7.3. Watershed and Forest Management

Degradation of land environment is easily observed in the DIDP Area especially in upland such as denudation of forest, soil erosion and others. They result from inappropriate upland use such as cutting trees, kaingin (slash-and-burn), upland farming, encroachment of squatters and settlers, and mining activities. Environmental problems of the land connect with the coastal area so that conservation of terrestrial environment contributes to conservation of the coastal environment.

(1) Enhancement of slope protection

DENR promotes Sloping Agricultural Land Technology (SALT) originated from Mindanao Baptist Rural Life Center. Although the SALT covers area below 18% of slope, upland farmers practice it even above 18% of slope area. Slope Management Areas and Slope Rehabilitation Area are proposed in Chapter 5. It is important that slope management guidelines should be disseminated to people.

(2) Monitoring for upland use

The large cultivated area of upland is categorized into forest land. However setters encroach into upland. Upland use should be monitored by LGUs for control of illegal activities and occupancy.

(3) Enhancement of CBFM and IFMA

DENR has watershed conservation and forest management programs such as Community Based Forest Management (CBFM) and Industrial Forest Management Agreement (IFMA) as timber production. These programs should be enforced continuously in coordination with forest conservation and protected area management.

(4) Ecological Watershed Rehabilitation

Although the CBFM program includes watershed management, its major is development of livelihood alternatives through gathering of forest products for communities. If mono-tree is planted in the same area, harvesting time coincide. Ecological watershed rehabilitation focuses on conservation and restoration of ecosystem and water resources. A variety of indigenous tree species should be planted within watershed area considering the transition of forest and structure of forests. This will benefit the development of water resources through ensuring quality and quantity of water resources rather than exploitation of forest products

Criteria to select sites for ecological watershed rehabilitation are the following:

- there are valuable fauna and flora to be conserved from ecological view point;
- there are water resource potentials; and
- there are water demand.

Ecological watershed rehabilitation areas are not the same as strict protection areas. These areas can be used for research, environmental education and training, and recreation purposes. However, these areas should be conserved. It is possible that activities within the carrying capacity and measurement activities are allowed. The following activities are prohibited at adopted ecological watershed rehabilitation areas:

- logging,
- construction of new infrastructure excluding tracking routes for monitoring, research and patrol, and
- establishment of large scale cultivated land.

Adopted areas for ecological watershed rehabilitation are implemented by the following:

- reforestation,
- protective measurement of soil erosion, and
- construction of tracking routes for monitoring, patrol and recreational purposes.

Ecological watershed rehabilitation sites are managed by LGUs and communities with support from NGOs. Entrance fees may be collected from visitors. Collected fees can be used to cover management cost.

7.4. Coastal Environmental Management

Coastal areas in the DIDP Area are important environmental components, which are not properly used at present. It is difficult, however, to identify actual problems due to lack of data and information. A coastal environmental management plan needs to be prepared based on scientific data. The following are recommended:

- Enhancement of research and monitoring of coastal environment,
- Integrated management planning of Davao Gulf,
- Strengthening of Davao Gulf Management Board and establishment of Supporting Staff Office,
- Sustainable use of fishery resources, and
- Control of coastal use.

(1) Enhancement for research and monitoring of coastal environment

Workshop participants and newspapers report that there are environmental problems on the coast of the DIDP Area such as heavy metal pollution, overfishing and others. However, there is not enough data available for scientific evaluation and formulation of a management plan. Especially Davao Gulf and Pujada Bay have been used for various purposes, not only fishery but also establishment of community, industry, tourism and others. It is required that Davao Gulf and Pujada Bay are researched and monitored for scientific assessment and management planning. The following are proposed.

a. Davao Gulf Research and Monitoring

Davao Gulf is surrounded by Davao Oriental, Compostela Valley, Davao del Norte, Davao City and Davao del Sur. Enhanced Davao Gulf Management Board and Supporting Staff Office (proposed in the following section), should carry out scientific research and monitoring, and establish database coordinating with academe, DENR, DA and NGOs.

Proposed subjects of research are:

- physical circulation model in Davao Gulf,
- fishery resource assessment (enhanced fishery assessment by DA), and
- modeling on water quality.

Monitoring should cover:

- water quality including chemical and biological parameters,
- fishery resources including fish landing by species,
- coral reefs, seagrass bed,
- mangrove forest, and
- sedimentation.

b. Pujada Bay research and monitoring

Pujada Bay is one of protected areas under NIPAS, and also used as fishing ground and for industry and residential areas. However, there exist few scientific data regarding coastal environmental management of the Bay. Data regarding marine environment need to be collected and compiled for effective management.

Davao Oriental State College of Science and Technology, Mati, established in 1990 has Natural Science Department including marine biology. This state collage opened recently so that there are not enough researchers and research equipment. However, it can be made into a core center for research and monitoring of Pujada Bay. It is recommendable that a Pujada Bay Research and Monitoring Core Center be established belonging to Davao Oriental State College (Figure 30). Furthermore, the collage's skill of research will be developed through study of Pujada Bay, and obtained data can also be used for education materials.

The Pujada Bay Research and Monitoring Core Center has the following functions:

- coordinate environmental surveys of Pujada Bay conducted by different agencies,
- conduct research and monitoring of coastal environment,
- develop environmental database which can be accessed from other academic and central and local governments,
- provide necessary data and information to governments for decision making regarding coastal environmental management, and
- organize seminar and symposium for academe and citizen.

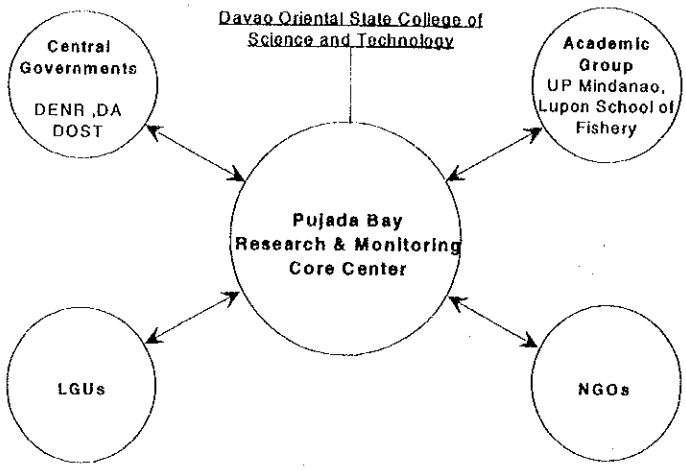

Figure 30 Network of Pujada Bay Research and Monitoring Core Center

(2) Integrated management plan of Davao Gulf

The existing Davao Gulf Management Program is not functioning because it is not a concrete plan. An Integrated Management Plan of Davao Gulf should be formulated. This plan should cover not only coastal area but also watershed of Davao Gulf. Because, coastal area is much affected by human activities.

Therefore, the coastal area and its watershed should be integrated. The following are to be included in the Davao Gulf Integrated Management Plan:

- coastal zone management plan including delineation of coastal water zoning,
- shoreline use plan,
- watershed management plan,
- area re-development plan in coastal zone of populated areas,
- fishery resources management plan, and
- alternative livelihood development plan for fishery communities.

(3) Strengthening of Davao Gulf Management Board

Davao Gulf is surrounded by DIDP's City and provinces. Davao Gulf has various problems such as pollution by wastewater from households and factories, sedimentation, overfishing and illegal fishing and illegal occupants. In the future, Davao Gulf may be affected more by other problems. Environmental problems of Davao Gulf are derived not only from coastal area itself but also from the land. Integrated management is required including watershed of Davao Gulf and the coastal area.

Davao Gulf Management Board (DGMB) established in 1996 consists of central and local governments. It can be said, however, that the Board is not functioning at present. Strengthening of the Board and establishment of Supporting Staff Office for the Board are recommended (Figure 31). DGMB should be enhanced in two stages. First, formulation of a management plan and guidelines, and monitoring will be carried out by the Board. Second, the Board should be re-established under regulations for authorizing the Board. The Board should have the following functions.

- formulate a Davao Gulf Environmental Management Plan including coastal use and resources use,
- issue endorsement for development to LGUs,
- issue endorsement for Environmental Impact Assessment to DENR,
- provide management policy to central and local governments,
- coordinate coastal use including watershed and water area based on the Environmental Management Plan, and
- coordinate coastal use of neighboring provinces and municipalities.

The supporting Staff Office provides necessary environmental data and information and technical advise to the Council for decision making. The Office will:

- implement environmental monitoring,
- disseminate and enlighten for people,
- evaluate development projects and programs, and
- monitor the implementation of the management plan.

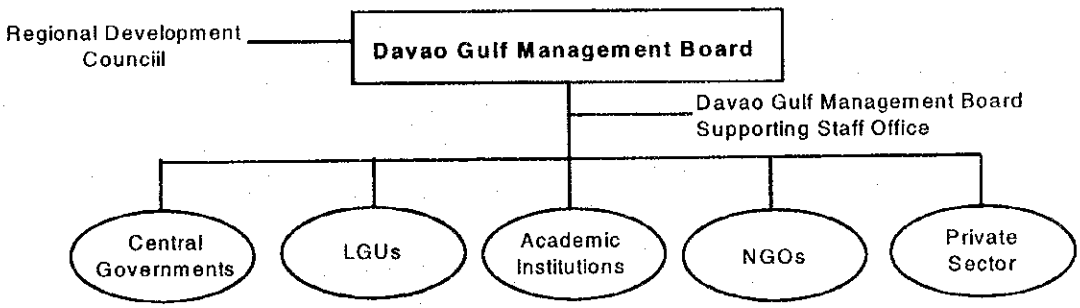

Figure 31 Proposed Davao Gulf Management Board

(4) Sustainable use of fishery resources

According to fishery resources assessment, fishery resources have been depleted by overfishing and destructive fishing. There are two approaches for sustainable use of fishery resource as follows:

- to control fish catch based on Maximum Sustainable Yield (MSY), and
- to conserve habitats and spawning sites.

The former is attained by control of fishing gear, fishing methods and establishment of fish catch quota. The latter includes establishment of fish sanctuaries as follows.

Fish sanctuaries are categorized into permanent fish sanctuary, seasonal sanctuary and shifting sanctuary. The Regional Office of DA aims to establish fish sanctuaries covering 15% of total municipality water in the DIDP Area. At present, 14 fish sanctuaries have already been established by municipal governments in Davao Gulf (July 1998). Seasonal sanctuary and shifting sanctuary are recommended in the DIDP Area. These should be established in line with the concepts outlined below.

Seasonal fish sanctuary

Prohibited areas are designated at spawning time. On conditions that spawning sites can not be pin-pointed, a large area is to be seasonally designated as a fish sanctuary. However, research is required.

Shifting fish sanctuary

Fishing grounds are divided into several sub-areas. These areas are used for fishing and prohibited against fishing like a rotation of fishing. The sub-areas after using as fishing ground are prohibited for several years. Prohibited areas already rehabilitated are used for fishing (Figure 32).

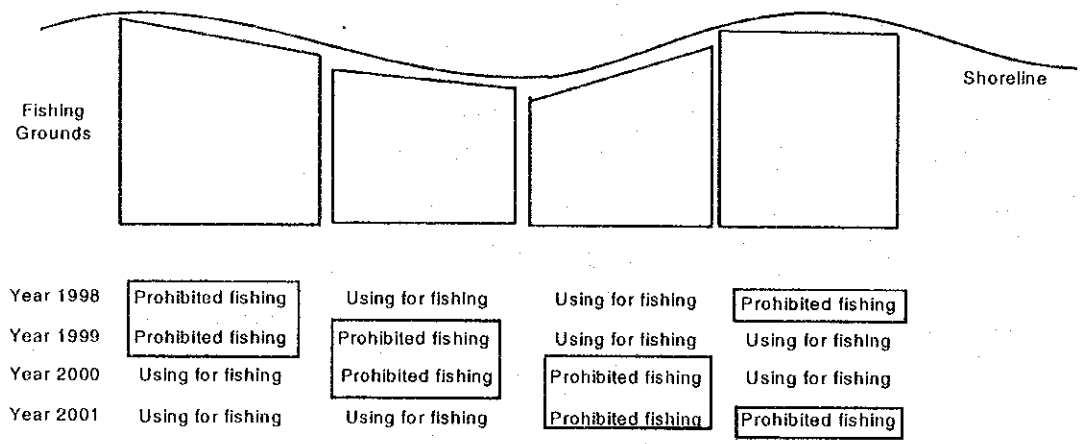

Figure 32 Concept of Shifting Fish Sanctuary

Boundaries of fish sanctuaries should be indicated by natural monuments and/or installation of buoys. The following are very important in delineating boundaries:

- to build consensus of fisherman and other coastal users,
- to announce location of boundary to people,
- to show concrete objectives of establishment (each sanctuary should have different objectives because of different conditions),
- to formulate each management plan and guidelines, and
- to show boundaries and markers of fish sanctuaries.

(5) Control of coastal use

There are lots of inappropriate coastal uses. Settlers encroach upon the shore in protected area and public land. Zoning of coastal use based on assessment is required. People can not access the shore, which are occupied by beach resorts under Foreshore Lease Contact with DENR. Area re-development approach is one of solutions for coastal management in populated areas.

7.5. Living Environment and Urban Environment Management

In this section, promotion of preventive pollution control and living environment improvement are proposed. Appropriate solid waste management systems are also

proposed not only for pollution control but also for improvement of living environment.

(1) Promotion of preventive pollution control

Existing pollution problems in the DIDP Area are not serious yet, except in urban area of Davao City at present. It is possible, however, that the environment will be polluted by human activities in the near future.

a. Promotion of increasing number of Pollution Control Officers

This will be for decreasing pollution at sources. The Pollution Control Office (PCO) system was established under Amending Memorandum Circulation No. 1, 1981. According to Memorandum Circulation, industrial, commercial and manufacturing establishments and the private sector appoint PCO(s). A PCO should monitor pollutants, supervise operation and maintenance of pollution control facilities, and report to DENR. Appointment of PCO(s) should be promoted through seminars and campaigns.

b. Incentives for pollution control

Incentives for pollution control should be given to the private sector. Incentives may consist of tax rebates for pollution control device, subsidies for better production processes, and technical supports as well as penalties against violations of environmental regulations.

c. Strengthening of monitoring

In the DIDP Area, lack of monitoring capability is major problems for pollution control, because emission gasses and effluent can not be controlled without monitored data. DENR and LGUs should strengthen environmental monitoring capability in advance of facing serious pollution problems.

d. Integration of industrial plants

Some of industrial plants are located in inadequate areas; for example gold mining processing factories are located in a community in Apokon. It is recommendable that the same kinds of factories are integrated in the same site. It is expected that wastewater treatment facilities, industrial waste treatment and disposal site and other infrastructure can be used by factories in common because of scale merit. This matter is taken up in Economic Sector Report.

e. Polluter pay principle

The Conference on the Mindanao Summit on Sustainable Development, supported by NEDA and UNDP, recommended in October 1997 that a polluter pays for damages of environment and people as long term measures. Persons who generate wastewater and emission gasses should have responsibilities of management and observing regulations. They must pay for installation of pollution control device. The Government should enforce regulations for pollution control.

(2) Introduction of appropriate solid waste management systems

LGUs have to establish solid waste management systems under Local Govemment Code,1991. Although LGUs have solid waste management systems, they can be collapsed without reduction of wastes. Waste reduction requires supports from communities. Therefore, appropriate solid waste management requires team work

of government and communities. Targets of solid waste management are shown in Table 47. An in-depth study for Davao Integrated Solid Waste Management System Development is presented in Project Report.

Table 47 Existing Solid Waste Management System and Proposed System

Sub-System	Existing Conditions	Proposed System
Collection and Haulage	• door to door collection • dump track is dominant collection vehicle	• establishment of waste container in high density area • introduction of compactor car and mini-dump track for urban area • establishment of transfer station
Intermediate Treatment	non	• introduction of source separation for recycling • promotion of compost
Final Disposal	• open dumping	• sanitary landfill

(3) Development of city parks

There are only two city parks in Davao City. The total number and the per capita area of city parks can be used as an index of living environmental quality. It is possible that city park will be developed in urban area of Davao City. Establishment of city parks should be considered at planning stage for new and re-development area.

(4) Beautification

There are living environmental problems such as scattered garbage, destroy of public facilities, and ruined houses from viewpoint of landscape. The following are recommended:

- development of tree lining streets,
- improvement of waste collection system,
- improvement of construction of sidewalk, and
- maintenance of drainage channels.

(5) Natural disaster prevention

There are possibilities of natural disasters in the DIDP Area such as flood, landslide, tornado, wave and tsunami, earthquake and volcanic activities. City and Provincials Disaster Coordinating Councils formulated natural disaster prevention plans. However, they are not based on scientific data. It is required that natural disaster risk assessment be conducted and natural disaster prevention plans formulated based on risk assessment especially for landslide, earthquake, and volcanic activities.

7.6. Protected Area Management

Although there are nine protected areas managed by DENR in the DIDP Area, only two protected areas, Mt. Apo Natural Park and Pujada Bay Protected Landscape/Seascape, have been re-established under National Integrated Protected Areas System (NIPAS). There are various management problems due to encroachment of squatters and settlers, and manner of visitors. The following are required for appropriate management:

- Re-establishment of eight protected areas under NIPAS,
- Improvement of Protected Areas, and
- Establishment of Mt. Apo World Heritage Site.

(1) Re-establishment of eight protected areas under NIPAS

There are nine protected areas in the DIDP Area. However, only two protected areas have been re-established under the NIPAS. Seven protected areas were established before 1992 by former regulation. These protected areas, not yet categorized as NIPAS protected areas are called Initial Components. It is required that the following remaining seven protected areas are established as NIPAS protected areas immediately:

- Proposed Mainit Hot Spring Protected Landscape,
- Proposed Mabini Protected Landscape/Seascape,
- Proposed Babak Protected Landscape/Seascape,
- Proposed Malagos Protected Landscape,
- Proposed Mati Protected Landscape,
- Proposed Baganga Protected Landscape, and
- Proposed Baganga Bay Protected Landscape/Seascape .

At the same time, protected area management plans should be revised including re-delineation of protected area boundaries based on actual situation. An Integrated Protected Areas Fund can be formulated as a trust fund. Entrance fees can be collected from visitors. The following process should be followed:

- national review and recommendation,
- presidential proclamation,
- congressional action, and
- demarcation of protected area.

(2) Improvement of protected area

Protected area management facilities such as trekking route, signboards and others are not maintained or built in protected areas. Scattered garbages are found along the trekking routes, in camping sites and observation sites. Scattered garbages bring about ecological problems and destroy the scenery. The following are proposed.

a. Maintenance of trekking route

Some of trekking routes are not maintained so that they are unsafe for visitors. Destroyed tracking routes give rise to deterioration of environment by erosion.

b. Establishment of sign board

Protected areas provide teaching materials for environmental education. Proper signboards serve not only for education purposes but also for safety. The signboards include route maps, route directions and description boards and boundary markers of protected area. The following are considered for natural environmental conditions: materials, design, and location.

c. Clean up protected areas

There are two approaches:

- collection of scattered garbages by volunteers

  "Clean up protected area camping" is promoted led by DENR, DOT and NGOs

- promotion of environmental awareness

  The Protected Area Management Board (PAMB) guides "no thrown garbage and bring back garbage home"

d. Authorized park guides

Visitors hire local people as guides who are authorized guide. Authorized park guides are required for safety and promotion of environmental awareness aspects. Requirements of a park guide include the following:

- knowledge of natural environment,
- knowledge of protected area,
- skill for environmental education,
- knowledge of first aid for accidents, and
- guide against unsuitable activities of visitors.

(3) Establishment of Mt. Apo World Heritage Site

Mt. Apo Natural Park was established under NIPAS. Mt. Apo is the highest peak with 2938 m above mean sea a level in the Philippines, and has the watershed of 30 river systems. There are a variety of unique flora and fauna including flying lemur, Philippine tarsier, Philippine deer, Philippine civet and others within Mt. Apo Natural Park. Furthermore, Mt. Apo Natural Park was adopted as ASEAN Heritage Site at the Second ASEAN Ministerial Meeting at the Environment in 1984.

It is proposed that Mt. Apo Natural Park be nominated as a Natural Site of the World Heritage by UNESCO. There are three Wold Heritage Sites in the Philippine: the Baroque Churches of the Philippines, Tubbataha Reef and the Rice Terraces of the Philippines Cordilleras. Mt. Apo Natural Park can be evaluated as valuable Natural Site of World Heritage Site. Criteria of Natural Heritage are:

- natural feature consisting of physical and biological formations or such formations, which are of outstanding universal value from the aesthetic or scientific point of view,
- geological and physiographical formations and precisely delineation areas which constitute the habitat of threatened species of animals and plant of outstanding universal value from the point of view of science or conservation, and
- natural sites or precisely delineation natural areas of outstanding universal value from the point of view of science, conservation or natural beauty.

The nomination of Natural Heritage site will help to:

- protect and preserve ecosystem and society of indigenous cultural people,
- inform environmental value of Mt. Apo to the world,
- increase appreciation of the environmental significance of Mt. Apo, and
- obtain assistance for training staff in funding.

However, the Philippine Government should hold the following responsibilities:

- Site maintenance is performed and financed by the Country, not by UNESCO; and
- A World Heritage Center requires regular monitoring to determine the quality of site maintenance

The following process is to be followed:

1) Nomination dossier is officially submitted by the Philippines,

2) Assessment is made by technical experts who evaluate the dossier, and

3) The World Heritage Committee acts on the technical assessment and votes on the site inscription.

7.7. Land Development and Management

7.7.1. DIDP strategy in land sector

Land development in the DIDP Area is constrained physically by the large portion of land having large slopes, the dominance of highland/hillyland areas, and large extent of land susceptible to erosion as described above. Some lands are already over-used by human activities. Water and land regimes are particularly interacting in the DIDP Area through human interventions as exemplified by flooding and salt water intrusion. Land use conflicts are acute between agricultural and urban/industrial uses in rapidly urbanizing areas, and also between forest protection and livelihood of upland communities. Ancestral domain claims add another dimension to the land development and management in the DIDP Area.

More important land-related issues for the overall DIDP development are identified as (1) rationalization of land use, (2) integrated land and water resources management, (3) land tenure improvement, and (4) enforcement of land-related laws and regulations. They are examined first in the light of the DIDP strategy.

The Internal Integration strategy calls for the restoration of sustainable production capacity of land. This involves more rational use of overused lands through improved land management and enforcement of land-related laws and regulations. Another condition of the strategy is to improve land tenure through establishing ancestral domain claims and completing the CARP implementation.

Vitalization of livelihood of indigenous cultural communities and support to ARC's will expand and diversify the resource base, which will be an essential condition for pursuing the Globalization Drive strategy. Resolution of land use conflicts between agricultural and urban/industrial uses through proper land use planning is another prerequisite for the Globalization Drive strategy. The High Tech – High Services strategy in the land sector pursues high-grade urban land use for various services and amenity facilities of which urban land use planning is again a prerequisite.

7.7.2. Land development strategies

Land development strategies for the DIDP Area are established corresponding to the land-related issues identified above.

(1) Land use rationalization

Land resources in the DIDP Area are at present over-used in some areas and under-used in some others. Forestlands have been encroached upon by those seeking livelihood opportunities. Improper farming practices including slash and burn are still undertaken in hilly land to highland areas. The rapid population growth is applying increasing pressure on land resources in urban and rural areas. Rationalization of land use is a prerequisite for sustainable development of the DIDP Area.

The following are important components of the land rationalization strategy.

a. A realistic and practical delineation of land use classification for environmental management: namely, protection, conservation, and restoration areas

As mentioned in the section of environmental management, more realistic and practical delineation of areas for forest preservation, conservation and restoration areas should be undertaken. Large protected areas may be reclassified partly into conservation areas where limited and sustainable resources use may be allowed. Conservation forest areas could then be the main device to absorb the population pressure on forest lands.

b. Introduction of appropriate farming technology on slopes in uplands and hillylands

Introduction of technology for appropriated farming practices on slope lands is necessary to protect slopes in uplands and hillylands. Creation of livelihood as well as protection of slopes by employing appropriate farming technology such as contour farming and SALT should be undertaken through extension to upland farmers.

c. Correction of land use on over-used land in agricultural areas to realize suitable land use

Some lands are over-used, and conversely some others under-used in terms of land productivity. This will undermine the sustainability of the land. The mismatches in agricultural land use should be corrected by conversion in accordance with land suitability.

d. Land use conversion for crops on under-used land to maximize the productivity

Some lands are still under-used vis-à-vis their productivity. To meet the food security for increasing population as well as the DIDP's economic growth, optimal land use should be pursued to increase productivity of land.

e. Formulation and implementation of proper urban land use plans to prevent indiscriminate land use conversion from agriculture to urban uses

Fundamental to the issues of land use conversion is the considerable increase in population in the DIDP Area which has created an acute competition for the use of land. The land suitable for urban uses is in most cases also suitable for agricultural land; hence conflicts between uses of land. The DIDP Area will experience a rapid urbanization, and some areas are designated as PAIC areas. Furthermore, the land use conversion of agricultural land has a negative effect on the CARP promotion. Therefore, a comprehensive land use plan should be formulated by municipality based on inter-agencies coordination to avoid the indiscriminate conversion of agricultural lands.

f. Formulation and implementation of disaster-preventive settlement plan

Various disaster prone areas exist in the DIDP Area such as areas of habitual flooding, seismic risks, fault line, erosion susceptibility, riverbanks easement or water intrusive coastal area. To prevent disaster damages, it is required to prepare a disaster preventive settlement plan. The plan would include:

- Delineation of disaster prone area,
- Identification of people living in the area,
- Resettlement plan,
- Livelihood programs, and
- Resettlement housing program (government supported, or self help)

The plan would be better at municipality level because people are more likely to accept the relocation site close to where they live.

(2) Integrated land and water resources management

Community-based resources management is a viable idea to be applied to the DIDP development. To substantiate the idea, local capacities for land resources management need to be enhanced, involving LGUs, NGOs and POs as well as local people and communities.

The following are strategic elements for land resources management.

a. Establishment of base-line data on land resource and regular up-dating

Consistent inventory data on land resources constitute the basis for land resource management. Without figuring out the actual conditions of land resources, no management plan can be made. The base data must be consistent. Even when there are land resource data, sometimes data from different sources are inconsistent with each other, which hampers the correct judgment on the land resources. Regular up-dating of the data is another requirement. The base-line data would be better if they are stored in computer system with map information like GIS to help quick and precise data inquiry and retrieval.

b. Information and education campaign (IEC) to enhance awareness of local people for sustainable land use and management

In land resource management, local people based management measures are effective with the limited governmental capability like the lack of finance, the limited number of personnel, etc. For this purpose, local people must understand the importance of the land resource management from the viewpoints of sustainable development and resources use.

c. Human resources development in land resource management

Comprehensive municipal land use plans should be the basis for land management. Even though the land reclassification is under the authority of DAR, municipal planning offices prepare land use plans which become a basis for land use conversion. Also, the municipal officials are in the best position to observe and monitor what is happening within their community or neighborhoods, and evaluate them. To achieve better land use management, therefore, it is essential to develop capability of municipal officers.

d. Comprehensive planning by municipality

Management of land resources is inherently related to water resources management. Improper land use and management cause water related problems. A typical case is deforestation and improper mining activities causing water pollution such as high siltation and toxic chemicals and affecting even coastal and offshore environment.

Comprehensive land use plans by municipality should build in watershed management, and their implementation and monitoring should be coordinated with neighboring municipalities through Municipal ENROs as recommended in the section on environmental management.

(3) Land tenure improvement

CARP

As mentioned in the land use conversion, from land use plan view point, formulation and implementation of comprehensive land use plans by municipality backed by the land use ordinance is a must to reflect the DAR's idea about the CARP. This would provide the basis for the CARP promotion at the municipal level.

Ancestral domain claims

Because the CADC areas are located in the forest area and occupying a large area, the management of the CADC areas in environmentally sound manner is critically important. To manage the CADC land effectively, the following should be addressed.

1) Establishment of clear rules on territorial matters between the IPs within CADC areas and other beneficiaries of the other forest related project/programs within the said CADC areas.

   The CADC areas may overlap with other forest related programs like CBFM, etc. In fact, according to the interview with the person in charge of CADC Area of Land Management Services, DENR, there is a conflict between the IPs and non-IPs in the Talaingod CADC area. Though they are both supposed to be respected, the reality will not go as expected. Therefore, further rules of CADC should be established when the area overlaps with other forest related program/project areas.

2) Establishment of clear rules on the right of accessibility of outsiders/investors to use/exploit resources within CADC areas

   In principle, outsiders are not allowed to enter the CADC area for resource use or stay. However, with the approval of the tribal committee, the outsider can enter to use the resources within the CADC area as long as their operation follows a CADC management plan prepared as mandated by the IPRA. This possibility has potentially both positive and negative implications. It may attract investments from outside to maintain environment in a sustainable way and to create livelihood such as agro-forestry use in the CADC area. However, this type of operation may undermine the empowerment of the IPs, and go against the philosophy and principle of the IPRA, leading possibly to disintegration of IP communities. Therefore, clear rules of the accessibility of outsiders must be established.

(4) Law Enforcement

There are problems on environment or land use; there are laws and regulations to the problems; and there are violators of the regulations. There are already listed "What" in most cases; the issues is "How". The strategy to this is strict enforcement of regulations and laws related to the land use. This is rather a prerequisite than strategy. To that end, the following would be raised:

1) Stiffer penalties, and

2) Enhancement of monitoring capacity in GOs, POs, and NGOs.

Table 48 Proposed Projects and Programs and Environmental Strategy

Proposed Projects and Programs	EN-1 LGU Environmental Management Capability Build. Program	EN-2 Environmental Information Center Project	EN-3 Environmental Education Co-Curriculum Dev't. Project	EN-4 Broad-based Environmental Mgt. & Dissemination Program	EN-5 Urban Topographic Mapping Project	EN-6 Upgraded Regional Land Use Mapping Project	EN-7 Land Resource Data Base Development Project	EN-9 Cadastral Mapping and Land Information System Improvement Program	EN-10 Integrated Watershed Management Program	EN-11 Upland Farming Area Development Project	EN-12 Comprehensive Urban Development Program	EN-13 Pujada Bay Environmental Research and Monitoring Center Project	EN-14 Davao Gulf Coastal Resources Protection Project	EN-15 Davao City Integrated Waste Management Model System Dev't. Program	EN-16 Solid Waste Management Model System Development Project	EN-17 Natural Disaster Assessment and Prevention Project	EN-18 Environmental Health Research Centre Project	EN-19 Sludge Treatment and Energy Recovery Project	EN-20 Mt. Apo World Heritage Establishment Project	EN-21 NIPAS Protected Areas Re-establishment Project	EN-22 Strategic Agricultural & Fishery Development Zone Promotion Program
1. Environmental Management Capability Building	◎																				
(1) Human Resources Development for LGUs	◎	○								◎	◎	◎	◎	◎			◎		○		◎
(2) Community and Private Sector Organizing	◎		◎	◎					◎	◎	◎	○	◎	◎	○				○		◎
(3) Barangay Environmental Manager System	◎			◎										◎	○						
(4) Enhancement of Environmental Monitoring and Development of Data base	◎	◎			◎	◎	◎	◎			◎	◎							◎	◎	
(5) Implementation of EIA	◎	◎			○	○	○	◎			◎	○									
(6) Promotion of Environmental Awareness	◎		◎	◎			○			◎	◎	○	◎	◎					◎		○
2. Watershed and Forest Management	◎																				
(1) Enhancement of Slope Protection		◎		○		◎	○	◎	◎	◎						○					◎
(2) Monitoring for Upland Use		◎				◎	◎	◎	◎	◎											○
(3) Enhancement of CBFM and IFMA						○		◎	○	◎											
(4) Ecological Watershed Rehabilitation		○	○	○		◎	○	◎	◎	◎			○	○							○
3. Coastal Environmental Management	◎																				
(1) Enhancement for Research and Monitoring of Coastal Environment		◎								◎	◎									◎	
(2) Integrated Management Plan of Davao Gulf		◎				◎	○			◎							○			◎	◎
(3) Strengthening of Davao Gulf Management Board and establishment of Supporting St		◎								◎											
(4) Sustainable use of fishery resources		◎		◎				◎		◎	◎	◎								◎	◎
(5) Control of coastal use		○		◎	◎	◎	○		○	◎	○			?	○		○			◎	
4. Living Environmental and Urban Environmental Management	◎																				
(1) Promotion of Preventive Pollution Control			○	◎	○	◎	○				◎	◎	◎	◎	?		○	◎			
(2) Introduction of Appropriate Solid Waste Management System			○	○	○	○	○							◎	◎			○			
(3) Development of City Park					○	○		○													
(4) Beautification			○	○	○									○	○						
(5) Natural Disaster Prevention		○			○	◎	◎				◎	◎				◎					
5. Protected Area Management	◎																				
(1) Re-establishment of eight protected areas under NIPAS						◎	◎					◎								◎	◎
(2) Improvement of Protected Area		○		○							◎	◎								◎	◎
(3) Establishment of Mt. Apo World Heritage Site																			◎		
6. Land Development	◎																				
(1) Land use rationalization					◎	◎	◎		○							○					
(2) Integrated land and water resources management						◎	◎							○					○		
(3) Land tenure improvement					◎	○	○	◎	◎												
(4) Law enforcement					◎	○	◎	◎	◎												

◎ : strong connection to environmental strategy
○ : moderate connection to environmental strategy
Proposed Projects and Programs in bold : Anchor Projects and Programs

Table 48 Proposed Projects and Programs and Environmental Strategy

Proposed Projects and Programs / Environmental Strategy	EN-1 LGU Environmental Management Capability Bldg. Program	EN-2 Environmental Information Center Project	EN-3 Environmental Education Co-Curriculum Dev't. Project	EN-4 Broad-based Environmental Mgt. & Dissemination Program	EN-5 Urban Topographic Mapping Project	EN-6 Upgraded Regional Land Use Mapping Project	EN-7 Land Resource Data Base Development Project	EN-8 Comprehensive DASC-Forest Management Project	EN-9 Coastal Mapping and Land Information System Improvement Program	EN-10 Integrated Watershed Management Program	EN-11 Upland Farming Model Villages Establishment Project	EN-12 Comprehensive Davao Gulf Management Program	EN-13 Pujada Bay Environmental Research and Monitoring Program	EN-14 Pollution Control Officers Promotion Program	EN-15 Davao City Integrated Waste Management Center Project	EN-16 Solid Waste Management Model System Dev't Program	EN-17 Natural Disaster Assessment and Prevention Project	EN-18 Environmental Health Research Centre Project	EN-19 Sludge Treatment and Energy Recovery Project	EN-20 Mt. Apo World Heritage Establishment Project	EN-21 NIPAS Protected Areas Re-establishment Project	EN-22 Sirawai, Aplaya & Fishery Development Zone Programs
1. Environmental Management Capability Building	◎																					
(1) Human Resources Development for LGUs	◎	○								○	○	◎	○	◎	◎	◎		◎		○		◎
(2) Community and Private Sector Organizing	◎		◎	◎						◎	○	◎	○	◎	◎	○				○		◎
(3) Barangay Environmental Manager System	◎			◎											◎	◎						
(4) Enhancement of Environmental Monitoring and Development of Data base	◎	◎			◎	◎	◎	◎		◎		◎	◎							◎	◎	
(5) Implementation of EIA	◎	◎			○	○	○	◎		◎		◎	○									
(6) Promotion of Environmental Awareness	◎		◎	◎			○			○		◎	○	◎	◎					◎		○
2. Watershed and Forest Management	○																					
(1) Enhancement of Slope Protection		◎		○		◎	○	○		◎	◎					○						◎
(2) Monitoring for Upland Use		◎				◎	◎			◎	◎											○
(3) Enhancement of CBFM and IFMA						○		◎		◎	◎											
(4) Ecological Watershed Rehabilitation		○		○		◎	○	◎		◎	◎				○	○						○
3. Coastal Environmental Management	○																					
(1) Enhancement for Research and Monitoring of Coastal Environment		◎								◎	◎										◎	
(2) Integrated Management Plan of Davao Gulf		◎				◎	○			◎	◎							○			◎	◎
(3) Strengthening of Davao Gulf Management Board and establishment of Supporting Staff		◎								◎	◎											
(4) Sustainable use of fishery resources		◎		◎						○	◎		◎	◎							◎	◎
(5) Control of coastal use		○		◎	◎	◎	○		○	◎	○		○		?	○		○			◎	
4. Living Environmental and Urban Environmental Management	○																					
(1) Promotion of Preventive Pollution Control			○	◎	○	◎	○					◎	◎	◎	◎	?		○	◎			
(2) Introduction of Appropriate Solid Waste Management System			○	○	○	○	○								◎	◎			○			
(3) Development of City Park					○	○			○													
(4) Beautification			○	○	○										○	○						
(5) Natural Disaster Prevention		○			○	◎	◎					○	◎				◎					
5. Protected Area Management	○																					
(1) Re-establishment of eight protected areas under NIPAS						◎	◎						◎								◎	◎
(2) Improvement of Protected Area		○		○								○	◎								◎	◎
(3) Establishment of Mt. Apo World Heritage Site																			◎			
6. Land Development	○																					
(1) Land use rationalization					◎	◎	◎		○							○						
(2) Integrated land and water resources management						◎	◎								○					○		
(3) Land tenure improvement					◎	○	○	◎	◎													
(4) Law enforcement					◎	○	◎	◎	◎													

◎ : strong connection to environmental strategy
○ : moderate connection to environmental strategy
Proposed Projects and Programs in bold: Anchor Projects and Programs

Chapter 8 Projects and Programs for Environmental Management

A total of twenty-two projects and programs are proposed for environmental management. They are listed in Table 48 classified by environmental management component and issue. Some of them are composite projects or programs comprising a few component projects. These projects and programs are described below. Profiles of these projects and programs are contained in Project Report.

(1) LGU Environmental Management Capability Building Program (EN-1)

Environmental management is one of the areas suffering the most from shortages of financial and administrative capacities after the devolution. The LGU Environmental Capacity Building Program addresses this issue with the four components: (1) establishment of an Environmental Training Center at the Institute for Local Government Administration, (2) development of environmental curriculum and education materials, (3) operation of training courses through lectures and laboratory/field works, and (4) publication of environmental information and education materials.

(2) Environmental Information Center Project (EN-2)

The Environmental Information Center Project aims to provide more accurate and comprehensive data and information on environmental conditions that would be shared broadly for better environmental management. The center under DENR will conduct field surveys to collect baseline data in cooperation with NGOs and Barangay Environmental Managers also proposed.

(3) Environmental Co-Curriculum Development Project (EN-3)

The Environmental Education Co-Curriculum Development Project is to develop environmental curriculum for elementary and secondary schools combining classroom instruction and field trips. The project is expected to enhance environmental awareness of the future generation.

(4) Broad-based Environmental Management and Dissemination Program (EN-4)

The Broad-based Environmental Management and Dissemination Program is also to enhance the environmental awareness through mobilizing more people. The program includes the establishment of barangay environmental manager system (EN-4a), support program for environmental activities by boy/girl scouts and sea scouts (EN-4b), and mobile environmental IEC (EN-4c). Barangay environmental manages monitor environmental conditions of their respective barangays, and function as interface between local governments and communities. The mobile IEC system consists of audio visual equipment, wagon-type vehicles, development of educational and publicity materials, and trained personnel.

(5) Urban Topographic Mapping Project (EN-5)

The Urban Topographic Mapping Project is to provide large scale maps to be used for land use planning, urban facility planning and other urban management purposes. Maps of major urban centers will be prepared at scale of 1:2,000.

(6) Upgraded Regional Land Use Mapping Project (EN-6)

The Upgraded Regional Land Use Mapping Project is to prepare updated land use maps necessary for urban and regional planning. The project will cover the Davao Metropolitan Area at scale of 1:4,000, and the entire DIDP Area at 1:100,000.

(7) Land Resource Data Base Development Project (EN-7)

The Land Resource Data Base Development Project aims to establish up-to-date baseline data and maps for the environmental and land resources management. A center will be established to collect and manage the data and information, and map data may be stored in a GIS.

(8) Comprehensive CADC-Forest Management Program (EN-8)

The Comprehensive CADC-Forest Management Program is to establish better management organizations and formulate more effective Ancestral Domains Management Plans (ADMPs). Existing conflicts in the classified forest area should be resolved and a comprehensive forest management plan prepared at the regional or the provincial level. This will involve re-classification of the forest land that has been settled and/or cultivated into the A & D land, depending on the land suitability or otherwise formulation of reforestation plan for such land. A task force may be formed to prepare any ADMP in line with the forest management plan by representatives of indigenous cultural communities, supporting NGOs, concerned LGUs and other stakeholders as well as DENR providing technical guidance.

(9) Cadastral Mapping and Land Information Systems Improvement Program (EN-9)

The Cadastral Mapping and Land Information Systems Improvement Program aims to promote the modernization and computerization of tax system for improvement of LGU financial ability. It is implemented for Davao City.

(10) Integrated Watershed Management Program (EN-10)

The Integrated Watershed Management Program aims to restore and enhance productive capacity of major river basins combining ecological watershed rehabilitation (EN-10c) and structural measures such as multi-purpose dams, flood control works and warning systems with reforestation to be planned and implemented by community-based participatory approaches. Establishment of a basin council is proposed to effect the coordination and management of each river basin.

(11) Upland Farming Model Villages Establishment Project (EN-11)

The Upland Farming Model Villages Establishment Project is to promote proper upland farming practices and also to enhance the livelihood of upland people. Model villages may be identified in the area designated for slope rehabilitation to demonstrate better farming practices through training, provision of seedlings of forest trees and tree crops and necessary infrastructure. Model farming schemes will be established for wider application subsequently.

(12) Comprehensive Davao Gulf Management Program (EN-12)

The Comprehensive Davao Gulf Management Program aims at effecting integrated management of coastal and marine resources of the Gulf through strengthening the management functions and ensuring accountability of the Davao Gulf Management

Board (DGMB). The DGMB membership should be enlarged to include academic institutions, NGOs/POs and the private sector as well as concerned municipalities to prepare a Davao Gulf Environmental Management Plan, enforce laws and regulations through monitoring, coordinate researches, and establish more fish sanctuaries.

(13) Pujada Bay Environmental Research and Monitoring Center Project (EN-13)

The Pujada Bay Environmental Research and Monitoring Center Project is to establish a center for research and monitoring on the environment of the Pujada Bay – one of protected areas under the NIPAS, to develop database for environmental management, and to establish a Pujada Bay Research Network linking government agencies such as DENR, DA and DOST, research institutes, LGUs and NGOs.

(14) Pollution Control Officers Promotion Program (EN-14)

The Pollution Control Officers Promotion Program aims to increase the number of Pollution Control Officers to be appointed by industrial and commercial establishments as required by law. Seminars and campaign will be conducted for the purpose.

(15) Davao City Integrated Waste Management System Development Project (EN-15)

The Davao City Integrated Solid Waste Management System Development Project will be implemented in the near future starting with the urgent establishment of a new landfill site (EN-15a). In the meantime, a master plan for solid waste management in Davao City will be prepared to formulate projects to be implemented in the medium to the long terms, covering intermediate treatment of wastes such as composting, waste recycling, and environmental education and institutions for solid waste management.

(16) Solid Waste Management Model System Development Project (EN-16)

The Solid Waste Management Model System Development Project is to establish appropriate solid waste management system models for wide application in the provinces of the DIDP Area. The project will promote intermediate treatment and final disposal by sanitary landfill. Community-based Waste Collection and Management (EN-16a) may be an important component of some models.

(17) Natural Disaster Assessment and Prevention Project (EN-17)

The Natural Disaster Assessment and Prevention Project is to assess possibility and risks of various natural disasters and to formulate a Natural Disasters Prevention Plan.

(18) Environmental Health Research Center Project (EN-18)

The Environmental Health Research Center Project is to establish a regional research and training institutions attached to a provincial health office or medical school to carry out chemical analyses, epidemiological survey and training for environmental health control. It will be a joint undertaking with DENR and other related agencies implementing environmental health control projects.

(19) Sludge Treatment and Energy Recovery Project (EN-19)

The Sludge Treatment and Energy Recovery Project is to treat sludge to be generated from wastewater treatment plants and septic tanks and to recover the energy to be generated through the sludge treatment. It will be implemented in steps as the wastewater treatment plants are expanded.

(20) Mt. Apo World Heritage Establishment Project (EN-20)

The Mt. Apo World Heritage Establishment Project is a symbolic project to establish the World Heritage under UNESCO. The project will help to protect the Mt. Apo National Park from further encroachment, preserving also the sacred land for indigenous cultural peoples and the habitat of the endangered Philippine Eagles.

(21) NIPAS Protected Area Re-establishment Project (EN-21)

The NIPAS Protected Areas Re-establishment Project aims to re-establish seven areas called Initial Components as NIPAS protected areas. The project will prepare revised protected area management plans for the purpose.

(22) Strategic Agricultural and Fishery Development Zone (SAFDZ) Promotion Program (EN-22)

The SAFDZ Promotion Program is implemented to satisfy the mandate of Republic Act No. 7160 to identify areas within the Network of Areas for Agricultural and Agro-Industrial Development National for production, agro-processing and marketing activities in order to modernize the agriculture and the fishery sectors in an environmentally and socio-culturally sound manner. Land use plans and zoning ordinances shall be prepared for all cities and municipalities, incorporating the SAFDZ.

APPENDICES

Appendix 1	**Criteria for Evaluation in LMU**
Appendix 2	**SMU Capability Class**
Appendix 3	**Tables of Land Capability Class by Land Management Unit**

Appendix 1: Criteria for Evaluation in LMU

A. Evaluation of Soil Rooting Conditions

A.1 Soil quality no.1: Sufficient soil depth for root growth and development

CRITERIA	Effective Soil Depth (cm)				RATING
	Lowland Rice	Upland Crops	Orchard	Pasture	
Deep	>=50	>=100	>=100	>=50	Class 1
Moderately deep	50-25	100-50	100-50	50-25	Class 2
Shallow	25-15	50-25	50-25	25-15	Class 3
Very shallow	<15	<25	<25	<15	Class 4

A.2 Soil quality no.2: Ease of seed germination and root penetration

A.2.1 Optimal Range

Soil Penetrometer Reading	Optimal Bulk Density (Landon, 1984)	
	Soil Textural Group	Bulk Density
< 8 mm	Clays, silty clays, sandy clays	1.08 - 1.30
8 - 22 mm	Clay loams, sandy clay loams	1.00 - 1.60
> 22 mm	Silt loams, silty clay loams, loams	1.34 - 1.51
	Sandy loams, loamy sand	1.20 - 1.80
	Sand	1.67 - 1.90
	Main range, uncultivated uncompact	1.10 - 1.40
	Recently cultivated soils	0.90 - 1.60

A.2.2 Range for ease of seed germination and root penetration

CRITERIA	Depth of topsoil (cm)				Compaction/Hardness or Bulk Density	Soil structure of sub-surface horizon within 50 cm below the surface	Rating
	Lowland area	Upland crops	Orchard	Pasture			
Ease for root penetration	>=15 (deep)	>=25 (deep)	>=25 (deep)	>=15 (deep)	Within optimal range	Strong to moderate	Class 1
						Weak and single grain	Class 1
						Massive	Class 2
					Outside optimal range	Strong to moderate	Class 2
						Weak and single grain	Class 2
						Massive	Class 3
Moderate for root penetration	15 - 10 (moderately deep)	25 - 15 (moderately deep)	25 – 15 (moderately deep)	15 - 10 (moderately deep)	Within optimal range	Strong to moderate	Class 1
						Weak and single grain	Class 2
						Massive	Class 3
					Outside optimal range	Strong to moderate	Class 2
						Weak and single grain	Class 3
						Massive	Class 3
Difficult for root penetration	<10 (shallow)	<15 (shallow)	<15 (shallow)	<10 (shallow)	Within optimal range	Strong to moderate	Class 2
						Weak and single grain	Class 3
						Massive	Class 3
					Outside optimal range	Strong to moderate	Class 3
						Weak and single grain	Class 3
						Massive	Class 4

A.3 Rating soil rooting conditions

The class rating of soil rooting conditions is decided by the lower class between soil qualities A.1 and A.2

B. Evaluation of Soil Moisture

B.1 Soil quality no.3: Low risk from over wetness

Topography/Landform	Soil Texture	Risk of Overwetness			
		Lowland rice	Upland crops	Orchard	Pasture
Deltas, oxbow lakes, swamps, marshes, lake margins, back-swamps, flood plains, infilled valleys	loamy sand to clay	Class 2	Class 4	Class 4	Class 4
River levees, alluvial fans, footslopes, alluvial terraces, beach ridges	sandy loam to clay loam	Class 1	Class 2	Class 2	Class 2
River levees, alluvial fans, footslopes, alluvial terraces, beach ridges	clay	Class 1	Class 3	Class 3	Class 3
Plateaus	loamy sand to clay	Class 1	Class 1	Class 1	Class 1
Hills/mountains; all areas	loamy sand to clay	Class 1	Class 1	Class 1	Class 1

B.2 Soil quality no.4: Low risk from water stress or drought condition

Topography/Landform	Soil Texture	Risk of Drought			
		Lowland rice	Upland crops	Orchard	Pasture
Deltas, oxbow lakes, swamps, marshes, lake margins, back-swamps, flood plains, infilled valleys	Clay loam to clay	Class 1	Class 1	Class 1	Class 1
Deltas, oxbow lakes, swamps, marshes, lake margins, back-swamps, flood plains, infilled valleys	Loamy sand, sandy loam	Class 2	Class 2	Class 3	Class 2
River levees, alluvial fans, footslopes, alluvial terraces, beach ridges	Clay loam to clay	Class 1	Class 1	Class 1	Class 1
River levees, alluvial fans, footslopes, alluvial terraces, beach ridges	loamy sand to sandy loam				
Plateaus	loamy sand to sandy loam	Class 3	Class 3	Class 3	Class 3
Plateaus	clay loam to clay	Class 2	Class 1	Class 1	Class 1
Hills/mountains; all areas >8% slope	loamy sand to sandy loam	Class 3	Class 3	Class 3	Class 3
Hills/mountains; all areas >8% slope	clay loam to clay	Class 2	Class 2	Class 2	Class 2

B.3 Rating soil moisture

The class rating for soil moisture is decided by the lower class between the soil qualities B.1 and B.2.

C. Evaluation of soil fertility

C.1 Soil quality no.5: Capacity for nutrient renewal

Depth of topsoil (cm)		Organic matter content (%) of topsoil		Lowland Rice	Upland Crops	Orchard	Pasture
>=15	Deep	>=10	Very high	Class 1	Class 1	Class 1	Class 1
		10 - 5	High	Class 1	Class 1	Class 1	Class 1
		5 - 3	Medium	Class 1	Class 1	Class 1	Class 1
		3 - 1	Low	Class 2	Class 2	Class 2	Class 2
		<1	Very low	Class 3	Class 3	Class 3	Class 3
15 - 10	Medium	>=10	Very high	Class 1	Class 1	Class 1	Class 1
		10 - 5	High	Class 1	Class 1	Class 1	Class 1
		5 - 3	Medium	Class 2	Class 2	Class 2	Class 2
		3 - 1	Low	Class 3	Class 3	Class 3	Class 3
		<1	Very low	Class 3	Class 3	Class 3	Class 3
< 10	Shallow	>=10	Very high	Class 2	Class 2	Class 2	Class 2
		10 - 5	High	Class 2	Class 2	Class 2	Class 2
		5 - 3	Medium	Class 3	Class 3	Class 3	Class 3
		3 - 1	Low	Class 3	Class 3	Class 3	Class 3
		<1	Very low	Class 3	Class 3	Class 3	Class 3

C.2 Soil quality no.6: Availability of the crop nutrients in the topsoil

Criteria	Total N (%)	Avail. P (Olsen, ppm)	Exch. K (cmol kg^{-1})	Exch. Mg (cmol kg^{-1})	Exch. Ca (cmol kg^{-1})	%BSP (NH_4OAc)
Very high	>=1.0	>=25	>=0.60	>=4.00	>=10.0	>=100
High	1.0 - 0.5	25 - 15	0.60 - 0.40	4.00 - 1.20	10.0 - 7.0	100 - 75
Medium	0.5 - 0.3	15 - 10	0.40 - 0.25	1.20 - 0.50	7.0 - 4.0	75 - 50
Low	0.3 - 0.2	10 - 5	0.25 - 0.15	0.50 - 0.25	4.0 - 2.0	50 - 20
Very low	<0.2	<5	<0.15	<0.25	<2.0	<20

C.2.1 The sub-rating of C.2 nutrient availability of top soil is determined by the frequency of occurrence.

	Frequency of occurrence (5 of 6 criteria*)																		
Very high to high	5	4	4	3	3	3	2	2	1	1	0	0	0	2	2	1	1	1	0	0
Medium	0	1	0	1	2	0	3	2	4	3	5	4	3	0	1	0	2	1	2	0
Low to very low	0	0	1	1	0	2	0	1	0	1	0	1	2	3	2	4	2	3	3	5
Lowland Rice	Class 1		Class 2											Class 3						
Upland Crops	Class 1		Class 2											Class 3						
Orchard	Class 1		Class 2											Class 3						
Pasture	Class 1		Class 2											Class 3						

C.3 Soil quality no.7: High inherent fertility for sustainability of long term crop production

CRITERIA	CEC of topsoil NH_4OAc (cmol kg^{-1})	% P retention of topsoil (Blakemore)	pH(1:1 H_2O) of subsurface horizons within 50 cm
High	>=20	< 55	7.0 - 5.5
Medium	20 – 10	85 - 55	8.5 - 7.0; 5.5 - 4.5
Low	<10	>=85	>=8.5; <4.5

C.3.1 The sub-rating of C.3 inherent fertility is determined by the frequency of occurrence

	Frequency of occurrence									
High	3	2	1	2	1	0	1	0	0	0
Medium	0	1	2	0	1	3	0	2	1	0
Low	0	0	0	1	1	0	2	1	2	3
Lowland Rice	Class 1			Class 2			Class 3			
Upland Crops	Class 1			Class 2			Class 3			
Orchard	Class 1			Class 2			Class 3			
Pasture	Class 1			Class 2			Class 3			

C.4 Soil quality no.8: Absence of soil fertility constraints

C.4.1 Rating of topsoil pH (1:1, H_2O)

Topsoil pH	Criteria	Rating
7.0 - 5.5	Medium	Class 1
8.5 - 7.0; 5.5 - 4.5	High, Low	Class 2
8.5 - 8.8; 4.5 - 4.0	Very high, very low	Class 3
>=8.8; <4.0	Very high, very low	Class 4

C.4.2 Rating of electrical conductivity (EC)

EC of topsoil ($mS\ cm^{-1}$)	Total Salt as % NaCl	Criteria	Rating
< 4	<0.15	Medium	Class 1
4 - 8	0.15 - 0.35	High, Low	Class 2
8 - 15	0.35 - 0.65	Very high, very low	Class 3
> 15	>=0.65	Very high, very low	Class 4

C.4.3 Rating for depth of the upper boundary of organic horizons or layers having more than 25 centimeter thickness

Depth of organic layers (cm)		Rating
None, >=50	None or deep	Class 1
50 – 25	Moderately deep	Class 2
25 – 10	Shallow	Class 3
< 10	Very shallow	Class 4

C.4.4 Rating for C.4 - absence of soil fertility constraints

The rating of the absence of soil fertility constraints is decided by the lowest class rating among the three soil characteristics of pH, EC, and depth of organic horizen.

C.5 Rating of soil fertility

The class rating for soil fertility is determined by the lowest class among the soil qualities: C.1 (nutrient renewal), C.2 (nutrient availability), C.3 (inherent fertility), and C.4 (absence of fertility constraints)

D. Evaluation of soil workability

D.1 Soil quality no.9: Ease of plowing (for upland soils) or puddling (lowland soils)

D.1.1 Ease of plowing (upland soils)

Criteria of workability	Consistence when moist	Stickiness	Texture
Easy	loose, very friable and friable	Non-sticky and slightly sticky	S, LS, SL
Moderate	Firm	Sticky	SCL, L, SiL, Si
Difficult	Very firm and extremely firm	Very sticky	SC, CL, SiCL, SiC, C

D.1.1.a Rating for ease of plowing

	Frequency of occurrence									
Easy	3	2	1	2	1	0	1	0	0	0
Medium	0	1	2	0	1	3	0	2	1	0
Difficult	0	0	0	1	1	0	2	1	2	3
Upland Crops	Class 1			Class 2				Class 3		
Orchard	Class 1			Class 2				Class 3		
Pasture	Class 1			Class 2				Class 3		

D.1.2 Ease of puddling (lowland rice soils)

In lowland soil, the soil workability does not matter because the land for transplanting rice seedling is prepared by plowing in standing water (or by puddling the soil). The separation of the lowland rice soil from the upland crops is considered so as not to downgrade clayey soil in lowland rice production which is a negative factor in assessing ease of plowing in the uplands.

D.2 Soil quality no.10: Absence of impediments to cultivation

Criteria of workability	Fragment content of topsoil (%)		Lowland Rice	Upland Crops	Orchard	Pasture
Easy	<5	None to few	Class 1	Class 1	Class 1	Class 1
Moderate	5 - 15	Common	Class 2	Class 2	Class 2	Class 2
Difficult	>=15	Many to dominant	Class 3	Class 3	Class 3	Class 3

D.3 Rating soil workability

The class rating for soil workability is decided by the lower class between soil qualities D.1 and D.2

E. Evaluation of soil hazards

E.1 Soil quality no.11: Absence of erosion hazards

(determined either by slope map or by erosion hazard map)

E.1.1 Using slope map

Slope (%)		Lowland Rice	Upland Crops	Orchard	Pasture
<3	Flat to gently sloping	Class 1	Class 1	Class 1	Class 1
3 - 8	Gently sloping to sloping	Class 2	Class 1	Class 1	Class 1
8 - 18	Strongly sloping to steep	Class 3	Class 2	Class 2	Class 2
18 - 30	Moderately steep	Class 3	Class 3	Class 3	Class 3
>=30	Steep to very steep	Class 4	Class 4	Class 4	Class 4

E.1.2 Using erosion map

Degree of erosion	Lowland Rice	Upland Crops	Orchard	Pasture
None	Class 1	Class 1	Class 1	Class 1
Slight	Class 2	Class 2	Class 1	Class 1
Moderate	Class 3	Class 3	Class 2	Class 2
Severe	Class 4	Class 4	Class 3	Class 3

E.2 Soil quality no.12: Absence of flooding hazards (determined by flooding map)

Degree of erosion	Lowland Rice	Upland Crops	Orchard	Pasture
None to slight	Class 1	Class 1	Class 1	Class 1
Moderate	Class 2	Class 2	Class 2	Class 2
Severe	Class 3	Class 3	Class 3	Class 3
Very severe	Class 4	Class 4	Class 4	Class 4

E.3 Rating soil hazards

The class rating for soil hazards is decided by the lower class between soi qualities E.1 (erosion hazard) and E.2 (flooding hazard)

F. Final expression of Soil Productivity Capability Classification

F.1 Detailed expression (sample classification of a sample SMU)

Crop groups	Class	A - A.1, A.2	B - B.1, B.2	C - C.1, C.2, C.3, C.4	D - D.1, D.2	E - E.1, E.2
Lowland rice	3	1 - 1, 1	2 - 1, 2	3 - 1, 2, 3, 3	2 - 1, 2	3 - 3, 1
Upland crops	3	1 - 1, 1	2 - 1, 2	3 - 1, 2, 3, 3	2 - 1, 2	3 - 3, 1
Orchard	3	1 - 1, 1	1 - 1, 1	3 - 1, 2, 3, 3	1 - 1, 1	3 - 3, 1
Pasture	3	1 - 1, 1	1 - 1, 1	3 - 1, 2, 3, 3	2 - 1, 2	3 - 3, 1

F.2 Simplified formula (same sample classification)

Crop Groups	SPCC Raging
Lowland rice	3CE2BD1A
Upland crops	3CE2BD1A
Orchard	3CE1ABD
Pasture	3CE2D1AB

F.3 Quantitative Rating

Mr. Lapis, the proponent, discussed thoroughly the concept of quantitative ranking of soil pedons separately under Chapter 3. The formula is as follows: Soil Productivity Capability Score = 100 - FL where F = 100/BC, B is the number of evaluation components considered, C is the number of classes of criteria minus one, necessarily starting from zero for pedons with no limitation, and L is the summation of the limitation class index of the criteria.

Appendix 2: SMU Capability Class

Soil Taxonomy	Capability Class	
	Paddy	Others
Typic Tropofibrists	3	4
Hapludults-Rhodudults-Dystropepts Association	4	4
Typic Paleudults	2	4
Hapludults-Dystropepts-Eutropepts Association	4	4
Rendolls-Eutropepts Association	2	3
Vertic Epiaqualfs	2	3
Aquiq Hapludalfs	4	4
Typic Hapludalfs	3	3
Aeriq Tropaquepts	2	3
Aquiq Eutropepts	3	3
Fluventic Eutropepts	3	4
Typic Eutropepts	4	4
Eutropepts - Hapludalfs Association	2	3
Eutropepts - Troporthents Association	2	2
Typic Hydraquents	2	2
Typic Psammaquents	2	3
Typic Tropopsamments	3	3
Lithic Troporthents	2	2
Troporthents - Eutropepts - Hapludalfs Association	3	3
Riverwash	2	3
Escarpments	2	2
Unclassified	2	3

Source: JICA Study Team

Appendix 3: Tables of Land Capability Class by Land Management Unit

Table A Land Capability by LMU in Agricultural Use (Lowland paddy)

Class for lowland paddy

LMU No.	LMU affix	Description of LMU	Davao Province		Davao City		Davao del Sur		Davao Oriental	
			LMU	Class	LMU	Class	LMU	Class	LMU	Class
1		Active tidal flats, developed (fishpond, saltbed)	x	4E			x	4E	x	4
2		Active tidal flats, natural (mangrove/nipa)	x	4E			x	4E	x	4
3		Swamps (Tree type)	x	4E						
4		Marshes (Grassy type)	x	4E			x	4E	x	4
5		Lake			x	4			x	4
8		Beach ridges and swales	x	2B			x	2B	x	2
9	J	Broad alluvial plains, none to slight flooding	x	2E	x	1	x	1		
9	K	Broad alluvial plains, moderate flooding	x	3E			x	2BE		
9	L	Broad alluvial plains, severe flooding	x	4E						
9		Broad alluvial plains (width > 500m)	x	1	x	1			x	1
10		Former/old tidal flats	x	2E	x	2	x	2E	x	2
11		River levees							x	2
12	T	Lower river terraces, moderately eroded	x	3E						
12		Lower river terraces	x	2B	x	2BE	x	3E	x	3
13		Upper river terraces	x	2B	x	1	x	2B	x	2
14		Inter-hill mini plains	x	2AB						
16		Infilled/localized valleys							x	4
17	H	Inland/stream/enclosed valleys, well drained					x	2		
17		Inland/stream/enclosed valleys			x	2E	x	2		
18	A	Colluvial fans, shallow soils					x	3		
18		Colluvial fans	x	2B			x	1	x	2
19		Narrow alluvial plains (width < 500 m)			x	1			x	1
27		Low piedmon (plain/footslope, volcanic hills)					x	2		
48		Residual terraces, level to gently sloping							x	1
49		Residual terraces, sloping to undulating					x	2B		
50		Residual terraces, undulating to rolling					x	2B		
51	O	Lower footslope, (volcanic hills or mountains), undulating to rolling			x	2	x	2B		
51		Lower footslope, (volcanic hills or mountains)			x	1	x	2B		
53	A	Upper footslope, (volcanic/pyroclastic hills or mountains) shallow soils			x	2				
53	AO	Upper footslope, (volcanic/pyroclastic hills or mountains) shallow soils undulating to rolling			x	2B				
53	B	Upper footslope, (volcanic/pyroclastic hills or mountains) moderately deep soils			x	2				
62	O	Limestone / karst plains, lower terraces, undulating to rolling					x	2B	x	2
62	ST	Limestone/ karst plains, lower terraces, slightly to moderately dissected							x	2
62		Limestone / karst plains, lower terraces	x	1			x	1	x	1
63	O	Limestone / karst plains, upper terraces, undulating to rolling	x	3						
63		Limestone / karst plains, upper terraces	x	2						
65	O	Limestone hill (high relief), undulating to rolling							x	3
65		Limestone hill (high relief)					x	2		
66	O	Low limestone hills, undulating to rolling	x	2AB	x	2B	x	2	x	3
66	SO	Low limestone hills, slightly dissected, undulating to rolling	x	3A						
86		Low limestone hills, undulating to rolling	x	2B					x	3
67		Karst plateau with isolated, undulating to rolling							x	3
68		Shale/sandstone plateau							x	2
76	O	Low shale/sandstone hills, undulating to rolling	x	2	x	2				
76	TO	Low shale/sandstone hills, moderately dissected, undulating to rolling	x	2B	x	2B				
76	UO	Low shale/sandstone hills, severely dissected, undulating to rolling	x	2B	x	2				
76		Low shale/sandstone hills	x	2B						
77	O	Low conglomeratic hills, undulating to rolling	x	3	x	2B			x	3
79		Low basaltic hills							x	2
80	O	Low volcanic complex hills, undulating to rolling	x	2B	x	2				
80	SDO	Low volcanic complex hills, slightly dissected, coarse textured soil, undulating to rolling					x	3B		
80		Low volcanic complex hills					x	2		
82	SDO	Low andesitic hills, slightly dissected, coarse textured soil, undulating to rolling	x	2	x	2	x	2		
82	STO	Low andesitic hills, slightly to moderately dissected, undulating to rolling	x	2						
82	TO	Low andesitic hills, moderately dissected, undulating to rolling					x	2		
82	UO	Low andesitic hills, severely dissected, undulating to rolling	x	2B	x	2	x	2		
86	O	Low meta-volcanic hills, undulating to rolling					x	3		
111	S	High limestone hills, slightly dissected	x	2B						
111		High limestone hills	x	2B	x	2AB	x	2	x	2
112	ST	High shale/sandstone hills, slight to moderately dissected					x	2		
112	T	High shale/sandstone hills, moderately dissected	x	3	x	2B				
112	U	High shale/sandstone hills, severely dissected	x	4	x	2	x	2AB		
112		High shale/sandstone hills	x	2	x	2	x	2	x	2
113	U	High conglomeratic hills, severely dissected					x	4		
113		High conglomeratic hills	x	4	x	2B			x	3
115	SD	High basaltic hills, slightly dissected, coarse textured soil	x	3			x	3		
115	TO	High basaltic hills, moderately dissected, steep					x	2B		
115	UR	High basaltic hills, severely dissected, very steep					x	2AB		
115		High basaltic hills	x	2			x	2	x	2
117	TO	High volcanic complex hills, moderately dissected, steep soil					x	3AB		
117	UR	High volcanic complex hills, severely dissected, very steep soil	x	4						
117		High volcanic complex hills	x	3	x	2AB			x	3
118		High ultrabasic hills							x	3
119		High volcanic agglomerate hills			x	3A	x	3		
120		High dioritic hills							x	3
124		High volcanic hills					x	3		
126		High meta-rock complex hills	x	3					x	3
140		Intermountain valleys	x	3B						
153		Meta-rock plateau	x	4A	x	3A			x	4
156	ST	Shale/sandstone mountains, slightly to moderately dissected	x	4						
156	T	Shale/sandstone mountains, moderately dissected	x	3B						
156		Shale/sandstone mountains	x	4	x	2AB			x	4
161		High meta-volcanic mountains					x	3A		
163		Basaltic mountains	x	2AB	x	2AB	x	2	x	4
164		Andesitic mountains					x	4		
165		Ultrabasic mountains	x	2AB			x	2	x	4
166		Dioritic mountains	x	4					x	4
167	T	Agglomeratic hills, moderately dissected	x	2	x	2	x	2B		
167	TO	Agglomeratic hills, moderately dissected, steep			x	3A	x	3		
167	U	Agglomeratic hills, severely dissected	x	4	x	4			x	4
167		Agglomeratic hills					x	4		
168		Complex volcanic mountains	x	3	x	3A			x	4
170		Volcanic cones, non-active			x	4	x	4		
180		Built-up areas/urban area	x	4	x	4	x	4	x	4
191		Escarpment			x	4				
193		Major river							x	4

Source: JICA Study Team

Table B Land Capability by LMU in Agricultural (Upland crops)

LMU No.	LMU affix	Description of LMU	Class for upland crops: Davao Province LMU	Davao Province Class	Davao City LMU	Davao City Class	Davao del Sur LMU	Davao del Sur Class	Davao Oriental LMU	Davao Oriental Class
1		Active tidal flats, developed (fishpond, saltbed)	x	4BE			x	4E	x	4
2		Active tidal flats, natural (mangrove/nipa)	x	4BE			x	4E	x	4
3		Swamps (Tree type)	x	4BE						
4		Marshes (Grassy type)	x	4BE			x	4E	x	4
5		Lake			x	4			x	4
8		Beach ridges and swales	x	2AB			x	2AB	x	2
9	J	Broad alluvial plains, none to slight flooding	x	2BE	x	2	x	2B		
9	K	Broad alluvial plains, moderate flooding	x	3BE			x	2BE		
9	L	Broad alluvial plains, severe flooding	x	4E						
9		Broad alluvial plains (width > 500m)	x	2B	x	2B			x	2
10		Former/old tidal flats	x	2AE	x	2	x	2AE	x	2
11		River levees							x	2
12	T	Lower river terraces, moderately eroded	x	3E						
12		Lower river terraces	x	3B	x	2BE	x	3E	x	3
13		Upper river terraces	x	2B	x	3B	x	2AB	x	2
14		Inter-hill mini plains	x	2B						
16		Infilled/localized valleys							x	4
17	H	Inland/stream/enclosed valleys, well drained					x	3		
17		Inland/stream/enclosed valleys			x	4E	x	4		
18	A	Colluvial fans, shallow soils					x	4		
18		Colluvial fans	x	2B			x	2A	x	2
19		Narrow alluvial plains (width < 500 m)			x	1			x	1
27		Low piedmon (plain/footslope, volcanic hills)					x	1		
48		Residual terraces, level to gently sloping							x	1
49		Residual terraces, sloping to undulating					x	2AB		
50		Residual terraces, undulating to rolling					x	2AB		
51	O	Lower footslope, (volcanic hills or mountains), undulating to rolling			x	2	x	2AB		
51		Lower footslope, (volcanic hills or mountains)			x	3B	x	2AB		
53	A	Upper footslope, (volcanic/pyroclastic hills or mountains) shallow soils			x	2				
53	AO	Upper footslope, (volcanic/pyroclastic hills or mountains) shallow soils undulating to rolling			x	3B				
53	B	Upper footslope, (volcanic/pyroclastic hills or mountains) moderately deep soils			x	2				
62	O	Limestone / karst plains, lower terraces, undulating to rolling					x	3A	x	3
62	ST	Limestone/ karst plains, lower terraces, slightly to moderately dissected							x	2
62		Limestone / karst plains, lower terraces	x	2			x	2A	x	2
63	O	Limestone / karst plains, upper terraces, undulating to rolling	x	3						
63		Limestone / karst plains, upper terraces	x	2						
65	O	Limestone hill (high relief), undulating to rolling							x	3
65		Limestone hill (high relief)					x	2		
66	O	Low limestone hills, undulating to rolling	x	2AB	x	2B	x	2	x	2
66	SO	Low limestone hills, slightly dissected, undulating to rolling	x	2AB						
66		Low limestone hills, undulating to rolling	x	2AB					x	2
67		Karst plateau with isolated, undulating to rolling							x	3
68		Shale/sandstone plateau							x	2
76	O	Low shale/sandstone hills, undulating to rolling	x	2	x	2				
76	TO	Low shale/sandstone hills, moderately dissected, undulating to rolling	x	2AB	x	2B				
76	UO	Low shale/sandstone hills, severely dissected, undulating to rolling	x	2AB	x	2				
76		Low shale/sandstone hills	x	2B						
77	O	Low conglomeratic hills, undulating to rolling	x	2	x	2AB			x	2
79		Low basaltic hills							x	2
80	O	Low volcanic complex hills, undulating to rolling	x	2AB	x	2				
80	SDO	Low volcanic complex hills, slightly dissected, coarse textured soil, undulating to rolling					x	3B		
80		Low volcanic complex hills					x	2		
82	SDO	Low andesitic hills, slightly dissected, coarse textured soil, undulating to rolling	x	2	x	2	x	2		
82	STO	Low andesitic hills, slightly to moderately dissected, undulating to rolling	x	2						
82	TO	Low andesitic hills, moderately dissected, undulating to rolling					x	2		
82	UO	Low andesitic hills, severely dissected, undulating to rolling	x	2AB	x	2	x	2		
86	O	Low meta-volcanic hills, undulating to rolling					x	3		
111	S	High limestone hills, slightly dissected	x	2AB						
111		High limestone hills	x	2AB	x	3A	x	2	x	2
112	ST	High shale/sandstone hills, slight to moderately dissected					x	2		
112	T	High shale/sandstone hills, moderately dissected	x	3	x	2AB				
112	U	High shale/sandstone hills, severely dissected	x	3	x	2	x	3A		
112		High shale/sandstone hills	x	2	x	2	x	2	x	2
113	U	High conglomeratic hills, severely dissected					x	4		
113		High conglomeratic hills	x	3	x	2AB			x	3
115	SD	High basaltic hills, slightly dissected, coarse textured soil	x	3			x	3		
115	TO	High basaltic hills, moderately dissected, steep					x	2AB		
115	UR	High basaltic hills, severely dissected, very steep					x	3A		
115		High basaltic hills	x	2			x	2	x	2
117	TO	High volcanic complex hills, moderately dissected, steep soil					x	4A		
117	UR	High volcanic complex hills, severely dissected, very steep soil	x	4						
117		High volcanic complex hills	x	3	x	3A			x	3
118		High ultrabasic hills							x	3
119		High volcanic agglomerate hills			x	4A	x	4		
120		High dioritic hills							x	3
124		High volcanic hills					x	3		
126		High meta-rock complex hills	x	3					x	3
140		Intermountain valleys	x	3B						
153		Meta-rock plateau	x	4A	x	4A			x	4
156	ST	Shale/sandstone mountains, slightly to moderately dissected	x	4						
156	T	Shale/sandstone mountains, moderately dissected	x	3B						
156		Shale/sandstone mountains	x	3	x	3A			x	3
161		High meta-volcanic mountains					x	4A		
163		Basaltic mountains	x	3A	x	3A	x	3	x	3
164		Andesitic mountains					x	4		
165		Ultrabasic mountains	x	3A			x	3	x	3
166		Dioritic mountains	x	4					x	4
167	T	Agglomeratic hills, moderately dissected	x	2	x	2	x	2AB		
167	TO	Agglomeratic hills, moderately dissected, steep			x	4A	x	4		
167	U	Agglomeratic hills, severely dissected	x	4	x	4			x	4
167		Agglomeratic hills					x	4		
168		Complex volcanic mountains	x	4	x	4A			x	4
170		Volcanic cones, non-active			x	4	x	4		
180		Built-up areas/urban area	x	4	x	4	x	4	x	4
191		Escarpment			x	4				
193		Major river							x	4

Source: JICA Study Team

Table C Land Capability by LMU in Agricultural (Orchard)

LMU No.	LMU affix	Description of LMU	Class for Orchard: Davao Province LMU	Davao Province Class	Davao City LMU	Davao City Class	Davao del Sur LMU	Davao del Sur Class	Davao Oriental LMU	Davao Oriental Class
1		Active tidal flats, developed (fishpond, saltbed)	x	4BE			x	4E	x	4
2		Active tidal flats, natural (mangrove/nipa)	x	4BE			x	4E	x	4
3		Swamps (Tree type)	x	4BE						
4		Marshes (Grassy type)	x	4BE			x	4E	x	4
5		Lake			x	4			x	4
8		Beach ridges and swales	x	2AB			x	2AB	x	2
9	J	Broad alluvial plains, none to slight flooding	x	2BE	x	2	x	2B		
9	K	Broad alluvial plains, moderate flooding	x	3BE			x	2BE		
9	L	Broad alluvial plains, severe flooding	x	4E						
9		Broad alluvial plains (width > 500m)	x	2B	x	2B			x	2
10		Former/old tidal flats	x	2AE	x	2	x	2AE	x	2
11		River levees							x	2
12	T	Lower river terraces, moderately eroded	x	3E						
12		Lower river terraces	x	3B	x	2BE	x	3E	x	3
13		Upper river terraces	x	2B	x	3B	x	2AB	x	2
14		Inter-hill mini plains	x	2B						
16		Infilled/localized valleys							x	4
17	H	Inland/stream/enclosed valleys, well drained					x	3		
17		Inland/stream/enclosed valleys			x	4E	x	4		
18	A	Colluvial fans, shallow soils					x	4		
18		Colluvial fans	x	2B			x	2A	x	2
19		Narrow-alluvial plains (width < 500 m)			x	1			x	1
27		Low piedmon (plain/footslope, volcanic hills)					x	1		
48		Residual terraces, level to gently sloping							x	1
49		Residual terraces, sloping to undulating					x	2AB		
50		Residual terraces, undulating to rolling					x	2AB		
51	O	Lower footslope, (volcanic hills or mountains), undulating to rolling			x	2	x	2AB		
51		Lower footslope, (volcanic hills or mountains)			x	3B	x	2AB		
53	A	Upper footslope, (volcanic/pyroclastic hills or mountains) shallow soils			x	2				
53	AO	Upper footslope, (volcanic/pyroclastic hills or mountains) shallow soils undulating to rolling			x	3B				
53	B	Upper footslope, (volcanic/pyroclastic hills or mountains) moderately deep soils			x	2				
62	O	Limestone / karst plains, lower terraces, undulating to rolling					x	3A	x	3
62	ST	Limestone/ karst plains, lower terraces, slightly to moderately dissected							x	2
62		Limestone / karst plains, lower terraces	x	2			x	2A	x	2
63	O	Limestone / karst plains, upper terraces, undulating to rolling	x	3						
63		Limestone / karst plains, upper terraces	x	2						
65	O	Limestone hill (high relief), undulating to rolling							x	3
65		Limestone hill (high relief)					x	2		
66	O	Low limestone hills, undulating to rolling	x	2AB	x	2B	x	2	x	2
66	SO	Low limestone hills, slightly dissected, undulating to rolling	x	2AB						
66		Low limestone hills, undulating to rolling	x	2AB					x	2
67		Karst plateau with isolated, undulating to rolling							x	3
68		Shale/sandstone plateau							x	2
76	O	Low shale/sandstone hills, undulating to rolling	x	2	x	2				
76	TO	Low shale/sandstone hills, moderately dissected, undulating to rolling	x	2AB	x	2B				
76	UO	Low shale/sandstone hills, severely dissected, undulating to rolling	x	2AB	x	2				
76		Low shale/sandstone hills	x	2B						
77	O	Low conglomeratic hills, undulating to rolling	x	2	x	2AB			x	2
79		Low basaltic hills							x	2
80	O	Low volcanic complex hills, undulating to rolling	x	2AB	x	2				
80	SDO	Low volcanic complex hills, slightly dissected, coarse textured soil, undulating to rolling					x	3B		
80		Low volcanic complex hills					x	2		
82	SDO	Low andesitic hills, slightly dissected, coarse textured soil, undulating to rolling	x	2	x	2	x	2		
82	STO	Low andesitic hills, slightly to moderately dissected, undulating to rolling	x	2						
82	TO	Low andesitic hills, moderately dissected, undulating to rolling					x	2		
82	UO	Low andesitic hills, severely dissected, undulating to rolling	x	2AB	x	2	x	2		
86	O	Low meta-volcanic hills, undulating to rolling					x	3		
111	S	High limestone hills, slightly dissected	x	2AB						
111		High limestone hills	x	2AB	x	3A	x	2	x	2
112	ST	High shale/sandstone hills, slight to moderately dissected					x	2		
112	T	High shale/sandstone hills, moderately dissected	x	3	x	2AB				
112	U	High shale/sandstone hills, severely dissected	x	3	x	2	x	3A		
112		High shale/sandstone hills	x	2	x	2	x	2	x	2
113	U	High conglomeratic hills, severely dissected					x	4		
113		High conglomeratic hills	x	3	x	2AB			x	3
115	SD	High basaltic hills, slightly dissected, coarse textured soil	x	3			x	3		
115	TO	High basaltic hills, moderately dissected, steep					x	2AB		
115	UR	High basaltic hills, severely dissected, very steep					x	3A		
115		High basaltic hills	x	2			x	2	x	2
117	TO	High volcanic complex hills, moderately dissected, steep soil					x	4A		
117	UR	High volcanic complex hills, severely dissected, very steep soil	x	4						
117		High volcanic complex hills	x	3	x	3A			x	3
118		High ultrabasic hills							x	3
119		High volcanic agglomerate hills			x	4A	x	4		
120		High dioritic hills							x	3
124		High volcanic hills					x	3		
126		High meta-rock complex hills	x	3					x	3
140		Intermountain valleys	x	3B						
153		Meta-rock plateau	x	4A	x	4A			x	4
156	ST	Shale/sandstone mountains, slightly to moderately dissected	x	4						
156	T	Shale/sandstone mountains, moderately dissected	x	3B						
156		Shale/sandstone mountains	x	3	x	3A			x	3
161		High meta-volcanic mountains					x	4A		
163		Basaltic mountains	x	3A	x	3A	x	3	x	3
164		Andesitic mountains					x	4		
165		Ultrabasic mountains	x	3A			x	3	x	3
166		Dioritic mountains	x	4					x	4
167	T	Agglomeratic hills, moderately dissected	x	2	x	2	x	2AB		
167	TO	Agglomeratic hills, moderately dissected, steep			x	4A	x	4		
167	U	Agglomeratic hills, severely dissected	x	4	x	4			x	4
167		Agglomeratic hills					x	4		
168		Complex volcanic mountains	x	4	x	4A			x	4
170		Volcanic cones, non-active			x	4	x	4		
180		Built-up areas/urban area	x	4	x	4	x	4	x	4
191		Escarpment			x	4				
193		Major river							x	4

Source: JICA Study Team

Table D Land Capability by LMU in Agricultural (Pasture)

LMU No.	LMU affix	Description of LMU	Class for Pasture: Davao Province LMU	Davao Province Class	Davao City LMU	Davao City Class	Davao del Sur LMU	Davao del Sur Class	Davao Oriental LMU	Davao Oriental Class
1		Active tidal flats, developed (fishpond, saltbed)	x	4BE			x	4E	x	4
2		Active tidal flats, natural (mangrove/nipa)	x	4BE			x	4E	x	4
3		Swamps (Tree type)	x	4BE						
4		Marshes (Grassy type)	x	4BE			x	4E	x	4
5		Lake			x	4			x	4
8		Beach ridges and swales	x	2B			x	2B	x	2
9	J	Broad alluvial plains, none to slight flooding	x	2BE	x	2	x	2B		
9	K	Broad alluvial plains, moderate flooding	x	3BE			x	2BE		
9	L	Broad alluvial plains, severe flooding	x	4E						
9		Broad alluvial plains (width > 500m)	x	2B	x	2B			x	2
10		Former/old tidal flats	x	2E	x	2	x	2B	x	2
11		River levees							x	
12	T	Lower river terraces, moderately eroded	x	3E						
12		Lower river terraces	x	3B	x	2BE	x	3E	x	3
13		Upper river terraces	x	2B	x	3B	x	2B	x	2
14		Inter-hill mini plains	x	2B						
16		Infilled/localized valleys							x	4
17	H	Inland/stream/enclosed valleys, well drained					x	3		
17		Inland/stream/enclosed valleys			x	4B	x	4		
18	A	Colluvial fans, shallow soils					x	4		
18		Colluvial fans	x	2B			x	1	x	2
19		Narrow alluvial plains (width < 500 m)			x	1			x	1
27		Low piedmon (plain/footslope, volcanic hills)					x	1		
48		Residual terraces, level to gently sloping							x	1
49		Residual terraces, sloping to undulating					x	2B		
50		Residual terraces, undulating to rolling					x	2B		
51	O	Lower footslope, (volcanic hills or mountains), undulating to rolling			x	2	x	2B		
51		Lower footslope, (volcanic hills or mountains)			x	3B	x	2B		
53	A	Upper footslope, (volcanic/pyroclastic hills or mountains) shallow soils			x	2				
53	AO	Upper footslope, (volcanic/pyroclastic hills or mountains) shallow soils undulating to rolling			x	3B				
53	B	Upper footslope, (volcanic/pyroclastic hills or mountains) moderately deep soils			x	2				
62	O	Limestone / karst plains, lower terraces, undulating to rolling					x	2AB	x	2
62	ST	Limestone/ karst plains, lower terraces, slightly to moderately dissected							x	2
62		Limestone / karst plains, lower terraces	x	1			x	1	x	1
63	O	Limestone / karst plains, upper terraces, undulating to rolling	x	3						
63		Limestone / karst plains, upper terraces	x	2						
65	O	Limestone hill (high relief), undulating to rolling							x	3
65		Limestone hill (high relief)					x	2		
66	O	Low limestone hills, undulating to rolling	x	2AB	x	2B	x	2	x	2
66	SO	Low limestone hills, slightly dissected, undulating to rolling	x	3A						
66		Low limestone hills, undulating to rolling	x	2B					x	2
67		Karst plateau with isolated, undulating to rolling							x	3
68		Shale/sandstone plateau							x	2
76	O	Low shale/sandstone hills, undulating to rolling	x	2	x	2				
76	TO	Low shale/sandstone hills, moderately dissected, undulating to rolling	x	2B	x	2B				
76	UO	Low shale/sandstone hills, severely dissected, undulating to rolling	x	2B	x	2				
76		Low shale/sandstone hills	x	2B						
77	O	Low conglomeratic hills, undulating to rolling	x	2	x	2B			x	2
79		Low basaltic hills							x	2
80	O	Low volcanic complex hills, undulating to rolling	x	2B	x	2				
80	SDO	Low volcanic complex hills, slightly dissected, coarse textured soil, undulating to rolling					x	3B		
80		Low volcanic complex hills					x	2		
82	SDO	Low andesitic hills, slightly dissected, coarse textured soil, undulating to rolling	x	2	x	2	x	2		
82	STO	Low andesitic hills, slightly to moderately dissected, undulating to rolling	x	2						
82	TO	Low andesitic hills, moderately dissected, undulating to rolling					x	2		
82	UO	Low andesitic hills, severely dissected, undulating to rolling	x	2AB	x	2	x	2		
86	O	Low meta-volcanic hills, undulating to rolling					x	3		
111	S	High limestone hills, slightly dissected	x	2B						
111		High limestone hills	x	2B	x	2AB	x	2	x	2
112	ST	High shale/sandstone hills, slight to moderately dissected					x	2		
112	T	High shale/sandstone hills, moderately dissected	x	3	x	2B				
112	U	High shale/sandstone hills, severely dissected	x	2	x	2	x	2AB		
112		High shale/sandstone hills	x	2	x	2	x	2	x	2
113	U	High conglomeratic hills, severely dissected					x	4		
113		High conglomeratic hills	x	2	x	2B			x	2
115	SD	High basaltic hills, slightly dissected, coarse textured soil	x	3			x	3		
115	TO	High basaltic hills, moderately dissected, steep					x	2AB		
115	UR	High basaltic hills, severely dissected, very steep					x	2B		
115		High basaltic hills	x	2			x	2	x	2
117	TO	High volcanic complex hills, moderately dissected, steep soil					x	3AB		
117	UR	High volcanic complex hills, severely dissected, very steep soil	x	4						
117		High volcanic complex hills	x	2	x	2AB			x	2
118		High ultrabasic hills							x	3
119		High volcanic agglomerate hills			x	3A	x	3		
120		High dioritic hills							x	3
124		High volcanic hills					x	3		
126		High meta-rock complex hills	x	3					x	3
140		Intermountain valleys	x	3B						
153		Meta-rock plateau	x	4A	x	3A			x	4
156	ST	Shale/sandstone mountains, slightly to moderately dissected	x	4						
156	T	Shale/sandstone mountains, moderately dissected	x	3B						
156		Shale/sandstone mountains	x	2	x	2AB			x	2
161		High meta-volcanic mountains					x	3A		
163		Basaltic mountains	x	2AB	x	2AB	x	2	x	2
164		Andesitic mountains					x	4		
165		Ultrabasic mountains	x	2AB			x	2	x	2
166		Dioritic mountains	x	4					x	4
167	T	Agglomeratic hills, moderately dissected	x	2	x	2	x	2B		
167	TO	Agglomeratic hills, moderately dissected, steep			x	3A	x	3		
167	U	Agglomeratic hills, severely dissected	x	4	x	4			x	4
167		Agglomeratic hills					x	4		
168		Complex volcanic mountains	x	3	x	3A			x	3
170		Volcanic cones, non-active			x	4	x	4		
180		Built-up areas/urban area	x	4	x	4	x	4	x	4
191		Escarpment			x	4				
193		Major river							x	4

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