

## **INITIAL ENVIRONMENTAL EXAMINATION**

### **A. INTRODUCTION**

1. His Majesty's Government of Nepal, with assistance from the Asian Development Bank (ADB), intends to implement the Community Managed Irrigated Agriculture Sector Project (the Project) in the Central, and Eastern regions of Nepal which aims to improve the agricultural productivity and sustainability of farmer-managed irrigation systems (FMISs) while strengthening the policies, investment plans, and institutions for irrigated agriculture, following the lessons learned during the Loan No. 1437-NEP: Second Irrigation Sector Project (SISP). The Department of Irrigation (DOI) under the Ministry of Water Resources (MOWR) will be the executing agency.

2. The Project will be located in the Eastern and Central regions of Nepal and comprises two parts: (i) participatory irrigated agriculture development for FMIS; and (ii) institutional strengthening and project management (ISPM). Under the first parts 210 FMIS will be rehabilitated, resulting in improvements in irrigated agriculture over 34,000 ha benefiting about 270,000 people. The second component comprises the development and implementation of improved institutional mechanisms for FMIS development, further improved policies and regulations, strengthening of the key stakeholder agencies and their linkages.

3. Detailed implementation guidelines for subprojects have been prepared, along with feasibility studies for three core subprojects. The purpose of this report is to summarize the sector loan, sector level environmental impacts, environmental criteria for sub-project procedures for the environmental assessment of sub-projects and incorporation of findings into project design and planning for the project. In addition it provides a summary of environmental issues related to three community managed irrigation schemes for which feasibility studies were prepared and the Environmental Management Plans (EMPs) for these. The report summarizes the findings of consultations and investigations undertaken under ADB TA 3745 NEP which included (i) national workshops at inception interim and draft final stages (ii) a review of the lessons learned relating to environmental impacts and management on SISP including strengths and weaknesses of environmental documents, (iii) a review of the performance of the irrigation sector, (iv) river basin studies for the Mai and Bighi rivers, in which the three core subprojects will be located, (v) review of secondary data relating to the core sub-project areas (vi) site visits and consultations with beneficiaries at the three subproject sites (vii) completion of IEEs for the three subprojects (viii) extrapolation of the findings of these IEEs and consideration of the full range of potential subprojects to identify sectoral impacts and mitigation measures, (ix) a review of existing laws and procedures for environmental assessment and management in Nepal and (x) an assessment of the institutional setup of DOI.

### **B. DESCRIPTION OF THE PROJECT**

#### **1. Overview of the Sector Loan**

##### **a. Type**

4. The project is associated primarily with irrigated agriculture. The environmental screening process has therefore followed the checklists for Irrigation projects, given in the Asian Development Bank's Environmental Guidelines for Selected Agricultural and Natural Resources Development Projects.

**b. Environmental Category**

5. **Category B:** The environmental category according to the Bank's classification is B, where some environmental impacts may occur and an IEE is to be undertaken. Should the IEE conclude that no significant environmental impacts are likely to result, the IEE serves as the completed Environmental Impact Assessment (EIA) for the project.

**c. Need**

6. The project is aimed at the reduction of rural poverty which is intense and widespread in Nepal, itself one of the poorest countries in the world. The incidence of poverty in the country follows a complex pattern and tracts and pockets of high concentration of poverty are widely found in the project area, such as the rural hills in the Central development region where the headcount ratio was 67% in 1996. The Agriculture sector in Nepal provides employment for 80% of the active workforce and the only area of economic activity open to most rural dwellers in the country. While the sector has showed signs of improvement in recent years, productivity of the main crops remains behind that achieved in the neighboring countries in South Asia. With erratic rainfall patterns, irrigation offers a key means of enhancing agricultural production in Nepal. Approximately 46% of potentially irrigable land in Nepal is irrigated FMIS, mostly developed by farmers in the past, and approximately 18% is served by schemes developed and managed by the Department of Irrigation (DOI). Remaining areas are yet to have access to irrigation. Production on land served by FMIS is constrained by fragile and rudimentary intake and distribution systems that are vulnerable to flood damage and difficult to maintain. Support to Water User Associations (WUAs) in the form of capacity building, technical advice and an enabling policy and regulation framework is essential for the sustainability of improvements brought to FMIS and associated agricultural practices. Enhancing agricultural productivity and the sustainability of FMIS while establishing sound institutional mechanisms is one of the key strategic pillars of the Government's Poverty Reduction Strategy Paper and the 10<sup>th</sup> Five Year Plan (2003-2008) as well as the ADB's sector assistance strategy and Water Policy.

**d. Location**

7. The project will be located in rural farmland in the mountain, hill, churia (lower hills) and terai regions of the Central and Eastern Development Regions of Nepal.

**e. Magnitude of Operations**

8. Approximately 210 subprojects will be implemented, covering an area of 34,000 ha.

9. Subproject sizes to be considered for infrastructure improvement will be limited to less than 1000 ha (in command area in the terai). They are existing FMISs and will not have received previous external assistance. New projects, or those that have had previous assistance, may be considered only if there are exceptionally high additional benefits to be gained in terms of poverty alleviation. This component will address irrigation improvement requirements in all 35 districts and in the regions of the terai, the churia and the hills.

**f. Proposed schedule for implementation**

10. The implementation period will be 7 years, from January 2005 to December 2011. An implementation schedule comprising five batches of subprojects (one batch commencing per year for five years) has been prepared on this basis. A typical subproject will take about one

year for SIP preparation and development of WUA, followed by one year of construction and an additional year for O&M training and agriculture and social development support.

### **g. Description of Components**

11. The components of the Project are grouped into two parts: Part A: participatory irrigated agriculture development for FMISs, and Part B: institutional strengthening and project management (ISPM).

12. Part A will support participatory development of FMIS subprojects through a process approach. It comprises 3 subcomponents: (i) participatory planning and beneficiary mobilization; (ii) community-based irrigation and associated infrastructure; (iii) agriculture and social development support; and (iv) regular monitoring of completed schemes. For the purpose of effective monitoring and achievements of maximum outputs, each subproject will have distinct performance targets at each stage of implementation process, quality achievement of which will be mandated before initiating the activities of the succeeding stage. The number of subprojects implemented in each district will also be governed on the basis of the performance and quality of the achieved targets, such as the level of beneficiary contribution provided by the water user association (WUA), WUA endorsement of the plan document and of the quality of infrastructure, and the amount of services provided for agriculture extension and outputs such as incremental cropping intensity and yields.

13. Part B comprises (i) support for national level institutional strengthening; (ii) operation of improved FMIS intervention mechanisms in the permanent organizations including DOI, DAO, DDC, and WUA, along with the supporting institutions including private sector, NGO, and CBO; and (iii) training of project personnel in these institutions and stakeholders. Services by consultants will be provided to support these activities, along with the necessary hardware and software.

14. Subproject implementation will follow a process of (i) participatory planning and WUA beneficiary mobilization; (ii) provision of irrigation and associated infrastructure; (iii) agriculture and social development support; (iv) self-sustained O&M by WUA. Comprehensive implementation guidelines including guidelines for IEE have been prepared for sub-project implementation. This process is elaborated on, in describing the core subprojects, below.

## **2. Description of Core Subprojects**

### **a. Participatory Planning and Beneficiary Mobilization.**

15. The identification and planning of sub-projects occurred through national workshops and consultations during the course of the PPTA. Subproject selection criteria, planning and implementation process, and roles and responsibilities of the WUAs were discussed with the concerned WUAs. WUA beneficiary mobilization, under sub-component (i) of the project, will occur prior to construction to provide the WUA with the means to become empowered community organizations capable of mobilizing resources for subproject implementation and self-sustained O&M. This will occur on the basis of a WUA institutional development plan covering membership enrollment, formal registration and formation of executive structure and operational rules, management of O&M and formation of agreements on land arrangements. The guidance and support required for this process will be provided by an NGO engaged for the project, who will provide training in the first instance to community organizers (COs) selected by

the WUA. Upon satisfactory formation of the WUA, a memorandum of understanding will be signed by all concerned parties, following which design and construction activities can proceed.

### b. Irrigation and Associated Infrastructure.

16. According to the feasibility studies prepared for three core subprojects including IEEs in accordance with the arrangements and approaches adopted for project, the following infrastructure was identified.

**Table 1 Summary of scope of principal works for the three core subprojects**

| Project Name                                   | Harinmari  | Talkharka  | Inгла Khola   |
|--|--|--|---|
| Location                                       | Mahottari and Dhanusa districts, in the terai region   | Ilam district, in the hills region   |   |
| Size of command area                           | Current: 185 ha<br>After project: 255 ha   | Current: 110 ha<br>After project: 210 ha   | Current: 131 ha<br>After Project: 141 ha  |
| Nature and scope of headworks improvements     | Strengthening of existing diversion bund, permanent escape structure, gabion mattressing and twin discharge weir system.   | Construction of 11m concrete weir, gallery and gravel trap and control device  | Construction of 24m gabion weir, gravel trap and control device   |
| Nature and scope of canal network improvements | Strengthening of 3,807m main canal, 5,340m branch canals and 1,460m tertiary canals. Provision of bed bars to retain canal profile where necessary. Diversion boxes and some drop structures as required | Strengthening of 1,200m main canal, 1,100 branch canal and construction of new 1,500m branch canal.<br>Offtake structures<br>Drop structures | Strengthening of 4,260m main canal, 1,480m of branch canals and 1,020m extension one branch canal.<br>Offtake structures<br>Drop structures |
| Additional provisions                          | Concrete crossings and culverts for track crossings  | Concrete crossings and culverts for track crossings<br>Gabion and masonry retaining structures<br>Slope protection works                     | Concrete crossings and culverts for track crossings<br>Gabion and masonry retaining structures<br>Slope protection works                    |

### c. Agriculture and Social Development Support

17. Agricultural extension services will be provided to promote (i) adoption of high-yielding and improved varieties of crops; (ii) diversification of cropping patterns; (iii) integrated pest management (IPM); (iv) improved on-farm water management as a basis of these agriculture practices; and (v) cropping and irrigation calendar management to save time and water. Specific activities will include (i) WUA group formation and design of extension program based on the needs and marketing opportunities; (ii) field demonstration and training through a farmer field school approach including IPM; (iii) on-farm seed multiplication; (iv) farmer tours to advanced areas; and (v) training workshops for service providers.

18. In addition to agricultural extension, training will be provided to WUAs in organizational management and in O&M of the schemes. WUAs are also trained to become a viable local agents to promote productive irrigated agriculture by provision of in-house extension services and networking with public and private providers of inputs and services, and marketing agents.

**d. Regular Monitoring of Completed FMIS**

19. Completed FMISs will be placed under regular monitoring and auditing by DOI in terms of their institutional, technical, social, and financial management. Schemes damaged by natural calamities that exceed the design return period will be provided with rehabilitation assistance.

**e. Implementation Schedule**

20. Construction on these sub-projects is expected to commence in January 2006, following beneficiary mobilization, and to last one year until December 2006. O&M training, agriculture and social development support will take place for each subproject between January and December 2007.

**C. DESCRIPTION OF THE ENVIRONMENT****1. Overall Project Area****a. Physical Resources.**

21. **Topography.** The project area features considerable diversity of environment. Of the 55,900 square kilometers representing 38% of the country, approximately 12% of the Project area is situated in the mountain region, where altitudes range from around 4,800m to over 8,000m. The hills comprise approximately 50% of the project area, with altitudes between 300m in some deeper valleys and 4,800m. The area mainly consists of phyllite, schist, limestone, granite, and quartzite, which have landslide potential along steep slopes. A further lower altitude hilly zone is called the churia, situated to the south of the hills range and north of the terai, occupying around 15% of the project area and comprising shale, conglomerate and fragile sandstone. The remaining 23% is within the terai region, which lies across the southern belt of the project area and is primarily flat, stratified alluvium containing groundwater resources, with altitudes below 500m.

22. **Climate.** Rainfall in the project area varies considerably, from around 300mm in rain shadow areas to around 4,000mm in certain higher rainfall zones, the variation being attributable primarily to interaction between the direction of flow of moist air during the summer, and topography. The summer monsoon occurs between June and September each year, caused by a movement of moist air towards the northwest. This movement causes higher rainfall on south and eastern facing slopes, and rain shadows on northern and western facing slopes. The effect of rain shadows can be very pronounced, with aridity in such locations increasing with altitude and latitude. Cropping patterns are linked to the arrival of the summer monsoon, with untimely arrivals impacting strongly on the success of farming in much of the project area. A second rainy season occurs during the winter months, resulting from moist air carried by northeasterly trade winds. This results in relatively brief and isolated rain on the plains and increased precipitation at higher elevations. It causes significant snowfall in the mountain region, which is important for sustaining river flows on which many irrigation schemes are dependent. Average annual rainfall increases to altitudes of around 3,000m and then gradually decreases with altitude.

23. Temperature varies considerably with altitude and season. On the terai, temperatures can reach 44°C during the hottest season, immediately prior to the summer monsoon in April and May. During the winter months (November to February) temperatures on the terai can fall to as little as 5°C. The hills and churia are generally cooler, though pre-monsoon temperatures can

rise to as much as 41°C in some locations within the hills. In the Mountain region, temperatures are generally much lower going below 0°C, though in the lower reaches temperatures are relatively mild for much of the year, reaching up to 30°C in places during the pre-monsoon.

24. **Water Resources.** The country has approximately 6,000 rivers that are categorized into (i) large perennial rivers originating in the Hymalayas that carry snow-fed flows with significant discharges; (ii) medium rivers that originate in the middle hills and are perennial but have wide seasonal fluctuations; and (iii) a large number of small rivers in the terai which originate from the southern lower hill range, and are seasonal with little or no flow during the dry season. While there is no water shortage in large rivers, there are possibilities of water deficits in the medium river basins in particular in small sub-basins during the March – May period. Small rivers that originate from southern hills do not have enough water to meet the demand for irrigation much beyond the post-monsoon and short winter season rainfall period. Water use in FMISs is thus constrained by the availability of water in their water source. In particular, many FMISs in the southern terai belt along these small and medium rivers have limited scope for year-round irrigation through run-of-the river irrigation, calling for conjunctive use with groundwater and detailed assessment of water resource availability for schemes to be included in the project.

25. In the hill zone, FMISs are generally diverting water from streams that are subject to seasonal flooding that carries significant suspended and bed-load sediment. Some streams are broad and actively eroding their banks, while others are in steep, rocky, and stable channels. Command areas are developed for cropping, either as sloping terraces for dry land or leveled terraces for irrigation. In the terai zone, FMISs may draw water from streams flowing from the hills that may have similar problems in terms of bank erosion, sediment, and seasonal flooding, while others have streams originating almost entirely in the terai that have seasonal flows only or small dry-season flows made by seepage from groundwater.

#### **b. Ecological Resources**

26. Topographical and climatic biodiversity result in a wide range of ecosystems, mainly forest ecosystems but also significant areas of wetland. Schemes to be improved under the Project are situated on existing agricultural land that often borders on areas of existing forest, particularly in the churia and the hills. The terai bore large expanses of tropical moist high forest that have now largely disappeared or been degraded as a result of increasing settlement in the area over recent decades. In the churia, hills and lower reaches of the mountain regions, forests remain important as wildlife habitats, and as the source important subsistence products (primarily fuelwood, timber, leaf litter for compost, and animal fodder) to rural villagers but are also subject to decline in extent and quality through increasing population pressure.

27. Some protected areas and wildlife sanctuaries occur within the Project area. These are mainly in the mountain region, though part of the extensive Chitwan National Park in the terai is also within the project area. Habitation within this area is controlled, and the livelihoods of people living within the area focus on the tourism industry, with little or no dependence on agriculture for subsistence or income. A further protected area within the terai is in the Koshi river delta which does not have a significant population. No sub-projects will occur within this protected area.

28. Protected areas within the hills and mountain portions of the project area consist mainly of mountain areas where settlement is controlled, habitable areas are limited, and livelihoods are derived principally from the tourism industry. Agriculture and horticulture practiced by mountain dwellers takes place mainly outside the protected areas. In some cases, marginalized

groups occur who may benefit from small- or micro-scale irrigation facilities within the protected areas. In the event that proposals are made for suitable sub-projects within these areas, project guidelines require consultation with the Department of National Parks and Wildlife, as well as participatory planning with beneficiary communities, to ensure that schemes conform to the rules made for each park and according to the needs and wishes of communities that are dependant on them.

29. Outside the protected areas, significant expanses of forest occur in the churia the hills and to some extent in the mountains, particularly on steep hillsides and ridge tops. These are important for slope protection and bio-diversity conservation. Most of these forests are protected by law, and are often an important source of forest products to local rural populations. While law enforcement has proven problematic, forest decline can be substantially mitigated by improved management particularly where communities are willing and able to undertake this, with appropriate technical and advisory support. The Government currently has a policy of formally handing forest user rights to communities who are able to manage forests. The implementation of this policy is receiving extensive donor support. In much of the project area, forest product needs are met from small stands of multipurpose trees planted primarily on private land.

### **c. Human and Economic Development, and Quality of Life Values**

30. Nepal remains one of the least developed nations in the world, with a per capita income of \$241 in 2001; 39% of the total population of 23.2 million people are living below the poverty line. The country also ranks 129<sup>th</sup> among 174 countries in human development index, characterized by high infant mortality, low life expectancy, low adult literacy and nutrition levels. Ecologically, poverty incidence is higher in the mountains followed by the terai and the hills. It is generally lower in the project regions compared with other development regions, due to the higher level of urbanization. However, tracts and pockets of high concentration of poverty are widely found in rural areas of these regions, such as the rural hills in the Central development region where a headcount ratio was 67% in 1996. Poverty is also more concentrated among the landless group, marginal and small farmers, occupational castes (comprising 13% of the population), and marginalized and minority ethnic groups, with significant gender gap. Over 90% of the poor live in rural areas.

31. Agriculture accounts for approximately 40% of the gross domestic product (GDP), providing employment for 80% of the active workforce. However, agricultural productivity of major food crops, which account for 80% of the cultivated area, remains at the lowest level among the neighboring countries in the South Asia, and hence still subsistence oriented, although there are sign of strong growth in some small areas and in limited sub-sectors such as high value crops and livestock products. Due to a very high labor to land ratio (10 people per ha) and small land holdings (60% of rural households having less than 0.5ha), it is difficult for many farmers to go much beyond the food self-sufficiency. For the rural poor having less access to land, non-crop activities such as livestock, trading, and cottage industries are becoming major livelihood activities, along with migration to urban areas and India. In general, agriculture provides more livelihood opportunities to the poor through crop cultivation and agricultural labor in areas having access to reliable irrigation.

32. The total population of the Central and Eastern development regions, covered under the Project, is 10.66 million, of which 8.9 million are rural inhabitants. The rural population is growing at 2.0% annually. Other general indicators in the 35 districts included in the Project area are: a population density of 186/km<sup>2</sup> and 291/km<sup>2</sup> in the eastern and the central region, respectively; a life expectancy of 59.7 years, and ethnic population of 3.4 million (1.7 million in

each region), and a dalit population of 1 million (0.4 million and 0.6 million in the eastern and the central region, respectively). There are also 1.49 million farm holdings, covering 1.5 million ha. The project will impact directly on the farming activities and agricultural livelihoods of 49,000 households, representing a total population of about 270,000. In the 3 sample subproject areas, per capita income ranges from NRs 4,200 (in the terai) to NRs 7,900 (in the hills) against the current national poverty line of NRs 6,100, with the %age of population facing problems of food deficit for their subsistence ranges from over 40-60%. Thus the majority of the population in the sample subprojects were found to be poor.

## 2. Core Sub-Project Areas

### a. Physical and Water Resources

33. **Harinmari.** The Harinmari scheme is located in Mahattari district, in the terai. The water source is a small local stream, the Geruka Khola with a catchment area of about 1 km<sup>2</sup> lying within the Bighi Khola basin. The Geruka is largely spring water fed, providing for perennial flow. There are no permanent headworks for the system. Farmers currently have to adopt temporary means to divert water using soil embankments, entailing rebuilding after each flood occurrence. The total length of the main stream is about 1 km (up to the proposed diversion). The total length of the river from origin to its confluence is 5 km. The average stream gradient was 0.18 % consistent with the very flat local topography. Again, the catchment has alluvial soil with moderate infiltration rate.

34. **Talkharka.** The Talkharka irrigation system is located North West of Ilam, in steep, hilly terrain. The climate is moist, and much cultivable land is terraced in order to allow irrigated rice cultivation. Soils vary in composition; the predominant soils are relatively acidic, white in color, with pockets of more basic soils and red soils. Water resources are substantial, with river flows sustained through the dry season by snowmelt. The source water is very clean and is suitable for irrigation throughout the command area. For domestic use, treatment would be required. The command area is free from industrial pollutants.

35. **Inгла Khola.** The project area is located north east of Ilam in steep, hilly terrain. Again, the climate is moist and most cultivable land is terraced, though mainly reliant on rainwater for cropping. Rudimentary irrigation is possible through diverting water with temporary diversions made of bush, logs and stones, which require regular rebuilding. Inгла Khola originates from the Simha Lila Dada at the border of Nepal and India near Gairi Bas at an altitude 2,800 m. This is a perennial river, sustained during the dry season by snowmelt. The catchment area for the Inгла Khola is 16.34 km<sup>2</sup>. The total length of the main stream is about 7.2 km (up to the proposed diversion). The elevation along the mainstream length ranges from 1,640 m at the proposed intake site to 2,800 m at the highest watershed point. The average stream gradient obtained is 16.11%.

### b. Ecological Resources

36. **Terai Region: Harinmari Subproject.** This sub-project is situated in the terai region, which was originally covered by dense tropical forest, has been substantially cleared for agriculture and human settlement. No significant remnants of the original forest cover occur within the command area. Trees have been planted around homes. These are usually small stands of fruit trees, though some small plantations of timber species (usually *Dalbergia sissoo*) occur in places. Bamboo is commonly grown alongside the fruit trees, forming scattered, dense

clumps of vegetation that provide some habitat for wildlife. No protected areas occur within the sub-project, however, small pockets of trees and bamboos provide limited habitats for wildlife.

37. **Hill Regions: Talkharka and Ingla Khola Subprojects.** A large number of multi-purpose trees are grown around the houses, including fodder and fruit trees. No protected areas occur within. Forested steep slopes and ridges, as well as pockets of cultivated trees afford significant habitats to wildlife. On both sites the main canal, in its present state, assists the movement of people and animals in most cases as its banks provide a level surface along which people can walk easily (except where it traverses rock faces). Some small stone temples occur at various locations around the command area, but these are unaffected by the canal alignment. No relocation or displacement is associated with the scheme.

### c. Human and Economic Development

38. **Harinmari.** The average household size is 5.8 in the area served by the FMIS. The overall population above 5 years is 235 out of which male constitute 52.3% and female are only 47.7%. Likewise, 60.2% of male and 33.9% of female are literate totaling 59.6% as the total literacy rate of population in the FMIS area. The predominant activity in this area is agriculture.

39. **Tarkharka.** Gorung and Chhetri are the major ethnic groups in the FMIS area. More than 92% of economically active population is engaged in agriculture and irrigation is the main source of employment. More than 40% of people in the area do not have sufficient food for their subsistence and about 2% of the local population is landless. About 48% of farm households are small; 39% are medium sized.

40. **Ingla Khola.** The average household size is 6.5 in the FMIS area. The overall population above 5 years is 205 (about 57% male and 43% female). The overall literacy rate is 77%. The main source of employment is agriculture, with 77% of the economically active population stating agriculture as their main occupation. In the unirrigated area, there is a relatively low percentage employed in agriculture (about 59%).

### d. Quality of Life Values

41. **Harinmari.** The rapid and unplanned nature of human settlement and economic development in the project area has a strong influence on the quality of life for residents of the command area and its surrounds. The command area is rural, but within 5-15km of major urban settlement. Services such as potable water supply and electrical power supply are almost entirely absent. Settlements are served by a network of drivable tracks, though bus or jeep travel is problematic for much of the year. Rivers and streams are subject to industrial pollution.

42. **Talkharka and Ingla Khola.** Services such as power, drinking water supply and roads are extremely limited. Access to health and education is similarly poor. This can result in severe hardship, particularly when emergency access to health services is needed. There is a high degree of cultural integrity. Residents of the area are predominantly Hindu, and worship at small temples around the villages.

## D. SCREENING OF POTENTIAL IMPACTS AND MITIGATION MEASURES

### 1. Sector Impacts and Mitigation Measures

43. Output-related Project activities were screened and the results tabulated according to the operational strategies: environmental problems due to project location, design, construction, and operations. Based on the environmental screening of project components and interventions using ADB Environmental Assessment Guidelines (2003), the Project subcomponent were classified as shown in Table 1. Potential impacts were assessed against the checklist provided for irrigation projects in the ADB Guidelines for selected Agricultural and Natural Resources Development Projects.

**Table 2. Screening of output-related activities by project component**

| Output-related activities by project component                                 | Environmental impacts |     |     |     |
|--|-----------------------|-----|-----|-----|
|  | L                     | D   | C   | O   |
| <b>Part A: Participatory Irrigated Agriculture Development for FMIS</b>        |                       |     |     |     |
| <b>Component a: Participatory Planning and Beneficiary Mobilization</b>        |                       |     |     |     |
| Irrigated agriculture development strategy at district/ basin level            | No                    | No  | No  | No  |
| Participatory feasibility study and subproject implementation plan formulation | No                    | No  | No  | No  |
| Beneficiary mobilization of water user associations (WUA)                      | No                    | No  | No  | No  |
| <b>Component b: Irrigation and Associated Infrastructure</b>                   |                       |     |     |     |
| Detailed design  | No                    | No  | No  | No  |
| Construction of irrigation and associated infrastructure                       | Yes                   | Yes | Yes | Yes |
| <b>Component c: Agriculture and Social Development</b>                         |                       |     |     |     |
| Agriculture extension activities   | No                    | No  | No  | Yes |
| Social development activities  | No                    | No  | No  | Yes |
| <b>Component d: Monitoring and support for completed schemes</b>               | No                    | No  | Yes | Yes |
| <b>Part B: Institutional Strengthening and Project Management</b>              |                       |     |     |     |
| National Level Institutional Strengthening                                     | No                    | No  | No  | No  |
| Strengthening institutions to operate improved FMIS intervention procedures    | No                    | No  | No  | No  |
| Training   | No                    | No  | No  | No  |

L = Project location; D = Project design; C = Project construction; O = Project operation;

No = no adverse environmental impacts; Yes = with potential adverse environmental impacts (to be addressed by mitigation measures)

#### a. Environmental impacts related to project location

44. **Effects on downstream water use.** In some catchments in the project area, especially some water-stressed river basins in the terai, reductions in river flows due to infrastructure improvements may cause hardship to downstream water users through both reduced water availability and increased concentration of pollutants present in the water as a result of upstream industry, agriculture and human habitation. Mitigation measures include (i) mapping water resource availability over the project area as an initial project wide activity and verifying quality and quality of available water during feasibility study, excluding schemes that will result in significant reductions of downstream flows on which there are users who are dependent (ii) provision in scheme design for the use of any available supplementary water sources, such as groundwater, and (iii) inclusion of training and support to WUAs in the coordination of water use and practice of rotational water intake.

45. **Water resource conflicts.** In some cases, conflicts over sources of drinking water may result from increased water abstraction due the improvements of the irrigation systems. Mitigation can be achieved by (i) including an evaluation of existing and future drinking water needs in the water resource assessment undertaken as part of the feasibility study for each scheme, taking into account the water needs identified by project beneficiaries and (ii) providing for alternative or supplementary sources of irrigation water at detailed project design stage.

46. **Cumulative effects.** Where several proposals for sub-projects occur within a single catchment, the cumulative effects on downstream water quantity and quality may become increasingly significant and represent a potential source of conflict. The inclusion in the feasibility studies of river basin studies will allow for the assessment of cumulative effects on water resource use and downstream effects. Where significant cumulative effects for candidate schemes may be forecasted, these should be considered at sub-project selection stage and modified or excluded as appropriate, based on the selection criteria developed for sub-project selection.

#### **b. Environmental Impacts related to project design**

47. **Land Acquisition and Resettlement.** Infrastructure improvements under component (ii) may affect land or property. A resettlement framework for the project will ensure that any loss of land or property will qualify those affected as a Project Affected Person (PAP). Under the resettlement framework, all PAPs will be entitled to compensation from their lost assets, incomes and businesses according to a replacement cost determined through agreement between the PAP and the WUA.

48. **Watershed erosion and scour.** Watershed erosion and scour on hill schemes: Rills and gullies are regular occurrences in the middle hills of Nepal, as well as occasional landslides. While these will occur in the absence of project activities, there is some increased risk associated with the construction and operational phases due to the concentration of water in the canals. These can be substantially mitigated by using low cost bio-engineering techniques that are primarily labor-based, and utilize locally understood technology. Bio-engineering techniques utilize species already abundant in the area and whose cultivation techniques are either well known, or easily learned. Recommended techniques are (i) grass planting on slopes (ii) dry stone check dams (iii) live check dams and (iv) palisades made from live cuttings. Detailed descriptions of these techniques and standard specifications can be found in bio-engineering manuals produced by the Department of Roads<sup>1</sup>. The techniques should be applied to cut slopes and to deposits of spoil material arising from excavations.

49. **Drainage congestion and salinization.** In the case of larger schemes, increases in water flows within the improved canal network attributable to infrastructure improvements may result in significant impacts on soil and water at the scheme outflow. Schemes with command areas of up to 1,000ha in the terai will be considered for improvement under the project. In the case of larger schemes impacts of potential concern are (i) soil salinization in areas where the hydraulic gradient and soil permeability are low and (ii) changes to water table levels. Soil condition needs to be reviewed carefully during the feasibility stage for necessary mitigation measures including exclusion from the Project, promotion of efficient water use, and provision groundwater drains at the scheme outflow.

50. **Obstruction of movements of people.** The widening of canals as part of the infrastructure improvement may restrict movements of people and animals, and the accessibility to the site by vehicles and carts for schemes where there are roads and tracks. This can be mitigated by the provision of crossings made of permanent materials and adequately sized culverts.

---

<sup>1</sup> Howell, J. Roadside Bio-Engineering: Site Handbook and Roadside Bio-Engineering: Reference Manual. Department of Roads, HMGN/DFID. Kathmandu. Available from Geo-Environmental Unit, Department of Roads.

51. **Groundwater quality.** In some cases on the terai, groundwater sources may be used which may contain arsenic. Project selection criteria require groundwater sources to be tested, and for projects to be excluded if the arsenic content exceeds 100 micrograms per litre.

52. **O&M Problems.** In FMIS interventions, poorly designed facility may cause difficulty in operation and maintenance (O&M) by WUAs, thereby causing ineffective and inefficient O&M and total system failure in extreme cases. Therefore, it is critical that the structure should be designed in a manner for which O&M is easy undertaken with local technologies with affordable costs. For this purpose, the Project will review and prepare appropriate design standards for FMIS corresponding to different needs in different ecological regions, which will be applied during the implementation period.

### c. Environmental impacts related to construction

53. **Pollution and destabilization of slopes.** Infrastructure improvements of schemes in the hills will entail excavation which will result in temporary increases in silt runoff and, where due care is not taken, destabilization of steep slopes. This applies both to sites where canals will be improved and to quarries and borrow areas. Mitigation measures include (i) adequate supervision of construction operations, (ii) confining excavation operations to the dry season (iii) the use of silt traps and (iv) careful deposition of spoil arising from excavation works, ensuring that it is not cast directly over steep slopes. To the extent possible, spoil should be used as fill, either where required for the scheme or to construct level surfaces, as desired by villagers, elsewhere. In all cases it must be compacted and treated either using bio-engineering techniques, or by using dry stone walls or stone pitching.

54. **Temporary irrigation system closure.** Construction operations may also involve the temporary closure of irrigation systems. Because construction will take place mainly during the dry season, this may have significant impacts on crops and livestock and the overall livelihoods of the farmers depending on such assets. This can be mitigated by the use of temporary diversions, either in channels or by the use of flexible hose pipes. In each case, the need for these measures should be assessed during detailed design and appropriate quantities included in contract documentation. User communities will also be involved in scheme planning and construction, ensuring that local farmers are aware of the construction schedule will further mitigate the effects of temporary closure.

55. **Other impacts.** Other possible environmental impacts would include (i) dust generation caused by certain construction operations such as excavation of hard and soft rock, which can be mitigated by wetting excavation sites and other sources of dust to control its emission, and public information (ii) noise generation which can be mitigated by use of properly maintained equipment and public information; and (iii) land use conflicts caused by temporary use of land for temporary facilities for construction, which will be rented from land owners and re-instated to its former state after completion of the construction.

56. The Project will also include (i) WUA beneficiary contribution which include earthwork undertaken through labor mobilization; and (ii) rehabilitation of FMIS facilities that were damaged due to catastrophic natural disasters exceeding the design return period. The same construction standard will be applied for these activities to avoid any environmental impacts.

#### d. Environmental impacts related to operation

57. **Soil modification.** Agriculture practiced by beneficiary farmers will intensify as a result of infrastructure improvements. The nature and extent of improvements will be influenced by agriculture extension. The changes in agriculture practices may result in soil modifications, including increased susceptibility to slumping, reduced nutrient status and impaired structure if the organic matter content is not maintained. These can be mitigated by including sustainable land use practices in the agriculture extension component. These include (i) continued use of traditional terrace construction and management of water flows (ii) the use of deep rooting grasses and shrubs to further strengthen bunds and terrace walls, and (iii) promotion of continued use of organic based practices.

58. **Soil and water contamination due to agrochemicals.** The intensification of agriculture may also result in increased use of agrochemicals including mineral fertilizers and pesticides, which may result in soil and water contamination. Although the use of agrochemical is currently far less than the level applied in productive agriculture systems, these need to be carefully monitored, and mitigated through agriculture extension that promotes (i) optimum, informed use of mineral fertilizers in combination with organic manure, (ii) promotion of the concept of integrated pest management, focusing on cost effective and environmentally friendly or benign pest management techniques; and (iii) emphatic discouragement of the use of persistent pesticides.

59. **Biodiversity.** Biodiversity may be affected by increased specialized mono-cropping, use of agrochemicals, introduction of alien (invasive) species, introduction of high yielding varieties (HYV) at the expense of traditional low yielding varieties, and by the conversion of ecosystems such as forests and wetlands or particular habitats hosting unique and endangered species. These can be mitigated by (i) awareness raising through the agriculture extension component and through training and support to WUAs of the importance of maintaining diversity of farming practices and local landscape, (ii) promoting under the agriculture extension component the maintenance of variety of production of both cash and subsistence crops and (iii) promoting under the agriculture extension component the use of indigenous multi-purpose trees for soil protection, watershed management and cash crop production.

60. **Waterborne diseases.** The incidence of waterborne diseases is high in much of the project area, due to inadequate sanitation measures to control the source of pathogens. In some cases, the increased volume of water distributed around the command area may result in increased occurrence of water logging, providing a habitat for vectors of diseases. In addition, in areas where potable water is not available, some villagers may use the irrigation network as a source of drinking water, which may bear dangerous pathogens. These effects can be mitigated by (i) promoting improved operation and maintenance of the schemes as part of training and support to WUA's so that blockages and ruptures causing water logging are rapidly repaired, (ii) providing for adequate drainage design where appropriate, and (iii) raising awareness through the agriculture extension component, training and support to WUAs on the hazards posed by poor sanitation, water logging and use of untreated irrigation water for drinking.

#### e. Potential Environmental Enhancement Measures

61. Most sub-projects will comprise rehabilitation and improvements to existing schemes. Physical works will include strengthening of intake and distribution structures using permanent materials which will significantly reduce existing soil erosion risks, and risks of damage to fields and property. Where existing schemes use wooden structures for intakes, diversions and

crossings, their replacement with concrete structures will reduce timber demand on local forests. The project includes substantial support to WUAs in establishing functional structures and managing the water resources on a sustainable and equitable basis. The approach is founded on prior experience in the sector, and on approaches to strengthening community level structures in various other sectors in Nepal. The expected improvements in operation and maintenance (O&M) capability will result in a more regular and reliable scheme maintenance, and reduced environmental risks associated with the operation of the scheme such as inequitable water distribution, damage from overflows induced by blockages and/or ruptures to the canal and conveyance of water borne diseases. In addition to the organizational support for O&M to be received by the WUAs, extension in irrigated agriculture and related land management will be incorporated into each sub-project and linked to district level agricultural extension operations under the Department of Agriculture. This will encourage the adoption of environmentally sound practices such as crop diversification, and help reduce risks associated with intensification and specialization of farming, such as the excessive use of agrochemicals and conversion of natural habitats to farmland.

## 2. Specific Impacts of Core Subprojects and Mitigation Measures

### a. All Subprojects

62. **Adverse soil modifications and risk of land conversion.** Increase in fertilizer and pesticides use as a result of more intensive irrigated production is expected but this will be addressed through the agricultural extension component of the project, which will promote optimal uses of such inputs.

63. **Hazards associated with the use of toxic chemicals.** Intensified agriculture and greater cash incomes resulting from improvements to the irrigation scheme may cause farmers to purchase toxic pesticides and fungicides, placing human health and the integrity of local ecosystems at risk. This tendency will be mitigated against through the agriculture extension component, which will promote integrated pest management and the proper use of chemical inputs where necessary.

### b. Harinmari

64. **Downstream water quality.** This is a concern as the scheme may result in lower water volumes of the perennial Geruka flow, increasing the concentration of pollutants from industrial effluent from a nearby paper mill, in particular, during the dry season. More detailed impact study is needed to estimate the level of impacts before the appraisal of this subproject.<sup>2</sup> Mitigation measures include monitoring of the water quality downstream, and enforcement of the environmental regulations to the concerned factory.

### c. Inгла Khola and Talkharka

65. **Watershed erosion.** Rills and gullies are regular occurrences in the middle hills of Nepal, as well as occasional landslides. While these will occur in the absence of the scheme, there is some increased risk associated with the construction and operational phases. These

---

<sup>2</sup> However, the concerned factory is in the process of installing facilities for treating both raw materials and effluent to reduce effluent discharge. The site needs to be inspected further to estimate the potential impacts of the subproject.

can be substantially mitigated using low cost bio-engineering techniques that are primarily labour based, and utilize locally understood technology.

66. **Scouring hazards.** Some of the canals of are subjected to seasonal scouring when water flows are high. This will be mitigated by strengthening of the canal walls during scheme rehabilitation, and the promotion of improved maintenance capacities of the WUA during the operational phase.

67. **Temporary pollution.** Excavations, both for canal improvement works and extraction of materials will cause silt runoff and entail a risk of destabilizing steep slopes. This can be mitigated by ensuring adequate supervision of construction operations, and the use of silt traps where appropriate. Contracts for the works should include clauses pertaining to earthworks, engineering practice and adequate evacuation of drainage waters. Finally, temporarily water diversions during construction may undercut slopes and damage agricultural and residential land. Works should therefore not take place during the monsoon season and again, be adequately supervised.

## E. INSTITUTIONAL REQUIREMENTS AND ENVIRONMENTAL MONITORING PLAN

68. **Institutional requirements.** Nepal has an established legal and policy framework for environmental safeguarding in relation to projects. Environmental protection is overseen by the Environment Protection Council (EPC), which is chaired by the Prime Minister. The Ministry of Population and Environment (MOPE) holds overall responsibility for environmental policy. The principal legislation for environmental safeguarding is the 1997 Environmental Protection Act (EPA). Implementation of the EPA is the responsibility of the MOPE and the sectoral ministries. For those projects having insignificant environmental impacts, the responsibility of undertaking and approving IEEs and implementing the subsequent environmental monitoring plan (EMP) are delegated to the concerned sectoral ministries. The DOI is under the MOWR. Both DOI and MOWR have environmental sections that liaise with each other. The Environmental Section within DOI was established in 1988 and is located within the Surface Irrigation Division (SID)

69. **Institutional arrangements and responsibilities.** At the DOI headquarters level, a central project management office (CPMO) will be set up with class-I engineer as full time project director, and will be responsible for overall environmental management, under technical support and guidance from Environmental Section in SID. At the regional level, regional project support unit (RPSU) will be established with director of the Regional Irrigation Directorate as project manager of each region and will be responsible for day-to-day implementation of the Project. RPSU will have an assigned staff to manage environmental activities with the assistance of the consultants. At the field level, subproject management unit (SMU) will be established in each district headed by the chief of the irrigation development division/ sub-division (IDD/IDSD), which will undertake field operations including environmental planning and monitoring under supervision by RPSU. Specific institutional responsibilities during the subproject implementation cycle are stipulated as below.

**Table 3. Institutional Responsibilities for Environmental Management**

| Subproject Stage | Responsible Organization | Responsibilities   |
|------------------|--------------------------|--|
| Overall          | ISPM consultants         | Support capacity development of environmental planning, monitoring, and management |
|                  | EB in SWD                | Guidance for environmental planning, monitoring, and mitigation                    |
|                  | MEQCB in PDMED           | Management of monitoring and evaluation data                                       |
| Screening        | RPSU/SMU                 | Screen the project requests in light of environmental and other criteria.          |

| Subproject Stage               | Responsible Organization                  | Responsibilities   |
|--------------------------------|---|--|
| Planning                       | RPSU/SMU/firms                            | Prepare IEE (included in SIP), minimize avoidable losses, incorporate mitigation measures, and prepare EMP           |
|                                | CPMO-EB in SWD                            | Endorse IEE and SIP  |
|                                | Subproject Appraisal Subcommittee         | Approve IEE and SIP  |
|                                | Ministry of Water Resources               | Approve IEE  |
| WUA formation                  | RPSU/SMU/NGOs/<br>Cos                     | Strengthen WUA including monitoring capacities   |
| Detailed Design                | RPSU/SMU/ firms                           | Assist preparing RP, incorporate EMP into engineering design and specifications                                      |
|                                | RPSU/SMU/NGOs                             | Prepare and implement RP   |
|                                | CPMO-DB in PDMED                          | Approve detailed design  |
| Construction                   | Contractor                                | Implement required environmental measures  |
|                                | RPSU/SMU/firms                            | Supervise contractor implementation of environmental measures  |
| Agriculture and social support | RPSU/SMU/firms/<br>NGOs                   | Implement specific environmental mitigation measures incorporated in the agriculture and social development programs |
| Operational                    | DOI                                       | Provide budget to undertake annual monitoring and audit  |
|                                | RPSU/SMU/NGOs<br>(during Project)         | Carry out annual performance audit of completed schemes. Support additional mitigation measures as necessary         |
|                                | RID/IDD/IDSD/DDC/<br>DADO (after Project) | Same as above.   |
|                                | WUAs                                      | Monitor agriculture practice and impacts and report them to SMU  |

DB=Design Branch; EB=Environmental Branch; MEQCB=Monitoring, Evaluation, and Quality Control Branch; PDMED=Planning, Design, Monitoring and Evaluation Division; SWD=Surface Water Division

70. **Environmental Monitoring Plan (EMP).** Preliminary EMPs were prepared in the context of individual IEEs and will be further refined during the subproject appraisal and detailed design stage. Environmental monitoring will be integrated into the Project performance monitoring and evaluation (PPME) system. Essentially, it will be put into operation through data collection at subproject level by SMU with the engagement of private firms as necessary and/or WUA, monitored and supervised by RPSU through regular management review and field confirmation, and processing and analysis by Monitoring and Evaluation Branch of DOI in coordination with DOA. Environmental data will be shared with Environment Division. Monitoring costs have been incorporated into the design of the PPME system for the project. The findings of the monitoring activities will be incorporated in the regular PPME reports prepared by CPMO with the assistance of the consultants engaged under institutional strengthening and project management, and submitted to ADB.

71. Monitoring is necessary in respect of (i) water resources quantity and quality; (ii) any evidence of water resources dispute among users or environmental degradation; (iii) progress and status on resettlement activities; (iv) environmental indicators related to design and construction; (v) agricultural impacts such as input use (seeds, fertilizer, and pesticides) and outputs; and (vi) maintenance requirements and status of the subprojects including conditions of riverbank, structures, canals, and adjacent slopes.

72. For schemes located in the terai or in other locations close to or potentially close to polluting industries, water quality requires monitoring. The following parameters should be monitored on a quarterly basis, sampling at sources and at further points along the length of the principal canals: Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOC), pH, Presence of Chromium, Presence of Lead, and Presence of Arsenic. In cases where

conjunctive use of surface water and groundwater is promoted, the output rate from a sample of source wells should be monitored during each dry season to detect any trends in availability. The outputs should be monitored three times each dry season, at regularly spaced intervals.

73. Specific environmental impacts, mitigation measures, and responsibilities for planning, monitoring and mitigation are set out below.

**Table 4. Summary of Environmental Effect, Mitigation Measures, and Institutional Responsibilities**

| Potential Effect  | Mitigation Measures   | Agencies responsible for planning and monitoring                             |
|---|---|--|
| <b>Environmental impacts related to project location</b>  |   |  |
| Effects on downstream water use including reduced water availability to users and concentration of pollutants | Mapping water resource availability over the project area (excluding areas of known water deficit)                                | DOI/CPMO   |
|   | Reconfirmation of adequate water availability (excluding schemes with inadequate sources)   | SMU/consultants engaged for SIP preparation/RPSU                             |
|   | Provision in scheme design for use of any availability supplementary water sources e.g. groundwater                               | SMU/consultants engaged for SIP preparation/RPSU                             |
|   | Training and support to WUAs in coordination of water use and practice of rotational water intake                                 | SMU/NGOs engaged for beneficiary mobilization and social development support |
| Water resource conflicts where increased abstraction exacerbates existing shortages                           | Water resource assessment as above  | DOI/CPMO, SMU/consultants engaged for SIP preparation/RPSU                   |
|   | Reviewing scope for supplementary or alternative water sources during feasibility study and incorporation into design if feasible | SMU/consultants engaged for SIP preparation/RPSU                             |
| Cumulative effects should more than one scheme in any one basin receive support under the project             | Water resource assessment as above, assessing extent of cumulative water extraction and drainage effects                          | DOI/CPMO, SMU/consultants engaged for SIP preparation/RPSU                   |
| Restrictions on movement of people and animals  | Provision of adequate super-passages and culvert crossings in the design  | SMU/consultants engaged for SIP preparation/RPSU                             |
| <b>Environmental impacts related to project design</b>  |   |  |
| Effects on land or property   | Application of resettlement framework, prepared during PPTA   | CPMO/RPSU/SMU/consultants and NGOs   |
| Watershed erosion and scour on hill schemes   | Use of low cost bio-engineering techniques  | SMU/consultants engaged for SIP preparation/RPSU                             |
| In the case of larger schemes, soil salinization and changes in water table levels                            | Appropriate design measures such as provision of groundwater drains   | SMU/consultants engaged for SIP preparation/RPSU                             |
| Arsenic poisoning   | Exclusion criterion for schemes using groundwater where the source is found to contain excessive levels of arsenic                | SMU/consultants engaged for SIP preparation/RPSU                             |
| Structures and facilities that are difficult to operate by WUAs   | Preparation of design standards that encourage user-friendly design measures  | DOI/CPMO   |
|   | Consideration of feasibility of operation in design/adherence to standards  | SMU/consultants engaged for SIP preparation/RPSU                             |

| Potential Effect  | Mitigation Measures   | Agencies responsible for planning and monitoring  |
|---|---|---|
| <b>Environmental impacts related to construction</b>  |   |   |
| Temporary increases in silt runoff/induced erosion  | Provision in standard contract documentation for adequate supervision of operations and adherence to them by contractors; confining of operations to the dry season, use of silt traps, careful deposition of spoil.  | DOI/CMPO – preparation of standard contract documentation   |
|   | Incorporation of the above measures into BOQ for subproject contract documentation  | SMU/consultants engaged for SIP preparation/RPSU  |
|   | Supervision of Contractors  | SMU   |
| Temporary closure of irrigation systems   | Participation by users and information to them  | SMU/Contractors/WUAs  |
|   | Use of flexible hosing and/or diversion canals  | DOI/CPMO for inclusion into standard contract documentation<br>SMU/consultants for incorporation into BoQ<br>SMU for contractor supervision |
| Dust generation   | Appropriate timing of operations wetting of surfaces and notice to/involvement of public  | As above  |
| Noise generation  | Appropriate timing of operations and notice to/involvement of public  | As above  |
| Land use conflict for construction facilities/ work camps/plant parking sites   | Negotiation with landowners and compensation to them, in accordance with the resettlement framework as appropriate  | As above  |
| <b>Environmental impacts related to operation</b>   |   |   |
| Soil modifications as a result of intensified agriculture   | Encouragement of (i) continued use of traditional terrace construction and management of water flows (ii) the use of deep rooting grasses and shrubs to further strengthen bunds and terrace walls, (iii) promotion of continued use of organic based practices | SMUs/DADO/NGOs engaged for the component  |
| Soil and water contamination due to increased use of agrochemicals including fertilizer and pesticides  | Agriculture extension to include (i) optimum, informed use of mineral fertilizers, (ii) promotion of integrated pest management, (iii) emphatic discouragement of the use of persistent pesticides  | SMUs/DADO/NGOs engaged for the component  |
| Biodiversity concerns associated with introduced plant species and varieties, reduced diversity of cropping and land use changes from tree cover to agriculture | (i) awareness raising on bio-diversity issues, (ii) promotion of diversity in farming practices and local landscape (iii) promoting planting of multipurpose trees  | SMUs/DADO/NGOs engaged for the component  |
| Increases in incidence of waterborne diseases, particularly due to increases in water logging   | Promotion of improved O&M of the schemes by WUAs  | SMUs/ NGOs engaged for the component  |
|   | Awareness raising on hazards posed by poor sanitation, water logging and use of untreated water for drinking  | SMUs/ NGOs engaged for the component  |
|   | Provision for adequate drainage in the scheme design  | DOI/CPMO for inclusion into standard contract documentation<br>SMU/consultants for incorporation into BoQ                                   |

## **F. PUBLIC CONSULTATION AND DISCLOSURE**

74. Several national and regional workshops were held at the completion stage of the Second Irrigation Sector Project (SISP), at PPTA inception, mid-term, and loan fact-finding with the participation of a wide range of stakeholders. During the workshop, it was generally recognized that the Project environmental impacts are generally positive given its focus on improving the productivity and socio-economic, institutional, and environmental sustainability of existing FMIS with a participatory and demand-driven approach. However, the systems and capacities of IEE within DOI remain weak and need to be strengthened, with particular attention to ensure due assessments in water resources availability, vulnerability of physical conditions or land stability in the hills, and agrochemical use.

75. Discussions were held with groups of beneficiaries during initial field visits and the preparation of feasibility studies for the core sub-projects. During these discussions, the scheme was discussed with groups of beneficiaries, typically 6 to 12 persons in size, and their views sought on key issues including (i) anticipated effects of the proposed scheme improvement, (ii) the extent and nature of changes in land use that may occur with improved supplies of irrigation water (iii) presence of any sites of archaeological or cultural importance (iv) land stability in the around the existing scheme and (v) potential land use conflicts. No serious concerns were raised by villagers during these discussions. Villagers anticipated higher yields of existing crops as well as the ability to produce a greater range of crops, including cash crops, as well marketable surpluses that would increase cash incomes.

76. The approach adopted for the Project ensures that all sub-projects are community driven. Design and implementation involves the groups potentially affected by the schemes, ensuring a very high level of public awareness and involvement at each stage. Procedures for public consultation and disclosure are incorporated in sub-project implementation guidelines prepared for the project. These build upon procedures followed in the preceding Second Irrigation Sector Project (SISP). In accordance with the main issues identified in the SISP implementation in the Project Completion Report (PCR), essential elements incorporated into procedures for the Project include (i) understanding the project during the planning phase, (ii) physical and financial contributions during the construction phase, and (iii) taking ownership for operation, maintenance and management of the irrigation systems after construction.

77. The modified implementation guidelines have therefore been designed to ensure projects developed have (i) genuine sub-project demand, (ii) participatory, comprehensive and accurate sub-project preparation, (iii) strong WUA organizations, (iv) committed participation of the WUA in sub-project implementation, (v) effective and transparent communication between supporting agencies and WUAs, and (vi) efficient use of financial resources. The modified guidelines are based on and adapted from the 13-step approach adopted in the SISP.

78. An SIEE prepared for the project will be posted on the ADB website and copies of individual feasibility study reports including IEEs will be made available to the concerned DDCs.

## **G. FINDINGS AND RECOMMENDATIONS**

79. The principal findings are that the Project provides for inherently environmentally friendly irrigation interventions and contributes to significantly improved living conditions through (i) community emphasis on subproject design and implementation, (ii) extensive technical support in eliciting sustainable practices in irrigated agriculture and (iii) addressing institutional needs for

sustained and equitable O&M. The identified adverse effects will be addressed through proper planning, design, implementation, and O&M while incorporating identified mitigation measures. The EMP will ensure that future subprojects are also subjected to environmental assessment.

80. Potential concerns remain over the extent to which sub-projects may exacerbate the effects of industrial pollution. Industrial activity is growing in Nepal, particularly on the terai. Levels of pollution from these industries can be high, partly as a result of weak enforcement of the law, but also because economic constraints within the region reduce the ability of industries to make the investments in plant and operating space necessary to adopt manufacturing processes that limit polluting by-products and to treat effluent to bring pollutant contents down to acceptable levels. The Ministry of Population and Environment (MOPE) has developed effluent standards for different industries, and the Environment Protection Act (1997) provides the necessary legislation to enforce these. At present, many industries do not comply with mandatory standards, and require technical support and high levels of investment before they can do so. These issues are being addressed by the Ministry of Industry Commerce and Supply with donor support. Overall the Project scope as a whole may be constrained by the presence of such industries, as environmental risks associated with enhanced irrigation for potential sub-projects located downstream from polluting industries will render such sites infeasible. The option exists to encourage stepped-up enforcement of the Environment Protection Act, based on the attainment of realistic milestone reductions in pollution by offending industries.

## **H. CONCLUSIONS**

81. The overall finding of the IEEs is that the Project will not cause significant environmental problems and that potential adverse impacts are manageable through proper site location, design, construction and management. The Project can therefore be classified under Category B: *Projects judged to have some adverse environmental impacts, but of lesser degree or significance than those for category A projects.* The IEEs are considered adequate and the preparation of a full EIA is not required.