	1016	813	812	650	325	225		204	163	325	425	
Swaroptar MIP	Udayapur	Complete	MS	ED	62	50	62	50	25	25		0	0	25	25	
Baruwakhola MIP	Udayapur	Complete	MS	ED	100	80	100	80	40	40		0	0	40	40	
Asare Kulo MIP	Udayapur	Complete	MS	ED	63	50	63	50	25	25		0	0	25	25	
Chilaunekhola MIP	Udayapur	Complete	MS	ED	94	75	94	75	37	35		0	0	38	40	
Lamakhola MIP	Udayapur	1989	MS	ED	87	70	0	0	0	0		87	70	0	0	
Karonjekhola MIP	Udayapur	1989	MS	ED	63	50	0	0	0	0		63	50	0	0	
Total Udayapur					1485	1188	1131	905	452	350		354	283	453	555	
TOTAL FOR SIRDP					24750	19800	17830	14265	7237	5000		6920	5535	7028	9265	

Table A1-4 (continued)

PRESENT STATUS OF COMPLETED OR ONGOING DOI SUBPROJECTS

Project (1)	District (Proportion of Project)	Planned Completion (Year)	Irrigation Capability Status (2)	Development Intensity Status (3)	Planned		Developed		Command Areas (ha) Irrigated Net Summer	Irrigated Net Winter	Irrigated Net Spring	Ongoing (Plan - Dev) Gross	Ongoing (Plan - Dev) Net	Underused (Net Dev - Net Irr) Summer	Underused (Net Dev - Net Irr) Winter	Underused (Net Dev - Net Irr) Spring
					Gross	Net	Gross	Net								
GANDAKI AGRICULTURE DEVELOPMENT PROJECT (GADP)																
Baisjagar	Tanahun	Complete	MS	ID	12	10	12	10	10	0		0	0	0	10	
Total Tanahun					12	10	12	10	10	0		0	0	0	10	
Kareddanda	Syangja	Complete	MS	ID	19	15	19	15	15	0		0	0	0	15	
Total Syangja					19	15	19	15	15	0		0	0	0	15	
Swreeswara	Lamjung	Complete	MS	ID	5	4	5	4	4	0		0	0	0	4	
Taksar Head Reg.	Lamjung	Complete	MS	ID	50	40	50	40	40	0		0	0	0	40	
Dovan Lift	Lamjung	Complete	MS	CAD	2	1	2	1	1	0		0	0	0	1	
Phirdi Lift	Lamjung	Complete	MS	ED	62	50	62	50	50	0		0	0	0	50	
Total Lamjung					119	95	119	95	95	0		0	0	0	95	
TOTAL FOR GADP					150	120	150	120	120	0		0	0	0	120	
RAPTI INTEGRATED RURAL DEVELOPMENT PROJECT (RIRDP)																
Gobardiha	Dang	Complete	MS	ED	544	435	544	435	435	0		0	0	0	435	
Belghare	Dang	Complete	MS	ED	425	340	425	340	100	0		0	0	240	340	
Chiregad	Dang	Complete	MS	ED	438	350	438	350	100	0		0	0	250	350	
Total Dang					1407	1125	1407	1125	635	0		0	0	490	1125	
Dharnabati	Pyuthan	Complete	MS	ED	425	340	425	340	340	0		0	0	0	340	
Total Pyuthan					425	340	425	340	340	0		0	0	0	340	
TOTAL FOR RIRDP					1832	1465	1832	1465	975	0		0	0	490	1465	
MAHAKALI INTEGRATED RURAL DEVELOPMENT PROJECT (MIRDP)																
Saltuna	Dadeldhura	Complete	MS	ED	150	120	150	120	120	0		0	0	0	120	
Total Dadeldhura					150	120	150	120	120	0		0	0	0	120	
Sera	Baitadi	Complete	MS	ED	75	60	75	60	60	0		0	0	0	60	
Banku	Baitadi	Complete	MS	ED	75	60	75	60	60	0		0	0	0	60	
Dhungeli	Baitadi	Complete	MS	ID	25	20	25	20	20	0		0	0	0	20	
Total Baitadi					175	140	175	140	140	0		0	0	0	140	
TOTAL FOR MIRDP					325	260	325	260	260	0		0	0	0	260	

Notes

(1) STW = Shallow Tube Wells; DTW = Deep Tube Wells; MIP = Medium Irrigation Project;
all component projects of the SIRDP, GADP, RIRDP and MIRDP are included in aggregate form in the main listing of DOI projects, Table A1-3

(2) MS = Monsoon Season; YR = Year Round

(3) ED = Extensive Development (Service Block 300-500 ha); ID = Intensive Development (Service Block 30-50 ha); CAD = Command Area Development (Service Block 3-5 ha)

Table A1-5

COMMAND AREAS OF AGENCY ASSISTED FARMER MANAGED SCHEMES

District	Defined Projects Developed Net Command Areas (ha) (1)											Undefined Projects Developed Net Command Areas (ha) (2)				
Agency (3)	DOI	SID (FIWUD)			SID (MPLD)				ADBN	DOA	Total	DOI	FIWUD	MPLD	DOA	Total
Program (4)	Direct	Direct	HFPP	SINKALAMA	ILO	KHARDEP	DIDP	CARE	STW	ADPJ						
Table No. (5)	A1-A1	A1-A2	A1-A3	A1-A4	A1-A5	A1-A6	A1-A6	A1-A7	A1-A8	A1-A9		A1-A1	A1-A2	A1-A5	A1-A9	
EASTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT																
Jhapa	200	180						388	6500		7268					0
Morang	2780	0						142	5580		8502					0
Sunsari	880	600						0	7796		9276					0
Saptari	880	50						0	0		930					0
Siraha	2680	675						0	0	45	3400					0
TOTAL FOR EASTERN TERAI DISTRICTS	7420	1505	0	0	0	0	0	530	19876	45	29376	0	0	0	0	0
EASTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT																
Ilam	50	0			285						335					0
Panchthar	0	150			0						150					0
Terhathum	0	655			0	433					1088					0
Dhankuta	0	270			0	353					623					0
Bhojpur	25	200			0	280					505					0
Udayapur	0	254			0						254					0
Khotang	50	523			60						633					0
Okhaldhunga	0	60			150						210					0
TOTAL FOR EASTERN HILL DISTRICTS	125	2112	0	0	495	1066	0	0	0	0	3798	0	0	0	0	0
EASTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT																
Taplejung	0	0									0					0
Sankhuwasawa	0	0				440					440					0
Solukhumbu	0	56									56					0
TOTAL FOR EASTERN MOUNTAIN DISTRICTS	0	56	0	0	0	440	0	0	0	0	496	0	0	0	0	0
CENTRAL DEVELOPMENT REGION - TERAI ECOLOGICAL BELT																
Dhanusha	200	5847						70	1384	8299	15800		0			0
Mahottari	0	90						138	528	4130	4886		2407			2407
Sarlahi	40	0						200	908	9325	10473					0
Rautahat	3296	2700						0	3888	14	9898					0
Bara	3495	0						0	5984	73	9552					0
Parsa	1070	208						0	576	0	1854					0
Chitwan	650	1990						450	540	14	3644					0
TOTAL FOR CENTRAL TERAI DISTRICTS	8751	10835	0	0	0	0	0	858	13808	21855	56107	0	2407	0	0	2407
CENTRAL DEVELOPMENT REGION - HILL ECOLOGICAL BELT																
Sindhuli	0	650			0			0			650					0
Ramechhap	50	490			40			0			580					0
Makawanpur	0	60		225	60			179	32	14	570					0
Kabhre	0	135		200	60			40			435					0
Lalitpur	955	4			0			0			959					0
Bhaktapur	1490	33			0			0			1523					0
Kathmandu	610	287			0			0		45	942					0
Nuwakot	240	1511			0			86			1837					0
Dhading	12	120			200		185	0			517					0
TOTAL FOR CENTRAL HILL DISTRICTS	3357	3290	0	425	360	0	185	305	32	59	8013	0	0	0	0	0

COMMAND AREAS OF AGENCY ASSISTED FARMER MANAGED SCHEMES

District	Defined Projects Developed Net Command Areas (ha) (1)											Undefined Projects Developed Net Command Areas (ha) (2)				
Agency (3)	DOI	SID (FIWUD)			SID (MPLD)				ADBN	DOA	Total	DOI	FIWUD	MPLD	DOA	Total
Program (4)	Direct	Direct	HPPP	SIWALANA	ILO	KHARDEP	DIDP	CARE	STW	ADPJ						
Table No. (5)	A1-A1	A1-A2	A1-A3	A1-A4	A1-A5	A1-A6	A1-A6	A1-A7	A1-A8	A1-A9		A1-A1	A1-A2	A1-A5	A1-A9	
CENTRAL DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT																
Dolakha	0	155									155					0
Sindhupalchowk	450	100		68	20						638	1900				1900
Rasuwa	0	30									30					0
TOTAL FOR CENTRAL MOUNTAIN DISTRICTS	450	285	0	68	20	0	0	0	0	0	823	1900	0	0	0	1900
WESTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT																
Nawalparasi	480	100						0	1352		1932					0
Rupandehi	8060	220						212	5604		14096					0
Kapilbastu	1900	488						0	1072		3460					0
TOTAL FOR WESTERN TERAI DISTRICTS	10440	808	0	0	0	0	0	212	8028	0	19488	0	0	0	0	0
WESTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT																
Palpa	0	102	0		35						137					0
Arghakhanchi	0	106	0		80						186					0
Gulmi	0	44	0		190						234					0
Tanahun	30	0	281		100						411					0
Syangja	0	0	659		120						779					0
Gorkha	50	0	468		0			14			532					0
Lamjung	404	0	588	0	10						1002					0
Kaski	370	0	0		310						680	1127				1127
Parbat	108	418	0		0						526					0
Baglung	60	195	0		0						255					0
Myagdi	105	175	0		0						280					0
TOTAL FOR WESTERN HILL DISTRICTS	1127	1040	1996	0	845	0	0	14	0	0	5022	1127	0	0	0	1127
WESTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT																
Manang	0	0									0					0
Mustang	105	0									105					0
TOTAL FOR WESTERN MOUNTAIN DISTRICTS	105	0	0	0	0	0	0	0	0	0	105	0	0	0	0	0
MID WESTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT																
Dangdeukhuri	1740	0							1040		2780					0
Banke	440	60							3040		3540					0
Bardiya	80	0							4092		4172					0
TOTAL FOR MID WESTERN TERAI DISTRICTS	2260	60	0	0	0	0	0	0	8172	0	10492	0	0	0	0	0
MID WESTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT																
Pyuthan	60	0									60					0
Rolpa	0	86									86					0
Salyan	20	81									101					0
Rukum	0	55									55					0
Surkhet	0	0									0					0
Jajarkot	0	150									150					0
Dailekh	0	0									0					0
TOTAL FOR MID WESTERN HILL DISTRICTS	80	372	0	0	0	0	0	0	0	0	452	0	0	0	0	0

COMMAND AREAS OF AGENCY ASSISTED FARMER MANAGED SCHEMES

District	Defined Projects Developed Net Command Areas (ha) (1)											Undefined Projects Developed Net Command Areas (ha) (2)				
Agency (3)	DOI	SID (FIWUD)				SID (MPLD)			ADBN	DOA	Total	DOI	FIWUD	MPLD	DOA	Total
Program (4)	Direct	Direct	HFPP	SINKALAMA	ILO	KHARDEP	DIDP	CARE	STW	ADPJ						
Table No. (5)	A1-A1	A1-A2	A1-A3	A1-A4	A1-A5	A1-A6	A1-A6	A1-A7	A1-A8	A1-A9		A1-A1	A1-A2	A1-A5	A1-A9	
MID WESTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT																
Dolpa	0	7									7					0
Jumla	0	0									0					0
Kalikot	0	655									655					0
Mugu	0	0									0					0
Humla	0	0									0					0
TOTAL FOR MID WESTERN MOUNTAIN DISTRICTS	0	662	0	0	0	0	0	0	0	0	662	0	0	0	0	0
FAR WESTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT																
Kailali	4650	250							6332		11232					0
Kanchanpur	720	0							4796		5516					0
TOTAL FOR FAR WESTERN TERAI DISTRICTS	5370	250	0	0	0	0	0	0	11128	0	16748	0	0	0	0	0
FAR WESTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT																
Achham	0	128			82						210					0
Doti	0	285			545						830					0
Dadeldhura	0	0			427						427					0
Baitadi	150	210			205						565					0
TOTAL FOR FAR WESTERN HILL DISTRICTS	150	623	0	0	1259	0	0	0	0	0	2032	0	0	0	0	0
FAR WESTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT																
Bajura	0	0			65						65					0
Bajhang	0	25			293						318					0
Darchula	0	0			115						115					0
TOTAL FOR FAR WESTERN MOUNTAIN DISTRICTS	0	25	0	0	473	0	0	0	0	0	498	0	0	0	0	0
Undefined Locations												11840	0	8450	6041	26331
TOTALS BY DEVELOPMENT REGION																
EASTERN DISTRICTS	7545	3673	0	0	495	1506	0	530	19876	45	33670	0	0	0	0	0
CENTRAL DISTRICTS	12558	14410	0	493	380	0	185	1163	13840	21914	64943	1900	2407	0	0	4307
WESTERN DISTRICTS	11672	1848	1996	0	845	0	0	226	8028	0	24615	1127	0	0	0	1127
MID WESTERN DISTRICTS	2340	1094	0	0	0	0	0	0	8172	0	11606	0	0	0	0	0
FAR WESTERN DISTRICTS	5520	898	0	0	1732	0	0	0	11128	0	19278	0	0	0	0	0
TOTALS BY ECOLOGICAL BELT																
TERAI DISTRICTS	34241	13458	0	0	0	0	0	1600	61012	21900	132211	0	2407	0	0	2407
HILL DISTRICTS	4839	7437	1996	425	2959	1066	185	319	32	59	19317	1127	0	0	0	1127
MOUNTAIN DISTRICTS	555	1028	0	68	493	440	0	0	0	0	2584	1900	0	0	0	1900
TOTAL FOR ALL DISTRICTS	39635	21923	1996	493	3452	1506	185	1919	61044	21959	154112	14867	2407	8450	6041	31765

COMMAND AREAS OF AGENCY ASSISTED FARMER MANAGED SCHEMES

Notes:

(1) Aggregated from agency inventories compiled with details of individual projects and corrected for duplications in reported areas
(2) Official agency reported totals, less the defined project totals
(3) DOI = Department of Irrigation; SID = Small Irrigation Division of DOI;
FIWUD = Farm Irrigation and Water Utilization Division of DOA (incorporated into SID); DOA = Department of Agriculture;
MPLD = Ministry of Panchayat and Local Development, irrigation section (incorporated into SID);
ADBN = Agricultural Development Bank of Nepal
(4) HFFP = Hill Food Production Project (World Bank); SINKALAMA = Sindhupalchowk, Kavre, Lalitpur and Makwanpur Project (Asian Development Bank); ILO = International Labour Organization Projects; KHARDEP = Kosi Hill Area Development Project (British Aid); DIDP = Dhading Integrated Development Project (German Aid); CARE = Care Nepal Projects; STW = Shallow Tube Well Programme; ADPJ = Agriculture Development Project Janakpur (Japanese Aid)
(5) Refers to compiled agency inventory tables.

TABLE A1-A1 SUMMARY OF DOI ASSISTED FARMER MANAGED SCHEME NET COMMAND AREAS

District	Minor Irrigation	Agriculture Year	People's Participation	Farmer System Maintenances	Small Hill	Small Irrigation	Decentralization	Farm Irrigation	Food for Work	District Level I.P	Total
Table No.	A-1A	A-1B	A-1C	A-1D	A-1E	A-1F	A-1G	A-1H	A-1I	A-1J	
Jhapa	-	-	-	200	-	-	-	-	-	-	200
Morang	1,580	0 A	1,200	-	-	-	-	-	-	-	2,780
Sunsari	880	0 A	-	-	-	-	-	-	-	-	880
Saptari	880	-	-	-	-	-	-	-	-	-	880
Siraha	2,680	-	-	-	-	-	-	-	-	-	2,680
Ilam	-	-	-	50	-	-	-	-	-	-	50
Bhojpur	-	-	25	-	-	-	-	-	-	-	25
Khotang	-	-	-	50	-	-	-	-	-	-	50
Dhanusha	200	-	-	-	-	-	-	0 A	-	-	200
Mahottari	-	-	-	-	-	-	-	-	-	-	-
Sarlahi	40 A	-	-	-	-	-	-	-	-	-	40
Rauthat	3,056	-	-	-	-	-	-	-	-	-	3,296
Bara	3,495 A	-	-	-	-	-	-	-	-	-	3,495
Parsa	1,070	-	-	-	-	-	-	-	-	-	1,070
Chitwan	650	-	-	-	-	-	-	-	-	-	650
Ramechhap	-	-	-	50	-	-	-	-	-	-	50
Lalitpur	905	-	-	50	-	-	-	-	-	-	955
Bhaktapur	1,490	-	-	-	-	-	-	-	-	-	1,490
Kathmandu	460	-	-	-	-	-	150	-	-	-	610
Nuwakot	240	-	-	-	-	-	-	-	-	-	240
Dhading	-	-	-	12	-	-	-	-	-	-	12
Sindhupalchok	-	-	-	-	-	300 U	50	-	1600 U	400	2,350
Nawalparasi	280	-	-	200	-	-	-	-	-	-	480
Rupandehi	6,260	-	1,400	200	-	-	-	0 A	-	200	8,060
Kapilvastu	1,700	-	-	-	-	-	-	0 A	-	200	1,900
Tanahu	-	-	-	30	-	-	-	-	-	-	30
Gorkha	-	-	-	50	-	-	-	-	-	-	50
Lumjung	144	60	-	50	-	-	-	-	-	150	404
Kaski	-	300	-	70	1,127 U	-	-	-	-	-	1,497
Parbat	-	-	108	-	-	-	-	-	-	-	108
Baglung	60	-	-	-	-	-	-	-	-	-	60
Myagdi	20	-	-	25	-	-	-	-	-	60	105
Mustang	-	-	-	105	-	-	-	-	-	-	105
Dang Deukhuri	700	-	-	1,040	-	-	-	-	-	-	1,740
Banke	400	40	-	-	-	-	-	-	-	-	440
Bardiya	80	-	-	-	-	-	-	-	-	-	80
Pyuthan	-	60	-	-	-	-	-	-	-	-	60
Salyan	20	-	-	-	-	-	-	-	-	-	20
Kailali	4,650	-	-	-	-	-	-	0 A	-	-	4,650
Kanchanpur	720	0 A	-	-	-	-	-	0 A	-	-	720
Baitadi	-	-	-	150	-	-	-	-	-	-	150
Undefined	4360 A	-	7,400 U	-	-	-	-	-	-	320 U	11,840
Total Defined	32,900	460	2,733	2,332	0	0	200	0	0	1,010	39,635
Total Undefined	4,360	0	7,400	0	1,127	300	0	0	1,600	320	14,867
Total	37,020	460	10,133	2,332	1,127	300	200	0	1,600	1,330	54,502

A = After adjustments for double counting
U = Undefined projects

Note :

Minor Irrigation total includes tubewell areas of 400 ha in Sarlahi and 1400 ha in Bara previously accounted for as DOI managed projects. Agriculture Year total includes 330 ha in Morang, 150 ha in Sunsari and 60 ha in Kanchanpur already accounted for in Minor Irrigation total. Farm Irrigation total covers tubewell areas of 300 ha in Dhanusha, 300 ha in Rupandehi and 250 ha in Kapilvastu included in the ADPJ, plus tubewell areas of 350 ha in Kailali and 350 ha in Kanchanpur previously accounted for as DOI managed projects. Total adjustment for double counting is therefore 3,840 ha.

From DOI progress reports, command areas under agency assisted Farmer Managed Irrigation Systems are

1. Minor Irrigation	38,820 ha
2. Agriculture Year	1,000 ha
3. People's Participation 9,533 + 600	10,133 ha
4. Farmer's Canal Maintenance 1,212 + 1,120	2,332 ha
5. Small Hill Irrigation	1,127 ha
6. Small Irrigation	300 ha
7. Decentralization	200 ha
8. Farm Irrigation	1,500 ha
9. Food for Work	1,600 ha
10.District Level I.P	1,330 ha
	58,342 ha

TABLE A1-A1A FARMER MANAGED SYSTEMS WITH DOI INTERVENTION UNDER MINOR IRRIGATION PROGRAMME

District	Project Name	Developed Command Area (Ha) G.C.A	N.C.A
Morang	Baghi project	50	40
	Darlokna diversion	550	440
	Gadhi diversion	50	40
	Ghorjana Regulator	50	40
	Gouria	50	40
	Kajala	50	40
	Kathanu diversion	100	80
	Kochani diversion	50	40
	Mangalapur Pokhari	25	20
	Maria	500	400
	Sagar	250	200
	Sukna Pain	250	200
Sub-Total		1975	1580
Sunsari	Bajhgata tunnel	600	480
	Padaria-Garuda	250	200
	Sigia Daha Kachchawa	250	200
Sub-Total		1100	880
Saptari	Chapin	200	160
	Mutani	500	400
	Panchi	400	320
Sub-Total		1100	880
Siraha	Baburam Khola	1,250	1,000
	Gagan Nadi	1,500	1,200
	Lonia Bah	500	400
	Rajokhar Pokhari	75	60
	Rampur Kamala Wari	25	20
Sub-Total		3350	2680
Dhanusha	Jamuni	250	200
Sarlahi	Hariyai project	50	40
Rautahat	Baluwa Jabdi	1,250	1,000
	Bhakuwa	500	400
	Bhakuwa Dumaria	500	400
	Hatauna branch	250	200
	Jalaiya Bulkai	150	120
	Kharaiya Dah	400	320
	Manusmara	750	600
	Rampur Khopasi	20	16
Sub-Total		3820	3056

TABLE A1-A1A FARMER MANAGED SYSTEMS WITH DOI INTERVENTION UNDER MINOR IRRIGATION PROGRAMME (Continued)

District	Project Name	Developed Command Area (Ha) G.C.A	N.C.A
Bara	Bagari	156	125
	Behtani lift	150	120
	Gadhal	62	50
	Imriti	500	400
	Jamani	1,000	800
	Pasaha	2,000	1,600
	Thalahi	500	400
Sub-Total		4368	3495
Parsa	Chamari	200	160
	Gangola	12	10
	Oria	400	320
	Patlaiya-Mohana	100	80
	Rahat Kuwa-Bhabhanipur	12	10
	Rahat Kuwa-Suwarnpur	13	10
	Thoduwa	500	400
	Tilawe Minor	100	80
Sub-Total		1337	1070
Chitwan	Anandpur	13	10
	Anjana Tal	250	200
	Krishnapur	200	160
	Kusatta Overpass	150	120
	Lower Kerunga	25	20
	Pungi Khola	75	60
	Upper Kerunga	100	80
Sub-Total		813	650
Lalitpur	Aphal Kulo	312	250
	Ikud Kulo	150	120
	Kambhu Kulo	62	50
	Lele Kulo	32	25
	Lubhu Kulo	575	460
Sub-Total		1131	905
Bhaktapur	Dhungedhara Rajkulo	250	200
	Ghatte Kulo	125	100
	Kathudhal	50	40
	Kathuraj Kulo	500	400
	Katunje Kulo	50	40
	Lapsetar	75	60
	Nala Kulo	150	120
	Suryabinayak	62	50
	Thimi Manohara Kulo	50	40
	Walarku Kulo	50	40
	Yugdhara Kulo	500	400
Sub-Total		1862	1490

TABLE A1-A1A FARMER MANAGED SYSTEMS WITH DOI INTERVENTION UNDER MINOR IRRIGATION PROGRAMME (Continued)

District	Project Name	Developed Command Area (Ha) G.C.A	N.C.A
Kathmandu	Gagal Indrayani Kulo	162	130
	Pharping Dhungedhara	125	100
	Sankhu Rajkulo	250	200
	Tukucha Rajkulo	38	30
Sub-Total		575	460
Nuwakot	Andheri Khola	300	240
Nawalparasi	Gaidakot	25	20
	Hulasi diversion	250	200
	Potaha reservoir	75	60
Sub-Total		350	280
Rupandehi	Manigram Tubewell	75	60
	Solah Chattis Kulo	7,500	6,000
	Teller Nala	250	200
Sub-Total		7825	6260
Kapilvastu	Bhutaha	375	300
	Jamuar diversion	750	600
	Marthi project	1,000	800
Sub-Total		2125	1700
Lamjung	Chisankha Besi	150	120
	Mulmule	30	24
Sub-Total		180	144
Baglung	Kudle and Kathe Kulo	75	60
Myagdi	Babia Chour	25	20
Dang	Bela project	250	200
	Bhote Dah	50	40
	Chaime Khola	250	200
	Chandanpur	200	160
	Charange Dah	75	60
	Rakse Chour	50	40
Sub-Total		875	700
Banke	Puraiya Tal	300	240
	Shuruwa (Garwa Gaon) Tal	200	160
Sub-Total		500	400

TABLE A1-A1A FARMER MANAGED SYSTEMS WITH DOI INTERVENTION UNDER MINOR IRRIGATION PROGRAMME (Continued)

District	Project Name	Developed Command Area (Ha) G.C.A	N.C.A
Bardia	Gularia Kulo	50	40
	Manpur Tapara	50	40
Sub-Total		100	80
Salyan	Ghatte Khola	25	20
Kailali	Gular Gappa Pump	225	180
	Gurgi diversion	2,687	2,150
	Kailali Nala	700	560
	Kateni Nala	1,500	1,200
	Khareti Pump	225	180
	Pahalwanpur Pump	225	180
	Shukti Irrigation	250	200
Sub-Total		5812	4650
Kanchanpur	Routeli Khola	900	720
(Terai)	Unidentified Projects	5,452	4,360
TOTAL		46,275	37,020

Note:

The progress reports of the following Minor Irrigation Projects are shown in D.O.I lists. They are double counted, hence the area has been deleted from the M.I.P list.

	G.C.A	N.C.A
Sarlahi Tubewells	500	400
Bara Tubewells	1750	1400

Bara tubewell areas are included in the Narayani Project.

TABLE A1-A1B FARMER MANAGED SYSTEMS WITH DOI INTERVENTION UNDER AGRICULTURE YEAR PROGRAMME

District	Name of Project	Developed Command Area (ha) G.C.A	N.C.A
Morang	Chiradhar	125	(100)1
	Kajala	288	(230)1
Sub-Total		413	0
Sunsari	Bajh gadha	187	150
Lamjung	Barahbise Kulo Jyamire Kulo Pang Kulo Satrasai Kulo	75	60
Sub-Total		75	60
Kaski	Lower Hyanja Upper Hyanja	375	300
Sub-Total		375	300
Banke	Dugwel Nimade	50	40
Pyuthan	Bijuli Biraulla	75	60
Kanchanpur	Kanchanpur Tubewell	75	60
TOTAL		1,250	670

Notes :

1. These areas were previously included in the Minor Irrigation list, and are not recognised here.

TABLE A1-A1D FARMER MANAGED SYSTEMS WITH DOI INTERVENTION UNDER FARMERS IRRIGATION SYSTEM MAINTENANCE PROGRAMME

District	Name of Project	G.C.A in ha	N.C.A in ha
Jhapa	Mawa Khola	250	200
Ilam	Ek Tappa and Mahamai	63	50
Khotang	Sabju Khola	62	50
Ramechhap	Mugitar	62	50
Lalitpur	Saibu	62	50
Dhading	Dudurung	15	12
Nawalparasi	Bhartipur Gaon	125	100
	Tang Khola	125	100
Sub-Total		250	200
Rupandehi	Pahela Khola	250	200
Tanhun	Rishinch Patan Kutiaphant	37	30
Gorkha	Dhawatar	63	50
Lumjung	Bangrebesi	62	50
Kaski	Lahachok	87	70
Myagdi	Ratnachour Small Kulo	32	25
Mustang	Chaile	7	6
	Chetang	25	20
	Chuksang	5	4
	Gyakar	25	20
	Jhang	25	20
	Tangwe	44	35
Sub-Total		131	105
Dang	Chamai Khola	1050	840
	Sankram Khola	250	200
Sub-Total		1300	1040
Baitadi	Bagari	94	75
	Tungali	94	75
Sub-Total		188	150
TOTAL		2914	2332

TABLE A1-A1E FARMER MANAGED SYSTEMS WITH DOI INTERVENTION UNDER SMALL HILL IRRIGATION PROGRAMME

District	Name of Project	G.C.A in ha	N.C.A in ha
Kaski	Unidentified Projects	1408	1127
TOTAL		1408	1127

TABLE A1-A1F FARMER MANAGED SYSTEMS WITH DOI INTERVENTION UNDER SMALL IRRIGATION PROGRAMME

District	Name of Project	G.C.A in ha	N.C.A in ha
Sindhupalchok	Unidentified Projects	375	300
TOTAL		375	300

TABLE A1-A1G FARMER MANAGED SYSTEMS WITH DOI INTERVENTION UNDER DECENTRALISATION PROGRAMME

District	Name of Project	G.C.A in ha	N.C.A in ha
Kathmandu	Shali Nadi	188	150
Sindhupalchok	Ghatte Kulo	62	50
TOTAL		250	200

TABLE A1-A1H FARMER MANAGED SYSTEMS WITH DOI INTERVENTION UNDER FARM IRRIGATION AND WATER UTILISATION PROGRAMME

District	Name of Project	G.C.A in ha	N.C.A in ha
Dhanusha	JADP Tubewell	375	300
Rupandehi & Kapilvastu	Tubewell	625	500
Kailali & Kanchanpur	Tubewell	875	700
TOTAL		1875	1500

TABLE A1-A1I FARMER MANAGED SYSTEMS WITH DOI INTERVENTION UNDER FOOD FOR WORK PROGRAMME

District	Name of Project	G.C.A in ha	N.C.A in ha
Sindhupalchok	Unidentified Projects	2000	1600
TOTAL		2000	1600

TABLE A1-A2 DETAILS OF SID (FIWUD) SCHEMES

District	Name of Project	Type of Project	Command Area (ha)
Jhapa	Dhaijan	Reh.	100
	Rekhapaini	Reh.	80
Sub-Total			180
Sunsari	Baklauri	-	100
	Sukumari	-	500
Sub-Total			600
Saptari	Khado Khola (100 ha)	Reh.	30
	Ghod Daha (100 ha)		20
Sub-Total			50
Siraha	Sarsoti Khola (150 ha)	Reh.	15
	Gagan Khola		300
	Kamala Paini	Reh.	300
	Maina Wati (300 ha)		60
Sub-Total			675
Panchthar	Kafalbote	New	150
Tehrathum	Halchok	New	25
	Hattihal	-	30
	Jirikhimti	-	300
	Lohatopa	-	100
	Teliya Khola	New	100
	Uwa Khola	New	100
Sub-Total			655
Dhankuta	Guthitar Pond	-	5
	Kavre	-	30
	Leguwa	-	200
	Mulghat	-	35
Sub-Total			270
Bhojpur	Champe	-	200
Udayapur	Basaha (100 ha)	New	55
	Flood affected area of Udayapur (65 Nos)		164
	Sukha Sundari (100 ha)	New	35
Sub-Total			254

TABLE A1-A2 DETAILS OF SID (FIWUD) SCHEMES (Continued)

District	Name of Project	Type of Project	Command Area (ha)
Khotang	Bulku	New	15
	Chyan Danda	New	50
	Dorpa	New	250
	Ekchhange	New	200
	Makshingtar (33 ha)	New	3
	Sawa Katahare (100 ha)	New	5
Sub-Total			523
Okhaldhunga	Devi Tar (17 ha)		8
	Gamnang Tar (80 ha)		23
	Khata	New	3
	Kutunje (70 ha)	New	21
	Mamkha (100 ha)	New	5
Sub-Total			60
Solukhumbu	Mukali (50 ha)		46
	Salyan (50 ha)	New	10
Sub-Total			56
Dhanusha	Agangir		50
	Amari		200
	Aumara		22
	Bacharaja		125
	Bagdi Mogaliya		100
	Baigapiparadi		75
	Bakchura		75
	Balha Kathal	New	80
	Banguhai		100
	Basahi		10
	Bidhi		500
	Bighi		100
	Bighi	New	120
	Birta Kulo	New	100
	Bu.Ja Nadi	New	125
	Chaubahi		75
	Dabari		10
	Daldale Ghigh	New	100
	Dhadar Kulo		50
	Duchamati	New	200
	Gagatiya Bandh		150
	Gagdar Khola		75
	Galaiya	New	150
	Ganeshpur		150
	Jalad		25
	Jallad		250
	Jamuni		10

TABLE A1-A2 DETAILS OF SID (FIWUD) SCHEMES (Continued)

District	Name of Project	Type of Project	Command Area (ha)
	Jamuni Kulo		75
	Jhallha		50
	Jhojhhi Kataiya		55
	Kagibandh		100
	Kagipain		150
	Kagipain		50
	Kagipain yamba Bhari		225
	Kamala Sownpur		85
	Litara	New	100
	Lohana		100
	Lohara Khola		70
	Lohara Khola		100
	Madhubasa		50
	Magalhaiya		75
	Maruwahi	New	25
	Mechi Kulo		100
	Mithilayshwar		250
	Pain Bi Bi	New	75
	Pain P.B.		7
	Pujagari		8
	Purano Jalladha		250
	Satokhar		150
	Sidhipai		150
	Silami		20
	Sima		12
	Sinujoda	New	100
	Sugrahai		13
	Thumchuna		125
	Tilcho		75
	Vas Khola		100
	Vugaliya		75
Sub-Total			5847
Mahottari	Judo	New	90
Rauthat	Bhakuwa (A) *		(200)
	Bhakuwa (B) *		(500)
	Kamdehi		200
	Lal Bakia		2500
Sub-Total			2700
Parsa	Anara	New	8
	Doda	New	200
Sub-Total			208

TABLE A1-A2 DETAILS OF SID (FIWUD) SCHEMES (Continued)

District	Name of Project	Type of Project	Command Area (ha)
Chitwan	Bad Gaon	Reh.	150
	Birendra Nagar	Reh.	50
	Dunge Khola	Reh.	50
	Jagatpur		200
	Junpur		100
	Kahirani	Reh.	200
	Kapiya Kumroj		200
	Kathar Kapini		250
	Kathar Kulo	Reh.	30
	Kathar (A)		400
	Ladari	Reh.	60
	Majhui	Reh.	150
	Tanahi	Reh.	150
Sub-Total			1990
Sindhuli	Andheri Khola	New	165
	Barah Palase	New	150
	Bardeutar	Reh.	6
	Batonigale	Reh.	15
	Chaurahi Khola	Reh.	34
	Dhami Dumaria	New	39
	Gairi Khet	Reh.	10
	Kamala	-	39
	Khattar	Reh.	16
	Khopi Kharka	Reh.	19
	Khurkot	-	77
	Lamu Kulo	Reh.	8
	Nigale	Reh.	2
	Pokhari Khet	Reh.	5
	Sindhuli	-	5
	Thulo Khola	New	60
Sub-Total			650
Ramechap	Babiya Kharka	-	1
	Bathare Khola	-	25
	Bhatauli Khola	New	25
	Bhyagure Khola	-	23
	Bire Khola	New	2
	Bohora Khola	New	150
	Haluwa Khola	New	150
	Junga Ghorang	New	25
	Kamare Khola	New	20
	Karki Tar	New	25
	Khimti Khola	New	12
	Majuwa	New	2
	Utise	-	5
	Waling Khola	New	25
Sub-Total			490

TABLE A1-A2 DETAILS OF SID (FIWUD) SCHEMES (Continued)

District	Name of Scheme	Type of Project	Command Area (ha)
Makwanpur	Rapti Nawalpur		60
Kavre	Balthali	New	55
	Bhygure Khola	New	80
Sub-Total			135
Lalitpur	Godawari	New	4
Bhaktapur	Dhunge Khola (25 ha)	New	3
	Narayanthali	New	30
Sub-Total			33
Kathmandu	Bagmati	New	250
	Thado Khola (150 ha)	New	37
Sub-Total			287
Nuwakot	Andheri Khola	New	60
	Archale (100 ha)	New	64
	Baspani	New	250
	Betini Khola	New	70
	Bhanjyang Bhurung	New	70
	Chhupang Khola	New	250
	Chhyang Khola	New	200
	Darsan Tar	New	125
	Duichhange	New	150
	Gomati Khola	New	30
	Hatti Khola (150 ha)	New	59
	Majhuwa	New	150
	Puranagawn (100 ha)	New	33
Sub-Total			1511
Dhading	Salang (125 ha)	New	20
	Tabal Besi	New	100
Sub-Total			120
Dolakha	Dolti Khola	Reh.	20
	Gopi Khola	New	135
Sub-Total			155
Sindhupalchok	Hoste Khola	New	100
Rasuwa	Phalakhu Khola	New	30
Nawalparasi	Misrauli Bhaluwa	New	100

TABLE A1-A2 DETAILS OF SID (FIWUD) SCHEMES (Continued)

District	Name of Scheme	Type of Project	Command Area (ha)
Rupandehi	Hagani Khola		50
	Mudiyari Khola		50
	Sota Jharana	New	120
Sub-Total			220
Kapilbastu	Ghorai Dhankauli (300 ha)		225
	Maurma (150 ha)		150
	Sankarpur (150 ha)		113
Sub-Total			488
Palpa	Chhewa Phant	Reh.	30
	Galcha Phat (25 ha)	New	10
	Gijanchour Panche (28 ha)	New	4
	Heklang Thangali (65 ha)		33
	Sera Danda (25 ha)		15
	Thulo Khola (100 ha)	New	10
Sub-Total			102
Arghakhanchi	Chorika Solatra (20 ha)		8
	Mandre Khola	Reh.	75
	Sichkhok (150 ha)		23
Sub-Total			106
Gulmi	Hile Khola	New	44
Parbat	Arthar Dandakharka		25
	Baraute-syal	New	20
	Chinne Khola	Reh.	25
	Dhairing Lougdi		25
	Gade Khola	New	25
	Gahare Khola		25
	Jharuwa (65 ha)		20
	Jhyaple Khola		8
	Khahare Khola (100 ha)		50
	Khandula (125 ha)		50
	Lasti Khola	New	45
	Rayou		50
	Sirubari		25
	Sundare Khola	New	25
Sub-Total			418
Baglung	Dhapa Khola	Reh.	50
	Dhapa Khola (65 ha)		65
	Ghudi Khola	New	60
	Lubhuwa Khola (200 ha)		20
Sub-Total			195

TABLE A1-A2 DETAILS OF SID (FIWUD) SCHEMES (Continued)

District	Name of Scheme	Type of Project	Command Area (ha)
Myagdi	Nildaha		25
	Phaure Khola (25 ha)		25
	Thulo Khola	New	125
Sub-Total			175
Banke	Nibuwa Chappargadi (100 ha)		60
Rolpa	Dhabang (60 ha)		26
	Jawal Khola	New	60
Sub-Total			86
Salyan	Goth Khola (40 ha)		38
	Pharula Chaur (50 ha)		43
Sub-Total			81
Rukum	Chandriwang	New	15
	Rijegad		40
Sub-Total			55
Jajarkot	Chokha	New	15
	Matela	New	40
	Nabalgar	New	60
	Tal Chhahara	New	35
Sub-Total			150
Dolpa	Shanti Chchetra Horticulture	New	7
Kalikot	Chhati		155
	Khola Kharka		500
Sub-Total			655
Kailali	Kuldiyo	-	125
	Pratap pur Chawrahi	-	125
Sub-Total			250
Accham	Darta (50 ha)		30
	Tausi (150 ha)		98
Sub-Total			128

TABLE A1-A3 DETAILS OF PROJECTS UNDER THE HILL FOOD PRODUCTION PROJECT

District	Name of Project	Type	Command Area (ha)
Tanahu	Bande Khola	A	50
	Byandi Khola	A	30
	Chundi Khola (Chitti)	A	30
	Chundi Khola (Basantpur)	A	50
	Daudi Khola	A	30
	Dhalesti Khola	A	31
	Kulang Khola	C	30
	Thasam Kandi Khola	B	30
Sub-Total			281
Syanja	Andhi Khola	C	50
	Batang Khola	D	27
	Bodi Khola	A	30
	Chhore Khola	A	40
	Chiti Khola	D	100
	Dolche Khola	A	50
	Gudi Khola	A	25
	Jare Khola	B	30
	Jyagdi Khola	A	70
	Jyagdi Khola	A	55
	Kebare Khola	B	32
	Labdi Khola	A	50
	Labdi Khola	A	25
	Mirdi Khola	A	25
	Mulung Khola	C	30
	Thulo Tal	D	20
Sub-Total			659
Gorkha	Andheri Khola	A	50
	Beni Khola	B	50
	Blang Khola	B	13
	Daraudi Khola	A	10
	Dhakde Khola	D	115
	Khar Khola	A	50
	Mul Apeng Khola	A	10
	Raudi Khola	A	20
	Sirdi Khola	A	50
	Sirdiru Khola	A	50
	Taudi Khola	C	50
Sub-Total			468

TABLE A1-A3 DETAILS OF PROJECTS UNDER THE HILL FOOD PRODUCTION PROJECT

District	Name of Project	Type	Command Area (ha)
Lamjung	Bhidim Khola	A	100
	Bisedi Khola	A	20
	Dhad Khola	A	65
	Dhuwa Khola	A	25
	Jyamitre Khola	A	10
	Jyamitre Khola	A	60
	Khahare Khola	C	50
	Khali Marang	A	70
	Lupu Khola	B	65
	Paudi Khola	A	15
	Rople Khola	A	35
	Rumtako Khola	A	40
	Sisueri Khola	B	15
	Tardo Khola	A	18
Sub-Total			588
OVERALL TOTAL			1996

A - Present seasonal upgraded to perennial
B - Present rainfed to perennial
C - Present indigenous seasonal to improved seasonal
D - Present rainfed to improved seasonal

TABLE A1-A5 DETAILS OF ILO ASSISTED PROJECTS UNDER MPLD

District	Project Name	Command Area (ha)
Ilam	Dhuseni	150
	Shantipur	70
	Shantipur	65
Sub-Total		285
Khotang	Haunchaur	60
Okhaldhunga	Molung	150
Ramechap	Darkha	40
Makwanpur	Namtar	60
Kavre	Ghattekhola	60
Dhading	Marpark I	40
	Marpark II	60
	Satyadevi *	100
Sub-Total		200
Sindhupalchok	Jade Khola	20
Palpa	Binapathe	35
Arghakhanchi	Sitapur	20
	Waclakhola	60
Sub-Total		80
Gulmi	Gwalichour	100
	Kumaltari	90
Sub-Total		190
Tanahun	Nayatar	100
Syangja	Baguwakar	60
	S Phant	60
Sub-Total		120
Lamjung	Malebagar	10
Kaski	K Majuwa	60
	Lahachowk	100
	Takanjatar	150
Sub-Total		310

TABLE A1-A5 DETAILS OF ILO ASSISTED PROJECTS UNDER MPLD
(Continued)

District	Subproname	Command Area (ha)
Achham	Digreni	20
	Kogarsoot	15
	Poitorani	20
	Tarskuna	15
	Thanti	12
Sub-Total		82
Doti	Alrkot	9
	Amtoda	18
	Bolasan	1.5
	Chadakot *	20
	Chaneesen *	10
	Deuliaam	20
	Dipayal	50
	Dogod	80
	Hodrani	25
	Jakholekulo *	4
	Kachadakulo *	18
	Kundko	25
	Makgel	10
	Malloajit	35
	Matalkhat	2
	Mulesala	1.5
	Pokhari	10
	Roitara	40
	Rowakhat	2
	Saltoda	3
	Sapori	10
	Sara	1.5
	Serakhet *	40
	Serikulo *	40
	Talikhat	5
	Talkot	50
	Thadichoma	5
	Thali	5
	Tulakhet *	5
Sub-Total		545

TABLE A1-A5 DETAILS OF ILO ASSISTED PROJECTS UNDER MPLD
(Continued)

District	Subproname	Command Area (ha)
Dadeldhura	Ancholi	10
	Chaur	60
	Jormana	15
	Khajjar	1
	Korali	5
	Letum	5
	Melmoda	10
	Okhani	6
	Radil	150
	Randgon *	125
	Sunikhet	10
	Talai	10
	Tileta	20
Sub-Total		427
Baitadi	Dhungad (Sajha)	20
	Gurhadi	40
	Kumaligad Syadi	80
	Likhadi	10
	Liskela	15
	Surkal	40
	Wwoo Kul-Kalayoon	2 Km
Sub-Total		205
Bajura	Gankhel	10
	Kagebagar	8
	Parijadanga	7
	Serakhel	8
	Simsera	9
	Tapre	10
	Titrasan	6
	Warijadonga	7
Sub-Total		65
Bajhang	Boddi Kulo	50
	Byasi	45
	Deura	41
	Echeli	5
	Maj Kulo	35
	Marailregam	7
	Mulkado Dewal	80
	Parakaina	0.4
	Wad Kulo	30
Sub-Total		293

TABLE A1-A6 DETAILS OF IRRIGATION PROJECTS UNDER KOSI HILL AREA DEVELOPMENT PROJECT

District	Name Of Project	Type of Project	Command Area (ha)
Tehrathum	Basantpur	New	40
	Hattisar	Reh.	35
	Morhang	Reh.	50
	Piguwa	Reh.	150
	Samdu	Reh.	100
	Solma	New	33
	Sungnam	Reh.	25
Sub-Total			433
Dhankuta	Belharabesi	Reh.	40
	Bhaise	New	34
	Chungmang	Reh.	30
	Dandagaon	Reh.	60
	Dharapani	Reh.	20
	Dilungatar	Reh.	9
	Hathi Khark	New	25
	Hathitar	Reh.	10
	Jitpur	Reh.	45
	Piliyatar	Reh.	15
	Sano	New	35
	Tankhuwa	Reh.	30
Sub-Total			353
Bhojpur	Boya	Reh.	100
	Bukula	Reh.	20
	Dewangtar	Reh.	20
	Majuwatar	Reh.	40
	Manebhanjhang	Reh.	25
	Panchkanya	Reh.	75
Sub-Total			280
Sankhuwasabha	Bardeo	Reh.	15
	Hidangma	Reh.	75
	Kurkusani	New	30
	Malimulkhark	New	30
	Malinga	Reh.	50
	Noom	Reh.	40
	Pairaini	Reh.	10
	Pangma	New	40
	Sibhuwa	Reh.	45
	Sitalpati	Reh.	55
	Tama Phok	Reh.	50
Sub-Total			440
OVERALL TOTAL KHADP			1506

ADDENDUM : IRRIGATION PROJECTS UNDER DHADING INTEGRATED DEVELOPMENT PROJECT (G.T.Z.)

Dhading	Karkidada	Reh.	185

TABLE A1-A7 DETAILS OF CARE/USAID PROJECTS UNDER AGRICULTURAL DEVELOPMENT BANK

District	Name of Project	SFDP Name (ADB/N)	Type of Project	Command Area (ha)
Jhapa	Bahundangi	Bahundangi	New	388
Morang	Bhorjana II	Dulari	Reh.	(116)
	Bhorjana III	Dulari	Reh.	(125)
	Letang I	Letang	New	92
	Letang II	Letang	Reh.	(265)
	Letang III	Letang	Reh.	(134)
	Sijuwa	Sijuwa	Reh.	(99)
	Sunderpur	Dulari	New	50
Sub-Total				142
Sunsari	Pakli	Pakli	Reh.	(167)
Dhanusha	Chakkar	Chakkar	New	(250)
	Dhanusha Dham	Dhanusha Dha	New	(250)
	Tulsi	Tulsi	Reh.	70
Sub-Total				70
Mahottari	Hathilet	Hathilet	Reh.	(247)
	Khayarmara	Khayarmara	New	138
Sub-Total				138
Sarlahi	Haripur	Haripur	New	200
	Parwanipur	Parwanipur	Reh.	(400)
Sub-Total				200
Chitwan	Kumroj D/S	Kumroj	New	390
	Kumroj U/S	Kumroj	Ext.	60
Sub-Total				450
Makwanpur	Baraytar	Namtar	Reh.	39
	Jhilkeni	Jyamire	New	24
	Namtar	Namtar	New	50
	Rajaiya	Jyamire	Reh.	28
	Thade	Jyamire	New	10
	Tistung	Tistung	New	28
Sub-Total				179

TABLE A1-A7 DETAILS OF CARE/USAID PROJECTS UNDER AGRICULTURAL DEVELOPMENT BANK (Continued)

District	Name of Project	SFDP Name (ADB/N)	Type of Project	Command Area (ha)
Kavre	Balthal I	Khopasi	Reh.	20
	Bhumultar I	Bhumultar I	New	20
	Jamunay	Bhumultar	Reh.	(15)
	Khopasi II	Khopasi	Reh.	(36)
	Nayagaon	Nayagaon	Reh.	(250)
	Taramarang	Taramarang	New	(20)
Sub-Total				40
Nuwakot	Bhorle	Bhorle	New	(25)
	Jilling I	Jilling	New	25
	Kholaygaon	Kholaygaon	Reh.	(110)
	Lechyang	Lechyang	New	36
	Samari	Samari	New	(30)
	Sano Bhorle	Sano Bhorle	New	25
	Sundera Devi	Sundera Devi	Reh.	(80)
	Thulochour	Jilling	Reh.	(26)
Sub-Total				86
Rupandehi	Gauribandh	Kerbani	Reh.	212
Gorkha	Pyaudi	Chyangli	Reh.	(20)
	Taklung	Taklung	Reh.	14
Sub-Total				14
Lamjung	Sunder Bazar	Sunder Bazar	Ext.	(15)
TOTALS -	COMPLETED PROJECTS			1,919
	UNCOMPLETED PROJECTS			2,680
	OVERALL TOTAL			4,599

Notes :

1. Completed projects totalled 1919 ha by 1988. Only completed projects are included in Table 5.

2. Uncompleted projects are shown in brackets.

TABLE A1-A8 DETAILS OF ADBN TUBEWELL AND DUGWELL PROGRAMS

District	Shallow Tubewells		Dugwell
	No.	Net Command Area (ha)	No.
Jhapa	1625	6500	344
Morang	1395	5580	-
Sunsari	1949	7796	-
Saptari	-	-	52
Siraha	-	-	37
Udayapur	-	-	30
Dhanusha	346	1384	36
Mahottari	132	528	5
Sarlahi	227	908	260
Rauthat	972	3888	46
Bara	1496	5984	52
Parsa	144	576	-
Chitwan	135	540	658
Makwanpur	8	32	-
Nawalparasi	338	1352	152
Rupandehi	1401	5604	56
Kapilvastu	268	1072	14
Dang-Deukhuri	260	1040	66
Banke	760	3040	33
Bardiya	1023	4092	3
Kailali	1583	6332	3
Kanchanpur	1199	4796	-
Unidentified			21
OVERALL TOTAL	15261	61044	1868

TABLE A1-A8 DETAILS OF ADBN TUBEWELL AND DUGWELL PROGRAMS (Continued)

Notes :

1. Reconciliation of agency reported totals :

STW	61,044 ha	(see Table A-8)
Dugwell	7,472 ha	(see Note 3 below)
Rower Pumps	1,075 ha	(see Note 4 below)
	69,591 ha	
Double counting of STW areas of SIRDP & ADPJ	21,073 ha	
CARE/USAID Surface Projects	1,919 ha	(see Table A-7)
Reported Total	92,583 ha	

2. Basic data were obtained in the form of numbers of tubewells and dugwells assisted by ADBN between 1980 and 1988. Net command area irrigated by STW's was estimated assuming that each well serves an average of 4 ha.

3. Dugwells are normally temporary in nature and are primarily used for domestic purposes, with up to 0.5 ha of home garden being irrigated from each well. The potential NCA from dugwells is therefore ignored in computing the total area developed through ADBN assistance.

4. The areas that could be irrigated by Rower Pumps are ignored, as these areas are not permanent and usually serve less than 0.5 ha per pump.

TABLE A1-A9 DETAILS OF PROJECTS UNDER AGRICULTURAL DEVELOPMENT PROJECT, JANAKPUR

A. DEEP TUBEWELLS FROM 2031/032 TO 2044/045

District	Successful Tubewell Nos	Command Area (ha)	
Siraha	1	45	
Dhanusha	62	2790	
Mahottari	7	315	
Sarlahi	12	540	
Bara (Parwanipur)	1	45	
Kathmandu	1	45	
Total	84	3780	1

B. SHALLOW TUBEWELLS FROM 2037/038 TO 2044/045

District	Successful Tubewell Nos	Command Area (ha)	
Dhanusha	787	5509	
Mahottari	545	3815	
Sarlahi	1255	8785	
Rauthat	2	14	
Bara	4	28	
Chitwan	2	14	
Makwanpur	2	14	
Total	2597	18179	2

C. SURFACE IRRIGATION PROJECTS

District	Command Area (ha)	
Unidentified Surface Irrigation Projects in Dhanusha, Mahottari, Sarlahi, Dolakha, Ramechhap and Solukhumbu Districts	6041	
Total	6041	3
Grand Total A+B+C	28000	

1. Basic data were obtained in the form of numbers of tubewells completed. Net Command Area was estimated assuming that each Deep Tubewell serves as average of 45 ha.

2. Basic data were obtained in the form of numbers of tubewells completed. Net Command Area was estimated assuming that each Shallow Tubewell serves an average of 7 ha.

3. Recorded separately as "Undefined Projects" on Table A1-5.

Table A1-6

IRRIGATION STATUS OF AGRICULTURAL LAND FROM LRMP

District	Net Agricultural Areas (ha) (1)					
	Unirrigated	Monsoon Season Irrigated	Year Round Irrigated	Total Irrigated	Total Irrigable	Overall Total
EASTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT						
Jhapa	53391	45604	10534	56139	109530	109530
Morang	49456	37541	15941	53483	99959	102939
Sunsari	46889	16861	8007	24868	70629	71757
Saptari	58158	12605	6186	18791	76950	76950
Siraha	56433	16738	4555	21292	77726	77726
TOTAL FOR EASTERN TERAI DISTRICTS	264328	129350	45223	174573	434793	438901
EASTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT						
Ilam	25786	7473	3146	10619	12742	36405
Panchthar	25253	4184	2815	6998	7241	32251
Terhathum	15380	4729	1553	6282	6282	21661
Dhankuta	20302	3185	3310	6495	7495	26797
Bhojpur	28720	3540	2416	5957	6820	34677
Udayapur	19795	6284	4694	10978	18408	30773
Khotang	29215	6494	2241	8735	8859	37949
Okhaldhunga	20339	2893	919	3812	4478	24151
TOTAL FOR EASTERN HILL DISTRICTS	184790	38782	21094	59875	72324	244665
EASTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT						
Tapiejung	14691	5970	1441	7411	7443	22102
Sankhuwasawa	21380	2592	2000	4592	5170	25972
Solukhumbu	16000	1251	483	1733	2038	17734
TOTAL FOR EASTERN MOUNTAIN DISTRICTS	52071	9813	3924	13736	14651	65807
CENTRAL DEVELOPMENT REGION - TERAI ECOLOGICAL BELT						
Dhanusha	45676	15482	11767	27249	72925	72925
Mahottari	32963	11329	16357	27686	60633	60648
Sarlahi	33937	18561	21212	39772	73521	73709
Rautahat	21348	23281	11761	35042	56141	56390
Bara	18536	23723	18413	42136	60390	60666
Parsa	22007	11695	14672	26367	48374	48374
Chitwan	16227	15616	12694	28310	41963	44537
TOTAL FOR CENTRAL TERAI DISTRICTS	190688	119686	106876	226562	413948	417250
CENTRAL DEVELOPMENT REGION - HILL ECOLOGICAL BELT						
Sindhuli	21586	6892	5855	12747	20652	34333
Ramechhap	28356	2468	1452	3921	4248	32276
Makawanpur	27672	3802	4302	8105	23502	35777
Kabhre Palanchowk	23645	3466	2810	6277	7958	29922
Lalitpur	5530	2786	2752	5538	7425	11067
Bhaktapur	2113	2555	2555	5109	6274	7223
Kathmandu	6042	5531	5531	11062	14069	17103
Nuwakot	18373	5941	7469	13410	15047	31783
Dhading	27384	5522	3284	8805	10839	36189
TOTAL FOR CENTRAL HILL DISTRICTS	160701	38964	36009	74973	110014	235673

IRRIGATION STATUS OF AGRICULTURAL LAND FROM LRMP

District	Net Agricultural Areas (ha) (1)					
	Unirrigated	Monsoon Season Irrigated	Year Round Irrigated	Total Irrigated	Total Irrigable	Overall Total
CENTRAL DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT						
Dolakha	19267	2704	2071	4775	4911	24042
Sindhupalchowk	21915	7646	4259	11905	12276	33820
Rasuwa	4450	509	242	751	836	5201
TOTAL FOR CENTRAL MOUNTAIN DISTRICTS	45632	10859	6572	17431	18023	63063
WESTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT						
Nawalparasi	29842	14094	11302	25396	50690	55237
Rupandehi	43357	28314	16745	45059	87979	88417
Kapilbastu	45873	27683	11229	38912	84453	84785
TOTAL FOR WESTERN TERAI DISTRICTS	119072	70092	39276	109367	223122	228439
WESTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT						
Palpa	25586	1822	2946	4768	8857	30354
Arghakhanchi	16210	1583	2227	3809	4799	20019
Gulmi	21646	2042	1918	3960	4240	25605
Tanahun	27572	3222	3178	6399	14496	33971
Syangja	23270	3495	4253	7747	9848	31017
Gorkha	27082	4472	2360	6833	11027	33915
Lamjung	14031	7734	2083	9817	11937	23848
Kaski	24236	4791	2378	7169	15960	31405
Parbat	9314	3625	2292	5917	6455	15231
Baglung	20268	4659	1595	6254	7780	26522
Myagdi	12164	2605	971	3576	3685	15740
TOTAL FOR WESTERN HILL DISTRICTS	221378	40049	26201	66250	99084	287628
WESTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT						
Manang	718	0	0	0	121	718
Mustang	4221	0	0	0	159	4221
TOTAL FOR WESTERN MOUNTAIN DISTRICTS	4939	0	0	0	280	4939
MID WESTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT						
Dangdeukhuri	40536	18719	5267	23986	59505	64522
Banke	39529	7487	2509	9995	48550	49524
Bardiya	40945	9627	2264	11891	52660	52836
TOTAL FOR MID WESTERN TERAI DISTRICTS	121010	35832	10040	45872	160715	166882
MID WESTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT						
Pyuthan	18907	2197	2093	4290	7037	23197
Rolpa	26922	1303	1426	2729	3980	29651
Salyan	23586	2308	2139	4447	5282	28032
Rukum	21372	1110	1110	2221	4170	23592
Surkhet	23448	4337	3446	7783	19275	31231
Jajarkot	17800	1663	1651	3314	4143	21114
Dailekh	22268	3631	2474	6105	7075	28373
TOTAL FOR MID WESTERN HILL DISTRICTS	154302	16549	14339	30888	50962	185190

IRRIGATION STATUS OF AGRICULTURAL LAND FROM LRMP

District	Net Agricultural Areas (ha) (1)					
	Unirrigated	Monsoon Season Irrigated	Year Round Irrigated	Total Irrigated	Total Irrigable	Overall Total
MID WESTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT						
Dolpa	4896	50	50	100	544	4995
Jumla	10532	1115	995	2110	4765	12642
Kalikot	10372	1547	1207	2754	3084	13125
Mugu	7830	893	893	1787	2030	9617
Humla	4425	279	279	558	969	4984
TOTAL FOR MID WESTERN MOUNTAIN DISTRICTS	38055	3884	3424	7309	11392	45363
FAR WESTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT						
Kailali	36458	20873	9392	30265	64112	66722
Kanchanpur	19000	13783	8187	21970	40891	40971
TOTAL FOR FAR WESTERN TERAI DISTRICTS	55458	34656	17579	52235	105003	107693
FAR WESTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT						
Achham	21629	5037	5316	10353	10972	31982
Doti	18862	3877	4823	8699	10468	27562
Dadeldhura	9954	2060	4018	6078	7266	16032
Baitadi	19022	2695	3826	6521	7450	25543
TOTAL FOR FAR WESTERN HILL DISTRICTS	69467	13668	17983	31651	36155	101118
FAR WESTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT						
Bajura	9797	1241	1143	2384	3584	12181
Bajhang	15931	3306	3405	6712	7549	22643
Darchula	9960	1276	1965	3241	4239	13201
TOTAL FOR FAR WESTERN MOUNTAIN DISTRICTS	35687	5823	6514	12337	15373	48024
TOTALS BY DEVELOPMENT REGION						
EASTERN DISTRICTS	501189	177944	70241	248184	521769	749374
CENTRAL DISTRICTS	397021	169508	149457	318965	541984	715986
WESTERN DISTRICTS	345389	110140	65477	175617	322486	521006
MID WESTERN DISTRICTS	313367	56265	27804	84069	223069	397436
FAR WESTERN DISTRICTS	160611	54148	42076	96223	156531	256835
TOTALS BY ECOLOGICAL BELT						
TERAI DISTRICTS	750556	389615	218994	608609	1337581	1359165
HILL DISTRICTS	790637	148012	115626	263638	368540	1054275
MOUNTAIN DISTRICTS	176384	30379	20434	50813	59719	227196
TOTAL FOR ALL DISTRICTS	1717577	568005	355054	923059	1765839	2640636

Note

(1) From LRMP agricultural land use database analysis of cultivation types and cropping sequences; assumptions defining irrigated and irrigable cultivation types and cropping sequences are given in Table A1-2

Table A1-7

PRESENT IRRIGATION DEVELOPMENT COMMAND AREAS

District (1)	Developed Gross Command Area (GCA) (ha)							Developed Net Command Area (NCA) (ha)							Ratio NCA/GCA (Ident. Irrig.)
	Identified Irrigation					Unident. Irrig.	Overall Total	Identified Irrigation					Unident. Irrig.	Overall Total	
	DOI Schemes		Farmer Schemes		Total			DOI Schemes		Farmer Schemes		Total			
	SW (2)	GW (2)	SW (3)	GW (4)	(5)	(6)	(7)	SW (2)	GW (2)	SW (3)	GW (4)	(5)	(6)	(7)	(8)
EASTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT															
Jhapa *	7200	0	69380	8125	84705	0	84705	6000	0	55504	6500	68004	0	68004	0.80
Morang *	52100	0	40488	6975	99563	0	99563	33000	0	32390	5580	70970	0	70970	0.71
Sunsari *	52100	0	10910	9745	72755	0	72755	33000	0	8728	7796	49524	0	49524	0.68
Saptari *	40325	7187	9410	0	56922	0	56922	32260	5750	7528	0	45538	0	45538	0.80
Siraha *	16594	7218	11670	56	35538	0	35538	13275	5775	9336	45	28431	0	28431	0.80
TOTAL FOR EASTERN TERAI DISTRICTS	168319	14405	141858	24901	349483	0	349483	117535	11525	113486	19921	262467	0	262467	0.75
EASTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT															
Ilam	0	0	8362	0	8362	5981	14343	0	0	6191	0	6191	4428	10619	0.74
Panchthar	0	0	4826	0	4826	4774	9599	0	0	3518	0	3518	3480	6998	0.73
Terhathum	0	0	4328	0	4328	4579	8907	0	0	3052	0	3052	3230	6282	0.71
Dhankuta	0	0	4968	0	4968	3892	8860	0	0	3642	0	3642	2853	6495	0.73
Bhojpur	0	0	4582	0	4582	3655	8237	0	0	3314	0	3314	2643	5957	0.72
Udayapur *	319	812	12102	75	13308	414	13722	255	650	9682	60	10647	331	10978	0.80
Khotang	250	0	5701	0	5951	6124	12075	200	0	4104	0	4304	4430	8735	0.72
Okhaldhunga	300	0	2641	0	2941	2211	5152	240	0	1936	0	2176	1636	3812	0.74
TOTAL FOR EASTERN HILL DISTRICTS	869	812	47510	75	49266	31630	80895	695	650	35439	60	36844	23031	59875	0.75
EASTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT															
Taplejung	0	0	5054	0	5054	5303	10357	0	0	3617	0	3617	3794	7411	0.72
Sankhuwasawa	0	0	3456	0	3456	2862	6318	0	0	2512	0	2512	2080	4592	0.73
Solukhumbu	0	0	1340	0	1340	1006	2346	0	0	990	0	990	743	1733	0.74
TOTAL FOR EASTERN MOUNTAIN DISTRICTS	0	0	9851	0	9851	9170	19021	0	0	7119	0	7119	6617	13736	0.72
CENTRAL DEVELOPMENT REGION - TERAI ECOLOGICAL BELT															
Dhanusha *	18025	125	17696	12104	47950	0	47950	14500	100	14157	9683	38440	0	38440	0.80
Mahottari *	0	256	32570	5823	38649	0	38649	0	205	26056	4658	30919	0	30919	0.80
Sarlahi *	6000	500	28353	12791	47644	2896	50541	5800	400	21060	10233	37493	2279	39772	0.79
Rautahat *	5285	0	9450	4878	19593	23401	42994	4500	0	7567	3902	15969	19073	35042	0.82
Bara *	15885	3355	23277	7571	50088	1016	51104	13720	2900	18622	6057	41299	837	42136	0.82
Parsa *	18195	0	9185	720	28100	2638	30738	16180	0	7348	576	24104	2263	26367	0.86
Chitwan *	14000	0	15690	693	30383	5447	35830	10900	0	12552	554	24006	4304	28310	0.79
TOTAL FOR CENTRAL TERAI DISTRICTS	77370	4236	136221	44579	262406	35398	297804	65600	3605	107361	35663	212229	28757	240986	0.81
CENTRAL DEVELOPMENT REGION - HILL ECOLOGICAL BELT															
Sindhuli *	75	0	11625	0	11700	4234	15934	60	0	9300	0	9360	3387	12747	0.80
Ramechhap	50	0	2751	0	2801	2519	5320	40	0	2024	0	2064	1857	3921	0.74
Makawanpur	0	0	13997	58	14055	0	14055	0	0	11373	46	11419	0	11419	0.81
Kabhre *	0	0	4044	0	4044	3802	7846	0	0	3235	0	3235	3041	6277	0.80
Lalitpur *	1762	0	3079	0	4841	2080	6921	1410	0	2463	0	3873	1665	5538	0.80
Bhaktapur *	1630	0	1237	0	2867	3517	6384	1305	0	990	0	2295	2815	5109	0.80
Kathmandu	2738	0	5699	56	8493	5250	13743	2190	0	4601	45	6836	4226	11062	0.80
Nuwakot	965	0	8876	0	9841	8209	18050	772	0	6539	0	7311	6099	13410	0.74
Dhading	480	0	6485	0	6965	4680	11645	385	0	4882	0	5267	3539	8805	0.76
TOTAL FOR CENTRAL HILL DISTRICTS	7700	0	57793	114	65607	34291	99898	6162	0	45407	91	51660	26627	78287	0.79

PRESENT IRRIGATION DEVELOPMENT COMMAND AREAS

District (1)	Developed Gross Command Area (GCA) (ha)							Developed Net Command Area (NCA) (ha)							Ratio NCA/GCA
	Identified Irrigation					Unident. Irrig.	Overall Total	Identified Irrigation					Unident. Irrig.	Overall Total	(Ident. Irrig.)
	DOI Schemes		Farmer Schemes		Total			DOI Schemes		Farmer Schemes		Total			
	SW	GW	SW	GW				SW	GW	SW	GW				
	(2)	(2)	(3)	(4)	(5)	(6)	(7)	(2)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CENTRAL DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT															
Dolakha	200	0	3133	0	3333	3336	6668	175	0	2211	0	2386	2388	4775	0.72
Sindhupalchowk	0	0	8231	0	8231	8196	16427	0	0	5965	0	5965	5940	11905	0.72
Rasuwa	0	0	558	0	558	474	1033	0	0	406	0	406	345	751	0.73
TOTAL FOR CENTRAL MOUNTAIN DISTRICTS	200	0	11921	0	12121	12006	24128	175	0	8582	0	8757	8674	17431	0.72
WESTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT															
Nawalparasi *	17245	0	25332	1690	44267	0	44267	14090	0	18990	1352	34432	0	34432	0.78
Rupandehi *	600	10725	44361	7005	62691	0	62691	500	8600	35579	5604	50283	0	50283	0.80
Kapilbastu *	8500	575	25505	1340	35920	12720	48640	6800	460	20404	1072	28736	10176	38912	0.80
TOTAL FOR WESTERN TERAI DISTRICTS	26345	11300	95198	10035	142878	12720	155598	21390	9060	74973	8028	113451	10176	123627	0.79
WESTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT															
Palpa *	0	0	4209	0	4209	1751	5960	0	0	3367	0	3367	1401	4768	0.80
Arghakhanchi *	0	0	2959	0	2959	1765	4724	0	0	2386	0	2386	1423	3809	0.81
Gulmi *	75	0	2356	0	2431	2519	4950	60	0	1885	0	1945	2015	3960	0.80
Tanahun	437	0	8381	0	8818	0	8818	350	0	6694	0	7044	0	7044	0.80
Syangja	19	0	6126	0	6145	3804	9950	15	0	4770	0	4785	2962	7747	0.78
Gorkha	611	0	6337	0	6948	1912	8861	489	0	4869	0	5358	1475	6833	0.77
Lamjung	1011	0	6583	0	7594	5260	12854	809	0	4991	0	5800	4017	9817	0.76
Kaski	4412	0	5423	0	9835	0	9835	3540	0	4215	0	7755	0	7755	0.79
Parbat	625	0	3602	0	4227	3747	7974	500	0	2637	0	3137	2780	5917	0.74
Baglung	0	0	5094	0	5094	3334	8429	0	0	3780	0	3780	2474	6254	0.74
Myagdi	0	0	2442	0	2442	2434	4876	0	0	1791	0	1791	1785	3576	0.73
TOTAL FOR WESTERN HILL DISTRICTS	7190	0	53513	0	60703	26527	87230	5763	0	41384	0	47147	20333	67480	0.78
WESTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT															
Manang	0	0	74	0	74	0	74	0	0	59	0	59	0	59	0.80
Mustang	198	0	131	0	329	0	329	158	0	105	0	263	0	263	0.80
TOTAL FOR WESTERN MOUNTAIN DISTRICTS	198	0	205	0	403	0	403	158	0	164	0	322	0	322	0.80
MID WESTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT															
Dangdeukhuri *	2607	0	39645	1300	43552	0	43552	2085	0	31716	1040	34841	0	34841	0.80
Banke *	1560	0	7661	3800	13021	0	13021	1250	0	6129	3040	10419	0	10419	0.80
Bardiya *	1200	0	31774	5115	38089	0	38089	960	0	23527	4092	28579	0	28579	0.75
TOTAL FOR MID WESTERN TERAI DISTRICTS	5367	0	79080	10215	94662	0	94662	4295	0	61372	8172	73839	0	73839	0.78
MID WESTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT															
Pyuthan *	425	0	3818	0	4243	568	4811	340	0	3444	0	3784	506	4290	0.89
Rolpa	0	0	2550	0	2550	1049	3599	0	0	1934	0	1934	795	2729	0.76
Salyan *	0	0	3495	0	3495	2063	5558	0	0	2796	0	2796	1651	4447	0.80
Rukum	750	0	1814	0	2564	246	2810	600	0	1426	0	2026	194	2221	0.79
Surkhet *	0	0	12327	0	12327	0	12327	0	0	9862	0	9862	0	9862	0.80
Jajarkot	0	0	2658	0	2658	1717	4374	0	0	2013	0	2013	1301	3314	0.76
Dailekh	0	0	4612	0	4612	3578	8191	0	0	3438	0	3438	2667	6105	0.75
TOTAL FOR MID WESTERN HILL DISTRICTS	1175	0	31274	0	32449	9221	41670	940	0	24912	0	25852	7114	32967	0.80

PRESENT IRRIGATION DEVELOPMENT COMMAND AREAS

District (1)	Developed Gross Command Area (GCA) (ha)							Developed Net Command Area (NCA) (ha)							Ratio NCA/GCA (Ident. Irrig.)
	Identified Irrigation					Unident. Irrig.	Overall Total	Identified Irrigation					Unident. Irrig.	Overall Total	
	DOI Schemes		Farmer Schemes		Total			DOI Schemes		Farmer Schemes		Total			
	SW (2)	GW (2)	SW (3)	GW (4)	(5)	(6)	(7)	SW (2)	GW (2)	SW (3)	GW (4)	(5)	(6)	(7)	(8)
MID WESTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT															
Dolpa	0	0	328	0	328	0	328	0	0	264	0	264	0	264	0.81
Jumla	0	0	2857	0	2857	0	2857	0	0	2315	0	2315	0	2315	0.81
Kalikot	0	0	2016	0	2016	1689	3704	0	0	1498	0	1498	1255	2754	0.74
Mugu	0	0	1306	0	1306	1059	2365	0	0	987	0	987	800	1787	0.76
Humla	0	0	595	0	595	111	705	0	0	471	0	471	88	558	0.79
TOTAL FOR MID WESTERN MOUNTAIN DISTRICTS	0	0	7102	0	7102	2858	9960	0	0	5535	0	5535	2143	7678	0.78
FAR WESTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT															
Kailali *	10245	3952	36277	7915	58389	0	58389	7133	3162	29022	6332	45649	0	45649	0.78
Kanchanpur *	5520	2434	7355	5995	21304	5248	26552	5000	1948	5884	4796	17628	4342	21970	0.83
TOTAL FOR FAR WESTERN TERAI DISTRICTS	15765	6386	43632	13910	79693	5248	84941	12133	5110	34906	11128	63277	4342	67619	0.79
FAR WESTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT															
Achham	0	0	7234	0	7234	6814	14048	0	0	5331	0	5331	5022	10353	0.74
Doti	0	0	6721	0	6721	4774	11495	0	0	5086	0	5086	3613	8699	0.76
Dadeldhura	150	0	4430	0	4580	3305	7885	120	0	3410	0	3530	2548	6078	0.77
Baitadi	494	0	4394	0	4888	3918	8806	395	0	3225	0	3620	2901	6521	0.74
TOTAL FOR FAR WESTERN HILL DISTRICTS	644	0	22779	0	23423	18812	42235	515	0	17052	0	17567	14084	31651	0.75
FAR WESTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT															
Bajura	0	0	2250	0	2250	830	3080	0	0	1742	0	1742	642	2384	0.77
Bajhang	0	0	4734	0	4734	3928	8662	0	0	3668	0	3668	3044	6712	0.77
Darchula	0	0	2748	0	2748	1576	4323	0	0	2060	0	2060	1181	3241	0.75
TOTAL FOR FAR WESTERN MOUNTAIN DISTRICTS	0	0	9732	0	9732	6334	16066	0	0	7470	0	7470	4867	12337	0.77
TOTALS BY DEVELOPMENT REGION															
EASTERN DISTRICTS	169188	15217	199219	24976	408600	40800	449400	118230	12175	156045	19981	306431	29648	336079	0.75
CENTRAL DISTRICTS	85270	4236	205936	44693	340134	81696	421830	71937	3605	161351	35754	272647	64058	336704	0.80
WESTERN DISTRICTS	33733	11300	148916	10035	203984	39247	243231	27311	9060	116521	8028	160920	30509	191429	0.79
MID WESTERN DISTRICTS	6542	0	117456	10215	134213	12079	146292	5235	0	91819	8172	105226	9257	114483	0.78
FAR WESTERN DISTRICTS	16409	6386	76143	13910	112848	30394	143241	12648	5110	59427	11128	88313	23294	111607	0.78
TOTALS BY ECOLOGICAL BELT															
TERAI DISTRICTS	293166	36327	495989	103640	929122	53367	982489	220953	29300	392098	82912	725263	43275	768539	0.78
HILL DISTRICTS	17578	812	212869	189	231447	120481	351928	14075	650	164195	151	179071	91190	270261	0.77
MOUNTAIN DISTRICTS	398	0	38811	0	39209	30368	69577	333	0	28870	0	29203	22301	51504	0.74
TOTAL FOR ALL DISTRICTS	311142	37139	747668	103829	1199778	204216	1403994	235361	29950	585164	83063	933538	156766	1090304	0.78

PRESENT IRRIGATION DEVELOPMENT COMMAND AREAS

Notes

(1) Asterisks indicate those districts for which WECS WUIs were available
(2) DOI implemented and managed surface water (SW) and groundwater (GW) projects from DOI information sources (Table A1-3)
(3) Farmer managed SW schemes from WECS WUIs, as available, excluding overlaps with DOI projects in (2);
else from derived representative ratio of irrigated to irrigable agricultural land area,
corrected where appropriate from agency inventories reconciled with respect to duplications (Table A1-5)
(4) Farmer managed STW and DTW GW developments from ADBN/STW and DOA/ADPJ inventories (Table A1-5)
(5) Sum of (2), (3) and (4)
(6) Net total irrigated agricultural area from LRMP agricultural land use database analysis (Table A1-6)
less net total identified irrigation area in (5), with negative differences set to zero;
GCA = NCA / [Ratio in (8)]
(7) Sum of (5) and (6); values differ from those for total irrigated area in Table A1-6,
in those cases where zero is used instead of a negative value in (6)
(8) Ratio of NCA in (5) to GCA in (5)

Table A1-8

PRESENT LEVEL OF IRRIGATION DEVELOPMENT

Development Region	Ecological Belt	Net Agricultural Areas (ha)						
		Overall Total	Total Irrigable	Existing Irrigation Development				
				Developed DOI Schemes	Developed Farmer Schemes	Total Developed Schemes	Ongoing DOI Schemes	Total Existing Schemes
		(1)	(1)	(2)	(2)	(3)	(4)	(5)
Eastern	Terai	438901	434793	129060	133407	262467	10752	273219
	Hill	244665	72324	1345	35499	36844	283	37127
	Mountain	65807	14651	0	7119	7119	0	7119
	Total	749373	521768	130405	176025	306430	11035	317465
Central	Terai	417250	413948	69205	143024	212229	6500	218729
	Hill	235673	110014	6162	45498	51660	0	51660
	Mountain	63063	18023	175	8582	8757	0	8757
	Total	715986	541985	75542	197104	272646	6500	279146
Western	Terai	228439	223122	30450	83001	113451	4400	117851
	Hill	287628	99084	5763	41384	47147	1008	48155
	Mountain	4939	280	158	164	322	0	322
	Total	521006	322486	36371	124549	160920	5408	166328
Mid Western	Terai	166882	160715	4295	69544	73839	0	73839
	Hill	185190	50962	940	24912	25852	0	25852
	Mountain	45363	11392	0	5535	5535	0	5535
	Total	397435	223069	5235	99991	105226	0	105226
Far Western	Terai	107693	105003	17243	46034	63277	1990	65267
	Hill	101118	36155	515	17052	17567	0	17567
	Mountain	48024	15373	0	7470	7470	0	7470
	Total	256835	156531	17758	70556	88314	1990	90304
Nepal	Terai	1359165	1337581	250253	475010	725263	23642	748905
	Hill	1054274	368539	14725	164345	179070	1291	180361
	Mountain	227196	59719	333	28870	29203	0	29203
	Total	2640635	1765839	265311	668225	933536	24933	958469

Notes

(1) From Table A1-6
(2) From Table A1-7, sum of identified surface water and groundwater scheme net command areas
(3) Sum of developed DOI and farmer scheme areas
(4) From Table A1-3
(5) Sum of developed and ongoing scheme areas

Figure A1–1

Command Areas – DOI Schemes

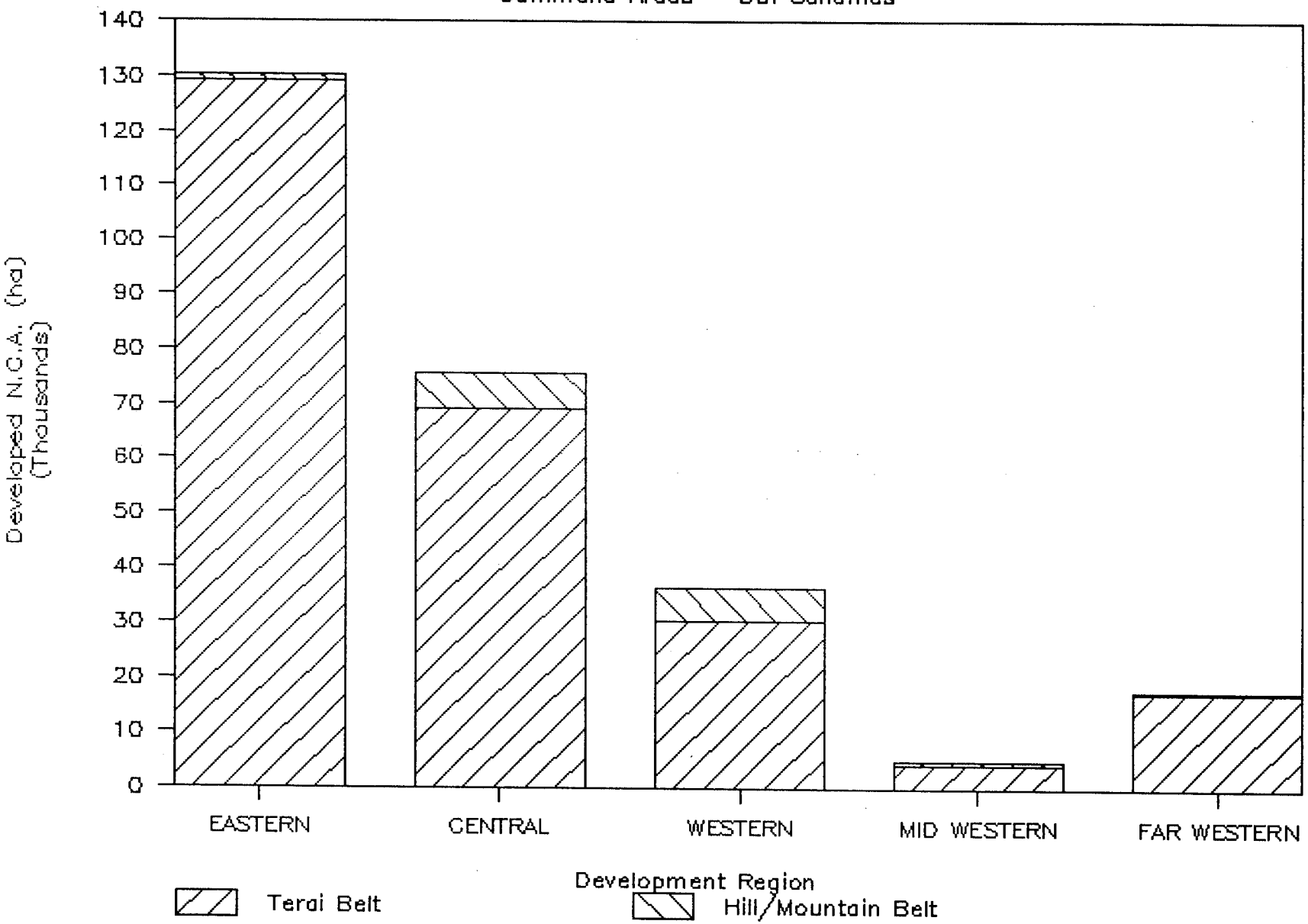

Figure A1–2

Command Areas – Defined Agency FMS

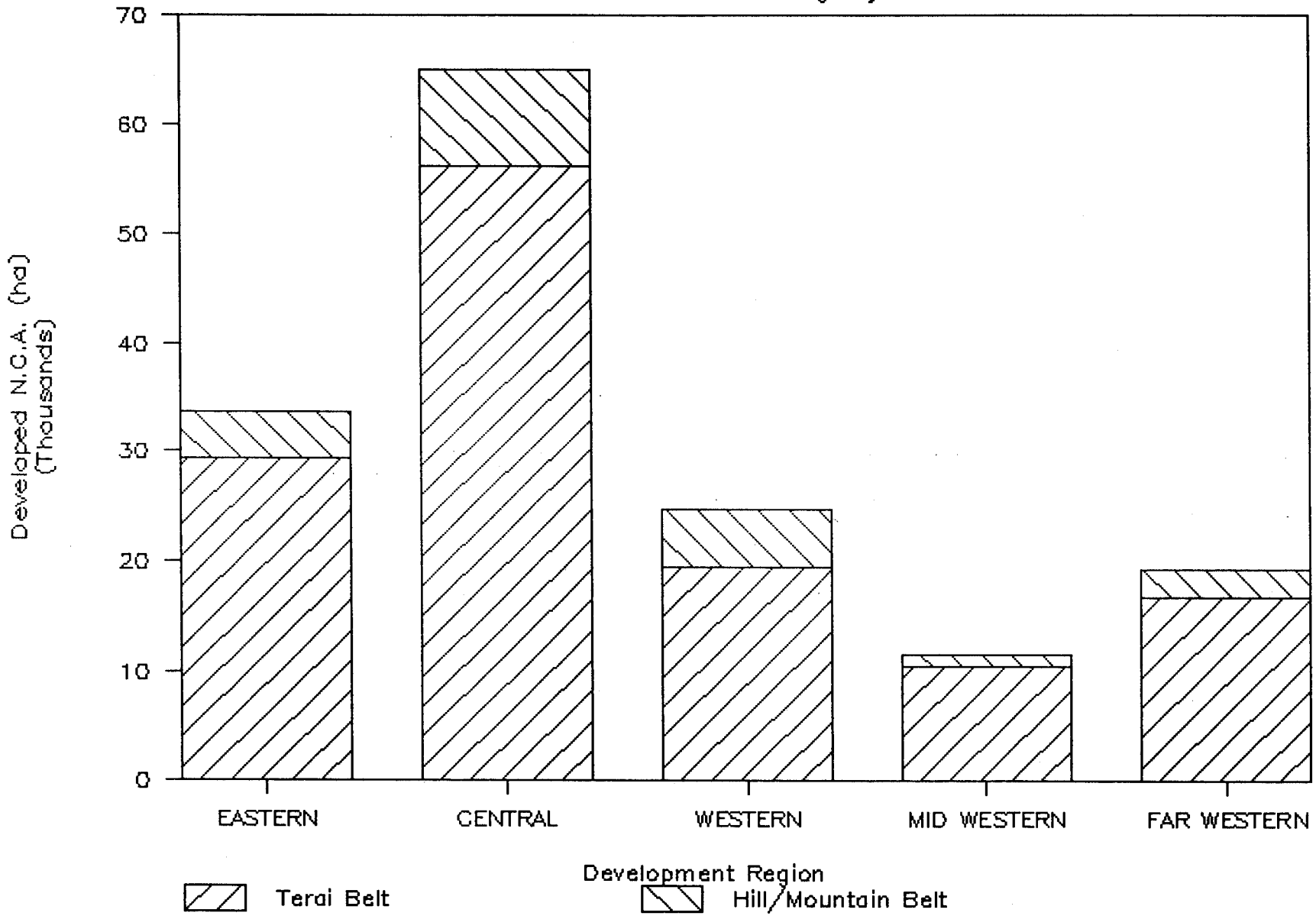

Figure A1—3a

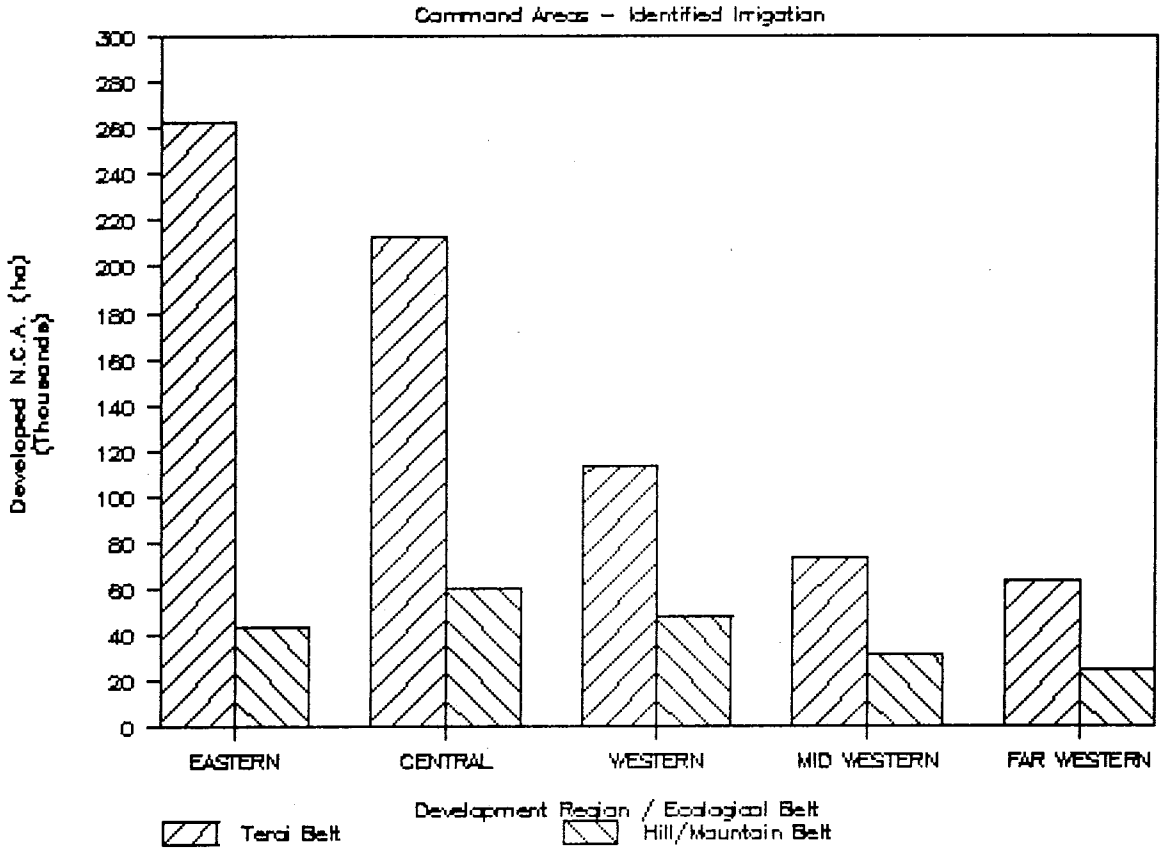

Figure A1—3b

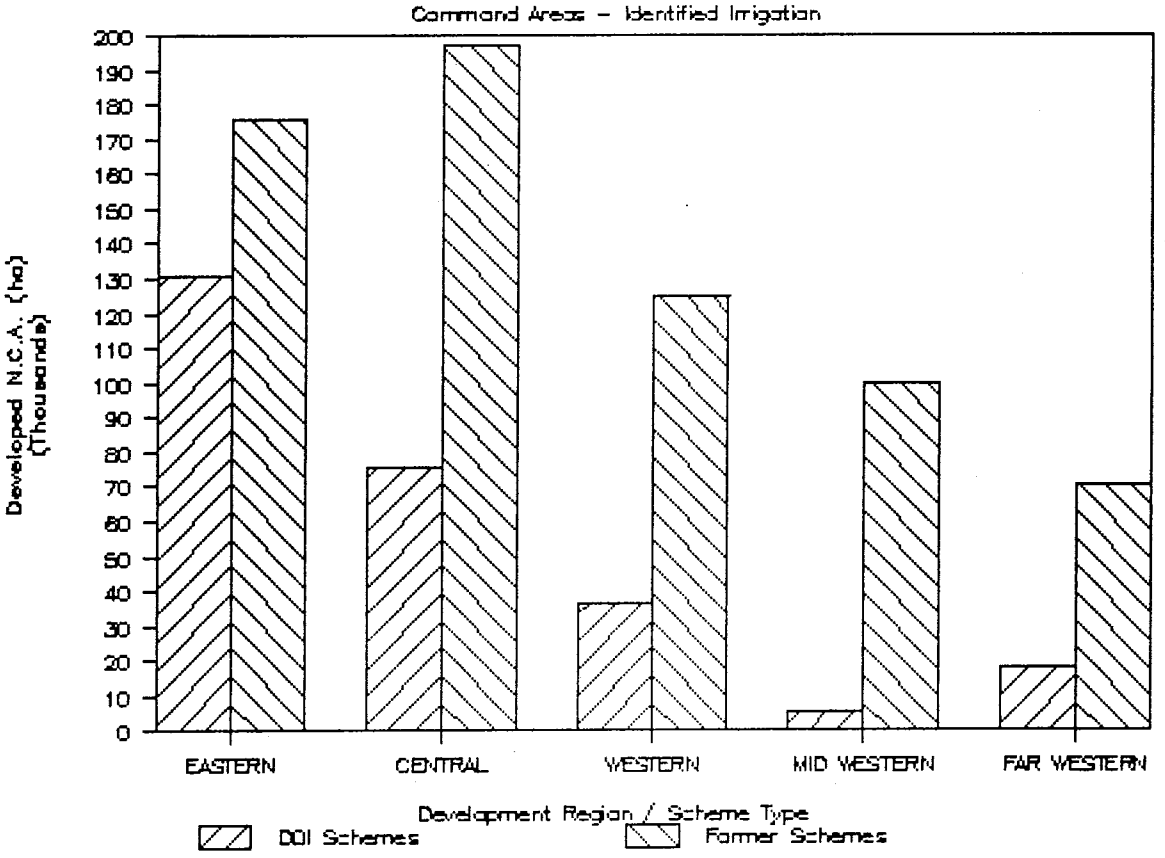

Figure A1—4

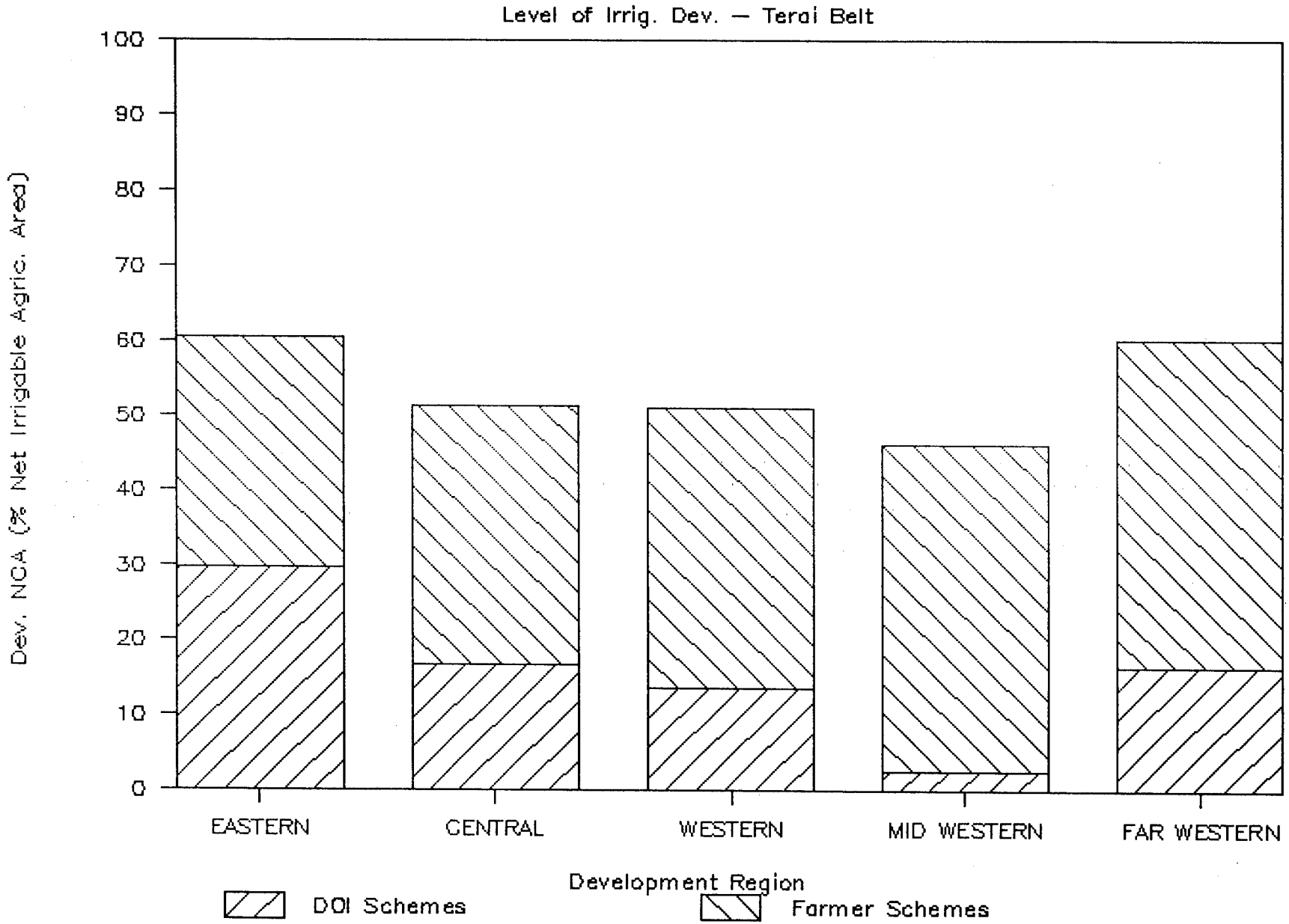
Level of Irrig. Dev. — Terai Belt
Dev. NCA (% Net Irrigable Agric. Area)
100
90
80
70
60
50
40
30
20
10
0
EASTERN
CENTRAL
WESTERN
MID WESTERN
FAR WESTERN
Development Region
DOI Schemes
Farmer Schemes

Figure A1–5

Level of Irrig. Dev. — Hill/Mount. Belt

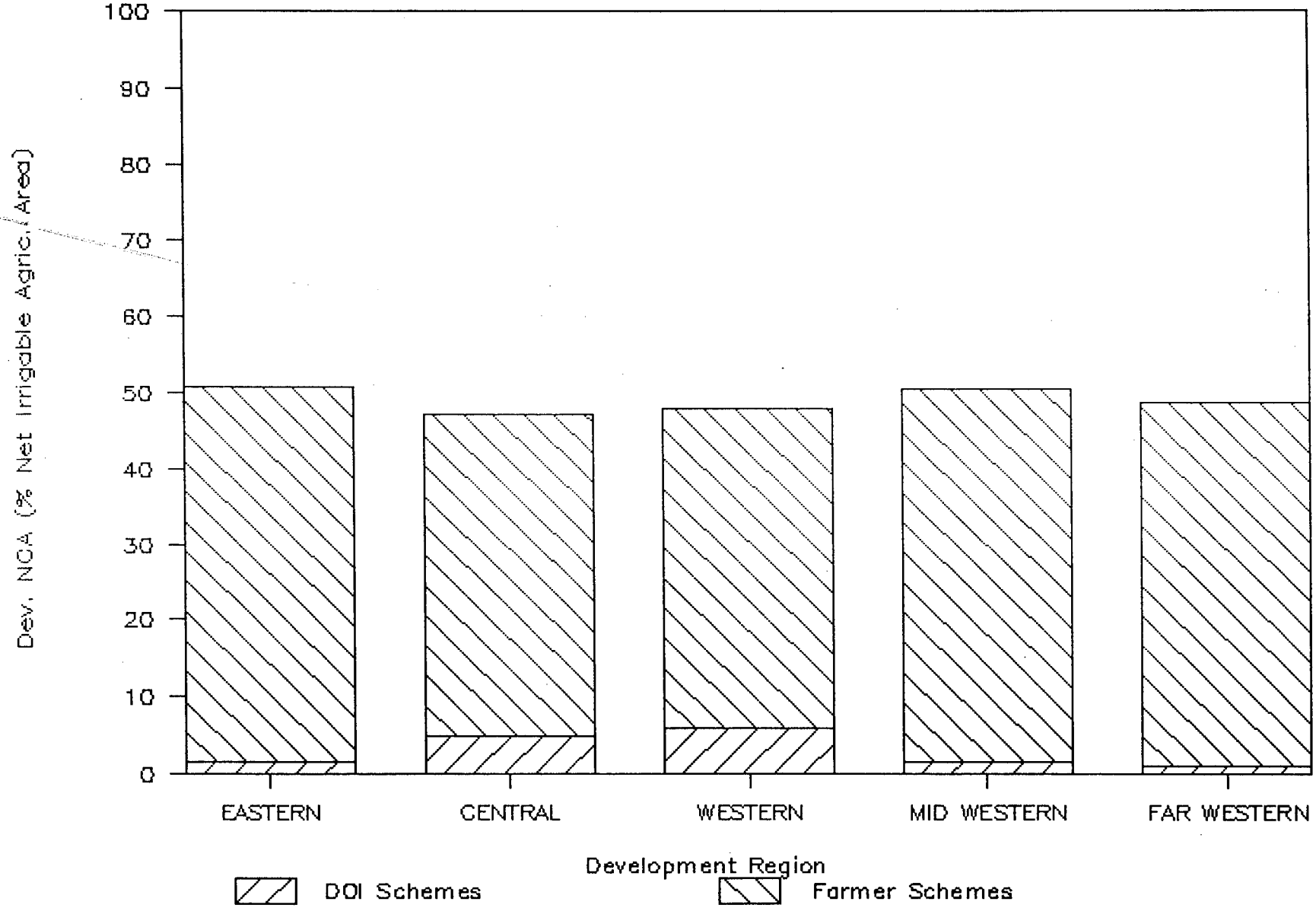

Figure A1–6

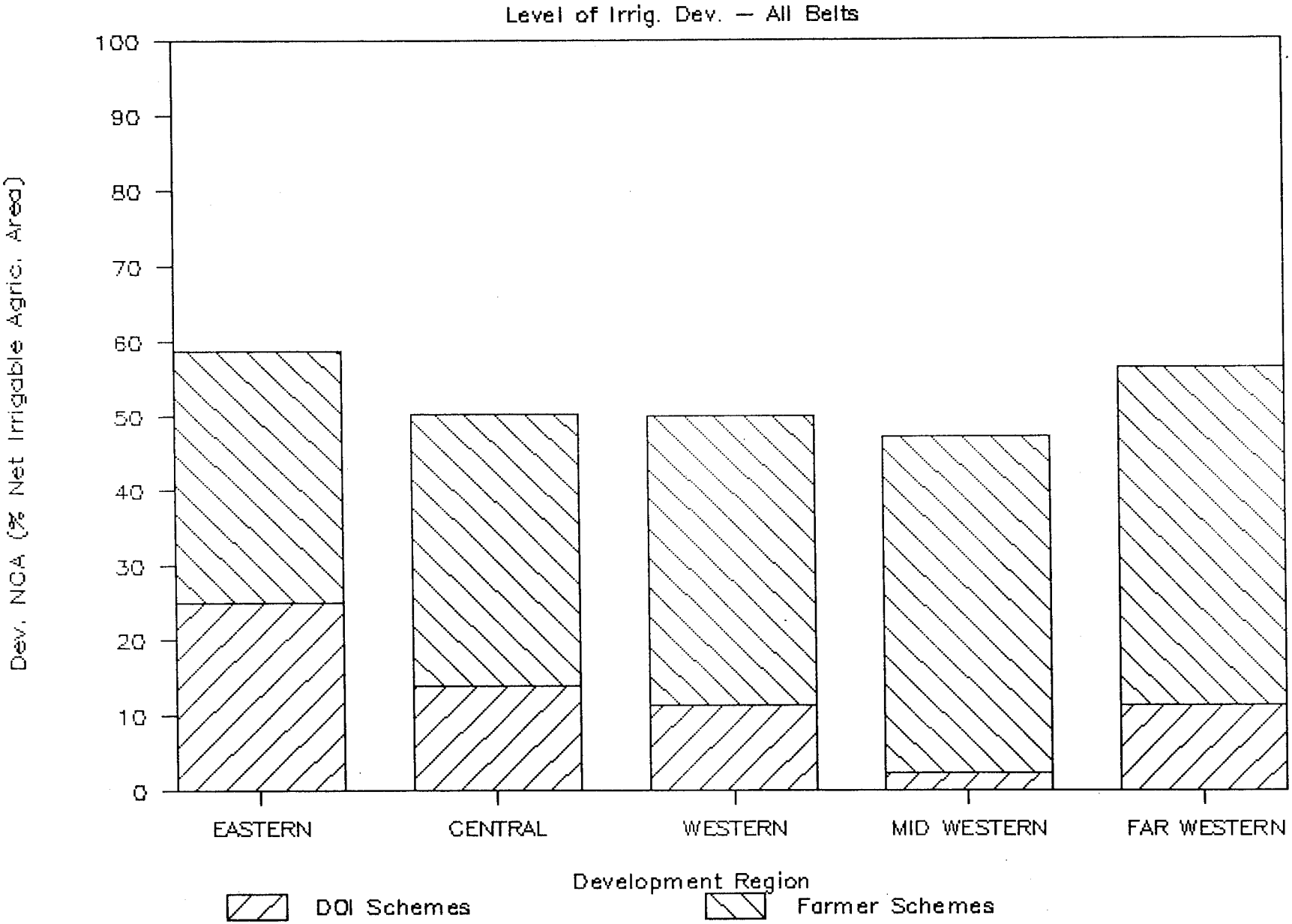
Level of Irrig. Dev. – All Belts
Dev. NCA (% Net Irrigable Agric. Area)
100
90
80
70
60
50
40
30
20
10
0
EASTERN
CENTRAL
WESTERN
MID WESTERN
FAR WESTERN
Development Region
DOI Schemes
Farmer Schemes

TABLE OF CONTENTS

MASTER PLAN SECOND CYCLE REPORT - ANNEX A - LAND RESOURCE DATA

ANNEX A2 - Irrigable Land Resources

A2-1 - INTRODUCTION

A2-1.1 - Objectives

Annex A2 has two objectives :

1. To present a reliable estimate of irrigable land areas, together with breakdowns by land types and land use

2. To provide direct compatibility with Annex A1 and Annex A3 in the presentation of results, to provide the data required for analysis of irrigation development potential.

A2-1.2 - Scope and Outline

This annex provides a summary of those land areas in Nepal which are considered to be irrigable. This information is used with data on existing irrigation developments (Annex A1) and on identified potential irrigation developments (Annex A3) to estimate the remaining land resource availability for as yet unidentified potential irrigation developments. Annex A4 presents the results of this reconciliation of land resource data.

For master planning purposes, it is necessary to have some knowledge not only of the total irrigable land areas but also of their current land use. A breakdown of the irrigable areas into current agricultural and nonagricultural land areas is therefore provided. The former correspond to cultivated lands, or lands developed for cropping, while the latter correspond to grass or forest lands. In the case of the Terai ecological belt*, a further estimate has been made, giving the breakdown of irrigable nonagricultural land areas into irrigable grassland areas and irrigable forest land areas.

Another useful breakdown of the irrigable land areas for planning purposes is that which differentiates between land types. A breakdown into the following two broad land type categories is provided

- Terai plains and hill valleys, which includes the main Terai plains, inner Terai plains (Siwalik valleys), hill valleys, and hill tars

- Hill slopes, which include the terraced lands

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* See Annex A1 for discussion on the use of development regions and ecological belts for master planning purposes.

A2-2 - DATA SOURCES

A2-2.1 - Land Resources Mapping Project

The Land Resources Mapping Project (LRMP) (Ref 1), discussed in Annex A1 (Section A1-2.3), has provided a comprehensive and country-wide account of the land resources of Nepal. Its separate land utilization and land capability components, each comprising a detailed database and mapping, have been the primary data source for this annex.

The land utilization database offers an indirect approach to estimating those agricultural land areas which are currently developed for irrigation and, by extension, which could be developed for irrigation. This is based on an analysis of cultivation type and cropping sequence data, using generalized assumptions about irrigation status and irrigability.

The land capability database includes an account of irrigable land areas based on an irrigation suitability classification. These estimates are independent of land use, and therefore include current grass and forest land areas as well as current agricultural land areas. Application of the LRMP irrigation suitability classification was governed by natural slope and soil depth criteria. The major effect of the slope restriction was to exclude from the account of irrigable land areas the irrigated level terraces on hill slopes, which represent a highly significant portion of the irrigated land area in the Hill and Mountain ecological belts. It is also likely that the soil restriction classed significant hill valley areas as unirrigable.

Since the land utilization and land capability databases are entirely separate, it is not possible to generate from them directly a breakdown of the total irrigable areas into current land use areas. This breakdown is, however, physically obtainable from the two map sets, by superimposing them to delineate and measure the area subdivisions. This would be a lengthy procedure and could not be undertaken at present, but an exercise of this nature was undertaken for the Water and Energy Commission Secretariat (WECS) and is discussed in Section A1-2.2 below. A broader and more approximate breakdown of the irrigable areas into agricultural and nonagricultural components is obtainable by a subtraction of the irrigable agricultural land areas, derived from the land use database, from the total irrigable land areas, derived from the land capability database. In all these exercises, it is essential to properly account for the irrigated level terraces, by either fully including or fully excluding their land areas.

A2-2.2 - WECS Report on Irrigable Land in Terai Districts

WECS, in conjunction with the Integrated Surveys Section (ISS) of the Topographic Mapping Branch of the Ministry of Land Reform, undertook a transposition of irrigation suitability data from LRMP land capability maps onto corresponding LRMP land utilization maps. This was followed by determination of land use areas according to irrigation potential, and aggregation of results to district level. The work was done for Terai districts only. Initial results were included in a 1986 report (Ref 2), and improved results were presented in a 1988 report (Ref 3). The latter report is the one used in this analysis.

A comparison between the WECS study and the more definitive LRMP land capability database shows that the total mapped irrigable area in the Terai ecological belt was underestimated in the WECS study by about 10%. This could be considered an acceptable and perhaps inevitable difference, given the fact that the WECS study involved the manual overlaying, copying, planimetering and aggregating of numerous small areas. However, the same comparison at district level showed underestimates of between 21% and 32% for 5 of the 20 Terai districts; these represent significant land area differences.

In spite of the consistency difficulties encountered with the WECS study results, they do represent a valid and basic analysis of the combination of LRMP land use and land capability data. The study also provides the only currently available means of estimating separately the areas of irrigable grasslands and forest lands.

A2-3 - METHODOLOGY

A2-3.1 - Use of Land Utilization Database

In Annex A1, an explanation is provided of the methodology used to estimate irrigable agricultural land areas from the LRMP land use database. In addition to the total irrigable agricultural areas, a separate account of irrigable agricultural areas on hill slopes was obtained. As noted in Section A2-2.1, these areas were not accounted for in the LRMP irrigation suitability classification.

The information presented in Table A1-2 of Annex A1 shows that there are two hill slope cultivation types defined -- level terraces and sloping terraces. It was judged as part of the analysis that the situation in Nepal was such that there was no significant potential for development of hill slopes for irrigation beyond the present level of development. Hence only those level terraces which are assumed to be irrigated at present were taken as irrigable. The opposite approach was taken in the case of the Terai plain and hill valley cultivation types -- all were deemed to be irrigable from the land resource viewpoint. The first approach may be conservative and the second may be optimistic, but a greater refinement with this database was not possible.

The LRMP land utilization study included, from field level observations, a derivation of appropriate ratios for estimating net agricultural areas from mapped agricultural areas. Net areas are required for master planning purposes, and hence conversions are applied when only mapped or gross areas are available. The land use database analysis was undertaken for both mapped and net areas, so as to define conversion ratios for subsequent use in the land capability database analysis.

A2-3.2 - Use of Land Capability Database

The LRMP land capability database can provide directly an account of all land areas according to their irrigation suitability rating, irrespective of current land use. Land areas deemed to be firmly irrigable correspond to irrigation suitability Classes 1, 1R, 2 and 2R, where R denotes a primary suitability for paddy rice crops. Land areas deemed to be tentatively irrigable correspond to Class 5, while those deemed unirrigable correspond to Class 6. As mentioned in Section A2-2.1, the classification system and its application did not account for the irrigated level terraces and may have classed as unirrigable significant agricultural areas in the hill valleys.

The database was used to generate firm and tentative irrigable areas, which are taken to represent the overall land resource potential for irrigation in the Terai plains and hill valleys. Since this database provides only mapped areas, the equivalent ratios of net to mapped agricultural areas obtained from the land use database were applied to convert the mapped areas to net areas.

A2-3.3 - Synthesis of Methods to Establish Irrigation Potential

A2-3.3.1 - Terai Plains and Hill Valleys

For the Terai plains and hill valleys, the land capability analysis discussed in Section A2-3.2 provides an estimate of the overall irrigable areas, while the land use database analysis discussed in Section A2-3.1 provides an estimate of the irrigable agricultural areas. It follows that a subtraction of the latter from the former should serve as an estimate of irrigable nonagricultural (grass and forest) areas in the Terai plains and hill valleys.

If only the firm irrigable areas from the land capability database analysis are used in this subtraction at district level, some negative values for irrigable nonagricultural areas occur. For the Terai districts, these occurrences are infrequent (3 out of 20 districts) and relatively minor in percentage terms (up to 7% of the firm irrigable area). For the Hill and Mountain districts they are very frequent (45 out of 55 districts) and often very large in percentage terms. When total (firm and tentative) irrigable areas are used, the frequency and size of the negative values decrease notably, and disappear completely in the case of the Terai districts. The negative values clearly result from the natures and limitations of the two different databases and analyses; it is noted from Sections A2-3.1 and A2-3.2 that the land capability analysis may be somewhat restrictive, while the land use analysis may be giving optimistic values of irrigable agricultural areas.

It is considered that inclusion of the tentative irrigable (Class 5) areas in an assessment of overall irrigable areas would normally be unduly optimistic, especially in the Terai plains. On the other hand, it seems likely that some irrigation of Class 5 and even Class 6 lands is occurring at present and could reasonably occur in the future, especially in the hill valleys. A resolution of these conflicting assessments was achieved as follows

- In the normal situation, only the firm irrigable area is used as the estimate of overall irrigable area. This is consistent with previous assessments of this nature in other studies, and applies to most of the Terai districts

- In the situation where the estimate of irrigable agricultural area exceeds the firm irrigable area, the former is used as the estimate of overall irrigable area. This applies to most of the Hill and Mountain districts and provides some recognition of the potential importance of marginally suitable lands.

Once the overall irrigable land areas are defined in this way, subtraction of the irrigable agricultural land areas gives either zero or positive values for the irrigable nonagricultural land areas.

A2-3.3.2 - Hill Slopes

The estimate of irrigable hill slope areas is obtained from the land use database as discussed in Section A2-3.1. It is equivalent to the estimates of irrigable agricultural hill slope areas and of current irrigated level terrace land areas. There is no information on these areas obtainable from the land capability database.

Adding the irrigable hill slope areas to the Terai plain and hill valley irrigable areas (Section A2-3.3.1) gives the total irrigable areas. They are also included in the estimated total irrigable agricultural areas (Section A2-3.1), so that total irrigable nonagricultural areas are obtained by subtracting the total irrigable agricultural areas from the overall total irrigable areas.

A2-3.4 - Irrigable Land Use in Terai Districts

For the reasons discussed in Section A2-2.2, irrigable area values from the WECS 1988 study were not used to derive the definitive irrigable areas for the present annex. However, the WECS study did provide the means of obtaining a breakdown of the estimated irrigable nonagricultural areas of the Terai districts into irrigable grass and irrigable forest areas.

Simple ratios were derived from the results of the WECS 1988 study, relating the irrigable grassland areas and the irrigable forest areas to the total irrigable nonagricultural areas. These ratios were then applied to the total irrigable nonagricultural areas derived as explained in Section A2-3.3.2, to give the breakdown into irrigable grass and irrigable forest areas.

A2-4 - RESULTS

A2-4.1 - Irrigation Potential of Agricultural Land

Table A2-1 presents the data by district on agricultural land irrigation potential resulting from the LRMP land use database analysis. It includes the estimated irrigated, irrigable and total agricultural areas, to allow for comparisons between these values. The subdivision of the irrigable areas into the two land type categories -- Terai plain and hill valley, and hill slope -- is also shown. Both mapped and net areas are given. As explained in Section A2-3.1, these areas were obtained by a reapplication of the method used for the equivalent exercise described in Annex A1. Values from Table A2-1 which are carried forward to subsequent tables are those for irrigable Terai plain and hill valley areas and those for irrigable hill slope areas.

A2-4.2 - Land Resource Irrigation Potential

Table A2-2 presents the data by district on overall land resource irrigation potential resulting from the LRMP land capability database analysis. The firm and tentative irrigable areas are shown as separate components of total "optimistic"* irrigable areas. These represent estimates corresponding to the Terai plains and hill valleys only, since hill slopes were not assigned irrigation suitability rankings. The corresponding values for irrigable agricultural Terai plain and hill valley areas, from Table A2-1, are shown here for direct comparison purposes, and the differences are also shown. The differences, where they are positive, represent "optimistic"* estimates of the irrigable nonagricultural land areas; where they are negative, as noted and explained in Section A2-3.3.1, they reflect, in addition, the discrepancies between the two estimating methodologies.

Both mapped and net areas are given in Table A2-2. In the case of the irrigable areas from the land capability database, net areas are calculated from mapped areas, applying the ratios of net to mapped areas given in the table. These ratios correspond to the comparable irrigable agricultural Terai plain and hill valley areas, which originate from the land use database. The implicit assumption in this is that future irrigation development will have the same net to mapped area ratios as present irrigation development.

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* "Optimistic" irrigable areas include tentative irrigable areas; see Section A2-3.3.1.

Firm irrigable area values in Table A2-2 are carried forward to subsequent tables.

A2-4.3 - Irrigation Potential by Land Type and Land Use

Table A2-3 represents the synthesis of the two methodologies applied to obtain an account of overall irrigation potential by land type (Terai plain and hill valley or hill slope) and land use (agricultural or nonagricultural). Both mapped and net irrigable areas are given.

Irrigable Terai plain and hill valley areas shown in the table are either the firm irrigable areas from Table A2-2 or the irrigable agricultural Terai plain and hill valley areas from Table A2-1, whichever are the greater (see Section A2-3.3.1). Irrigable hill slope areas are the irrigable agricultural hill slope areas from Table A2-1. The two are added to give the overall total irrigable areas.

Irrigable agricultural areas shown in the table are those from Table A2-1. These are subtracted from the overall total irrigable areas to give the irrigable nonagricultural areas.

Table A2-4 gives an expanded account of the breakdown by land use of the irrigable areas in the Terai ecological belt. The irrigable agricultural areas and total nonagricultural areas shown in the table are taken from Table A2-3. The breakdown of the irrigable nonagricultural areas into grassland and forest land components directly reflects the proportions of these components obtained in the WECS 1988 study.

A2-5 - OVERVIEW OF LAND RESOURCE LIMITATIONS TO IRRIGATION DEVELOPMENT

The summary totals of Table A2-3 indicate that there is a total net irrigable area in Nepal of about 2,178,000 ha. Of this total, about 1,743,000 ha are located in the Terai ecological belt and about 435,000 ha are located in the Hill and Mountain ecological belts.

The Terai plains and hill valleys together have about 2,016,000 ha of net irrigable area, while the hill slopes have about 162,000 ha. Irrigable Terai plain and hill (Siwalik) valley areas make up practically all of the irrigable area in the Terai ecological belt and amount to about 1,742,000 ha net. Irrigable hill valley (and tar) areas in the Hill and Mountain ecological belts amount to about 274,000 ha net. There are only about 1,000 ha net of irrigable hill slope areas in the Terai belt, while the Hill and Mountain belts have about 161,000 ha net of irrigable hill slope areas.

The irrigable agricultural lands cover in total about 1,766,000 ha net, and the irrigable nonagricultural (grass and forest) lands cover about 412,000 ha net. Irrigable agricultural lands in the Terai ecological belt amount to about 1,337,000 ha net; in the Hill and Mountain ecological belts they amount to about 429,000 ha net. Most of the irrigable nonagricultural land areas, about 406,000 ha net, are located in the Terai belt; only about 6,000 ha net are located in the Hill and Mountain belts.

Table A2-4 shows that, of the irrigable nonagricultural land area in the Terai ecological belt, only about 33,000 ha net correspond to irrigable grassland, while there are about 373,000 ha net of irrigable forest land. It is noted that clearance of forest lands has continued to some extent in the years since the LRMP was undertaken*. The effect of this is not reflected in the irrigable area values derived for this annex, but it is likely that most of the clearance will have been for agriculture on irrigable lands.

Figures A2-1, A2-2 and A2-3 have been prepared from the data in Table A2-3 to give a visual perspective of the regional distribution of irrigable areas by land type and land use. Figure A2-1 corresponds to the Terai ecological belt, Figure A2-2 corresponds to the Hill and Mountain ecological belts combined, and Figure A2-3 corresponds to the whole country (all ecological belts). Some of the indications that emerge from a study of these figures are given below.

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* Aerial photography for the LRMP dates from 1979; field verification and final studies for the LRMP were completed in 1985.

In the Terai belt, the Central Development Region has the greatest irrigable area (about 540,000 ha net), but a substantial part of this area (about 126,000 ha net) is currently nonagricultural (predominantly forest) land. Both the Eastern and Central regions have over 400,000 ha of net irrigable agricultural lands. The three remaining regions each have between 200,000 and 300,000 ha net irrigable areas. The nonagricultural parts of these areas increase from east to west, with the greatest part (about 128,000 ha net), over half of the region's total irrigable area, being in the Far Western region. However, the recent forest clearance referred to previously would have occurred primarily in these regions.

In the Hill and Mountain belts, the Central Development Region again has the greatest irrigable area (about 128,000 ha net); the Western and Eastern regions both have over 90,000 ha net, and the two remaining regions have over 50,000 ha net. Most of the irrigable area in the Eastern region is located on the hill slopes (about 54,000 ha net), as is half of the irrigable area in the Far Western region (about 25,000 ha net); hill slope irrigable areas also form significant parts of the total irrigable areas in the three remaining regions. The current land use of irrigable areas in the Hill and Mountain belts is essentially all agricultural; the occurrence of irrigable nonagricultural lands in these belts is minimal.

In the country as a whole, the distribution of irrigable areas by region obviously reflects to a great extent the distribution in the Terai belt. The Central region has the greatest irrigable area (about 668,000 ha net) and the Eastern region has the second greatest irrigable area (about 535,000 ha net). The three remaining regions each have net irrigable areas from about 300,000 ha to about 400,000 ha. Irrigable hill slope areas account for only 5% to 10% of the total irrigable areas. The principal irrigable nonagricultural (predominantly forest) areas are in the Central and Far Western regions, and amount to about 130,000 ha net in each region. At the other extreme, the Eastern Region has a net irrigable nonagricultural area of only about 13,000 ha, reflecting the fact that agricultural development has been underway in this region over the longest period of time.

Table A2-1

AGRICULTURAL LAND IRRIGATION POTENTIAL FROM LRMP LAND UTILIZATION DATABASE

District	Mapped Agricultural Areas (ha) (1)					Net Agricultural Areas (ha) (1)				
	Irrigated	Irrigable			Total	Irrigated	Irrigable			Total
		TP & HV	HS	Total			TP & HV	HS	Total	
	(2)	(3)	(4)	(5)	(6)	(2)	(3)	(4)	(5)	(6)
EASTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT										
Jhapa	63567	123574	0	123574	123574	56139	109530	0	109530	109530
Morang	61510	113359	214	113573	120599	53483	99888	71	99959	102939
Sunsari	28283	79354	0	79354	81944	24868	70629	0	70629	71757
Saptari	22093	86382	0	86382	86382	18791	76950	0	76950	76950
Siraha	25186	88355	0	88355	88355	21292	77726	0	77726	77726
TOTAL FOR EASTERN TERAI DISTRICTS	200640	491025	214	491239	500855	174573	434723	71	434793	438901
EASTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT										
Ilam	17441	5478	14526	20004	67640	10619	4537	8205	12742	36405
Panchthar	11240	2496	9073	11569	58320	6998	1870	5371	7241	32251
Terhathum	9989	0	9989	9989	37282	6282	0	6282	6282	21661
Dhankuta	10122	3041	8439	11480	46816	6495	2276	5219	7495	26797
Bhojpur	10578	1784	9961	11745	65734	5957	1338	5482	6820	34677
Udayapur	13953	21074	1862	22935	52315	10978	17529	879	18408	30773
Khotang	14766	2122	12812	14934	70923	8735	1620	7238	8859	37949
Okhaldhunga	6560	2224	5242	7466	48838	3812	1667	2811	4478	24151
TOTAL FOR EASTERN HILL DISTRICTS	94650	38219	71904	110122	447869	59875	30838	41487	72324	244665
EASTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT										
Taplejung	12541	243	12340	12583	40890	7411	184	7259	7443	22102
Sankhuwasawa	7870	1577	7076	8653	49382	4592	1175	3995	5170	25972
Solukhumbu	2816	488	2722	3210	33313	1733	383	1655	2038	17734
TOTAL FOR EASTERN MOUNTAIN DISTRICTS	23226	2307	22138	24445	123585	13736	1742	12909	14651	65807
CENTRAL DEVELOPMENT REGION - TERAI ECOLOGICAL BELT										
Dhanusha	32037	83182	0	83182	83182	27249	72925	0	72925	72925
Mahottari	31944	69286	0	69286	69324	27686	60633	0	60633	60648
Sarlahi	45709	84183	0	84183	84736	39772	73521	0	73521	73709
Rautahat	40509	63942	0	63942	64598	35042	56141	0	56141	56390
Bara	48550	68847	0	68847	69568	42136	60390	0	60390	60666
Parsa	30378	54732	0	54732	54732	26367	48374	0	48374	48374
Chitwan	32598	48491	0	48491	55279	28310	41963	0	41963	44537
TOTAL FOR CENTRAL TERAI DISTRICTS	261725	472662	0	472662	481419	226562	413948	0	413948	417250
CENTRAL DEVELOPMENT REGION - HILL ECOLOGICAL BELT										
Sindhuli	16296	24418	1580	25998	58785	12747	19947	705	20652	34333
Ramechhap	6317	1806	4932	6738	59179	3921	1414	2834	4248	32276
Makawanpur	10738	27637	2152	29789	59657	8105	22387	1115	23502	35777
Kabhre Palanchowk	9404	7762	3805	11567	61599	6277	6056	1902	7958	29922
Lalitpur	7243	8594	1086	9680	17660	5538	6672	754	7425	11067
Bhaktapur	6605	7312	759	8072	9681	5109	5759	515	6274	7223
Kathmandu	14393	17084	1164	18249	24604	11062	13391	677	14069	17103
Nuwakot	23519	7468	18171	25639	60582	13410	5849	9199	15047	31783
Dhading	14634	7509	9765	17274	73005	8805	5821	5018	10839	36189
TOTAL FOR CENTRAL HILL DISTRICTS	**109150**	**109591**	**43416**	**153007**	**424752**	**74973**	**87295**	**22719**	**110014**	**235673**

AGRICULTURAL LAND IRRIGATION POTENTIAL FROM LRMP LAND UTILIZATION DATABASE

District	Mapped Agricultural Areas (ha) (1)					Net Agricultural Areas (ha) (1)				
	Irrigated	Irrigable			Total	Irrigated	Irrigable			Total
		TP & HV	HS	Total			TP & HV	HS	Total	
	(2)	(3)	(4)	(5)	(6)	(2)	(3)	(4)	(5)	(6)
CENTRAL DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT										
Dolakha	7951	542	7585	8127	45018	4775	390	4521	4911	24042
Sindhupalchowk	20918	2786	18608	21395	63872	11905	2161	10116	12276	33820
Rasuwa	1414	183	1338	1521	10381	751	143	692	836	5201
TOTAL FOR CENTRAL MOUNTAIN DISTRICTS	30284	3511	27531	31042	119271	17431	2693	15330	18023	63063
WESTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT										
Nawalparasi	28478	58040	0	58040	67967	25396	50690	0	50690	55237
Rupandehi	48829	96862	0	96862	97905	45059	87979	0	87979	88417
Kapilbastu	42029	92811	55	92867	93729	38912	84436	17	84453	84785
TOTAL FOR WESTERN TERAI DISTRICTS	119335	247713	55	247769	259601	109367	223105	17	223122	228439
WESTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT										
Palpa	6349	11574	219	11792	57172	4768	8735	122	8857	30354
Arghakhanchi	5118	6091	298	6389	39946	3809	4635	164	4799	20019
Gulmi	5667	4722	1321	6043	54178	3960	3526	714	4240	25605
Tanahun	8794	17785	1786	19571	66100	6399	13503	993	14496	33971
Syangja	11546	9464	4869	14333	60018	7747	7238	2610	9848	31017
Gorkha	10765	9921	6402	16323	64361	6833	7507	3520	11027	33915
Lamjung	16286	9580	9512	19092	43761	9817	7229	4708	11937	23848
Kaski	10869	17233	5123	22356	53003	7169	13139	2822	15960	31405
Parbat	10170	3410	7483	10893	28605	5917	2546	3909	6455	15231
Baglung	11420	4170	9211	13381	52344	6254	3178	4602	7780	26522
Myagdi	6143	927	5354	6281	29962	3576	702	2984	3685	15740
TOTAL FOR WESTERN HILL DISTRICTS	103125	94876	51578	146454	549450	66250	71937	27148	99084	287628
WESTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT										
Manang	0	154	0	154	1077	0	121	0	121	718
Mustang	0	201	0	201	5425	0	159	0	159	4221
TOTAL FOR WESTERN MOUNTAIN DISTRICTS	0	354	0	354	6502	0	280	0	280	4939
MID WESTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT										
Dangdeukhuri	27552	69295	49	69344	80672	23986	59484	22	59505	64522
Banke	11698	56345	106	56451	58976	9995	48505	45	48550	49524
Bardiya	13843	61083	83	61165	61546	11891	52619	41	52660	52836
TOTAL FOR MID WESTERN TERAI DISTRICTS	53093	186723	237	186960	201194	45872	160607	108	160715	166882
MID WESTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT										
Pyuthan	6048	8328	1297	9625	43041	4290	6374	664	7037	23197
Rolpa	4549	2814	3329	6143	59855	2729	2192	1788	3980	29651
Salyan	6568	5002	2661	7663	52674	4447	3790	1492	5282	28032
Rukum	3113	4399	1150	5549	45300	2221	3491	678	4170	23592
Surkhet	10625	22659	2368	25027	51730	7783	18165	1110	19275	31231
Jajarkot	4848	2512	3403	5914	38222	3314	1975	2168	4143	21114
Dailekh	10021	3367	7934	11301	52618	6105	2540	4536	7075	28373
TOTAL FOR MID WESTERN HILL DISTRICTS	45773	49082	22141	71222	343441	30888	38527	12435	50962	185190

AGRICULTURAL LAND IRRIGATION POTENTIAL FROM LRMP LAND UTILIZATION DATABASE

District	Mapped Agricultural Areas (ha) (1)					Net Agricultural Areas (ha) (1)				
	Irrigated	Irrigable		Total	Total	Irrigated	Irrigable		Total	Total
		TP & HV	HS				TP & HV	HS		
	(2)	(3)	(4)	(5)	(6)	(2)	(3)	(4)	(5)	(6)
MID WESTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT										
Dolpa	122	666	0	666	9340	100	544	0	544	4995
Jumla	2866	5607	525	6131	24057	2110	4526	239	4765	12642
Kalikot	4400	813	3992	4805	23748	2754	661	2423	3084	13125
Mugu	2873	971	2201	3172	18826	1787	764	1267	2030	9617
Humla	714	1022	194	1216	9298	558	836	133	969	4984
TOTAL FOR MID WESTERN MOUNTAIN DISTRICTS	10974	9078	6912	15990	85270	7309	7331	4060	11392	45363
FAR WESTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT										
Kailali	35133	73573	1095	74668	80780	30265	63580	532	64112	66722
Kanchanpur	24977	47257	0	47257	47371	21970	40891	0	40891	40971
TOTAL FOR FAR WESTERN TERAI DISTRICTS	60110	120830	1095	121925	128151	52235	104471	532	105003	107693
FAR WESTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT										
Achham	16859	4884	12785	17669	59592	10353	3725	7246	10972	31982
Doti	13781	7473	8623	16096	49367	8699	5710	4757	10468	27562
Dadeldhura	9007	6457	4077	10534	27232	6078	4983	2283	7266	16032
Baitadi	11442	3669	8991	12659	50503	6521	2796	4653	7450	25543
TOTAL FOR FAR WESTERN HILL DISTRICTS	51088	22482	34476	56958	186695	31651	17215	18940	36155	101118
FAR WESTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT										
Bajura	3921	2924	2573	5497	23346	2384	2229	1355	3584	12181
Bajhang	10131	6600	4627	11227	41715	6712	5026	2523	7549	22643
Darchula	5534	2545	4297	6842	24866	3241	1943	2296	4239	13201
TOTAL FOR FAR WESTERN MOUNTAIN DISTRICTS	19586	12069	11497	23566	89926	12337	9198	6175	15373	48024
TOTALS BY DEVELOPMENT REGION										
EASTERN DISTRICTS	318516	531551	94256	625807	1072308	248184	467303	54466	521769	749374
CENTRAL DISTRICTS	401158	585764	70947	656711	1025441	318965	503936	38048	541984	715986
WESTERN DISTRICTS	222460	342944	51633	394577	815553	175617	295322	27164	322486	521006
MID WESTERN DISTRICTS	109839	244883	29290	274173	629904	84069	206466	16603	223069	397436
FAR WESTERN DISTRICTS	130785	155382	47068	202449	404772	96223	130884	25647	156531	256835
TOTALS BY ECOLOGICAL BELT										
TERAI DISTRICTS	694903	1518953	1602	1520555	1571219	608609	1336853	727	1337581	1359165
HILL DISTRICTS	403785	314250	223514	537763	1952206	263638	245811	122728	368540	1054275
MOUNTAIN DISTRICTS	84070	27320	68078	95398	424553	50813	21245	38474	59719	227196
TOTAL FOR ALL DISTRICTS	1182758	1860523	293194	2153716	3947979	923059	1603910	161929	1765839	2640636

Table A2-2

LAND RESOURCE IRRIGATION POTENTIAL FROM LRMP LAND CAPABILITY DATABASE

District	Mapped Irrigable Areas (ha)					Net Irrigable Areas (ha)					Ratio of (4) Net to (4) Mapped
	Land Capability Database			Agric.	Difference	Land Capability Database			Agric.	Difference	
	Firm	Tentative	Total	TP & HV		Firm	Tentative	Total	TP & HV		
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)	(6)
EASTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT											
Jhapa	124238	12333	136571	123574	12997	110118	10931	121049	109530	11520	0.89
Morang	121167	17440	138607	113359	25248	106768	15368	122136	99888	22248	0.88
Sunsari	74150	17709	91859	79354	12505	65998	15762	81760	70629	11130	0.89
Saptari	82533	6858	89391	86382	3009	73521	6109	79630	76950	2680	0.89
Siraha	86524	2880	89404	88355	1049	76115	2534	78648	77726	923	0.88
TOTAL FOR EASTERN TERAI DISTRICTS	488612	57220	545832	491025	54807	432519	50704	483223	434723	48500	0.89
EASTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT											
Ilam	6810	1771	8581	5478	3103	5640	1467	7107	4537	2570	0.83
Panchthar	1537	0	1537	2496	-959	1151	0	1151	1870	-718	0.75
Terhathum	215	10	225	0	225	173	8	182	0	182	0.81
Dhankuta	2182	552	2734	3041	-307	1633	413	2046	2276	-230	0.75
Bhojpur	2439	371	2810	1784	1026	1830	278	2108	1338	770	0.75
Udayapur	24477	5521	29998	21074	8924	20360	4592	24952	17529	7423	0.83
Khotang	2921	244	3165	2122	1043	2230	186	2416	1620	796	0.76
Okhaldhunga	1652	625	2277	2224	53	1239	469	1707	1667	40	0.75
TOTAL FOR EASTERN HILL DISTRICTS	42233	9094	51327	38219	13108	34257	7414	41670	30838	10833	0.81
EASTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT											
Taplejung	160	50	210	243	-33	121	38	159	184	-25	0.76
Sankhuwasawa	1723	728	2451	1577	874	1284	543	1827	1175	652	0.75
Solukhumbu	44	18	62	488	-426	35	14	49	383	-334	0.79
TOTAL FOR EASTERN MOUNTAIN DISTRICTS	1927	796	2723	2307	416	1440	595	2034	1742	292	0.76
CENTRAL DEVELOPMENT REGION - TERAI ECOLOGICAL BELT											
Dhanusha	86166	2356	88522	83182	5340	75541	2065	77606	72925	4682	0.88
Mahottari	74388	3963	78351	69286	9065	65098	3468	68566	60633	7933	0.88
Sarlahi	93856	6060	99916	84183	15733	81969	5293	87262	73521	13740	0.87
Rautahat	81444	5634	87078	63942	23136	71509	4947	76455	56141	20314	0.88
Bara	102841	4505	107346	68847	38499	90209	3952	94161	60390	33770	0.88
Parsa	89053	12983	102036	54732	47304	78708	11475	90183	48374	41809	0.88
Chitwan	88464	9145	97609	48491	49118	76555	7914	84469	41963	42506	0.87
TOTAL FOR CENTRAL TERAI DISTRICTS	616212	44646	660858	472662	188196	539589	39113	578702	413948	164754	0.88
CENTRAL DEVELOPMENT REGION - HILL ECOLOGICAL BELT											
Sindhuli	18616	5978	24594	24418	176	15207	4883	20090	19947	144	0.82
Ramechhap	1154	161	1315	1806	-491	904	126	1030	1414	-385	0.78
Makawanpur	27636	6552	34188	27637	6551	22386	5307	27694	22387	5307	0.81
Kabhre Palanchowk	5961	669	6630	7762	-1132	4651	522	5173	6056	-883	0.78
Lalitpur	7028	1519	8547	8594	-47	5456	1179	6635	6672	-36	0.78
Bhaktapur	4910	1618	6528	7312	-784	3867	1274	5141	5759	-618	0.79
Kathmandu	14981	2893	17874	17084	790	11743	2268	14010	13391	619	0.78
Nuwakot	6535	1250	7785	7468	317	5118	979	6097	5849	248	0.78
Dhading	5147	1265	6412	7509	-1097	3990	981	4970	5821	-850	0.78
TOTAL FOR CENTRAL HILL DISTRICTS	91968	21905	113873	109591	4282	73321	17519	90840	87295	3545	0.80

LAND RESOURCE IRRIGATION POTENTIAL FROM LRMP LAND CAPABILITY DATABASE

District	Mapped Irrigable Areas (ha)					Net Irrigable Areas (ha)					Ratio of (4) Net to (4) Mapped
	Land Capability Database			Agric.	Difference	Land Capability Database			Agric.	Difference	
	Firm	Tentative	Total	TP & HV		Firm	Tentative	Total	TP & HV		
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)	(6)
CENTRAL DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT											
Dolakha	595	168	763	542	221	428	121	549	390	159	0.72
Sindhupalchowk	1461	1189	2650	2786	-136	1133	922	2055	2161	-106	0.78
Rasuwa	290	325	615	183	432	227	254	481	143	338	0.78
TOTAL FOR CENTRAL MOUNTAIN DISTRICTS	2346	1682	4028	3511	517	1788	1297	3085	2693	392	0.77
WESTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT											
Nawalparasi	80904	6673	87577	58040	29537	70659	5828	76486	50690	25797	0.87
Rupandehi	108834	2808	111642	96862	14780	98853	2550	101404	87979	13424	0.91
Kapilbastu	124411	4776	129187	92811	36376	113184	4345	117529	84436	33093	0.91
TOTAL FOR WESTERN TERAI DISTRICTS	314149	14257	328406	247713	80693	282696	12723	295419	223105	72314	0.90
WESTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT											
Palpa	5889	1538	7427	11574	-4147	4445	1161	5606	8735	-3130	0.75
Arghakhanchi	4287	141	4428	6091	-1663	3262	107	3370	4635	-1265	0.76
Gulmi	4193	245	4438	4722	-284	3131	183	3314	3526	-212	0.75
Tanahun	11963	5799	17762	17785	-23	9083	4403	13486	13503	-18	0.76
Syangja	5086	1277	6363	9464	-3101	3890	977	4866	7238	-2371	0.76
Gorkha	9072	7024	16096	9921	6175	6865	5315	12180	7507	4673	0.76
Lamjung	5382	2372	7754	9580	-1826	4061	1790	5851	7229	-1378	0.75
Kaski	8510	8260	16770	17233	-463	6488	6298	12786	13139	-353	0.76
Parbat	2154	1026	3180	3410	-230	1608	766	2374	2546	-172	0.75
Baglung	3946	1466	5412	4170	1242	3007	1117	4124	3178	946	0.76
Myagdi	781	1035	1816	927	889	591	783	1374	702	673	0.76
TOTAL FOR WESTERN HILL DISTRICTS	61263	30183	91446	94876	-3430	46431	22900	69330	71937	-2607	0.76
WESTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT											
Manang	104	28	132	154	-22	82	22	104	121	-17	0.79
Mustang	69	138	207	201	6	55	109	164	159	5	0.79
TOTAL FOR WESTERN MOUNTAIN DISTRICTS	173	166	339	354	-15	137	131	268	280	-12	0.79
MID WESTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT											
Dangdeukhuri	77780	7863	85643	69295	16348	66767	6750	73517	59484	14033	0.86
Banke	98205	12441	110646	56345	54301	84540	10710	95250	48505	46745	0.86
Bardiya	109426	16142	125568	61083	64485	94264	13905	108169	52619	55550	0.86
TOTAL FOR MID WESTERN TERAI DISTRICTS	285411	36446	321857	186723	135134	245571	31365	276936	160607	116329	0.86
MID WESTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT											
Pyuthan	5509	236	5745	8328	-2583	4216	181	4397	6374	-1977	0.77
Rolpa	1107	211	1318	2814	-1496	862	164	1027	2192	-1165	0.78
Salyan	3633	60	3693	5002	-1309	2753	45	2798	3790	-992	0.76
Rukum	3342	146	3488	4399	-911	2653	116	2768	3491	-723	0.79
Surkhet	20469	5534	26003	22659	3344	16409	4436	20845	18165	2681	0.80
Jajarkot	2282	165	2447	2512	-65	1794	130	1924	1975	-51	0.79
Dailekh	891	200	1091	3367	-2276	672	151	823	2540	-1717	0.75
TOTAL FOR MID WESTERN HILL DISTRICTS	37233	6552	43785	49082	-5297	29359	5223	34583	38527	-3944	0.78

LAND RESOURCE IRRIGATION POTENTIAL FROM LRMP LAND CAPABILITY DATABASE

District	Mapped Irrigable Areas (ha)					Net Irrigable Areas (ha)					Ratio of (4) Net to (4) Mapped
	Land Capability Database			Agric.	Difference	Land Capability Database			Agric.	Difference	
	Firm	Tentative	Total	TP & HV		Firm	Tentative	Total	TP & HV		
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)	(6)
MID WESTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT											
Dolpa	1063	1334	2397	666	1731	868	1089	1957	544	1413	0.82
Jumla	4386	0	4386	5607	-1221	3541	0	3541	4526	-985	0.81
Kalikot	441	0	441	813	-372	359	0	359	661	-302	0.81
Mugu	570	0	570	971	-401	448	0	448	764	-316	0.79
Humla	1956	369	2325	1022	1303	1601	302	1903	836	1066	0.82
TOTAL FOR MID WESTERN MOUNTAIN DISTRICTS	8416	1703	10119	9078	1041	6816	1391	8207	7331	876	0.81
FAR WESTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT											
Kailali	157406	12408	169814	73573	96241	136026	10723	146748	63580	83169	0.86
Kanchanpur	111598	9248	120846	47257	73589	96564	8002	104567	40891	63675	0.87
TOTAL FOR FAR WESTERN TERAI DISTRICTS	269004	21656	290660	120830	169830	232590	18725	251315	104471	146844	0.86
FAR WESTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT											
Achham	1662	126	1788	4884	-3096	1268	96	1364	3725	-2362	0.76
Doti	3483	69	3552	7473	-3921	2662	53	2714	5710	-2996	0.76
Dadeldhura	5449	972	6421	6457	-36	4205	750	4955	4983	-28	0.77
Baitadi	1405	127	1532	3669	-2137	1071	97	1168	2796	-1629	0.76
TOTAL FOR FAR WESTERN HILL DISTRICTS	11999	1294	13293	22482	-9189	9205	996	10201	17215	-7014	0.77
FAR WESTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT											
Bajura	1732	0	1732	2924	-1192	1320	0	1320	2229	-909	0.76
Bajhang	4522	2693	7215	6600	615	3443	2051	5494	5026	468	0.76
Darchula	1652	83	1735	2545	-810	1261	63	1325	1943	-618	0.76
TOTAL FOR FAR WESTERN MOUNTAIN DISTRICTS	7906	2776	10682	12069	-1387	6025	2114	8139	9198	-1059	0.76
TOTALS BY DEVELOPMENT REGION											
EASTERN DISTRICTS	532772	67110	599882	531551	68331	468216	58712	526928	467303	59625	0.88
CENTRAL DISTRICTS	710526	68233	778759	585764	192995	614697	57930	672627	503936	168691	0.86
WESTERN DISTRICTS	375585	44606	420191	342944	77247	329263	35754	365018	295322	69696	0.86
MID WESTERN DISTRICTS	331060	44701	375761	244883	130878	281747	37979	319726	206466	113260	0.84
FAR WESTERN DISTRICTS	288909	25726	314635	155382	159253	247820	21834	269655	130884	138771	0.84
TOTALS BY ECOLOGICAL BELT											
TERAI DISTRICTS	1973388	174225	2147613	1518953	628660	1732965	152630	1885595	1336853	548742	0.88
HILL DISTRICTS	244696	69028	313724	314250	-526	192573	54052	246624	245811	813	0.78
MOUNTAIN DISTRICTS	20768	7123	27891	27320	571	16206	5528	21734	21245	489	0.78
TOTAL FOR ALL DISTRICTS	2238852	250376	2489228	1860523	628705	1941744	212209	2153953	1603910	550043	0.86

IRRIGATION POTENTIAL BY LAND TYPE AND LAND USE

District	Mapped Irrigable Areas (ha)						Net Irrigable Areas (ha)					
	Breakdown by Land Type			Breakdown by Land Use			Breakdown by Land Type			Breakdown by Land Use		
	TP & HV (1)	HS (2)	Total (3)	Agric. (4)	Non Agric. (5)	Total (6)	TP & HV (1)	HS (2)	Total (3)	Agric. (4)	Non Agric. (5)	Total (6)
EASTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT												
Jhapa	124238	0	124238	123574	664	124238	110118	0	110118	109530	588	110118
Morang	121167	214	121381	113573	7808	121381	106768	71	106839	99959	6880	106839
Sunsari *	79354	0	79354	79354	0	79354	70629	0	70629	70629	0	70629
Saptari *	86382	0	86382	86382	0	86382	76950	0	76950	76950	0	76950
Siraha *	88355	0	88355	88355	0	88355	77726	0	77726	77726	0	77726
TOTAL FOR EASTERN TERAI DISTRICTS	499496	214	499710	491239	8472	499710	442191	71	442262	434793	7468	442262
EASTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT												
Ilam	6810	14526	21336	20004	1332	21336	5640	8205	13845	12742	1103	13845
Panchthar *	2496	9073	11569	11569	0	11569	1870	5371	7241	7241	0	7241
Terhathum	215	9989	10204	9989	215	10204	173	6282	6455	6282	173	6455
Dhankuta *	3041	8439	11480	11480	0	11480	2276	5219	7495	7495	0	7495
Bhojpur	2439	9961	12400	11745	655	12400	1830	5482	7311	6820	491	7311
Udayapur	24477	1862	26339	22935	3403	26339	20360	879	21239	18408	2831	21239
Khotang	2921	12812	15733	14934	799	15733	2230	7238	9469	8859	610	9469
Okhaldhunga *	2224	5242	7466	7466	0	7466	1667	2811	4478	4478	0	4478
TOTAL FOR EASTERN HILL DISTRICTS	44623	71904	116527	110122	6404	116527	36047	41487	77533	72324	5209	77533
EASTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT												
Taplejung *	243	12340	12583	12583	0	12583	184	7259	7443	7443	0	7443
Sankhuwasawa	1723	7076	8799	8653	146	8799	1284	3995	5279	5170	109	5279
Solukhumbu *	488	2722	3210	3210	0	3210	383	1655	2038	2038	0	2038
TOTAL FOR EASTERN MOUNTAIN DISTRICTS	2454	22138	24592	24445	146	24592	1851	12909	14760	14651	109	14760
CENTRAL DEVELOPMENT REGION - TERAI ECOLOGICAL BELT												
Dhanusha	86166	0	86166	83182	2984	86166	75541	0	75541	72925	2616	75541
Mahottari	74388	0	74388	69286	5102	74388	65098	0	65098	60633	4465	65098
Sarlahi	93856	0	93856	84183	9673	93856	81969	0	81969	73521	8448	81969
Rautahat	81444	0	81444	63942	17502	81444	71509	0	71509	56141	15367	71509
Bara	102841	0	102841	68847	33994	102841	90209	0	90209	60390	29819	90209
Parsa	89053	0	89053	54732	34321	89053	78708	0	78708	48374	30334	78708
Chitwan	88464	0	88464	48491	39973	88464	76555	0	76555	41963	34592	76555
TOTAL FOR CENTRAL TERAI DISTRICTS	616212	0	616212	472662	143550	616212	539589	0	539589	413948	125641	539589
CENTRAL DEVELOPMENT REGION - HILL ECOLOGICAL BELT												
Sindhuli *	24418	1580	25998	25998	0	25998	19947	705	20652	20652	0	20652
Ramechhap *	1806	4932	6738	6738	0	6738	1414	2834	4248	4248	0	4248
Makawanpur *	27637	2152	29789	29789	0	29789	22387	1115	23502	23502	0	23502
Kabhre Palanchowk *	7762	3805	11567	11567	0	11567	6056	1902	7958	7958	0	7958
Lalitpur *	8594	1086	9680	9680	0	9680	6672	754	7425	7425	0	7425
Bhaktapur *	7312	759	8072	8072	0	8072	5759	515	6274	6274	0	6274
Kathmandu *	17084	1164	18249	18249	0	18249	13391	677	14069	14069	0	14069
Nuwakot *	7468	18171	25639	25639	0	25639	5849	9199	15047	15047	0	15047
Dhading *	7509	9765	17274	17274	0	17274	5821	5018	10839	10839	0	10839
TOTAL FOR CENTRAL HILL DISTRICTS	109591	43416	153007	153007	0	153007	87295	22719	110014	110014	0	110014

IRRIGATION POTENTIAL BY LAND TYPE AND LAND USE

District	Mapped Irrigable Areas (ha)						Net Irrigable Areas (ha)					
	Breakdown by Land Type			Breakdown by Land Use			Breakdown by Land Type			Breakdown by Land Use		
	TP & HV (1)	HS (2)	Total (3)	Agric. (4)	Non Agric. (5)	Total (6)	TP & HV (1)	HS (2)	Total (3)	Agric. (4)	Non Agric. (5)	Total (6)
CENTRAL DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT												
Dolakha	595	7585	8180	8127	53	8180	428	4521	4949	4911	38	4949
Sindhupalchowk *	2786	18608	21395	21395	0	21395	2161	10116	12276	12276	0	12276
Rasuwa	290	1338	1628	1521	107	1628	227	692	919	836	84	919
TOTAL FOR CENTRAL MOUNTAIN DISTRICTS	3671	27531	31203	31042	160	31203	2815	15330	18145	18023	122	18145
WESTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT												
Nawalparasi	80904	0	80904	58040	22864	80904	70659	0	70659	50690	19969	70659
Rupandehi	108834	0	108834	96862	11972	108834	98853	0	98853	87979	10874	98853
Kapilbastu	124411	55	124466	92867	31600	124466	113184	17	113201	84453	28748	113201
TOTAL FOR WESTERN TERAI DISTRICTS	314149	55	314204	247769	66436	314204	282696	17	282712	223122	59591	282712
WESTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT												
Palpa *	11574	219	11792	11792	0	11792	8735	122	8857	8857	0	8857
Arghakhanchi *	6091	298	6389	6389	0	6389	4635	164	4799	4799	0	4799
Gulmi *	4722	1321	6043	6043	0	6043	3526	714	4240	4240	0	4240
Tanahun *	17785	1786	19571	19571	0	19571	13503	993	14496	14496	0	14496
Syangja *	9464	4869	14333	14333	0	14333	7238	2610	9848	9848	0	9848
Gorkha *	9921	6402	16323	16323	0	16323	7507	3520	11027	11027	0	11027
Lamjung *	9580	9512	19092	19092	0	19092	7229	4708	11937	11937	0	11937
Kaski *	17233	5123	22356	22356	0	22356	13139	2822	15960	15960	0	15960
Parbat *	3410	7483	10893	10893	0	10893	2546	3909	6455	6455	0	6455
Baglung *	4170	9211	13381	13381	0	13381	3178	4602	7780	7780	0	7780
Myagdi *	927	5354	6281	6281	0	6281	702	2984	3685	3685	0	3685
TOTAL FOR WESTERN HILL DISTRICTS	94876	51578	146454	146454	0	146454	71937	27148	99084	99084	0	99084
WESTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT												
Manang *	154	0	154	154	0	154	121	0	121	121	0	121
Mustang *	201	0	201	201	0	201	159	0	159	159	0	159
TOTAL FOR WESTERN MOUNTAIN DISTRICTS	354	0	354	354	0	354	280	0	280	280	0	280
MID WESTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT												
Dangdeukhuri	77780	49	77829	69344	8485	77829	66767	22	66789	59505	7284	66789
Banke	98205	106	98311	56451	41860	98311	84540	45	84585	48550	36035	84585
Bardiya	109426	83	109509	61165	48343	109509	94264	41	94305	52660	41645	94305
TOTAL FOR MID WESTERN TERAI DISTRICTS	285411	237	285648	186960	98688	285648	245571	108	245679	160715	84964	245679
MID WESTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT												
Pyuthan *	8328	1297	9625	9625	0	9625	6374	664	7037	7037	0	7037
Rolpa *	2814	3329	6143	6143	0	6143	2192	1788	3980	3980	0	3980
Salyan *	5002	2661	7663	7663	0	7663	3790	1492	5282	5282	0	5282
Rukum *	4399	1150	5549	5549	0	5549	3491	678	4170	4170	0	4170
Surkhet *	22659	2368	25027	25027	0	25027	18165	1110	19275	19275	0	19275
Jajarkot *	2512	3403	5914	5914	0	5914	1975	2168	4143	4143	0	4143
Dailekh *	3367	7934	11301	11301	0	11301	2540	4536	7075	7075	0	7075
TOTAL FOR MID WESTERN HILL DISTRICTS	49082	22141	71222	71222	0	71222	38527	12435	50962	50962	0	50962

Table A2-3 (continued)

IRRIGATION POTENTIAL BY LAND TYPE AND LAND USE

District	Mapped Irrigable Areas (ha)						Net Irrigable Areas (ha)					
	Breakdown by Land Type			Breakdown by Land Use			Breakdown by Land Type			Breakdown by Land Use		
	TP & HV (1)	HS (2)	Total (3)	Agric. (4)	Non Agric. (5)	Total (6)	TP & HV (1)	HS (2)	Total (3)	Agric. (4)	Non Agric. (5)	Total (6)
MID WESTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT												
Dolpa	1063	0	1063	666	397	1063	868	0	868	544	324	868
Jumla *	5607	525	6131	6131	0	6131	4526	239	4765	4765	0	4765
Kalikot *	813	3992	4805	4805	0	4805	661	2423	3084	3084	0	3084
Mugu *	971	2201	3172	3172	0	3172	764	1267	2030	2030	0	2030
Humla	1956	194	2150	1216	934	2150	1601	133	1733	969	764	1733
TOTAL FOR MID WESTERN MOUNTAIN DISTRICTS	10409	6912	17321	15990	1331	17321	8420	4060	12480	11392	1088	12480
FAR WESTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT												
Kailali	157406	1095	158501	74668	83833	158501	136026	532	136558	64112	72446	136558
Kanchanpur	111598	0	111598	47257	64341	111598	96564	0	96564	40891	55673	96564
TOTAL FOR FAR WESTERN TERAI DISTRICTS	269004	1095	270099	121925	148174	270099	232590	532	233122	105003	128119	233122
FAR WESTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT												
Achham *	4884	12785	17669	17669	0	17669	3725	7246	10972	10972	0	10972
Doti *	7473	8623	16096	16096	0	16096	5710	4757	10468	10468	0	10468
Dadeldhura *	6457	4077	10534	10534	0	10534	4983	2283	7266	7266	0	7266
Baitadi *	3669	8991	12659	12659	0	12659	2796	4653	7450	7450	0	7450
TOTAL FOR FAR WESTERN HILL DISTRICTS	22482	34476	56958	56958	0	56958	17215	18940	36155	36155	0	36155
FAR WESTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT												
Bajura *	2924	2573	5497	5497	0	5497	2229	1355	3584	3584	0	3584
Bajhang *	6600	4627	11227	11227	0	11227	5026	2523	7549	7549	0	7549
Darchula *	2545	4297	6842	6842	0	6842	1943	2296	4239	4239	0	4239
TOTAL FOR FAR WESTERN MOUNTAIN DISTRICTS	12069	11497	23566	23566	0	23566	9198	6175	15373	15373	0	15373
TOTALS BY DEVELOPMENT REGION												
EASTERN DISTRICTS	546573	94256	640829	625807	15022	640829	480089	54466	534555	521769	12786	534555
CENTRAL DISTRICTS	729474	70947	800421	656711	143711	800421	629699	38048	667748	541984	125763	667748
WESTERN DISTRICTS	409380	51633	461013	394577	66436	461013	354913	27164	382077	322486	59591	382077
MID WESTERN DISTRICTS	344902	29290	374192	274173	100019	374192	292518	16603	309121	223069	86052	309121
FAR WESTERN DISTRICTS	303555	47068	350623	202449	148174	350623	259003	25647	284650	156531	128119	284650
TOTALS BY ECOLOGICAL BELT												
TERAI DISTRICTS	1984272	1602	1985874	1520555	465320	1985874	1742637	727	1743364	1337581	405783	1743364
HILL DISTRICTS	320654	223514	544168	537763	6404	544168	251020	122728	373749	368540	5209	373749
MOUNTAIN DISTRICTS	28958	68078	97036	95398	1637	97036	22564	38474	61038	59719	1319	61038
TOTAL FOR ALL DISTRICTS	2333884	293194	2627077	2153716	473361	2627077	2016221	161929	2178151	1765839	412312	2178151

IRRIGATION POTENTIAL BY LAND USE IN TERAI DISTRICTS

District	Mapped Irrigable Areas (ha) Breakdown by Land Use					Net Irrigable Areas (ha) Breakdown by Land Use				
	Agric.	Non Agric.			Total	Agric.	Non Agric.			Total
		Grass	Forest	Total			Grass	Forest	Total	
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
EASTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT										
Jhapa	123574	9	655	664	124238	109530	8	580	588	110118
Morang	113573	336	7472	7808	121381	99959	296	6584	6880	106839
Sunsari	79354	0	0	0	79354	70629	0	0	0	70629
Saptari	86382	0	0	0	86382	76950	0	0	0	76950
Siraha	88355	0	0	0	88355	77726	0	0	0	77726
TOTAL FOR EASTERN TERAI DISTRICTS	491239	346	8126	8472	499710	434793	305	7164	7468	442262
CENTRAL DEVELOPMENT REGION - TERAI ECOLOGICAL BELT										
Dhanusha	83182	1621	1364	2984	86166	72925	1421	1195	2616	75541
Mahottari	69286	62	5040	5102	74388	60633	55	4410	4465	65098
Sarlahi	84183	515	9158	9673	93856	73521	450	7998	8448	81969
Rautahat	63942	787	16715	17502	81444	56141	691	14676	15367	71509
Bara	68847	1560	32434	33994	102841	60390	1368	28450	29819	90209
Parsa	54732	1847	32474	34321	89053	48374	1632	28702	30334	78708
Chitwan	48491	14489	25485	39973	88464	41963	12538	22054	34592	76555
TOTAL FOR CENTRAL TERAI DISTRICTS	472662	20881	122669	143550	616212	413948	18156	107486	125641	539589
WESTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT										
Nawalparasi	58040	912	21953	22864	80904	50690	796	19173	19969	70659
Rupandehi	96862	478	11494	11972	108834	87979	434	10440	10874	98853
Kapilbastu	92867	443	31157	31600	124466	84453	403	28345	28748	113201
TOTAL FOR WESTERN TERAI DISTRICTS	247769	1833	64603	66436	314204	223122	1633	57958	59591	282712
MID WESTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT										
Dangdeukhuri	69344	930	7555	8485	77829	59505	798	6486	7284	66789
Banke	56451	1826	40033	41860	98311	48550	1572	34463	36035	84585
Bardiya	61165	2655	45688	48343	109509	52660	2287	39358	41645	94305
TOTAL FOR MID WESTERN TERAI DISTRICTS	186960	5411	93277	98688	285648	160715	4657	80307	84964	245679
FAR WESTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT										
Kailali	74668	3711	80122	83833	158501	64112	3207	69239	72446	136558
Kanchanpur	47257	5777	58563	64341	111598	40891	4999	50674	55673	96564
TOTAL FOR FAR WESTERN TERAI DISTRICTS	121925	9488	138685	148174	270099	105003	8206	119913	128119	233122
TOTAL FOR ALL TERAI DISTRICTS	1520555	37958	427361	465320	1985874	1337581	32957	372827	405783	1743364

Notes

(1) Irrigable agricultural land areas as given in Table A2-3
(2) Irrigable grassland areas obtained from (4) by applying ratio derived from WECS 1988 study of irrigable land in the Terai districts
(3) Irrigable forest land areas obtained from (4) by applying ratio derived from WECS 1988 study of irrigable land in the Terai districts
(4) Sum of (2) and (3), equal to irrigable nonagricultural land areas as given in Table A2-3

Figure A2—1a

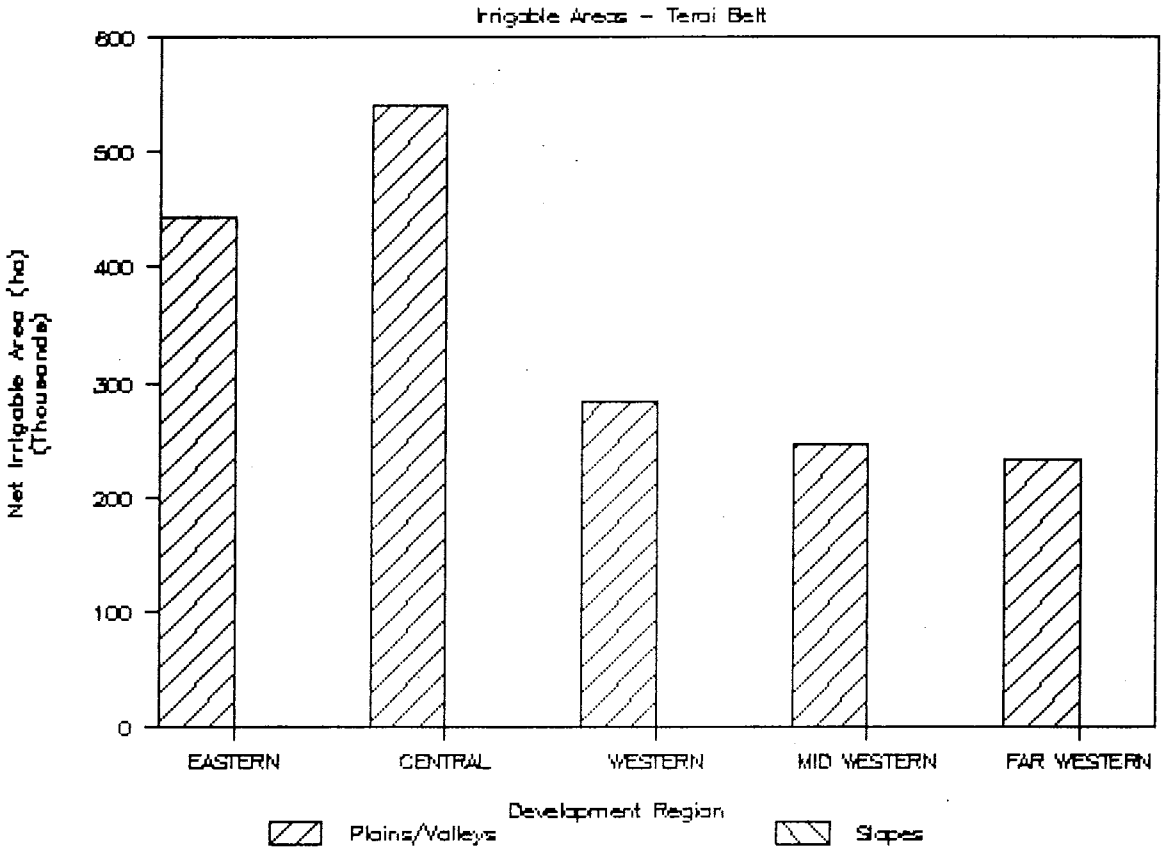


Figure A2—1b

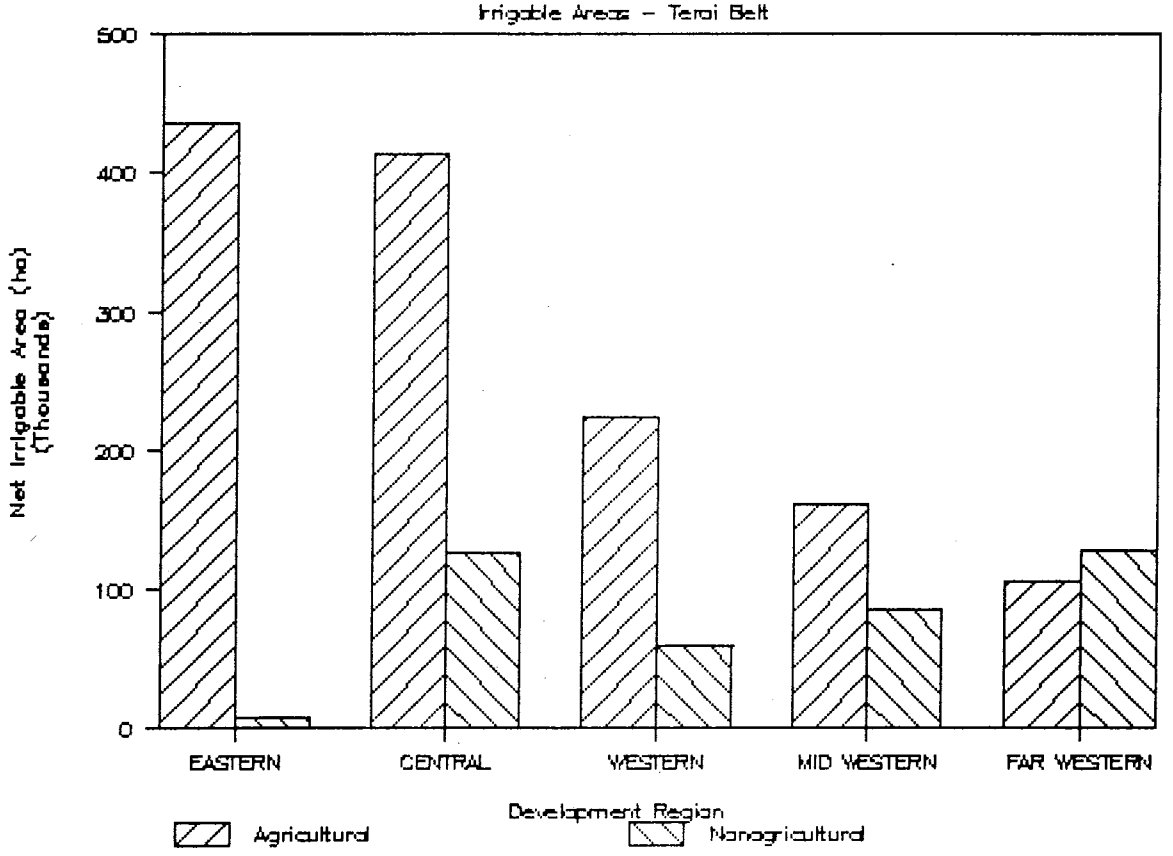


Figure A2–2a

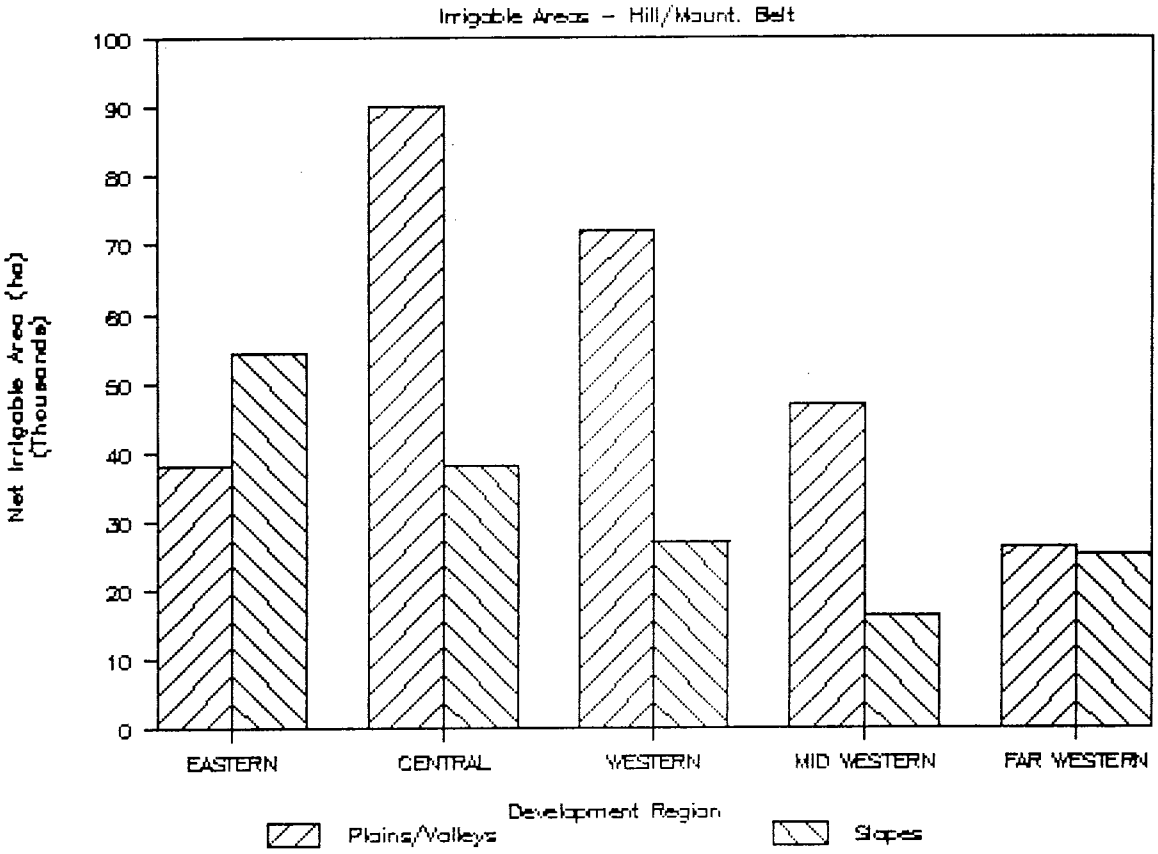


Figure A2–2b

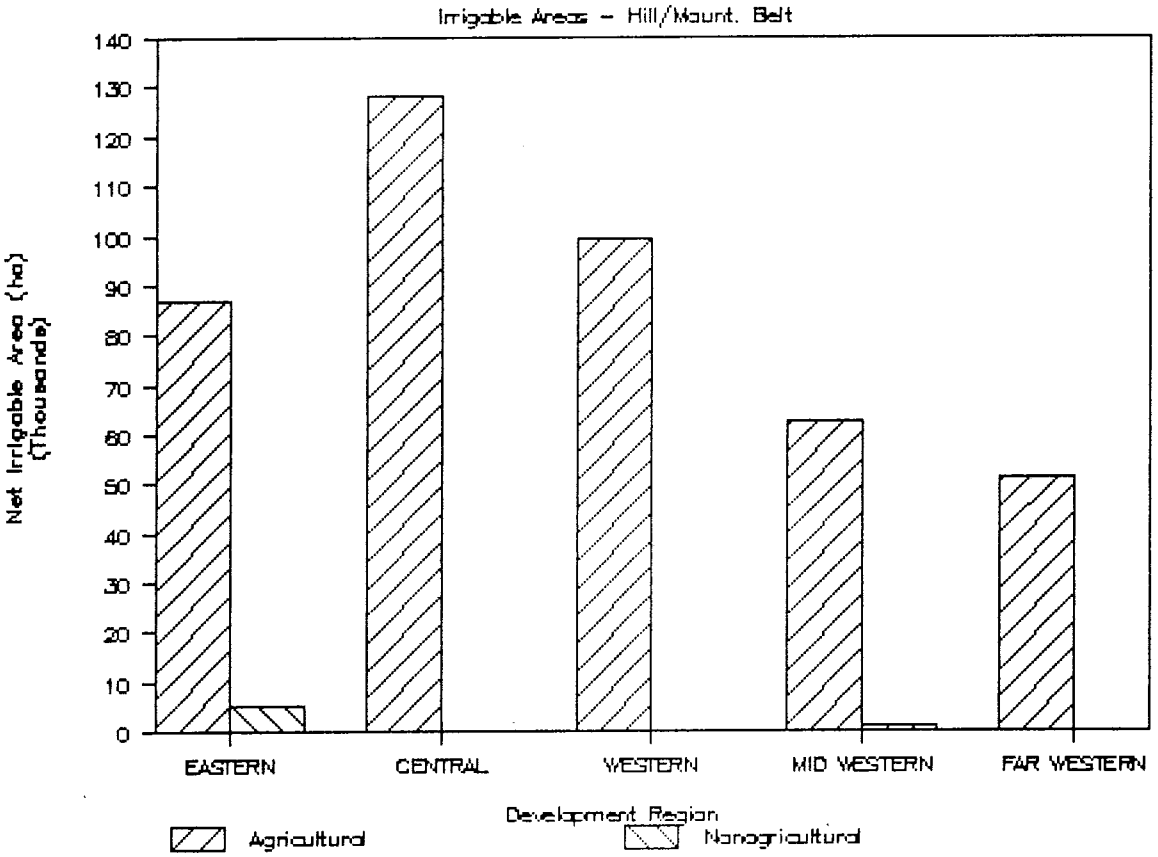


Figure A2–3a

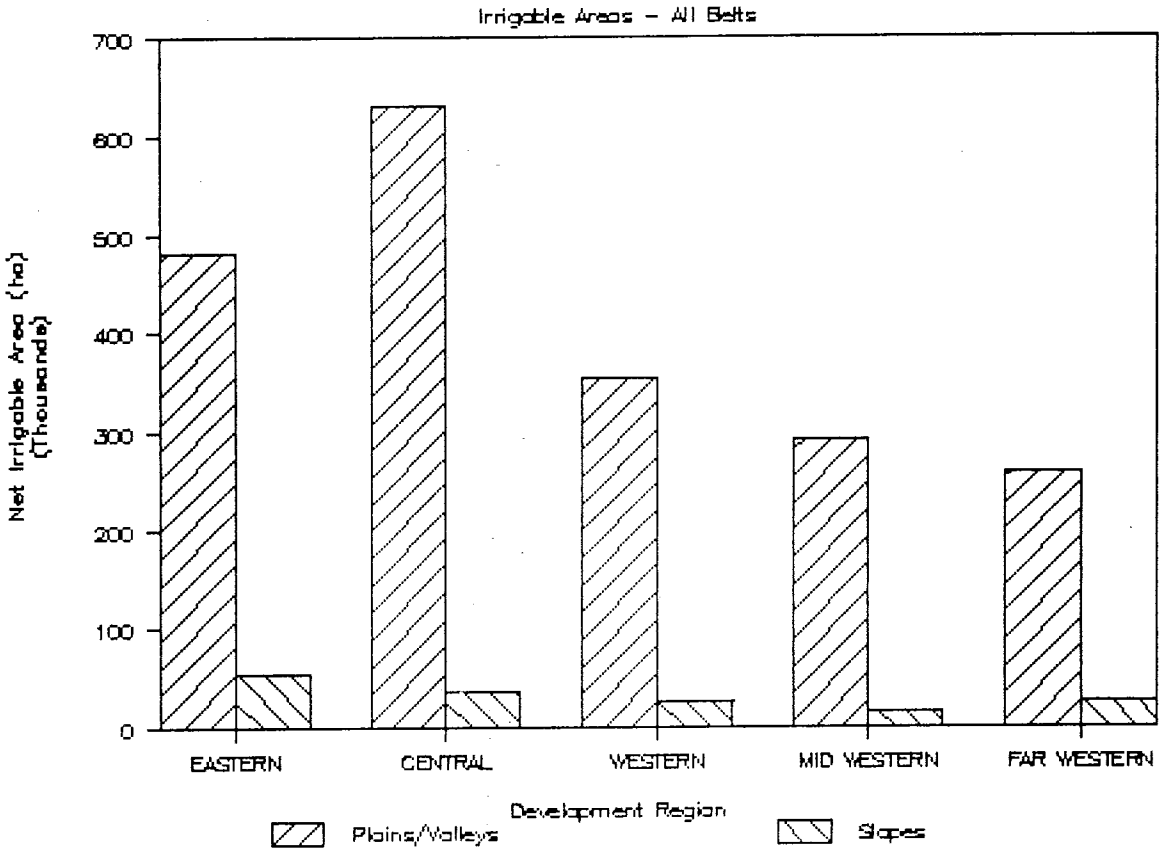
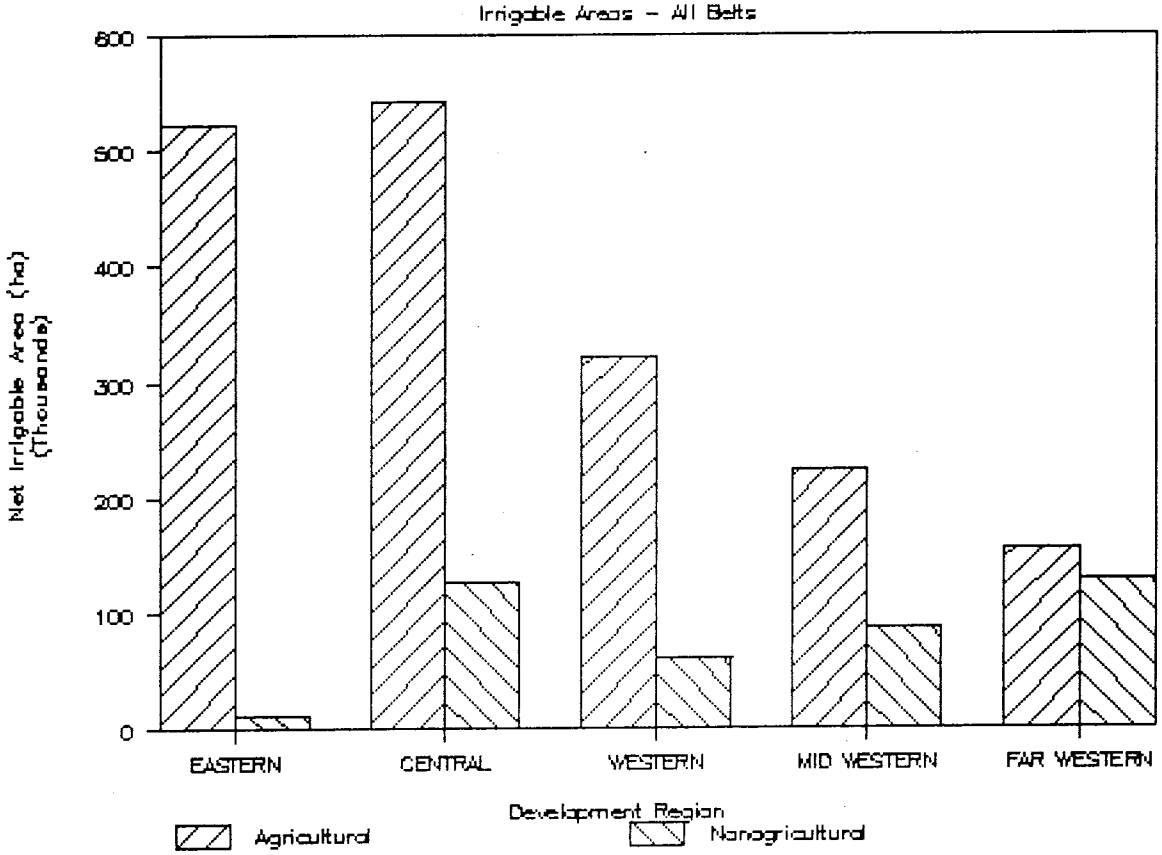


Figure A2–3b



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MASTER PLAN SECOND CYCLE REPORT - ANNEX A - LAND RESOURCE DATA

ANNEX A3 - Inventory of Identified Potential Irrigation Projects

LIST OF TABLES

A3-1 - INTRODUCTION

A3-1.1 - Objectives

Annex A3 has three objectives :

1. To present the principal characteristics of all formally identified potential new irrigation projects

2. To complement the information on the present level of irrigation development presented in Annex A1, such that there is compatibility between the two annexes and no duplication with respect to identified irrigation projects and their command areas

3. To serve as a land resource reference for irrigation expansion planning.

A3-1.2 - Scope and Outline

This annex provides a summary of those potential new irrigation projects in Nepal which have been identified and studied and for which some formal evaluation report is available. Project identification of this nature has been undertaken only by, or on behalf of, the Department of Irrigation (DOI) or the Nepal Electricity Authority (NEA), the latter when there is a hydro-electric power component of the project.

Numerous additional potential small projects have been proposed by DOI district offices or other agencies interested in promoting irrigation development. Some of these projects have been included in official development programs, pending confirmation of their technical and economic viability; these are listed in the Ministry of Finance irrigation projects database. Because formal study reports are not available for them, they are not covered in this annex. This has little significance for the overall master planning process, as these projects are generally small in terms of size, cost and production potential.

Potential projects concerned with rehabilitation, intensification or upgrading of the existing DOI developments listed in Annex A1 are not considered in this annex, although potential command area extensions to the existing developments are covered. It is noted, however, that many of the potential new DOI projects listed in this annex incorporate existing schemes; these are most often farmer schemes but are sometimes DOI schemes. The extent to which the identified potential new projects incorporate existing schemes needs to be documented for evaluation purposes. This annex includes

A3-2 - DATA SOURCES

A3-2.1 - Project Study Reports

All of the identified potential irrigation projects listed in this annex have been the subject of technical studies; most but not all of the corresponding formal reports have been available for review. The level of study achieved to date for each project is variable but has usually been described as either feasibility or prefeasibility level. The study reports where available have been the primary references for the compilation of project characteristics, but these have been adopted from the other data sources discussed below if they were considered to be more appropriate.

A3-2.2 - Annex A1

Data presented in Annex A1 and the sources of data used in its preparation have been important sources of data for the present compilation. Many of the identified potential irrigation projects would incorporate existing DOI and farmer schemes. Command areas corresponding to the existing defined DOI schemes involved in these overlaps are sometimes identified in the project study reports, but in all cases use of the areas presented in Annex A1 for these schemes was preferred, to ensure compatibility as far as possible between the two annexes. In the case of existing farmer managed irrigation schemes (FMIS), Annex A1 presents district aggregates of command areas based on the Water Use Inventories (WUIs) prepared for the Water and Energy Commission Secretariat (WECS). This source was used as the basis for estimating the overlaps between existing defined FMIS and identified potential projects located in Terai districts. Since WUIs were not available for most of the Hill and Mountain districts, overlap information for Hill and Mountain projects was taken directly from the project study reports as available.

A3-2.3 - Department of Irrigation

The DOI has periodically prepared irrigation development plans and summary descriptions, lists and tables of potential irrigation projects, often in connection with submissions to international development agencies. Project details presented in these documents tend to take on official status yet may differ from those of the project study reports. DOI versions of project details have been adopted where they are compatible with, or can be reconciled with, those given in the project study reports.

A3-3 - METHODOLOGY

A3-3.1 - Larger Projects

In keeping with the standard approach adopted for the Master Plan, larger potential irrigation projects are defined as projects with planned net command areas greater than 2,000 ha. All of these projects are located in districts within the Terai ecological belt*. Data on the larger projects are often available from more than one data source.

The larger projects have been reviewed and are described individually in this annex. Particular attention has been given to estimating satisfactorily the command area overlaps not only with existing schemes but also with other potential schemes. The overlap with existing schemes represents the command area which corresponds to a potential upgrading from a present irrigation to a future irrigation development situation, as opposed to a potential upgrading from a present rainfed or uncultivated situation. The overlap with other potential projects offers a means of estimating the true potential addition to the existing irrigation command area. Command area data were compiled by project, and by district within projects where applicable.

The use of information from Annex A1 and the WUIs in conjunction with the project study reports to estimate the command area overlaps with existing schemes was relatively straightforward. Command area boundaries for the potential projects were first compared with those for the existing schemes on the WUI maps. Command area data from Annex A1 or the WUIs for those existing schemes that would be incorporated into the potential projects were then aggregated to give the required command area overlaps. Existing scheme command areas include both the developed and the ongoing command areas given in Annex A1.

Estimation of command area overlaps with other potential projects cannot yield a final estimate of potential additions to existing irrigation command areas until a sequence of development of potential projects is established. It should be further noted that the potential projects could not all be implemented as identified at present, since there are cases where implementation of one project would render another project redundant or would result in a need to reformulate the other project. Selection and sequencing of potential projects is a variable in the master planning process, but the present compilation is intended to serve as a standard reference on formally identified potential projects.

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* See Annex A1 for discussion on the use of development regions and ecological belts for master planning purposes.

An overview of the potential command area additions can be obtained by classifying the larger potential projects into two categories of projects -- run-of-river/large groundwater projects, and storage and diversion projects. There are no overlaps between potential projects in the first category. Projects in the second category can incorporate projects in the first category. They can also overlap with each other; to assess this aspect a hierarchy of projects has been postulated, based on their scope and complexity. From this has emerged a generalized statement of the additional command area corresponding to each new project.. More specific assessments of incremental command areas need to be compiled for each proposed development sequence, to conform with the component projects and their configurations in space and time.

A3-3.2 - Smaller Projects

Most of the smaller identified potential irrigation projects, which have planned net command areas less than 2,000 ha each, are located in districts within the Hill and Mountain ecological belts. However, there is also some identified potential command area corresponding to smaller projects in the Terai ecological belt. In both cases, information on the command area overlaps with existing schemes was obtained as available from the project study reports. The location of the smaller potential Terai projects was established, to determine their possible incorporation into larger potential projects. Overlaps between potential Hill and Mountain projects were not assessed, since their occurrence is believed to be minimal or nonexistent. A listing of all of the smaller identified potential projects, including their principal characteristics, has been prepared for this annex.

A3-3.3 - Other Projects

Some other currently formulated potential irrigation projects are not location specific. Their relationships with existing schemes and other potential projects are therefore not definable. However, available information on these projects has been obtained and is presented.

A3-4 - RESULTS

A3-4.1 - Larger Projects

A3-4.1.1 - Data Sheets

The work described in Section A3-3.1 has resulted in an inventory of 19 identified potential irrigation projects having net command areas greater than 2,000 ha. Key data for these larger potential projects have been compiled on an individual project basis. A standard two-page project data sheet was prepared for recording these key data. A data sheet was then completed for each of the projects; the completed data sheets are included in the Appendix.

The Appendix serves as a reference inventory of the larger identified potential irrigation projects. Use of the standard data sheet has made the inventory amenable to future updating and expansion as improved information or details of new potential projects become available. The data sheets document those individual project characteristics that are important for broad master planning purposes. These characteristics are discussed briefly in the following paragraphs.

Each project has been assigned a project number which is used to reference overlaps between the projects. The original sequence of project numbers reflects the geographical locations of the projects, with the numbers ascending in value from east to west*. Name and type of project are also given; the latter provides an indication of the major water supply characteristic (run-of-river, groundwater, storage, diversion) and of the major linkage with subsidiary projects, existing or potential.

The location of each project is specified in terms of ecological belt and development regions, the combinations of which define the basic planning units proposed for master planning. The districts and zones in which the project is located are also identified, as is the water source for the project.

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* Because of the relatively small number of larger projects, it is considered that future project additions to the inventory can adequately be made using the next available sequential number, regardless of project location. This has already been done in this final version of the annex, for the recently defined Bhairawa-Lumbini Groundwater Irrigation Project, Phase III.

The planned irrigation capability and development intensity have been recorded as available for each project, based where possible on information given in the project study reports. The projected cropping intensity has also been given, to serve as an indication of the expected production from each project.

Net command areas for each project given in the data sheets of the Appendix are those for

- the overall scheme
- the overlaps with existing DOI schemes
- the overlaps with existing FMIS
- the resulting new, unirrigated, portion of the scheme.

It is emphasised that these values apply to each project as originally defined* and taken independently, as if implemented without any interaction with other potential projects. As in Annex A1, existing FMIS have not been named individually; their overlap areas are given directly as a total. However, each existing DOI project, and each of the other larger identified potential projects, which overlaps with or could overlap with the project, has been named in the data sheet; the corresponding net command area overlap values are also given. The overlap areas given for the individual existing DOI projects are additive, and sum to give their total overlap area. The overlap areas given for the other potential projects are those for the individual projects taken independently; they are therefore not additive if there are overlaps between these other projects.

The remaining information given in the data sheets for each project, when known, includes

- the agencies responsible for development of the project
- project appraisal level, year, and responsible organization
- implementation schedule earliest start and completion years.

Relevant additional comments are presented in text form at the end of each project data sheet.

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* Annex D2 describes water balance studies which led to reductions in the projected net command areas below the values quoted in this annex.

A3-4.1.2 - Net Command Areas

For master planning purposes, a comprehensive account of the command areas pertaining to each potential project is required. Tables A3-1 and A3-2 have been prepared with this in mind, and more specifically to meet three objectives

a) To summarize concisely the net command area information pertaining to the larger identified potential irrigation projects

b) To provide a district-level breakdown of the net command areas of the larger potential projects, to allow for subsequent analysis of irrigation development potential by district or planning unit

c) To give an indication of the true incremental (i.e new and unirrigated) net command area of each of the larger potential projects, accounting for overlaps not only with existing schemes but also with possible previously implemented potential schemes

Table A3-1 presents the net command areas of the larger potential projects accounting for overlaps with existing schemes. The total project areas in this table correspond to those given in the data sheets of the Appendix, but the breakdown by district within projects is also given where applicable. By identifying the command area overlaps with existing DOI and farmer schemes, and subtracting these from the overall project command areas, the new scheme command areas are obtained, as given in Table A3-1. As mentioned in Section A3-4.1.1, the new scheme command areas apply to each potential project taken independently; they are not additive if there are overlaps with other potential projects.

Table A3-2 presents an account of the net command areas of the larger potential projects accounting for incorporation of all other schemes both existing and potential. It therefore gives an indication of the true and additive incremental areas of the projects. As in Table A3-1, net command areas are given by project, and by district within projects where applicable. To arrive at the incremental scheme areas, in accordance with the discussion of Section A3-3.1, projects have been grouped and shown as either run-of-river/large groundwater projects or storage and diversion projects.

The nature of the run-of-river/large groundwater projects is such that they are more modest and less complex than the storage and diversion projects; they are also intrabasin as opposed to interbasin projects, at least with respect to the larger river basins. This relatively minor scope implies that they may fully incorporate some of the smaller identified potential projects

discussed in Section A3-4.2, but that they may themselves be incorporated into the larger potential storage and diversion projects.

The storage and diversion projects, in addition to incorporating some more minor potential projects, may also have command area overlaps with other similar potential projects. This is because they may have been formulated at different times and in different studies, in some cases without reference to studies of previously formulated projects.

To give an indication of the previously unirrigated portion of a potential project's command area, as an additive increment over that for other potential projects that may precede and overlap it, a logical hierarchy of the groups of projects has been postulated, in which higher order projects potentially incorporate lower order projects. Thus the smaller potential projects of Section A3-4.2 are of lower order than the potential run-of-river/large groundwater projects, which in turn are of lower order than the potential storage and diversion projects. Within the latter category of potential projects, those which are essentially intrabasin storage projects, or direct expansions of equivalent potential run-of-river projects, are of lower order than the more extensive interbasin projects.

Specifically, the hierarchy of the larger identified potential projects which have overlaps between them is as shown below by groups from lowest to highest order

<u>Hierarchy of Identified Potential Projects With Overlaps</u>

a) Run-of-River/Large Groundwater Projects

Rato
Bagmati
Sikta
Babai
Geruwa Island
Jamuar Nala
Khutiya II

b) Lower Order Storage and Diversion Projects

Kamala Multipurpose
Bagmati Multipurpose
West Rapti Multipurpose
Bheri-Babai Multipurpose

c) Higher Order Storage and Diversion Projects

Sun Kosi-Kamala Multipurpose
Karnali (Chisapani) Multipurpose

As indicated in Section A3-3.1, use of this hierarchy in the present annex does not prejudge any outcome of the master planning process with regard to sequencing of development of potential projects, since there are many factors other than project size and complexity to be considered.

By applying the above defined hierarchy, the incremental command area of each potential project can be obtained from the overall command area by first subtracting the incorporated command areas of all the overlapping lower order potential projects and then subtracting the command areas of the additional incorporated existing schemes. The results of this are presented in Table A3-2, using net command areas. Values are shown separately for the smaller and larger identified potential schemes, and for the additional DOI and farmer schemes, incorporated into each potential project as described above.

A3-4.2 - Smaller Projects

Key planning data for the numerous identified potential irrigation projects with net command areas less than 2,000 ha are presented in Table A3-3. The table is intended to serve as a reference inventory for these smaller potential projects. Command area totals are given by district, planning unit, development region and ecological belt.

Reference project numbers have been assigned to each potential project listed in Table A3-3. The numbering convention used identifies the planning unit with the first two digits (01 to 15), the district within the planning unit with the next two digits (01, 02, etc.), and the project within the district with the last two digits (01, 02, etc.). This will facilitate future expansion of the inventory of smaller potential projects, by allowing new projects to be inserted into the appropriate location in the table while maintaining a sequential numbering system. Subsequent versions of the database could usefully include the project codes from the Ministry of Finance irrigation projects database, in anticipation of the possible need to combine the two databases.

For each project in Table A3-3, the district, name and water source is given. This is followed by the irrigation capability, development intensity and cropping intensity planned for the project, as explained in Section A3-4.1 for the larger projects. Net command areas are given for the overall project, and for the existing and additional new scheme portions of the project.

It is assumed that responsibility for development of the smaller projects will lie exclusively with DOI and the beneficiary farmers, therefore Table A3-3 does not include an indication of development responsibility. Project appraisal information, including level, year and responsible organization, is given in the table, together with any relevant comments on each project.

A3-4.3 - Other Projects

As mentioned in Section A3-3.3, some other potential irrigation projects have been formulated. However, there are no quantitative data available on their interactions or overlaps either with existing schemes or with other potential schemes. The following paragraphs summarize the available information on these projects, which at best have been studied to preliminary level only.

The Groundwater Development Project, as envisaged by DOI, would irrigate by groundwater a total net command area of 76,910 ha, divided among all or most of the districts in the Terai ecological belt. It would thus have some impact on irrigated agriculture in all the development regions, but the proposed distribution and locations of the development areas have not as yet been specified.

The Dang Valley Groundwater Irrigation Development Project has a proposed net command area of 50,000 ha, which covers essentially all of the net agricultural land area of the Dang Valley in Dangdeukhuri district. Aquifer capabilities in the area have yet to be determined, and there are possible alternative surface water supply schemes involving pumping from the Babai River or a transbasin diversion.

The Surkhet Valley Irrigation Development Project would provide irrigation supplies to a net command area of 2,500 ha in Surkhet district. It is envisaged that both surface and subsurface water sources would be exploited, but their capabilities have not yet been determined.

Finally, the Agricultural Development Bank of Nepal (ADB/N) plans to continue to fund individual tubewell developments. However, since these are undertaken on a demand-driven basis, there is no advance identification of potential projects or indication of potential development locations.

A3-5 - OVERVIEW OF IDENTIFIED POTENTIAL IRRIGATION PROJECTS

From the results of the work on identified potential irrigation projects presented in Section A3-4, a summary in terms of command areas by district, planning unit, development region and ecological belt has been prepared as shown in Table A3-4. This table gives the aggregated overall, new and incremental scheme net command areas of all of the identified potential projects for each of the geographic divisions. Net command areas are also given separately for the larger projects and for the smaller projects.

Table A3-4 shows that, for the country taken as a whole, an overall potential project net command area of about 983,500 ha has been identified. The corresponding new net command area, after accounting for all existing schemes within the overall area, is about 594,500 ha; however, there is a substantial portion of this area which is covered by more than one identified potential project. After applying the assumed hierarchy of potential projects, to obtain a plausible estimate of the overlap between them, a final incremental net command area of about 391,100 ha is estimated. Of this incremental area, about 342,200 ha or 88% corresponds to the larger identified potential projects, while only about 48,900 ha or 12% corresponds to the smaller projects. Total incremental NCA in the Terai districts is estimated to be 364,100 ha*, while 27,000 ha is located in the Hill and Mountain districts.

The distribution of the identified potential project net command areas between development regions is also given in Table A3-4, but a visual overview of this is provided by the graphs of Figure A3-1. Figure A3-1a shows the overall net command areas and their division into the overlap areas (existing and other potential scheme areas) and the incremental areas. Figure A3-1b shows the incremental areas only, with a division into those for the larger projects and those for the smaller projects.

Figure A3-1 shows that the Central Development Region has the greatest identified potential project command area, while the Western Region has the least. The larger projects contribute the dominant portion of the identified potential command area in all the regions; the most significant contribution from the smaller projects is in the Western region.

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* Although Annex D describes water balance and project evaluation studies that resulted in reductions in NCA's for some individual Terai projects, the estimate of incremental NCA obtainable by implementing all proposed projects remains valid and is used in Annex A4 to estimate remaining development potential. Reducing NCA's of individual projects can be compensated by eliminating some of the command area overlaps between the large multipurpose projects.

Table A3-1

NET COMMAND AREAS OF THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS, ACCOUNTING FOR OVERLAPS WITH EXISTING SCHEMES

Project Number	Project Name	District	Net Command Areas (ha) Overall Scheme Total	Overlaps with Existing Schemes DOI	Farmer	Total	New Scheme Total
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	Kankai MP	Jhapa	67000	8000	24532	32532	34468
2	Eastern Terai	Morang	7000	0	7000	7000	0
3	Sunkoshi-Kamala MP	Saptari	16200	700	4164	4864	11336
		Siraha	51000	15375	6226	21601	29399
		Dhanusha	42700	14500	12531	27031	15669
		Mahottari	41900	0	22667	22667	19233
		Sarlahi	23300	4640	6250	10890	12410
		Total	175100	35215	51838	87053	88047
4	Kamala MP	Siraha	51000	15375	6226	21601	29399
		Dhanusha	33200	14500	8587	23087	10113
		Mahottari	11800	0	6043	6043	5757
		Total	96000	29875	20856	50731	45269
5	Bagmati MP	Dhanusha	6900	0	2352	2352	4548
		Mahottari	12100	0	8470	8470	3630
		Sarlahi	43200	5800	18031	23831	19369
		Rautahat	34100	1500	7527	9027	25073
		Bara	23700	0	8710	8710	14990
		Total	120000	7300	45090	52390	67610
6	Rato	Mahotarri	3200	0	1400	1400	1800
7	Bagmati	Sarlahi	14000	0	7920	7920	6080
		Rautahat	23000	0	7527	7527	15473
		Total	37000	0	15447	15447	21553
8	East Rapti	Chitwan	9500	1390	2810	4200	5300
9	Marchwar Lift I	Rupendehi	5600	0	0	0	5600
10	West Rapti MP	Kapilbastu	30500	800	4996	5796	24704
		Dangdeukhuri	9500	435	7396	7831	1669
		Banke	36070	1250	2890	4140	31930
		Total	76070	2485	15282	17767	58303
11	Sikta	Banke	36070	1250	2890	4140	31930
12	Karnali MP	Banke	36151	1250	2430	3680	32471
		Bardiya	64169	960	23527	24487	39682
		Kailali	90630	3633	28653	32286	58344
		Total	190950	5843	54610	60453	130497

NET COMMAND AREAS OF THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS, ACCOUNTING FOR OVERLAPS WITH EXISTING SCHEMES

Project Number	Project Name	District	Net Command Areas (ha) Overall Scheme Total	Overlaps with Existing Schemes DOI	Farmer	Total	New Scheme Total
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
13	Bheri-Babai MP	Bardiya	40000	960	11312	12272	27728
14	Babai	Bardiya	13500	0	5308	5308	8192
15	Geruwa Island	Bardiya	15000	0	12215	12215	2785
16	Jamuar Nala	Kailali	13600	0	13600	13600	0
17	Khutiya II	Kailali	3500	0	1000	1000	2500
18	Mahakali II	Kanchanpur	6800	0	703	703	6097
19	Bhairawa-Lumbini III	Rupandehi	8600	0	725	725	7875
TOTAL LARGER PROJECTS			924490	92318	286618	378936	545554

Notes

(1) MP = Multi Purpose
(2) Sequence of districts as in Annex A1
(3) Division between districts from approximate estimate, unless available from project study report
(4) Based on values from Annex A1 and project study reports
(5) Based on values from Annex A1 and Water Use Inventory studies
(6) Sum of (4) and (5)
(7) Total in (6) subtracted from (3). Note that although the figures in Column 3 represent originally proposed NCA's and water balance studies here indicated that reductions are required in some projects, the "New Scheme Total" still represents a realistic estimate of incremental irrigation potential. This is because overlaps between projects (eg Bagmati MP, Kamala MP and Sun Kosi-Kamala MP) would permit the same overall to be irrigated.

NET COMMAND AREAS OF THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS, ACCOUNTING FOR INCORPORATION OF OTHER SCHEMES

Project Number	Project Name	District	Net Command Areas (ha) Overall Scheme Total	Incorporation of Other Schemes: Identified Potential Schemes Larger	Smaller	Total	Additional Existing Schemes DOI	Farmer	Total	Incremental Scheme Total
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
RUN-OF-RIVER/GROUNDWATER PROJECTS										
2	Eastern Terai	Morang	7000	0	0	0	0	7000	7000	0
6	Rato	Mahottari	3200	0	0	0	0	1400	1400	1800
7	Bagmati	Sarlahi	14000	0	0	0	0	7920	7920	6080
		Rautahat	23000	0	400	400	0	7127	7127	15473
		Total	37000	0	400	400	0	15047	15047	21553
8	East Rapti	Chitwan	9500	0	0	0	1390	2810	4200	5300
9	Marchwar Lift I	Rupendehi	5600	0	0	0	0	0	0	5600
11	Sikta	Banke	36070	0	0	0	1250	2890	4140	31930
14	Babai	Bardiya	13500	0	290	290	0	5308	5308	7902
15	Geruwa Island	Bardiya	15000	0	0	0	0	12215	12215	2785
16	Jamuar Nala	Kailali	13600	0	0	0	0	13600	13600	0
17	Khutiya II	Kailali	3500	0	0	0	0	1000	1000	2500
18	Mahakali II	Kanchanpur	6800	0	0	0	0	703	703	6097
19	Bhairawa-Lumbini III	Rupandehi	8600	0	0	0	0	725	725	7875
TOTAL RUN-OF-RIVER/GROUNDWATER PROJECTS			159370	0	690	690	2640	62698	65338	93342
STORAGE AND DIVERSION PROJECTS										
1	Kankai MP	Jhapa	67000	0	4821	4821	8000	24128	32128	30051
3	Sunkoshi-Kamala MP	Saptari	16200	0	0	0	700	4164	4864	11336
	(11)	Siraha	51000	51000	0	51000	0	0	0	0
		Dhanusha	42700	40100	0	40100	0	1592	1592	1008
		Mahottari	41900	27100	1200	28300	0	6194	6194	7406
		Sarlahi	23300	23300	0	23300	0	0	0	0
		Total	175100	141500	1200	142700	700	11950	12650	19750
4	Kamala MP	Siraha	51000	0	0	0	15375	6226	21601	29399
	(12)	Dhanusha	33200	0	410	410	14500	8379	22879	9911
		Mahottari	11800	0	0	0	0	6043	6043	5757
		Total	96000	0	410	410	29875	20648	50523	45067
5	Bagmati MP	Dhanusha	6900	0	2000	2000	0	2352	2352	2548
	(13)	Mahottari	12100	0	500	500	0	8470	8470	3130
		Sarlahi	43200	14000	810	14810	5800	10111	15911	12479
		Rautahat	34100	23000	0	23000	1500	0	1500	9600
		Bara	23700	0	1472	1472	0	7910	7910	14318
		Total	120000	37000	4782	41782	7300	28843	36143	42075

NET COMMAND AREAS OF THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS, ACCOUNTING FOR INCORPORATION OF OTHER SCHEMES

Project Number	Project Name	District	Net Command Areas (ha) Overall Scheme Total	Incorporation of Other Schemes: Identified Potential Scheme Larger	Smaller	Total	Additional Existing Schem DOI	Farmer	Total	Incremental Scheme Total
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
STORAGE AND DIVERSION PROJECTS (Continued)										
10	West Rapti MP	Kapilbastu	30500	0	360	360	800	4996	5796	24344
	(14)	Dangdeukhuri	9500	0	1835	1835	435	6100	6535	1130
		Banke	36070	36070	0	36070	0	0	0	0
		Total	76070	36070	2195	38265	1235	11096	12331	25474
12	Karnali MP	Banke	36151	34270	0	34270	0	0	0	1881
	(15)	Bardiya	64169	55000	0	55000	0	0	0	9169
		Kailali	90630	17100	0	17100	3633	14053	17686	55844
		Total	190950	106370	0	106370	3633	14053	17686	66894
13	Bheri-Babai MP (16)	Bardiya	40000	13500	0	13500	960	6004	6964	19536
TOTAL STORAGE AND DIVERSION PROJECTS			765120	334440	13408	347848	51703	116722	168425	248847
TOTAL LARGER PROJECTS			924490	334440	14098	348538	54343	179420	233763	342189

Notes

(1) MP = Multi Purpose
(2) Sequence of districts as in Annex A1
(3) Division between districts from approximate estimate unless available from project study report
(4) See Notes (11) to (16); corresponds to overlaps with projects >2,000 ha N.C.A. of the next lowest order
(5) Based on values from Table A3-3; corresponds to overlaps with projects <=2,000 ha N.C.A. additional to those already accounted for in (4) (i.e. which overlap with projects >2,000 ha N.C.A.)
(6) Sum of (4) and (5)
(7) Based on values from Annex A1
(8) Based on values from Annex A1
(9) Sum of (7) and (8)
(10) Sum of (6) and (9) subtracted from (3)
(11) Incorporating Kamala MP project and part of Bagmati MP project; however, Bagmati MP project could probably be reformulated to make use of saved water elsewhere
(12) Not incorporating any lower order identified potential scheme >2,000 ha N.C.A.
(13) Incorporating Bagmati run-of-river project
(14) Incorporating Sikta run-of-river project
(15) Incorporating part of West Rapti MP project, Bheri-Babai MP project, and Geruwa Island, Jamuar Nala and Khutiya II run-of-river projects; the following observations apply:
- West Rapti MP project could probably be reformulated to make use of saved water elsewhere
- Bheri-Babai MP project would probably be redundant and could probably not coexist with the Karnali MP project

(16) Incorporating Babai run-of-river project

DATA FOR THE SMALLER IDENTIFIED POTENTIAL IRRIGATION PROJECTS

District	Project Number	Project Name	Water Source	Irrigation Capability	Development Intensity	Cropping Intensity (%)	Net Command Areas (ha) Overall Scheme	Existing Scheme	New Scheme	Project Appraisal Level	Year	Organization	Comments
				(1)	(2)	(3)	(4)	(5)	(6)	(7)		(8)	(9)
EASTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT													
Jhapa	010101	Deonia	Deonia	YR	ED	200	1650	0	1650	F	1985	Ara	
	010102	Gauradaha	Krishna Nadi	MS	ED	183	1347	404	943	F	1984	B.N.Acharya	
	010103	Siddhikhola	Siddhi	YR	ED	292	400	0	400	F		Const. Mgmnt.	
	010104	Bhutankhola	Bhutan				400	0	400	F			Report n.a.
	010105	Surungakhola	Surunga	MS	ED	197	704	0	704	F		DOI(FS)	
	010106	Hadiakhola	Hangrayakhola	MS	ED		720	0	720	F	1984	DOI(FS)	
		Total					5221	404	4817				
Morang	010201	Khadaakhola	Khadam	MS	ED	267	204	0	204	F		Rajbandhu	
	010202	Sanyakhola	Sanya	MS	ED		220	0	220	F	1988	DOI(FS)	
	010203	Chisangkhola	Chisang	YR	ED	261	264	264	0	F	1986	Biswakarma	
	010204	Telikhola	Telikhola	MS	ED	268	368	0	368	F	1986	Biswakarma	
		Total					1056	264	792				
Sunsari	0103												
Saptari	0104												
Siraha	0105												
TOTAL FOR EASTERN TERAI DISTRICTS							6277	668	5609				
EASTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT													
Ilam	020101	Puwakhola	Puwakhola	YR	ED	200	450	0	450	F	1984	East	
	020102	Jogmaikhola	Jogmaikhola	YR	ED	201	525	0	525	F	1984	East	
	020103	Deomaikhola	Deomai Nadi	MS	ED		800	0	800	F	-	DOI(FS)	
		Total					1775	0	1775				
Panchthar	020201	Jinjuwakhola	Jinjuwakhola	MS	ED	156	226	0	226	F	1984	B.N.Acharya	
	020202	Lunkhwa	Lunkhwa	MS	ED	235	320	200	120	F	1982	Ara	
		Total					546	200	346				
Terhathum	020301	Koya	Koyakhola	MS	ED		600	0	600	F	-	DOI(FS)	
	020302	Teliakhola	Teliakhola	MS	ED	175	393	0	393	F	1984	DOI(FS)	
	020303	Piguwakhola	Piguwakhola	YR	ED		525	0	525	F	-	DOI(FS)	
	020304	Saduwa	Saduwakhola	MS	ED		200	0	200	F		Luna	
		Total					1718	0	1718				
Dhankuta	020401	Kewakhola	Kewakhola	MS	ED		160	23	137	F	1984	B.N.Acharya	
	020402	Mahendra Kulo	Leguwakhola				489	0	489				Report n.a.
	020403	Hanguwakhola	Hanguwa				200	0	200				Report n.a.
		Total					849	23	826				
Bhojpur	020501	Siganekhola	Siganekhola	MS	ED	200	400	0	400	F	1983	Ara	
	020502	Pancheme	Nashingkhola	YR	ED	250	50	0	50	F	1985	United	
	020503	Chhange	Pewa & Shyam Kh.	YR	ED		75	0	75	F	1984	Ara	
	020504	Hougrayokhola	Hougrayo Dhobi Kh.	MS	ED	280	200	200	0	F	1984	United	
	020505	Nagdaha	Akwakhola	MS	ED		113	50	63	F	1984	ECO	
	020506	Shyamkhola	Shyamkhola	MS	ED		200	0	200	F	1985	Const. Mgmnt.	
		Total					1038	250	788				

DATA FOR THE SMALLER IDENTIFIED POTENTIAL IRRIGATION PROJECTS

District	Project Number	Project Name	Water Source	Irrigation Capability (1)	Development Intensity (2)	Cropping Intensity (%) (3)	Net Command Areas (ha) Overall Scheme (4)	Existing Scheme (5)	New Scheme (6)	Project Appraisal Level (7)	Year	Organization (8)	Comments (9)
Udayapur	020601	Tarikhola	Tarikhola	MS	ED		120	0	120	F		DOI(FS)	
	020602	Tawakhola	Tawakhola	YR	ED	200	860	860	0	F	1982	United	
		Total					980	860	120				
Khotang	020701	Tawakhola	Tawakhola	MS	ED		250	0	250	F	1982	EKO Engineering	
Okhaldhunga	020801	Dhuseni	Serakhola	MS	ED	200	150	5	145	F	1984	EKO Engineering	
	020802	Hoksetar	Simlekhola	MS	ID	280	17	2	15	F	1985	DOI(FS)	
		Total					167	7	160				
TOTAL FOR EASTERN HILL DISTRICTS							7323	1340	5983				
EASTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT													
Taplejung	0301												
Sankhuwasawa	030201	Tumlingtar	Pangekhola							F	1983	Cemat	
	030202	Hiwasima	Hima & Sima	YR	ED	185	300	0	300	F	1985	DOI(FS)	
		Total					300	0	300				
Solukhumbu	0303												
TOTAL FOR EASTERN MOUNTAIN DISTRICTS							300	0	300				
CENTRAL DEVELOPMENT REGION - TERAI ECOLOGICAL BELT													
Dhanusha	040101	Jamuni	Jamuni	MS	ED		2000	0	2000	F	1985	Multi	
	040102	Bachharaya	Bachharaya	MS	ED		410	260	150	F	1985	DOI(FS)	
		Total					2410	260	2150				
Mahottari	040201	Kantwa	Kantwa	MS	ED	210	500	0	500	F	1985	Abhiyant	
	040202	Bighi	Bighi	MS	ED	275	1200	520	680	F	1984	United	
		Total					1700	520	1180				
Sarlahi	040301	Sapaha Nadi	Sapaha Nadi	MS	ED		810	0	810	F	1984	DOI(FS)	
Rautahat	040401	Bhakuwa	Bhakuwa	MS	ED	220	400	400	0	F	1983	United	
Bara	040501	Umjan	Tier	YR	ED	240	1000	1000	0	F	1984	United	
	040502	Bhagwanpur	Aruwa	MS	ED	260	472	472	0	F		United	
		Total					1472	1472	0				
Parsa	0406												
Chitwan	040701	Kerungakhola	Kerungakhola	MS	ED	141	600	0	600	F		Abhiyant	
	040702	Jugedikhola	Jugedikhola	YR	ED		200	0	200	F	1984	DOI(FS)	
	040703	Gunjuntar	Rapti	YR	ED	255	1004	0	1004	F	1985	Multi	
		Total					1804	0	1804				
TOTAL FOR CENTRAL TERAI DISTRICTS							8596	2652	5944				

DATA FOR THE SMALLER IDENTIFIED POTENTIAL IRRIGATION PROJECTS

District	Project Number	Project Name	Water Source	Irrigation Capability	Development Intensity	Cropping Intensity (%)	Net Command Areas (ha) Overall Scheme	Existing Scheme	New Scheme	Project Appraisal Level	Year	Organization	Comments
				(1)	(2)	(3)	(4)	(5)	(6)	(7)		(8)	(9)
CENTRAL DEVELOPMENT REGION - HILL ECOLOGICAL BELT													
Sindhuli	050101	Mahendrajhadi	Marinkhola	YR	ED	291	182	0	182	F	1983	Abhiyant	
	050102	Ladavir	Thakur	YR	ED	258	300	0	300	F	1985	DOI(FS)	
	050103	Sapaha Nadi	Sapaha Nadi	MS	ED		810	0	810	F	1984	DOI(FS)	
		Total					1292	0	1292				
Ramechhap	050201	Saipu	Hingakhola	MS	ID	170	100	0	100	P	1987	Sir M. MacDonald	Third Hill IP
	050202	Bhirpani	Sunkosi	YR	ED		50	0	50	F		DOI(FS)	
	050203	Birtatar	Bitizore	YR	ED	215	99	0	99	F	1984	DOI(FS)	
		Total					249	0	249				
Makawanpur	050301	Rapti	Rapti	YR	ED	260	800	600	200	F	1984	DOI(FS)	
	050302	Manahari	Manahari	MS	ID	235	150	0	150	P	1987	Sir M. MacDonald	Third Hill IP
		Total					950	600	350				
Kabhre Palanchowk	050401	Pipaltar	Roshi	MS	ID	235	55	8	47	F	1987	Sir M. MacDonald	Third Hill IP
	050402	Khaharepangu	Simsimkhola	MS	CAD	250	90	30	60	F	1987	Sir M. MacDonald	Third Hill IP
	050403	Ghattekhola	Ghattekhola	MS	ED		100	0	100	F	1983	United	
	050404	Yoggen	Yonbelkhola	MS	ID	180	20	0	20	P	1987	Sir M. MacDonald	Third Hill IP
		Total					265	38	227				
Lalitpur	050501	Tikabhairav	Nakhukhola	MS	ID	200	220	220	0	P	1987	Sir M. MacDonald	Third Hill IP
Bhaktapur	050601	Salinadi	Sankhu				150	0	150				Report n.a.
	050602	Hanumantekhola	Hanumante	MS	ED		160	0	160	F	1984	DOI(FS)	
		Total					310	0	310				
Kathmandu	0507												
Nuwakot	050801	Dunikhola	Gomatikhola	MS	ED		100	0	100	F	1983	United	
	050802	Gerkhutar	Phalankhu	YR	ED	230	915	0	915	F	1985	United	
	050803	Phalangukhola	Phalankhu	MS	ID	200	850	105	745	P	1987	Sir M. MacDonald	Third Hill IP
	050804	Salankhukhola	Salankhu	MS	ID	170	165	10	155	P	1987	Sir M. MacDonald	Third Hill IP
		Total					2030	115	1915				
Dhading	050901	Ampatar	Malekhukhola	MS	ED	261	57	0	57	F	1981	Trisul	
	050902	Gomatitar	Gomati	MS	ED	286	60	32	28	F	1983	United	
	050903	Richoktar	Malekhu	YR	CAD	300	100	0	100	F	1987	ILO	Nepal Medium IP
	050904	Jogimara	Rigdikhola	MS	ID	200	100	0	100	P	1987	Sir M. MacDonald	Third Hill IP
	050905	Ratamate	Adherikhola	MS	ID	200	10	10	0	P	1987	Sir M. MacDonald	Third Hill IP
		Total					327	42	285				
TOTAL FOR CENTRAL HILL DISTRICTS							5643	1015	4628				

DATA FOR THE SMALLER IDENTIFIED POTENTIAL IRRIGATION PROJECTS

District	Project Number	Project Name	Water Source	Irrigation Capability	Development Intensity	Cropping Intensity (%)	Net Command Areas (ha) Overall Scheme	Existing Scheme	New Scheme	Project Appraisal Level	Year	Organization	Comments
				(1)	(2)	(3)	(4)	(5)	(6)	(7)		(8)	(9)
CENTRAL DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT													
Dolakha	060101	Jhankrekhola	Jhankre	MS	ED		110	0	110	F	1984	Nepal Engineers	
	060102	Andherikhola	Andherikhola	MS	ID	170	200	30	170	P	1987	Sir M. MacDonald	Third Hill IP
		Total					310	30	280				
Sindhupalchowk	060201	Bhimtar	Alanpur				50	0	50				Report n.a.
	060202	Selang	Selang				100	0	100				Report n.a.
	060203	Legarche	Kamero				100	0	100				Report n.a.
	060204	Phulpingkot	Simsim	YR	ED	168	95	0	95	F	1985	Phi	
	060205	Thokarpa	Ghattekhola	YR	ED	282	65	0	65	F		DOI(FS)	
		Total					410	0	410				
Rasuwa	0603												
TOTAL FOR CENTRAL MOUNTAIN DISTRICTS							720	30	690				
WESTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT													
Nawalparasi	070101	Tokreghat	Devsetkhola	MS	CAD	210	150	70	80	F	1987	ILO	Nepal Medium IP
	070102	Girwari	Giriwari	YR	CAD	185	1321	1321	0	F	1984	ILO	Nepal Medium IP
	070103	Turiabandh	Turia	MS	ED	259	246	0	246	F	1985	Nepal Engineers	
	070104	Benaikhola	Benaikhola	MS	ED	230	1000	0	1000	F	1988	DOI(FS)	
		Total					2717	1391	1326				
Rupandehi	070201	Telar Nadi	Kailihawa	MS	ID	200	1355	0	1355	F	1985	Ara	
	070202	Madhubani	Koilihawa	MS	ED	108	1050	0	1050			Nepal Engineers	
		Total					2405	0	2405				
Kapilbastu	070301	Zakira Bandh	Surai	MS	ED		360	0	360		1984	Abhiyant	
	070302	Rajkundwa	Kundra	MS	ED	200	900	0	900		1988	BDA	
		Total					1260	0	1260				
TOTAL FOR WESTERN TERAI DISTRICTS							6382	1391	4991				
WESTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT													
Palpa	080101	Kachalphant	Dovankhola	YR	CAD	175	282	95	187	F	1981	ILO	Nepal Medium IP
	080102	Thomakhola	Thomakhola	MS	ED		90	0	90		1984	DOI(FS)	
		Total					372	95	277				
Arghakhanchi	080201	Pawaratar	Bangangakhola	YR	CAD	250	50	16	34	F	1987	ILO	Nepal Medium IP
	080202	Darbantar	Simruk		ID		42	0	42			Unknown	
	080203	Durgakhola	Durgakhola	MS	ID	212	38	0	38			Trimurti	
	080204	Khanchikhola	Khaneni	MS	ED	210	50	0	50			Trimurti	
	080205	Ringdiwangle	Khanchikhola	YR	ID	258	60	0	60	F		Masina	
	080206	Chawahatae		MS	ED	247	78	0	78	F		Silt	
		Total					318	16	302				

DATA FOR THE SMALLER IDENTIFIED POTENTIAL IRRIGATION PROJECTS

District	Project Number	Project Name	Water Source	Irrigation Capability	Development Intensity	Cropping Intensity (%)	Net Command Areas (ha) Overall Scheme	Existing Scheme	New Scheme	Project Appraisal Level	Year	Organization	Comments
				(1)	(2)	(3)	(4)	(5)	(6)	(7)		(8)	(9)
Gulmi	080301	Chaldikhola	Chaldi	YR	ID	275	667	0	667	F		Multi	
	080302	Apachaur	Gyedikhola	YR	CAD	205	100	10	90	F	1987	ILO	Nepal Medium IP
	080303	Wamitaksar	Dharam	MS	ED	300	130	0	130	F	1985	Nepal Engineers	
	080304	Arbani Thumka	Rodikhola	YR	ED	298	56	0	56	F	1987	Abhiyanta	
	080305	Khagdakot	Palung	MS	ED	275	80	4	76	F		DOI(FS)	
	080306	Ghamirkhola	Ghamir	MS	ID	150	113	13	100	P	1987	Sir M. MacDonald	Third Hill IP
		Total					1146	27	1119				
Tanahun	080401	Pipaltar	Kothangkhola	YR	CAD	280	75	0	75	F	1987	Sir M. MacDonald	Third Hill IP
	080402	Thulotar	Saudi	MS	ED	200	52	0	52	F	1980	Spit	
	080403	Bhagwatipur	Phedi	YR	CAD	240	90	10	80	F	1987	Sir M. MacDonald	Third Hill IP
	080404	Satrasayaphant	Adhikhola	YR	ED	260	55	0	55	F	1985	Trimurti	
	080405	Rataulitar		YR	ED	230	275	0	275	F	1984	Silt	
	080406	Thulo-Khumal Tar	Kalestikhola	YR	ID	245	50	0	50	F	1984	Luna	
	080407	Rishtikhola	Rishtikhola	MS	ED		250	0	250	F		DOI(FS)	
	080408	Dulegamda	Kotrekhola	YR	ED	264	415	0	415	F		DOI(FS)	
	080409	Atrauliputtar	Maidi	MS	ED		293	40	253	F		Unknown	
	080410	Bariphant	Chundikhola	MS	ID	233	170	42	128	P	1987	Sir M. MacDonald	Third Hill IP
	080411	Piudhartar	Bhutkhola	YR	ED	245	55	0	55	F		Abhiyant	
		Total					1780	92	1688				
Syangja	080501	Batangkhola	Batang	YR	ID	211	28	0	28			Abhiyant	
	080502	Andhikhola	Andhikhola	YR	CAD	300	110	50	60	F	1987	Sir M. MacDonald	Third Hill IP
	080503	Chapakot	Jagdikhola	MS	ID	200	850	0	850	F		Unknown	
		Total					988	50	938				
Gorkha	080601	Kunduntar	Latirah	MS	ED		150	0	150		1979	Luna	
	080602	Palungtar	Chhepe	YR	CAD	265	850	50	800	F	1987	Sir M. MacDonald	Third Hill IP
	080603	Kyanauntal	Jyadukhola	MS	ED	200	65	0	65	F	1985	Trimurti	
	080604	Daraudikhola	Daraundi	YR	ID	240	400	100	300	P	1987	Sir M. MacDonald	Third Hill IP
		Total					1465	150	1315				
Lamjung	080701	Jita	Gaiyakhola	MS	ED		50	0	50	F		Unknown	
	080702	Carapu	Rudikhola	YR	ID		40	0	40	F		Unknown	
	080703	Rainastar	Chhepe	YR	CAD	240	610	24	586	F	1987	ILO	Nepal Medium IP
	080704	Sami Banjyang	Pistikhola	MS	ID	200	50	50	0	P	1987	Sir M. MacDonald	Third Hill IP
		Total					750	74	676				
Kaski	080801	Puranchaur	Bhurjung	MS	ID	200	250	0	250	F		Luna	
	080802	Paudharphant					200	0	200	F			Report n.a.
	080803	Kahunkhola	Kahunkhola	MS	ID	175	110	0	110	F		Raj Bandhu	
	080804	Mijure Danda	Rudikhola	YR	ED	245	235	0	235	F	1987	Raj Bandhu	
		Total					795	0	795				
Parbat	080901	Ratikhola	Rati				360	150	210	F	1982		Report n.a.
	080902	Pungdikhola	Pungdi	MS	CAD	170	325	27	298	F	1987	ILO	Nepal Medium IP
	080903	Taklachaur	Setikhola	YR	CAD	245	32	0	32	F	1987	ILO	Nepal Medium IP
	080904	Limithan	Chirdikhola				105	0	105	F	1982		Report n.a.
		Total					822	177	645				

DATA FOR THE SMALLER IDENTIFIED POTENTIAL IRRIGATION PROJECTS

District	Project Number	Project Name	Water Source	Irrigation Capability (1)	Development Intensity (2)	Cropping Intensity (%) (3)	Net Command Areas (ha) Overall Scheme (4)	Existing Scheme (5)	New Scheme (6)	Project Appraisal Level (7)	Year	Organization (8)	Comments (9)
Baglung	081001	Harichaur	Dharan				90	0	90	F	1983		Report n.a.
	081002	Chhisti	Palungkhola	YR	CAD	260	63	23	40	F	1987	ILO	Nepal Medium IP
		Total					153	23	130				
Myagdi	081101	Gandakhola	Dharkhola				640	0	640	F	1982		Report n.a.
	081102	Jhaprekhola	Jhaprekhola	YR	ED	215	168	0	168	F		Biswabandhu	
	081103	Askarekhola	Askare	YR	ED		128	0	128	F	1983	Biswabandhu	
	081104	Dhukkukhola	Dhukku	YR	ED	157	140	0	140	F	1986	Rajbandhu	
		Total					1076	0	1076				
TOTAL FOR WESTERN HILL DISTRICTS							9665	704	8961				
WESTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT													
Manang	0901												
Mustang	090201	Lomang Thang	Jhyang Dokpa				52	0	52	F	1982	Unknown	
TOTAL FOR WESTERN MOUNTAIN DISTRICTS							52	0	52				
MID WESTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT													
Dangdeukhuri	100101	Bahundanda	Sewakhola	YR	ED	222	440	2	438	F	1983	Masina	
	100102	Sirkhola	Sirkhola	MS	ED	160	450	0	450	F	1984	Abhiyant	
	100103	Arjunkhola	Arjunkhola	MS	ED	200	500	475	25	F	1985	Multi	
	100104	Satbariya	Rapti	YR	ED	245	1335	0	1335	F		DOI(FS)	
	100105	Sonpur	Buralahiya	YR	ED	230	400	3	397	F	1985	DOI(FS)	
	100106	Sivapur Kulo											Report n.a.
	100107	Chorahi Manpur											Report n.a.
	100108	Sudi Kulo											Report n.a.
		Total					3125	480	2645				
Banke	1002												
Bardiya	100301	Rehukhola	Rehunala	YR	ED	255	290	0	290	F	1984	Masina	
TOTAL FOR MID WESTERN TERAI DISTRICTS							3415	480	2935				
MID WESTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT													
Pyuthan	110101	Maranthana	Dharmawati	YR	ID		40	0	40	F		DOI(FS)	
	110102	Phalkabesi	Jhiurikhola	YR	ED	225	180	0	180	F	1987	Nep Consult	
	110103	Lungrimadi	Lungrimadi	YR	ID	225	780	0	780	F	1985	Ara	
		Total					1000	0	1000				
Rolpa	110201	Khungrichaur	Deukhurikhola				100	0	100	F	1982		Report n.a.
Salyan	110301	Banjhakande	Sardakhola	YR	ID		70	0	70	F	1987	DOI(FS)	

Table A3-3 (continued)

DATA FOR THE SMALLER IDENTIFIED POTENTIAL IRRIGATION PROJECTS

District	Project Number	Project Name	Water Source	Irrigation Development Capability (1)	Intensity (2)	Cropping Intensity (%) (3)	Net Command Areas (ha) Overall Scheme (4)	Existing Scheme (5)	New Scheme (6)	Project Appraisal Level (7)	Year	Organization (8)	Comments (9)
Rukum	110401	Ghattekhola	Nathigad	YR	ID		58	0	58	F		Multi	
	110402	Majaukhola	Majoo	YR	ID	211	42	0	42	F	1982	B.N. Acharya	
	110403	Rukumkot	Harikhola	YR	ED	200	275	0	275	F		DOI(FS)	
	110404	Nathigad	Nathigad	YR	ED	214	50	0	50	F	1988	Seth Eng	
	110405	Kotjhari											Report n.a.
		Total					425	0	425				
Surkhet	110501	Babiyachaur	Apsainikhola	MS	CAD	170	325	125	200	F	1987	ILO	Nepal Medium IP
	110502	Salkot	Khamare & Bhyagute	YR	ED	200	300	0	300	F	1984	Amatya	
	110503	Kaprichaur	Simtakhola	YR	CAD	200	210	75	135	F	1987	ILO	Nepal Medium IP
	110504	Khorkhekhola	Khorkhe	YR	ID	217	108	0	108	F	1985	Abhiyanta	
		Total					943	200	743				
Jajarkot	110601	Nalgad	Nalgad	YR	CAD	270	55	17	38	F	1987	ILO	Nepal Medium IP
	110602	Holubhairabi	Holukhola	YR	CAD	243	54	50	4	F	1987	ILO	Nepal Medium IP
	110603	Jukot		MS	ED	220	-					Unknown	
	110604	Dahakhola											Report n.a.
		Total					109	67	42				
Dailekh	110701	Rawatkot	Sanokhola	YR	ED	260	477	0	477	F	1985	Ara	
TOTAL FOR MID WESTERN HILL DISTRICTS							3124	267	2857				
MID WESTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT													
Dolpa	120101	Challa	Ghungharu	YR	ED		110	0	110	F	1984	DOI(FS)	
	120102	Jupaltar											Report n.a.
		Total					110	0	110				
Jumla	120201	Garyangkot	Talpunera	YR	ED	200	200	0	200	F		Ara	
	120202	Dhupijyula	Tilanadi	YR	ED	200	50	0	50	F		DOI(FS)	
		Total					250	0	250				
Kalikot	120301	Okhadi	Okhadikhola	YR	ED	202	215	0	215	F	1985	DOI(FS)	
	120302	Jubitha	Khanlagadkhola		ED		100	0	100	F	1987	W.B. Van	
		Total					315	0	315				
Mugu	120401	Natharpur	Humla Karnali	YR	ED	183	60	0	60	F	1985	DOI(FS)	
	120402	Dhilanaghatta	Kaligad	MS	ED	143	141	0	141	F	1988	Rajbandhu	
		Total					201	0	201				
Humla	120501	Sanya	Sanyakhola	YR	ED	190	60	0	60	F	1988	DOI(FS)	
	120502	Yanchu	Yanchukhola	MS	ID	187	30	0	30	F		DOI(FS)	
		Total					90	0	90				
TOTAL FOR MID WESTERN MOUNTAIN DISTRICTS							966	0	966				

DATA FOR THE SMALLER IDENTIFIED POTENTIAL IRRIGATION PROJECTS

District	Project Number	Project Name	Water Source	Irrigation Capability	Development Intensity	Cropping Intensity (%)	Net Command Areas (ha) Overall Scheme	Existing Scheme	New Scheme	Project Appraisal Level	Year	Organization	Comments
				(1)	(2)	(3)	(4)	(5)	(6)	(7)		(8)	(9)
FAR WESTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT													
Kailali	1301												
Kanchanpur	130201	Kalapani	Sihali & Tolinala	MS	ED	203	649	0	649	F	1985	Masina	
	130202	Malaria Nala	Malaria Nala	YR	ED	260	1800	0	1800	F	1987	A. Gupta	
		Total					2449	0	2449				
TOTAL FOR FAR WESTERN TERAI DISTRICTS							2449	0	2449				
FAR WESTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT													
Achham	140101	Lungreli Parbali	Lungreli Parbali	YR	ID	190	142	142	0	D	1987	Ara	Second Hill IP
Doti	140201	Dipayal	Dware & Godre Kh.	YR	ID	215	100	100	0	D	1986	East	Second Hill IP
	140202	Bhumirajmandu	Salyanigad	YR	ID	196	100	50	50	D	1986	BDA	Second Hill IP
	140203	Kadamandu	Gandigad	YR	ID	250	140	14	126	D	1987	Ara	Second Hill IP
	140204	Bandungrasain	Ghattegad	YR	ID	227	155	48	107	D	1987	BDA	Second Hill IP
	140205	Mastamandu	Sailighat	YR	ID	257	102	41	61	D	1986	Ara	Second Hill IP
	140206	Kaflebari II	Pilegad	YR	ID	200	25	0	25	D	1988	East	Second Hill IP
	140207	Latamandu	Talkotgad	YR	ID	200	120	0	120	D	1988	Luna	Second Hill IP
	140208	Kaflebari I	Talkotgad	YR	ID	200	60	60	0	D	1988	Luna/DOI	Second Hill IP
	140209	Mudegaon	Kalagad	YR	ID	200	300	0	300	D	1988	Luna/DOI	Second Hill IP
		Total					1102	313	789				
Dadeldhura	140301	Gilla	Sakail	MS	ED	240	85	0	85	F	1983	DOI(FS)	
	140302	Sakayal	Sakayal	YR	ED	250	100	0	100			Unknown	
	140303	Dotikhola	Mahakali				120	0	120				Report n.a.
	140304	Sirsekhola											Report n.a.
		Total					305	0	305				
Baitadi	140401	Surnayagad	Surnayagad	MS	ID	200	61	0	61	F	1983	DOI(FS)	
	140402	Satgad	Satgad	MS	ID	200	68	0	68	F	1983	DOI(FS)	
	140403	Dilleswari	Lohigad	MS	ID	200	74	0	74	F	1983	DOI(FS)	
	140404	Dumanigad	Dumanigad	MS	ID	200	24	0	24	F	1983	DOI(FS)	
	140405	Kakarimalghat											
		Total					227	0	227				Report n.a.
TOTAL FOR FAR WESTERN HILL DISTRICTS							1776	455	1321				

Table A3-3 (continued)

DATA FOR THE SMALLER IDENTIFIED POTENTIAL IRRIGATION PROJECTS

District	Project Number	Project Name	Water Source	Irrigation Capability	Development Intensity	Cropping Intensity (%)	Net Command Areas (ha) Overall Scheme	Existing Scheme	New Scheme	Project Appraisal Level	Year	Organization	Comments
				(1)	(2)	(3)	(4)	(5)	(6)	(7)		(8)	(9)
FAR WESTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT													
Bajura	150101	Kolti	Badigadkhola	MS	ID	200	150	0	150	D	1987	East	Second Hill IP
	150102	Gothi	Kalagad	YR	ID	200	80	0	80	D	1987	East	Second Hill IP
	150103	Martadi	Bauligad	YR	ID	200	65	45	20	D	1987	East	Second Hill IP
		Total					295	45	250				
Bajhang	150201	Juili	Juiligad	YR	ID	220	122	122	0	D	1987	Luna	Second Hill IP
	150202	Thapagaon	Jogdakhola	YR	ID	200	117	85	32	D	1987	Luna	Second Hill IP
	150203	Ritapata	Bauligad	YR	ID	200	124	124	0	D	1987	East	Second Hill IP
	150204	Majhigaon	Dhauligad	YR	ID	200	170	170	0	D	1987	East	Second Hill IP
	150205	Deuraphant	Kalangad	MS	ID	259	34	34	0	D	1987	Ara	Second Hill IP
	150206	Pujarikot	Sainigad	YR	ID	246	41	20	21	D	1987	Ara	Second Hill IP
	150207	Gairasela	Khateranala	YR	ID	236	44	0	44	D	1987	Ara	Second Hill IP
	150208	Bisket	Runigad	YR	ID	242	69	45	24	D	1987	Ara	Second Hill IP
	150209	Khaira	Bauligad	YR	ID	200	40	40	0	D	1988	BDA	Second Hill IP
	150210	Talkot-Dantoli	Dantoligad	YR	ID	200	172	116	56	D	1987	BDA	Second Hill IP
	150211	Bhandar Panesh	Patalgad	MS	ID	200	86	67	19	D	1987	BDA	Second Hill IP
	150212	Kuchha	Thalangad	YR	ID	200	47	27	20	D	1988	Luna	Second Hill IP
	150213	Pikhet	Thalangad	YR	ID	200	105	60	45	D	1988	Luna	Second Hill IP
	150214	Paringal	Seti	YR	ID	200	100	20	80	D	1988	Luna/DOI	Second Hill IP
	150215	Regam	Regam	YR	ID	200	50	25	25	D	1988	Luna/DOI	Second Hill IP
	150216	Tontali	Kalagad	YR	ID	200	60	10	50	D	1988	Luna/DOI	Second Hill IP
		Total					1381	965	416				
Darchula	150301	Kukhuregad	Kukhuregad	MS	ED	200	114	0	114	F	1982	Ara	
	150302	Latinath	Dedkhola	MS	ID	200	95	25	70	F		Unknown	
	150303	Dharigad	Dharigad	MS	ED	150	300	0	300	F	1987	Unknown	
	150304	Dhap	Thaligad	MS	ED	200	120	65	55			TAEC	
		Total					629	90	539				
TOTAL FOR FAR WESTERN MOUNTAIN DISTRICTS							2305	1100	1205				
TOTALS BY DEVELOPMENT REGION													
EASTERN DISTRICTS							13900	2008	11892				
CENTRAL DISTRICTS							14959	3697	11262				
WESTERN DISTRICTS							16099	2095	14004				
MID WESTERN DISTRICTS							7505	747	6758				
FAR WESTERN DISTRICTS							6530	1555	4975				
TOTALS BY ECOLOGICAL BELT													
TERAI DISTRICTS							27119	5191	21928				
HILL DISTRICTS							27531	3781	23750				
MOUNTAIN DISTRICTS							4343	1130	3213				
TOTAL FOR ALL DISTRICTS							58993	10102	48891				

Table A3-4

SUMMARY OF IDENTIFIED POTENTIAL NET COMMAND AREAS

District	Net Command Areas (ha) (1)								
Project Category:	Larger (>2,000 ha)			Smaller (<=2,000 ha)			All		
Area Description:	Overall	New Incremental		Overall	New Incremental		Overall	New Incremental	
EASTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT									
Jhapa	67000	34468	30051	5221	4817	4817	72221	39285	34868
Morang	7000	0	0	1056	792	792	8056	792	792
Sunsari	0	0	0	0	0	0	0	0	0
Saptari	16200	11336	11336	0	0	0	16200	11336	11336
Siraha	102000	58798	29399	0	0	0	102000	58798	29399
TOTAL FOR EASTERN TERAI DISTRICTS	192200	104602	70786	6277	5609	5609	198477	110211	76395
EASTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT									
Ilam	0	0	0	1775	1775	1775	1775	1775	1775
Panchthar	0	0	0	546	346	346	546	346	346
Terhathum	0	0	0	1718	1718	1718	1718	1718	1718
Dhankuta	0	0	0	849	826	826	849	826	826
Bhojpur	0	0	0	1038	788	788	1038	788	788
Udayapur	0	0	0	980	120	120	980	120	120
Khotang	0	0	0	250	250	250	250	250	250
Okhaldhunga	0	0	0	167	160	160	167	160	160
TOTAL FOR EASTERN HILL DISTRICTS	0	0	0	7323	5983	5983	7323	5983	5983
EASTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT									
Taplejung	0	0	0	0	0	0	0	0	0
Sankhuwasawa	0	0	0	300	300	300	300	300	300
Solukhumbu	0	0	0	0	0	0	0	0	0
TOTAL FOR EASTERN MOUNTAIN DISTRICTS	0	0	0	300	300	300	300	300	300
CENTRAL DEVELOPMENT REGION - TERAI ECOLOGICAL BELT									
Dhanusha	82800	30330	13467	2410	2150	2150	85210	32480	15617
Mahottari	69000	30420	18093	1700	1180	1180	70700	31600	19273
Sarlahi	80500	37859	18559	810	810	810	81310	38669	19369
Rautahat	57100	40546	25073	400	0	0	57500	40546	25073
Bara	23700	14990	14318	1472	0	0	25172	14990	14318
Parsa	0	0	0	0	0	0	0	0	0
Chitwan	9500	5300	5300	1804	1804	1804	11304	7104	7104
TOTAL FOR CENTRAL TERAI DISTRICTS	322600	159445	94810	8596	5944	5944	331196	165389	100754
CENTRAL DEVELOPMENT REGION - HILL ECOLOGICAL BELT									
Sindhuli	0	0	0	1292	1292	1292	1292	1292	1292
Ramechhap	0	0	0	249	249	249	249	249	249
Makawanpur	0	0	0	950	350	350	950	350	350
Kabhre	0	0	0	265	227	227	265	227	227
Lalitpur	0	0	0	220	0	0	220	0	0
Bhaktapur	0	0	0	310	310	310	310	310	310
Kathmandu	0	0	0	0	0	0	0	0	0
Nuwakot	0	0	0	2030	1915	1915	2030	1915	1915
Dhading	0	0	0	327	285	285	327	285	285
TOTAL FOR CENTRAL HILL DISTRICTS	0	0	0	5643	4628	4628	5643	4628	4628

SUMMARY OF IDENTIFIED POTENTIAL NET COMMAND AREAS

District / Project Category: / Area Description:	Net Command Areas (ha) (1) Larger (>2,000 ha) Overall	Larger (>2,000 ha) New Incremental	Smaller (<=2,000 ha) Overall	Smaller (<=2,000 ha) New Incremental	All Overall	All New Incremental
CENTRAL DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT						
Dolakha	0	0	310	280	310	280
Sindhupalchowk	0	0	410	410	410	410
Rasuwa	0	0	0	0	0	0
TOTAL FOR CENTRAL MOUNTAIN DISTRICTS	0	0	720	690	720	690
WESTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT						
Nawalparasi	0	0	2717	1326	2717	1326
Rupandehi	14200	13475	2405	2405	16605	15880
Kapilbastu	30500	24704	1260	1260	31760	25964
TOTAL FOR WESTERN TERAI DISTRICTS	44700	38179	6382	4991	51082	43170
WESTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT						
Palpa	0	0	372	277	372	277
Arghakhanchi	0	0	318	302	318	302
Gulmi	0	0	1146	1119	1146	1119
Tanahun	0	0	1780	1688	1780	1688
Syangja	0	0	988	938	988	938
Gorkha	0	0	1465	1315	1465	1315
Lamjung	0	0	750	676	750	676
Kaski	0	0	795	795	795	795
Parbat	0	0	822	645	822	645
Baglung	0	0	153	130	153	130
Myagdi	0	0	1076	1076	1076	1076
TOTAL FOR WESTERN HILL DISTRICTS	0	0	9665	8961	9665	8961
WESTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT						
Manang	0	0	0	0	0	0
Mustang	0	0	52	52	52	52
TOTAL FOR WESTERN MOUNTAIN DISTRICTS	0	0	52	52	52	52
MID WESTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT						
Dangdeukhuri	9500	1669	3125	2645	12625	4314
Banke	108291	96331	0	0	108291	96331
Bardiya	132669	78387	290	290	132959	78677
TOTAL FOR MID WESTERN TERAI DISTRICTS	250460	176387	3415	2935	253875	179322
MID WESTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT						
Pyuthan	0	0	1000	1000	1000	1000
Rolpa	0	0	100	100	100	100
Salyan	0	0	70	70	70	70
Rukum	0	0	425	425	425	425
Surkhet	0	0	943	743	943	743
Jajarkot	0	0	109	42	109	42
Dailekh	0	0	477	477	477	477
TOTAL FOR MID WESTERN HILL DISTRICTS	0	0	3124	2857	3124	2857

Table A3-4 (continued)

SUMMARY OF IDENTIFIED POTENTIAL NET COMMAND AREAS

District	Net Command Areas (ha) (1)								
Project Category:	Larger (>2,000 ha)			Smaller (<=2,000 ha)			All		
Area Description:	Overall	New	Incremental	Overall	New	Incremental	Overall	New	Incremental
MID WESTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT									
Dolpa	0	0	0	110	110	110	110	110	110
Jumla	0	0	0	250	250	250	250	250	250
Kalikot	0	0	0	315	315	315	315	315	315
Mugu	0	0	0	201	201	201	201	201	201
Humla	0	0	0	90	90	90	90	90	90
TOTAL FOR MID WESTERN MOUNTAIN DISTRICTS	0	0	0	966	966	966	966	966	966
FAR WESTERN DEVELOPMENT REGION - TERAI ECOLOGICAL BELT									
Kailali	107730	60844	58344	0	0	0	107730	60844	58344
Kanchanpur	6800	6097	6097	2449	2449	2449	9249	8546	8546
TOTAL FOR FAR WESTERN TERAI DISTRICTS	114530	66941	64441	2449	2449	2449	116979	69390	66890
FAR WESTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT									
Achham	0		0	142	0	0	142	0	0
Doti	0		0	1102	789	789	1102	789	789
Dadeldhura	0		0	305	305	305	305	305	305
Baitadi	0		0	227	227	227	227	227	227
TOTAL FOR FAR WESTERN HILL DISTRICTS	0	0	0	1776	1321	1321	1776	1321	1321
FAR WESTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT									
Bajura	0		0	295	250	250	295	250	250
Bajhang	0		0	1381	416	416	1381	416	416
Darchula	0		0	629	539	539	629	539	539
TOTAL FOR FAR WESTERN MOUNTAIN DISTRICTS	0	0	0	2305	1205	1205	2305	1205	1205
TOTALS BY DEVELOPMENT REGION									
EASTERN DISTRICTS	192200	104602	70786	13900	11892	11892	206100	116494	82678
CENTRAL DISTRICTS	322600	159445	94810	14959	11262	11262	337559	170707	106072
WESTERN DISTRICTS	44700	38179	37819	16099	14004	14004	60799	52183	51823
MID WESTERN DISTRICTS	250460	176387	74333	7505	6758	6758	257965	183145	81091
FAR WESTERN DISTRICTS	114530	66941	64441	6530	4975	4975	121060	71916	69416
TOTALS BY ECOLOGICAL BELT									
TERAI DISTRICTS	924490	545554	342189	27119	21928	21928	951609	567482	364117
HILL DISTRICTS	0	0	0	27531	23750	23750	27531	23750	23750
MOUNTAIN DISTRICTS	0	0	0	4343	3213	3213	4343	3213	3213
TOTAL FOR ALL DISTRICTS	924490	545554	342189	58993	48891	48891	983483	594445	391080

Note
(1) Aggregated from values in Tables A3-1, A3-2 and A3-3

Figure A3—1a

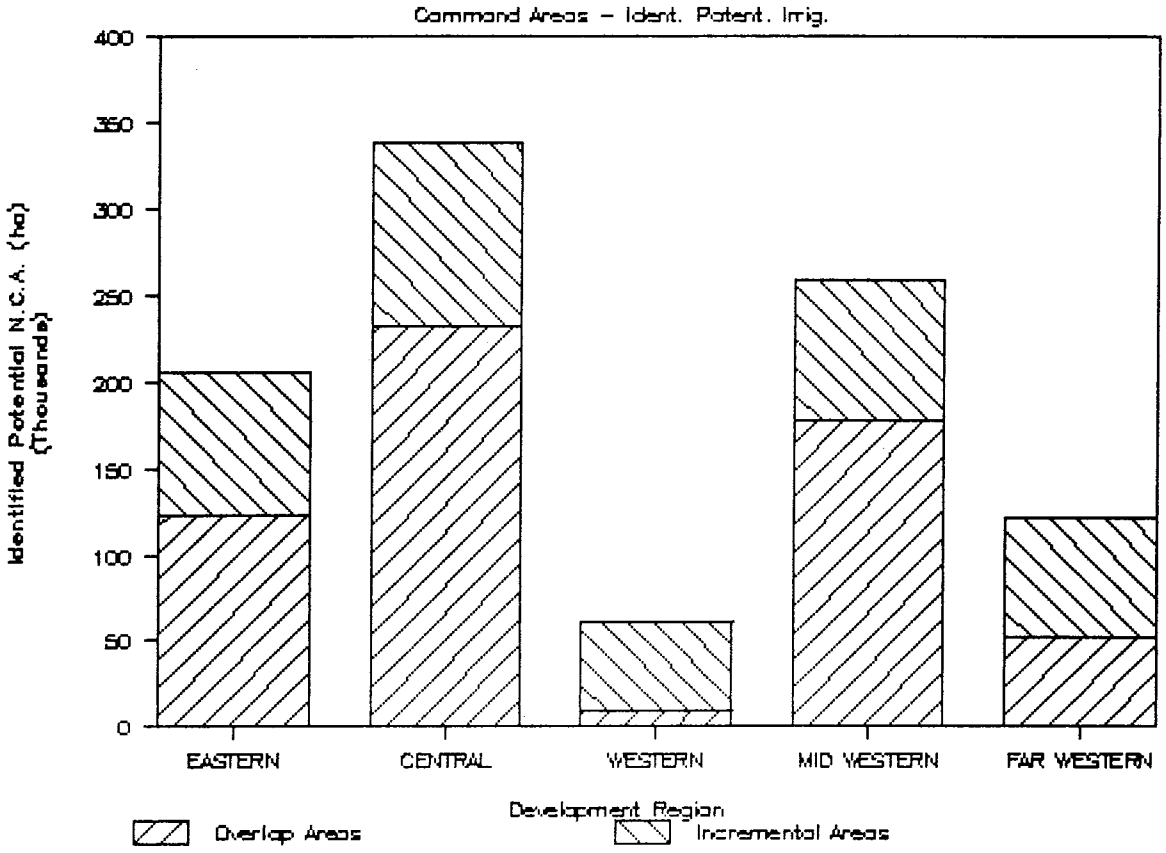

Figure A3—1b

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR KANKAI MULTIPURPOSE PROJECT

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	1		
Name of Project	Kankai Multipurpose Project		
Type of Project	Storage project, expansion of existing DOI project		
Basic Details			
Location of Project			
- Ecol. Belt / Devel. Regions	Terai / Eastern		
- Districts (Zones)	Jhapa (Mechi)		
Water Source	Kankai River		
Irrigation Capability (1)	YR		
Development Intensity (2)	CAD		
Cropping Intensity (%)	200		
Net Command Area (ha)			
- Overall Scheme Total		67,000	a
- Overlap with Existing DOI Schemes		8,000	b
- Overlap with Existing Farmer Schemes		24,532	c
- New Scheme Total		34,468	d=a-b-c
Development Responsibility	DOI and NEA		
Project Appraisal			
- Level	Feasibility		
- Year	1988		
- Organization	Electricite de France (consortium)		
Implementation Schedule			
- Earliest Start Year	.....		
- Earliest Completion Year	.....		

Overlaps with Existing DOI Projects

Name of Project	NCA Overlap (ha)
Kankai	8,000

Overlaps with Other Identified Potential Irrigation Projects

Name of Project	NCA Overlap (ha)
-	-

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR KANKAI MULTIPURPOSE PROJECT

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	1 (continued)
Name of Project	Kankai Multipurpose Project
Type of Project	Storage project, expansion of existing DOI project

Additional Comments

The project feasibility study envisages a flow regulation dam with a 60 MW powerhouse on the Kankai River about 3 km upstream from the East-West highway, a diversion barrage about 0.5 km downstream from the dam, and irrigation distribution systems serving total net areas of about 33,500 ha on each bank (including the 8,000 ha existing right bank Kankai project). The project would also have flood damage reduction benefits. The hydroelectric power generated at the dam would be transmitted to the national power grid, connecting at Anarmani.

Notes

(1) MS = Monsoon Season; YR = Year Round
(2) ED = Extensive Dev.; ID = Intensive Dev.; CAD = Command Area Dev.

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR EASTERN TERAI IRRIGATION PROJECT

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	2		
Name of Project	Eastern Terai Irrigation Project		
Type of Project	Run-of-river/groundwater project, improvement of farmer schemes		
Basic Details			
Location of Project			
- Ecol. Belt / Devel. Regions	Terai / Eastern		
- Districts (Zones)	Morang (Koshi)		
Water Source	Bakra River and aquifers		
Irrigation Capability (1)	YR		
Development Intensity (2)	CAD		
Cropping Intensity (%)	205		
Net Command Area (ha)			
- Overall Scheme Total		7,000	a
- Overlap with Existing DOI Schemes		0	b
- Overlap with Existing Farmer Schemes		7,000	c
- New Scheme Total		0	d=a-b-c
Development Responsibility	DOI		
Project Appraisal			
- Level	Feasibility		
- Year	1984		
- Organization	Electrowatt Engineering Services		
Implementation Schedule			
- Earliest Start Year	.....		
- Earliest Completion Year	.....		

Overlaps with Existing DOI Projects

Name of Project	NCA Overlap (ha)
-	-

Overlaps with Other Identified Potential Irrigation Projects

Name of Project	NCA Overlap (ha)
-	-

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR EASTERN TERAI IRRIGATION PROJECT

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	2 (continued)
Name of Project	Eastern Terai Irrigation Project
Type of Project	Run-of-river/groundwater project, improvement of farmer schemes

Additional Comments

This conjunctive use project would allow for increased agricultural production from a net area of 7,000 ha, by providing reliable and adequate irrigation water supplies from surface and subsurface sources. The existing surface water farmer schemes would be remodeled, headworks and feeder canals would be built, and about 90 deep tubewells would be sunk to provide supplementary groundwater supplies direct to the distribution system.

Notes

(1) MS = Monsoon Season; YR = Year Round
(2) ED = Extensive Dev.; ID = Intensive Dev.; CAD = Command Area Dev.

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR SUNKOSHI-KAMALA MULTIPURPOSE PROJECT

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	3		
Name of Project	Sunkoshi-Kamala Multipurpose Project		
Type of Project	Storage and diversion project, major incorporation of other schemes		
Basic Details			
Location of Project			
- Ecol. Belt / Devel. Regions	Terai / Eastern and Central		
- Districts (Zones)	Saptari, Siraha, Dhanusha, Mahottari & Sarlahi (Sagarmatha & Janakpur)		
Water Source	Sunkosi and Kamala Rivers		
Irrigation Capability (1)	YR		
Development Intensity (2)	CAD		
Cropping Intensity (%)	200		
Net Command Area (ha)			
- Overall Scheme Total		175,100	a
- Overlap with Existing DOI Schemes		35,215	b
- Overlap with Existing Farmer Schemes		51,838	c
- New Scheme Total		88,047	d=a-b-c
Development Responsibility	DOI and NEA		
Project Appraisal			
- Level	Preliminary		
- Year	1985		
- Organization	JICA		
Implementation Schedule			
- Earliest Start Year	.....		
- Earliest Completion Year	.....		

Overlaps with Existing DOI Projects

Name of Project (3)	NCA Overlap (ha)
Kosi	0
SIRDP	3,575
Kamala	25,000
Hardinath	2,000
Manusmara	4,640
Total:	35,215

Overlaps with Other Identified Potential Irrigation Projects

Name of Project (4)	NCA Overlap (ha)
Kamala MP (No.4)	96,000
Bagmati MP (No. 5)	42,300
Rato (No. 6)	3,200
Bagmati (No.7)	7,000

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR SUNKOSHI-KAMALA MULTIPURPOSE PROJECT

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	3 (continued)
Name of Project	Sunkoshi-Kamala Multipurpose Project
Type of Project	Storage and diversion project, major incorporation of other schemes

Additional Comments

The project would divert water from the Sunkosi River through a tunnel to a dam on the Kamala River, from which total net command areas of 67,200 ha on the left bank and 107,900 ha on the right bank could be irrigated, and at which 93.4 MW of hydropower generating capacity could be installed. It is essentially an expansion of the potential Kamala multipurpose project. Three project stages are proposed, as follows

- Stage I would comprise a 16.6 km diversion tunnel from the Sunkosi to the Kamala, a 61.4 MW diversion hydropower station, a Chisapani pickup barrage, and irrigation systems to serve 55,000 ha (including the existing 25,000 ha Kamala project).

- Stage II would comprise a dam on the Kamala near Timnai, a 32 MW hydropower station at the dam, and a left bank extension to the irrigation system to serve a further 24,200 ha.

- Stage III would comprise a right bank extension to the irrigation system to serve a further 95,400 ha

Because of the project's overlap with the potential Bagmati multipurpose project, some reformulation of one or both of the projects may be needed.

Notes

(1) MS = Monsoon Season; YR = Year Round
(2) ED = Extensive Dev.; ID = Intensive Dev.; CAD = Command Area Dev.
(3) SIRDP = Sagarmatha Integrated Rural Development Project
(4) MP = Multi Purpose

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR KAMALA MULTIPURPOSE PROJECT

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	4		
Name of Project	Kamala Multipurpose Project		
Type of Project	Storage project, expansion of existing DOI project		
Basic Details			
Location of Project			
- Ecol. Belt / Devel. Regions	Terai / Eastern and Central		
- Districts (Zones)	Siraha, Dhanusha & Mahottari (Sagarmatha & Janakpur)		
Water Source	Kamala River		
Irrigation Capability (1)	YR		
Development Intensity (2)	CAD		
Cropping Intensity (%)	185		
Net Command Area (ha)			
- Overall Scheme Total		96,000	a
- Overlap with Existing DOI Schemes		29,875	b
- Overlap with Existing Farmer Schemes		20,856	c
- New Scheme Total		45,269	d=a-b-c
Development Responsibility	DOI and NEA		
Project Appraisal			
- Level	Preliminary		
- Year	1972		
- Organization	Nippon Koei Co Ltd		
Implementation Schedule			
- Earliest Start Year	.....		
- Earliest Completion Year	.....		

Overlaps with Existing DOI Projects

Name of Project (3)	NCA Overlap (ha)
SIRDP	2,875
Kamala	25,000
Hardinath	2,000
Total:	29,875

Overlaps with Other Identified Potential Irrigation Projects

Name of Project (4)	NCA Overlap (ha)
Sunkoshi-Kamala MP (No.3)	96,000

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR KAMALA MULTIPURPOSE PROJECT

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	4 (continued)
Name of Project	Kamala Multipurpose Project
Type of Project	Storage project, expansion of existing DOI project

Additional Comments

The proposed project would consist of a high dam on the Kamala River 20 km upstream from Chisapani village, a 30 MW hydropower station, a downstream barrage to divert water for irrigation purposes at Chisapani, irrigation water distribution systems to serve net areas of 51,000 ha and 45,000 ha on the left and right banks respectively (including the existing 25,000 ha Kamala project), and a transmission line to connect to the national power grid near Dhelkewar. The project would be fully integrated into the potential Sunkoshi-Kamala multipurpose project, and would yield important flood control benefits as well as power and irrigation benefits.

Notes

(1) MS = Monsoon Season; YR = Year Round
(2) ED = Extensive Dev.; ID = Intensive Dev.; CAD = Command Area Dev.
(3) SIRDP = Sagarmatha Integrated Rural Development Project
(4) MP = Multi Purpose

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR BAGMATI MULTIPURPOSE PROJECT

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	5		
Name of Project	Bagmati Multipurpose Project		
Type of Project	Storage project, expansion of Bagmati project (No. 7)		
Basic Details			
Location of Project			
- Ecol. Belt / Devel. Regions	Terai / Central		
- Districts (Zones)	Dhanusha, Mahottari, Sarlahi, Rautahat & Bara (Janakpur & Narayani)		
Water Source	Bagmati River		
Irrigation Capability (1)	YR		
Development Intensity (2)	CAD		
Cropping Intensity (%)	216		
Net Command Area (ha)			
- Overall Scheme Total		120,000	a
- Overlap with Existing DOI Schemes		6,700	b
- Overlap with Existing Farmer Schemes		45,090	c
- New Scheme Total		68,210	d=a-b-c
Development Responsibility	DOI and NEA		
Project Appraisal			
- Level	Feasibility		
- Year	1980		
- Organization	GTZ et al		
Implementation Schedule			
- Earliest Start Year	.....		
- Earliest Completion Year	.....		

Overlaps with Existing DOI Projects

Name of Project	NCA Overlap (ha)
Manusmara	5,200
Jhaj	1,500
Narayani	0
Total:	6,700

Overlaps with Other Identified Potential Irrigation Projects

Name of Project (3)	NCA Overlap (ha)
Sunkoshi-Kamala MP (No. 3)	42,300
Rato (No.6)	0
Bagmati (No. 7)	37,000

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR BAGMATI MULTIPURPOSE PROJECT

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	5 (continued)
Name of Project	Bagmati Multipurpose Project
Type of Project	Storage project, expansion of Bagmati project (No. 7)

Additional Comments

The project as envisaged consists of a high dam on the Bagmati River about 2 km upstream from the East-West highway near Karmaiya, a downstream barrage to divert water for irrigation purposes (now under construction as part of the potential Bagmati project), irrigation water distribution systems to serve net areas of 62,200 ha and 57,800 ha on the left and right banks respectively, installed hydropower generating capacity of 140 MW, and a transmission line to connect to the national power grid near Karmaiya. In addition to the primary power and irrigation benefits, the project has potential secondary flood damage reduction benefits. Because of its overlap with the potential Sunkoshi-Kamala multipurpose project, one or both of the projects may need some reformulation.

Notes

(1) MS = Monsoon Season; YR = Year Round
(2) ED = Extensive Dev.; ID = Intensive Dev.; CAD = Command Area Dev.
(3) MP = Multi Purpose

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR RATO IRRIGATION PROJECT

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	6		
Name of Project	Rato Irrigation Project		
Type of Project	Run-of-river project		
Basic Details			
Location of Project			
- Ecol. Belt / Devel. Regions	Terai / Central		
- Districts (Zones)	Mahottari (Janakpur)		
Water Source	Rato Nadi		
Irrigation Capability (1)	MS		
Development Intensity (2)	ED		
Cropping Intensity (%)	175		
Net Command Area (ha)			
- Overall Scheme Total		3,200	a
- Overlap with Existing DOI Schemes		0	b
- Overlap with Existing Farmer Schemes		1,400	c
- New Scheme Total		1,800	d=a-b-c
Development Responsibility	DOI and farmers		
Project Appraisal			
- Level	Feasibility (committed)		
- Year	.....		
- Organization	HMG/		
Implementation Schedule			
- Earliest Start Year	Commenced		
- Earliest Completion Year	1992		

Overlaps with Existing DOI Projects

Name of Project	NCA Overlap (ha)
-	-

Overlaps with Other Identified Potential Irrigation Projects

Name of Project (3)	NCA Overlap (ha)
Sunkoshi-Kamala MP (No. 3)	3,200
Bagmati MP (No. 5)	0

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR BAGMATI IRRIGATION PROJECT

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	7		
Name of Project	Bagmati Irrigation Project		
Type of Project	Run-of-river project		
Basic Details			
Location of Project			
- Ecol. Belt / Devel. Regions	Terai / Central		
- Districts (Zones)	Sarlahi & Rautahat (Janakpur & Narayani)		
Water Source	Bagmati River		
Irrigation Capability (1)	MS		
Development Intensity (2)	ED		
Cropping Intensity (%)	181		
Net Command Area (ha)			
- Overall Scheme Total		37,000	a
- Overlap with Existing DOI Schemes		0	b
- Overlap with Existing Farmer Schemes		15,447	c
- New Scheme Total		21,553	d=a-b-c
Development Responsibility	DOI		
Project Appraisal			
- Level	Feasibility (committed)		
- Year	1980; also later revisions		
- Organization	GTZ et al; HMG/MWPI/DIHM		
Implementation Schedule			
- Earliest Start Year	Commenced		
- Earliest Completion Year	1997		

Overlaps with Existing DOI Projects

Name of Project	NCA Overlap (ha)
Manusmara	0
Jhaj	0
Narayani	0
Total:	0

Overlaps with Other Identified Potential Irrigation Projects

Name of Project (3)	NCA Overlap (ha)
Sunkoshi-Kamala MP (No. 3)	7,000
Bagmati MP (No. 5)	37,000

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR BAGMATI IRRIGATION PROJECT

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	7 (continued)
Name of Project	Bagmati Irrigation Project
Type of Project	Run-of-river project

Additional Comments

The project as presently committed to implementation and under construction will develop net irrigation command areas of 14,000 ha and 23,000 ha on the left and right banks respectively of the Bagmati River, making use of the river's natural flow availability. The project comprises a diversion barrage on the river upstream from the East-West highway, and irrigation and drainage systems on both banks. The project would be fully integrated into the potential Bagmati multipurpose project. It also has some command area overlap with the potential Sunkoshi-Kamala multipurpose project, so that if the latter project were to be implemented some project reformulation would be needed.

Notes

(1) MS = Monsoon Season; YR = Year Round
(2) ED = Extensive Dev.; ID = Intensive Dev.; CAD = Command Area Dev.
(3) MP = Multi Purpose

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR EAST RAPTI IRRIGATION PROJECT

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	8		
Name of Project	East Rapti Irrigation Project		
Type of Project	Run-of-river project, including improvement of farmer schemes		
Basic Details			
Location of Project			
- Ecol. Belt / Devel. Regions	Terai / Central		
- Districts (Zones)	Chitwan (Narayani)		
Water Source	East Rapti River		
Irrigation Capability (1)	YR		
Development Intensity (2)	CAD		
Cropping Intensity (%)	243		
Net Command Area (ha)			
- Overall Scheme Total		9,500	a
- Overlap with Existing DOI Schemes		1,390	b
- Overlap with Existing Farmer Schemes		2,810	c
- New Scheme Total		5,300	d=a-b-c
Development Responsibility	DOI		
Project Appraisal			
- Level	Feasibility (committed)		
- Year	1986		
- Organization	Nippon Koei Co Ltd		
Implementation Schedule			
- Earliest Start Year	1989		
- Earliest Completion Year	1994		

Overlaps with Existing DOI Projects

Name of Project	NCA Overlap (ha)
Chitwan (Panch Kanya)	0
Chitwan (Lothar)	1,200
Pithuwa	190
Total:	1,390

Overlaps with Other Identified Potential Irrigation Projects

Name of Project	NCA Overlap (ha)
-	-

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR EAST RAPTI IRRIGATION PROJECT

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	8 (continued)
Name of Project	East Rapti Irrigation Project
Type of Project	Run-of-river project, including improvement of farmer schemes

Additional Comments

The project would improve current reliability of irrigation water supply to existing schemes and allow for expansion of irrigated agriculture in the eastern Chitwan valley. The envisaged project works include a diversion weir and headworks on the East Rapti river below its confluence with the Lothar River, river training and bank protection works, and right bank irrigation and drainage systems to serve the 9,500 ha net command area.

Notes

(1) MS = Monsoon Season; YR = Year Round
(2) ED = Extensive Dev.; ID = Intensive Dev.; CAD = Command Area Dev.

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR MARCHWAR LIFT IRRIGATION PROJECT I

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	9		
Name of Project	Marchwar Lift Irrigation Project I		
Type of Project	Run-of-river project		
Basic Details			
Location of Project			
- Ecol. Belt / Devel. Regions	Terai / Western		
- Districts (Zones)	Rupandehi (Lumbini)		
Water Source	Tinau and Dano Rivers		
Irrigation Capability (1)	YR		
Development Intensity (2)	CAD		
Cropping Intensity (%)	177		
Net Command Area (ha)			
- Overall Scheme Total		5,600	a
- Overlap with Existing DOI Schemes		0	b
- Overlap with Existing Farmer Schemes		0	c
- New Scheme Total		5,600	d=a-b-c
Development Responsibility	DOI		
Project Appraisal			
- Level	Feasibility (committed)		
- Year	1983; 1989		
- Organization	Sir M. MacDonald; UNCDF		
Implementation Schedule			
- Earliest Start Year	Commenced (suspended)		
- Earliest Completion Year	1994		

Overlaps with Existing DOI Projects

Name of Project	NCA Overlap (ha)
Bhairawa-Lumbini I	0
Bhairawa-Lumbini II	0
Siyari	0
Total:	0

Overlaps with Other Identified Potential Irrigation Projects

Name of Project	NCA Overlap (ha)
Bhairawa-Lumbini III	0

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR MARCHWAR LIFT IRRIGATION PROJECT I

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	9 (continued)
Name of Project	Marchwar Lift Irrigation Project I
Type of Project	Run-of-river project

Additional Comments

The project envisages the provision of reliable irrigation water supplies by pumping from the Tinau and Dano Rivers to the abandoned Tinau irrigation project area on the left bank of the Tinau. Implementation of the project has commenced but has been suspended. The Phase I project works include a river pumping station at Bhangahia (the confluence of the two rivers), link canals, and rehabilitation works to return the old irrigation systems to working order.

Notes

(1) MS = Monsoon Season; YR = Year Round
(2) ED = Extensive Dev.; ID = Intensive Dev.; CAD = Command Area Dev.

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR WEST RAPTI MULTIPURPOSE PROJECT

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	10		
Name of Project	West Rapti Multipurpose Project		
Type of Project	Storage and diversion project, includes Sikta project (No. 11)		
Basic Details			
Location of Project			
- Ecol. Belt / Devel. Regions	Terai / Western and Mid Western		
- Districts (Zones)	Kapilbastu, Dangdeukhuri & Banke (Lumbini, Rapti & Bheri)		
Water Source	West Rapti River		
Irrigation Capability (1)	YR		
Development Intensity (2)	CAD		
Cropping Intensity (%)	200		
Net Command Area (ha)			
- Overall Scheme Total		76,070	a
- Overlap with Existing DOI Schemes		2,485	b
- Overlap with Existing Farmer Schemes		15,282	c
- New Scheme Total		58,303	d=a-b-c
Development Responsibility	DOI and NEA		
Project Appraisal			
- Level	Prefeasibility		
- Year	1976; also later revisions		
- Organization	Lahmeyer International; HMG/MWR/WECS		
Implementation Schedule			
- Earliest Start Year	.....		
- Earliest Completion Year	.....		

Overlaps with Existing DOI Projects

Name of Project (3)	NCA Overlap (ha)
Banganga	0
Surahi	400
Jabai	400
RIRDP	435
Dunduwa	1,250
Total:	2,485

Overlaps with Other Identified Potential Irrigation Projects

Name of Project (4)	NCA Overlap (ha)
Sikta (No. 11)	36,070
Karnali MP (No. 12)	34,270

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR WEST RAPTI MULTIPURPOSE PROJECT

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	10 (continued)
Name of Project	West Rapti Multipurpose Project
Type of Project	Storage and diversion project, includes Sikta project (No. 11)

Additional Comments

The original study envisages a large storage dam on the West Rapti River at Bhalubang near the East-West highway. It also considers a tunnel diversion to the Kapilvastu area for irrigation and possible power generation purposes. Downstream areas in Dangdeukhuri and Banke districts would also receive regulated irrigation water supply.

The revision essentially considers the same scheme but locates the main regulation reservoir at Naumori, about 25 km upstream from Bhalubang at the confluence of the Mari and Jhimruk Kholas. The dam would give potential for hydropower generation, and would provide the flow regulation needed to develop the irrigation potential -- net command areas of 30,500 ha in Kapilvastu, 9,500 ha in the Deukhuri valley, and 36,070 ha in Banke (the potential Sikta project). However, the revised scheme requires a second dam on the West Rapti at Siling, about 23 km downstream from Naumori, from which the diversion to the Kapilvastu area would be effected with a much simpler tunnel arrangement than the one originally envisaged. Power could also be generated at the Siling dam and would be transmitted along with the Naumori dam power output to the national grid, connecting at Lamai.

Because of the project's overlap with the potential Karnali multipurpose project, one of the two projects would need to be reformulated if it were planned to implement both projects.

Notes

(1) MS = Monsoon Season; YR = Year Round
(2) ED = Extensive Dev.; ID = Intensive Dev.; CAD = Command Area Dev.
(3) RIRDP = Rapti Integrated Rural Development Project
(4) MP = Multi Purpose

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR SIKTA IRRIGATION PROJECT

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	11		
Name of Project	Sikta Irrigation Project		
Type of Project	Run-of-river project		
Basic Details			
Location of Project			
- Ecol. Belt / Devel. Regions	Terai / Mid Western		
- Districts (Zones)	Banke (Bheri)		
Water Source	West Rapti River		
Irrigation Capability (1)	MS		
Development Intensity (2)	ID		
Cropping Intensity (%)	182		
Net Command Area (ha)			
- Overall Scheme Total		36,070	a
- Overlap with Existing DOI Schemes		1,250	b
- Overlap with Existing Farmer Schemes		2,890	c
- New Scheme Total		31,930	d=a-b-c
Development Responsibility	DOI		
Project Appraisal			
- Level	Feasibility		
- Year	1980		
- Organization	Lahmeyer International		
Implementation Schedule			
- Earliest Start Year	.....		
- Earliest Completion Year	.....		

Overlaps with Existing DOI Projects

Name of Project	NCA Overlap (ha)
Dunduwa	1,250

Overlaps with Other Identified Potential Irrigation Projects

Name of Project (3)	NCA Overlap (ha)
West Rapti MP (No. 10)	36,070
Karnali MP (No. 12)	34,270

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR SIKTA IRRIGATION PROJECT

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	11 (continued)
Name of Project	Sikta Irrigation Project
Type of Project	Run-of-river project

Additional Comments

The project envisages the withdrawal of unregulated flow from the West Rapti river, to provide irrigation water supplies to net command areas of 1,800 ha on the left bank and 34,270 ha on the right bank of the river. The works would comprise a diversion weir and headworks near Agaiya, a small left bank canal and corresponding system network, a 36 km right bank feeder canal, and a major right bank irrigation and drainage system. The project would be an integral component of the potential West Rapti multipurpose project. Its right bank command area would also be commanded by the potential Karnali multipurpose project or by a reformulated Bheri-Babai Diversion project. Either of the latter projects could render the Sikta project redundant.

Notes

(1) MS = Monsoon Season; YR = Year Round
(2) ED = Extensive Dev.; ID = Intensive Dev.; CAD = Command Area Dev.
(3) MP = Multi Purpose

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR KARNALI MULTIPURPOSE PROJECT

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	12		
Name of Project	Karnali Multipurpose Project		
Type of Project	Storage project, major incorporation of other schemes		
Basic Details			
Location of Project			
- Ecol. Belt / Devel. Regions	Terai / Mid Western & Far Western		
- Districts (Zones)	Banke, Bardiya & Kailali (Bheri & Seti)		
Water Source	Karnali River		
Irrigation Capability (1)	YR		
Development Intensity (2)	CAD		
Cropping Intensity (%)	240		
Net Command Area (ha)			
- Overall Scheme Total		190,950	a
- Overlap with Existing DOI Schemes		5,843	b
- Overlap with Existing Farmer Schemes		54,610	c
- New Scheme Total		130,497	d=a-b-c
Development Responsibility	DOI and NEA		
Project Appraisal			
- Level	Feasibility (in progress)		
- Year	1989		
- Organization	Himalayan Power Consultants		
Implementation Schedule			
- Earliest Start Year	.....		
- Earliest Completion Year	.....		

Overlaps with Existing DOI Projects

Name of Project	NCA Overlap (ha)
Dunduwa	1,250
Chapala Tal	480
Badaiya Tal	480
Pathraiya	2,133
Khutia I	1,500
Mohana	0
Total:	5,843

Overlaps with Other Identified Potential Irrigation Projects

Name of Project (3)	NCA Overlap (ha)
West Rapti MP (No. 10)	34,270
Sikta (No. 11)	34,270
Bheri-Babai MP (No. 13)	40,000
Babai (No. 14)	13,500
Geruwa Island (No. 15)	15,000
Jamuar Nala (No. 16)	13,600
Khutia II (No. 17)	3,500

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR KARNALI MULTIPURPOSE PROJECT

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	12 (continued)
Name of Project	Karnali Multipurpose Project
Type of Project	Storage project, major incorporation of other schemes

Additional Comments

The project envisages a major development of the hydropower and irrigation potential of the Karnali River, by provision of a high storage and regulation dam on the river at Chisapani, a hydroelectric power generating station at the dam with up to 10,800 MW installed capacity, a downstream barrage and headworks for withdrawal of irrigation water, and irrigation systems as required to serve 85,320 ha on the left bank, 90,630 ha on the right bank, and 15,000 ha on Geruwa Island. The project as formulated has command area overlaps with the potential West Rapti (Sikta) and Bheri-Babai (Babai) multipurpose projects, so that reformulation of one or more of the projects may be needed.

Notes

(1) MS = Monsoon Season; YR = Year Round
(2) ED = Extensive Dev.; ID = Intensive Dev.; CAD = Command Area Dev.
(3) MP = Multi Purpose

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR BHERI-BABAI MULTIPURPOSE PROJECT

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	13		
Name of Project	Bheri-Babai Multipurpose Project		
Type of Project	Diversion project, expansion of Babai project (No.14)		
Basic Details			
Location of Project			
- Ecol. Belt / Devel. Regions	Terai / Mid Western		
- Districts (Zones)	Bardiya (Bheri)		
Water Source	Bheri and Babai Rivers		
Irrigation Capability (1)	YR		
Development Intensity (2)	CAD		
Cropping Intensity (%)	200		
Net Command Area (ha)			
- Overall Scheme Total		40,000	a
- Overlap with Existing DOI Schemes		960	b
- Overlap with Existing Farmer Schemes		11,312	c
- New Scheme Total		27,728	d=a-b-c
Development Responsibility	DOI		
Project Appraisal			
- Level	Reconnaissance		
- Year	1977		
- Organization	Tahal Consulting Engineers		
Implementation Schedule			
- Earliest Start Year	.....		
- Earliest Completion Year	.....		

Overlaps with Existing DOI Projects

Name of Project	NCA Overlap (ha)
Chapala Tal	480
Badaiya Tal	480
Total:	960

Overlaps with Other Identified Potential Irrigation Projects

Name of Project (3)	NCA Overlap (ha)
Karnali MP (No. 12)	40,000
Babai (No. 14)	13,500

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR BHERI-BABAI MULTIPURPOSE PROJECT

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	13 (continued)
Name of Project	Bheri-Babai Multipurpose Project
Type of Project	Diversion project, expansion of Babai project (No.14)

Additional Comments

The Bheri River is the major tributary of the Karnali River. The project would divert flow from the Bheri to the Babai River, to expand the potential irrigation development in that area to about 20,000 ha of net command area on each bank. It would also include an installed hydroelectric generating capacity of 24 MW. Alternatively, a larger diversion tunnel could be constructed and the command area reformulated to concentrate development to the east of the Babai River. The effect of a Bheri diversion to the Babai on a Karnali (Chisapani) multipurpose high dam project would need to be evaluated. The project on its own appears to be technically and economically very attractive, but it is unlikely to coexist feasibly with the Karnali multipurpose project.

Notes

(1) MS = Monsoon Season; YR = Year Round
(2) ED = Extensive Dev.; ID = Intensive Dev.; CAD = Command Area Dev.
(3) MP = Multi Purpose

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR BABAI IRRIGATION PROJECT

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	14		
Name of Project	Babai Irrigation Project		
Type of Project	Run-of-river project, including improvement of farmer schemes		
Basic Details			
Location of Project			
- Ecol. Belt / Devel. Regions	Terai / Mid Western		
- Districts (Zones)	Bardiya (Bheri)		
Water Source	Babai River		
Irrigation Capability (1)	YR		
Development Intensity (2)	CAD		
Cropping Intensity (%)	160		
Net Command Area (ha)			
- Overall Scheme Total		13,500	a
- Overlap with Existing DOI Schemes		0	b
- Overlap with Existing Farmer Schemes		5,308	c
- New Scheme Total		8,192	d=a-b-c
Development Responsibility	DOI		
Project Appraisal			
- Level	Feasibility; detail design		
- Year	1978 and 1980; 1982 and 1984		
- Organization	Tahal; Sir M. MacDonald		
Implementation Schedule			
- Earliest Start Year	.....		
- Earliest Completion Year	.....		

Overlaps with Existing DOI Projects

Name of Project	NCA Overlap (ha)
-	

Overlaps with Other Identified Potential Irrigation Projects

Name of Project (3)	NCA Overlap (ha)
Karnali MP (No. 12)	13,500
Bheri-Babai MP (No. 13)	13,500

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR BABAI IRRIGATION PROJECT

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	14 (continued)
Name of Project	Babai Irrigation Project
Type of Project	Run-of-river project, including improvement of farmer schemes

Additional Comments

The project would develop for irrigation a net command area of 13,500 ha on the left bank of the Babai River, using the natural flow of the river. The project works would include a river diversion weir and headworks, main feeder canals, and irrigation and drainage systems within the command area. The project would be fully integrated into the potential Bheri-Babai multipurpose project. Its command area would also be commanded by the potential Karnali multipurpose project.

Notes

(1) MS = Monsoon Season; YR = Year Round
(2) ED = Extensive Dev.; ID = Intensive Dev.; CAD = Command Area Dev.
(3) MP = Multi Purpose

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR GERUWA ISLAND IRRIGATION PROJECT

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	15		
Name of Project	Geruwa Island Irrigation Project		
Type of Project	Run-of-river project, improvement of farmer schemes		
Basic Details			
Location of Project			
- Ecol. Belt / Devel. Regions	Terai / Mid Western		
- Districts (Zones)	Bardiya (Bheri)		
Water Source	Karnali River		
Irrigation Capability (1)	YR		
Development Intensity (2)	ID		
Cropping Intensity (%)	185		
Net Command Area (ha)			
- Overall Scheme Total		15,000	a
- Overlap with Existing DOI Schemes		0	b
- Overlap with Existing Farmer Schemes		12,215	c
- New Scheme Total		2,785	d=a-b-c
Development Responsibility	DOI		
Project Appraisal			
- Level	Preliminary		
- Year	1980		
- Organization	HMG/		
Implementation Schedule			
- Earliest Start Year	.....		
- Earliest Completion Year	.....		

Overlaps with Existing DOI Projects	NCA Overlap (ha)
Name of Project	
-	-

Overlaps with Other Identified Potential Irri	NCA Overlap (ha)
Name of Project (3)	
Karnali MP (No. 12)	15,000

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR GERUWA ISLAND IRRIGATION PROJECT

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	15 (continued)
Name of Project	Geruwa Island Irrigation Project
Type of Project	Run-of-river project, improvement of farmer schemes

Additional Comments

Geruwa Island is presently irrigated from the Karnali River by villager constructed and farmer managed systems. These would be remodeled under the project. The project works would prevent flooding of large tracts of farm land, presently caused by flood waters diverted into the systems at the uncontrolled headworks on the Karnali. Thus the project would yield benefits both from improved reliability of irrigation water supply and from reduction of flood-related damages. The project would be an integral component of the potential Karnali multipurpose project, and is currently under study as the Rajapur Irrigation Rehabilitation project (see Table A3-A16).

Notes

(1) MS = Monsoon Season; YR = Year Round
(2) ED = Extensive Dev.; ID = Intensive Dev.; CAD = Command Area Dev.
(3) MP = Multi Purpose

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR JAMUAR NALA IRRIGATION PROJECT

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	16		
Name of Project	Jamuar Nala Irrigation Project		
Type of Project	Run-of-river project, improvement of farmer scheme		
Basic Details			
Location of Project			
- Ecol. Belt / Devel. Regions	Terai / Far western		
- Districts (Zones)	Kailali (Seti)		
Water Source	Karnali River		
Irrigation Capability (1)	YR		
Development Intensity (2)	ID		
Cropping Intensity (%)	185		
Net Command Area (ha)			
- Overall Scheme Total		13,600	a
- Overlap with Existing DOI Schemes		0	b
- Overlap with Existing Farmer Schemes		13,600	c
- New Scheme Total		0	d=a-b-c
Development Responsibility	DOI		
Project Appraisal			
- Level	Reconnaissance		
- Year	1977		
- Organization	Tahal Consulting Engineers		
Implementation Schedule			
- Earliest Start Year	.....		
- Earliest Completion Year	.....		

Overlaps with Existing DOI Projects

Name of Project	NCA Overlap (ha)
-	-

Overlaps with Other Identified Potential Irrigation Projects

Name of Project (3)	NCA Overlap (ha)
Karnali MP (No. 12)	13,600

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR JAMUAR NALA IRRIGATION PROJECT

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	16 (continued)
Name of Project	Jamuar Nala Irrigation Project
Type of Project	Run-of-river project, improvement of farmer scheme

Additional Comments

The proposed project would improve the present farmer scheme by providing proper diversion and intake facilities, and by remodeling the canal and drain network. This would allow for significant increases in cropping intensity and corresponding crop production. The project would be fully incorporated into the potential Karnali multipurpose project, and may be included as a component of the Rajapur Irrigation Rehabilitation project (see Table A3-A15).

Notes

(1) MS = Monsoon Season; YR = Year Round
(2) ED = Extensive Dev.; ID = Intensive Dev.; CAD = Command Area Dev.
(3) MP = Multi Purpose

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR KHUTIA IRRIGATION PROJECT II

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	17		
Name of Project	Khutiya Irrigation Project II		
Type of Project	Run-of-river project, extension to existing DOI project		
Basic Details			
Location of Project			
- Ecol. Belt / Devel. Regions	Terai / Far Western		
- Districts (Zones)	Kailali (Seti)		
Water Source	Khutia River		
Irrigation Capability (1)	MS		
Development Intensity (2)	ID		
Cropping Intensity (%)	.....		
Net Command Area (ha)			
- Overall Scheme Total		3,500	a
- Overlap with Existing DOI Schemes		0	b
- Overlap with Existing Farmer Schemes		1,000	c
- New Scheme Total		2,500	d=a-b-c
Development Responsibility	DOI		
Project Appraisal			
- Level	Feasibility (committed)		
- Year	.....		
- Organization	HMG/		
Implementation Schedule			
- Earliest Start Year	.....		
- Earliest Completion Year	.....		

Overlaps with Existing DOI Projects

Name of Project	NCA Overlap (ha)
Khutiya I	0

Overlaps with Other Identified Potential Irrigation Projects

Name of Project (3)	NCA Overlap (ha)
Karnali MP (No. 12)	3,500

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR KHUTIA IRRIGATION PROJECT II

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	17 (continued)
Name of Project	Khutiya Irrigation Project II
Type of Project	Run-of-river project, extension to existing DOI project

Additional Comments

(Pending availability of project report).

The project would be fully incorporated into the potential Karnali multipurpose project. Stage I of the project, which is committed to implementation, envisages an upgrading of the existing 1,500 ha command area and construction of a permanent headworks and head reach canal capable of serving the full proposed net command area of 5,000 ha.

Notes

(1) MS = Monsoon Season; YR = Year Round
(2) ED = Extensive Dev.; ID = Intensive Dev.; CAD = Command Area Dev.
(3) MP = Multi Purpose

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR MAHAKALI IRRIGATION PROJECT II

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	18		
Name of Project	Mahakali Irrigation Project II		
Type of Project	Run-of-river/groundwater project, extension to existing DOI project		
Basic Details			
Location of Project			
- Ecol. Belt / Devel. Regions	Terai / Far Western		
- Districts (Zones)	Kanchanpur (Mahakali)		
Water Source	Mahakali River and aquifers		
Irrigation Capability (1)	YR		
Development Intensity (2)	CAD		
Cropping Intensity (%)	186		
Net Command Area (ha)			
- Overall Scheme Total		6,800	a
- Overlap with Existing DOI Schemes		0	b
- Overlap with Existing Farmer Schemes		703	c
- New Scheme Total		6,097	d=a-b-c
Development Responsibility	DOI		
Project Appraisal			
- Level	Feasibility (committed)		
- Year	1987; 1988		
- Organization	Sir W. Halcrow; World Bank		
Implementation Schedule			
- Earliest Start Year	1989		
- Earliest Completion Year	1993		

Overlaps with Existing DOI Projects

Name of Project	NCA Overlap (ha)
Mahakali I	0

Overlaps with Other Identified Potential Irrigation Projects

Name of Project	NCA Overlap (ha)
-	-

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR MAHAKALI IRRIGATION PROJECT II

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	18 (continued)
Name of Project	Mahakali Irrigation Project II
Type of Project	Run-of-river/groundwater project, extension to existing DOI project

Additional Comments

The project, which is now committed to implementation, will add a net command area of 6,800 ha to the existing 5,000 ha Mahakali I project. The projects are located in the left bank area of the Mahakali River in Nepal and are served from a diversion and headworks structure on the river in India. The Stage II project works will include full irrigation and drainage networks, about 12 augmentation tubewells for dry season supplementary groundwater supplies, and flood protection works.

Notes

(1) MS = Monsoon Season; YR = Year Round
(2) ED = Extensive Dev.; ID = Intensive Dev.; CAD = Command Area Dev.

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR BHAIRAWA-LUMBINI GROUNDWATER IRRIGATION PROJECT III

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	19		
Name of Project	Bhairawa-Lumbini GW Irrig. Proj. III		
Type of Project	Groundwater project, extension to existing DOI project		
Basic Details			
Location of Project			
- Ecol. Belt / Devel. Regions	Terai / Western		
- Districts (Zones)	Rupandehi (Lumbini)		
Water Source	Deep Aquifer		
Irrigation Capability (1)	YR		
Development Intensity (2)	CAD		
Cropping Intensity (%)	178		
Net Command Area (ha)			
- Overall Scheme Total		8,600	a
- Overlap with Existing DOI Schemes		0	b
- Overlap with Existing Farmer Schemes		725	c
- New Scheme Total		7,875	d=a-b-c
Development Responsibility	DOI		
Project Appraisal			
- Level	Feasibility		
- Year	1988		
- Organization	Tahal Consulting Engineers Ltd		
Implementation Schedule			
- Earliest Start Year	1989		
- Earliest Completion Year	1997		

Overlaps with Existing DOI Projects

Name of Project	NCA Overlap (ha)
Bhairawa-Lumbini I	0
Bhairawa-Lumbini II	0
Siyari	0

Overlaps with Other Identified Potential Irrigation Projects

Name of Project	NCA Overlap (ha)
Marchwar Lift I (No. 9)	0

DATA SHEETS FOR THE LARGER IDENTIFIED POTENTIAL IRRIGATION PROJECTS - DATA SHEET FOR BHAIRAWA-LUMBINI GROUNDWATER IRRIGATION PROJECT III

(See Annex D3 for modified project data resulting from water balance and agricultural benefit studies and used in Master Plan evaluations)

Project Number	19 (continued)
Name of Project	Bhairawa-Lumbini GW Irrig. Proj. III
Type of Project	Groundwater project, extension to existing DOI project

Additional Comments

The project would extend the existing Stage I and Stage II deep tubewell (DTW) irrigation developments into three new areas as follows

Location (Sector)	NCA (ha)	DTW (No.)
Eastern	3,000	26
Central	4,200	35
Western	1,400	12
Total	8,600	73

The comprehensive development concepts which have evolved from the two previous stages of the project would be applied in the development of the new areas.

Notes

(1) MS = Monsoon Season; YR = Year Round
(2) ED = Extensive Dev.; ID = Intensive Dev.; CAD = Command Area Dev.

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A4-1 - INTRODUCTION

A4-1.1 - Objectives

Annex A4 has eight objectives :

1. To combine district-wise land resource data tabulated in earlier annexes, for developing estimates of remaining potential irrigation areas.

2. To depict in map form existing land use in the Terai districts, emphasizing irrigated, rainfed agricultural, and forested areas.

3. To depict in map form the areas to be covered by the large identified potential Terai irrigation projects, and the areas with significant groundwater development potential.

4. To depict in map form the land capability characteristics of the Terai district areas not covered by existing or identified potential irrigation projects, as a means of defining the locations of remaining potential irrigation areas in the Terai.

5. To effect a reconciliation between tabular and mapped information, to define and quantify land use within the remaining potential irrigation areas.

6. To identify in a preliminary manner the possible sources of water supply for irrigation in the remaining potential Terai development areas, and to proceed to tentative formulation of development concepts for possible new large Terai projects.

7. To commence a rational assessment of remaining irrigation potential in the Hill and Mountain districts, by undertaking sample Hill district land and water resource assessments.

8. To derive from the study results an estimate of the ultimate potential irrigation development area in Nepal, as determined by both land and water resource limitations.

A4-1.2 - Scope and Outline

This annex describes a study undertaken to identify remaining potential irrigation development areas, and to suggest possible development modes for them. The study had both an analytical component and a mapping component. It was initially office based only, but was later extended to include a field program.

The analytical component of the study aimed at a numerical reconciliation of land use and land capability data, or more specifically, of irrigation project areas (existing and potential) and irrigable areas. This provided quantitative estimates of the remaining potential development areas.

The mapping component of the study developed maps depicting current and projected land use, and the distribution of irrigable land areas and aquifer zones. This led to an identification of the locations, extents, current land use and groundwater development potential of the remaining potential development areas.

The tabulated numerical reconciliation of land resource data covers the entire country, while the completed mapping covers only the Terai Plains and Siwalik Valleys within the Terai ecological belt. A correlation between mapped and tabular information was effected for the Terai districts, based on mapped area measurements. This gave a comprehensive estimate of the undeveloped irrigable areas and their current land use.

The assessment of remaining irrigation potential in the Terai ecological belt was extended in a qualitative way to consider water resource aspects, and to outline in preliminary fashion five specific projects which may warrant further study at prefeasibility level. Broad assessments of remaining irrigation potential in three Hill districts were also undertaken, from which some generalized indications for the Hill and Mountain ecological belts were derived.

Following this introductory section, data sources and methodologies used in the study are documented in Section A4-2. The results of the numerical and mapping work, and of the individual project and sample district assessments, are then presented in Section A4-3 and in an Appendix. A concluding discussion on estimated ultimate irrigation potential is given in Section A4-4. The maps themselves are presented in a separate Map Volume.

A4-2 - DATA SOURCES AND METHODOLOGY

A4-2.1 - Compilation of Tabular Data

To quantify the net remaining potential irrigation development areas, a calculation procedure was set up to assemble and reconcile all relevant previously compiled data on land use, land capability, existing irrigation developments and identified potential irrigation developments. These data, which are presented in Annexes A1, A2 and A3, were compiled in the present study for each district, with aggregations by planning unit (combination of ecological belt with development region).

Total irrigable areas* from Annex A2, Table A2-3, were taken to represent the total land resource areas which are assumed to be amenable to development for irrigation. For Terai district analyses, irrigable areas were quantified according to two current land uses, as follows :

- irrigable agricultural areas, corresponding to both irrigated and rainfed lands.
- irrigable non-agricultural areas, corresponding to forest lands, grasslands and urban areas, and including reserve lands.

This distinction was not made for Hill and Mountain district analyses, since in these districts the irrigable non-agricultural areas generally represent insignificant proportions of the total irrigable areas.

Existing irrigation development areas, taken from Annex A1, Tables A1-3 and A1-7, represent all defined surface water and groundwater DOI schemes and Farmer Managed Irrigation Schemes (FMIS). Not all existing irrigation developments are actually fully developed. There are some existing DOI schemes which have both a developed and an ongoing or planned component; this distinction was carried forward from Annex A1 in the compilation of areas for the present study.

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* In this procedure, all areas - irrigable, irrigated, etc- are taken as net areas, as opposed to mapped areas. Net areas are typically smaller than mapped areas by 10 to 25 percent.

The subtraction of the existing irrigation project areas from the irrigable areas gives the irrigable areas with current development potential. These can still be quantified as either agricultural or non-agricultural areas, since existing project areas all correspond to agricultural areas.

Identified potential irrigation development areas, taken from Annex A3, Table A3-4, cover all potential irrigation projects which have been identified in previous formal studies. Since these projects often overlap with existing projects, and even with other identified potential projects, only their incremental areas (areas exclusive of such overlaps), as presented in Annex A3, were used in the present study. The distinction between larger projects (NCA greater than 2,000 ha) and smaller projects (NCA less than 2,000 ha), as made in Annex A3, was maintained for Terai districts in the present compilation of areas.

The subtraction of the incremental identified potential irrigation project areas from the current development potential areas provides an estimate of the irrigable area with remaining, as yet unidentified, development potential. The tabular calculation procedure does not quantify these areas in the Terai districts as either agricultural or non-agricultural areas, since this distinction has not normally been made in the studies for the identified potential projects. However, the mapping work which was undertaken does provide a means of estimating this breakdown of the remaining irrigable areas, as described in Section A4-2.3.

A4-2.2 - Presentation of Relevant Information in Map Form

A4-2.2.1 - Compilation of Basic Information

The first step in the preparation of mapping to illustrate irrigation development potential was to depict, as accurately as possible, the locations and boundaries of all existing and identified potential irrigation developments. Sources of data for this exercise included the Water Use Inventory (WUI) maps, prepared for each Terai district for the Water and Energy Commission Secretariat (WECS) by several consultants, and maps from individual project study reports as available. The personal knowledge of Master Plan team members and DOI staff was also used where possible.

A map scale of 1:250,000 was adopted, and eight base map plates covering the Terai ecological belt were prepared. This arrangement is similar to that employed for the maps which form part of the GDC Terai groundwater development strategies study (Ref 1); these maps, supplemented by those of the Land Resources Mapping Project (LRMP) (Ref 2), served as the initial source of data for the base map details.

Two development location overlays were prepared for each base map plate, the first (Overlay Series A) to depict the existing land resource development situation and the second (Overlay Series B) to depict the projected land resource development situation. The latter corresponds to a possible future scenario in which all identified potential projects have been fully implemented.

The overlays needed to distinguish between DOI projects and FMIS. Maps prepared for Terai district WUI's were reduced in scale from 1:50,000 to 1:250,000, to allow all existing FMIS boundaries to be traced and to check DOI scheme boundaries.

To show the overlaps between identified potential projects, the hierarchy of identified potential projects defined in Annex A3 was used to define the boundaries of "higher order" and "lower order" multipurpose schemes. However, the depiction of these boundaries on the overlays does not reflect the complex overlaps resulting from superposition of all the individual projects. A rationalization or reformulation of command area boundaries has therefore been undertaken. This allowed the development concepts which have evolved during preparation of the Master Plan to be presented, eliminating the less practical configurations previously proposed. The final selection of scheme boundaries will be subject to modification resulting from future project-specific studies.

A4-2.2.2 - Depiction of Development Potential

To depict the existing and projected development situations in a land use context, an indication of present land use outside of the irrigation development boundaries is included on Overlay Series A and B. A distinction is made between rainfed agricultural lands and non-agricultural (mainly forest) lands. Non-agricultural reserve lands are also shown as a separate land use category. The principal source of these land use data was the LRMP land utilization map series (Ref 2), interpreted for land use details in similar fashion to the GDC study (Ref 1).

For the assessment of remaining irrigation development potential, two further sets of overlays were prepared, which in transparent form could be superimposed as required on the other sets to obtain relevant information. These further overlay sets, Overlay Series C and D, depict the irrigability of land and the groundwater development potential respectively.

Maps from the LRMP land capability map series (Ref 2) were reduced in scale from 1:125,000 to 1:250,000 to allow irrigable area boundaries to be transferred directly to Overlay Series C. Irrigable areas were defined as areas with designated irrigation suitability classes 1, 1R, 2 and 2R. This conforms with the definition used in Annex A2 and in the GDC study. Overlay Series C

was prepared to show directly the superposition of irrigable and non-irrigable areas on agricultural and non-agricultural areas*.

The GDC study map series depicting groundwater irrigation development potential was used to outline areas of shallow and deep aquifers with high development potential. These areas were designated as high potential aquifer zones; they comprise Class S1 aquifers, in the case of shallow aquifer zones, and Class D1 and D2 aquifers, in the case of deep aquifer zones. The aquifer zones were numbered for reference purposes and mapped on Overlay Series D.

A4-2.3 - Reconciliation of Tabular and Mapped Information

To obtain quantitative estimates of the current land use within undeveloped irrigable areas, mapped areas were measured for reconciliation with, and hence extension of, the tabulated data. A two phase approach to this exercise was adopted.

The first phase was concerned with establishing the reliability of the mapping and of the area measurement work. This was accomplished by measuring areas for which there were equivalent tabulated values available (such as total land area and total irrigable area). All measurements were undertaken on a district basis, using a simple "square counting" method**. This resulted in direct comparisons between tabulated and measured mapped areas, from which large differences could be identified, explained and corrected.

The second phase was concerned with providing a breakdown by land use of the mapped irrigable areas within the two principal development status categories - existing and identified potential projects, and remaining development potential areas. The ultimate purpose was to define for each of these the irrigable area and its breakdown into 3 principal current land use categories - non-agricultural reserves, other non-agricultural (mainly forest), and agricultural. Appropriate ratios to convert mapped areas to net areas were then applied. The resulting total net irrigable areas were compared with the equivalent tabulated areas, and explanations were sought for any large differences that were identified.

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* The maps prepared for the GDC study (Ref 1) could not be used to prepare this overlay series, since they do not separate the non-agricultural (primarily forested) lands into irrigable and non-irrigable categories.

** The accuracy of this simplified area measurement method was demonstrated in comparison with planimetered areas. It was judged to be the most suitable method for this study, combining a level of accuracy that was consistent with map accuracy with a reliable means of checking the results.

A4-2.4 - Tentative Formulation of New Large Terai Projects

Having gained a perspective of the remaining potential development areas from the mapping work, it was decided to examine at a tentative level of detail some of the possible options for irrigation development in those areas. Some of these options had been identified prior to commencement of work on the Master Plan, while others evolved during the preparation of the Master Plan. It is emphasized that the projects discussed in this annex are at a much earlier stage of definition than those described in Annex A3; they must therefore be considered as long term development prospects. The present formulation of these projects corresponds to less than full reconnaissance level.

The tentative formulation of new large Terai projects comprised, where possible and appropriate, the following elements

- selection and observation of headworks locations and conditions
- estimation of command water levels
- estimation of possible withdrawal flows at critical times
- alignment of main diversion and conveyance systems
- outline and estimation of possible command areas

Basic data used in this work included 1:50,000 scale contour mapping, land capability data as represented by LRMP data on the Overlay Series C maps, representative irrigation water requirement and streamflow data (see Annexes D1 and D2), available study reports, discussions with DOI and NEA officials, and site observations.

A4-2.5 - Hill District Irrigation Development Assessments

A greater effort is required to obtain estimates of irrigation development potential in the Hill and Mountain districts that are comparable to those obtained for the Terai districts. This is due in large measure to the different scale and nature of the land and water resources in the hill and mountain areas. Irrigable land most often occurs in numerous small and widely scattered pockets, and the streams which serve as water sources are usually small and ungauged. The analytical effort required at the planning level is thus considerably greater on a unit area basis than for Terai areas.

A methodology for undertaking broad planning assessments of irrigation development potential in Hill and Mountain districts was developed and applied to three sample districts. Based on experience with its use, it was then modified somewhat and is presented here to serve as a guide for further similar assessments. The required reference and source material includes a completed WUI for each district being studied, corresponding LRMP land capability maps and topographic maps, and any relevant district-specific development program reports.

The methodology begins with an office-based review and study of available land and water resource data for the district under study. This is followed by field visits to the district, to examine areas showing the greatest potential for new development, and to meet with DOI District Irrigation Office (DIO) and other irrigation development agency staff. Further desk studies are then undertaken to define, as quantitatively as possible, the extent of expansion potential and the areas for which further investigations would be warranted. The specific steps are as follows :

a) Prepare a tracing of irrigable areas from 1:50,000 LRMP land capability maps for the district. Overlay this on district WUI maps at the same scale, to correlate irrigability with current land use, including existing irrigation areas.

b) Perform approximate water availability calculations on a watercourse or river basin basis, using available streamflow data and estimates, and standard per ha irrigation water requirements*. Compare the resulting supportable area with the area of existing projects on the same watercourse, to estimate whether a water resource surplus or deficit exists, and to estimate its magnitude.

c) Classify the irrigable potential expansion areas as either extension areas for existing projects or completely new potential project areas. Identify priority areas for further investigation, based on water availability considerations**. Refer also to relevant previous studies of irrigation development potential, to help define and apply appropriate criteria, and evaluate the priority areas. Obtain air photos if possible, for use in the evaluation process.

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* The assessments undertaken to date made use of average streamflow estimates from the WUI reports (reduced by factors to approximate 80% reliable conditions) and representative irrigation water requirements from Annex D1.

** Modest interbasin water transfer schemes (including diversion, lift pump and pipeline aqueduct schemes) will often be the means required to effect significant irrigation development expansion.

d) Visit the DOI District Engineer and staff of other project implementing agencies for the district, obtain their views on irrigation development potential in the district, and review with them the information prepared in the desk studies. Take note of additional information provided on water rights, water availability and development concepts for the identified priority areas.

e) Visit the priority areas as possible, to obtain first-hand information on present land and water use, on available streamflows and current water rights, and on the physical, operational and organizational status of existing irrigation schemes. Obtain farmers' views on the potential for new irrigation development, including the potential for improving existing systems, conserving water, and extending existing systems into adjacent areas.

f) Refine the desk studies to quantify, as much as possible, land and water resource availability and the potential for further irrigation development. Prepare an action plan to carry project identification studies further, discussing it at the draft stage with the District Engineer.

g) Estimate the overall potential for expansion of the existing irrigation development area in the district, expressing it in both absolute terms and as a percentage of the remaining available irrigable land area. Prepare an assessment report for the district, to document the study and present its conclusions.

A4-3 - STUDY RESULTS

A4-3.1 - Tabular Analysis

The tabular analysis of irrigable and development areas by district is summarized in Table A4-1 for the Hill and Mountain districts and in Table A4-2 for the Terai districts. The two tables are presented in comparable formats. Column 1 of Table A4-1 and Columns 1 to 3 of Table A4-2 present net irrigable land area data taken from Annex A2; these serve as the starting point for the analysis. Columns 2 to 4 of Table A4-1 and Columns 4 to 6 of Table A4-2 present data on existing project net areas taken from Annex A1. Subtracting these areas from the irrigable land areas yields estimates of irrigable land areas that could be available for irrigation development, as given in Column 6 of Table A4-1 and Columns 7, 8 and 9 of Table A4-2. The net incremental areas that could be developed under identified potential projects, taken from Annex A3, are tabulated in Column 8 of Table A4-1 and Columns 10 to 12 of Table A4-2. The figures in Column 9 of Table A4-1 and in Column 13 of Table A4-2 are then calculated by subtraction. These represent the total remaining areas which could be available for irrigation development, outside of the boundaries of existing and identified potential irrigation projects.

A4-3.1.1 - Hill and Mountain Districts

As expected from the estimating methodology of Annex A1, results for Hill and Mountain districts presented in Table A4-1 show considerable consistency among regions and districts. On average, 48 percent of the total net irrigable area has been estimated as developed to date, with district level percentage development normally in the range of 37 to 54 percent*. After allowing for the net areas of identified potential projects, the remaining development potential area averages 46 percent of net irrigable area, and varies between districts normally in the range of 22 to 59 percent.

District WUI's conducted to date reflect the degree of consistency in relative development areas given in Table A4-1. As explained in Annex A1, the developed areas in those districts not yet covered by WUI's were estimated using a simple relationship based on irrigable agricultural areas. For this reason, the pattern observed in the 11 Hill districts for which WUI's were available when Annex A1 was prepared (denoted by asterisks (*) in Table A4-1) is repeated in

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* Three Mountain districts (Mustang, Dolpa and Humla) have some unusual characteristics which place their levels of development outside of this range.

the other districts. More meaningful assessments of the areas available for further irrigation development in the other districts must await the completion of a WUI or equivalent study for each.

A4-3.1.2 - Terai Districts

The data presented in Table A4-2 for the Terai districts show considerable variability among districts, and incorporate the distinction between irrigable agricultural and non-agricultural (mainly forest) land areas. As mentioned in Section A4-2.1, the identified potential project study reports do not generally identify the extent of forested irrigable areas to be developed, so that the estimated remaining potential development areas for each district (Column 13) include both land use categories. The tabular data can be enhanced by map based data to obtain an estimation of the distribution of remaining irrigable land between these two important land use categories, as shown in Section A4-3.3.

Referring to the tabular data alone provides a quantitative overview of remaining development potential in the Terai districts as follows :

a) A total approximate* net area (convertible to NCA of irrigation projects if adequate water supplies can be provided) of about 630,000 ha is available for further irrigation development in the Terai.

b) Approximately one half of the remaining potential development area is located in the Eastern and Central development regions, with the balance evenly distributed over the three western regions.

c) Only Parsa (69 percent), Chitwan (58 percent), and Kanchanpur (72 percent) have remaining development potential that substantially exceeds 50 percent of the total irrigable area. These could be considered relatively "underdeveloped" districts, but their development potential is limited by the presence of large tracts of reserve land. This limitation to development potential applies also to Bardiya District.

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* approximate because of the loss of accuracy when large numbers are subtracted, and when standard factors are used to convert "mapped" to "net" irrigable areas and "gross" to "net" command areas.

d) Five districts could be classed as "well developed" upon completion of all identified potential projects. At that time, the remaining development potential in Jhapa, Saptari, Siraha, Mahottari and Kailali will be less than 25 percent of total irrigable area. All except Kailali are located in the eastern Terai. It is unlikely that significant additional developments could be planned for these districts.

e) The largest tracts of remaining irrigable land are located in the Central Terai (220,000 ha), the Western Terai (122,000 ha), Banke District (40,000 ha), and Kanchanpur District (69,000 ha).

A4-3.2 - Terai District Mapping

A4-3.2.1 - General Description

Map sets covering the Terai Plain and Siwalik Valley portions of the Terai ecological belt, developed to illustrate existing and projected land resource development, remaining land resource development potential, and high potential aquifer zones, are presented in the Map Volume. The map contents, and the procedures used for their preparation, are described in Section A4-2.2. All map sets have been printed with screened black (grey) base maps and unscreened black (black) overlay maps. Additional overlays for enhancement of information on Map Set C have been printed in colour.

Map Set A (Existing Land Resource Development) presents a picture of existing DOI and FMIS development in the overall land use context. It shows a pattern of increasing irrigation development across the Terai from west to east, generally associated with a corresponding pattern of decreasing non-agricultural (mainly forest) lands.

Map Set B (Projected Land Resource Development) shows these patterns being completely broken in the identified potential future situation, which has large new irrigation developments in both the western and eastern portions of the Terai, and comparatively small scale new developments between these two areas. The projected loss of forest cover is heavy in the Far Western Terai planning unit, moderate in the Mid Western Terai planning unit, and generally light in the Western, Central and Eastern Terai planning units. As noted in Section A4-2.1, many of the identified potential project study reports do not indicate whether or where existing forest and grassland areas within the project area are to be conserved. Where such information was not available, it was assumed for mapping purposes that these areas would be fully developed for irrigation.

Map Set C (Remaining Land Resource Development Potential) at one level conveys the basic information about the interaction between land irrigability and existing and identified potential land use. At another level it presents information on the location, land use characteristics, and possible water supply details of the remaining potential development areas. The first of these levels is discussed here, while the second level is discussed in Sections A4-3.2.2 and A4-3.4.

Land irrigability varies according to land slope, soil type and drainage limitations, with the steeper slopes and coarser (sand and gravel) soils being characteristic of non-irrigable lands. Map Set C demonstrates the normal pattern in the Terai Plains as one in which the non-irrigable lands are confined to a strip of land along the foot of the Siwalik hill range, and to strips along stream and river courses. The extent of these lands in most areas does not have a very significant effect on irrigation development planning. However, in the western portion of the Terai, and most especially in the Far Western Terai planning unit, there is a third type of non irrigable land which is very significant and which will require careful consideration in irrigation development planning, design and construction. These are extensive tracts of undulating or broken land with coarse grained soils located in the middle plains areas. They are currently mostly under forest cover but fall largely within the potential Karnali multipurpose project area. They are areas which should probably be maintained under forest cover; however, they have not been shown in this manner in Map Set B because there was insufficient detail on projected irrigation and drainage canal and block layouts available in the Karnali project study report.

Map Set D (High Potential Aquifer Zones) shows the distribution and extent of the high potential shallow and deep aquifer zones delineated as described in Section A4-2.2.2; a summary of the aquifer zone information is given in Table A4-3. All planning units have areas with high aquifer potential. This should provide good opportunities for the reformulation of identified potential projects which may have surface water limitations rather than irrigable land limitations. By directing surface water supplies to areas without high groundwater development potential, and by encouraging groundwater exploitation within the high potential aquifer zones, it may be possible to serve almost all of the irrigable lands with reliable water supplies.

The overlays of Map Sets B, C and D were superimposed in the final instance to identify the locations and characteristics of the remaining potential development areas. The results of this exercise, which are depicted on Map Set C, are briefly discussed for each map sheet in the following section.

A4-3.2.2 - District-Specific Comments

Comments in the following paragraphs are based on a visual inspection and interpretation of each of the maps presented under Map Set C. Section A4-3.3 provides a quantitative summary of the irrigable areas and their implications for future developments.

Plate 1C covers the Far Western Terai planning unit, incorporating Kanchanpur and Kailali districts. The remaining development potential in Kanchanpur District is quite large. The Royal Suklaphant Wildlife Reserve accounts for a significant portion of this, but there is another large portion in the southeastern part of the district. Surface water supplies for this area may be obtainable from the Mahakali river or from extended Karnali project right bank main and pumped canals (see Section A4-3.4.1). Groundwater should probably be considered as the primary water source for another area in the west of the district, adjacent to the Mahakali river. Some potentially irrigable areas in Kailali District are located to the north of the proposed Karnali project right bank main canal, but overall there is little further development potential in this district.

Plate 2C covers Bardiya and Banke districts in the Mid Western Terai planning unit. In Bardiya District, remaining development potential is largely restricted to the Royal Bardiya Wildlife Reserve located to the north of the proposed Karnali project left bank main canal. Central and eastern Banke District contains some major irrigable forest areas along the West Rapti river. The northern areas might be developed as a pumped extension of the proposed Karnali project left bank system, while the southern areas have good tubewell development potential.

Plate 3C covers Dangdeukhuri District in the Mid Western Terai planning unit. There appears to be little scope for developing the remaining potential in this area, but the Dang valley area in northern Dangdeukhuri District is believed to have some as yet unproven groundwater development potential.

Plate 4C covers Kapilvastu District, Rupandehi District and the Terai Plains portion of western Nawalparasi District in the Western Terai planning unit. There is considerable remaining development potential across the entire area, but availability of adequate water supplies represents a major development constraint. Eastern Kapilvastu District and much of Rupandehi District are underlain by high potential deep and/or shallow aquifers, while shallow tubewell development potential is good in the remaining potential development areas of Nawalparasi District. Surface water supplies could possibly be obtained from a reformulated West Rapti (extended Kapilvastu development) project (see Section A4-3.4.2), from a possible Kali Gandaki diversion to the Tinau river (see Section

A4-3.4.3), and/or from a possible extended Sapt Gandaki/Lumbini Zone project (see Section A4-3.4.4).

Plate 5C covers the Siwalik Valley areas of eastern Nawalparasi District in the Western planning unit and Chitwan District in the Central planning unit. All the irrigable area to the south of the East Rapti river lies within the Royal Chitwan National Park, and the forest corridor to the east of Bharatpur is currently also protected. The possible Sapt Gandaki multipurpose project could provide surface water by gravity to almost all areas, both developed and potential, on both banks of the Narayani river (see Section A4-3.4.4). The Lumbini Zone irrigation project could serve the same area on the right bank.

Plate 6C covers the central portion of the Central Terai planning unit (Parsa, Bara, Rautahat and Sarlahi districts). Parsa District contains large extents of remaining irrigable agricultural and non-agricultural land. The northern part lies mostly within the Parsa Wildlife Reserve; the remainder is underlain by high potential shallow and deep aquifers. Since reliable surface water supplies are unlikely to be generally available in this area, tubewell development should be assigned a high priority here. Bara and Rautahat districts also have large areas of remaining irrigable land, most of which is under forest cover. Tubewell development potential is also high in much of this area, but it is not clear whether present forest conservation policies would permit these areas to be released for irrigation development. The remaining irrigable lands in Sarlahi District may be amenable to development by pumping from the potential Bagmati multipurpose project left bank main canal.

Plate 7C covers Mahottari and Dhanusha districts in the Central Terai planning unit, and Siraha and Saptari districts in the Eastern Terai planning unit. In all four districts, remaining development potential is concentrated to the north of the proposed Sun Kosi - Kamala development, where there are no high potential aquifers. The only likely development mode in these areas is small pumping schemes drawing from the main canals of the Sun Kosi-Kamala development. The principal exception is a small amount of tubewell potential in eastern Saptari District.

Plate 8C covers the remaining three districts of the Eastern Terai planning unit - Sunsari, Morang and Jhapa. Although Table A4-2 indicates that a large extent of irrigable land should be available for further development in Sunsari District, Plate 8C shows only a small extent located in the northern portion of the district. This inconsistency probably arises primarily from the relatively low ratio of net to mapped area for the Sunsari-Morang project (only 0.63 compared to 0.80 for many projects). High potential deep and shallow aquifers underlie the area, so much of the remaining available area should be amenable to development. In Morang District, shallow tubewell potential could be exploited in a large

area of irrigable agricultural land to the southeast; there is little such potential for developing the irrigable forest area to the north. The possible Kosi High Dam multipurpose project could provide reliable year round surface water supplies by gravity to almost all development areas in both Sunsari and Morang districts (see Section A4-3.4.5). Jhapa District has little remaining irrigation development potential.

The suggestions described above, regarding potential water sources for the remaining potential development areas, have been provided in the form of notes and possible new project boundaries on Map Set C, and in the form of quantitatives estimates as described in Section A4-4. Tubewell development potential has been suggested based on the superposition of Map Set D overlays, and potential extensions of identified potential surface water projects have been identified based on the superposition of Map Set B overlays. Outlines of possible new large Terai projects were derived as discussed in Section A4-2.4; further details of these projects are given in Section A4-3.4. The indications relating to surface water projects must be considered as tentative only, since they do not consider possible physical or economic limitations.

In examining Map Set C, it will be noted that some small areas adjacent to large project canals have been identified as having potential for development. It is normally preferable that small irrigable areas located close to the main canals of a new project be planned for ultimate inclusion in the project. If such areas are ignored at the planning stage, no allowance is made for their water requirements and no physical provision is made for water supply, then unauthorized water taking is likely to occur. This will probably be detrimental to the functioning of the overall project. Small irrigable areas located within gravity command can be served by special outlets, preferably supplied from a separate secondary canal that runs parallel to the main canal. Small areas located above gravity command can be supplied with water from small farmer-operated pump sets. In such cases, providing simple pump sumps and conduits to accommodate pump discharge lines at appropriate locations should be sufficient to ensure that farmer-operated pumping does not interfere with canal operations.

A4-3.3 - Mapped Area Measurements and Findings

The quantification for Terai districts of current land use within the irrigable potential development areas, based on mapped area measurements, was undertaken as outlined in Section A4-2.3. Results are given in Tables A4-4 and A4-5 and are discussed in the following two subsections .

A4-3.3.1 - Equivalent Area Comparisons

Table A4-4 shows the results of the first phase reconciliation between tabular and mapped information, in which equivalent mapped area values were compared. Differences are expressed as percentages of the tabular database values. It is noted that small absolute area differences can lead to large percentage differences in the cases where the land areas themselves are small. In assessing the results, therefore, attention is placed on the larger, dominant areas within each Terai district, which are

- the total district land area
- the Terai Plain and Hill Valley portion of the district, which is a subset of the total district land area
- the irrigable portion of the plains and valleys, which is a subset of the total Terai Plain and Hill Valley portion of the district.

Of these areas, only the first can be considered as truly equivalent between database and map, so that differences are attributable solely to errors in depiction or recording of areas. Table A4-4 shows that good compatibility (less than 6% difference) has been achieved in total district areas, with one exception. The major discrepancy in the case of Banke District has been traced to the LRMP maps and database, in which over 30 km of the upper Babai river valley to the north have been incorrectly included within the district. The present mapping work has used the correct district boundary, excluding the Babai river valley.

In the case of the plain and valley portions of the districts, it must be noted that the mapping work depicts only the Terai Plains and Siwalik Valleys, whereas the database values include all the Hill Valley areas. However, for the Terai districts, this discrepancy is insignificant, and Table A4-4 shows in fact that very good compatibility between tabular and map values has been achieved. The principal exception was Banke District, where Siwalik Valley areas along the Babai river contributed to the discrepancy shown in Table A4-4.

The definition of irrigable plain and valley areas is also not directly equivalent between database and map. Mapped irrigable areas correspond directly to LRMP irrigability classes 1, 1R, 2 and 2R, whereas the tabulated values can include additional areas based on the land use assessments described and applied in Annexes A1 and A2. However, these adjustments for Terai districts were small in percentage terms and in any case were applicable to only 3 Terai districts (see Annex A2, Table A2-3).

The differences between tabulated and mapped irrigable areas shown in Table A4-4 cannot in general be attributed to the minor definition aspect discussed above. Although the comparison differences are greater (up to 11 percent) than those for the other comparisons, they can still be considered as generally acceptable, so that a meaningful reconciliation between mapped and tabulated irrigable areas can be achieved. However, it must be assumed in this case that the accuracy of mapping and measurement is noticeably reduced for the non-irrigable lands, due to their small, broken and scattered nature. By extension, a similar comment would apply to the mapping and measurement of land use areas.

A4-3.3.2 - Irrigable Area Land Use Breakdown

Table A4-5 presents the results of the second phase of the reconciliation, in which district-level estimates of the current land use of Terai Plain and Siwalik Valley irrigable areas have been obtained, both within existing and identified potential development areas (Section A of Table A4-5) and within remaining potential development areas (Section B of Table A4-5). Within these two development status categories, a quantified current irrigable land use breakdown into non-agricultural reserve, other non-agricultural (mainly forest) and agricultural components has been provided. The breakdown is also given for the district as a whole (Section C of Table A4-5).

The total mapped irrigable areas shown in Section C of Table A4-5 are directly comparable to those shown in Table A4-4; the total net irrigable areas derived from these mapped areas are comparable to the corresponding values tabulated in Table A4-2. As expected from the results of Table A4-4, the comparison of net irrigable areas shows close agreement for most districts, with the maximum difference of 11 percent observed in Parsa District. This indicates that any major differences between map-derived and tabular data in Sections A and B of the table are due to the manner in which the command areas of existing or potential projects are delineated on the maps.

Section A of Table A4-5 shows close agreement in most districts between map-derived and tabular data for existing and potential projects. For districts showing close agreement (difference under 10 percent), it can be concluded that existing and potential projects are delineated on the maps correctly. It can also be concluded that the assumptions regarding use of irrigable land (ratio between NCA and mapped area, accounting for loss of irrigable land to physical infrastructure) that were inherent in the compilation of the tabular data were consistent with the situation shown on the maps. For districts exhibiting major discrepancies, the following observations apply :

Sunsari - about 9,000 ha (net) more irrigable area than expected is incorporated into mapped existing and potential project areas. This is due to the delineation of the Sunsari-Morang project and existing FMIS - more irrigable area is mapped than would be expected from the tabulated NCA's.

Dhanusha - about 12,000 ha (net) more irrigable area than expected is incorporated into mapped existing and potential project areas. This is primarily due to delineation of the Kamala project's command area - more irrigable area is mapped than would be expected from the declared NCA of 25,000 ha.

Chitwan - about 11,000 ha (net) more than expected is incorporated into mapped existing and potential project areas. This appears to be due to inaccurate mapping of existing FMIS in the Water Use Inventory.

Rupandehi - about 28,000 ha (net) less area has been mapped under existing projects than has been tabulated. This appears to arise primarily from the Water Use Inventory - not all existing FMIS have been mapped, and NCA's of existing FMIS have been over-estimated in the tabular data presented in the WUI.

Dangdeukhuri - About 8,000 ha (net) more areas has been mapped under existing projects than has been tabulated. This is probably due to the difficulty of accurately mapping and measuring the scattered projects in this district.

Kailali - about 9,000 ha (net) more area has been mapped under existing plus potential projects than has been tabulated. This is primarily due to the manner in which the Kailali (right bank) portion of the proposed Karnali Multipurpose is delineated on the map. More irrigable area than expected has been consumed, but this could have been due to allocation of some irrigable forested lands to forest reserves. This was not shown on the map.

Kanchanpur - about 10,000 ha (net) less area has been mapped under existing projects than has been tabulated. This is probably due to groundwater development that has been recorded since the air photos were taken in 1979 (7,000 ha recorded), and to unmapped potential small projects (2,000 ha).

Section B of Table A4-5 shows close agreement overall between map-derived and tabulated data, but large discrepancies for several districts illustrate the problems associated with subtracting large numbers in the case of the tabular data, or the effects of delineation of existing and potential projects noted above. Major district discrepancies (over 15 percent and over 10,000 ha) are as follows :

Sunsari - 16,000 ha - this discrepancy arises from total mapped irrigable area being 7,000 ha less than tabulated data (see Section C), and the 9,000 ha discrepancy in Section A of the table as noted above.

Dhanusha - 13,000 ha - this discrepancy arises directly from the manner in which the Kamala project's boundaries have been established, as noted above.

Chitwan - 10,000 ha - this discrepancy arises directly from inaccurate mapping of existing FMIS, as noted above.

Rupandehi - 29,000 ha - this discrepancy arises directly from the over-estimation of NCA's of existing FMIS, as noted above.

Kapilvastu - 12,000 ha - this discrepancy arises from a combination of total map-derived irrigable area being less than tabulated irrigable area by 5,000 ha (see Section C), and a 7,000 ha discrepancy in Section A of the table.

Dangdeukhuri - 12,000 ha - this discrepancy arises from a combination of total map derived irrigable area being less than tabulated irrigable area by 4,000 ha (see Section C), and the 8,000 ha discrepancy in Section A of the table, as noted above.

Kailali - 22,000 ha - this discrepancy arises primarily from the delineation of the Karnali project area described earlier (9,000 ha). In addition, the map-derived total irrigable area was less than the equivalent tabulated area by 13,000 ha.

Kanchanpur - 11,000 ha - this discrepancy arises directly from the lack of map identification of existing groundwater developments and small potential projects, as noted above.

Recognizing the reasons for the major discrepancies in Table A4-5 allowed the tabular and mapped data to be used together in Section A4-4 to assess overall irrigation potential in the Terai districts*. This was achieved by combining information on existing and identified potential projects with information on remaining development potential, as described in Section A4-4.

A4-3.4 - Overview of Five Possible New Large Terai Projects

In Section A4-3.2.2, and on Map Set C of the Map Volume, indications have been given with regard to options for development of the remaining irrigation potential in the Terai belt. Among these options are five possible large scale surface water schemes, not yet fully identified, for which tentative development concepts have been formulated. Section A4-2.4 outlines the approach used in these tentative formulations, and the present section provides some further details of the possible projects. As indicated in Section A4-2.4, the level of detail is preliminary; more comprehensive reconnaissance level work would be required in many cases before proceeding with prefeasibility studies. It is also noted that these project formulations are derived from technical considerations and relate only to potential irrigation development in Nepal.

A4-3.4.1 - Kanchanpur Irrigation Project

The Tanakpur barrage, currently under construction by the Government of India, is located 7 km upstream from the Sarda barrage on the Mahakali river. It would be possible to offtake from the barrage a left (east) bank gravity canal, which would traverse northern Kanchanpur District from west to east and bring much of the irrigable land in the district under command for irrigation. The command water level at the barrage would be about 246 m above datum. The possibility of constructing this canal and the irrigation development that could result are to be investigated under the program of studies for the proposed Pancheswar multipurpose project.

The presence of the Royal Suklaphant Wildlife Reserve in the west of the district would restrict development below the upper reaches of the canal, while the principal development area in the southeast of the district would be served from the lower end of the canal. This implies a comparatively high cost of conveyance works (long supply canals) to gain benefits from a major irrigation area at the tail of the system.

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* The analysis of discrepancies allowed the most reliable data to be used in estimating the irrigable areas that are likely to be available for development.

An alternative approach to development of the larger and less scattered irrigable areas in the southeast of the district may be to incorporate them into an expanded Karnali multipurpose (irrigation) project, based on an extension of the main right (west) bank gravity canal across the Mohana river. The command water level in the main canal at the Mohana river would be about 182 m above datum. It may also be feasible to consider a similar extension to the western pumped canal (command level about 197 m above datum), to command the smaller higher level irrigable areas.

The tentative main canal alignments for these two possible developments, representing the upper command area boundaries, are shown on Plate 1C of the Map Volume. Given the large flows of both the Mahakali and Karnali rivers, the maximum possible project area would be determined by land and not water availability considerations. The net irrigable areas that could be commanded by the two alternative canal concepts outlined above* would be as follows :

	Gravity Supply from Mahakali	Gravity Supply from Karnali
Mapped Areas (ha)		
Irrigable agricultural	21,900	12,000
Irrigable non-agricultural	25,100	8,500
Total Irrigable	47,000	20,500
Net Areas (ha)		
Irrigable agricultural	17,500	9,600
Irrigable non-agricultural	20,100	6,800
Total Irrigable	37,600	16,400

Given the configuration of the potential project area, especially the limitations imposed by the location of the Royal Suklaphant Wildlife Reserve, the practical upper limit on the NCA of the development is about 30,000 ha.

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* The areas shown exclude the Mahakali irrigation project (Stage I & Stage II NCA of 11,800 ha), and irrigable lands within the Royal Suklaphant Wildlife Reserve.

Recognizing the reasons for the major discrepancies in Table A4-5 allowed the tabular and mapped data to be used together in Section A4-4 to assess overall irrigation potential in the Terai districts*. This was achieved by combining information on existing and identified potential projects with information on remaining development potential, as described in Section A4-4.

A4-3.4 - Overview of Five Possible New Large Terai Projects

In Section A4-3.2.2, and on Map Set C of the Map Volume, indications have been given with regard to options for development of the remaining irrigation potential in the Terai belt. Among these options are five possible large scale surface water schemes, not yet fully identified, for which tentative development concepts have been formulated. Section A4-2.4 outlines the approach used in these tentative formulations, and the present section provides some further details of the possible projects. As indicated in Section A4-2.4, the level of detail is preliminary; more comprehensive reconnaissance level work would be required in many cases before proceeding with prefeasibility studies. It is also noted that these project formulations are derived from technical considerations and relate only to potential irrigation development in Nepal.

A4-3.4.1 - Kanchanpur Irrigation Project

The Tanakpur barrage, currently under construction by the Government of India, is located 7 km upstream from the Sarda barrage on the Mahakali river. It would be possible to offtake from the barrage a left (east) bank gravity canal, which would traverse northern Kanchanpur District from west to east and bring much of the irrigable land in the district under command for irrigation. The command water level at the barrage would be about 246 m above datum. The possibility of constructing this canal and the irrigation development that could result are to be investigated under the program of studies for the proposed Pancheswar multipurpose project.

The presence of the Royal Suklaphant Wildlife Reserve in the west of the district would restrict development below the upper reaches of the canal, while the principal development area in the south-east of the district would be served from the lower end of the canal. This implies a comparatively high cost of conveyance works (long supply canals) to gain benefits from a major irrigation area at the tail of the system.

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* The analysis of discrepancies allowed the most reliable data to be used in estimating the irrigable areas that are likely to be available for development.

A4-3.4.2 - West Rapti Multipurpose Project (Extended Kapilvastu Development)

The West Rapti multipurpose project, as formally identified and as described in Annex A3, would comprise irrigation areas in Banke District (the Sikta irrigation project), in the Deukhuri Valley area, and in Kapilvastu District. However, Master Plan studies (see Annex D3) have indicated that the Sikta project may be better developed as part of a reformulated Bheri-Babai multipurpose project. This would then provide the possibility of an extended (larger than the previously proposed 30,500 ha development) Kapilvastu District development, based on an increased diversion flow from the West Rapti river. This development could provide irrigation water to areas for which no other development options are currently apparent. It could also provide supplementary irrigation supplies to the Banganga project if needed.

The project's extended main canal would traverse the district from west to east and could cross the Banganga river. The command water level at the head of the main canal, below the tunnel diversion, would be about 196 m above datum, but at the head of the extended main canal it would be about 122 m above datum. This drop in level is as envisaged in the identified project study report, and is provided to avoid crossing difficult and unproductive terrain.

The tentative main canal alignment for the possible project, representing the upper command area limit, is shown on Plate 4C of the Map Volume. The project area would actually be limited by water rather than land availability. From the methodology and assumptions of Annex D2, a constant diversion flow of 60 m^3/s from the West Rapti river to Kapilvastu District can be contemplated, leading to a total year round reliably irrigable area of about 55,000 ha. These values correspond to an operational priority given to irrigation, and would yield an increase of 24,500 ha beyond the previously proposed 30,500 ha development. Operating the Naumouri dam with priority given to power generation at the dam would allow a diversion flow of 57 m^3/s and a development area of 52,300 ha. The diversion itself would, in either case, also have an associated hydropower station. The development areas indicated above are less than the physically commandable irrigable area, because water availability would limit the size of the irrigation development.

A4-3.4.3 - Kali Gandaki Diversion Project

A previously proposed concept involving a diversion of flow from the Kali Gandaki river to the Tinau river, for subsequent withdrawal for irrigation of Terai areas in Rupandehi and Nawalparasi districts, was examined as part of the Master Plan studies. The favoured diversion site (near Ramdi village) would give a diversion tunnel length of about 20 km, but this site lies upstream from the potential Kali Gandaki No. 1 hydroelectric project power station tailrace. The same tailrace site is being used by the Andhi Khola power project, which is now under construction. It therefore appears prudent for planning purposes to assume a diversion site just downstream of the tailrace site (near Asardi village); this would result in a diversion tunnel length of at least 25 km.

The diversion tunnel could emerge at the confluence of the Tinau and Jhumsa rivers, where the bed level is about 335 m above datum. There would be no significant drop in level between tunnel entrance and exit in this case, so that a diversion hydropower station would not be contemplated. However, between this point and Butwal, also on the Tinau river about 10 km downstream, there is a total drop of about 200 m. The withdrawal of water for irrigation would be from the river at or near Butwal, using a command water level of about 137 m above datum.

The Tinau river reach above Butwal offers potential for both storage and hydropower developments, but quantification of this potential has not been attempted for the Master Plan. It may be feasible to obtain power benefits by extending the diversion tunnel to exploit the drop in level. Alternatively, refurbishing, expanding or replacing the existing Butwal Power Company facility, to benefit from the very substantial increase in firm flow, may prove feasible. This facility is located in the gorge about 3 km upstream from Butwal; a storage dam may also be feasible at this site.

At Butwal, a barrage and head regulators to serve main gravity canals on both banks of the river could be constructed. However, some major irrigation benefits could also be realized by leaving at least part of the diverted flow in the Tinau river for use downstream, to improve water availability to the Marchwar Lift project and to develop adjacent irrigable areas which have no identified water source at present. Many other parts of the possible project command area have good groundwater development potential; the Bhairawa-Lumbini groundwater project is in this area.

The Kali Gandaki diversion project area could extend west into Kapilvastu District, overlapping with the possible extended Kapilvastu development of the West Rapti multipurpose project (see Section A4-3.4.2). It must also be noted that an extended Sapt Gandaki project or the Lumbini Zone irrigation project (see Section

A4-3.4.4) would overlap with some or all of the Kali Gandaki project area. Each project has several different possible development concepts which would require substantial study before selecting the most favourable ones.

For present purposes, the Kali Gandaki diversion project is tentatively formulated as a simple run-of-river project which would divert flows from an unregulated Kali Gandaki river. The project would have no storage on the Tinau river, but it would provide reliable year round irrigation to its command area. Using the methodology of Annex D2, with approximate estimations of reliable flows at the diversion site, it was deduced that a maximum diversion of 44 m^3/s, corresponding to the Kali Gandaki's 90% reliable monthly flow in March, would reliably serve a command area of 40,000 ha for Year-round irrigation. In proposing this diversion flow, it is assumed that there are no significant downstream users in the Kali Gandaki basin, and that the loss of flow will not significantly affect downstream Narayani (Sapt Gandaki) river users.

The upper limits on the command area of the possible project are shown on Plate 4C of the Map Volume; they are assumed at present to be confined to Rupandehi District. Command over all of the Terai portion of Nawalparasi District would also be physically possible. However, the actual extent of the project would be determined by water and not land availability, as noted above, so that the irrigable area that could physically be commanded exceeds the 40,000 ha figure derived on the basis of water availability.

A4-3.4.4 - Sapt Gandaki Multipurpose Project

The development concepts for a possible Sapt Gandaki multipurpose project arise from a previously formulated possible run-of-river hydroelectric power project. The project would be located on the Narayani (Sapt Gandaki) river below the confluence of the Kali Gandaki and Trisuli rivers, at the point of emergence of the river into the Siwalik Valley of Chitwan and Nawalparasi districts. The proposed dam at this location would provide an operating level of 230 m above datum.

With a command water level of 230 m above datum, most of the irrigable land in the valley on both sides of the river could be served for irrigation by gravity; this includes the existing Chitwan project on the left (east) bank area, which is now served in part by pumping from the Narayani river downstream. On the same bank, it would be possible to consider provision of supplementary water supplies, if needed, to the proposed East Rapti project. On the right (west) bank, existing FMIS and undeveloped irrigable areas could be served.

A principal difficulty in formulating this possible project will be the interaction between power and irrigation interests. The power-dominated scheme envisages an installed capacity commensurate with the instream use of 300 m^3/s. This exceeds the 90% reliable flows in the river during the period from January to April (see Annex D2). If irrigation headworks are located at the dam, and if the irrigation project is entitled to withdraw only from the incremental river flows above 300 m^3/s, then the project could support only monsoon season cropping. It is possible to envisage removal of this restriction by siting irrigation headworks below the dam. This would reduce the command water level to about 184 m above datum, thus reducing the commandable area, and may require another river control structure or other works to ensure reliable withdrawals. This option would not appear to be very attractive.

To obtain a reliable year round supply for the irrigation project based on shared headworks, a reduction in scope of the power project would be required. A careful study of the irrigation project requirements will be required to assess alternative development options. The study should cover the entire Siwalik Valley area but should examine all options with regard to supplementing or superceding existing projects. For example, the Chitwan project lift pump scheme may warrant incorporation into the gravity scheme for monsoon season irrigation only, with the pump scheme operating during winter and spring seasons; this could give considerable operational benefits, due to reduced sediment handling problems and energy savings. The study would determine the required level of withdrawals to complete a fully integrated development of the valley for reliable Year-round irrigation. The remaining available instream flows for power generation purposes would then be determined and the multipurpose project's irrigation and power benefits evaluated.

The main canal alignments of the possible Sapt Gandaki project, representing its upper command area limits, are shown on Plate 5C of the Map Volume. Because of the large flows of the Narayani river, the project is considered to be limited by land rather than water availability. On the left bank, up to 8,800 ha (NCA) of existing DOI schemes could be served, along with up to 8,800 ha (NCA) of irrigable agricultural land, most of which is under rainfed cultivation at present*. On the right bank, up to 15,800 ha (NCA) of irrigable land could be served within the Siwalik Valley portion of Nawalparasi District.

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* The proposed East Rapti irrigation project (NCA = 9,500 ha) could also receive supplementary water supplies.

It is expected that the multipurpose project as formulated above will not in fact result in a very marked reduction in power generating potential; the reduction might be in the range of 10 to 20 percent. However, an alternative development concept was examined for the Master Plan studies, involving an extension of the right (west) bank main canal through the Siwalik hills in a 4 km tunnel to the Terai Plains. From this point, with a command water level of about 152 m above datum, the project could extend to cover the large Terai Plain portions of Nawalparasi and Rupandehi districts, and possibly even further to the west*. A more practical formulation would probably limit it to Nawalparasi District; this area could also be commanded by the possible Kali Gandaki diversion project (see Section A4-3.4.3), but water availability limitations on that project could preclude this.

With the extended Sapt Gandaki project, the drop in system water level through the Siwalik hills would permit an associated hydropower development, but the additional water withdrawal requirements would further reduce the project's power generation component at the Narayani dam. The project may, therefore, need to be evaluated as an irrigation-dominated project. In addition, although the project may continue to be viewed as restricted by land rather than water availability, it will probably be necessary to quantify the effects of withdrawals on water availability for existing downstream developments.

At the time of writing of the present annex, DOI's Feasibility Studies section was conducting further investigations into the potential for diverting large flows from the Narayani into the western Terai area. This potential development, referred to as the Lumbini Zone irrigation project, would use an inundation-type intake (no barrage would be required) near the confluence of the Kali Gandaki and Trisuli rivers. The canal would follow a similar alignment as that shown on Plate 4C for the Sapt Gandaki multipurpose project, and could potentially command the same extent of irrigable land. The present thinking within DOI is to limit the NCA irrigated to under 100,000 ha.

Four alternative development concepts to use Narayani basin waters for major irrigation developments have been outlined in this section and in Section A4-3.4.3 :

- the Kali Gandaki diversion (NCA up to 40,000 ha)
- the smaller Sapt Gandaki multipurpose project (NCA up to 33,000 ha)

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* Alternatively, the Terai plains area could be commanded by pumping from the Gandak Barrage head pond.

- the larger Sapt Gandaki multipurpose project (NCA up to 100,000 ha)

- Lumbini Zone irrigation project (NCA up to 100,000 ha)

If any of these developments are to be considered seriously, basin studies will be needed to examine power and irrigation benefits, and the needs of existing downstream irrigation users.

A4-3.4.5 - Kosi High Dam Multipurpose Project

The possible Kosi High Dam multipurpose project was proposed in previous studies and would include a high dam and a reregulating dam* on the Sapt Kosi river near Barahchhetra and Chatraghat respectively. The reregulating dam, which would probably be located about 3 km upstream from the existing Sunsari-Morang project's Chatra canal intake, would have an operating water level of about 152 m above datum. From here, a left (east) bank main gravity canal could extend from west to east across the northern part of Sunsari and Morang districts, commanding a large portion of the irrigable land area in these districts and providing supplies for year round irrigation.

The only major tract of undeveloped irrigable land area which would be served by this project is located in southeastern Morang District, in what would be the tail end of the project system. However, the project could also represent a means of overcoming the severe underutilization problems of the existing Sunsari-Morang project. This could be effected by a carefully planned integration of the two projects, or by completely superceding part or all of the existing project's water withdrawal and main canal systems. The project would also supplement or supercede the many FMIS in the areas to the north of the Sunsari-Morang project; the proposed Eastern Terai irrigation project area also falls within the possible command area.

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* a reregulating dam is presumed to be necessary to provide a uniform flow pattern to permit irrigation withdrawals by existing downstream irrigation developments. The underlying assumption is that Kosi High Dam peaking operations would not be compatible with existing downstream irrigation operations, thus necessitating the provision of a reregulating structure that is chargeable to the hydropower development.

The tentative main canal alignment of the possible project, which also represents the upper command area limit, is shown on Plate 8C of the Map Volume. Given the large perennial flows in the Sapt Kosi river, the project is viewed as limited by land and not water availability. The incremental irrigable area that could be served by the canal is estimated to be 57,000 ha (NCA) located to the north of the Chatra main canal in Sunsari and Morang districts. Most of this area has already been developed for farmer managed irrigation - only about 10,000 ha is now under rainfed cultivation or forest cover.

A4-3.5 - Irrigation Development Assessments for Three Hill Districts

The assessment of irrigation development potential in three sample Hill districts - Kabhre, Palpa and Surkhet - was undertaken using the methodology described in Section A4-2.5. The results of the assessments are presented separately for each district in Appendixes A4-1, A4-2 and A4-3, while the general conclusions are discussed in this section.

Although the three sample districts are each located in a different development region, they exhibit some similar irrigation development characteristics. The Hill Valleys, which are the principal areas for irrigated agriculture, represent only a small percentage of the total land area and are quite scattered. Identified existing irrigation schemes within these valleys cover about half the corresponding irrigable land area, although this percentage figure increases if unidentified irrigation area estimates are added to the identified areas. The principal rivers are deeply incised, and are therefore not extensively used as water sources for irrigation.

Notwithstanding the observed similarities, significant differences among the districts are also apparent; these are primarily associated with location. Kabhre District, which is located in the Central Development Region and also close to Kathmandu, has a high existing level of development (79% of total irrigable land area, if estimated unidentified irrigation areas are included). It also has a high incidence of water surplus basins. Surkhet District, which is located in the Mid Western Development Region, is currently less developed and has a high incidence of water-deficit basins. Palpa District, which is located in the Western Development Region, appears to fall between these two extremes.

To obtain an indication of district-level net ultimate irrigation development potential, based on both land and water constraints within those subsidiary basins which were assessed, the following criteria were applied.

a) Total net irrigable areas (from Annex A2 Table A2-3) were taken to represent the maximum available land resource.

b) The existing situation was taken as represented by the identified irrigation scheme areas (from Annex A1, Table A1-7).

c) The remaining potential expansion areas were taken as those corresponding to the assessed basins (from Appendixes A4.1 to A4.3); the non-assessed basins were assumed to have no remaining expansion potential.

This results in the following estimate of ultimate irrigation development potential, expressed as "net" areas, in each district:

	Assessed District			Three District Total	Hill and Mountain District Totals
	Kabhre	Palpa	Surkhet		
Total Irrigable Area (ha)	7,958	8,857	19,275	36,090	434,787
Existing Irrigation Area (ha)	3,235	3,367	9,862	16,464	208,274
Undeveloped Irrigable Area (ha)	4,723	5,490	9,413	19,626	226,513
Estimated Additional Irrigation Potential (ha)					
- Year Round	1,703	1,113	1,760	4,576	
- Monsoon (Includes Year Round area)	2,714	1,355	3,007	7,076	
Estimated Ultimate Irrigation Area (ha) (Existing & Additional Monsoon)	5,949	4,722	12,869	23,540	
Proportion of Total Irrigable Area (%)	75	53	67	65	

The results obtained for Kabhre and Surkhet districts can be accepted with some confidence, although discussions with district office staff and field observations indicated that some of the water availability estimates were likely to be optimistic. Thus the estimates of ultimate irrigation potential for these districts may be biased on the high side. Conversely, the estimate of ultimate irrigation potential for Palpa District may be biased on the low side, due to the assumption that the Tinau basin is a water deficit basin. This assumption was adopted because downstream (Terai) users of the Tinau river are known to experience water shortages, and they would be adversely affected by expansion of irrigation in the upper basin. However, there may be feasible alternative water sources in the Terai (groundwater or transbasin diversions), whereas there are none in the case of the hills.

Notwithstanding the potential for bias in the results, the weighted average results from the three districts are proposed as a basis for estimating the ultimate irrigation potential of the Hill and Mountain districts. The three assessed districts represent 8 percent of the total irrigated and irrigable land area in these districts, and they cover a representative range of topographic and water availability conditions. Using the overall figures of the above table indicates that about 65 percent of the total irrigable area in the Hill and Mountain districts could ultimately be brought under irrigation. Applying this figure to the total estimated irrigable area in these districts of 435,000 ha yields an estimated ultimate irrigation area of 280,000 ha. This represents an increase of 35 percent over the present area under irrigation, or development of 33 percent of the remaining irrigable area.

Each of the three reported assessments of irrigation development potential represent a useful step in broad-based irrigation development planning in the assessed district. Appendixes A4-1, A4-2 and A4-3 provide district-specific recommendations on the further steps required to complete the district-level planning process to the stage that all feasible projects to irrigate available irrigable lands have been identified.

A4-4 - ESTIMATED ULTIMATE IRRIGATION POTENTIAL

The net irrigable agricultural area in the Hill and Mountain districts, as summarized in Table A2-3, is estimated to be 435,000 ha; about 210,000 ha or 48 percent of the area has been developed to date. Water availability, topographic limitations and technical and economic factors will prevent full development of the remaining 225,000 ha. Based on the analyses of the three representative Hill districts summarized in Section A4-3.5, it is estimated that about 75,000 ha of the remaining 225,000 could be developed for irrigation, indicating an upper limit of 280,000 ha on irrigation development in the Hill and Mountain districts. This level of development would entail a 35 percent increase over the present level of development, and would represent development of 65 percent of all irrigable lands.

Table A4-6 presents a rationale for estimating the upper limit on irrigation development in the Terai districts. Six steps were followed in preparing this table :

a) Net irrigable land resource data were taken from Annex A2 (as in Table A4-2) and tabulated in Columns 1, 2, and 3.

b) Existing irrigation project area data (including ongoing projects) were taken from Annex A1 (as in Table A4-2) and tabulated in Column 4.

c) Identified project area data were taken from Annex A3 (as in Table A4-2) and tabulated in Column 5. If all of these projects are implemented, the irrigation "coverage" depicted in Plates 1B to 8B would be achieved, leaving the "remaining development areas" highlighted on Plates 1C to 8C to be developed for irrigation, if possible.

d) Data on land areas in the "remaining development area" category were assembled from Section B of Table A4-5, and tabulated in Columns 7, 8, 9 and 10. Mapped area data were taken from the table and directly converted to "net" areas, except where the area reconciliation discussed in Section A4-3.3.2 indicated significant discrepancies. In such cases, the tabulated data served as a guide to estimate the distribution of land use. Where necessary, adjustments were made to ensure that the sum of existing and potential development areas did not exceed the total irrigable land area in the district.

e) The potential for irrigating the total remaining development area (Column 10) was estimated by postulating two possible development modes :

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e) The potential for irrigating the total remaining development area (Column 10) was estimated by postulating two possible development modes :

- identified large projects - Column 11 - these are the five potential projects discussed in Section A4-3.4. It was assumed that opportunities for developing further surface projects in the Terai would be minor, given the generally water short status of the "remaining development area".

- groundwater development - Column 12 - data presented in Annex D4, together with assessments of the coincidence of irrigable land and high potential aquifer zones, were used to estimate additional groundwater potential*.

f) The summation presented in Column 14 represents the estimated upper limit on irrigation development in each district. This figure can be compared with irrigable area and present irrigation data in columns 1,2 3, and 4 to assess the postulated increase in irrigation development, and the proportional development represented.

The assessment presented in Table A4-6 indicates that developing all previously identified projects, plus the five additional projects described in Section A4-3.4, would yield a total net irrigated area in the Terai of about 1,220,000 ha. Adding the estimated additional groundwater development area of 110,000 ha would yield a total Terai NCA of 1,340,000 ha. Combining this with the figure of 280,000 ha estimated for the Hill and Mountain districts yields a figure of 1,620,000 ha for Nepal as a whole. This represents 73 percent of the total net irrigable area of 2.2 million hectares estimated for the country, and an increase of 73 percent above the present net irrigated area of 934,000 ha.

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* this does not represent total groundwater development potential, as some of the areas designated as identified surface projects in Plates 1B to 8B may, in fact, be developed for some form -- full use or conjunctive use-- of groundwater irrigation.

IRRIGABLE AREA DEVELOPMENT POTENTIAL - HILL AND MOUNTAIN DISTRICTS

District	Net Areas (ha)									
	Irrigable		Existing Projects			Current Devel. Potential		Ident. Pot. Proj.	Remaining Devel. Potential	
	Total (1)	Developed (2)	Ongoing (3)	Total (4)	Proportion (5)	Total (6)	Proportion (7)	(Incr.) (8)	Total (9)	Proportion (10)
EASTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT										
Ilam	13845	6191	0	6191	0.45	7654	0.55	1775	5879	0.42
Panchthar	7241	3518	0	3518	0.49	3722	0.51	346	3376	0.47
Terhathum	6455	3052	0	3052	0.47	3403	0.53	1718	1685	0.26
Dhankuta	7495	3642	0	3642	0.49	3853	0.51	826	3027	0.40
Bhojpur	7311	3314	0	3314	0.45	3997	0.55	788	3209	0.44
Udayapur *	21239	10647	283	10930	0.51	10309	0.49	120	10189	0.48
Khotang	9469	4304	0	4304	0.45	5165	0.55	250	4915	0.52
Okhaldhunga	4478	2176	0	2176	0.49	2302	0.51	160	2142	0.48
TOTAL FOR EASTERN HILL DISTRICTS	77533	36844	283	37127	0.48	40406	0.52	5983	34423	0.44
EASTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT										
Taplejung	7443	3617	0	3617	0.49	3826	0.51	0	3826	0.51
Sankhuwasawa	5279	2512	0	2512	0.48	2767	0.52	300	2467	0.47
Solukhumbu	2038	990	0	990	0.49	1048	0.51	0	1048	0.51
TOTAL FOR EASTERN MOUNTAIN DISTRICTS	14760	7119	0	7119	0.48	7641	0.52	300	7341	0.50
CENTRAL DEVELOPMENT REGION - HILL ECOLOGICAL BELT										
Sindhuli *	20652	9360	0	9360	0.45	11292	0.55	1292	10000	0.48
Ramechhap	4248	2064	0	2064	0.49	2184	0.51	249	1935	0.46
Makawanpur	23502	11419	0	11419	0.49	12083	0.51	350	11733	0.50
Kabhre Palanchowk *	7958	3235	0	3235	0.41	4723	0.59	227	4496	0.56
Lalitpur *	7425	3873	0	3873	0.52	3552	0.48	0	3552	0.48
Bhaktapur *	6274	2295	0	2295	0.37	3979	0.63	310	3669	0.58
Kathmandu	14069	6836	0	6836	0.49	7233	0.51	0	7233	0.51
Nuwakot	15047	7311	0	7311	0.49	7736	0.51	1915	5821	0.39
Dhading	10839	5267	0	5267	0.49	5572	0.51	285	5287	0.49
TOTAL FOR CENTRAL HILL DISTRICTS	110014	51660	0	51660	0.47	58354	0.53	4628	53726	0.49
CENTRAL DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT										
Dolakha	4949	2386	0	2386	0.48	2563	0.52	280	2283	0.46
Sindhupalchowk	12276	5965	0	5965	0.49	6311	0.51	410	5901	0.48
Rasuwa	919	406	0	406	0.44	513	0.56	0	513	0.56
TOTAL FOR CENTRAL MOUNTAIN DISTRICTS	18144	8757	0	8757	0.48	9387	0.52	690	8697	0.48

IRRIGABLE AREA DEVELOPMENT POTENTIAL - HILL AND MOUNTAIN DISTRICTS

District	Net Areas (ha)									
	Irrigable		Existing Projects			Current Devel. Potential		Ident. Pot. Proj.	Remaining Devel. Potential	
	Total (1)	Developed (2)	Ongoing (3)	Total (4)	Proportion (5)	Total (6)	Proportion (7)	(Incr.) (8)	Total (9)	Proportion (10)
WESTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT										
Palpa *	8857	3367	1008	4375	0.49	4482	0.51	277	4205	0.47
Arghakhanchi *	4799	2386	0	2386	0.50	2413	0.50	302	2111	0.44
Gulmi *	4240	1945	0	1945	0.46	2295	0.54	1119	1176	0.28
Tanahun	14496	7044	0	7044	0.49	7452	0.51	1688	5764	0.40
Syangja	9848	4785	0	4785	0.49	5063	0.51	938	4125	0.42
Gorkha	11027	5358	0	5358	0.49	5669	0.51	1315	4354	0.39
Lamjung	11937	5800	0	5800	0.49	6137	0.51	676	5461	0.46
Kaski	15960	7755	0	7755	0.49	8205	0.51	795	7410	0.46
Parbat	6455	3137	0	3137	0.49	3319	0.51	645	2674	0.41
Baglung	7780	3780	0	3780	0.49	4000	0.51	130	3870	0.50
Myagdi	3685	1791	0	1791	0.49	1895	0.51	1076	819	0.22
TOTAL FOR WESTERN HILL DISTRICTS	99084	47147	1008	48155	0.49	50929	0.51	8961	41968	0.42
WESTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT										
Manang	121	59	0	59	0.49	62	0.51	0	62	0.51
Mustang	159	263	0	263	1.66	-104	-0.66	52	-156	-0.98
TOTAL FOR WESTERN MOUNTAIN DISTRICTS	280	322	0	322	1.15	-42	-0.15	52	-94	-0.33
MID WESTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT										
Pyuthan *	7037	3784	0	3784	0.54	3253	0.46	1000	2253	0.32
Rolpa	3980	1934	0	1934	0.49	2046	0.51	100	1946	0.49
Salyan *	5282	2796	0	2796	0.53	2486	0.47	70	2416	0.46
Rukum	4170	2026	0	2026	0.49	2144	0.51	425	1719	0.41
Surkhet *	19275	9862	0	9862	0.51	9413	0.49	743	8670	0.45
Jajarkot	4143	2013	0	2013	0.49	2130	0.51	42	2088	0.50
Dailekh	7075	3438	0	3438	0.49	3637	0.51	477	3160	0.45
TOTAL FOR MID WESTERN HILL DISTRICTS	50962	25852	0	25852	0.51	25110	0.49	2857	22253	0.44
MID WESTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT										
Dolpa	868	264	0	264	0.30	604	0.70	110	494	0.57
Jumla	4765	2315	0	2315	0.49	2450	0.51	250	2200	0.46
Kalikot	3084	1498	0	1498	0.49	1585	0.51	315	1270	0.41
Mugu	2030	987	0	987	0.49	1044	0.51	201	843	0.42
Humla	1733	471	0	471	0.27	1262	0.73	90	1172	0.68
TOTAL FOR MID WESTERN MOUNTAIN DISTRICTS	12480	5535	0	5535	0.44	6945	0.56	966	5979	0.48

IRRIGABLE AREA DEVELOPMENT POTENTIAL - HILL AND MOUNTAIN DISTRICTS

District	Net Areas (ha)									
	Irrigable		Existing Projects			Current Devel. Potential		Ident. Pot. Proj.	Remaining Devel. Potential	
	Total (1)	Developed (2)	Ongoing (3)	Total (4)	Proportion (5)	Total (6)	Proportion (7)	(Incr.) (8)	Total (9)	Proportion (10)
FAR WESTERN DEVELOPMENT REGION - HILL ECOLOGICAL BELT										
Achham	10972	5331	0	5331	0.49	5641	0.51	0	5641	0.51
Doti	10468	5086	0	5086	0.49	5381	0.51	789	4592	0.44
Dadeldhura	7266	3530	0	3530	0.49	3735	0.51	305	3430	0.47
Baitadi	7450	3620	0	3620	0.49	3830	0.51	227	3603	0.48
TOTAL FOR FAR WESTERN HILL DISTRICTS	36155	17567	0	17567	0.49	18587	0.51	1321	17266	0.48
FAR WESTERN DEVELOPMENT REGION - MOUNTAIN ECOLOGICAL BELT										
Bajura	3584	1742	0	1742	0.49	1843	0.51	250	1593	0.44
Bajhang	7549	3668	0	3668	0.49	3881	0.51	416	3465	0.46
Darchula	4239	2060	0	2060	0.49	2180	0.51	539	1641	0.39
TOTAL FOR FAR WESTERN MOUNTAIN DISTRICTS	15373	7470	0	7470	0.49	7903	0.51	1205	6698	0.44
TOTALS BY DEVELOPMENT REGION										
EASTERN DISTRICTS	92293	43963	283	44246	0.48	48047	0.52	6283	41764	0.45
CENTRAL DISTRICTS	128158	60417	0	60417	0.47	67741	0.53	5318	62423	0.49
WESTERN DISTRICTS	99365	47469	1008	48477	0.49	50887	0.51	9013	41874	0.42
MID WESTERN DISTRICTS	63442	31388	0	31388	0.49	32055	0.51	3823	28232	0.44
FAR WESTERN DISTRICTS	51527	25037	0	25037	0.49	26490	0.51	2526	23964	0.47
TOTALS BY ECOLOGICAL BELT										
HILL DISTRICTS	373748	179071	1291	180362	0.48	193386	0.52	23750	169636	0.45
MOUNTAIN DISTRICTS	61037	29203	0	29203	0.48	31835	0.52	3213	28622	0.47
TOTAL FOR ALL DISTRICTS	434785	208274	1291	209565	0.48	225220	0.52	26963	198257	0.46

Notes : (1) Total net irrigable area from Annex A2, Table A2-3
(2) Developed net command areas for identified irrigation schemes from Annex A1, Table A1-7; asterisks indicate those districts for which WECS WUIs were available
(3) Ongoing DOI project net command areas from Annex A1, Table A1-3
(4) Sum of (2) and (3)
(5) Total as a proportion of irrigable area, ratio of (4)/(1)
(6) Area at (1) less area at (4)
(7) Total as a proportion of irrigable area, ratio of (6)/(1)
(8) Identified potential project incremental net command areas from Annex A3, Table A3-4
(9) Area at (6) less area at (8)
(10) Total as a proportion of irrigable area, ratio of (9)/(1)

TABLE A4-2

IRRIGABLE AREA DEVELOPMENT POTENTIAL - TERAI DISTRICTS

District	Net Areas (ha)												
	Irrigable			Existing Projects			Current Development Potential			Identified Potential Projects (Incremental Areas)			Remaining Dev. Pot.
	Agric. (1)	Non Agric. (2)	Total (3)	Developed (4)	Ongoing (5)	Total (6)	Agric. (7)	Non Agric. (8)	Total (9)	>2,000ha (10)	<=2,000ha (11)	Total (12)	Total (13)
EASTERN DEVELOPMENT REGION													
Jhapa	109530	588	110118	68004	2000	70004	39526	588	40114	30051	4817	34868	5246
Morang	99959	6880	106839	70970	0	70970	28989	6880	35869	0	792	792	35077
Sunsari	70629	0	70629	49524	0	49524	21105	0	21105	0	0	0	21105
Saptari	76950	0	76950	45538	6390	51928	25022	0	25022	11336	0	11336	13686
Siraha	77726	0	77726	28431	2362	30793	46933	0	46933	29399	0	29399	17534
TOTAL FOR EASTERN TERAI DISTRICTS	434794	7468	442262	262467	10752	273219	161575	7468	169043	70786	5609	76395	92648
CENTRAL DEVELOPMENT REGION													
Dhanusha	72925	2616	75541	38440	0	38440	34485	2616	37101	13467	2150	15617	21484
Mahottari	60633	4465	65098	30919	0	30919	29714	4465	34179	18093	1180	19273	14906
Sarlahi	73521	8448	81969	37493	0	37493	36028	8448	44476	18559	810	19369	25107
Rautahat	56141	15367	71508	15969	5700	21669	34472	15367	49839	25073	0	25073	24766
Bara	60390	29819	90209	41299	0	41299	19091	29819	48910	14318	0	14318	34592
Parsa	48374	30334	78708	24104	0	24104	24270	30334	54604	0	0	0	54604
Chitwan	41963	34592	76555	24006	800	24806	17157	34592	51749	5300	1804	7104	44645
TOTAL FOR CENTRAL TERAI DISTRICTS	413947	125641	539588	212230	6500	218730	195217	125641	320858	94810	5944	100754	220104
WESTERN DEVELOPMENT REGION													
Nawalparasi	50690	19969	70659	34432	0	34432	16258	19969	36227	0	1326	1326	34901
Rupandehi	87979	10874	98853	50283	3900	54183	33796	10874	44670	13475	2405	15880	28790
Kapilbastu	84453	28748	113201	28736	500	29236	55217	28748	83965	24344	1260	25604	58361
TOTAL FOR WESTERN TERAI DISTRICTS	223122	59591	282713	113451	4400	117851	105271	59591	164862	37819	4991	42810	122052
MID WESTERN DEVELOPMENT REGION													
Dangdeukhuri	59505	7284	66789	34841	0	34841	24664	7284	31948	1130	2645	3775	28173
Banke	48550	36035	84585	10419	0	10419	38131	36035	74166	33811	0	33811	40355
Bardiya	52660	41645	94305	28579	0	28579	24081	41645	65726	39392	290	39682	26044
TOTAL FOR MID WESTERN TERAI DISTRICTS	160715	84964	245679	73839	0	73839	86876	84964	171840	74333	2935	77268	94572
FAR WESTERN DEVELOPMENT REGION													
Kailali	64112	72446	136558	45649	1090	46739	17373	72446	89819	58344	0	58344	31475
Kanchanpur	40891	55673	96564	17628	900	18528	22363	55673	78036	6097	2449	8546	69490
TOTAL FOR FAR WESTERN TERAI DISTRICTS	105003	128119	233122	63277	1990	65267	39736	128119	167855	64441	2449	66890	100965
TOTAL FOR ALL TERAI DISTRICTS	1337581	405783	1743364	725264	23642	748906	588675	405783	994458	342189	21928	364117	630341

IRRIGABLE AREA DEVELOPMENT POTENTIAL - TERAI DISTRICTS

Notes :

(1) Net irrigable agricultural area from Annex A2, Table A2-3
(2) Net irrigable nongricultural area from Annex A2, Table A2-3
(3) Sum of (1) and (2)
(4) Developed net command areas for identified irrigation schemes from Annex A1, Table A1-7
(5) Ongoing DOI project net command areas from Annex A1, Table A1-3
(6) Sum of (4) and (5)
(7) Area at (1) less area at (6)
(8) Area at (9) less area at (7)
(9) Area at (3) less area at (6)
(10) Larger identified potential project incremental net command areas from Annex A3, Table A3-4
(11) Smaller identified potential project incremental net command areas from Annex A3, Table A3-4
(12) Sum of (10) and (11)
(13) Area at (9) less area at (12)

TABLE A4-3

HIGH POTENTIAL AQUIFER ZONES

Zone No. (1)	Location (District)	Aquifer Class (2)	Areal Extent
a) Shallow Aquifer Zones			
SAZ 1	Kanchanpur & Kailali	S1	Moderate
SAZ 2	Kailali	S1	Minor
SAZ 3	Kailali, Bardiya & Banke	S1	Major
SAZ 4	Bardiya	S1	Minor
SAZ 5	Kapilvastu & Rupandehi	S1	Moderate
SAZ 6	Nawalparasi	S1	Moderate
SAZ 7	Parsa, Bara, Rautahat, Sarlahi, Mahottari, Dhanusha, Siraha, Saptari, Sunsari, Morang & Jhapa	S1	Major
b) Deep Aquifer Zones			
DAZ 1	Kanchanpur	D2	Moderate
DAZ 2	Kailali & Bardiya	D2	Moderate
DAZ 3	Bardiya	D2	Minor
DAZ 4	Bardiya & Banke	D2	Minor
DAZ 5	Banke	D2	Moderate
DAZ 6	Kapilvastu & Rupandehi	D1 & D2	Moderate
DAZ 7	Parsa, Bara, Rautahat & Sarlahi	D2	Major
DAZ 8	Mahottari & Dhanusha	D1 & D2	Moderate
DAZ 9	Saptari, Sunsari & Morang	D1 & D2	Major
DAZ 10	Morang	D1 & D2	Moderate

Notes :

(1) SAZ = Shallow Aquifer Zone; DAZ = Deep Aquifer Zone; the numerical sequence of zones is from west to east

(2) High potential aquifer classes are as defined in Ref. 1.

TABLE A4-4

MAPPED AREA COMPARISONS - TERAI DISTRICTS

District	Mapped Areas (ha)										Measurement Differences (% of Database Values)				
	From Tabular Databases					From Map Measurements									
	Terai Plains & Hill Valleys			Hill Slopes	District	Terai Plains & Hill Valleys			Hill Slopes	District	Terai Plains & Hill Valleys			Hill Slopes	District
	Irrigable	Non Irrig.	Total	Total	Total	Irrigable	Non Irrig.	Total	Total	Total	Irrigable	Non Irrig.	Total	Total	Total
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
EASTERN DEVELOPMENT REGION															
Jhapa	124238	32306	156544	347	156891	135744	20625	156369	312	156681	9.3	-36.2	-0.1	-10.2	-0.1
Morang	121167	32200	153367	31314	184680	118125	24375	142500	32000	174500	-2.5	-24.3	-7.1	2.2	-5.5
Sunsari	79354	37277	116631	10445	127076	71750	43125	114875	10187	125062	-9.6	15.7	-1.5	-2.5	-1.6
Saptari	86382	19572	105955	29974	135929	88421	18752	107173	30500	137673	2.4	-4.2	1.1	1.8	1.3
Siraha	88355	9839	98194	24603	122797	90701	9371	100072	24125	124197	2.7	-4.8	1.9	-1.9	1.1
TOTAL FOR EASTERN TERAI DISTRICTS	499496	131194	630690	96683	727374	504741	116248	620989	97124	718113	1.1	-11.4	-1.5	0.5	-1.3
CENTRAL DEVELOPMENT REGION															
Dhanusha	86166	9491	95657	26089	121746	84521	8915	93436	26875	120311	-1.9	-6.1	-2.3	3.0	-1.2
Mahottari	74388	10372	84760	13986	98745	76110	10000	86110	15625	101735	2.3	-3.6	1.6	11.7	3.0
Sarlahi	93856	15503	109359	16968	126327	97281	12555	109836	16250	126086	3.6	-19.0	0.4	-4.2	-0.2
Rautahat	81444	14620	96064	7644	103709	86653	11880	98533	7500	106033	6.4	-18.7	2.6	-1.9	2.2
Bara	102841	11145	113986	15578	129564	106336	5633	111969	16500	128469	3.4	-49.5	-1.8	5.9	-0.8
Parsa	89053	20879	109932	29011	138943	99154	9000	108154	30625	138779	11.3	-56.9	-1.6	5.6	-0.1
Chitwan	88464	28095	116559	102895	219454	88651	29380	118031	99469	217500	0.2	4.6	1.3	-3.3	-0.9
TOTAL FOR CENTRAL TERAI DISTRICTS	616212	110105	726317	212171	938488	638706	87363	726069	212844	938913	3.7	-20.7	0.0	0.3	0.0
WESTERN DEVELOPMENT REGION															
Nawalparasi	80904	28061	108965	92648	201613	83122	29690	112812	100313	213125	2.7	5.8	3.5	8.3	5.7
Rupandehi	108834	11342	120176	21175	141351	110126	14840	124966	17500	142466	1.2	30.8	4.0	-17.4	0.8
Kapilbastu	124411	22762	147173	28521	175694	118753	32810	151563	26250	177813	-4.5	44.1	3.0	-8.0	1.2
TOTAL FOR WESTERN TERAI DISTRICTS	314149	62165	376314	142344	518658	312001	77340	389341	144063	533404	-0.7	24.4	3.5	1.2	2.8
MID WESTERN DEVELOPMENT REGION															
Dangdeukhuri	77780	37685	115465	181875	297339	73000	31410	104410	188750	293160	-6.1	-16.7	-9.6	3.8	-1.4
Banke	98205	41971	140176	95807	235983	88125	34840	122965	53750	176715	-10.3	-17.0	-12.3	-43.9	-25.1
Bardiya	109426	41353	150779	52774	203553	106202	44060	150262	53750	204012	-2.9	6.5	-0.3	1.9	0.2
TOTAL FOR MID WESTERN TERAI DISTRICTS	285411	121009	406420	330455	736875	267327	110310	377637	296250	673887	-6.3	-8.8	-7.1	-10.4	-8.5
FAR WESTERN DEVELOPMENT REGION															
Kailali	157406	41613	199019	125772	324791	143954	51400	195354	129303	324657	-8.5	23.5	-1.8	2.8	0.0
Kanchanpur	111598	31649	143247	20431	163678	111503	34050	145553	20116	165669	-0.1	7.6	1.6	-1.5	1.2
TOTAL FOR FAR WESTERN TERAI DISTRICTS	269004	73263	342267	146203	488469	255457	85450	340907	149419	490326	-5.0	16.6	-0.4	2.2	0.4
TOTAL FOR ALL TERAI DISTRICTS	1984272	497735	2482007	927856	3409863	1978232	476711	2454943	899700	3354643	-0.3	-4.2	-1.1	-3.0	-1.6

TABLE A4-5

MEASURED AND DERIVED DEVELOPMENT AREAS - TERAI DISTRICTS

A. EXISTING AND IDENTIFIED POTENTIAL PROJECTS - TERAI PLAINS AND HILL VALLEYS

District	Mapped Areas (Measured) (ha)						Ratio of	Total Irrigable Net Areas (ha)		Differences	Irrigable Area Land Use (% of Total)			
	Overall Total (1)	Non Irrig. Total (2)	Irrigable Total (3)	Irrigable Reserve (4)	Irrigable Non Agric. (5)	Irrigable Agricultural (6)	Net/Mapped Areas (7)	Derived (8)	Tabulated (9)	in Net Areas (% of Tab.) (10)	Irrigable Reserve (11)	Irrigable Non Agric. (12)	Irrigable Agricultural (13)	Irrigable Total (14)
EASTERN DEVELOPMENT REGION														
Jhapa	141562	18750	122812	0	7812	115000	0.89	108854	104872	3.8	0	6	94	100
Morang	95000	12500	82500	0	0	82500	0.88	72600	71762	1.2	0	0	100	100
Sunsari	75625	9375	66250	0	0	66250	0.89	58720	49524	18.6	0	0	100	100
Saptari	82625	15625	67000	0	625	66375	0.89	59385	63264	-6.1	0	1	99	100
Siraha	76250	5625	70625	0	0	70625	0.88	62150	60192	3.3	0	0	100	100
TOTAL FOR EASTERN TERAI DISTRICTS	471062	61875	409187	0	8437	400750	0.89	361710	349614	3.5	0	2	98	100
CENTRAL DEVELOPMENT REGION														
Dhanusha	81250	6406	74844	0	937	73907	0.88	65863	54057	21.8	0	1	99	100
Mahottari	60000	6250	53750	0	0	53750	0.88	47300	50192	-5.8	0	0	100	100
Sarlahi	77870	10000	67870	0	1000	66870	0.87	59047	56862	3.8	0	1	99	100
Rautahat	70625	11250	59375	0	1250	58125	0.88	52250	46742	11.8	0	2	98	100
Bara	62185	1875	60310	0	0	60310	0.88	53073	55617	-4.6	0	0	100	100
Parsa	34062	3437	30625	0	0	30625	0.88	26950	24104	11.8	0	0	100	100
Chitwan	49375	0	49375	0	0	49375	0.87	42956	31910	34.6	0	0	100	100
TOTAL FOR CENTRAL TERAI DISTRICTS	435367	39218	396149	0	3187	392962	0.88	347439	319484	8.7	0	1	99	100
WESTERN DEVELOPMENT REGION														
Nawalparasi	49157	1875	47282	0	0	47282	0.87	41135	35758	15.0	0	0	100	100
Rupandehi	49375	2812	46563	0	468	46095	0.91	42372	70063	-39.5	0	1	99	100
Kapilbastu	70750	2625	68125	0	750	67375	0.91	61994	54840	13.0	0	1	99	100
TOTAL FOR WESTERN TERAI DISTRICTS	169282	7312	161970	0	1218	160752	0.90	145501	160661	-9.4	0	1	99	100
MID WESTERN DEVELOPMENT REGION														
Dangdeukhuri	54530	0	54530	0	0	54530	0.86	46896	38616	21.4	0	0	100	100
Banke	60937	12812	48125	0	5625	42500	0.86	41388	44230	-6.4	0	12	88	100
Bardiya	92812	14687	78125	0	21250	56875	0.86	67188	68261	-1.6	0	27	73	100
TOTAL FOR MID WESTERN TERAI DISTRICTS	208279	27499	180780	0	26875	153905	0.86	155471	151107	2.9	0	15	85	100
FAR WESTERN DEVELOPMENT REGION														
Kailali	168125	34843	133282	0	43750	89532	0.86	114623	105083	9.1	0	33	67	100
Kanchanpur	19794	732	19062	0	937	18125	0.87	16584	27074	-38.7	0	5	95	100
TOTAL FOR FAR WESTERN TERAI DISTRICTS	187919	35575	152344	0	44687	107657	0.89	131206	132157	-0.7	0	29	71	100
TOTAL FOR ALL TERAI DISTRICTS	1471909	171479	1300430	0	84404	1216026	0.88	1141327	1113023	2.5	0	6	94	100

MEASURED AND DERIVED DEVELOPMENT AREAS - TERAI DISTRICTS

B. REMAINING DEVELOPMENT POTENTIAL - TERAI PLAINS AND HILL VALLEYS

District	Mapped Areas (Measured) (ha)						Ratio of	Total Irrigable Net Areas (ha)		Differences in Net Areas	Irrigable Area Land Use (% of Total)			
	Overall Total (1)	Non Irrig. Total (2)	Irrigable Total (3)	Irrigable Reserve (4)	Irrigable Non Agric. (5)	Irrigable Agricultural (6)	Net/Mapped Areas (7)	Derived (8)	Tabulated (9)	(% of Tab.) (10)	Irrigable Reserve (11)	Irrigable Non Agric. (12)	Irrigable Agricultural (13)	Irrigable Total (14)
EASTERN DEVELOPMENT REGION														
Jhapa	14807	1875	12932	0	4262	8670	0.89	11462	5246	118.5	0	33	67	100
Morang	47500	11875	35625	0	17500	18125	0.88	31350	35077	-10.6	0	49	51	100
Sunsari	39250	33750	5500	0	2875	2625	0.89	4875	21105	-76.9	0	52	48	100
Saptari	24548	3127	21421	0	1500	19921	0.89	18986	13686	38.7	0	7	93	100
Siraha	23822	3746	20076	0	750	19326	0.88	17667	17534	0.8	0	4	96	100
TOTAL FOR EASTERN TERAI DISTRICTS	149927	54373	95554	0	26887	68667	0.89	84340	92648	-9.0	0	28	72	100
CENTRAL DEVELOPMENT REGION														
Dhanusha	12186	2509	9677	0	750	8927	0.88	8516	21484	-60.4	0	8	92	100
Mahottari	26110	3750	22360	0	10250	12110	0.88	19677	14906	32.0	0	46	54	100
Sarlahi	31966	2555	29411	0	14437	14974	0.87	25588	25107	1.9	0	49	51	100
Rautahat	27908	630	27278	0	20000	7278	0.88	24005	24766	-3.1	0	73	27	100
Bara	49784	3758	46026	0	33375	12651	0.88	40503	34592	17.1	0	73	27	100
Parsa	74092	5563	68529	30312	21250	16967	0.88	60306	54604	10.4	44	31	25	100
Chitwan	68656	29380	39276	18750	11250	9276	0.87	34170	44645	-23.5	48	29	24	100
TOTAL FOR CENTRAL TERAI DISTRICTS	290702	48145	242557	49062	111312	82183	0.88	212763	220104	-3.3	20	46	34	100
WESTERN DEVELOPMENT REGION														
Nawalparasi	63655	27815	35840	625	16875	18340	0.87	31181	34901	-10.7	2	47	51	100
Rupandehi	75591	12028	63563	0	11875	51688	0.91	57842	28790	100.9	0	19	81	100
Kapilbastu	80813	30185	50628	0	23125	27503	0.91	46071	58361	-21.1	0	46	54	100
TOTAL FOR WESTERN TERAI DISTRICTS	220059	70028	150031	625	51875	97531	0.90	135095	122052	10.7	0	35	65	100
MID WESTERN DEVELOPMENT REGION														
Dangdeukhuri	49880	31410	18470	0	11560	6910	0.86	15884	28173	-43.6	0	63	37	100
Banke	62028	22028	40000	0	31068	8932	0.86	34400	40355	-14.8	0	78	22	100
Bardiya	57450	29373	28077	16250	8437	3390	0.86	24146	26044	-7.3	58	30	12	100
TOTAL FOR MID WESTERN TERAI DISTRICTS	169358	82811	86547	16250	51065	19232	0.86	74430	94572	-21.3	19	59	22	100
FAR WESTERN DEVELOPMENT REGION														
Kailali	27229	16557	10672	0	9375	1297	0.86	9178	31475	-70.8	0	88	12	100
Kanchanpur	125759	33318	92441	26250	28437	37754	0.87	80424	69490	15.7	28	31	41	100
TOTAL FOR FAR WESTERN TERAI DISTRICTS	152988	49875	103113	26250	37812	39051	0.89	89602	100965	-11.3	25	37	38	100
TOTAL FOR ALL TERAI DISTRICTS	983034	305232	677802	92187	278951	306664	0.88	596230	630341	-5.4	14	41	45	100

MEASURED AND DERIVED DEVELOPMENT AREAS - TERAI DISTRICTS

C. TOTAL DEVELOPMENT AREAS - TERAI PLAINS AND HILL VALLEYS

District	Mapped Areas (Measured) (ha)						Ratio of	Total Irrigable Net Areas (ha)		Differences	Irrigable Area Land Use (% of Total)			
	Overall Total (1)	Non Irrig. Total (2)	Irrigable Total (3)	Irrigable Reserve (4)	Irrigable Non Agric. (5)	Irrigable Agricultural (6)	Net/Mapped Areas (7)	Derived (8)	Tabulated (9)	in Net Areas (% of Tab.) (10)	Irrigable Reserve (11)	Irrigable Non Agric. (12)	Irrigable Agricultural (13)	Irrigable Total (14)
EASTERN DEVELOPMENT REGION														
Jhapa	156369	20625	135744	0	12074	123670	0.89	120316	110118	9.3	0	9	91	100
Morang	142500	24375	118125	0	17500	100625	0.88	103950	106839	-2.7	0	15	85	100
Sunsari	114875	43125	71750	0	2875	68875	0.89	63595	70629	-10.0	0	4	96	100
Saptari	107173	18752	88421	0	2125	86296	0.89	78372	76950	1.8	0	2	98	100
Siraha	100072	9371	90701	0	750	89951	0.88	79817	77726	2.7	0	1	99	100
TOTAL FOR EASTERN TERAI DISTRICTS	620989	116248	504741	0	35324	469417	0.89	446050	442262	0.9	0	7	93	100
CENTRAL DEVELOPMENT REGION														
Dhanusha	93436	8915	84521	0	1687	82834	0.88	74378	75541	-1.5	0	2	98	100
Mahottari	86110	10000	76110	0	10250	65860	0.88	66977	65098	2.9	0	13	87	100
Sarlahi	109836	12555	97281	0	15437	81844	0.87	84634	81969	3.3	0	16	84	100
Rautahat	98533	11880	86653	0	21250	65403	0.88	76255	71508	6.6	0	25	75	100
Bara	111969	5633	106336	0	33375	72961	0.88	93576	90209	3.7	0	31	69	100
Parsa	108154	9000	99154	30312	21250	47592	0.88	87256	78708	10.9	31	21	48	100
Chitwan	118031	29380	88651	18750	11250	58651	0.87	77126	76555	0.7	21	13	66	100
TOTAL FOR CENTRAL TERAI DISTRICTS	726069	87363	638706	49062	114499	475145	0.88	560202	539588	3.8	8	18	74	100
WESTERN DEVELOPMENT REGION														
Nawalparasi	112812	29690	83122	625	16875	65622	0.87	72316	70659	2.3	1	20	79	100
Rupandehi	124966	14840	110126	0	12343	97783	0.91	100215	98853	1.4	0	11	89	100
Kapilbastu	151563	32810	118753	0	23875	94878	0.91	108065	113201	-4.5	0	20	80	100
TOTAL FOR WESTERN TERAI DISTRICTS	389341	77340	312001	625	53093	258283	0.90	280596	282713	-0.7	0	17	83	100
MID WESTERN DEVELOPMENT REGION														
Dangdeukhuri	104410	31410	73000	0	11560	61440	0.86	62780	66789	-6.0	0	16	84	100
Banke	122965	34840	88125	0	36693	51432	0.86	75788	84585	-10.4	0	42	58	100
Bardiya	150262	44060	106202	16250	29687	60265	0.86	91334	94305	-3.2	15	28	57	100
TOTAL FOR MID WESTERN TERAI DISTRICTS	377637	110310	267327	16250	77940	173137	0.86	229901	245679	-6.4	6	29	65	100
FAR WESTERN DEVELOPMENT REGION														
Kailali	195354	51400	143954	0	53125	90829	0.86	123800	136558	-9.3	0	37	63	100
Kanchanpur	145553	34050	111503	26250	29374	55879	0.87	97008	96564	0.5	24	26	50	100
TOTAL FOR FAR WESTERN TERAI DISTRICTS	340907	85450	255457	26250	82499	146708	0.89	220808	233122	-5.3	10	32	57	100
TOTAL FOR ALL TERAI DISTRICTS	2454943	476711	1978232	92187	363355	1522690	0.88	1737557	1743364	-0.3	5	18	77	100

MEASURED AND DERIVED DEVELOPMENT AREAS - TERAI DISTRICTS

Notes :

(1) From measurements
(2) From measurements
(3) Area at (1) less area at (2)
(4) From measurements
(5) From measurements
(6) Area at (3) less sum of areas at (4) and (5)
(7) Ratio of net to mapped irrigable areas from Table A2-2
(8) Product of area at (3) and ratio at (7)
(9) From Table A4-2 (calculated as a sum in the case of existing and identified potential projects)
(10) {[(8)-(9)]/(9)}*100
(11) [(4)/(3)]*100
(12) [(5)/(3)]*100
(13) [(6)/(3)]*100
(14) Sum of percentages at (11), (12) and (13)

TABLE A4-6

SIMPLIFIED ESTIMATE OF ULTIMATE IRRIGATION POTENTIAL - TERAI DISTRICTS

District	Irrigable Agricultural Area (1)	Irrigable Non-Agric Area (2)	Total Irrigable Area (3)	Present Irrigation Area (4)	Identified Potential Projects (5)	Total Identified Development (6)	Remaining Development Area: Irrigable Agricultural (7)	Remaining Development Area: Irrigable Non Agric (8)	Remaining Development Area: Irrigable Reserves (9)	Remaining Development Area: Total (10)	Likely Further Development: Identified Projects (11)	Likely Further Development: Incremental Groundwater (12)	Likely Further Development: Total (13)	Projected Overall Total (14)	Remarks
EASTERN DEVELOPMENT REGION															
Jhapa	109,000	1,000	110,000	70,000	35,000	105,000	2,000	3,000	0	5,000	0	5,000	5,000	110,000	Full development projected
Morang	100,000	7,000	107,000	71,000	1,000	72,000	16,000	16,000	0	32,000	6,000	10,000	16,000	88,000	
Sunsari	71,000	0	71,000	50,000	0	50,000	9,000	3,000	0	12,000	4,000	4,000	8,000	58,000	
Saptari	77,000	0	77,000	52,000	11,000	63,000	13,000	1,000	0	14,000	0	5,000	5,000	68,000	
Siraha	78,000	0	78,000	31,000	29,000	60,000	16,000	1,000	0	17,000	0	0	0	60,000	
TOTAL FOR EASTERN TERAI DISTRICTS	435,000	8,000	443,000	274,000	76,000	350,000	56,000	24,000	0	80,000	10,000	24,000	34,000	384,000	
CENTRAL DEVELOPMENT REGION															
Dhanusha	73,000	3,000	76,000	38,000	16,000	54,000	8,000	1,000	0	9,000	0	0	0	54,000	
Mahottari	61,000	4,000	65,000	31,000	19,000	50,000	8,000	7,000	0	15,000	0	0	0	50,000	
Sarlahi	74,000	8,000	82,000	37,000	19,000	56,000	13,000	12,000	0	25,000	0	7,000	7,000	63,000	
Rautahat	56,000	15,000	71,000	22,000	25,000	47,000	11,000	13,000	0	24,000	0	12,000	12,000	59,000	Most irr non ag developed
Bara	60,000	30,000	90,000	41,000	14,000	55,000	5,000	30,000	0	35,000	0	20,000	20,000	75,000	Most irr non ag developed
Parsa	48,000	30,000	78,000	24,000	0	24,000	13,000	17,000	24,000	54,000	0	14,000	14,000	38,000	Some irr non ag developed
Chitwan	42,000	35,000	77,000	25,000	7,000	32,000	14,000	11,000	19,000	44,000	9,000	0	9,000	41,000	No irr non ag developed
TOTAL FOR CENTRAL TERAI DISTRICTS	414,000	125,000	539,000	218,000	100,000	318,000	72,000	91,000	43,000	206,000	9,000	53,000	62,000	380,000	
WESTERN DEVELOPMENT REGION															
Nawalparasi	51,000	20,000	71,000	34,000	1,000	35,000	16,000	15,000	0	31,000	16,000	6,000	22,000	57,000	
Rupandehi	88,000	11,000	99,000	54,000	16,000	70,000	19,000	10,000	0	29,000	22,000	7,000	29,000	99,000	Full development projected
Kapilbastu	84,000	29,000	113,000	29,000	26,000	55,000	29,000	24,000	0	53,000	25,000	2,000	27,000	82,000	
TOTAL FOR WESTERN TERAI DISTRICTS	223,000	60,000	283,000	117,000	43,000	160,000	64,000	49,000	0	113,000	63,000	15,000	78,000	238,000	
MID WESTERN DEVELOPMENT REGION															
Dangdeukhuri	60,000	7,000	67,000	35,000	4,000	39,000	20,000	8,000	0	28,000	0	10,000	10,000	49,000	
Banke	49,000	36,000	85,000	10,000	34,000	44,000	22,000	18,000	0	40,000	0	10,000	10,000	54,000	Some irr non ag developed
Bardiya	53,000	42,000	95,000	29,000	40,000	69,000	3,000	6,000	15,000	24,000	0	0	0	69,000	Most irrgbl area reserved
TOTAL FOR MID WESTERN TERAI DISTRICT	162,000	85,000	247,000	74,000	78,000	152,000	45,000	32,000	15,000	92,000	0	20,000	20,000	172,000	
FAR WESTERN DEVELOPMENT REGION															
Kailali	64,000	72,000	136,000	47,000	58,000	105,000	2,000	20,000	0	22,000	0	0	0	105,000	
Kanchanpur	41,000	56,000	97,000	19,000	9,000	27,000	30,000	19,000	20,000	69,000	30,000	2,000	32,000	59,000	
TOTAL FOR FAR WESTERN TERAI DISTRICT	105,000	128,000	233,000	66,000	67,000	132,000	32,000	39,000	20,000	91,000	30,000	2,000	32,000	164,000	
TOTAL FOR ALL TERAI DISTRICTS	1,339,000	406,000	1,745,000	749,000	364,000	1,112,000	269,000	235,000	78,000	582,000	112,000	114,000	226,000	1,338,000	

SIMPLIFIED ESTIMATE OF ULTIMATE IRRIGATION POTENTIAL - TERAI DISTRICTS

Notes :

(1) Source: Table A4-2 - Col 1 (rounded)
(2) Source: Table A4-2 - Col 2 (rounded)
(3) (1) + (2)
(4) Source: Table A4-2 - Col 6 (rounded)
(5) Source: Table A4-2 - Col 12 (rounded)
(6) (4) + (5)
(7) Source: Table A4-5 - Section B - Col 6 adjusted to net area and to reflect overall area reconciliation
(8) Source: Table A4-5 - Section B - Col 5 adjusted to net area and to reflect overall area reconciliation
(9) Source: Table A4-5 - Section B - Col 4 adjusted to net area
(10) (7) + (8) + (9)
(11) Source: Text Section A4-3.4, quoting only incremental areas served by newly identified developments
(12) Source: Approximate estimates based on district-wise estimates in Annex D4 and assessments of aquifer overlaps with irrigable land
(13) (11) + (12)
(14) (6) + (13)

APPENDIX A4-1

HILL DISTRICT IRRIGATION DEVELOPMENT ASSESSMENT - KABHRE DISTRICT

A4-1.1 - General

Kabhre District is a Hill district located in the Central Development Region. It has a total mapped land area of about 140,500 ha, of which about 8,850 ha or 6.3 percent is classified as Siwalik or Middle Mountain valley (see Annex A1, Table A1-1). The principal town is Banepa, located in the northwestern portion of the district. The principal land access route is the paved Kathmandu to China road, which traverses the northern part of the district. Figure A4-1.1 summarizes relevant information in map form.

A4-1.2 - Land Resources

Of the total mapped Hill Valley area of 8,850 ha, 5,961 ha are classified as firmly irrigable and a further 669 ha are classified as tentatively irrigable (see Annex A2, Table A2-2). These areas have been outlined in Figure A4-1.1. It should be noted, however, that the total mapped irrigable valley area derived for this district in the Master Plan studies is 7,762 ha, based on land utilization analyses (see Annex A2, Table A2-3). It should also be noted that there is a further 3,805 ha of mapped irrigable area in the hill slope regions, corresponding to level terraces. This gives a total mapped irrigable area of 11,567 ha for the district.

For assessment purposes, irrigable areas need to be expressed as net areas. The derived net irrigable areas in Kabhre are 6,056 ha in Hill Valleys and 1,902 ha in hill slopes, giving a district total of 7,958 ha (see Annex A2, Table A2-3). All of this area is classed as being under agricultural use at present.

A4-1.3 - Present Level of Development

Identified irrigation schemes in the district, most of which are located in the Hill Valleys, are estimated to cover a total net area of 3,235 ha (see Annex A1, Table A1-7). This represents 53 percent of the net Hill Valley irrigable land area, or 41 percent of total net irrigable area. All of these are FMIS; their areas are outlined in Figure A4-1.1.

It is estimated from the land utilization analyses that a further net area of 3,041 ha in the district may be under some form of unidentified irrigation (see Annex A1, Table A1-7). This area could include the hill slope level terraces and some Hill Valley areas in which there are no formal irrigation systems but which may be irrigated by direct withdrawal and field-to-field water transfer methods. Some such areas were seen during the field visits. If this broader interpretation of irrigation development is applied, the present net level of development in the district could be as much as 6,276 ha or 79% of the total net irrigable area.

Of the identified FMIS Net Command Area of 3,235 ha, 435 ha correspond to schemes that have received some form of agency assistance (see Annex A1, Table A1-5). The SINKALAMA program has been the principal assistance program in the district.

A4-1.4 - Water Resources

There are three principal drainage basins in Kabhre District, as shown in Figure A4-1.1. These are the Indrawati/Sun Kosi rivers, the Rosi Khola and the Bagmati river basins, which cover the north, center and south of the district respectively. Except in the case of the Rosi Khola in its upper reaches, the main rivers do not themselves serve as water sources for irrigation. This is because they are deeply incised and well below the level of most of the irrigable land areas; even lift pumping must normally be considered infeasible in the case of the main rivers. Irrigation supplies are generally withdrawn from the small tributary streams along which irrigable valleys are located.

A4-1.5 - Irrigation Development Assessment

The assessment of potential irrigation development in Kabhre District was based on an office study supplemented by field visits and discussions with irrigation agency staff. The office study consisted of an analysis of Hill Valley basins which had identified irrigation developments and/or firmly irrigable land areas; it provided estimates of land areas that could be reliably served for irrigation from the corresponding streams. The field visits and discussions served to complement the office study, by providing details of existing and planned developments, and by confirming or refuting the basin analyses or expanding on them.

Details and results of the office study are given in Table A4-1.1. The assessed basins had existing identified scheme net areas totalling 3,016 ha (93 percent of the district total of 3,235 ha) and net irrigable Hill Valley areas totalling 5,730 ha (95 percent of the district total of 6,056 ha). From the estimates of both land

and water limitations to development in each individual basin, the study concluded that all of the 5,730 ha could be reliably served for monsoon season cropping and that 82 percent of it (4,720 ha) could be reliably served for year round cropping. This assessment assumed that there would be no transfer of water from surplus to deficit basins.

The field visits and discussions generally confirmed the results of the office study with regard to the ultimate irrigation development potential in the district, although it was felt that the actual potential for reliable year round irrigation may be less than the assessed potential. Furthermore, indications were provided that the actual existing extent of effective Hill Valley irrigation is greater than the identified and recorded level of development.

It has been assumed consistently in the Master Plan studies that any expansions in irrigation coverage in the hill slopes (level terraces) will be minor. The present level of irrigation development in these areas has been assumed to be 100 percent of the irrigable area, using the definitions of irrigable agricultural land provided in Annex A1, Table A1-2.

A4-1.6 - Basin-Specific Comments

The following paragraphs provide basin-specific comments resulting from the irrigation development assessment. The basins emphasized are those that offer some potential for irrigation improvement or expansion; they would therefore need to be assigned priority for conducting more detailed studies and assessments. The basin numbers used for reference purposes are consistent with those of Figure A4-1.1 and Table A4-1.1.

Basin 1. Dhanr Khola

Water availability calculations indicate that all of the remaining irrigable area (6 ha) can be provided with reliable water supplies for year round (YR) irrigation.

Basin 3. Chak Khola

Water availability calculations for this basin indicate that 667 ha could be supplied with water for YR irrigation. A water surplus is indicated, as existing schemes have a total NCA of 445 ha, and the remaining irrigable area is 55 ha. The new area could be irrigated by gravity canal from a tributary of the Chak Khola, or from the Chak Khola itself.

Basin 4. Jhiku Khola

The Jhiku Khola basin is a water deficit basin, although water availability calculations indicate that all of the irrigable land in the basin could be provided with sufficient water for monsoon (MS) irrigation. Bringing additional water from the adjoining Chak Khola would not be feasible, as the elevation of the Chak Khola basin is generally lower than that of the Jhiku Khola. Dry season irrigation of the remaining irrigable area of 530 ha might be achieved through improved water management, possibly combined with selective use of low consumption irrigation methods (sprinkler or drip) and/or the adoption of a cropping pattern incorporating low water consumption crops (eg vegetables). Kathmandu is a potential market for vegetables.

Basin 7. Timreni Khola

No flow estimates were available for this basin. The small additional irrigable area (6 ha) might be irrigated with better water management, as suggested for the Jhiku Khola basin.

Basin 8. Punyamati Khola

Water balance calculations indicated that all of the irrigable area in the Punyamati Khola basin could be provided with reliable water supplies for MS irrigation, and that much of the area could be irrigated on a year round basis. Most of the irrigable area in the basin is classified by the WUI as rainfed land, although many areas are irrigated by farmers without formal canal systems. This was confirmed during field visits through discussions with farmers and examination of their irrigation systems. During the field visit it was also observed that the area on both banks of the lower Punyamati Khola could be irrigated by low lift pumping. It can be concluded, therefore, that much of the expansion potential of the basin has already been realized, and that further development would be generally limited to providing formal canal systems to serve the same lands.

Basin 10. Dapche Khola

Water balance calculations indicated that all of the remaining irrigable area could be provided with reliable water supplies for MS irrigation, and that some of it could be provided with YR irrigation.

Basin 11. Rosi Khola

Water balance calculations indicated significant water surpluses in the Rosi Khola basin, which is one of the largest sub-basins in Kabhre District. The remaining irrigable area is estimated to be 1182 ha; most of these areas are located on the Rosi Khola's tributaries. As in the Punyamati Khola, it was found that many of the "rainfed" areas are irrigated by farmers without formal canal systems. The Surahi Khola valley appears to be typical -- in this valley, nine dams have been constructed at intervals down the main stream. Water is conveyed directly to the first commandable field, after which the water is conveyed from field to field. The discharge in the Surahi Khola reduces rapidly when there is no rainfall during the monsoon season, and farmers report that water supplies are not adequate in the winter. This constraint could possibly be removed by pumping of Punyamati Khola water and conveying it by contour canal to the Surahi Khola. High patches of irrigable land along the lower reach of the Rosi Khola could be irrigated using low lift pumping, preferably at the initiative of individual farmers.

The 90 ha Khahare Pangu project, which was studied under the ADB Third Hill Irrigation Project (see Annex D4), is located in the Rosi Khola basin, south of Dabcha. The project would divert water from one of two possible sources on Rosi Khola tributaries (the Sim Sim Khola or Khare Khola), as the Rosi Khola itself is too deeply incised in the vicinity of the project area.

A4-1.7 - Recommended Further Studies

The principal basins offering potential for expansion of irrigated area in Kabhre District are the Chak Khola, Jhiku Khola, Punyamati Khola and Rosi Khola. In the Punyamati Khola and Rosi Khola basins, further studies should investigate the means by which existing informal FMIS could be improved and the remaining irrigable areas brought under irrigation. In the Jhiku Khola, studies should investigate the potential for both conventional and water-efficient irrigation developments. As in all of the surveyed districts, the potential for rehabilitating existing FMIS and for undertaking minor expansions of their NCA's should be treated on a project-specific basis, using the principles established under the Irrigation Sector Program. This represents a "bottom up" process, in which a farmer request prompts action by DOI to appraise a particular project. The present exercise represents a "top down" process, in which resource characteristics are used to identify potential projects.

TABLE A4-i.1

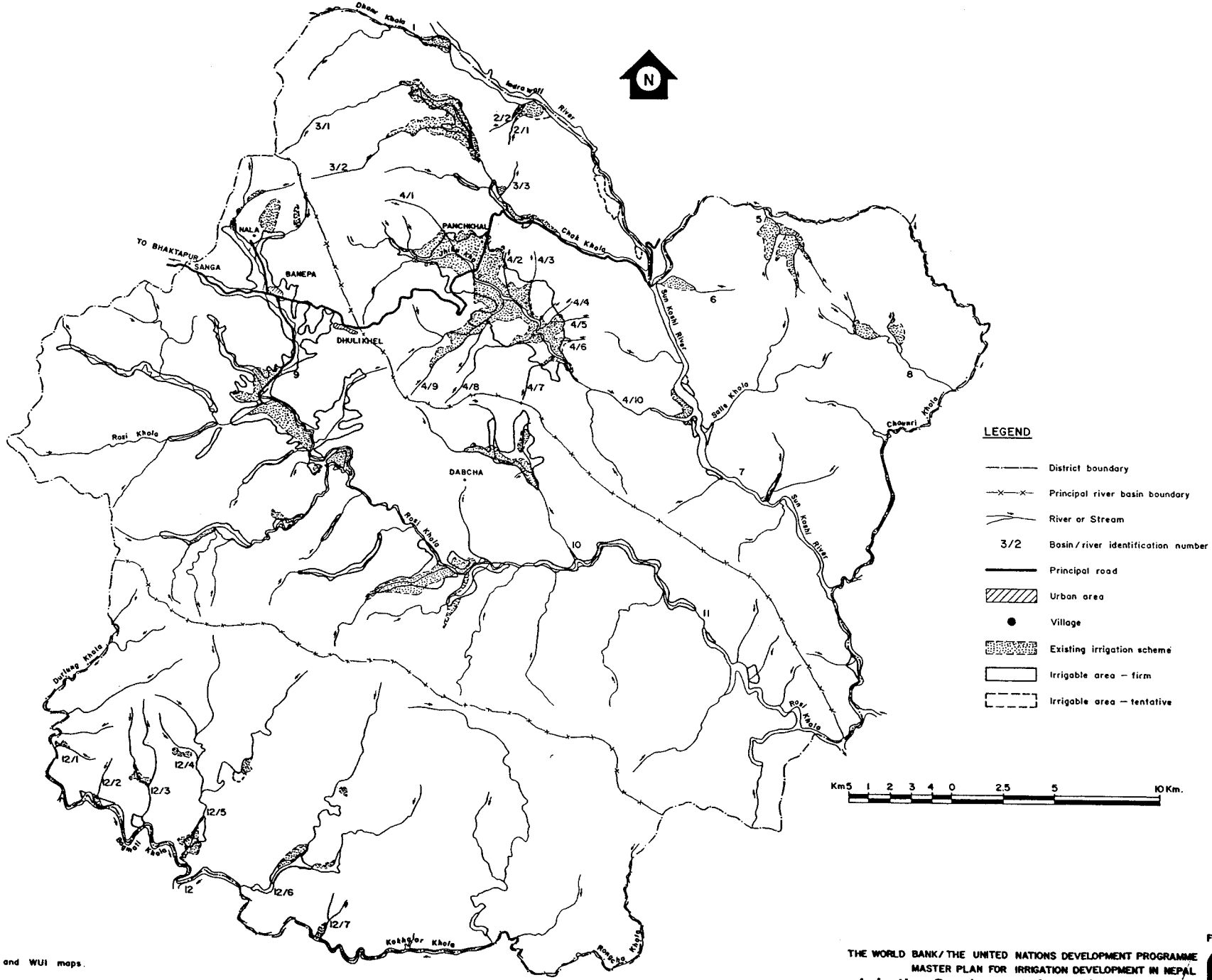
IRRIGATION DEVELOPMENT ASSESSMENT - KABHRE DISTRICT

Assessed Basin/Stream Number	Name	Existing Scheme Command Areas Gross (ha) (1)	Net (ha) (2)	Remaining Irrigable Areas Mapped (ha) (3)	Net (ha) (4)	Streamflow Estimates October Mean (m3/s) (5)	Rel. (m3/s) (6)	March Mean (m3/s) (7)	Rel. (m3/s) (8)	Repr.Irrig.Req. October MS (L/s/ha) (9)	March YR (L/s/ha) (10)	Net Reliably Irrigable Areas MS (ha) (11)	YR (ha) (12)	Net Potential Expansion Areas MS (ha) (13)	YR (ha) (14)	Further Water Availability MS (15)	YR (16)
1	Dhanr Khola	56	45	8	6	1.23	0.74	0.16	0.12	2.85	1.45	259	83	6	6	Surplus	Surplus
2/1	Govinde Khola	69	55														
2/2	Kaule Khola	14	11														
	Total	83	66	0	0	1.31	0.79	0.17	0.13	2.85	1.45	276	88	0	0	Surplus	Surplus
3/1	Chak Khola	323	258														
3/2	Ashi Khola	208	166														
3/3	Gangati Khola	25	20														
	Total	556	445	70	55	9.72	5.83	1.29	0.97	2.85	1.45	2046	667	55	55	Surplus	Surplus
4/1	Dhud Khola	226	181														
4/2	Dhap Khola	70	56														
4/3	Subarno Khola	49	39														
4/4	Sukundol Khola	10	8														
4/5	Namde Khola	92	74														
4/6	Bhote Khola	45	36														
4/7	Khahare Khola	22	18														
4/8	Andheri Khola	63	50														
4/9	Danfey Khola	363	290														
4/10	Jhiku Khola	551	441														
	Total	1491	1193	680	530	8.19	4.91	1.08	0.81	2.85	1.45	1724	559	530	0	Surplus	Deficit
5	Kabhre Khola	267	214	0	0	2.67	1.60	0.35	0.26	2.85	1.45	562	181	0	0	Surplus	Deficit
6	Ghatte Khola	58	46	0	0	1.11	0.67	0.15	0.11	2.85	1.45	234	78	0	0	Surplus	Surplus
7	Timreni Khola	15	12	8	6	NA	NA	NA	NA	2.85	1.45	NA	NA	NA	NA	NA	NA
8	Ghatte Khola	114	91	0	0	3.33	2.00	0.44	0.33	2.85	1.45	701	228	0	0	Surplus	Surplus
9	Punyamati Khola	340	272	994	775	10.42	6.25	1.38	1.04	2.85	1.45	2194	714	775	442	Surplus	Deficit
10	Dapche Khola	164	131	212	165	2.17	1.30	0.29	0.22	2.85	1.45	457	150	165	19	Surplus	Deficit
11	Rosi Khola	642	514	1515	1182	68.78	41.27	9.11	6.83	2.85	1.45	14480	4712	1182	1182	Surplus	Surplus
12/1	Pakadol Khola	13	10														
12/2	Dobhan Khola	12	10														
12/3	Phyang Khola	30	24														
12/4	Mul Khola	20	16														
12/5	Khani Khola	91	72														
12/6	Chan Khola	83	67														
12/7	Aanp Khola	19	15														
Total Assessed Basins (Excl. NA)		3771	3016	3479	2714							22933	7459	2714	1703		

IRRIGATION DEVELOPMENT ASSESSMENT - KABHRE DISTRICT

Notes :

(1) Aggregated from WUI report
(2) [0.8*(1)]
(3) Measured from Figure A4-1.1
(4) [0.78*(3)]
(5) Mean flow from WUI report
(6) Reliable flow; [0.6*(5)]
(7) Mean flow from WUI report
(8) Reliable flow; [0.75*(7)]
(9) Representative irrigation requirements from Annex D1, corresponding to HMV/E/MS cropping pattern
(10) Representative irrigation requirements from Annex D1, corresponding to HMV/E/YR/C cropping pattern
(11) [(6)*1000/(9)]
(12) [(8)*1000/(10)]
(13) Potential in-basin expansion calculated from areas in (11), (2) and (4)
(14) Potential in-basin expansion calculated from areas in (12), (2) and (4)
(15) Exportable surplus or restrictive deficit indicator calculated from areas in (11),(2) and (4)
(16) Exportable surplus or restrictive deficit indicator calculated from areas in (12), (2) and (4)



Source : LRMP maps and WUI maps.

Fig. A4-1.1

THE WORLD BANK / THE UNITED NATIONS DEVELOPMENT PROGRAMME
MASTER PLAN FOR IRRIGATION DEVELOPMENT IN NEPAL

Irrigation Development Area - Kabhre District

APPENDIX A4-2

HILL DISTRICT IRRIGATION DEVELOPMENT ASSESSMENT - PALPA DISTRICT

A4-2.1 - General

Palpa District is a Hill district located in the Western Development Region. It has a total mapped land area of about 136,600 ha, of which about 10,380 ha or 7.6 percent is classified as Siwalik or Middle Mountain valley (see Annex A1, Table A1-1). The principal town is Tansen, located near the center of the district. The principal land access route is the paved Butwal to Pokhara road, which traverses the district from south to north. Figure A4-2.1 summarizes relevant information in map form.

A4-2.2 - Land Resources

Of the total mapped Hill Valley area of 10,380 ha, 5,889 ha are classified as firmly irrigable and a further 1,538 ha are classified as tentatively irrigable (see Annex A2, Table A2-2). These areas have been outlined in Figure A4-2.1. It should be noted, however, that the total mapped irrigable valley area derived for this district in the Master Plan studies is 11,574 ha, based on land utilization analyses (see Annex A2, Table A2-3). It should also be noted that there is a further 219 ha of mapped irrigable area in the hill slope regions, corresponding to level terraces. This gives a total mapped irrigable area of 11,792 ha for the district.

For assessment purposes, irrigable areas need to be expressed as net areas. The derived net irrigable areas in Palpa are 8,735 ha in Hill Valleys and 122 ha in hill slopes, giving a district total of 8,857 ha (see Annex A2, Table A2-3). All of this area is classed as being under agricultural use at present.

A4-2.3 - Present Level of Development

Identified irrigation schemes in the district, most of which are located in the Hill Valleys, are estimated to cover a total net area of 3,367 ha (see Annex A1, Table A1-7). This represents 39 percent of the net Hill Valley irrigable land area, or 38 percent of total net irrigable area. All of these are farmer schemes; their areas are outlined in Figure A4-2.1.

Two DOI irrigation schemes are under construction in the district- the 282 ha Kachalphant project in the southwest, and the 760 ha Rampurphat project in the northeast. When these projects are completed, they will increase the total area under irrigation to 3,908 ha, after accounting for overlaps with existing farmer schemes.

It is estimated from the land utilization analyses that a further net area of 1,401 ha in the district may be under some form of unidentified irrigation (see Annex A1, Table A1-7). This area would include the hill slope level terraces and some Hill Valley areas in which there are no formal irrigation systems but which may be irrigated by direct withdrawal and field-to-field water transfer methods. If this broader interpretation of irrigation development is applied, then the present net level of development in the district could be as much as 4,765 ha or 54% of the total net irrigable area.

Of the identified FMIS NCA of 3,367 ha, 137 ha correspond to schemes that have received some form of agency assistance (see Annex A1, Table A1-5). DOI, ILO and HELVETAS have undertaken assistance programs in the district.

A4-2.4 - Water Resources

There are two principal river drainage basins in Palpa District, as shown in Figure A4-2.1. These are the Kali Gandaki and the Tinau river basins, which cover the north and most of the south of the district respectively. The Purba/Nisti Khola is a major tributary of the Kali Gandaki river in the district. There are also some further minor independent drainage basins in the south east of the district. Except in the case of the Tinau Khola in its upper reaches, the main rivers do not themselves serve as water sources for irrigation. This is because they are deeply incised and well below the level of most of the irrigable land areas; even lift pumping must normally be considered infeasible in the case of the main rivers. Irrigation supplies are generally withdrawn from the small tributary streams along which irrigable valleys are located.

A4-2.5 - Irrigation Development Assessment

The assessment of potential irrigation development in Palpa District was based on an office study supplemented by field visits and discussions with irrigation agency staff. The office study was restricted to the Kali Gandaki drainage basin only. This was because of the recognized water supply constraint to further irrigation development in the Tinau drainage basin; it was assumed that there is no potential for expansion of irrigation in this

basin. The study therefore consisted of an analysis of Kali Gandaki Hill Valley basins which had identified irrigation developments and/or firmly irrigable land areas; it provided estimates of land areas which could be reliably served for irrigation from the corresponding streams. The field visits and discussions served to complement the office study, by providing details of existing and planned developments, and by confirming or refuting the basin analyses or expanding on them.

Details and results of the office study are given in Table A4-2.1. The assessed basins had existing identified scheme net areas totalling 2,630 ha (78 percent of the district total of 3,367 ha) and net irrigable Hill Valley areas totalling 4,400 ha (50 percent of the district total of 8,735 ha). From the estimates of both land and water limitations to development in each individual basin, the study concluded that 90 percent of the 4,400 ha (3,985 ha) could be reliably served for monsoon season cropping and that 85 percent of it (3,745 ha) could be reliably served for year round cropping. This assessment assumed that there would be no transfer of water from surplus to deficit basins.

The field visits and discussions generally confirmed the results of the office study with regard to the ultimate irrigation development potential in the district, at least with respect to monsoon season irrigation. There are indications that the actual development potential for reliable year round irrigated cropping may be less than the assessed potential. For the Nisti Khola basin in particular, it was indicated that streamflow estimates used in the office study may be exaggerated. The Nisti Khola is a water surplus basin which is viewed as a potential source of water for westward water transfer to the water deficit basins of the Bau Khola and Tarundi Khola.

It has been assumed consistently in the Master Plan studies that any expansions in irrigation coverage in the hill slope (level terrace) will be minor. The present level of irrigation development in these areas has been assumed to be 100 percent of the irrigable area, using the definitions of irrigable agricultural land provided in Annex A1, Table A1-2.

A4-2.6 - Basin Specific Comments

The following paragraphs provide basin-specific comments resulting from the irrigation development assessment. The basins discussed are those that offer some potential for irrigation improvement or expansion; they would therefore need to be assigned priority for conducting more detailed studies and assessments. The basin numbers used for reference purposes are consistent with those of Figure A4-2.1 and Table A4-2.1.

Basin 1 Serdewa Khola

There is potential for expansion of the irrigated area in this basin. Estimated water supplies in October and March indicate that all of the remaining irrigable land should have access to sufficient water to permit year round (YR) irrigation. The remaining irrigable land is reportedly of good quality.

Basin 2 Kuru Khola

Estimated water supplies in October and March indicate that all of the remaining irrigable land should have access to sufficient water for monsoon (MS) irrigation. A small portion of the additional area could be irrigated during the winter season.

Basin 3 Barandi Khola

In this basin, about 103 ha has access to reliable irrigation water supplies. Estimated water supplies in October and March indicate that all of the remaining irrigable land should have access to sufficient water to permit year round irrigation. Expansion of the irrigated area should be possible with low cost interventions.

Basins 4 and 6 Godi Khola and Wasya Khola

Estimated water supplies from the Godi Khola and the Wasya Khola in October and March indicate that all of the remaining irrigable areas in each basin should have access to sufficient water to permit YR irrigation.

Basin 9 Bhattari Khola

Estimated water supplies in October and March indicate that there are water shortage problems in the Bhattari Khola basin. Hence expansion of the irrigated area is unlikely to be feasible.

Basin 14 and 15 Bandh Khola and Karande Khola

Estimated water supplies in October and March indicate that Karande Khola has surplus water, and that the Bandh Khola basin experiences water shortages. It should be possible to transfer surplus water to the deficit area, providing both basins with adequate water supplies. The combined flows of both basins are sufficient to meet the needs of all of the remaining irrigable land.

Basin 16 Jhamma Khola

In this basin, an estimated 60 ha of rainfed irrigable land is available for conversion to irrigation. Estimated water availability in October indicates that all irrigable land in the basin could be irrigated in the monsoon season. However, estimated supplies in March indicate that the entire irrigable area cannot be irrigated in the winter season. According to the Palpa District Engineer, however, the people in this basin are unlikely to participate actively in the implementation of a project.

Basins 17 and 18 Lide Khola and Gebdi Khola

Both of these basins have water shortage problems. Expansion to serve the remaining irrigable land is probably not possible.

Basin 19 and 20 Khahare Khola and Guhe Khola

Both of these basins have water shortage problems. Water availability calculations indicate that some expansion of irrigation should be possible, primarily with MS capability.

Basin 22 Turundi Khola

The Turundi Khola basin has water shortage problems, although some expansion of the irrigated area should be possible. Water availability calculations indicate that a total area of 181 ha can be provided with MS irrigation, and 104 ha with YR irrigation. Expanding to this degree would utilize about 40% of the remaining irrigable land.

Basin 23 Bau Khola

The Bau Khola basin experiences water shortage problems, and further expansion of the irrigated area is probably not possible.

Basin 25 Nisti Khola

The Rampurphat irrigation project is being executed by DOI, using water from the Nisti Khola basin. The estimated flow data indicate sufficient flows in October and March to serve the entire irrigable area within the basin for YR irrigation.

Had the water supply in Nisti Khola been sufficient, the command area of the Rampurphat project could presumably have been extended to the adjoining Randakhal area, which has good land potential but lacks water (Turundi Khola). Since this expansion was not undertaken, the estimated Nisti Khola flows may be overly optimistic.

Basin 8 Chhahare Khola

Under the Andhi Khola power project, which is under construction by the United Missions to Nepal (UMN), a total NCA of 84 ha in the Asardi area will receive irrigation water. The power project will divert 4 m^3/sec through a tunnel from the Andhi Khola basin to the Kali Gandaki basin. At the exit of the tunnel, the water will be divided into two parts -- 2.7 m^3/s allocated to power generation and 1.3 m^3/sec to irrigation. Out of the 1.3 m^3/s allocated to irrigation, 0.63 m^3/s will be used to irrigate land on the left bank of the Kali Gandaki in Syangja District, and 0.17 m^3/s will be used in the Asardi/ Hungi area of Palpa District. The water will be conveyed through steel pipes under pressure from the tunnel exit to the highest point of the Asardi command area. The pipes will cross the Kali Gandaki by means of a suspension bridge.

A4-2.7 - Recommended Further Studies

The principal basins offering potential for expansion of irrigated area in Palpa District are the Serdewa Khola, Wasya Khola, Bandh Khola, Jhamura Khola and Turundi Khola. Investigations of potential irrigation projects should be concentrated in these basins, to identify specific projects to develop the remaining "new" irrigation potential in Palpa District. The potential for further use of the Nisti Khola, beyond the requirements of the Rampurphat project, should also be investigated.

As in all of the surveyed districts, the potential for rehabilitating existing FMIS and for undertaking minor expansions of their NCA's should be treated on a project-specific basis, using the principles established under the Irrigation Sector Program. This represents a "bottom up" process, in which a farmer request prompts action by DOI to appraise a particular project. The present exercise represents a "top down" process, in which resource characteristics are used to identify potential projects.

TABLE A4-2.1

IRRIGATION DEVELOPMENT ASSESSMENT - PALPA DISTRICT

Assessed Basin/Stream Number	Name	Existing Scheme Command Areas Gross (ha) (1)	Net (ha) (2)	Remaining Irrigable Area Mapped (ha) (3)	Net (ha) (4)	Streamflow Estimates October Mean (m3/s) (5)	Rel. (m3/s) (6)	March Mean (m3/s) (7)	Rel. (m3/s) (8)	Repr.Irrig.Req. October MS (L/s/ha) (9)	March YR (L/s/ha) (10)	Net Reliably Irrigable Areas MS (ha) (11)	YR (ha) (12)	Net Potential Expansion Areas MS (ha) (13)	YR (ha) (14)	Further Water Availability MS (15)	YR (16)
1	Serdewa Khola	341	272	195	146	2.98	1.79	0.47	0.36	2.32	0.83	769	428	146	146	Surplus	Surplus
2	Kuru Khola	300	240	50	38	1.64	0.98	0.26	0.20	2.32	0.83	423	239	38	0	Surplus	Deficit
3	Barandi Khola	129	103	42	32	0.98	0.59	0.16	0.12	2.32	0.83	254	145	32	32	Surplus	Surplus
4	Godi Khola	90	72	12	9	1.06	0.64	0.17	0.13	2.32	0.83	274	155	9	9	Surplus	Surplus
5	Landi Khola	40	32	0	0	0.58	0.35	0.10	0.07	2.32	0.83	149	86	0	0	Surplus	Surplus
6	Wasya Khola	84	67	144	108	3.68	2.21	0.59	0.44	2.32	0.83	953	529	108	108	Surplus	Surplus
7	Saudi Khola	77	62	0	0	0.86	0.51	0.14	0.11	2.32	0.83	222	127	0	0	Surplus	Surplus
8	Chhahare Khola	10	8	19	14	0.14	0.08	0.02	0.02	2.32	0.83	36	22	14	14	Surplus	Deficit
9	Bhattari Khola	25	20	16	12	0.05	0.03	0.01	0.01	2.32	0.83	13	8	0	0	Deficit	Deficit
10	Khahare Khola	55	44	0	0	0.11	0.06	0.02	0.01	2.32	0.83	28	16	0	0	Deficit	Deficit
11	Daure Khola	7	5	0	0	0.20	0.12	0.03	0.03	2.32	0.83	52	31	0	0	Surplus	Surplus
12	Bojha Khola	15	12	0	0	0.04	0.02	0.03	0.02	2.32	0.83	11	23	0	0	Deficit	Surplus
13	Gahari Khola	10	8	0	0	0.07	0.04	0.01	0.01	2.32	0.83	19	12	0	0	Surplus	Surplus
14	Bandh Khola	48	38	148	111	0.40	0.24	0.07	0.05	2.32	0.83	102	60	64	22	Deficit	Deficit
15	Karande Khola	42	34	17	13	1.27	0.76	0.21	0.15	2.32	0.83	328	186	13	13	Surplus	Surplus
16	Jhamma Khola	183	146	80	60	1.13	0.68	0.18	0.14	2.32	0.83	292	166	60	20	Surplus	Deficit
17	Lide Khola	20	16	6	5	0.09	0.05	0.02	0.01	2.32	0.83	23	14	5	0	Surplus	Deficit
18	Gebdi Khola	66	52	12	9	0.12	0.07	0.02	0.02	2.32	0.83	32	19	0	0	Deficit	Deficit
19	Khahare Khola	66	53	31	23	0.31	0.19	0.05	0.04	2.32	0.83	81	47	23	0	Surplus	Deficit
20	Guhe Khola	3	2	92	69	0.15	0.09	0.03	0.02	2.32	0.83	39	23	36	20	Deficit	Deficit
21	Sukmadi Khola	30	24	0	0	0.05	0.03	0.03	0.02	2.32	0.83	12	25	0	0	Deficit	Surplus

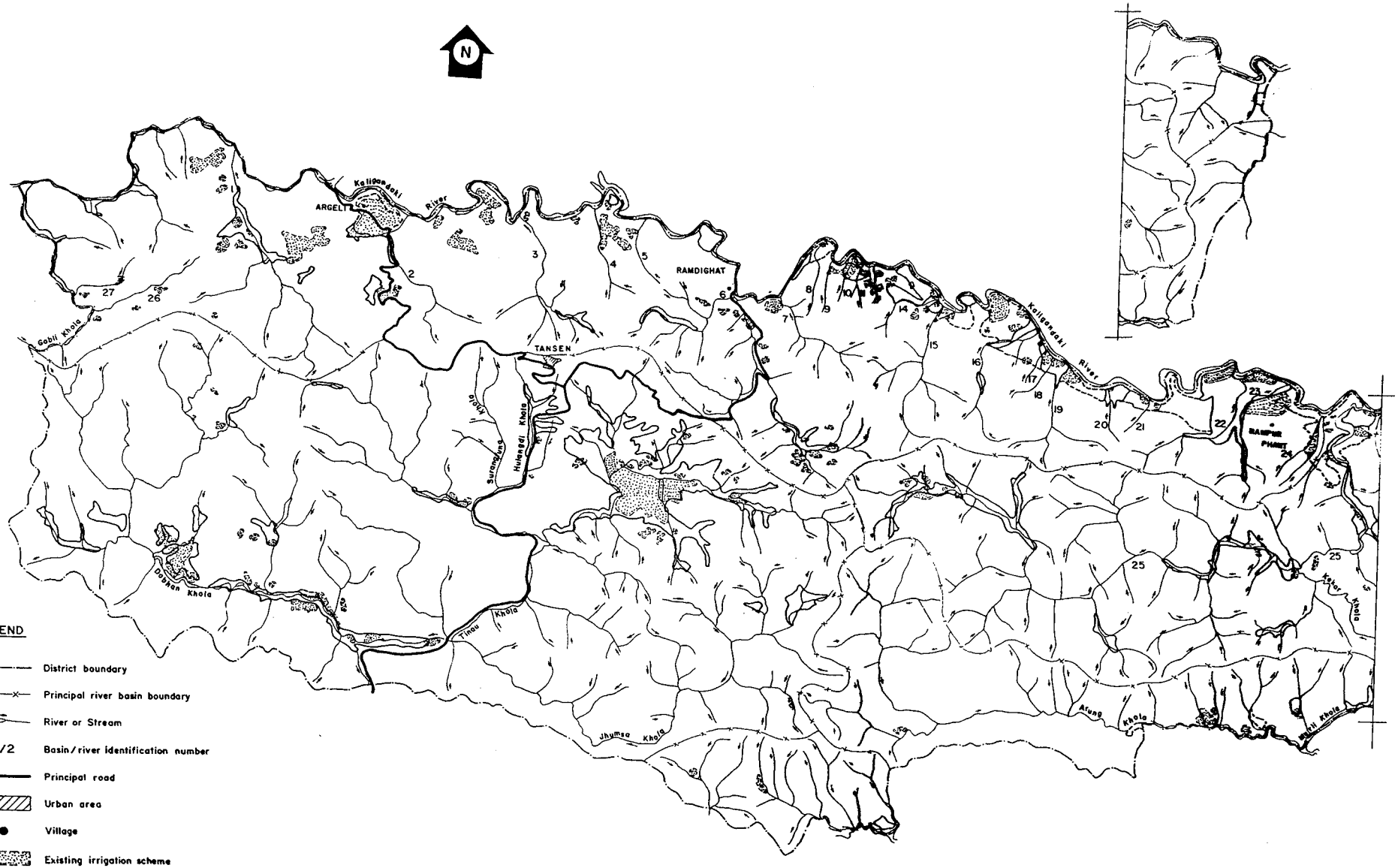
TABLE A4-2.1 (continued)

IRRIGATION DEVELOPMENT ASSESSMENT - PALPA DISTRICT

Assessed Basin/Stream Number	Name	Existing Scheme Command Areas Gross (ha) (1)	Net (ha) (2)	Remaining Irrigable Area Mapped (ha) (3)	Net (ha) (4)	Streamflow Estimates October Mean (m3/s) (5)	Rel. (m3/s) (6)	March Mean (m3/s) (7)	Rel. (m3/s) (8)	Repr.Irrig.Req. October MS (L/s/ha) (9)	March YR (L/s/ha) (10)	Net Reliably Irrigable Areas MS (ha) (11)	YR (ha) (12)	Net Potential Expansion Areas MS (ha) (13)	YR (ha) (14)	Further Water Availability MS (15)	YR (16)
22	Turundi Khola	56	45	325	244	0.70	0.42	0.12	0.09	2.32	0.83	181	104	136	59	Deficit	Deficit
23	Bau Khola	372	297	276	207	1.09	0.65	0.18	0.13	2.32	0.83	281	159	0	0	Deficit	Deficit
24	Andheri Khola	53	42	0	0	0.39	0.23	0.06	0.05	2.32	0.83	100	58	0	0	Surplus	Surplus
25	Nisti Khola	1150	920	895	671	13.24	7.95	2.05	1.54	2.32	0.83	3425	1851	671	671	Surplus	Surplus
26	Lamachar Khola	18	14	0	0	0.67	0.40	0.11	0.08	2.32	0.83	173	99	0	0	Surplus	Surplus
27	Pondhare Khola	7	5	0	0	NA	NA	NA	NA	2.32	0.83	NA	NA	NA	NA	NA	NA
Total Assessed Basins (Excl. NA)		3288	2630	2360	1770							8271	4630	1355	1113		

Notes :

(1) Aggregated from WUI report
(2) [0.8*(1)]
(3) Measured from Figure A4-2.1
(4) [0.75*(3)]
(5) Mean flow from WUI report
(6) Reliable flow; [0.6*(5)]
(7) From WUI report
(8) Reliable flow; [0.75*(7)]
(9) Representative irrigation requirements from Annex D1, corresponding to HMV/W/MS cropping pattern
(10) Representative irrigation requirements from Annex D1, corresponding to HMV/W/YR/C cropping pattern
(11) [(6)*1000/(9)]
(12) [(8)*1000/(10)]
(13) Potential in-basin expansion calculated from areas in (11), (2) and (4)
(14) Potential in-basin expansion calculated from areas in (12), (2) and (4)
(15) Exportable surplus or restrictive deficit indicator calculated from areas in (11), (2) and (4)
(16) Exportable surplus or restrictive deficit indicator calculated from areas in (12), (2) and (4)



Source : LRMP maps and WUI maps.

Fig. A4-2.1

THE WORLD BANK/ THE UNITED NATIONS DEVELOPMENT PROGRAMME
MASTER PLAN FOR IRRIGATION DEVELOPMENT IN NEPAL

Irrigation Development Area – Palpa District

APPENDIX A4-3

HILL DISTRICT IRRIGATION DEVELOPMENT ASSESSMENT - SURKHET DISTRICT

A4-3.1 - General

Surkhet District is a Hill district located in the Mid Western Development Region. It has a total mapped land area of about 240,000 ha, of which about 33,865 ha or 13.6 percent is classified as Siwalik or Middle Mountain valley (see Annex A1, Table A1-1). The principal town is Birendranagar, located in the Surkhet valley at the center of the district. The principal land access route is the paved and gravel topped Nepalgunj to Birendranagar road, which enters the district from the south. Figure A4-3.1 summarizes relevant information in map form.

A4-3.2 - Land Resources

Of the total mapped Hill Valley area of 33,865 ha, 20,469 ha are classified as firmly irrigable and a further 5,534 ha are classified as tentatively irrigable (see Annex A2, Table A2-2). These areas have been outlined in Figure A4-3.1. It should be noted that the total mapped irrigable valley area derived for this district in the Master Plan studies is 22,659 ha, based on land utilization analyses (see Annex A2, Table A2-3). It should also be noted that there is a further 2,368 ha of mapped irrigable area in the hill slope regions, corresponding to level terraces. This gives a total mapped irrigable area of 25,027 ha for the district (see Table A2-3).

For assessment purposes, irrigable areas need to be expressed as net areas. The derived net irrigable areas in Surkhet are 18,165 ha in Hill Valleys and 1,110 ha in hill slopes, giving a district total of 19,275 ha (see Annex A2, Table A2-3). Most of this area is classed as being under agricultural use at present.

A4-3.3 - Present Level of Development

Identified irrigation schemes in the district, most of which are located in the Hill Valleys, are estimated to cover a total net area of 9,862 ha (see Annex A1, Table A1-7). This represents 54 percent of the net Hill Valley irrigable land area, or 51 percent of total net irrigable area. All of these are farmer schemes; their areas are outlined in Figure A4-3.1.

The land utilization analyses indicate that there is no further area in the district which may be under some form of unidentified irrigation (see Annex A1, Table A1-7). However, some of the irrigated hill slope level terraces would be expected to fall into this category.

None of the identified FMIS (NCA 9,862 ha) have been identified in Annex A1 as having received any form of agency assistance (see Annex A1, Table A1-5). However, some assistance to farmer schemes has been and continues to be provided in the district by the Karnali-Bheri Integrated Rural Development (K-BIRD) project through MPLD and DOI. These areas are included in the "Undefined Projects" figures provided in Table A1-5.

A4-3.4 - Water Resources

There are two principal river drainage basins in Surkhet District, as shown in Figure A4-3.1. These are the Karnali river basin, which covers the northwestern part of the district, and the Bheri river basin, which covers the balance of the district. The Chingar Khola is a major tributary of the Bheri river in the district. The main rivers do not themselves serve as water sources for irrigation. This is because they are deeply incised and well below the level of most of the irrigable land areas; even lift pumping must normally be considered infeasible in the case of the main rivers. Irrigation supplies are withdrawn from the small tributary streams along which irrigable valleys are located.

A4-3.5 - Irrigation Development Assessment

The assessment of potential irrigation development in Surkhet District was based on an office study supplemented by field visits and discussions with irrigation agency staff. The office study consisted of an analysis of Hill Valley basins which had identified irrigation developments and/or firmly irrigable land areas; it provided estimates of land areas which could be reliably served for irrigation from the corresponding streams. The field visits and discussions served to complement the office study, by providing details of existing and planned developments, and by confirming or refuting the basin analyses or expanding on them.

Details and results of the office study are given in Table A4-3.1. The assessed basins had existing identified scheme net areas totalling 9,688 ha (98 percent of the district total of 9,862 ha) and net irrigable Hill Valley areas totalling 14,122 ha (78 percent of the district total of 18,165 ha). From the estimates of both land and water limitations to development in each individual basin, the study concluded that 90 percent of the 14,122 ha (12,695 ha)

could be reliably served for monsoon season cropping, and that 81 percent of it (11,448 ha) could be reliably served for year round cropping. This assessment assumed that there would be no transfer of water from surplus to deficit basins.

The field visits and discussions generally confirmed the results of the office study with regard to the ultimate irrigation development potential in the district, although it was felt that the actual potential for reliable year round irrigation may be less than the assessed potential. Attention was focused particularly on the water deficit situation in the Surkhet valley (Nikas Khola basin) and in other valleys just to the east (Gam Khola, Kagati Khola, Tusare Khola and Korelli Khola basins). It was further indicated that potential development in the adjacent Jhupra Khola basin, which has a water surplus, could not proceed due to the presence of a hydro-electric power plant downstream from the irrigable areas. By contrast, the Chingar Khola and its tributaries, located in the centre of this area, have a large water surplus and little in-basin irrigation potential. A study is under way to determine the feasibility of water transfer westward from the Chingar Khola basin to the Surkhet valley, via the Jhupra Khola. It is noted that this would be quite a long diversion system, and it is suggested that the possibilities of shorter southward water transfer systems to serve some of the other water deficit basins should also be examined.

It has been assumed consistently in the Master Plan studies that any expansions in irrigation coverage in the hill slopes (level terraces) will be minor. The present level of irrigation development in these areas has been assumed to be 100 percent of the irrigable area, using the definitions of irrigable agricultural land provided in Annex A1, Table A1-2.

A4-3.6 - Basin-Specific Comments

The following paragraphs provide basin-specific comments resulting from the irrigation development assessment. The basins emphasized are those which offer some potential for irrigation improvement or expansion; they would therefore need to be assigned priority in conducting more detailed studies and assessments. The basin numbers used for reference purposes are consistent with those of Figure A4-3.1 and Table A4-3.1.

Basin 1 Limu Khola

Estimated water supplies in October and March indicate that year round (YR) irrigation should be possible for all irrigable land in the basin. The remaining irrigable areas could be irrigated either by gravity or by low lift pumping.

Basin 2 Mauriban Khola

Estimated water supplies in Mauriban Khola indicate that existing irrigated areas have access to reliable water supplies for YR irrigation, but that significant expansion will be difficult to achieve. Some of the remaining irrigable land can be irrigated during the monsoon season, but significant water shortages will limit winter cropping.

Basin 3 and 4 Mallanga Khola and Baldo Khola

Water surpluses are indicated in both of these basins.

Basins 5, 6 and 7 Bhumka Khola, Kewari Khola and Karpa Khola

All of the irrigable land in the Bhumka Khola and Kewari Khola basins has been developed for irrigation and water balance calculations indicate that water shortages are likely. Additional irrigable land is available in the Karpa Khola basin, but water availability is not adequate to permit any expansion.

Basin 8 Basanti Khola

Estimated March and October flows in the tributaries of Basanti Khola indicate surplus water availability in the monsoon season and sufficient water for some expansion of winter cropping. It should be possible, therefore, to provide all of the remaining irrigable land with MS irrigation, and a portion of it with YR irrigation.

Basin 9 Kuliban Khola

Water balance calculations for the Kuliban Khola basin as a whole indicate that adequate water supplies are available to serve the existing irrigated area during the monsoon season, with minor shortfalls likely in the winter season. The individual assessments of tributaries indicate surpluses in most areas, but significant deficits in the Bhyagute/Khamare Khola catchment. During the field visit it was established that systems in this area have been improved with DOI assistance, with extensions to the irrigable area up to the Maigad/Dhandure catchment area. Conflicts among FMIS during periods of water scarcity were reported. Given the water availability situation, expansion of irrigated area should be planned with caution, restricting it to the sub-basins which have surplus water supplies.

Basin 10 Sot Khola

Water surpluses, enabling the development of all remaining irrigable areas for YR irrigation, are indicated for this basin.

Basin 11 Simalchaur Khola

Estimated flows for October and March indicate that all of the irrigable area in the basin could be developed for MS irrigation, and much of it could also receive winter irrigation. However, much of the undeveloped irrigable area is forested, which makes it unlikely that it will be developed for irrigation.

Basin 12 Nikas Khola

This important basin drains the entire Surkhet valley, where much of the population and economic activity of Surkhet District is concentrated. Figure A4-3.2 provides an enlarged view of the basin, identifying most of the tributaries numbered in Table A4-3.1, which was not possible in Figure A4-3.1. Water balance calculations for the overall basin indicate that significant water shortages can be expected for both MS and YR irrigation, and that expansion beyond the existing level of development will be difficult to achieve. Calculations for individual tributaries indicate that shortages are concentrated in the Dundhara Khola, Khorke Khola and the Nimare Khola, and that the most severe shortages can be expected in the Itram Khola basin. These conclusions were verified during the field visit.

The flow pattern of most of the tributaries of the Nisti Khola is characterized by the disappearance of surface flows during the dry season, at locations about 1 km downstream from the foothills, at approximately elevation 710 m. Flows typically reappear at approximately elevation 670 m, for example in the vicinity of the village of Bulbule. This water is used in FMIS in the lower basin, but no quantitative studies have been carried out to assess the effects of this surface/subsurface flow combination on ultimate irrigation development potential. It is not known, therefore, whether all flows re-emerge or whether the lower basin FMIS have the capacity to use all of the available flows.

DOI has constructed a deep cutoff wall at a new headworks structure on the upper Khorke Khola. This appears to have increased the availability of low flows, benefitting the irrigation scheme at that location. No reduction in the volume of water that re-emerges in the lower basin has been reported

as a result of the construction of the cutoff wall. DOI is considering the construction of cutoff walls at other irrigation diversion points on the Nikas Khola tributaries, where conditions permit.

The potential for alleviating water shortages in the Surkhet valley using diversions from adjacent water surplus watersheds is currently under study. Two river basins - Jhupra Khola (Basin 13) and Chingar Khola (Basin 14) - are candidates for diversion schemes. The Jhupra Khola lacks sufficient water in its headwaters, from which a gravity diversion could be effected, and an existing small hydro development beneficially uses all available flows. The Chingar Khola appears to be more suitable, and studies began in 1989 of a scheme to direct flows to the Surkhet valley via a 20 km canal.

Further studies to develop the most cost-effective program for water resource development in the Surkhet valley should consider the following points :

a) The effect on the overall water balance of constructing cutoff walls in the upper tributaries.

b) Available means for alleviating waterlogging in parts of the lower Surkhet valley, and their relationship to the surface/subsurface flow mix.

c) The potential to conserve water through the adoption of low water use irrigation methods and cropping patterns. Such measures could include the adoption of sprinkler or drip irrigation with high value cash crops.

d) The opportunity cost of the waters of the Chingar Khola. The potential benefits of using this water in the Surkhet valley should be compared with the benefits of using it in other water short basins. It may be possible to benefit more than one basin with diverted waters (Nisti Khola valley, Gam Khola valley, and the Ramghat area).

Basin 13 Karai/Jhupra Khola

Water balance calculations indicate that sufficient water should be available in this basin to permit development of all irrigable lands for YR irrigation. The 345 kw Jhupra hydroelectric projects on this stream has restricted upstream irrigation development in the past. However, the recent connection of Surkhet District to the national power good may allow the restrictions to be relaxed, permitting all of the irrigable area to be developed.

Basin 14 Chingar Khola

Water surpluses are indicated for this basin, enabling the development of all remaining irrigable areas for YR irrigation. It may also be possible to transfer surplus water to the Surkhet valley (Basin 12), Gam Khola (Basin 15), or to the Ramghat area (Basin 26).

Basin 15 Gam Khola

Water balance calculations indicate that water shortages are currently experienced in this basin, as the water supplies are inadequate to serve the existing irrigated area. This was confirmed during the field visit, when it was reported that acute water shortages are experienced in the winter, and that water-related conflicts are common among the FMIS. DOI has assisted one left bank FMIS by providing technical assistance and some repair works. The main canal, which now commands a NCA of 115 ha, has been extended beyond Kagati Khola on the left bank. If any expansion of irrigation is to be achieved in this basin, water supplies must be augmented. The most likely source is the Chingar Khola (Basin 14).

Basin 16 Kagati Khola

Existing Kagati Khola irrigation systems are located on both banks of the khola north of Dashrathpur village. In the upper reach of the stream there is a water turbine which is used for milling of paddy, maize, wheat and oilseed. No estimates of streamflows were available for the Kagati Khola, but the existing area reportedly receives adequate water supplies to permit MS irrigation, with a portion of the area being irrigated during the winter. It is unlikely that any of the remaining irrigable area can be developed for irrigation.

Basin 17 Khar Khola/Tushare Khola

Water balance calculations indicate that both the Khar khola and Tushare Khola have inadequate water supplies in October and March. DOI has conducted a prefeasibility study of a potential 150 ha irrigation scheme, drawing water from the Khar Khola. The feasibility of this project should be carefully reviewed, as water shortages are likely. No further development of the remaining irrigable area in the basin is likely to be possible.

Basin 18 and 19 Betaini Khola and Ghum Khola

Water balance calculations indicate that water supplies in October and March are inadequate to serve the existing irrigated area. Water-related conflicts are reported to be common in these basins, especially in the winter. Development of the remaining irrigable area is unlikely to be feasible.

Basin 21 Simte Khola

Water balance calculations indicate that there is a surplus of water in all seasons, permitting development of all of the remaining irrigable area. The Kaprichaure project, which DOI is constructing in the basin, will improve existing FMIS and extend irrigation to the Rukamchaur area. This will virtually complete the development of irrigable lands in this basin.

Basin 22 Khare Khola

Water balance calculations indicate that all of the irrigable lands in the basin can be provided with adequate water supplies for MS irrigation, with only minor shortfalls in the winter season. Under the K-BIRD project, a scheme to transfer water from the Gochhe Khola (Basin 23) was studied, but it was found to be infeasible.

Basin 23/1 Amkholi Khola

Water balance calculations for Basin 23 as a whole indicate that all irrigable lands can be provided with MS irrigation, and that a portion of the remaining irrigable area could be provided with winter water supplies as well. In the Amkholi Khola sub-basin, DOI and K-BIRD are studying a scheme to use Gochhe Khola waters to supplement water supplies from the Amkholi Khola to serve existing FMIS in the Sahare area.

Basin 23/2, 23/3, 23/4, 23/5 Gochhe Khola

As noted above, the Gochhe Khola basin as a whole has adequate water supplies to develop all irrigable lands for MS irrigation. DOI is developing a 50 ha project on the upper left bank of the Gochhe Khola. Further development should be possible on the lower right bank of the Gochhe Khola, although an earlier prefeasibility study conducted by DOI found a project in this area to be infeasible. Improvements to existing projects in sub-basins 23/2, 23/3 and 23/4 can be achieved by providing supplementary water from the Gochhe Khola, and an area on the left bank of the Bheri River can be provided with water for MS

irrigation. Since some of the Gochhe Khola flows will be diverted in future to the Jigne Khola (Basin 24), studies of further development of lands in the Gochhe Khola basin should be based on post-diversion conditions.

Basin 24 Jigne Khola

Water balance calculations for the Jigne Khola indicate severe water shortages for both MS and YR irrigation of the existing irrigated area. A K-BIRD sponsored project to alleviate these water shortages via a diversion from the Gochhe Khola is under construction. Development of the remaining irrigable area in the Jigne Khola basin is unlikely to be feasible, due to water supply limitations.

Basin 25 Nachne Khola

Water balance calculations indicate that ample water supplies are available for YR irrigation of all irrigable land in the basin. Development of the remaining irrigable area should therefore be feasible from the water supply viewpoint.

Basin 26 Korelli Khola

Water balance calculations indicate that this basin has insufficient water to serve the existing irrigated lands, even at the MS level. The only means available to improve the situation would be a scheme to transfer water from the Chingar Khola (Basin 14), or to lift water from the Bheri River. Neither of these alternatives are likely to be feasible.

Basin 27 Chhinchu Khola

The Chhinchu Khola basin has sufficient water to provide YR irrigation to all existing irrigation schemes and all potential irrigable areas. This conclusion, which was reached from water balance calculations, was confirmed during the field visit. DOI is providing assistance to construct a new irrigation system in the upper Hathikhel Khola, to serve an overall NCA of 115 ha.

Basin 28-33, 35 **Hallerighat, Magar, Khante, Battisi, Chhahre, and Rujkha Kholas, and Rajigaon Spring**

Water balance calculations indicate that all of these basins have surplus water in the months of October and March, indicating that all irrigable areas can be developed for YR irrigation.

Basin 34 and 36 **Sajhamul/Baghphyle Khola and Golfa Khola**

Water balance calculations indicate that both of these small basins experience water shortages at many times of the year, and that there is little potential for expanding irrigation to the remaining irrigable areas.

A4-3.7 - Recommended Further Studies

Proposed further studies are outlined in Section A4-3.6 for the water-short Nikas Khola basin. Apart from the studies of this basin and the potential schemes to divert water to it, studies of future development potential should concentrate on those basins with water surpluses. The principal basins with good prospects for expansion of irrigated area are the Basanti Khola, Jhupra Khola, Chingar Khola, and Gochhe Khola.

As in all of the surveyed districts, the potential for rehabilitating existing FMIS and for undertaking minor expansions of their NCA's should be treated on a project-specific basis, using the principles established under the Irrigation Sector Program. This represents a "bottom up" process, in which a farmer request prompts action by DOI to appraise a particular project. The present exercise represents a "top down" process, in which resource characteristics are used to identify potential projects.

IRRIGATION DEVELOPMENT ASSESSMENT - SURKHET DISTRICT

Assessed Basin/Stream Number	Name	Existing Scheme Command Areas Gross (ha) (1)	Net (ha) (2)	Remaining Irrigable Area Mapped (ha) (3)	Net (ha) (4)	Streamflow Estimates October Mean (m3/s) (5)	Rel. (m3/s) (6)	March Mean (m3/s) (7)	Rel. (m3/s) (8)	Repr.Irrig.Req. October MS (L/s/ha) (9)	March YR (L/s/ha) (10)	Net Reliably Irrigable Areas MS (ha) (11)	YR (ha) (12)	Net Potential Expansion Areas MS (ha) (13)	YR (ha) (14)	Further Water Availability MS (15)	YR (16)
1	Limu Khola	159	127	194	146	1.95	1.17	0.34	0.26	2.32	0.83	504	307	146	146	Surplus	Surplus
2	Mauriban Khola	25	20	50	38	0.21	0.13	0.04	0.03	2.32	0.83	54	36	34	16	Deficit	Deficit
3	Mallanga Khola	12	10	47	35	0.38	0.23	0.07	0.05	2.32	0.83	98	63	35	35	Surplus	Surplus
4	Baldo Khola	26	21	6	5	0.57	0.34	0.11	0.08	2.32	0.83	147	99	5	5	Surplus	Surplus
5/1	Bhumka Khola	80	64	0	0	0.17	0.10	0.03	0.02	2.32	0.83	44	27	0	0	Deficit	Deficit
5/2	Nauli Khola	0	0	0	0	0.50	0.30	0.10	0.08	2.32	0.83	129	90	0	0	Surplus	Surplus
5/3	Dung Khola (incremental)	128	102	0	0	0.43	0.26	0.07	0.05	2.32	0.83	111	63	0	0	Surplus	Deficit
	Total	207	166	0	0	1.10	0.66	0.20	0.15	2.32	0.83	284	181	0	0	Surplus	Surplus
6	Kewari Khola	64	51	0	0	0.09	0.05	0.02	0.02	2.32	0.83	23	18	0	0	Deficit	Deficit
7	Karpa Khola	184	147	67	50	0.21	0.13	0.04	0.03	2.32	0.83	54	36	0	0	Deficit	Deficit
8/1	Jeunerital/Simket Khola	97	77	NA	NA	0.75	0.45	0.14	0.11	2.32	0.83	194	127	NA	NA	NA	NA
8/2	Guttu/Jamule Khola	393	314	NA	NA	2.86	1.72	0.49	0.37	2.32	0.83	740	443	NA	NA	NA	NA
8/3	Biju Khola	134	107	NA	NA	1.06	0.64	0.19	0.14	2.32	0.83	274	172	NA	NA	NA	NA
8/4	Basanti Khola (incremental)	86	69	NA	NA	1.98	1.19	0.14	0.11	2.32	0.83	512	127	NA	NA	NA	NA
	Total	709	567	904	678	6.65	3.99	0.96	0.72	2.32	0.83	1720	867	678	300	Surplus	Deficit
9/1	Maigad/Dandhure Khola	102	81	NA	NA	1.29	0.77	0.23	0.17	2.32	0.83	334	208	NA	NA	NA	NA
9/2/1	Bhyagute/Khanare Khola	575	460	NA	NA	1.13	0.68	0.21	0.16	2.32	0.83	292	190	0	0	NA	NA
9/2/2	Singalighat Khola	70	56	NA	NA	0.43	0.26	0.08	0.06	2.32	0.83	111	72	NA	NA	NA	NA
9/2/3	Palote Khola	260	208	NA	NA	0.89	0.53	0.16	0.12	2.32	0.83	230	145	NA	0	NA	NA
9/2/4	Kota Khola	56	45	NA	NA	0.22	0.13	0.04	0.03	2.32	0.83	57	36	NA	0	NA	NA
9/2/5	Dharapani/Saktipur Khola	58	46	NA	NA	0.53	0.32	0.10	0.08	2.32	0.83	137	90	NA	NA	NA	NA
9/2/6	Srichaur Khola	59	47	NA	NA	0.11	0.07	0.02	0.02	2.32	0.83	28	18	0	0	NA	NA
9/2/7	Gaddele Khola (incremental)	67	54	NA	NA	0.70	0.42	0.12	0.09	2.32	0.83	181	108	NA	NA	NA	NA
9/3	Kuliban Khola (incremental)	40	32	NA	NA	0.79	0.47	0.04	0.03	2.32	0.83	204	36	NA	NA	NA	NA
	Total	1286	1028	798	599	6.09	3.65	1.00	0.75	2.32	0.83	1575	904	547	0	Deficit	Deficit
10/1	Dhanighat Khola	69	55	NA	NA	1.12	0.67	0.20	0.15	2.32	0.83	290	181	NA	NA	NA	NA
10/2	Sot Khola (incremental)	159	127	NA	NA	5.83	3.50	0.95	0.71	2.32	0.83	1508	858	NA	NA	NA	NA
	Total	228	182	98	74	6.95	4.17	1.15	0.86	2.32	0.83	1797	1039	74	74	Surplus	Surplus
11/1	Khetkhori Khola	34	27	NA	NA	0.48	0.29	0.09	0.07	2.32	0.83	124	81	NA	NA	NA	NA
11/2	Simalchaur Khola	32	26	NA	NA	0.54	0.32	0.10	0.08	2.32	0.83	140	90	NA	NA	NA	NA
	Total	66	52	205	154	1.02	0.61	0.19	0.14	2.32	0.83	264	172	154	119	Surplus	Deficit

TABLE A4-3.1 (continued)

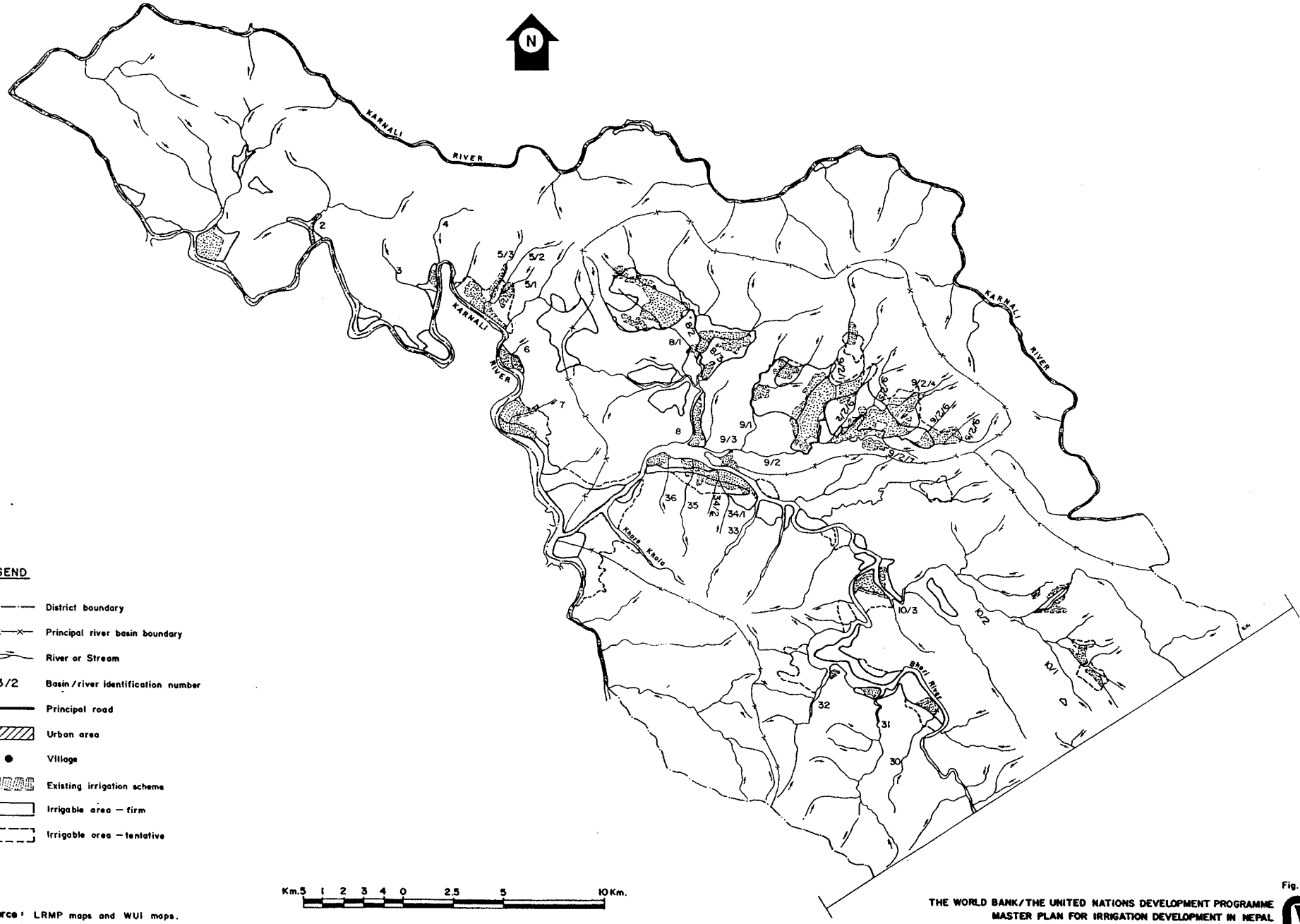
IRRIGATION DEVELOPMENT ASSESSMENT - SURKHET DISTRICT

Assessed Basin/Stream Number	Name	Existing Scheme Command Areas Gross (ha) (1)	Net (ha) (2)	Remaining Irrigable Area Mapped (ha) (3)	Net (ha) (4)	Streamflow Estimates October Mean (m3/s) (5)	Rel. (m3/s) (6)	March Mean (m3/s) (7)	Rel. (m3/s) (8)	Repr.Irrig.Req. October MS (L/s/ha) (9)	March YR (L/s/ha) (10)	Net Reliably Irrigable Areas MS (ha) (11)	YR (ha) (12)	Net Potential Expansion Areas MS (ha) (13)	YR (ha) (14)	Further Water Availability MS (15)	YR (16)
12/1	Bharuli Khola	196	157	NA	NA	1.36	0.82	0.24	0.18	2.32	0.83	352	217	NA	NA	NA	NA
12/2	Danne Khola	88	71	NA	NA	0.26	0.16	0.05	0.04	2.32	0.83	67	45	0	0	NA	NA
12/3	Utterganga Khola	77	62	NA	NA	0.15	0.09	0.03	0.02	2.32	0.83	39	27	0	0	NA	NA
12/4	Duwale Khola	39	31	NA	NA	0.57	0.34	0.11	0.08	2.32	0.83	147	99	NA	NA	NA	NA
12/5	Dhundhare Khola	160	128	NA	NA	0.11	0.07	0.02	0.02	2.32	0.83	28	18	0	0	NA	NA
12/6	Khorke Khola	934	747	NA	NA	2.25	1.35	0.39	0.29	2.32	0.83	582	352	0	0	NA	NA
12/7	Itran Khola	1274	1019	NA	NA	1.38	0.83	0.25	0.19	2.32	0.83	357	226	0	0	NA	NA
12/8	Nimare Khola	313	250	NA	NA	0.48	0.29	0.09	0.07	2.32	0.83	124	81	0	0	NA	NA
	Nikas Khola Total	3081	2365	925	694	6.56	3.94	1.18	0.89	2.32	0.83	1697	1066	0	0	Deficit	Deficit
13/1	Karai Khola	169	135	0	0	NA	NA	NA	NA	2.32	0.83	NA	NA	NA	NA	NA	NA
13/2	Jhupra Khola (incremental)	41	32	220	165	NA	NA	NA	NA	2.32	0.83	NA	NA	NA	NA	NA	NA
	Total	210	168	220	165	4.72	2.83	0.80	0.60	2.32	0.83	1221	723	165	165	Surplus	Surplus
14/1	Kol Khola	83	66	72	54	0.71	0.43	0.13	0.10	2.32	0.83	184	117	54	51	Surplus	Deficit
14/2	Chingar Khola (incremental)	0	0	287	215	10.76	6.46	1.72	1.29	2.32	0.83	2783	1554	215	215	Surplus	Surplus
	Total	83	66	359	269	11.47	6.88	1.85	1.39	2.32	0.83	2966	1672	269	269	Surplus	Surplus
15	Gam Khola	317	253	42	32	0.55	0.33	0.10	0.08	2.32	0.83	142	90	0	0	Deficit	Deficit
16	Kagati Khola	90	72	216	162	NA	NA	NA	NA	2.32	0.83	NA	NA	NA	NA	NA	NA
17/1	Khar Khola	50	40	NA	NA	NA	NA	NA	NA	2.32	0.83	NA	NA	NA	NA	NA	NA
17/2	Tushare Khola	942	753	NA	NA	NA	NA	NA	NA	2.32	0.83	NA	NA	NA	NA	NA	NA
	Total	992	793	255	191	1.98	1.19	0.35	0.26	2.32	0.83	512	316	0	0	Deficit	Deficit
18	Betaini Khola	693	555	62	47	1.35	0.81	0.24	0.18	2.32	0.83	349	217	0	0	Deficit	Deficit
19	Ghum Khola	449	359	66	50	0.93	0.56	0.17	0.13	2.32	0.83	241	154	0	0	Deficit	Deficit
20	Barmajar Khola	11	8	0	0	NA	NA	NA	NA	2.32	0.83	NA	NA	NA	NA	NA	NA
21	Simte Khola	483	386	160	120	5.01	3.01	0.84	0.63	2.32	0.83	1296	759	120	120	Surplus	Surplus
22	Khare Khola	142	113	44	33	0.79	0.47	0.15	0.11	2.32	0.83	204	136	33	22	Surplus	Deficit
23/1	Amkholi Khola	169	135	NA	NA	0.24	0.14	0.05	0.04	2.32	0.83	62	45	0	0	NA	NA
23/2	Kurmi Khola	36	28	NA	NA	0.57	0.34	0.11	0.08	2.32	0.83	147	99	NA	NA	NA	NA
23/3	Punyar Khola	234	187	NA	NA	0.38	0.23	0.07	0.05	2.32	0.83	98	63	NA	NA	NA	NA
23/4	Nakale Khola	86	68	NA	NA	0.46	0.28	0.09	0.07	2.32	0.83	119	81	NA	NA	NA	NA
23/5	Gochhe Khola (incremental)	281	225	NA	NA	3.28	1.97	0.51	0.38	2.32	0.83	848	461	NA	NA	NA	NA
	Total	805	644	431	323	4.93	2.96	0.83	0.62	2.32	0.83	1275	750	323	106	Surplus	Deficit
24/1	Katheghari Khola	324	259	NA	NA	0.48	0.29	0.09	0.07	2.32	0.83	124	81	0	0	NA	NA
24/2	Jigne Khola (incremental)	350	280	NA	NA	0.61	0.37	0.11	0.08	2.32	0.83	158	99	0	0	NA	NA
	Total	674	539	185	139	1.09	0.65	0.20	0.15	2.32	0.83	282	181	0	0	Deficit	Deficit

IRRIGATION DEVELOPMENT ASSESSMENT - SURKHET DISTRICT

Assessed Basin/Stream Number	Name	Existing Scheme Command Areas Gross (ha) (1)	Net (ha) (2)	Remaining Irrigable Area Mapped (ha) (3)	Net (ha) (4)	Streamflow Estimates October Mean (m3/s) (5)	Rel. (m3/s) (6)	March Mean (m3/s) (7)	Rel. (m3/s) (8)	Repr.Irrig.Req. October MS (L/s/ha) (9)	March YR (L/s/ha) (10)	Net Reliably Irrigable Areas MS (ha) (11)	YR (ha) (12)	Net Potential Expansion Areas MS (ha) (13)	YR (ha) (14)	Further Water Availability MS (15)	YR (16)
25/1	Kitch Khola	104	83	NA	NA	0.17	0.10	0.03	0.02	2.32	0.83	44	27	0	0	NA	NA
25/2	Nachne Khola (incremental)	56	45	NA	NA	1.06	0.64	0.19	0.14	2.32	0.83	274	172	NA	NA	NA	NA
	Total	160	128	45	34	1.23	0.74	0.22	0.17	2.32	0.83	318	199	34	34	Surplus	Surplus
26	Korelli Khola	221	176	186	140	0.43	0.26	0.08	0.06	2.32	0.83	111	72	0	0	Deficit	Deficit
27	Chhinchu Khola	443	354	106	80	6.50	3.90	1.09	0.82	2.32	0.83	1681	985	80	80	Surplus	Surplus
28	Hallerighat Khola	66	53	26	20	1.17	0.70	0.21	0.16	2.32	0.83	303	190	20	20	Surplus	Surplus
29	Magar Khola	119	95	55	41	1.79	1.07	0.32	0.24	2.32	0.83	463	289	41	41	Surplus	Surplus
30	Khante Khola	45	36	70	53	0.35	0.21	0.07	0.05	2.32	0.83	91	63	53	27	Surplus	Deficit
31	Battisi Khola	35	28	120	90	1.90	1.14	0.34	0.26	2.32	0.83	491	307	90	90	Surplus	Surplus
32	Chhahre Khola	22	18	0	0	1.01	0.61	0.18	0.14	2.32	0.83	261	163	0	0	Surplus	Surplus
33	Rujkha Khola	28	22	103	77	0.75	0.45	0.14	0.11	2.32	0.83	194	127	77	77	Surplus	Surplus
34/1	Sajhamul Khola	64	51	39	29	0.21	0.13	0.04	0.03	2.32	0.83	54	36	3	0	Deficit	Deficit
34/2	Baghpyle Khola	69	55	0	0	0.15	0.09	0.03	0.02	2.32	0.83	39	27	0	0	Deficit	Deficit
	Total	133	106	39	29	0.36	0.22	0.07	0.05	2.32	0.83	93	63	0	0	Deficit	Deficit
35	Rajigaon Spr. (Bargar Kh.)	28	22	8	6	0.52	0.31	0.10	0.08	2.32	0.83	134	90	6	6	Surplus	Surplus
36	Golfa Khola	46	37	36	27	0.24	0.14	0.05	0.04	2.32	0.83	62	45	25	8	Deficit	Deficit
Total Assessed Basins (Excl. NA)		12234	9688	5912	4434							20909	12380	3007	1760		

Notes :
(1) Aggregated from WUI report
(2) [0.8*(1)]
(3) Measured from Figure A4-3.1
(4) [0.8*(3)]
(5) Mean flow from WUI report
(6) Reliable flow; [0.6*(5)]
(7) Mean flow from WUI report
(8) Reliable flow; [0.75*(7)]
(9) Representative irrigation requirements from Annex D1, corresponding to HMV/W/MS cropping pattern
(10) Representative irrigation requirements from Annex D1, corresponding to HMV/W/YR/C cropping pattern
(11) [(6)*1000/(9)]
(12) [(8)*1000/(10)]
(13) Potential in-basin expansion calculated from areas in (11), (2) and (4)
(14) Potential in-basin expansion calculated from areas in (12), (2) and (4)
(15) Exportable surplus or restrictive deficit indicator calculated from areas in (11), (2) and (4)
(16) Exportable surplus or restrictive deficit indicator calculated from areas in (12), (2) and (4)


N
KARNALI RIVER
KARNALI RIVER
KARNALI RIVER
KARNALI RIVER
Khara Khola
Ghori River
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2
3
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9/3
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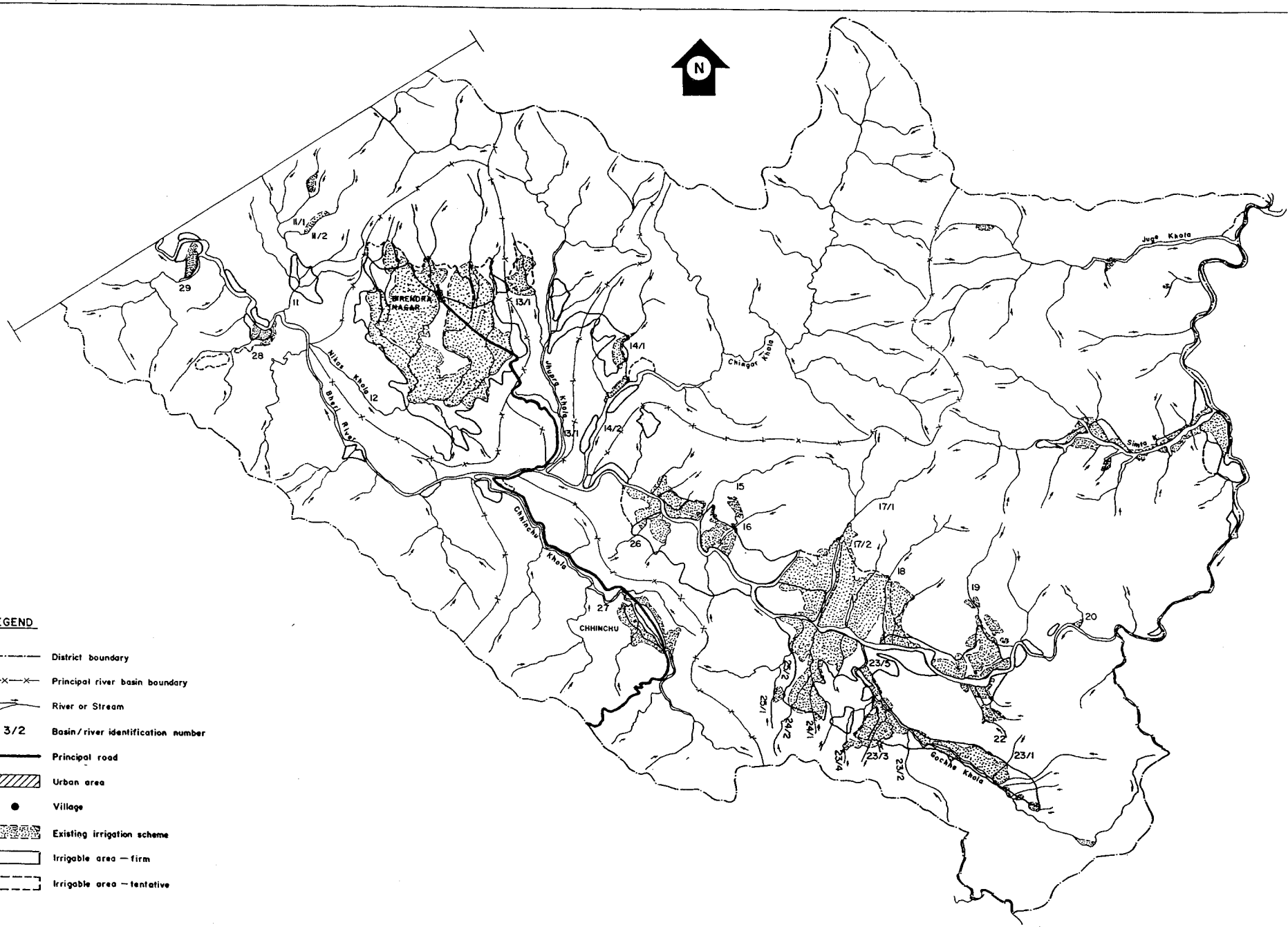
9/2/5
9/2/6
9/2/7
36
35
34/2
34/1
33
10/3
10/2
10/1
32
31
30
LEGEND
District boundary
Principal river basin boundary
River or Stream
3/2 Basin / river identification number
Principal road
Urban area
Village
Existing irrigation scheme
Irrigable area — firm
Irrigable area — tentative
Km. 5 1 2 3 4 0 2.5 5 10 Km.
Source : LRMP maps and WUI maps.
Fig. A4—3.1/a
THE WORLD BANK/THE UNITED NATIONS DEVELOPMENT PROGRAMME
MASTER PLAN FOR IRRIGATION DEVELOPMENT IN NEPAL
Irrigation Development Area — Surkhet District



Source : LRMP maps and WUI maps.

Fig. A4—3.1/b

THE WORLD BANK/THE UNITED NATIONS DEVELOPMENT PROGRAMME
MASTER PLAN FOR IRRIGATION DEVELOPMENT IN NEPAL

Irrigation Development Area — Surkhet District

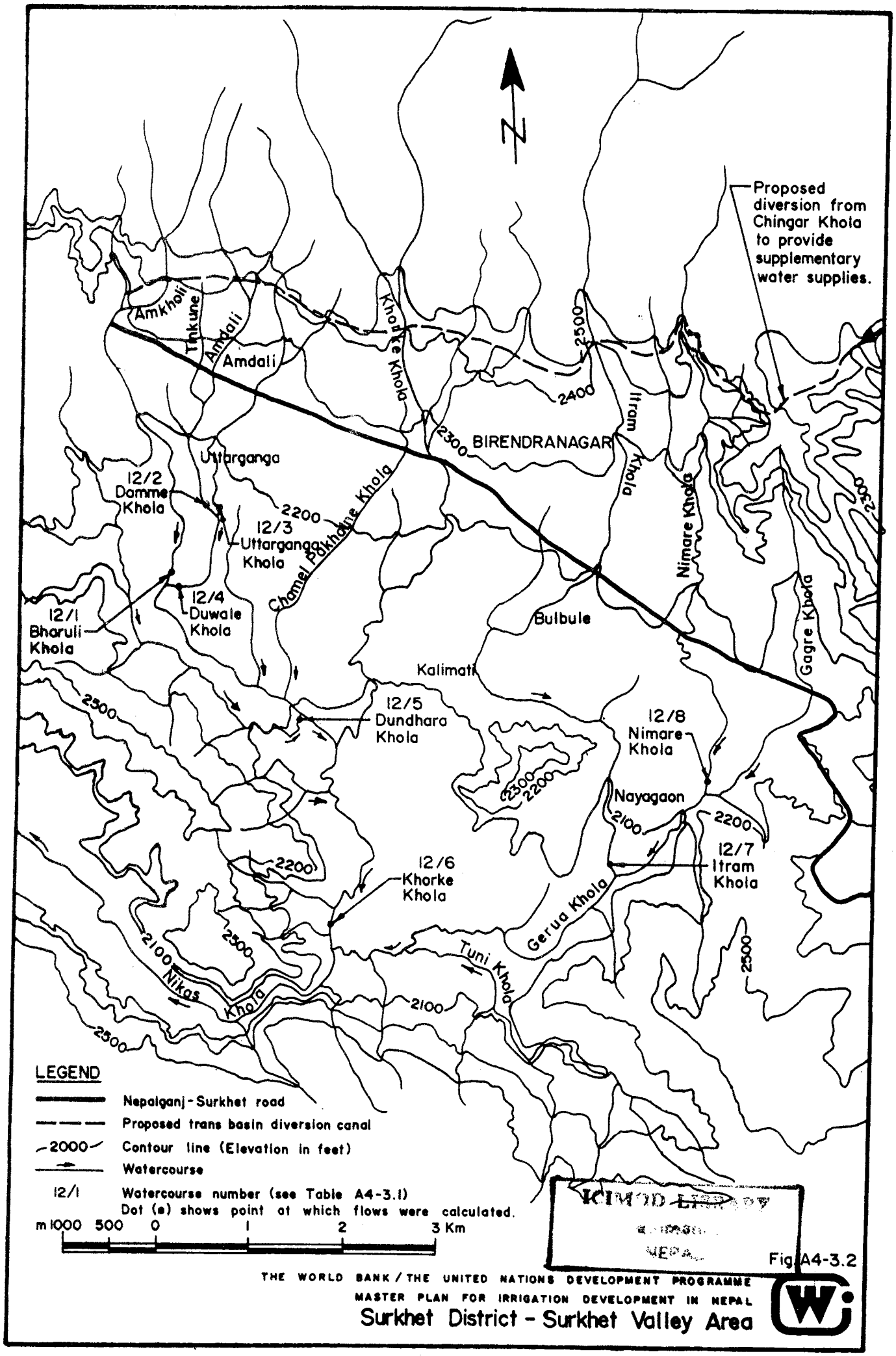


Fig. A4-3.2

THE WORLD BANK / THE UNITED NATIONS DEVELOPMENT PROGRAMME
MASTER PLAN FOR IRRIGATION DEVELOPMENT IN NEPAL

Surkhet District - Surkhet Valley Area