

8 Environmental Impact Mitigation Measures

8.1 Principles for preparation of environmental impact mitigation measures

(1) People-oriented principle

Priority should be given to the reservoir inundation, resettlement scale of migrants and ecological protection when selecting hydropower development plan. As for the layout of the sub-project and selection of specific schemes, the schemes should be compared. Public participation should be carried out and solicit public opinions and suggestions.

(2) Principle of ecological priority

The regional biological diversity, ecological system structure, as well as ecological function stability should be maintained. The ecological impact is taken as the important indicator for selection of the hydropower development schemes to promote sound development of regional ecological system.

(3) Principle of coordination

In preparation and implementation of hydropower development scheme, full consideration should be given to the interaction between the hydropower development and social development, economic development, and ecological environment protection. Moreover, efforts should be put into coordination with regional economic and social development.

(4) Principle of prevention first

In preparation and implementation of the hydropower development scheme, the possible adverse environmental impact due to the hydropower development should be prevented first. The hydropower development scheme should be optimized to avoid or mitigated the impact.

(5) Principle of impact minimization

Reasonable and feasible Measures should be drawn up to minimize the adverse environmental impact upon hydropower development.

(6) Principle of restoration and remedy

For the restorable ecological environment after hydropower development, relevant measures should be drawn up to repair and restore it for temporary occupied land. For the irreversible impact, relevant measures should be taken to ensure virtuous circle of the ecological environment, reducing adverse impact as much as practicable.

8.2 Environmental Impact Mitigation Measures

8.2.1 Protection Measures for Water Environment

(1) Water resource protection

Water resources development and utilization on the upper reaches of the Ayeyawady River should lay emphasis upon maintenance of better water ecological system and coordination. According to the ecological theory, coordinate the interaction between environment protection and development, and balance the relationship between economic and social development and water resource and water environment bearing capacities. During the hydropower development, limited and ordered development should be implemented to maintain original functions of the rivers, to keep the balance and virtuous circle of water ecological system and river ecosystem health.

To strengthen unified management of water resources of the Ayeyawady River, and to coordinate the utilization demand of water resources between the upper reaches and lower reaches of the river, to ensure water resources demand of the lower reaches, to establish sustainable the mode of ecological operation of reservoir and Coordinate the relationship between power generation and ecological protection, and to prevent adverse impact on water resources and aquatic ecology on the lower reaches of the dam due to operation of hydropower stations.

(2) Water quality protection

Initial reservoir impoundment is the main factor of affecting water quality of the reservoir. Stringent cleaning plan of the reservoir bottom should be made. Before impoundment of each cascade reservoir, pollutants and obstructions in the submerged area should be removed, such as buildings, trees, sanitation facilities, solid waste, etc. In addition, special treatment should be carried out for the exposed surface or main pollution sources.

Ecological agriculture, high-efficiency agriculture and featured agriculture should be developed according to local conditions. Highly effective fertilizer and low-toxin pesticide should be promoted to reduce non-point pollution of agricultural environment.

The domestic sewage and garbage from the towns in the reservoir area and along tributaries should be properly treated in the light of the requirement of environment protection. Random drainage and dumping is not allowed. The reservoir area shall stress or give priority to development of non-pollution or low pollution water-saving industry, and limit heavy pollution enterprises to avoid water pollution in reservoir area and the Ayeyawady River. During construction of the cascade hydropower stations, treatment and discharge management of waste water should be strengthened. The waste water and garbage shall not be discharged to the Ayeyawady River.

Environmental management agency of the cascade hydropower stations should be established, to compile relevant water environmental monitoring plan for monitoring water quality of the cascade reservoirs, surrounding pollution source and sewage discharge. The agency should organize and arrange regular water quality monitoring in control of temporal and spatial change of the water environment of the reservoirs.

8.2.2 Protection Measures of Aquatic Ecosystem

8.2.2.1 Protection Measures for Habitat

The upper reaches of the Ayeyawady River is of complete river structure. The river habitat is characterized by rich diversity in levels of micro-habitat, making it distinct from the reservoirs or lakes. Flow speed of the rivers and special bottom characteristics provide necessary conditions for development of the local fish species.

After implementation of hydropower development, the area of running water habitat on the upper reaches of Myitsone will be reduced, and the running water habitat of tributary will take on more importance. Thus, strengthening protection of the tributaries is the important ways to protect the fishes. On the Malikha River, attention should be paid to protecting the river reaches of natural running water and its main tributaries above the Laza hydropower station. On the Nmaiha River, attention should be paid to protection of the natural running reaches and longer tributaries with larger discharge above Yenau hydropower station. In the confluence of the two rivers, the fish species and biological diversity is richer than the main stream and tributaries. Thus protection of the main stream and tributaries above the backwater inundation area of the Myitsone hydropower station should be strengthened after the Myitsone hydropower station is built. In practice, the habitat protection can be fulfilled by establishing prohibited fishing zone and prohibited fishing period, as well as strengthening management construction of local fishery administration.

8.2.2.2 Management Measures

After reservoir impoundment, the water area will be enlarged, water flow will slow down, productivity will be heightened, and food organisms will be increased. This can promote the fish population of widely distribution species and sedentary species, and lead to increase of fishery production in reservoir. Relevant fishery management measures should be taken to reduce adverse impact and promote rational utilization of reservoirs. Fishery administration measures are as follows:

- (1) During hydropower development, a large amount of fishing near in the construction area should be restricted. The physiological ecology and behavior of the fishes in the construction area should be monitored to promptly save the fishes affected by construction.
- (2) After river closure, some fishes may which stay in the separate area above and below the cofferdam should be collected and released. During construction, particularly after flood season, the fishes in the foundation pit should be set for free.
- (3) After hydropower stations closure and reservoirs storage, fishing activities above and

below the constructions affected area are not permitted within 1 year once hydropower stations operates normally, and illegal fishing should be punished.

(4) In river reaches where feeding and reproduction of fishes is centralized in, frequency of fishing should be controlled and fishing gear types and net size should be confined. Management of the running water habitat of main rivers and tributaries should be enhanced. System of close-fishing and cease-fishing should be implemented in important seasons for fish.

(5) Management of exotic species should be enhanced, and fishery resources in the reservoir area should be monitored. Rational aquaculture mode of the reservoir area will be developed to guide the development of fishery industry.

(6) Regional fishery administration should be established and improved, and development of fishery departments should be strengthened to intensify law execution. Regional administration should be established to coordinate the relationship between fishery departments, construction company of projects, NGO and local people.

8.2.2.3 Investigation and Research

Subject to limitation of local traffic conditions and scientific research status, research foundation of the basin is weak, and even some field has never been touched upon. At present, Data related to the fishes on upper reaches of the Ayeyawady River is quite insufficient. Understanding of survival conditions of the indigenous species, such as spawning site, minimum survivability of species population and life cycle, etc is not insufficient, which pose great difficulties for the accurate evaluation on the effects of the hydropower development. The regional ecological environment and fish resources should be monitored continuously to obtain change extent and trend of ecological conditions in this area.

(1) Biological and ecological research on fish

Research on life cycle, reproductive biology, behavior ecology, and habitat demand of main

species affected by the project will be conducted. Quantitative descriptions of temporal and spatial distribution of elements of water quality, changes of water quality, and impact mechanism and biological and ecological effects on aquatic organisms in reservoir area, above reservoir tail area, and below the dam area due to change of hydrologic situations.

(2) Technical research on fish rescue

Research on exclusive rescue technology for rare and endemic species will be carried out. Prompt and effective rescuing should be performed if encountering them. Suitable rescuing measures should be considered to ensure safe passage of fishes above and below the construction area. When blasting cofferdam, the technique for whipping in fishes should be discussed to reduce loss of fishes as much as possible.

(3) Technical research on artificial propagation and release

Fish tagging technique should be researched to establish efficient tagging technique and method applicable to biology of released species. The tagging technique research will be developed to seek artificial releasing methods with optimal ecological effect, including suitable size, quantity, place, time, etc for releasing and to provide scientific reference for fish protection decision.

(4) Monitoring technique research

A complete monitoring system will be established to monitor the population size of the rare and endemic fishes that susceptible to environmental change, as well as the genetic diversity and genetic structure of natural populations. Based on the obtained ecological parameters of species population, the dynamic trend of population will be analyzed, and effect of protection measures such as artificial propagation and release will be verified. The relevant information system will be established to provide scientific reference for protection of rare and endemic fishes and lay foundation for review evaluation of environment impact after hydropower development.

8.2.3 Protection Measures for Terrestrial Ecosystem

(1) Protection measures for rare and endangered plants

The upper reaches of Ayeyawady River is located in one of 34 global biodiversity hotspots--Indo-Myanmar Biodiversity Hotspot. In the assessment area, there are 12 species of rare and endangered plants on IUCN Red List, 2 species of endemic plants, *Cyathea spp.* and Orchidaceous species listed on CITES Appendix II.

Ampelocalamus kachinensis and *Camellia irrawadiensis* Barua are found in the Myitsone reservoir area. It is suggested that typical individuals of genetic variation should be transplanted in ex situ conservation places. Seed propagation is adopted in protection of the plants.

Dipterocarpus retusus Blume and *Tetrameles nudiflora* R. Brown are constructive species of the local plant community. The impoundment of reservoirs will submerge some of them, but the population in different region represents different genetic characteristics. Thus, the best young plants to be submerged should be transplanted and protected.

For protective of plants to be submerged, the young trees will be transplanted and seed of the mature trees will be collected for propagation. The plants will be protected near the original habitat.

(2) Protection measures of habitat

As to reduce impact of hydropower development on terrestrial ecology and avoid adverse ecological environment problems, the projects site and route should be avoided through good habitat of wildlife, so as not to cause habitat loss and habitat fragmentation. Construction should be carried out within secondary ecological system or periphery of the habitat as possible, to reduce disturbance of ground surface and vegetation and to maintain integrity of the natural ecological system in the project area. The resettlement scale of migrants on the terrestrial ecological environment should be lowered, to reduce the impact on terrestrial ecosystem. Layout of construction roads should be optimized to reduce the length of construction roads and to maintain passage of terrestrial animals.

(3) Vegetation restoration measures

During construction, bio-ecological protection scheme will be compiled to determine place, scope and area of bio-ecological restoration, goals and bio-ecological restoration technique scheme. The general plan of soil and water conservation measures should be prepared for exposed surface of the temporary earth piling site, earth-rock material site, temporary construction area, construction roads to control soil erosion and ensure safety of construction. After construction, on the periphery of the hydropower stations, earth material sites, and spoil disposal sites, stabilization of side slope, and land reclamation shall be carried out promptly, and suitable species of indigenous plant will be planted for vegetation restoration.

Afforestation should be carried out for the permanent occupied land. The indigenous plants in the area to be submerged should be transplanted for afforestation as much as possible.

(4) Management measures

Protection policy of the local terrestrial wildlife should be made and improved. According to the local situations, it is suggested that Myanmar government establish and improve policies and laws for protection of the local terrestrial wildlife.

Habitat should be protected and restored. According to current protection situations of the terrestrial wildlife on the upper reaches of the Ayeyawady River, it is suggested that government select some typical terrestrial wildlife and carry out restoration of important habitat and species, to promote protection and recovery of terrestrial wildlife and their habitat ,in order to effectively slower decline of terrestrial wildlife.

Attention shall be paid to publicity and education and personnel training. By means of these measures, the public will know the terrestrial wildlife well, especially their functions and efficiency. Public awareness of protection of the terrestrial wildlife should be enhanced. This is good for formation of good protection atmosphere.

Alternation of crop rotation and intercropping should be adopted, to reduce burning

vegetation for farmland. Also, local residents should be encouraged to use power to decrease consumption of fire wood. Energy-saving stove, methane tank and power should be popularized and utilized to reduce consumption of forest.

The local government will be assisted to train the local residents so as to make them shift the slash and burn cultivation into modern agricultural production, to reduce destruction to forest resources especially virgin forest.

During construction, the construction workers shall not be allowed to hunt and purchase wild animals especially rare and endangered animals from the local hunters. The consumption of wild animals and their products should be given up.

In addition, attention shall be paid to biotic intrusion due to man-made interference during construction.

(5) Investigation and research

1) Investigation, evaluation and monitoring of terrestrial wildlife resources

Regular and irregular investigation work will be conducted, to observe and know the change and adaptive behavior of populations of the rare or endangered species after hydropower development.

The monitoring network plan includes the monitoring station of terrestrial wildlife on the upper reaches of the Ayeyawady River and location monitoring points of terrestrial wildlife in the 7 cascade power station areas. The relevant monitoring work of species will be conducted according to habitat characteristics and distribution of the mammals, birds, amphibian, reptiles and insects in assessment area.

2) Strengthening scientific research of terrestrial wildlife

To strengthen scientific research of terrestrial wildlife is the main ways to know terrestrial wildlife and also important guarantee to promote protection and sustainable utilization and development. Scientific research of terrestrial wildlife mainly includes:

Basic research such as taxonomy, distribution, phylogeny and evolution of terrestrial animal

Research of applied technology. Technology researches related to protection, breeding, releasing and habitat renovation, attraction, ecology restoration of animal community, sustainable utilization and management, as well as efficiency evaluation indicator system.

3) To strengthen research on protection and rational utilization of resources. Artificial domestication and breeding is encouraged, and attention should be paid to the research of ecosystem protection and regional protection, especially reclamation, restoration and reconstruction of the animal habitat in the declined ecosystem.

8.2.4 Mitigation Measures for Impact of Migrants

Positive propaganda that Hydropower development is conducive to the regional economic and social development and the improvement of living standard of the migrants and local residents should be strengthened.

Resettlement compensation standard will be disclosed and resettlement funds are available, to solve the construction of production and living facilities of migrants. Attention should be paid to the need of vulnerable groups such as the elder and women. Callback system will be established to promptly know demands of migrants and existing problems and resolve the potential dispute as much as possible.

During relocation and resettlement of migrants, the entire village should be relocated and resettled as possible. Concentrated and scattered resettlement is combined in order to keep the original social relationship of migrants as possible.

Regionally, overall consideration should be given to the reconstruction of roads, schools, hospitals and other public facilities of the resettlement area. The local residents will be encouraged to use power to reduce consumption of fire wood and use of diesel generator if conditions permit.

During resettlement of migrants, to respect ethnical custom and culture, and to reconstruct key churches and Buddhist pagoda.

During construction of the cascade hydropower stations, the migrants and local residents will be encouraged to participate in construction and service of the projects, to meet labor and consumption demands. This can provide conditions in increasing income of local and migrants.

According to construction requirements, training of production and service skills can be provided, such as planting, cultivation and infrastructure construction skills.

During resettlement of migrants, supervision shall be carried out to ensure payment of resettlement funds.

8.2.5 Protection Measures of Religion and Ethnical Culture

8.2.5.1 Protection measures for religious facilities

Opinions of the religious departments and relevant communities shall be sought for the relocation of large religious facilities, such as Buddhist, temples and Christian churches, or the temples where believers often worship or pray, and assistance shall be provided for relocation of the believers.

Buddhist temples, churches and religious facilities shall be reconstructed. On the basis of respect the local ethnical custom, the relevant work shall be conducted in a care and thoughtful manner, and some issues shall be solved with basic religious affair departments.

8.2.5.2 Protection measures for ethnic culture

During relocation and resettlement of the migrants, ethnic culture shall be protected. Different resettlement mode shall be adopted for the single ethnic village or mixed ethnic group, to maintain the original ethnic structure and relationship. For the single ethnic villages, the entire village will be relocated, to maintain the space and atmosphere of the traditional culture. The mixed ethnic groups can be relocated dispersedly, but attention shall be paid to protection, inheritance and development of the ethnic culture.

8.2.6 Protection Measures of People Health

The reservoir area shall be cleaned, and emphasis shall be laid on killing insects and rats to

lower the density of pathogenic microorganism, mosquito and rats insect-borne animal to control the spread of infectious disease and natural focal diseases in the reservoir area after impounding. Sanitation shall be carried out in construction and resettlement area, such as disinfection, deinsectization and deratization. Local people health shall be monitored to know change of types of infectious disease and disease incidence.

Due to higher incidence of the regional malaria, cleaning and disinfection shall be carried out before relocation of migrants. Infectious source and vector from animal shall be killed, to prevent and control the prevalence of infectious disease and natural focal diseases and to ensure sanitary environment in the resettlement area and reduce mosquito-borne infectious diseases.

Many infectious diseases invade human body through drinking water. Water quality is closely related to the health of residents. Thus, drinking water protection and hygiene management for food shall be strengthened during hydropower development.

Hygiene education on disease prevention shall be strengthened. Hygiene knowledge shall gain popularity to increase the ability of self-health care and awareness of disease prevention, and increase the activity of health and epidemic prevention. Education contents contain harms of infectious disease, transmission path, prevention method, and general knowledge of environmental and food hygiene. The education can be carried out through distribution of publicity materials, broadcast, meetings, and propaganda and explanation to the people.

9 Economic Analysis on Environmental Impact

The purpose of economic analysis on environmental impact of hydropower development on the upper reaches of Ayeyawady River is to analyze environmental benefits and losses of the hydropower development in accordance with principles of environmental economics and cost-benefit analytic method, considering the relationship between hydropower development and the sustainable, stable and harmonious development of eco-environment, social environment and social economy. According to equivalence principle and substitution principle, environmental benefit will be calculated by using “shadow project approach”.

9.1 Environmental Benefit

9.1.1 Economic Benefit

According to the proposal of cascade development on the upper reaches of Ayeyawady River above Myitkyina, the installed gross capacity is 18400MW and the annual power output is 99,110,000,000 kW·h. At the same time, with benefits in flood control, navigation and irrigation, economic benefit of hydropower development is significant.

9.1.2 Social Benefits

(1) Social economy

The hydropower development on the upper reaches of Ayeyawady River provides large amounts of capital as well as advanced technology. This will promote Myanmar's economic development and scientific improvement. Meanwhile, it will drive exploitation of other resources and the development of such industries as building materials, transportation, service industry and communication and so on, improve the transportation condition of both local places and both sides alongside the river (Maykha River and Malikha River), all of which will accelerate the urbanization process of these regions.

(2) Flood control

Myitkyina, through which the Ayeyawady River flows, locates at 45km lower reach of the

Myitsone station. Records show that there were 4 flood disasters during 1990s in Myitkyina, when the floods submerged parts of cities' streets and caused some losses.

The reserved flood storage of the cascade reservoir on the upper reaches Ayeyawady River is 0.85 billion m³ in flood season. It plays an important role in enhancing Myitkyina's flood control capacity and decreasing losses of floods and improves Myitkyina's flood control standard from once in five-year to once in twenty-year. At the same time, it is also helpful in easing the flood control pressure in middle and lower reach of the Ayeyawady River temporarily.

(3) Shipping

Only in some stream segments for hydropower development can pass small power driven wooden vessel because there are many shoals in dry season. On the contrary, the River is not in a navigable condition in flood season because it has a large flow and many rapids. The hydropower development benefits both the development of navigation in reservoir area and the improvement of shipping conditions of lower reach of the River.

9.1.3 Eco-environmental Benefits

The hydropower development on the upper reaches of the Ayeyawady River is a hydropower project. Therefore, compared to coal-fired power generation, environmental benefit of cascade power station is that it has no air pollution during normal operation. In comparison with coal-fired power generation, cascade power station will reduce about 70,950,000 t/a emission of CO₂, and decrease about 2,370,000 t/a emission of NO₂, and about 1,190,000 t/a emission of SO₂.

9.2 Losses of Environmental impact

(1) Environmental Protection Cost

The loss value of the project will be calculated by using "restoration cost method", that is the cost of protection and compensation measures for mitigating adverse effects or recovering and compensating the environmental benefit to reflect the loss of project impact.

The environmental protection measures to mitigate, recover or compensate the adverse effects mainly include: water environment protection measures, aquatic ecosystem impact mitigating measures, terrestrial ecosystem protection measures, social environment protection measures, environmental monitoring planning, environmental management and supervision program planning.

(2) Loss of Forest Vegetation on CO₂ Fixation

Due to the implementation of hydropower development, some vegetation will be submerged by reservoir. This will lead to losses of vegetation biomass and productivity within assessment area, which, accordingly, will somewhat affect the regional ecosystem's carbon fixation and oxygen production function.

9.3 Cost-benefit Analysis on Environmental Influence

Cost-benefit analysis method will be used to analyze the environmental economic cost and benefit. The economic benefit of hydropower development on the upper reaches of the Ayeyawady River is significant, with notable social benefits and environmental benefit of reducing CO₂ emission..The cost for environmental impact loss and for measures to avoid potential economic loss, to recover and compensate adverse environmental impact is smaller.The hydropower development on the upper reaches of the Ayeyawady River can generate significant economic benefit, and its social benefit and environmental benefit are much larger than environmental impact loss.

10 Public participation

10.1 Purpose and meaning

Public participation is important in the environmental impact assessment. Questionnaire survey in the hydropower development area, on one hand, will help the people and organizations affected by the hydropower development understand development situation of water resources of Ayeyawady River above Myitkyina, especially the problems related with their production and living, win their support and assistance, and give play to comprehensive, long-term benefits of the hydropower development project to an utmost extent; on the other hand, it will assist the assessing unit in understanding the attitude of the people and organizations affected by the hydropower development towards the regional hydropower development and their environmental concerns and requirements, make the forecast and assessment of environmental assessment more detailed, and improve the overall quality of the environmental impact assessment of the hydropower development, and based on these, pertinent, operable environmental protection measures will be formulated.

The construction of the hydropower project at the upstream of Ayeyawady River will convert hydropower resources advantages into economic advantages in Myanmar, and promote local and Burmese economic & social development; improve such local infrastructures as road, traffic and electric power; stimulate development of local service industry, create employment opportunities for local residents and increase their income. Meanwhile, the hydropower project may also bring some negative influence to local ecological environment and social environment. Then, how to utilize advantages and avoid disadvantages? In addition to economic verification of the engineering technique, the public is encouraged to participate in exchange and communication among the assessing unit, planning & compiling unit and the public, understand specific contents of the overall hydropower development scheme and environmental problems which may be brought about before and after the implementation of the hydropower development, collect the attitude of local

residents and governmental departments towards the hydropower development, their environmental concerns and their suggestions on solving sensitive environmental problems, to make forecast and assessment of various environmental impact more detailed, improve the quality of the overall environmental assessment of the river basin, adjust and optimize the hydropower development scheme, formulate pertinent, operable environmental protection measures, and give play to economic, social and environmental benefits of utilization and development of water resources to the maximum extent. At the same time, the hydropower development scheme, especially environmental protection, will be generally accepted by all social circles, to ensure smooth implementation of the hydropower development.

10.2 Questionnaire

For the people and groups affected by the hydropower development, CDC designs Questionnaire A and Questionnaire B. The former mainly aims at the people directly affected by the hydropower development, namely, migrants involved in reservoir submersion and land occupation in the engineering; the latter mainly aims at the people and groups indirectly affected by the hydropower development, including residents, governmental agencies, local ecological environmental experts and scholars of other professions in Myanmar. Specific contents of Questionnaire A and Questionnaire B are shown in Appendix 8.

10.3 Overview of survey process and mode

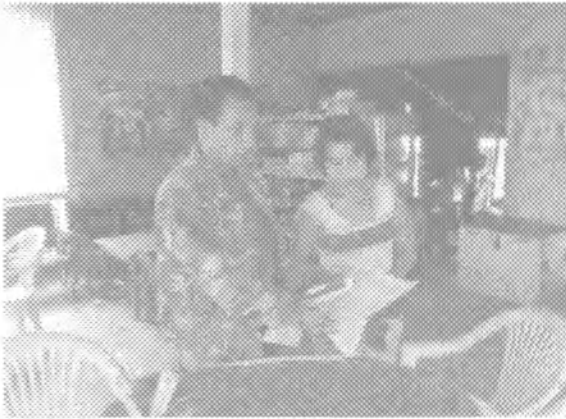
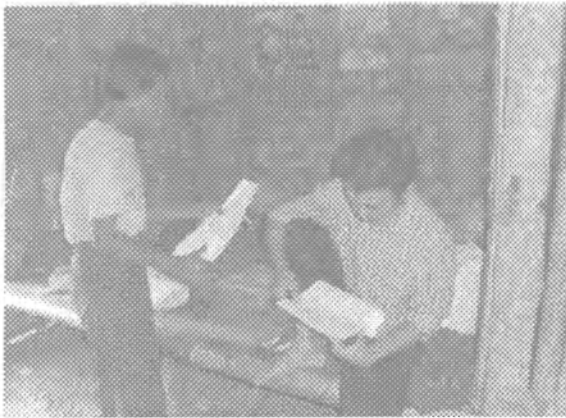
(1) Questionnaire

Public questionnaire survey on the hydropower development of Ayeyawady River above Myitkyina has been carried out three times. The first one was commenced in the first ten days of March, 2009 and completed in the middle ten days of the same month; the second one was conducted in the middle ten days of August, 2009, involving the migrants involved in the hydropower development, and followed by one supplementary questionnaire survey;

the third one was organized by MOEP1, commenced in the middle ten days of November, 2009 and completed in the first ten days of December, 2009.

For local residents under direct and indirect influence of the engineering, the environmental assessment unit employs local Burmese interpreters and some workers to provide training for Burmese workers with the aid of the workers of the environmental assessment unit. The training mainly covers main contents of the hydropower development project at the upstream of Ayeyawady River, main favorable influence and unfavorable influence of the cascade hydropower stations construction and main environmental protection measures, and offers answers to the problems about which local residents are concerned, including resettlement of affected residents and re-building of infrastructures. By means of training, local residents involved in questionnaire survey will have further understanding of both advantages and disadvantages of the hydropower development. After the training is completed, with the assistance of CPIYN, DHPI and Burmese workers, the environmental assessment unit carried out the public questionnaire survey.





(2) Communication symposium

To know the opinions of the environmental experts of non-governmental organizations on the hydropower development at the upstream of Ayeyawady River, totally 5 communication symposiums were organized during the field survey and the compilation of the environmental impact assessment report of the hydropower development of Ayeyawady River.

From Aug. 26, 2009 to Sep. 3, 2009, the aquatic ecological experts from Myanmar BANCA arrived at Wuhan, China for communication and data exchange with IHE, and had a discussion with the representatives of the experts of CDC and IHE.

From Sep. 2, 2009 to Sep. 3, 2009, the animal experts of South China Institute of Endangered Animal met the animal experts of Myanmar BANCA in Tengchong County, Yunnan Province, China, and both sides were involved in 2-day-long communication and discussion.

From Sep. 1, 2009 to Sep. 7, 2009, the terrestrial ecological experts from Myanmar BANCA arrived at South China Botanical Garden, Guangzhou, China for communication and data exchange, and the representatives of CDC and of CPIYN go there and had a discussion with the terrestrial ecological experts of Myanmar BANCA and the experts of South China Botanical Garden and South China Institute of Endangered Animal.

In the last ten days of Sep., 2009, the planning profession, construction profession, pivot profession and environmental assessment profession from Hydropower Project Department of CDC had discussions on the initial impoundment of Myitsone Hydropower stations.

From Oct. 29 to Oct. 30, 2009, 3 persons in charge of Myanmar BANCA had a discussion with the representatives of CDC on the environmental protection measures of the hydropower development at the upstream of Ayeyawady River in Wuhan, China.

(3) Advisory meeting

From March 2008 to December 2009, CDC invited and consulted the experts about environmental assessment of watershed several times.

10.4 Investigated Subjects

To know the opinions of local people from all social classes to the planning for development and utilization of water resource of river basin above Myitkyina of Ayeyawady River, the investigated subjects mainly include local governmental departments, the local residents directly affected by the hydropower development and the common people indirectly affected by the hydropower development, and Myanmar and Chinese ecological environmentalists

(1) Local governmental department: Hydropower Construction Department of MOEP1, Land Bureau, Immigration Authority and Military Security Service and other governmental departments.

(2) Local residents directly affected by hydropower development: the information of the 199 residents randomly investigated is as follows:

Age: number of the people at the age of 20 or below accounts for 11.1%, number of the people at the age of 20~40 accounts for 48.7%, and number of the people at the age of 40~60 accounts for 33.7%, and number of the people at the age of 60 above accounts for 6.5%.

Education background: The number of the people with college diploma or above takes up 9.5 %, the number of the people with senior high school diploma takes up 18.6%, the number of the people with junior high school diploma takes up 31.7%, and the number of the people with elementary school diploma or below takes up 40.2%.

Nationality: The investigated Kachin people account for 74.9%, the Myanmar people account for 12.6%, and the Shan people account for 7.0%, and the other people account for 5.5%.

Among the local residents directly affected by the hydropower development, the information of the people participated in this environmental impact evaluation is shown in the Table 10.4-1.

Table 10.4-1 Statistical information of the people directly affected by the project

Item	Group	Number of people	Percentage (%)
Age	20 or below	22	11.1%
	20 – 40	97	48.7%
	40 – 60	67	33.7%
	60 above	13	6.5%
Nationality	Kachins	149	74.9%
	Myanmarn	25	12.6%
	Shan	14	7.0%
	Lisu	2	1.0%
	Lao	3	1.5%
	Keyel	1	0.5%
	Laqi	1	0.5%
	Chinese	1	0.5%
	Ruowan	1	0.5%
	Gaoerka	2	1.0%
Gender	Male	136	68.3%
	Female	63	31.7%
Education background	College or above	19	9.5%
	Senior high school	37	18.6%
	Junior high school	63	31.7%
	Elementary school or below	80	40.2%
Residence	Myitkyina	109	54.8%
	Wangmo	60	30.2%
	Yinjiangyang Myitsone	30	15.1%

(3) Common people indirectly affected by the hydropower development: the information of the 121 investigated residents of Myitkyina City is as follows:

Age: number of the people at the age of 20 or below accounts for 3.3 %, number of the people at the age of 20~40 accounts for 53.7%, and number of the people at the age of 40~60 accounts for 39.7%, and number of the people at the age of 60 above accounts for 3.3%;

Education background: the number of the people with college diploma or above takes up 22.3%, the number of the people with senior high school diploma takes up 20.7%, the number of the people with junior high school diploma takes up 32.2%, and the number of the people with elementary school diploma or below takes up 24.8%.

Nationality: the investigated Kachin people account for 62.0%, the Myanmar people account for 24.8%, the Shan people account for 3.3%, and the other people accounts for 9.9%.

Among the local residents indirectly affected by the hydropower development, the information of the people participated in this environmental impact evaluation is shown in the Table 10.4-2.

Table 10.4-2 Statistical information of the people indirectly affected by the project

Item	Group	Number of people	Percentage (%)
Age	20 or below	4	3.3%
	20 – 40	65	53.7%
	40 – 60	48	39.7%
	60 or above	4	3.3%
Nationality	Kachins	75	62.0%
	Myanmarn	30	24.8%
	Shan	4	3.3%
	Lisu	3	2.5%
	Yakhain	2	1.7%
	Gaoerka	1	0.8%
	Chinese	1	0.8%
	Chin	1	0.8%
	Indian	1	0.8%
	Ruowan	1	0.8%
	Naka	1	0.8%
	Keye	1	0.8%
Gender	Male	82	67.8%
	Female	39	32.2%
Education background	College or above	27	22.3%
	Senior high school	25	20.7%
	Junior high school	39	32.2%
	Elementary school or below	30	24.8%
Residence	Myitkyina	49	40.5%
	Wangmo	51	42.1%
	Yinjiangyang Myitsone	21	17.4%

(4) Myanmar ecological environmentalists: they mainly include terrestrial plant experts, terrestrial and animal experts, aquatic animal experts, water environment researchers and socialists, totaling to 20.

10.5 Public opinions and suggestions

10.5.1 Questionnaire Results

As for hydropower development of upper reaches of Ayeyawady River, 340 collected questionnaire replies of the investigated people are collected. The survey results (see Table 10.5-1 and 10.5-2) indicate most people know the hydropower development of upper reaches of Ayeyawady River, and about 25% of the people objects to the Hydropower Development of upper reaches of Ayeyawady River. According to the public questionnaire replies of the people directly affected by the hydropower development, 47 “nonsupport” replies are from party villages of Myitkyina. The reason is that the development will bring disaster to the local plant and animal, cultural extinction and frequent occurrence of natural disasters. In combination of analysis of the field visit, the villagers of the party villages do not understand the hydropower development, so they “disapprove of” the hydropower development of upper reaches of Ayeyawady River.

From Table 10.5-1, 80.4% of the investigated subjects considers the hydropower development will provide more employment opportunities and economic income for local people ; 57.8% of the investigated subjects considers the hydropower development will obviously promote local social and economic development; as for their requirements (multiple choice) if relocation is needed, the local people pay attention to houses and cultivable land, compensation of loss of properties, hospitals, schools and public facilities shall be provided in the resettlement area, and the three choices account for 46.2%, 11.1% and 10.1% respectively.

From Table 10.5-2, 81.0% of the investigated subjects considers the hydropower development will bring more employment opportunities and economic income for the local residents; 62.8% of the investigated subjects considers the hydropower development will promote local social and economic development; the conspicuous problems of the river basin is inconvenient transport, and secondly insufficient development of natural resources and backward social economy. As for the most benefit of the hydropower development (multiple choice), the investigated subjects considers promotion of economic development

of the region and Myanmar, providing employment opportunities and increase of personal income, improvement of local infrastructure conditions, and the answers account for 36.4%, 21.5% and 15.7% respectively.

Table 10.5-1 Survey resluts of residents affected by hydropower development

No.	Content of survey	Opinion	Number of respondents	Percentage (%)
1	Do you know the hydropower development of Myitkyina river of Ayeyawady River	Yes	175	87.9%
		No	14	7.0%
2	Can the hydropower development bring more employment opportunities and economic income for local residents	Yes	160	80.4%
		No	26	13.1%
3	Effect of hydropower stations on local social and economic development	Obvious	115	57.8%
		Not obvious	19	9.5%
		Adverse	4	2.0%
4	What is the most benefit of hydropower development for the region	Will promote economy of region and Myanmar	72	36.2%
		Improve local infrastructure	50	25.1%
		Provide employment opportunities and increase personal income	9	4.5%
5	Do you want to move to other place if you are informed of relocation	Yes	104	52.3%
		No	79	39.7%
6	What is your requirement if relocating to other place?	Provide houses and cultivable land	92	46.2%
		Compensate the loss of property	22	11.1%
		The resettlement shall have hospitals, schools and public facilities	20	10.1%
		Provide training of production skills	5	2.5%
7	What is the conspicuous problem of the river basin	Backward social economy	44	22.1%
		Inconvenient transport	38	19.1%
		Development of natural resources is insufficient	22	11.1%
8	Which place is most affected by the hydropower development of the river basin	zone of reservoir inundation	125	62.8%
		Construction area of hydropower stations	44	22.1%
		Other place	10	5.0%
9	The impact of the hydropower development on terrestrial animal and aquatic organism in the river basin	No impact	38	19.1%
		Minor impact	75	37.7%
		Significant impact	22	11.1%
10	Do you support the hydropower development of the river basin	Support	78	39.2%
		Nonsupport	48	24.1%
		No comment	53	26.6%

Table 10.5-2 Survey results of residents indirectly affected by hydropower development

No.	Content of survey	Opinion	Number of respondents	Percentage (%)
1	Do you know the hydropower development of Myitkyina river of Ayeyawady River?	Yes	112	92.6%
		No	1	0.8%
2	Can the hydropower development bring more employment opportunities and economic income for local residents	Yes	98	81.0%
		No	11	9.1%
3	Effect of hydropower stations on local social and economic development	Obvious	76	62.8%
		Not obvious	17	14.0%
		Adverse	25	20.7%
4	Impact of hydropower development on local residents	No impact	75	62.0%
		Adverse impact	22	18.2%
		Improve living standard of local residents	4	3.3%
5	What is the most benefit of hydropower development for the region	Promote economy of region and Myanmar	44	36.4%
		Improve local infrastructure conditions	19	15.7%
		Provide employment opportunities and increase personal income	26	21.5%
6	What is the conspicuous problem of the river basin	Backward social economy	21	17.4%
		Inconvenient transport	28	23.1%
		Development of natural resources is insufficient	26	21.5%
7	Which place is most affected by the hydropower development of the river basin	Zone of reservoir inundation	54	44.6%
		Construction area of hydropower stations	40	33.1%
		Other place	18	14.9%
8	The impact of the hydropower development on terrestrial animal and aquatic organism in the river basin	No impact	22	18.2%
		Minor impact	44	36.4%
		Significant impact	30	24.8%
9	Do you support the hydropower development of the river basin	Support	57	47.1%
		Nonsupport	31	25.6%
		No comment	27	22.3%

The survey results show the problems which the local people pay attention to during the hydropower development, such as location of resettlement area, resettlement conditions, the means of livelihood of the affected residents; roads to be submerged; loss of homeland and famous Myitsone scenic spot of Myitkyina of Kachin State; resolution of the Myitsone scenic spot to be submerged and so on. Some residents affected by the hydropower development have no ideas about resettlement and their living standard after resettlement, they are afraid that their living quality will be worse after resettlement, so they object to the hydropower development.

10.5.2 Comments of live interviews

In the process of questionnaire survey participated by the public, with the assistance of interpreters, staff in questionnaire survey team make interviews with the residents in Myitkyina and Myitsone. Through live interviews, we know that, for some reasons, the local government conducts less positive propaganda with respect to the hydropower development in upstream of Ayeyawady River. Some people know little about the status of hydropower development in upstream of Ayeyawady River, and only listen to the news that in Myitsone region may build a large- scale hydropower stations from the radio and hear from other people or in any other ways. In the interview with local Chinese people, we know that most of them support China for investing and building a large-scale hydropower stations in Myanmar. In their opinions, this initiative can enhance the friendship between the people of Myanmar and China, promote economic and social development in Myanmar, and help to improve living standards of local people. While in the interview with the local Kachin, we know that some Kachin people hold cautious attitudes to the hydropower development in upstream of Ayeyawady River. They are worried that water reservoir makes them lose their homes; worried that the issue of reservoir flooding dwellings of migrants and the livelihood issue; caring about losing Myitsone, the representing attraction. In the interview with migrants who are affected by the reservoir inundation, we know that, some migrants hold opposing attitudes due to receive fake propaganda information by partial organizations. Through interviews, it is found that people know little about the impact of hydropower development made on social environment and ecological environment. They

are worried about losing homes, don't know how the government will resettle them, and do not know what can be lived on in future.

10.5.3 Seminars and experts advices

In the seminars held with BANCA experts in Myanmar, we know that, a majority of Myanmar experts have expressed positive supports for conducting hydropower development in upstream of Ayeyawady River by Chinese investment, whereas they also expressed concerns on some issues posed by the implementation of hydropower development, for example, migration and their resettlement issue, inundating infrastructure issue, and the impact of implementation of hydropower development made on the ecological environment. They believe that there is no doubt that China investing the hydropower development in upstream of Ayeyawady River will promote the social and economic development in Myanmar and improve the living standards of local residents. They believe that the Chinese enterprises have a high sense of responsibility, and hope it would conduct the hydropower development in accordance with Chinese environmental protection standards. After the principles of resettlement, general standards of resettlement, and the inundating infrastructure rehabilitation etc. are explained, Myanmar experts express that the project is feasible under premises that these measures actually put in practice.

10.5.4 Public comments summary

Through summary on statistical analysis made, the public concerned environmental issues mainly involve following issues. .

(1) Resettlement issue. Currently, the government of Myanmar is accelerating the arrangement of resettlement planning schemes and the local residents are not yet known how the migrants will be resettled. In consequence, the reservoir involves the migrants' concerned issues, for example, their resettlement destination, whether the loss of property will be compensated, the infrastructures in resettlement region, and how about the traffic conditions in resettlement region.

(2) The migrants' livelihood issue. Most migrants want their losing property to be

compensated. On the basis of compensation acquired in reality, they hope that the local government of Myanmar and Chinese enterprises would help them to resume normal production and life as soon as possible.

(3) The reservoir inundating Myitsone issue. Myitsone attraction is one of representing attractions in Kachin of Myitkyina. The public express much concern on this issue of inundating Myitsone attraction.

(4) Due to insufficient propaganda force in hydropower development in upper stream of Ayeyawady River, a part of local people are not familiar with hydropower development in Ayeyawady River, leading to misunderstanding.

10.6 Public participation comments and execution

For the public participation comments and advices on hydropower development in upstream of Ayeyawady River, the environmental impact assessment EIA units conducts a series of communication, receiving feedback, solutions and execution. The issues implemented and settled in the planning design will be communicated and jointly consulted together with each design profession and investment company; The issues not able to be solved at the present stage, should be responded to the owners in time to attract their attentions so as to make the issues being implemented and settled in the execution process of hydropower development as much as possible. Issues that attract more attentions and anxieties of Burmese public, for example, resettlement issue, will allow the Burmese to understand basic resettlement principles of investing party.. Additionally, Burmese should give more understanding and supports to constructive activities of the hydropower development in upstream of Ayeyawady River availing by propaganda. Solutions and countermeasures of public concerns are in Table 10.6-1.

Table 10.6-1 List of public participation comments processing results

Number	Public concerning issues	Processing Results
1	Relevant resettlement issue	Allow migrants to understand resettlement principles and inquire their willingness in following aspects, for example, no lower than the original living standards, concentrated resettlement, compensation for losing property of migrants, etc.
2	The migrants' livelihood issue	Explain to the public that traffic in resettlement region will be more convenient, will unified consider the living infrastructure construction, and the hydropower development will stimulate regional economic development, create employment opportunities and improve living standards of local residents.
3	The reservoir inundating Myitsone attraction	Explain to the public that implementation of Myitsone hydropower stations is able to create a new attraction and promote the development of local tourism; meanwhile, have been responded to the owner's side to arouse attention.
4	Propaganda issues by government	Suggest the government should strengthen the propaganda force of hydropower development in upstream of Ayeyawady River.

11 Environmental Management Planning

Since the hydropower development on the upper reaches of the Ayeyawady River is still in the primary phase of the project, the environmental management plans in this phase only include the overview of the project's environmental impact, summary of mitigation measures, environmental monitoring planning, statement of public consultation activity, statement of environment management responsibilities etc. The environment management planning and their contents shall be modified and perfected in the execution phase of the proposed hydropower project.

11.1 Overview of Major Environmental Influence

(1) Major positive impact

The implementation of hydropower development on the upper reaches of the Ayeyawady River has significant social benefit, economic benefit and environmental benefit. Its major positive impact includes:

Accelerate Kachin State's or even Myanmar's economic development. The Kachin State is located in the north of Myanmar and its economy remains to be developed. After the implementation of hydropower project on the upper reaches of the Ayeyawady River, the resources advantage can be transformed into economic advantages, and this will give renewed impetus to local fiscal revenue and accelerate greatly Kachin State's or even Myanmar's economic development.

Improve local residents' living standards. The construction investment of the hydropower project together with large quantities of construction workers' daily consumption will provide impetus to the prosperity and development of such local industries as catering industry, service industry, cultural entertainment industry and transportation and so on, which will provide local people with a number of employment opportunities and improve local people's living standards.

Better remarkably the region's infrastructures. As a part of the hydropower development, current roads alongside the Maykha River and the Malikha River will be rebuilt or created. This will greatly improve the transportation condition of the upper reaches of the Ayeyawady River and accelerate construction and rebuilding of infrastructures in the reservoir area, such as water conservancy project, power supply project, post and telecommunications and so on.

Flood control and navigation benefit. The cascade reservoir on the upper reaches of the Ayeyawady River will reserve certain flood control storage, which can improve Myitkyina's flood control standard from once in five-year to once in twenty-year. It plays an important role in improving Myitkyina's flood control capacity and decreasing losses of floods. The operation of cascade reservoir can increase the stream flows in the downstream of the river so that navigation conditions in the downstream of the river can be improved to some extent.

Improve regional environmental situation. The clean energy generated by hydropower development will gradually promote the present status of local areas, which is "replace oil by electricity, replace firewood by electricity". This will improve regional atmospheric environmental quality and protect forest vegetation.

(2) Major negative impact

Hydropower development has negative impact on the environment, including the impact on aquatic organism, terrestrial organism and social environment caused by reservoir inundation, the blocking of dam and change of hydrology.

1) Aquatic Organisms

The major adverse impact on fish resources by cascade development is that aquatic environment of fishes will be changed because of dam block and change of hydrological regime. Most of fishes living on the upper reaches of the Ayeyawady River are mainly settled fishes which make short-distance migration. The hydropower development has no influence on their population generation. However, the dam block may lead to genetic

differentiation of fishes population in different river reaches.

The hydropower development on the upper reaches of the Ayeyawady River will influence the distribution of *Anguilla nebulosa* and *Bengal eel*, two kinds of migration fishes. The Habitat scope of *Anguilla nebulosa* and *Bengal eel* will be reduced, but they are widely distributed in lower reach of Ayeyawady River and rivers into the sea in Southeast Asia. Therefore, the construction of hydropower stations has a small influence on the two kinds of migration fishes, since the main reach below the Myitsone dam is about 2700 km long, which provides a large habitat for the two.

The hydropower development on the upper reaches of the Ayeyawady River has a small influence on endemic fishes and has no influence on their population generation. The main economic fishes on the upper reaches of the Ayeyawady River lay sticky and demersal eggs, so they only need a small habitat range during their lifetime and will be less influenced. Among those fishes, the population quantity of *Tor putitora* and *Bangana Delvdevi* will increase largely within reservoir area.

2) Terrestrial Wildlife

A certain area of forest vegetation and wild animals' habitat will be submerged by the reservoir due to the hydropower development on the upper reaches of the Ayeyawady River. Rare or endangered species submerged includes *Dipterocarpus retusus* Blume, *Tetrameles nudiflora* R. Brown, *Bhesa robusta* (Roxb.) Ding Hou and *Aquilaria malaccensis* Lam. etc. and some individuals of local special plants such as *Camellia irrawadiensis* Barua and *Ampelocalamus kachinensis* N. H. Xia and so on. Meanwhile, the reservoir inundation will have some impact on rare or endangered animals.

The major vegetation submerged by cascade reservoir is Savanna Bamboo and Savanna plantain forests and the submerged area only covers 1.98% of the evaluation area. Since the reservoir only submerges some individuals of the rare or endangered species and endemic plants, the reservoir inundation have little influence on their population and will not cause disappearance of species. For terrestrial animals, most of animals' population and

quantity will not decrease significantly except for those ones with poor migration capability.

3) Social Influences

About 13,000 migrants will be involved in the hydropower development on the upper reaches of the Ayeyawady River, meanwhile, some forest, farmland and fruit gardens together with some religious facilities such as religious memorials, temples and churches will be submerged. Therefore, the resettlement of migrants will make modes of production and lifestyles of most migrants changed to some extent and lead to some influences on the health of both migrants and local residents in the inundation areas. At the same time, the submerged forest and farmland will influence local agricultural production, and the hydropower development will affect the local religious belief and ethnic culture. Furthermore, the reservoir submerging religious facilities will exert some effect on some religious facilities of local residents within a short time.

11.2 Summary of Mitigation Measures of Environmental Influences

(1) Water Environment Protection

Limited and ordered development should be implemented to maintain original functions of the rivers, to keep the balance and virtuous circle of water ecological system and river ecosystem health. The unified management of water resources on the upper reaches of the Ayeyawady River shall be strengthened and the water demand for eco-environment of both downstream and upstream of the river shall be coordinated to ensure eco-environmental water demand of the lower reach, and to maintain the ecological health of downstream river.

Strengthen unified management of water resources in Ayeyawady River, coordinate utilization requirements of upstream and downstream water resources, and guarantee requirements of downstream water resources and water use requirements for ecological environment in the river.

Before cascade reservoir impoundment, pollutants and obstructions in the submerged area

should be removed. Ecological agriculture, high-efficiency agriculture and featured agriculture shall be developed according to local conditions. Highly effective fertilizer and low-toxin pesticide should be promoted to reduce non-point pollution of agricultural environment. Heavy pollution enterprises should be limited in reservoir area. Treatment and discharge management of waste water should be strengthened limit during the construction.

(2) Aquatic Ecosystem Protection

To strengthen protection of habitats of fishes and reserve natural river reach above Machanbow and Yenan.

After hydropower stations closure, and when reservoir operation normally within 1 year, fishing above and below the dam is not permitted to fish, and illegal fishing should be punished.

In river reaches where ingestion and reproduction of fishes is concentrated, times of fishing should be controlled and types of fishing gear and net size should be limited. Prohibited fishing and stop fishing should be implemented in important season.

Management of exotic species should be enhanced, and fish resources in the reservoir area should be monitored. Rational aquaculture mode in the reservoir area will be developed to guide fishing development.

To strengthen research on life cycle, reproductive biology, behavior ecology and habitat demands of fishes, as well as artificial propagation and releasing technology.

(3) Terrestrial Ecosystem Protection

For protective of plants to be submerged, the young trees will be transplanted and seed of the mature trees will be collected for propagation. The plants will be protected near the original habitat,

The construction workers shall not be allowed to hunt and purchase wild animals especially rare and endangered animals from the local hunters. The consumption of wild animals and

their products should be given up.

Combined with water and soil conservation, vegetation restoration within the construction area shall be performed. Afforestation should be carried out for the permanent occupied land. The indigenous plants in the area should be chosen for afforestation.

Propaganda and education on ecological environment protection should be strengthened. The practice for land reclamation by burning vegetation shall be prohibited. Energy-saving stove, methane tank and electric power should be popularized to reduce consumption of forest.

To strengthen comprehensive protection and restoration of habitats as well as scientific research on terrestrial organisms; to carry out further investigation, evaluation and monitoring on the terrestrial organism resources.

(4) Mitigation Measures of impact of Migrants

The publicity on hydropower development should be strengthened to fully acquaint migrants and local residents with both advantages and disadvantages of hydropower development.

In the process of resettlement, migrants shall be avoided from scattered resettlement. The best way is to relocate entire villages intensively to maintain the migrants' current social relationships. Resettlement compensation standard will be disclosed and resettlement funds are available, to solve the construction of production and living facilities of migrants. Callback system will be established to promptly know demands of migrants and existing problems and resolve the potential dispute as much as possible. The reconstruction of such public facilities as water, electricity, schools and hospitals and so on shall be planned as a whole.

Migrants and local residents shall be encouraged to take part in the project's construction and service, so as to meet the requirements of the project on labour and living consumption. This can increase the migrants and local residents' economic income.

Trainings on production skills and services skills shall be conducted.

(5) Religious and ethnic Culture Protection Measures

Strengthen reconstruction of such religious buildings as Buddhist pagodas and churches and so on. For some key religious facilities, the relocation and reconstruction shall be made and so on. For some key religious facilities, the relocation and reconstruction shall be made on a basis of the local customs being fully respected, advice and comments from religion management departments and religion communities.

Strengthen the protection of ethnic culture. To those single ethnic villages, entire village resettlement is appropriate so that to maintain the existing space and atmosphere of traditional culture and reduce the influences on ethnic relationship. The protection, inheritance and development of all ethnic culture shall be payed much attention.

(6) Protection Measures of Population Health

Sanitation in the resettlement areas shall be performed before the migrants moving into these areas and measures shall be taken such as disinfection, deinfestation and deratization and so on. At the same time, the health of local residents shall be monitored to know the change of infectious disease and disease incidence at all times.

Strengthen the protection of drinking water source to maintain the health of migrants and local residents. To strengthen the hygiene education on disease prevention, popularize hygiene knowledge and enhance the residents' abilities of self-health care and awareness of disease prevention.

11.3 Environmental Monitoring Planning

11.3.1 Purpose of Environmental Monitoring

The hydropower development on the upper reaches of the Ayeyawady River will influence ecological environment and social environment, so environmental monitoring and follow-up evaluation shall be performed after the implementation of the hydropower project, to verify the accuracy of the environmental impact assessment and validity of environmental

protection measures. Based on this, the original environmental protection measures can be modified and adjusted according to actual changes of the environmental impact. Furthermore, both experiences and deficiencies can be summarized, for the purposes of better protecting ecological environment of the watershed.

11.3.2 Principles of Environmental Monitoring

(1) Principle of Highlighting Key Points

Key environmental factors influenced by the hydropower development have typical characteristics and can reflect the influence degree of the regional environment ,and its change trends shall be monitored and traced.

(2) Principle of Comprehensiveness

The scope, objects and time frame of monitoring and follow-up evaluation shall cover the river reach of hydropower development and their influencing areas. Moreover, the environmental changes of both hydropower development river reaches and their surrounding areas shall be handled completely,as well as influences of environmental changes on hydropower development.

(3) Principle of Coordination

The monitoring and follow-up evaluation shall be combined closely with the hydropower development so that the dynamic changes of key environmental factors can be monitored during the whole process of hydropower development ,and the relationship between the construction of hydropower stations and environmental protection can be coordinated.

(4) Principle of Economy and Operability

According to transportation condition of hydropower development drainage areas, combining with overall arrangement of cascade hydropower stations, if the monitoring items, frequencies, timeframe and methods can meet the requirements of monitoring tasks, the monitoring sections shall be set as few as possible. Meanwhile, the current monitoring points shall be used to collect complete environmental monitoring data with less

investment.

11.3.3 Environmental Monitoring Plans

11.3.3.1 Social Environment

(1) Scope of Investigation

The scope of investigation includes migrants resettlement areas for hydropower development on the upper reaches of the Ayeyawady River and Myitkyina City, Kachin State.

(2) Contents of Investigation

The hydropower development on the upper reaches of the Ayeyawady River involves conditions, standard of living, mode of production, educational conditions, health and medical levels, population health and customs and culture etc. The infrastructure construction in migrants' resettlement areas includes water, electricity, communication, transportation etc.

The economic development condition, infrastructure construction, utilization of water and electricity energy and industrial restructuring of the Myitkyina City, Kachin State, Myanmar.

(3) Investigation Frequency

The first investigation shall be carried out before the implementation of hydropower development on the upper reaches of the Ayeyawady River. One investigation during the construction of recent project and in the third year after the project completed shall be carried out respectively. Furthermore, one investigation shall be carried out in the third year after the implementation of the hydropower development.

11.3.3.2 Terrestrial Organisms

(1) Scope of Monitoring

The investigation areas include areas below the first cascade watershed on both sides of the reach above Myitkyina on Ayeyawady River, up to the reservoir head of Laza reservoir

on Malikha River and Yenani reservoir on Maykha River; and areas below the first cascade watershed on both sides of the reach 10 km upward from the confluence of major tributaries within this river reach.

(2) Contents of Monitoring

- 1) Flora: floristic composition, characteristics and distribution of plants.
- 2) Vegetation types: vegetation types, formation, distribution features, constructive species and dominant species consist of communities.
- 3) Rare or endangered plants: the types, quantity, distribution and growth condition.
- 4) Wild animals: fauna, species composition, distribution features and life habit etc. of Mammals, birds, amphibians and reptiles.
- 5) Rare or endangered and endemic wild animals: distribution features and life habit etc.
- 6) The protection and use of wild animal resources: management institutions of wild animals, hunting, catching and purchasing of wild animals, trade distribution of wild animals and their products etc.

(3) Investigation Frequency

The first investigation shall be carried out before the implementation of hydropower development (finished). Two times of investigation during the construction of recent project and one investigation within the period of operation shall be carried out. Furthermore, one investigation shall be carried out in the third year after the implementation of the hydropower development. The investigation shall be made in spring or autumn within the investigation period.

11.3.3.3 Aquatic Organisms

(1) Scope of Monitoring

The monitoring scope of aquatic organisms mainly includes main reach and major

tributaries above Myitkyina on Ayeyawady River, up to the reservoir head of Laza hydropower stations on Malikha River and Yenau hydropower stations on Maykha River.

(2) Monitoring Section Layout

Considering the influence scope of hydropower development on the upper reaches of the Ayeyawady River on aquatic organisms and fish resources, and combined with current monitoring sections, a total of 11 monitoring sections will be set in reservoir head of Yenau reservoir, Yenau reservoir area, Kaunglanphu reservoir area, Pisa reservoir area, Wutsok reservoir area, Chibwe reservoir area, reservoir head of Laza reservoir, Laza reservoir area, Myitsone reservoir area, after Myitsone dam, and the section where Myitkyina locates. A total of 8 monitoring sections also be set on Ahkyang River, Mekh Rame River, Ngawchahg Hka River, Tmnpang River, major tributaries of Maykha River, and Nam Lang River, Nam Tsang River, Hpungcin Hka River, Hkrang Hka River, major tributaries of Malikha River. Therefore, a total of 20 monitoring sections are set on both main reach and tributaries. These monitoring locations can be adjusted properly in light of actual conditions.

(3) Contents of Monitoring

1) Elements of aquatic habitats

Elements of aquatic habitats include Water temperature, transparency, water color, pH, conductivity, DO, alkalinity, hardness, total phosphorus, ammonia nitrogen, total nitrogen, and COD etc. Parts of those elements can be monitored by combining with the water environment monitoring.

2) Aquatic organisms

Species composition, quantity, distribution, major dominant species and quantity and seasonal variation of phytoplankton, zooplankton, benthic animals, aquatic vascular plants.

3) Fishes

Fish fauna: Species, taxonomic status, composition, distribution and evolution etc.

Present situation of fish resources: fish community structure (age, body length, weight, species composition), statistical analysis of fishing catches (community structure composition, age, body length, weight and gender composition of the major catches), investigation of fishery status (fishery practitioners, fishing gear, the amount and types of fishing methods and their change, the total catches over the years, the main fishery objects and their classification production etc.).

Propagation characteristics of rare, endangered, endemic fishes, and commercial fishes: propagation season, spawning type, spawning time, propagation scale and the environmental conditions required for propagation.

Biological features of rare, endangered, endemic fishes, and commercial fishes: age and growth, condition factor, growth rate.

Habitat of rare, endangered, endemic fishes, and commercial fishes: habitat characteristics of spawning grounds, wintering grounds, fishing grounds, and fattening units at different growth stages (water level, water temperature, water depth, flow rate, bed materials, aquatic vegetation and bait resources conditions etc.).

(4) Monitoring Frequency

The first monitoring shall be carried out before the implementation of hydropower development. Two times of monitoring during the course of recent project and two times of monitoring within the period of operation shall be carried out respectively. One time of monitoring shall be carried out respectively in the first year, the fourth year, the seventh year and the tenth year after the entire implementation of the cascade hydropower development. The aquatic habitat factors and aquatic organisms shall be monitored once respectively in the rainy season (from May to October) and drought season (from November to next April) every year within the monitoring period. The monitoring of fishes can be made based on the propagation seasons of fishes and production cycle of local fishery.

11.3.3.4 Water Quality

(1) Scope of Monitoring

The monitoring scope of water environment mainly includes main reach and major tributaries from Myitkyina on Ayeyawady River, up to the reservoir head of Laza hydropower stations on Malikha River and Yenau hydropower stations on Maykha River.

(2) Monitoring Section Layout

A total of 11 monitoring sections will be set in border between China and Myanmar, reservoir head of Yenau reservoir, Kaunglanhpu reservoir area, Pisa reservoir area, Wutsok reservoir area, Chibwe reservoir area, reservoir head of Laza reservoir, Laza reservoir area, Myitsone reservoir area, below Myitsone dam, and the section where Myitkyina locates. A total of 8 monitoring sections also be set on Ahkyang River, Mekh Rame River, Ngawchahg Hka River, Tmnpang River, major tributaries of Maykha River, and Nam Lang River, Nam Tsang River, Hpungcin Hka River, Hkrang Hka River, major tributaries of Malikha River. Therefore, a total of 19 monitoring sections are set on both main reach and tributaries. These monitoring locations can be adjusted properly in light of actual conditions.

(3) Contents of Monitoring

Regular items listed in *Pollution Prevention and Abatement Handbook* issued by World Bank will be monitored, including pH, temperature, BOD₅, COD, suspended solids, oils, volatile phenol, cyanide, total nitrogen, total phosphorus, fecal coliform, arsenic, chromium, lead, mercury, nickel, zinc.

(4) Monitoring Frequency

The first monitoring shall be carried out before the implementation of hydropower development. One time of monitoring during the construction of recent project and one time of monitoring within the period of operation shall be carried out respectively. One time of monitoring shall be carried out in the third year after the entire implementation of the cascade hydropower development. The water environment shall be monitored once

respectively in the high flow period (from May to October) and low flow period (from November to next April) every year within the monitoring period.

Layout of environmental Monitoring Points is shown in attached Figure 19.

11.3.3.5 Follow-up Evaluation

In different target years, follow-up evaluation shall be made according to results of investigation to analyze the trends, degree and reasons of the regional environmental changes ,and evaluate the actual environmental influence after the implementation of hydropower development. Based on this, environment protection measures will be adjusted and stage summarization will be made.

11.4 Statement of Public Consultation Activity

Before the implementation of the cascade hydropower stations, the related government departments of Myanmar shall make basic information about the proposed hydropower stations by adopting a notice way that is convenient for local publics to obtain. These basic information include:

- (1) Brief introduction of the proposed project;
- (2) Overview of environment influence that the proposed project may cause;
- (3) Key points of countermeasures on preventing or mitigating adverse effects.
- (4) Scope and main matters need to ask for public advice and comments.
- (5) Definite forms of public advice and suggestion.
- (6) Start time and end time for public to give advice and suggestion.

These basic public information can be opened by adopting announcement methods which are convenient to the local people, such as making a public announcement on local media, or distributing free booklets that contains the announcement information or posting announcement.

During the construction of the proposed project, the results of environment monitoring shall be announced regularly to local people and other related parties. To ensure the credibility of environment monitoring results, an independent third party can be introduced to perform environment monitoring and announce related results.

11.5 Statement of Environmental Management Responsibilities

Environmental management is an important constituent part of environmental protection in the hydropower development and also an important step to put environment protection measures into effect. To realize fully the social benefits, economic benefits and environmental benefits of hydropower stations on the upper reaches of the Ayeyawady River, to protect the ecological environment and to perform environmental management of the drainage basin is very essential. Companies in charge of projects are suggested to arrange specialized environmental management department and appoint personnel specially for the task of environmental management in the hydropower development.

Main tasks of environmental management include:

- (1) To pay close attention to viewpoints of international environmental protection organizations on the hydropower project on the upper reaches of the Ayeyawady River; to seek for a solution actively to response it if there are some unreal reports.
- (2) To trace and investigate resettlement of migrants involved in the hydropower project, and find out migrants' satisfaction and demands on relocation and resettlement, so as to avoid mass incidents caused by the migrants' relocation.
- (3) To deal with environmental accidents and social environment problems during the cascade hydropower development.
- (4) To put forward environmental protection requirements on single project and carry out instruction and supervision on them, in terms of drainage-basin environment protection.
- (5) To organize and perform environmental monitoring and environmental supervision. To

supervise and inspect the implementation of environmental protection measures at the different stages of hydropower development and to master the changes of drainage-basin environmental quality.

(6) To synthesize organically the hydropower development and environmental protection, and to facilitate the environmental protection during the hydropower development on the upper reaches of the Ayeyawady River .To accelerate the Kachin State's sustainable development of society, economy and environment.

12 Assessment conclusions and suggestions

12.1 Assessment conclusions

The hydropower development in the upper reaches of Ayeyawady River is carried out under the background of the Myanmar government actively developing country's hydropower resources by introducing foreign investments. Hydropower development can meet power demand of social and economic development in Myanmar, convey abundant power to neighboring nations so as to transfer its resource advantages into economic advantages, to promote social and economic development in Myanmar.

The hydropower development in the upper reaches of Ayeyawady River is a rare opportunity for Myanmar. The execution of hydropower development in the upper reaches of Ayeyawady River will significantly change baseline of regional social and economic development, greatly promote the Kachin State even the Myanmar's economic development and improve regional infrastructure; and it will motivate the development of catering industry, service and other industries, provide employment opportunities for local residents and migrants, and improve the local productivity and living standards. Meanwhile, the hydropower development in upper reaches of Ayeyawady River is able to improve the flood control standards of Myitkyina City, from the status once in 5 years to once in 20 years, and to some extents improve the downstream navigation conditions. The usage of hydropower clean energy can reduce the use of diesel fuel and firewood and improve the regional air quality and protect forest vegetation in this region. Overall, the hydropower development in the upper reaches of Ayeyawady River has significant benefits in terms of social, economy and environment for Kachin even Myanmar.

The hydropower development in the upper reaches of Ayeyawady River will have some unavoidable adverse impact on regional ecological environment. Reservoir inundation and hydrological changes will have some effect on water environment, aquatic organisms and terrestrial organisms; the reservoir inundation also has some impact on migrants' production and living. However, after taking some appropriate mitigation and compensatory

measures, such negative impact can be effectively controlled or slowed down. Therefore, *there is no constraint environmental impact* for the hydropower development in upper reaches of Ayeyawady River.

12.2 Advices

(1) Suggest strengthening the propaganda of hydropower development in Kachin and cascading reservoir area. Introduce some international hydropower development cases that stimulate local economic development, improve living standards of local residents, and create new reservoir attraction to eliminate the local residents' suspicions further.

(2) Suggest establishing a special agency responsible for resettlement. Keep up with migrants' needs and problems. Solve the problems appeared in the process of resettlement and defuse potentially destabilizing factors.

(3) Suggest establishing a special environmental management institution, which is responsible for the environmental management work in the course of hydropower development, supervision and inspection of the execution of environmental protection measures, and dealing with environmental incidents and problems arised in the process of hydropower development.

(4) Suggest that during the designing stage of main projects in cascade hydropower stations, the environmental impact assessment work should be well completed. In the execution stage of cascade hydropower stations, environmental monitoring and tracking environmental impact assessment should be carried out.