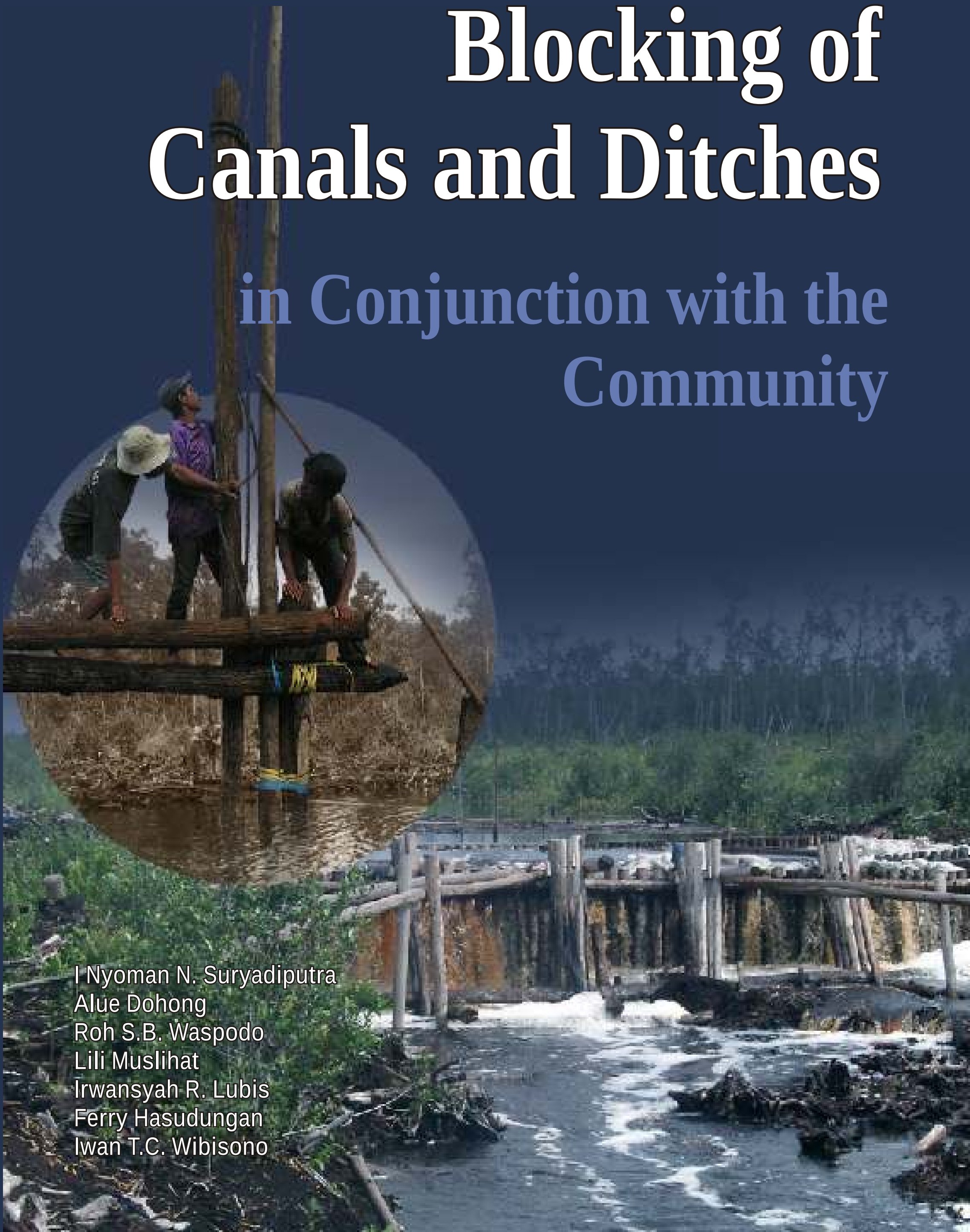
A Guide to the Blocking of Canals and Ditches

in Conjunction with the Community



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Foreword

A large part of Indonesia's peatlands and peatland forests are currently experiencing extremely serious damage as a result of human activities which lack any concept of the environment. Such activities include the burning of peatland in preparation for agriculture and plantations, the uncontrolled felling of peatland forest (both legal and illegal) for timber, the construction of canals and ditches for agricultural irrigation and drainage as well as for transportation, and the clearing of peatland to make way for agriculture, industrial estate crops, housing, etc. All of these activities not only cause physical damage to the peatland and its forests (such as subsidence, fire and a reduction in peat area), but also result in the loss of the peat's functions as a carbon sequester and sink, as a water recharging area capable of preventing the flooding of surrounding regions in the wet season and also of preventing the intrusion of saltwater in the dry season. In addition, damage to the peat land and forest also results in the loss of the biodiversity and natural resources which they contain.

The presence of ditches and canals in peatland (whether for transporting timber, agricultural products or people) without an adequate system for regulating the water has led to the uncontrolled loss of water flowing out from the peat soil into the rivers, with the result that in the dry season the peatland becomes dry and easily burnt

For this reason, these ditches and canals must be blocked immediately or even (if possible) completely filled in, otherwise they will cause increasingly serious damage to the peatland environment.

The main purpose of writing this book is to provide a guide on methods of repairing the condition and hydrology of peatland so that the peat will be prevented from drying out and becoming susceptible to fire, and thus that damage to the peat can be minimized and the rehabilitation activities (such as replanting) there stand a better chance of success. This book is an improvement upon its predecessor published in April 2004, entitled: Konservasi Air Tanah di Lahan Gabut (panduan penyekatan parit dan saluran di lahan gambut bersama masyarakat)

[Ground water Conservation in Peat Land (a guide to the blocking of canals and ditches in conjunction with the community)].

In addition to drawing upon the experiences of other parties, both in Indonesia and abroad, the writing of this book also makes use of profound input from the experiences of blocking ditches and canals carried out in Central Kalimantan (South Barito and Kapuas districts) and South Sumatra (Musi Banyuasin district) by the local communities with technical support from Wetlands International – Indonesia Programme. Furthermore, this book also includes the experiences of WWF-Indonesia who carried out canal blocking in the peatland forests of Sebangau, and of the Mawas-BOS foundation in Block A of the aborted One Million Hectare Peatland Project in Central Kalimantan.

We recognise that this book still needs a great deal more input from the parties involved, but nevertheless hope that it will be of use to those who are actively working to restore the peatlands.

Bogor, December 2005

The Authors

Acknowledgements

Wetlands International - Indonesia Programme would like to extend a sincere thank you to everybody involved directly or indirectly in the blocking of canals and ditches in the peatlands of Central Kalimantan and South Sumatra.

For activities in Central Kalimantan, our thanks go to :

❒ The people of Batilap village & Muara Puning sub-village in the Barito Selatan district, who carried out the work of blocking 14 ditches by constructing a total of 30 dams

❒ The Yayasan Komunitas Sungai (Yakomsu) foundation, who facilitated all the blocking activities in both of these locations

❒ The people of Mentangai village and its surroundings, who blocked 2 main primary Canals (total 4 dams) and 1 Primary Canal (3 dams) in the location of the aborted One Million Hectare Peatland Project

❒ The Kapuas District Government and Subdistrict Head for Mentangai village who gave their strong support to these activities by, among other things, granting permission for the activities, facilitating meetings with the local community, etc.

❒ All the staff of the CCFPI project in Central Kalimantan, both in Palangkaraya and in the field.

For activities in South Sumatera, our thanks go to:

- The people of Sungai Merang village in the Bayung Lincir subdistrict of Musi Banyuasin District, who carried out the work of blocking 6 ditches by constructing a total of 12 dams
- The Yayasan Wahana Bumi Hijau (WBH) foundation, who facilitated all the blocking activities in this location
- The Musi Banyuasin District Government, who gave their strong support to these activities by, among other things, granting permission for the activities, facilitating meetings with the local community, etc.
- All the staff of the CCFPI project in South Sumatera, both in Palembang and in the field.

We would also like to express our gratitude to the following agencies, both in Indonesia and abroad:

- CIDA (Canadian International Development Agency) who funded all these blocking activities through the CCFPI (*Climate Change, Forests and Peatlands in Indonesia)*Project
- GEF-UNEP (Global Environment Facility - United Nations Environmental Programme) who provided supporting funds for the monitoring of the results of the ditch/canal blocking in the villages of Mentangai and Muara Merang
- The CCFPI project's working partners: Wildlife Habitat Canada (WHC), Global Environmental Center (GEC), the Directorate General for Forest Protection and Nature Conservation (PHKA)- Ministry of Forestry, the Directorate General for Regional Development (Bangda)- Ministry of Internal Affairs, and the Ministry of the Environment for their cooperation and administrative support
- Palangkaraya University and Institut Pertanian Bogor for the services of their laboratories and technical field staff in monitoring water quality at the site of the canal and ditch blocking activities
- All the staff of the CCFPI Project and Wetlands International Indonesia Programme in Bogor for their valuable cooperation
- WWF-Indonesia and Mawas Bos for the information they provided to the authors thus enabling them to make this document more comprehensive.

Acronyms & Abbreviation

AMDAL	Analisis Mengenai Dampak Lingkungan (Environmental Impact Assessment)
BAPPEDA	Badan Perencanaan dan Pembangunan Daerah (Regional Planning Board)
BOS	Borneo Orangutan Survival Foundation
BOD	Biological Oxygen Demand.
CCFPI	Climate Change, Forests and Peatlands in Indonesia (CCFPI)
CIDA	Canadian International Development Agency
CITES	Convention on International Trade in Endangered Species of Wild flora and fauna
COP	Convention for the Parties.
COD	Chemical Oxygen Demand.
DO	Dissollved Oxygen (in mg/l)
Dit Jen-PHKA	Direktorat Jenderal Perlindungan Hutan dan Konservasi Alam, Departemen Kehutanan (Directorate General of Forest Protection and Nature Conservation, Ministry of Forestry)

Dit-Jen Bangda	Direktorat Jenderal Bina Pembangunan Daerah-Departemen Dalam Negeri (Directorate General of Regional Development Ministry of Home Affairs)
EAH	Ekosistem Air Hitam (Black Water Ecosystem)
EC	Electrical Conductivity (µS/cm).
GIS	Geographical Information System
GEC	Global Environmental Center,
GEF-UNEP	Global Environment Facility-United Nation Environmetal Programme
HPH	Hak Pengusahaan Hutan (Forest Concession Right)
HTI	Hutan Tanaman Industri (Commercial/Replanted Forest)
HPT	Hutan Produksi Terbatas (Limited Forest Production)
HRGMK	Hutan Rawa Gambut Merang – Kepahiyang (Merang Kepahyang Peatswamp Forest)
IUCN	International Union for the Conservation of Nature and Natural Resources
KK	Kepala Keluarga (Households)
KTK	Kapasitas Tukar Kation (cation exchange capacity).
LSM/NGO	Lembaga Swadaya Masyarakat (Non Government Organizations)
NRM	Natural Resource Management Program
PO	People Organisation

OKI	Ogan Komering Ilir, a district in south Sumatera Province
PEMDA	Pemerintah Daerah (Regional Government)
MRP	Mega Rice Project
PT SSI	PT (Perseroan Terbatas/Limited Company) Sanitra Sebangau Indah
PVC	Polyvinyl Chlorida
RLKT	Rehabilitasi Lahan dan Konservasi Tanah (Soil conservation and land rehabilitation, Ministry of Forestry)
RTRWP	Rencana Tata Ruang Wilayah Propinsi (Provincial Spatial Planing)
SPT	Satuan Peta Tanah (Soil Map Unit/SMU)
SPI	Saluran Primer Induk (Main Primary Canal)
SPU	Saluran Primer Utama (Primary Canal)
SPP	Saluran Primer Pembantu (Sub-primary Canal)
TDS	Total Dissolved Solid (in mg/l)
TSS	Total Suspended Solid (in mg/l)
THR	Taman Hutan Raya (Grand Forest Park)
TN	Taman Nasional (National Park)
UNDP	United Nations Development Programme
UNEP	United Nation Environmetal Programme

WB	World Bank
WBH	Yayasan Wahana Bumi Hijau (local NGO based in Palembang, South Sumatera)
WHC	Wildlife Habitat Canada
WI-IP	Wetlands International Indonesia Programme
WWF-Indonesia	Yayasan World Wide Fund for Nature Indonesia
Yakomsu	Yayasan Komunitas Sungai (local NGO, Based in Barito Selatan District, Central Kalimantan)

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Chapter 1

Introduction

1.1 BACKGROUND

There are 40 million hectares of tropical peatland in the world, with 50% (20 million hectares) found in Indonesia (Sumatra, Kalimantan, Papua, and a small amount in Sulawesi). Peat has a number of values, both extractive and non-extractive. It is extracted for energy purposes (for example, charcoal briquettes), for humic acid, for rearing seedlings, and to be used in the reclamation of dry land. Non-extractive uses include serving as habitat for biodiversity and providing land for forests, plantations and farming. In addition, because of peat's ability to store water (up to 90% of its volume) peat acts as a hydrological buffer for surrounding areas (providing protection against flooding and intrusion of sea water). In the last decade, especially since the link between greenhouse gases (including CO_2) and climate change gained prominence, there has been increasing international attention paid to the role that peatlands play in sequestering and storing carbon. This was especially evident at the end of the 1990s, when land fires (including peatlands) and forest fires caused widespread concern.

Forests and peatlands in Indonesia (especially in Kalimantan and Sumatra) are experiencing constant degradation, caused mainly by: farming activities, irrigation networks (for example, those constructed as part of the aborted one million hectare peatland project in Central Kalimantan), plantations, illegal logging, and land and forest fires. If this situation continues, the concern is that there will be very little remaining forest and peatland, and they could in fact disappear all together. The accumulation of peat such as that found in Indonesia has taken place over thousands of years. The degradation and loss of forest and peat results in an associated reduction or loss of the ecological and socio-economic functions of the peatlands.

One activity that greatly increases the rate of degradation and loss of forest and peatland in Indonesia is the digging of canals and ditches, whether they are legal or illegal, in and near forests and peatlands. These peatland canals and ditches typically exit into one or more rivers and are used to facilitate the movement of forest products to nearby villages. When these canals and ditches are dug, a great deal of soil (such as mud from mineral soil, fresh litter and peat) is intentionally or unintentionally discarded into rivers. This leads to a change in the morphology (for example depth) and water quality of affected rivers. For example, a number of tributaries of the Puning River (such as the Bateken River) in South Barito, Central Kalimantan have already experienced sedimentation as a result of materials from the digging of nearby ditches (there are seven ditches which enter into the Bateken River). There is concern that this will affect aquatic biodiversity (such as fish) and water quality. These ditches have been dug in stages since 1998 by a group of individuals. They are intended to facilitate the removal of logs from the peat swamp forest (see box 1).

Box 1

How ditches are made in peatland
(Please do not do this!!)

Making ditches to remove logs from the forest takes place in several stages, starting with digging peat or mineral soil at the banks of the main river, before moving inland. These ditches are typically dug by three to six people, using one or two chain saws. Five to ten metres can be dug in a day, or 150-200m in a month. The total length of the ditches is between three and five kilometres, with a width of 60 to 200 cm and a depth of 40 to 100cm. Some ditch owners are also loggers, but others only maintain the ditch and rent it out to loggers (in an arrangement that resembles a toll road). The charge for one log (two to four metres long) passing along a ditch in South Sumatra is Rp 500 (note: at the time of writing, 1 USD = Rp 9,200).

Wood can be cut to the right and left of the ditch before it is completed. In this situation, logging follows the pattern of ditch construction. Felling of trees usually takes place during the rainy season when the ditches are filled with water. This makes it easier to float the logs to specific villages via the ditches and rivers.

The situation is similar in the village of Labuan Pering near Berbak National Park in Jambi, and in the peatland area of the Merang – Kepahiyang Rivers in South Sumatra. Many of these ditches are no longer in use (they have been abandoned by their "owners") because the remaining trees have little economic value. The irrigation canals that were dug by the government in 1995-96 for the one million hectare mega rice project in Central Kalimantan have also been abandoned. These ditches and canals are resulting in the drying of the peatland due to uncontrolled drainage, leaving the peat vulnerable to fire.

One way of addressing this problem is to restore the hydrology of the forest and peatland ecosystems through blocking the ditches and canals. By building blocks and dams, it is expected that the water level and retention in the ditches and canals and nearby forest and peatlands will increase, therefore reducing the danger of fire during the dry season, and improving the possibility of rehabilitating nearby degraded land.

The blocking of the ditches and canals is a physical intervention of a multidisciplinary nature. Prior to blocking, it is necessary to carry out a number of scientific studies including: soil characteristics, limnology, hydrology, vegetation in the surrounding area, and socio-cultural characteristics, among others.

(Photograph: I Nyoman N. Suryadiputra)

Chapter 2

Damage to Water Systems in Peatlands

Damage to the water flow in peatlands is often caused by uncontrolled human activities such as digging ditches and canals, cutting the forest and clearing land with fire. Digging open ditches and canals (without maintaining a specific water level), whether it is to extract legal or illegal logs cut in the forest, or to irrigate farming and plantation land, drains the store of water in the peat, meaning that it becomes dry, and burns easily during the dry season. This has taken place at a number of peatland locations in Central Kalimantan and Sumatra, as evidenced by burnt areas near ditches and canals.

Box 2

There are many small canals or ditches (with a width of between 60 – 300 cm, a depth of 70 – 200 cm and a length of 3 – 9 km) in the peat swamp forests of Kalimantan and Sumatra. These ditches are dug by loggers to facilitate transport of logs out of the forest. A side effect of the ditches is drainage of the peat, leaving it prone to burning in the dry season. The photographs below show the size of a ditch in South Barito, Central Kalimantan. (Photograph: Alue Dohong).

The presence of these ditches and canals has resulted in uncontrolled drainage, meaning that the water in the peatlands flows out quickly, reducing the ground water holding capacity, and dramatically decreasing the level of the water table. This situation is then followed by oxidation and subsidence of the peat. All of this results in a change to the hydrology of the peatland.

Box 3

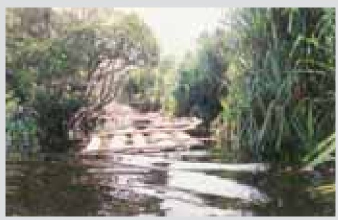
Ex-Mega Rice Project Canals

Photograph a) shows the main primary canal in the ex-mega rice project. The canal is tens of kilometres long with a width of ± 30 metres. In the ex-mega rice project area there are thousands of canals ranging from large (primary) to small (tertiary), with a total length of 4,470 km. The canals, which have been neglected, have led to uncontrolled drainage of the peat, leaving it prone to fire in the dry season. If these canals are blocked, and can be used as ponds which resemble beje*/fish ponds, many tons of fish could be caught, and the risk of fire would be reduced.*

Means of transporting illegal logs

Surveys in July 2003 and April 2004 by WI-IP and Wahana Bumi Hijau Foundation in the peat swamp forest of Merang – Kepahiyang, Bayung Lincir sub-district, Musi Banyuasin District, South Sumatra found that each month approximately 18,000 m^3 of various species of wood (including meranti and mixed peat swamp trees) were being cut illegally and transported out of the forest via ditches like those shown in photographs b) and c). There were a total of approximately 250 ditches in the area (typically spreading out from the left and right banks of the Merang River), with many still being used to remove wood.

(a) Photograph: Yus Rusila Noor



(b) Photograph: Alue Dohong

(c) Photograph: Vidya Fitrian

Chapter 3

Hidrology and Water Balance

The hydrological cycle, which encompasses the basic concepts of surface water balance and movement (see Illustration 1), consists of several steps, including:

1. Evaporation of water from the surface of the earth (from the surface of water bodies, soil and vegetation);
2. Condensation of the vapour in the troposphere, which leads to the formation of clouds;
3. Movement of clouds by the wind;
4. Precipitation in liquid (rain) or solid form (snow or ice crystals) which returns the water from the atmosphere to the earth's surface;
5. Movement of the water due to gravity (from high positions to lower positions) both as surface and below-ground water flows.

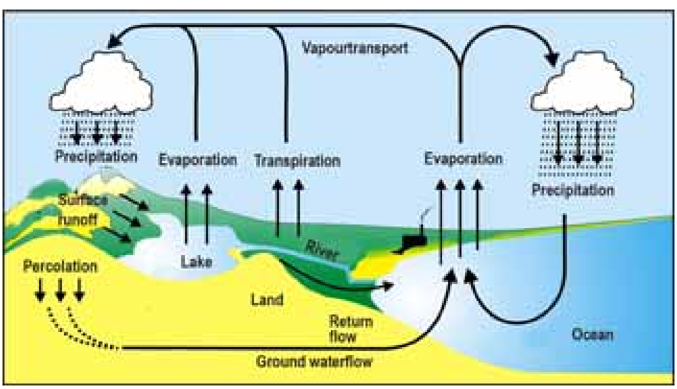


Illustration 1. *Hydrological Cycle (Max Planck Institute for Meteorology, 1999)*

This hydrological cycle, together with the water balance, can be depicted as follows:

$$P = ET + RO + I \pm \Delta S$$

P = Precipitation (mm/day)

ET = Evaporation (mm/day)

RO = Run off (mm/day)

I = Infiltration (mm/day)

“S = Change in ground water holding capacity (mm/day)

From the above it is evident that to guard against a decrease in the ground water level (a reduction in the value of “S) as a result of clearing forest (increase in the value of ET) and the opening of canals and ditches (increasing the value of RO), there need to be strong controls on the value of RO [note: assuming that the value of precipitation (P) and infiltration (I) remain constant].

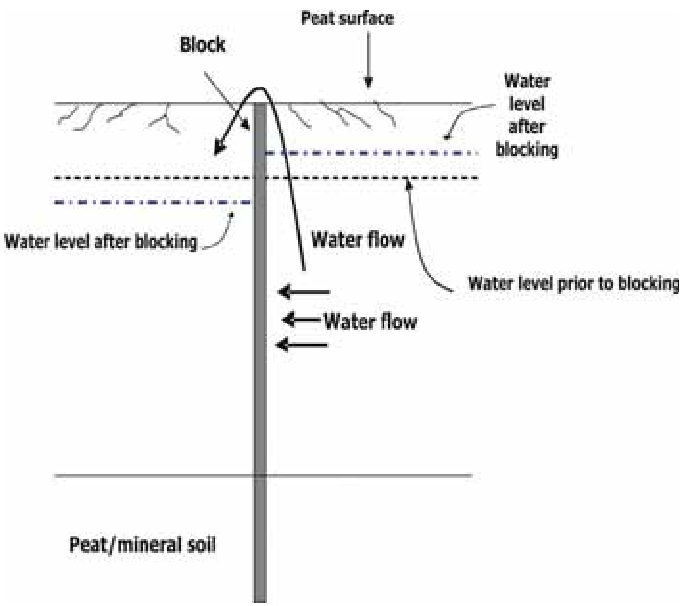


Illustration 2. *Main principles of blocking ditches and canals*

One way in which to control (reduce) the value of the RO value in peatlands is through blocking ditches and canals which have been opened, as shown in Illustration 2 and in the flow chart in Illustration 3. Through this blocking it is expected that the water level in the peatland will rise and the peat will not dry out.

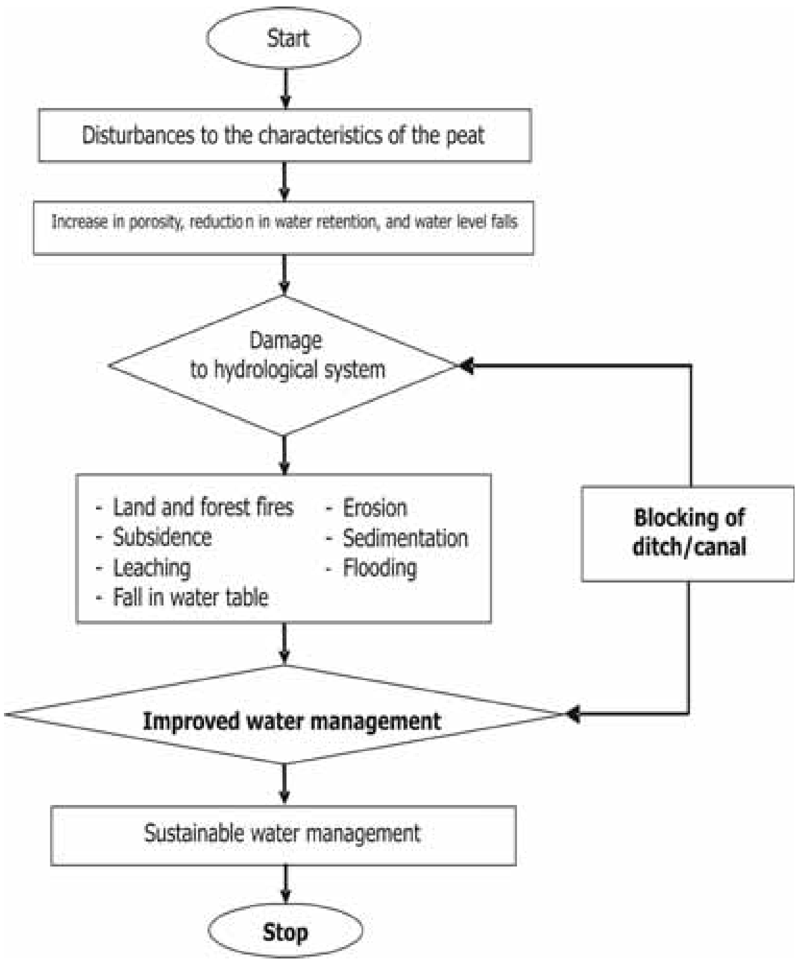


Illustration 3. *System to restore hydrology in forest and peatlands (modification from Grigg, 1996)*

(Foto: Yus Rusila Noor)

Bab 4

Stages for Blocking Ditches and Canals in Peatlands

The blocking of ditches and canals is used here to refer to activities which are intended to hold water in by the construction ofphysical barriers. With these blocks, the water cannot flow out into rivers or elsewhere and the peat will retain the characteristics of a wetland ecosystem. In Central Kalimantan the term used for these blocking activities is *menabat* (from the root word *tabat*), while in Sumatra the term is *menebat* (from the root word *tebat*). Blocking a ditch or canal in this case does not mean that all the earth is returned. The stages of blocking ditches and canals in peatlands include the pre-construction, construction and post-construction stages. Table 1 identifies the steps in undertaking a blocking activity (starting with obtaining permission through to maintenance and monitoring).

Table 1. Stages/planning schedule for blocking ditches and canals in peatlands with community involvement

No.	Activity Details	Responsibility	Schedule by Week/Month			
			1	2	3	4
A.	**Preparatory Phase**					
	Identify the location of the ditches/canals to be blocked, their usage status and current owner	Consultant, community members				
	Identification and consultation with the relevant authorities in order to socialize the plans for ditch/canal blocking	Consultant, community members and relevant government agencies				
	Obtain written permission from the highest responsible authorities and (if needed) also from relevant technical agencies and from the owners of the ditch/canal	Community members, businesses, ditch/canal owners, relevant government agencies				
	Cost analysis, access to the ditch/canal location, identification of the type of tools that will be needed and potential obstacles, among other things.	Consultant				
	Preparation of a proposal based on the items above.	Consultant				
B.	**Obtain data, prepare the design and carry out an environmental impact assessment (if necessary)**					
	Preliminary survey to collect baseline data on hydrology, soil, limnology, the socio-economic situation, biodiversity and forest for rehabilitation	Consultant and/or survey team				
	Preparation of the technical design	Consultant (civil engineer)				
	Prepare environmental impact assessment document (if necessary)	Consultant				

No.	Activity Details	Responsibility	Schedule by Week/Month			
			1	2	3	4
C. Block ditch and canal						
	Preparation of equipment and materials	Consultant, community members				
	Mobilization of human resources, equipment and materials	Community members, government, companies (forest concessions, plantations, palm oil plantations, among others)				
	Blocking activities	Community members, government, companies (forest concessions, plantations, palm oil plantations, among others)				
D. Maintenance and monitoring						
	Maintenance of block	Community members, government, companies (forest concessions, plantations, palm oil plantations, among others)				
	Prepare a monitoring and evaluation guide	Consultant, government, companies (forest concessions, plantations, palm oil plantations, among others)				
	Monitoring and evaluation activities	Consultant, government, companies (forest concessions, plantations, palm oil plantations, among others)				

4.1 PRE-CONSTRUCTION STAGE

This stage involves: a) socialization activities; b) identifying the location of ditches/canals to be blocked; c) clarifying ownership of the ditch/canal; d) determining the total number and physical dimensions of the ditches/ canals; e) determining the total number and type of blocks needed for the ditch/canal; f) identification of the materials needed for blocking; and g) preparing a cost analysis.

(a) Socialization activities

The purpose of socialization is to increase the understanding of both the people near the ditch/canal and the people controlling the canal as to the goals and importance of blocking the ditch/canal. This includes explaining the type of construction, stages of activities and mechanisms for blocking. The impacts of the blocking and plans for monitoring and maintenance are also clarified at this point.

(b) Identifying the location of ditches/canals to be blocked

Prior to the commencement of blocking activities the location of the ditches/canals must be identified, and the following things noted:

❐ The location of the ditch/canal that is to be blocked (prepare a sketch of the location of the ditch, the position of the ditch/canal in relation to the river and nearby land usages);

❐ Whether the ditch/canal in question is still in use (note the function, for example, whether it is used for irrigation or drainage of paddy fields/ farmland/ gardens, transportation of either legal or illegal logs, general public transportation);

❐ The distance between the ditch/canal to be blocked and nearby villages or homes (this is a consideration in terms of involving community members in the blocking activities, and determining the cost);

- ❐ Whether it is anticipated that there could be resistance to the blocking of the ditch/canal by the people living nearby (resistance might take the following forms, among others: damaging the blocks after they have been built, non-participation in building the blocks; provocation towards other parties in order to hinder the activities);

- ❐ The possible impacts of blocking the ditch/canal (for example, on the socio-economic and ecological aspects, among others);

- ❐ Whether the ditch/canal to be blocked is easy to access (mention the available transportation facilities, for example, by road or water) and how long it requires to reach the location (this is important in order to determine the costs of transportation).

(c) Clarifying ownership of the ditch/canal

Ditches and canals in peat swamps may be controlled or owned by individuals, by several individuals who have formed a group, by companies (such as forest concessions, forest plantations or oil palm plantations) or by the state. Typically ditches and canals that were dug by individuals are relatively small (with a width of less than two metres). Those that were dug by private sector interests or the state can be quite large (with a width of greater than two metres). The canals of the ex-mega rice project in Central Kalimantan are up to 30 metres wide.

In order to avoid future conflict, it is recommended that **WRITTEN PERMISSION/AGREEMENT** to block the ditches/canals be obtained from various parties (for example, from the owner/manager of the ditch or canal). In general, ditches that are owned by community members and were dug by groups are collectively owned. For canals that were dug by the private sector, permission should be obtained directly from the company involved. For canals that were dug by the government, permission should come from the highest power holder in the area, and from the relevant technical agencies.

Obtaining permission is very important, not only to avoid conflict, but also to avoid owners destroying blocks that were built without permission. (Note: if the ditch or canal is illegal, and the blocking activity is intended to restore the peatland ecosystem, it is not necessary to have permission from the owner. However, it is critical to have written support from the local government to carry out the blocking of illegal ditches/canals in anticipation of potential resistance in the field).

Box 4

The ditches that are used by illegal loggers to transport wood are usually owned by other people. The loggers pay a fee every time they use the ditches to transport their wood. In the Village of Merang River in South Sumatra the payment is Rp 500 per log. The owner is only responsible for making the ditch (usually using a chainsaw to "dig" the ditch) and maintaining it so that it does not fill in.

(Photograph: I Nyoman N. Suryadiputra)

Several ditches which were blocked by people in the Village of Merang River in South Sumatra and Batilap Village in Central Kalimantan were subsequently opened by illegal loggers. This happened because illegal loggers were not aware of the purpose of the blocks. Also, the ditches were far from settlements, meaning they were difficult to protect.

(Photograph: I Nyoman N. Suryadiputra)

d) Total number and physical dimensions of the ditches/canals

Total number and distribution of the ditches/canals

The blocking activities are not only intended to retain water in the ditches and canals, but also have the broader goal of improving both the immediate ecological conditions and also the conditions over a broader area. In order to achieve this, prior to blocking it is necessary to know the total number of ditches and canals and the area they are spread over (this can be done using satellite images combined with ground truthing in the field), Illustration 4. For example, in one river area there can be many ditches and canals which are relatively close to one another (Illustration 5).

If the blocking activities are only carried out on one ditch or canal, it is likely the blocking will have a minimal effect in restoring the surrounding ecosystem. Knowing the distribution of ditches and canals in an area will help in prioritising the ditches that should be blocked in order to have a real and positive impact on the surrounding environment. The location of all the ditches and canals that are identified during a survey (or from interpretation of satellite images) should be mapped (Illustration 6). If this map is overlaid with other maps which include additional information (such as land use, biodiversity, conditions following burning), it will become clear that there is a correlation between the presence of the ditches and canals and the surrounding biophysical conditions.

Dimensions of the ditch/canal

It is important to know the physical dimensions of the ditches/canals (including: length, width, depth, distance between ditches) in order to determine the type and amount of blocking materials that will be required. In addition to this, it is necessary to know the slope of the land in order to determine how many blocks need to be built in the ditch/canal. The steeper the slope of the ditch/canal, the more blocks that will need to be built (see Illustrations 7 and 8).

Illustration 4. *Satellite image showing the location of a primary canal (white arrow) and the main primary canal (yellow arrow) in Central Kalimantan*

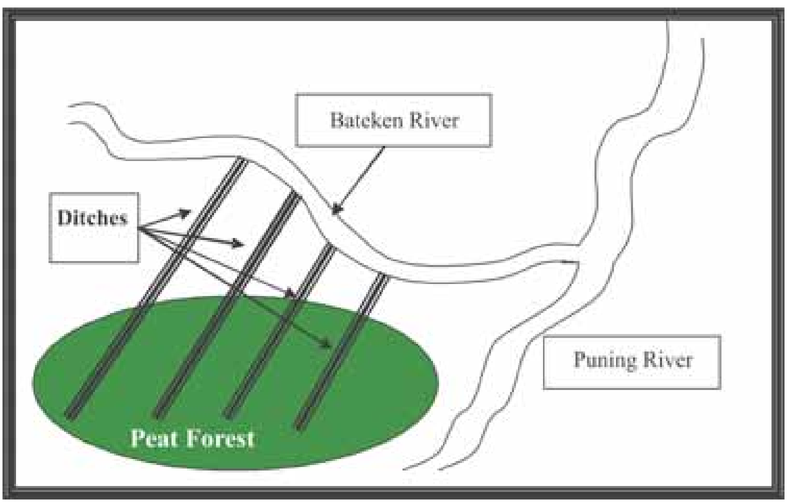
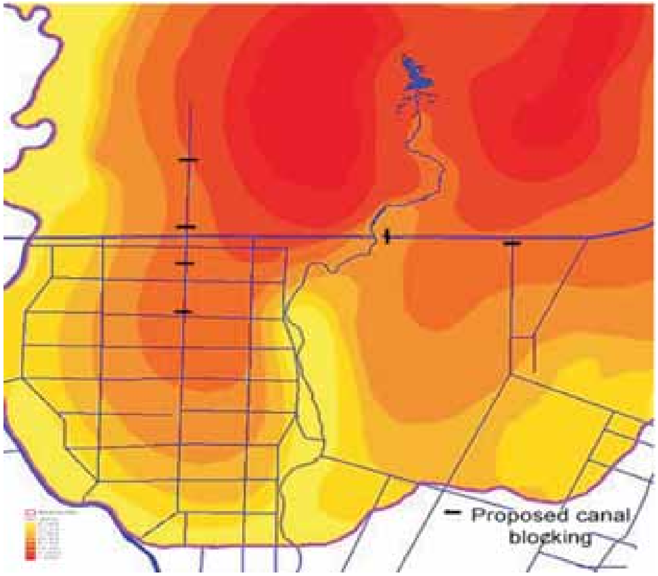


Illustration 5. *Ditches/canals off one river*



Note: *dark colours indicate deeper peat (>12m)*

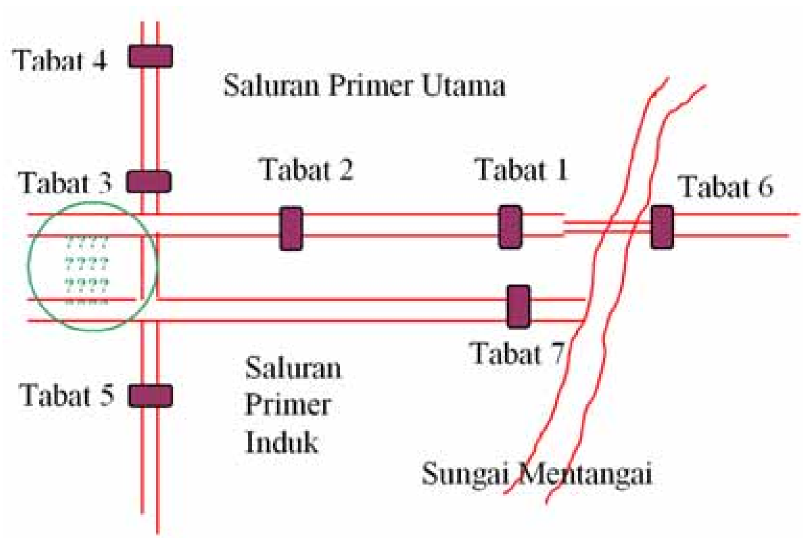


Illustration 6. *The location of the canals in relation to peat depth can be seen from the satellite image (top) and the schematic diagram for the location of the blocks (bottom)*

e) Total number and type of blocks in the ditches/canals

Total number of blocks

The total number of blocks in one ditch/canal is determined by the slope/topography of the peatland, the expected height of the water table and the strength of the current in the ditch/canal. The higher the water table, the lower the risk that the surrounding peatland will burn. If the ditch is on a steep slope (moving up towards the peat dome), the water flow will be stronger. In this situation a greater number of blocks will be built, and they will be relatively close together (approximately 100-200m between blocks), resembling a cascade of steps (Illustrations 7 and 8). As the current hits each block its strength will be reduced, so the life of the blocks will be longer. Additionally, a greater area of peatland will be flooded because a greater amount of water will be held back by the blocks. It is preferable to start blocking activities at the upstream end and carry them out during the dry season.

The spaces between blocks can be used for water storage, and act as a firebreak to prevent fire from jumping from one side of the canal to the other. Also, if appropriate, they can be used to cultivate fish, as is done with the *beje* ponds in Central Kalimantan.

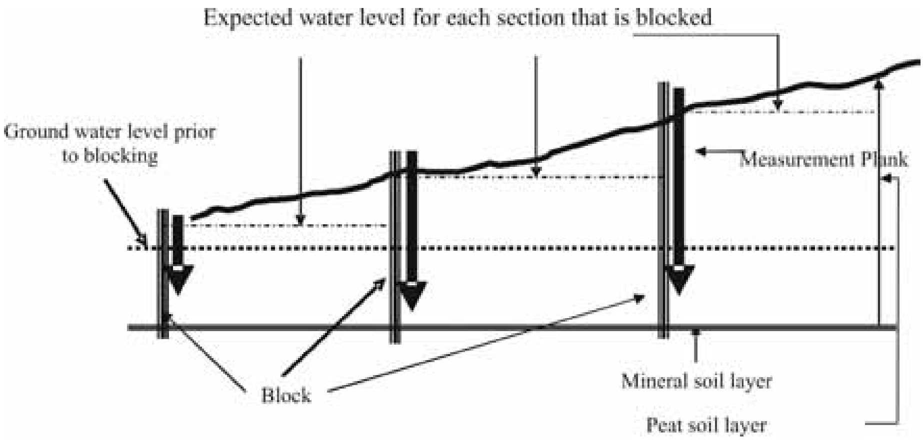


Illustration 7. *Location of several blocks to raise the water table*

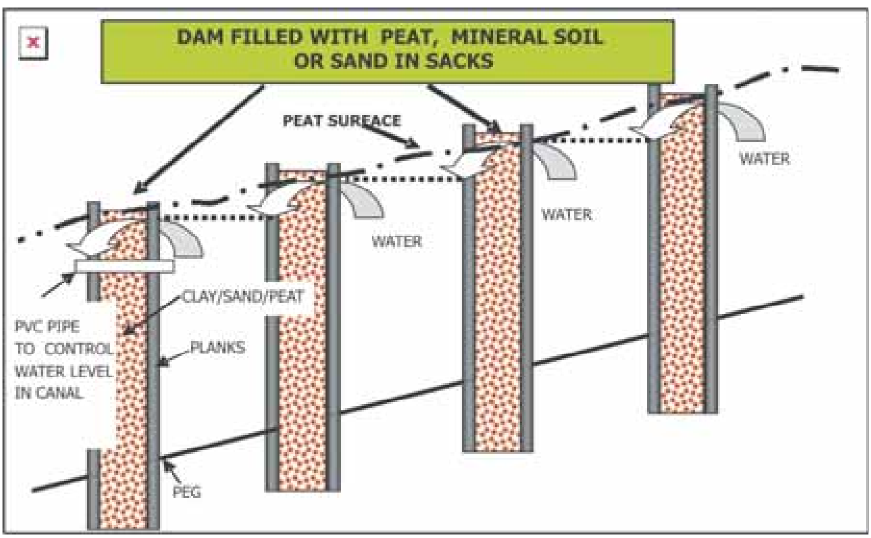


Illustration 8. *Cross section of several composite dams built in stages in a ditch/canal (Stoneman and Brooks, 1997)*

<u>Type of block</u>

The type of block to be constructed at any location will depend on the specific biophysical conditions there. Four types are recommended: plank dams, composite dams, plastic dams and sluices. A description of how these are applied is given below, along with a technique for pumping water from a river to a peat area.

1. Plank dam

   A plank dam (Illustration 9) can be made from hard wood planks (for example, iron wood or belangeran, *Shorea sp*). These have been used in a number of locations in Kalimantan in the past. Using the appropriate type of dam, and constructing it well, will allow for the blocking of relatively strong water flows in ditches/canals (for canals with a depth of more than one metre and a width of more than two metres). Installing this type of block does not require workers to have any specific expertise (Stoneman and Brooks, 1997).

   Below are a number of points to consider when using a plank dam:

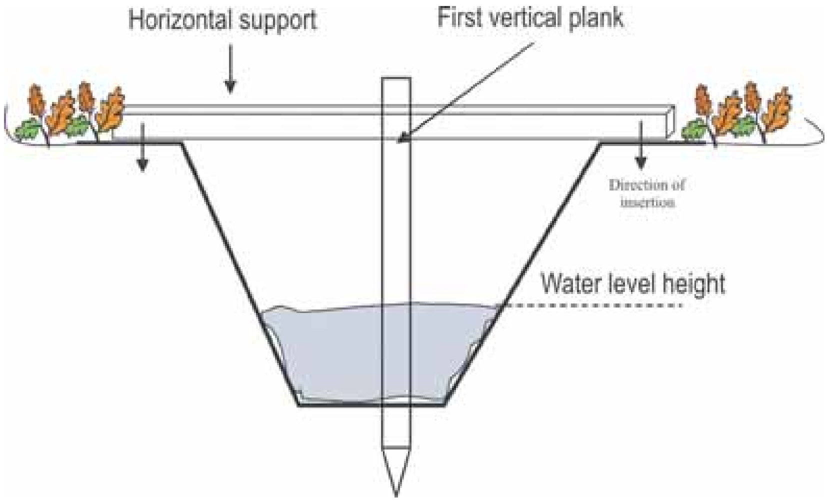
   a. Construction is labour intensive, meaning that among other things it results in employment opportunities for nearby residents;

   b. It is necessary to use a species of wood that is water and decay resistant;

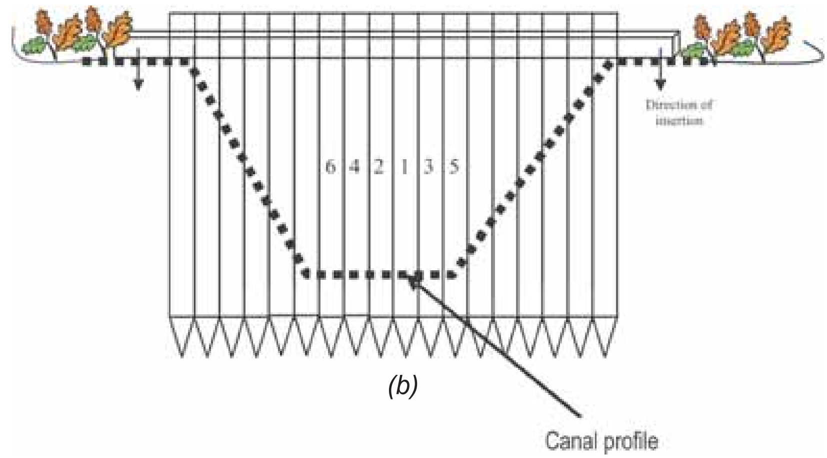
   c. A relatively large amount of wood is required, so it is important to consider the cost of transportation;

   d. It is necessary to avoid having too many people in the construction area as peat very easily subsides, which can compromise construction of the dam.

The planks should be assembled alternately (see the numbers in the diagram below) and should overlap evenly.



(a)

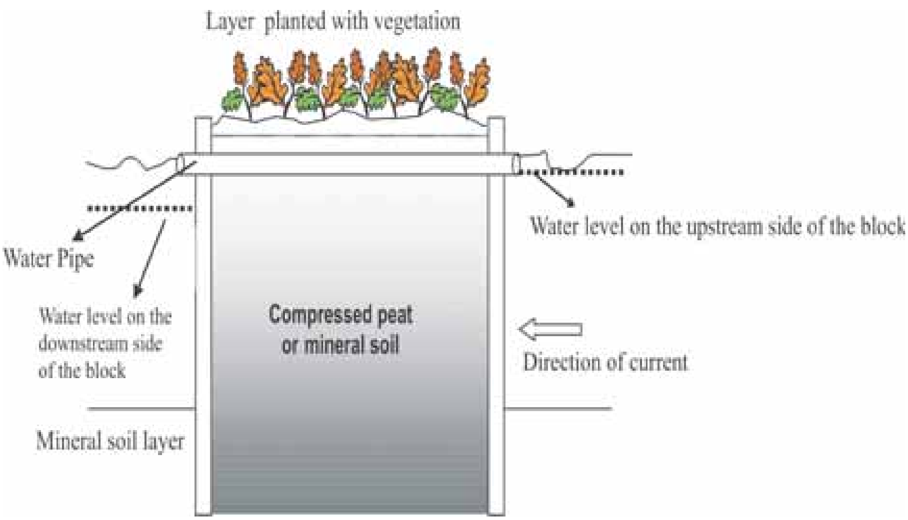


(b)

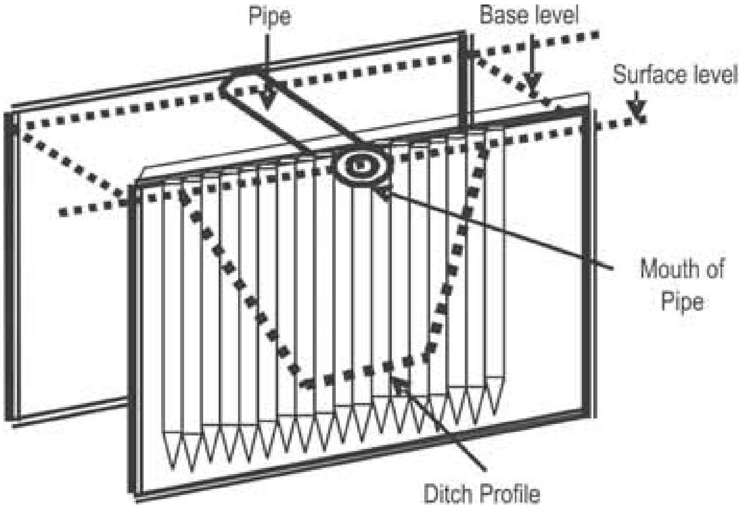
Illustration 9. *Rough diagram of a plank dam (Stoneman and Brooks, 1997)*

2. Composite dam

A composite dam (Illustrations 10 and 11) is made using two or more blocks (from wooden planks or beams/logs), which are lined with plastic or geotextile and then filled with sacks containing peat (see Boxes 4, 5 and 6) or mineral soil (the sacks should be tear resistant when exposed to rain and heat; geotextile is highly recommended). The peat or mineral soil in the sacks supports the structure of the block so that it is stronger and able to withstand water pressure. The top of the block can also be used as a foot bridge or planted with vegetation to strengthen the block (see photograph in Box 5).



(a) Side view



(b) Front view

Illustration 10. *Composite dam made from wooden planks (Stoneman and Brooks, 1997)*

Illustration 11. *Composite dam built by Yayasan MAWAS - BOS in one of eks-Mega Rice Project's canal, Kalimantan Tengah*

Box 5

Factors that need to be considered when using peat soil to fill a block

Peat to fill a block should not be taken from the area directly adjacent to the block (see photo a) as the resulting hole can easily fill with surface water during the rainy season, and can damage the block.

WRONG !

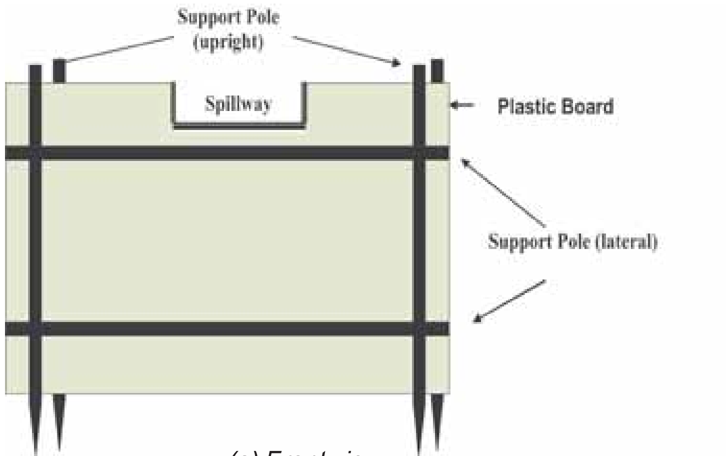
Photo (a): Peat taken from adjacent to the block

The peat or mineral soil filled sacks are easily damaged as a result of rain and intense heat. The sacks will eventually break open (see photograph b) and the material inside will be carried away by the water. For this reason, using sacks from geotextile is highly recommended.

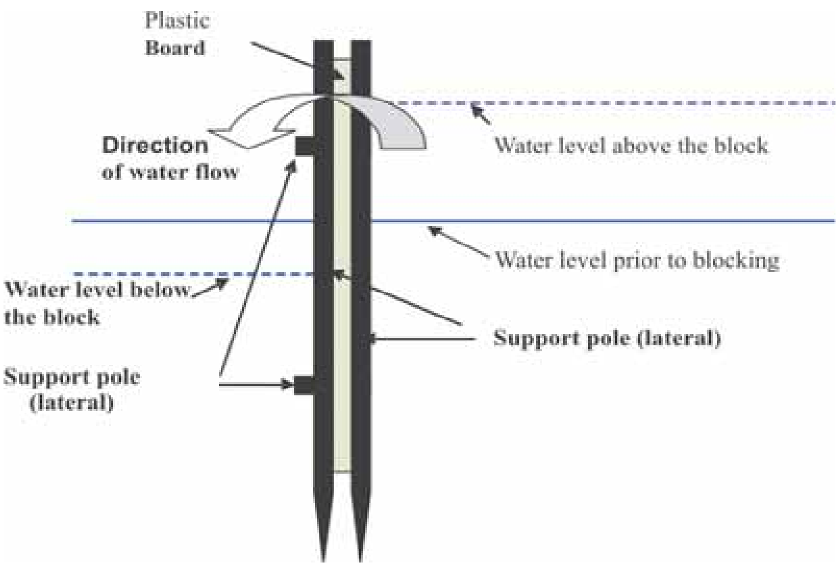
WRONG !

Photo (b): Peat filled in sacks are damaged

3. Plastic dam



(a) Front view



(b) Side view

Illustration 12. *Dam from plastic board (Stoneman and Brooks, 1997)*

A plastic dam (Illustration 12) allows for control of the water that flows to a ditch/canal, with the result that the water level above the block will rise and lead to an increase in the water table. A surplus of water is released through a spillway that is located in the middle of the block. The position of the spillway is adjusted according to the level of water desired in the ditch/canal. This is especially important during the dry season, when there is relatively little water in the canal.

Plastic dams are generally made from impermeable plastic sheets. The cost of plastic dams is higher than that of those made from wood because the materials are difficult to find near the blocking site, and if they are available they are expensive. However, plastic dams have a longer lifespan than wooden dams.

Materials required to construct a plastic dam include the following:

- ❒ plastic sheets/boards 5 - 20 mm thick
- ❒ poles 4x6cm
- ❒ nails and plastic ropes

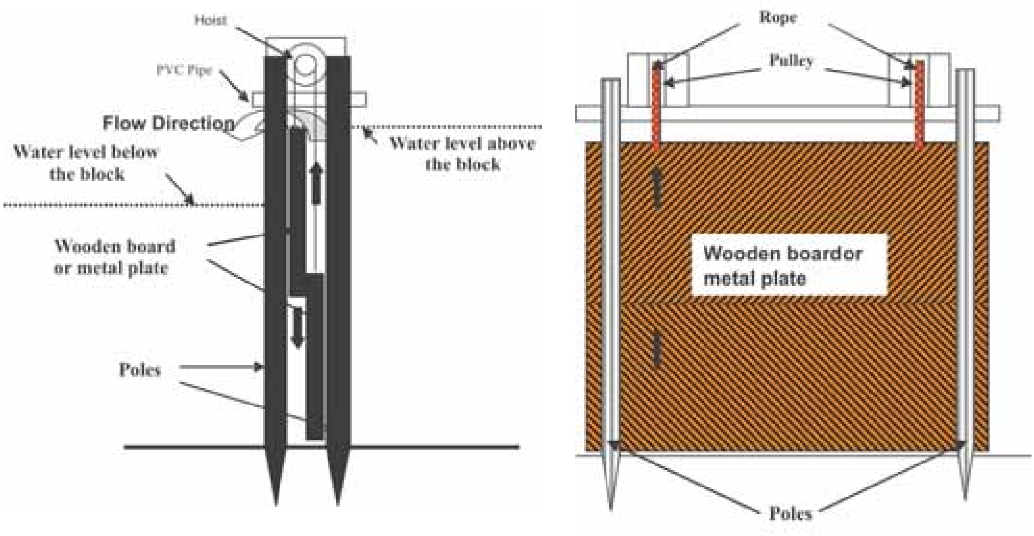
4. Sluice

Sluices (Illustration 13) are water gates that are used to control the water flow of a river or the ground water level. They can also be used to control the water exiting from a ditch or canal. Sluices consist of two sheets of wood with a thickness of 2-5 cm (or metal plates) which are raised and lowered using a rope. They also include hoists and a PVC pipe to release excess water from the top. The wooden sheets used to make a sluice have to be chosen from hard wood, which is strong and water resistant. These wooden boards are placed between two wooden poles (Illustration 13a).

The raising and lowering of the boards depends on the desired water level. If there is a need to raise the water level in the ditch/canal and in the surrounding peat, the two boards should be positioned so that the vertical closure for the surface water (cross section of the ditch/canal) is large. This should be done during the dry season. During the rainy season, when there is a relative surplus of water, the two boards should overlap in the centre, so that the water within the ditch/canal can continue to flow out through the gap above and below the sluice. Alternately, the two boards can overlap and touch the bottom of the ditch/canal so that only half of the height of the water in the ditch/canal is released.

Materials required to construct a sluice include the following:

- ❒ 2 boards 2-5cm thick or 2 metal plates 0.3-0.5cm thick
- ❒ poles 4x6cm
- ❒ 4 inch PVC pipe



(a) Side view *(b) Front view*

Illustration 13. *Sluice (Stoneman and Brooks, 1997)*

3. Pumping

Water is a vital component of the peatland ecosystem. Water can be drawn from a reservoir, such as a lake or river, and pumped into the peatland in order to raise the ground water level. This level can then be controlled by building a spillway (in the form of a small ditch or PVC pipe) and channelling the water to a lower location (Illustration 14). A pump and PVC pipe are required in order to set up this type of arrangement.

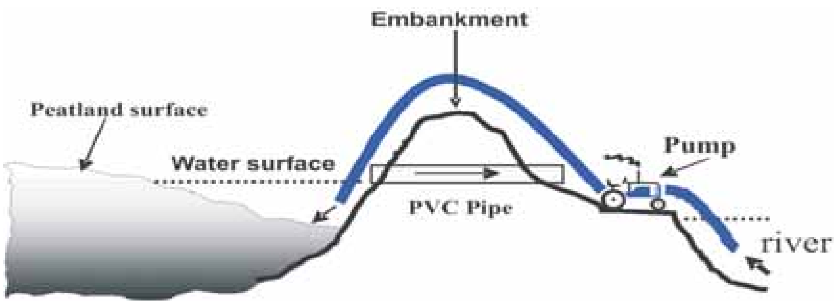


Illustration 14. *Control of water in peatlands through pumping (Stoneman and Brooks, 1997)*

f) Identification of the materials needed for blocking

The type of materials to be used in constructing the blocks is dependent on the size of the ditch/canal to be blocked. Table 2 shows the materials appropriate for different sized ditches and canals. Other materials can be substituted for those in the table, depending on what is available near the location of the blocking activities. When choosing materials for constructing blocks, it is also important to consider the price, the strength and durability (decay resistance and ability to withstand damage from the current, animals and humans).

g) Cost analysis

Activities to block ditches/canals can be restricted by cost limitations. Costs that need to be considered include: labour, insurance for workers, renting or buying tools (such as: shovels, saws, machetes, nails, hammers), transportation of people and tools (by boat, raft or car, for example), materials (including, for example, poles, wood, board, nails, plastic/geotextile, jute sacks). It is also important to consider involving nearby residents in the blocking activities. Not only will this create employment opportunities, but it will also increase the sense of ownership and raise awareness that they can use the blocked areas as ponds for cultivating fish (similar to the *beje* ponds). Additionally, being directly involved will encourage them to maintain the blocks and avoid damaging them.

Table 2. Ditch/canal dimensions, type of block and suggested materials for blocking

Size/dimensions		Type of lock recommended	Materials required for blocking the ditch/canal
Width (m)	Depth (m)		
< 1 m	< 1 m	Sekat papan	o Planks of water-resistant wood (such as belangeran) 2-4cm thick, or sheets of corrugated zinc/plastic o Wooden poles (6-20 x 12cm) for horizontal supports o Nails and plastic string o PVC pipe to act as spillway

Size/dimensions		Type of block recommended	Materials required for blocking the ditch/canal
Width (m)	Depth (m)		
< 2 m	1 m	Plank dam, sluice, or composite dam	o For a plank dam, the materials are the same as those listed above; o A sluice requires additional materials in the form of wooden boards or metal plates and a hoist and chain to move the metal/ wood plate. o A composite dam, in addition to using the same materials as a plank dam, also uses peat or mineral soil that is put directly between the blocks which are lined with plastic (it is preferable that the soil be put into geotextile sacks which will not easily tear).
> 2 m – < 3 m	1 m	Composite dam or sluice	o For both a composite dam and a sluice the materials are listed above.
> 3 m	> 1 m **	Composite dam	o The materials required are the same as those listed above. However, the material to fill the dam and the number of wooden planks and poles will be much greater because of the dimensions of the larger canals.

Note: ***) For ditches and canals >3 m wide with a depth of >1.5 m it is recommended that an experienced civil engineer be consulted.*

4.2. CONSTRUCTION STAGE (ACTIVITIES FOR BLOCKING DITCHES AND CANALS)

Once the pre-construction items have been completed, the next stage is to proceed with blocking the ditch/canal. Below are the steps that need to be completed:

a) Preparatory stage

Preparatory tasks include: data collection, preparation of design, environmental impact assessment (when required), blocking activities, maintenance, monitoring and evaluation (some of these tasks have already been detailed in previous sections). In addition to the technical side of construction, other supporting activities (such as research on soil characteristics, hydrology, limnology, biodiversity and forestry, among other things) must also receive attention. Research on these parameters is very important in preparing the technical design and also in monitoring what impact construction activities have on the surrounding environment. (This will be discussed in more detail in a later chapter).

b) Materials

As discussed earlier, the materials required for blocking are determined by the hydrological and limnological characteristics of the ditches and canals, and the size. A list of all the materials and equipment that need to be brought to the field should to be prepared, and responsibility assigned to individuals. Materials and equipment should be on site by the first day of blocking. It is advisable that the materials be reviewed to make sure everything is in place and the equipment checked to make sure it is in good working order. In order to ensure that no equipment is left behind, a list should be prepared. Any equipment that is forgotten will delay activities and lead to frustration among the people doing the work (especially if the ditch/canal to be blocked is far from a settlement).

c) Determining when to block

It is advisable to carry out blocking activities during the dry season (between July and September). During the dry season there is little water in the ditches/canals, which makes construction activities easier. However, if the location is only accessible by river, transportation for workers and equipment will be difficult. In order to address this, materials and equipment can be transported to the location during the rainy season when water levels in the river are higher, and the actual blocking activities can be carried out during the dry season. In addition to these natural obstacles, when working with local residents it is important to factor in their schedules. The timing of crop harvests, and the fishing season for ponds, *beje*, lakes and rivers needs to be considered, as do important holidays. When these factors are accounted for, the actual time available for people to carry out field activities can be very limited. For these reasons, the timing of the blocking activities needs to be set in consultation with the relevant communities, using community leaders as facilitators.

d) Blocking activities

The actual blocking involves: clearing the location, building a shelter for the workers (if the block being built is large), inserting poles and a base foundation from wood/logs, fastening the blocking boards/poles, attaching sheets of plastic/geotextile and inserting the bracing poles. For a composite dam, it is necessary to fill the area between the two walls of the dam with mineral or peat soil in plastic sacks that are tied with strong material (for example, geotextile).

Because peat is so loose, and the pressure of the water in the blocked canal will be very strong (especially for canals that are greater than three metres wide), in order to avoid leakage or damage of the block, it is recommended that:

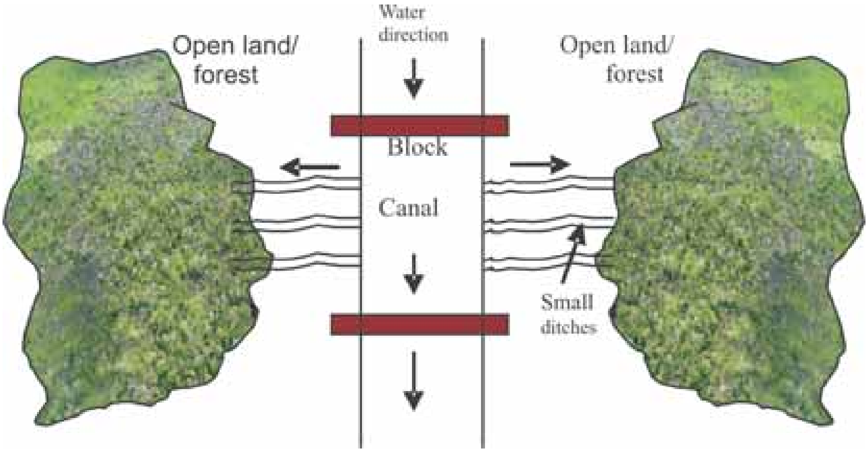
- ❒ The horizontal poles be pushed deeply into the peat soil on the left and right banks of the canal (approximately two metres on either side). The vertical poles need to be embedded into the bottom of the canal until they reach the mineral soil layer. This is to avoid damage to the block as a result of water pressure on the sides and the bottom of the block.

- ❒ In the centre of the block it is necessary to build a spillway. It must be capable of releasing excess water during the rainy season, but still able to retain water upstream during the dry season. Therefore, the spillway should not be too deep (a depth of 30cm from the top of the block is sufficient).

- On the outside of the downstream wall, it is necessary to attach supporting poles to strengthen the structure. The supports should be built in stages, and the total should be appropriate for the width of the block and canal (see Illustration).

- The inside wall of the block should be lined with a sheet of plastic/ geotextile in order to reduce the likelihood of leakage. The plastic must be well attached to the wall of the block so that it does not drift to the surface. The plastic must be immediately dug into the two sides of the canal.

- Between two blocks built in one canal it is possible to dig several small ditches with a depth of 30cm that run off the main canal to the left and right. The purpose of these is to decrease water pressure on the block, in order to reduce damage to the block. They also serve to wet the peat in the area of the canal so that if there is a fire it will have difficulty spreading to nearby peat and forest.



- ❒ Planting vegetation on the mound on top of the block is strongly recommended in order to strengthen the block.
- ❒ Planting vegetation in the water, upstream and downstream of the block, will reduce water current and this will also strengthen the block.

4.3. POST CONSTRUCTION STAGE

The post construction phase involves maintenance and monitoring of the ditch/canal. These activities can be carried out by the relevant government technical agencies, especially if the government was responsible for blocking the canals. For ditches and canals belonging to community members it is more appropriate for the maintenance and monitoring to be carried out by the community involved, with guidance from technical agencies.

Ditches and canals which have been blocked, whether by using simple materials from the immediate surroundings (for example: wood, logs, mineral and peat soil) or store bought materials (for example, metal plates and plastic) all need to be maintained.

The blocks, especially those built using simple materials, may experience erosion along the bank during the rainy season or may be damaged by animals or by people who do not want the block to be in that location. The latter situation may result if people find that the block hinders their use of the ditch or canal for transportation or to remove wood or other forest products.

Blocks that are made from cement and metal are typically stronger and have a longer life span. This does not mean, however, that these types of blocks do not need maintenance. Peat water, which is acidic, can be corrosive to metal. For these reasons, these blocks will also need maintenance and monitoring.

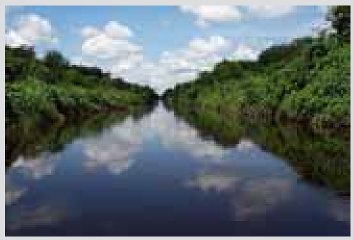
Blocks, which in this case function as a water control door and were built by the government (from cement and metal plates) in the ex-mega rice project in Central Kalimantan, are now experiencing physical damage due to the fact that there are no funds to maintain them and no monitoring system. Many of these blocks have been neglected, water gates made from metal plates have been stolen and others have started to rust and there is erosion damage due to the strength of the peat water flow in the canal.

The situation is similar for a block in the main primary canal (SPU) in Kalampangan Village, Palangka Raya, which was made from simple local materials. The block, which is about five metres long, two and a half metres deep, with a canal that is 10 metres wide, has been opened up by local residents. This was done because people found that that the dam hindered their transportation. The destruction of the block is regretful because its presence raised the water level and meant that the canal could be used for fishing activities (casting net and pole and line fishing) and protected the nearby area from forest fires.

Based on the two experiences above, when making plans to dam a ditch or canal, maintenance and monitoring activities must be an integral part of the plan right from the beginning. They must be implemented with full commitment. If these two things are not undertaken, the financial investment is wasted.

Box 6

The photograph below on the left shows the condition of the main primary canal in Kalampangan, Central Kalimantan (ex-mega rice project Block C) which was previously blocked by the government. Unfortunately, the nearby community was not made aware of the need for the block, even though they used this canal for transportation purposes. The block has therefore been breached and the canal is once again being used for water transportation. As a result of the damage to the dam, the surrounding peatland has become dry, and burns during the dry season.



The photograph on the right shows the impact of blocking the main primary canal in Kalampangan Village, Central Kalimantan, which has resulted in accelerated re-greening of the area.

(Foto: Alue Dohong)

Chapter 5

Research on Soil Characteristics, Hydrology and Water Quality, Forest Plant Rehabilitation and Fire Contro

As mentioned previously, damming a ditch or canal is not only about the physical activities of building the dam. Before and after the dam is built there are things that need to be investigated. This is intended to ensure that the dam is built based on a strong foundation of scientific research so that the positive impacts can be maximized and the negative impacts minimized.

5.1 RESEARCH ON THE SOIL CHARACTERISTICS OF THE CANAL TO BE BLOCKED

Soil characteristics are generally studied and analysed in soil surveys related to farming. However, these characteristics can also be used to determine the use of the soil for technical and engineering purposes. According to Sarwono (1992), most engineering work is carried out on soil, and for this reason it is important to consider the characteristics of the soil. Characteristics include, among other things: rheology and soil grain classification, hydrology or drainage of the soil, thickness of the soil down to the bedrock layer, susceptibility to erosion, the danger of flooding, the slope, bearing capacity, the potential for corrosion, presence of an organic layer, ease of digging. These characteristics are usually investigated for engineering activities on mineral soil.

However, what happens when the engineering activity (for example, damming a canal) is carried out on peat soil? For planning a dam in peatlands, the role of the soil researcher is vital. The physical and chemical characteristics of the soil need to be considered in planning the activity. The physical characteristics include, among other things: the maturity of the peat (texture), subsidence, the plasticity index, drainage, bulk density, thickness of the peat, depth of the mineral soil. The chemical characteristics include, among other things: the pH of the soil, salinity, cationic exchange capacity, base saturation, A1 saturation and potential pyrite content. Studies of the physical and chemical characteristics of the peat will influence the materials that are used for blocking and the length of the poles to be used.

Below are several soil characteristics that should be considered and measured in support of canal blocking.

Peat depth/thickness

The thickness of the peat must be known in order to determine the length of and distance between the poles that will be inserted in the canal. This measurement is carried out both in the canal and in nearby areas, with an interval of one metre (ideally) between measurements. The tool used is a ± 15m peat drill. Information gathered from this measurement includes the thickness of the peat, the location of the mineral soil and the height of the water in the canal. From this data it is possible to prepare a profile of the peat thickness at the location of the canal that is to be blocked. This profile can then be used to determine the length of the poles, so that they reach below the peat layer to the mineral soil layer (see Illustration 15).

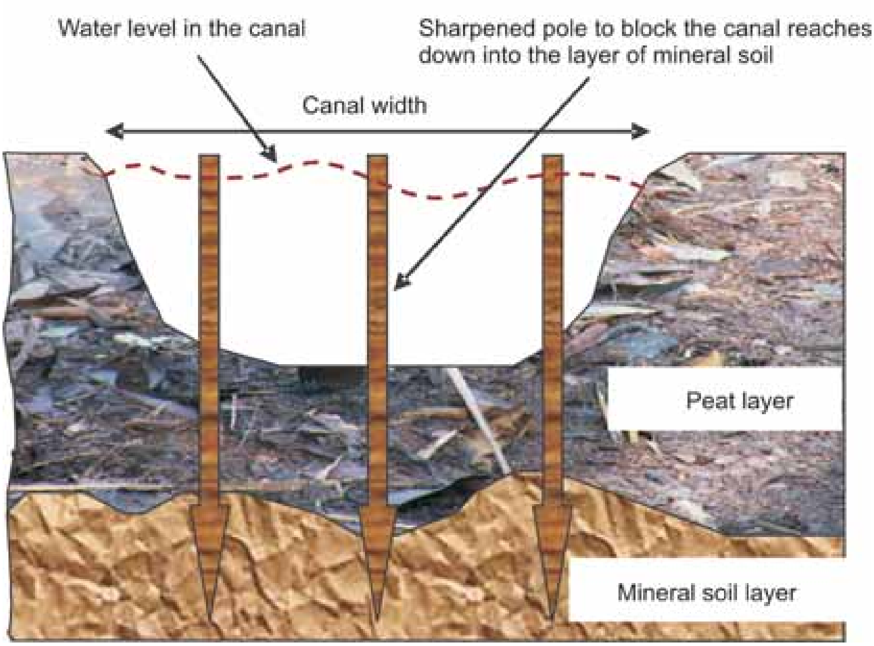


Illustration 15. *Cross section of a canal to be blocked with the poles reaching into the mineral soil layer*

Maturity (Texture)

The maturity of the peat or its level of decomposition (classified into fibric, hemic and sapric) must be known in order to determine the support compression and level of subsidence. Peat maturity can be measured manually in the field or can be determined in the laboratory by determining the level of fibre. Peat soil that is mature (sapric) has a high support compression and a low subsidence level (it is more stable), so it is more conducive to the construction of dams than immature peat soil (fibric). It is usually difficult to achieve optimal results in fibric peat, which is more porous, meaning that water can escape from the blocked canal through peat on the side and bottom.

Bearing Capacity

The bearing capacity is the capacity of the soil to withstand pressure or the ability to support heavy equipment. It is measured in kilograms per cm^2. The bearing capacity of soil is measured using a penetrometer. This tool can be used directly in the field. Based on experience, peatland has a low bearing capacity, with the result that the use of heavy equipment (such as tractors and excavators) is not recommended.

Bulk Density

Bulk density is the weight of a specific volume of soil in its undisturbed state, and is measured in gr/cc or kg/m^3. Bulk density can be an indicator in determining the availability of water, the need for fertilizer and the compression of the soil, as well as being used in measuring the carbon content. Soil with a high bulk density is highly compressed and has a low subsidence level (more stable, with the result that it is more conducive to construction of a dam when compared with soil with a low bulk density).

Porosity

The porosity of soil refers to the total number of interstices in the soil. Porosity has a direct link to the store of water and air in the soil. In peat soil, the interstices are generally filled with water and organic matter, meaning that the peat is porous and loose. The compression and bearing capacity are very low, which has implications for physical structures built on the peat.

Water content

For growing vegetation it is important to know the water content in the soil so that it can be raised or lowered to the optimal level. The water content of natural peat is very high (>80% volume), which is a major limiting factor for agriculture. Drying out of peatlands, as a result of overdrainage, for example, leaves the water level very low and can damage the structure of the peat, meaning that it no longer holds water (because of the structure of dried peat, this can be irreversible). In these conditions the peat can burn easily, and create difficulties in blocking the canals. In order to reduce the possibility of peatland fires, it is necessary to conserve water in the peat through appropriate water management. Damming the canals is expected to help address the dryness of the surrounding peatlands.

Slope

The degree of slope is a factor which influences the flow of surface water. For land with a slope of <2% the flow of water will be slow, while for areas with a slope of >2% the flow of water will be rapid. The moving water will exert pressure on the block, meaning that the materials used to make the block must be appropriate for the strength of the water flow. Additionally, the slope will influence the number of blocks required. The steeper the area to be blocked (for example, in the area of the peat dome), the greater the number of blocks that should be built to control the larger volume of water.

Chemical characteristics of peatland

Normally the chemical characteristics of the soil would not have a direct influence on the blocks. However, it is necessary to know the value of several parameters (such as pH and pyrite content). For peatland that has pyrite at the bottom layer, there is the potential for the pyrite to oxidize and become very acidic, which might cause metal materials used to block the canal (such as nails) to deteriorate because of rust.

Knowing the chemical characteristics of the peat soil in the area surrounding the block is also useful when it comes to carrying out other activities including, for example, rehabilitation and farming. In these cases it is important to know the fertility of the soil.

Measuring the chemical characteristics of peat soil is mostly carried out in a laboratory. The chemical characteristics that must be measured are: soil pH, carbon store and N-organic, cationic exchange capacity, total alkaline (Ca, Ng, Na and K), saturation, A1 saturation and iron, level of ash and fibre, salinity and the store of sulfidic substances (pyrite). These chemical characteristics, along with others, are related to the fertility of the soil. From the chemical analysis, it is possible to know which nutrients are lacking, and which are excessive in the soil. This can become a baseline for determining fertilizer needs for vegetation.

5.2. STUDY OF HYDROLOGY AND WATER QUALITY

As was mentioned earlier, the objective of blocking the canals is to increase the water table in surrounding peatlands. In order to show that blocking has raised the water level, it is necessary to measure hydrological parameters in a routine and systematic manner. These parameters include: rainfall, water level in the canal, height of the water table near the blocked canal, and height of surface water. These parameters need to be measured and analysed in order to determine from a hydrological perspective to what extent blocking the canal has improved the nearby water system and environment. This book does not include detailed information on how to measure hydrological parameters. For more detailed information the reader is advised to refer to a hydrology book that specifically discusses measurement techniques. This book provides information on how to set up the bore holes (Illustration 16) used to monitor changes in the water table of the peat near the blocked canal, and provides practical measurement techniques for use in the field. It also provides brief information on measuring the water discharge rate and rainfall.

Location of monitoring bore holes

Monitoring bore holes are made by inserting a PVC pipe into the peat soil until the bottom end of the pipe passes well into the water table below. It is recommended that the PVC pipe have a diameter of approximately 5cm (holes should already have been made in the walls, see Illustration 17), and a length of approximately two metres. The top of the pipe should be closed with plastic so that no debris can enter and the pipe should be marked (for example, with a bamboo stick and a piece of coloured cloth marked with a code for the bore hole). Using this method, ground water will enter into the pipe through the holes in the wall of the pipe. Enough bore holes should be made to the right and left of the blocked canal to be representative. After all the PVC pipes have been inserted into the peat soil, the ground water level for each hole should be measured using the technique detailed below.

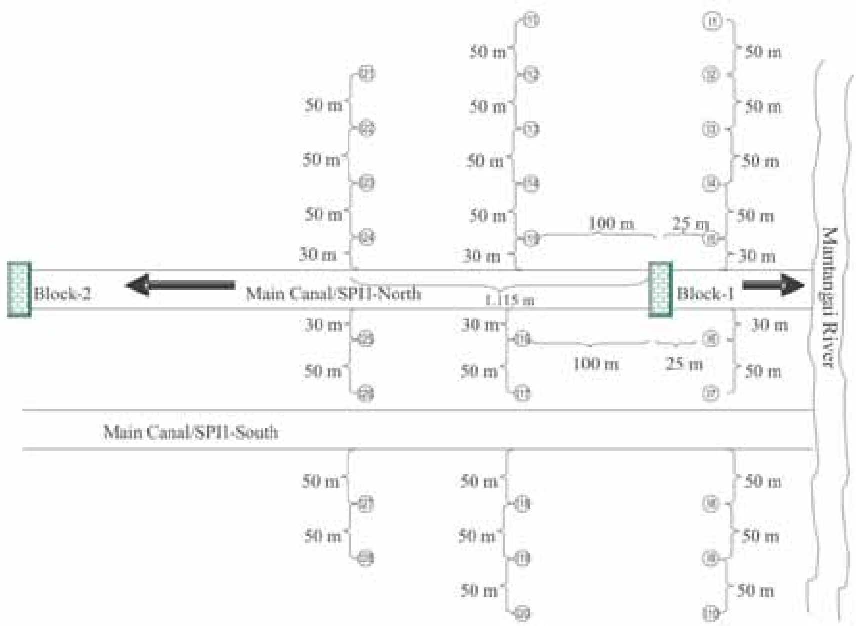


Illustration 16. *Location of monitoring bores near a blocked canal*

Measurement of ground water level

The level of the ground water is measured by dipping a dry measuring stick into the bore hole as illustrated in Illustration 17. Measure the length of the stick starting at the lip of the pipe above the earth until the section that is wet from the peat water inside the bore hole (for example, length a=75cm). After this, measure the height of the pole that sticks above the ground (for example, b=10cm). The height of the ground water table is a-b=65cm (the number reflects the height of the ground water from the surface). The smaller the value, the closer the water table is to the surface. (note: if there is flooding, the height of the ground water level to be measured is from the surface of the peat soil to the surface of the water. Under these conditions it is not necessary to insert the measurement stick into the pipe).

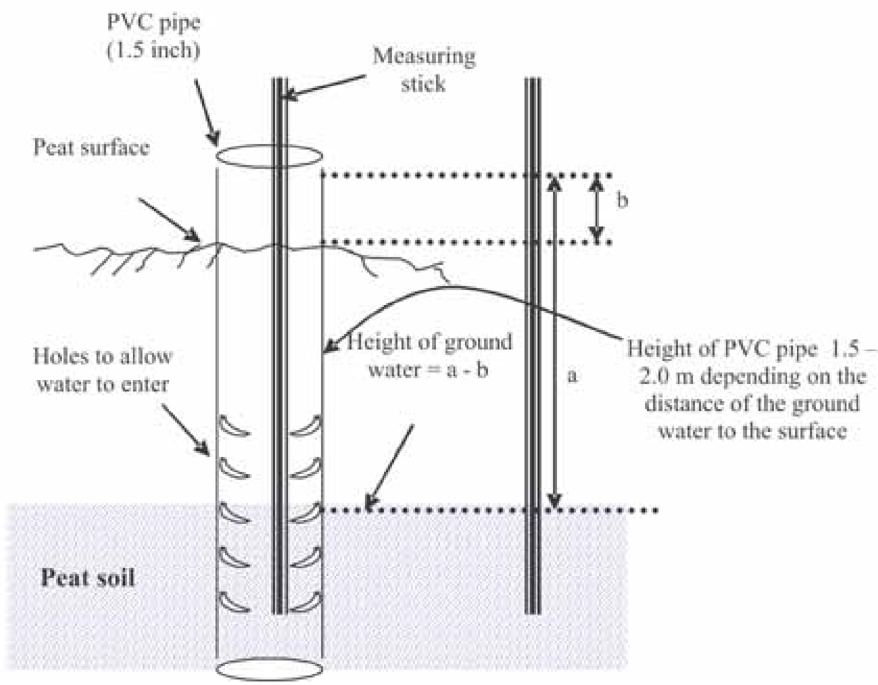


Illustration 17. *Method to Measure the Ground Water Table Depth in Peat*

Measurement of Surface Water Level

The height of the surface water (measured in the canal/ditch) can be measured using a staff gauge (see Illustration 18). A reading is taken by looking at the scale that is marked on the board.

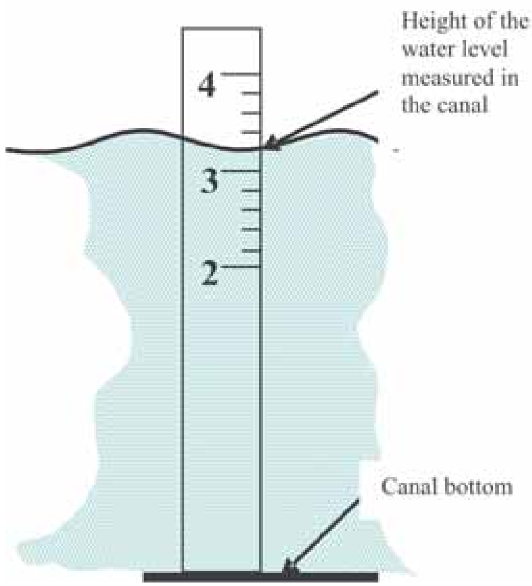


Illustration 18. *Staff Gauge to Measure Height of Water Surface*

A staff gauge should be located in the canal/ditch on the upstream and downstream sides of the block. The purpose is to determine the influence of the block in raising the water height on the upstream side of the block. The greater the difference in surface water height between the two measures, the greater the influence of the block in holding back water. When the difference is not significant (except during the rainy season), the reasons might include: the block is leaking (either on the side or below the block) or the peat soil is very porous (for example, fibric peat). In the first case, the block must be repaired as soon as possible. If not, a small leak will grow over time and eventually destroy the block.

Measurement of Discharge Rate

To measure the water discharge rate (m^3/second) it is necessary to first know the retention (m^2) of the canal/ditch (that is, the width of the canal multiplied by its depth) and the speed (m/second) of the water going through the canal/ditch. The speed of the current can be measured using a current meter or by putting an orange float in the canal and then recording the time it takes to travel a certain distance (m/second). The discharge rate is measured on the same schedule as measurement of the ground water table and the surface water level.

Measuring Rainfall

This information is required to complete the hydrological analysis related to blocking activities. It is best to gather rainfall data from the nearest meteorological station for a number of years (optimally, data would go back 20 years). In addition to this, rainfall data for the specific blocking location is needed to obtain a more accurate picture. The method for measuring rainfall in the target location is as follows:

The amount of rainfall in a specific location can be measured by dividing the volume of water which enters a rain gauge with the cross section area of the gauge (see Illustration 19). Mathematically the level of rainfall can be written as follows:

$$P = R/A$$

Where, P = Rainfall (mm/day)
R = Total amount of rain (mm^3/day)
A = Cross section area (mm^2)

Measurement of rainfall is carried out using a rain gauge and a measuring glass.

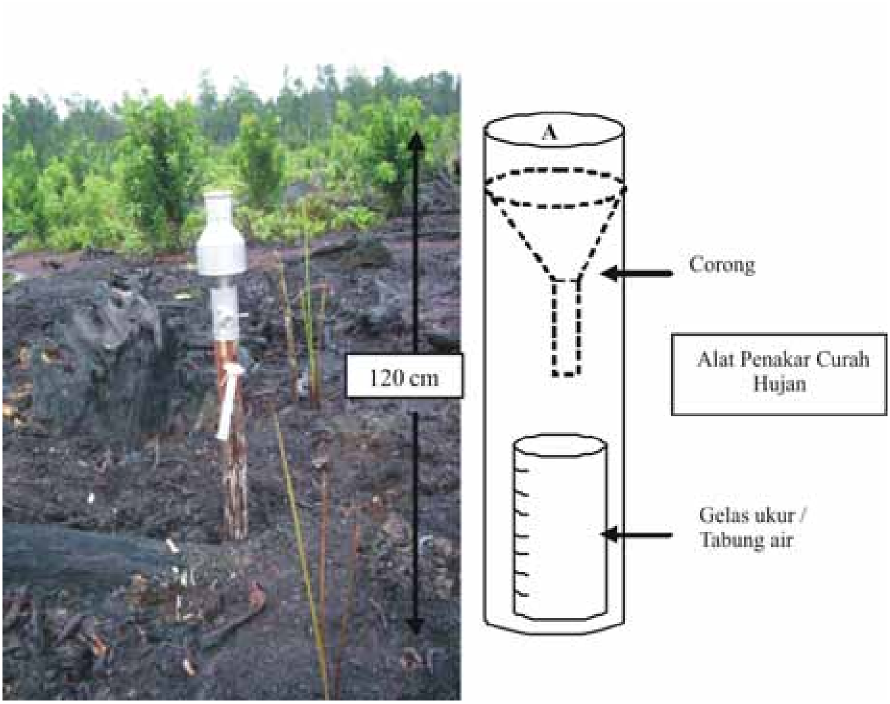


Illustration 19. *Rain Gauge*

Other Parameters to be Measured

Other parameters that are required include, for example, the slope of the land/topography, height above sea level and porosity. All of this data is needed by the hydrologist to analyze the impact of the blocks on the water level and saturation of the peat near the blocked canal.

Water Quality

It is not absolutely required that the water quality be measured, but if a blocked canal is going to be used as a fish cultivation pond (e.g. for *patin*), there are a number of parameters that should be measured, including, pH, dissolved oxygen (DO), total suspended solids (TSS) and electrical conductivity (EC). These four parameters are sufficient, the costs for analysing water quality parameters being quite high. The pH value will show the acidity of the water. Acidity that is too high (a very low pH) can cause fish mortality, and disrupt reproduction. DO shows the level of oxygen dissolved in the water, which is important in determining the species of fish to be cultivated (for fish with extra gills, such as catfish, a low level of dissolved oxygen might not be a problem). TSS will show the level of turbidity of the water, while at the same time showing the potential for sedimentation in the blocked canal and in the river the canal flows into. If the TSS is very high in the canal, it is best not to cultivate fish. EC shows the level of dissolved salt. If the value is very low, the growth of food for fish might be hindered.

Preparation of a Table of Hydrological Parameter Results

Information on the hydrological parameters discussed above should be recorded in a table (see Table 3). This information will then be used by an hydrologist for further analysis. (Measurements and entering of data should be done by someone who has been trained).

Table 3. Results of measurement of hydrological parameters of blocked canal and surrounding area

Date of Measure ment	Water Discharge (m3/s)		Surface Water Level (m)		Ground Water Level (cm)				Climatology
			In Canal		Measurement locations on the right and left of the canal going inland (code of bore)				Rainfall (mm/day of rainfall)
	Before Block	After Block	Before Block	After Block	S1	S2	S3	Etc	

5.3. REHABILITATING FORESTED LAND

After a canal has been blocked it is expected that the water table of the surrounding peat will rise. This is characterized by the water content of the peat near the canal. In addition to reducing the risk of peat fires, wet conditions also support rehabilitation programs on peat soil (it is suggested that local species be used) because the seeds that will be planted will have enough water, even during the dry season. In addition to restoring the ecological functions of the peat, it is expected that in future the trees will act as a type of “wood savings” for nearby communities. For this reason, after blocking is completed, the next step is to prepare a plan for rehabilitation of the land near the canal.

Below are the species of local plants that can be planted near a blocked canal (Wibisono et al, 2005):

- ❒ Jelutong (*Dyera loowi*)
- ❒ Marsh pulai (*Alstonia pneumatophora*)
- ❒ Meranti rawa (*Shorea sp.*)
- ❒ Campnosperma tree (*Campnosperma macrophylum*)
- ❒ Perepat tree (*Combretodatus rotundatus*)
- ❒ Keranji (*Dialium hydnocarpoides*)
- ❒ Punah (*Tetramesitra glabra*)
- ❒ Vatica (*Vatica sp.*)
- ❒ Rengas burung (*Melanoorhoea walichii*)
- ❒ Belangeran (*Shorea belangeran*)
- ❒ Ramin (*Gonystylus bancanus*)
- ❒ Wild Durian (*Durio carinatus*)
- ❒ Kempas (*Koompassia lalaccensis*)

Rehabilitation of the areas near blocked canals needs to be location specific. For severely degraded peat soil (for example, that which has been burnt or where the land has been cleared), rehabilitation activities (reforestation) are the appropriate alternative. Efforts to enrich vegetation can be carried out in forested areas that have been degraded but still have standing trees. For forested locations in relatively good condition, it might not be necessary to enrich, but rather, to use wildings or seeds that can be moved to burnt or otherwise degraded locations. (Note: additional information on rehabilitation techniques for peatlands can be found in the book: Guide to Rehabilitation and Silviculture Techniques in Peat Soil by Wibisono et al, 2005).

5.4. LAND AND FOREST FIRE CONTROL

Blocking canals in peat is one means of reducing the risk of fires through protecting the ground water. However, this does not mean that forest and land fires will not occur. Efforts to close the canals will be worthless if nearby forest and land fires are not controlled from the beginning. Factors causing these fires need to be guarded against through land management practices after the canal has been blocked. Preventing fire is the most important factor in any fire control strategy. Forest and land fires in peat are supported by environmental factors (weather, wind and the accumulation of flammable material). The process of burning occurs because the flammable material (such as fallen leaves or dry peat) is ignited by a heat source (fire) and there is available oxygen. This is shown by the fire triangle (Illustration 20) below:

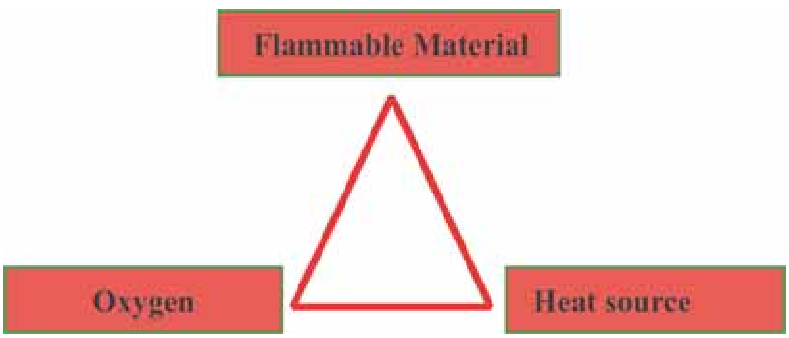


Illustration 20. *Fire triangle*

A simple concept to guard against burning is to eliminate one of the components of the fire triangle. This can be done by eliminating or reducing the heat source (fire) and eliminating or reducing the accumulation of flammable material.

Accumulation of dry flammable material can occur as a side effect of human activity, for example, the debris from farming activities or logging in the forest. At the same time, natural factors, such as windy weather (causing leaves to fall), along with hot dry weather, can cause the accumulation of dry flammable material on the floor of the forest. When this situation is combined with a heat source (for example, fire from clearing of land) and wind, it can ignite a forest fire. Additionally, burning can become more serious and difficult to extinguish if the forest or farming land is on peat. If the fire enters the peat it becomes extremely difficult to extinguish. Only extended heavy rain which saturates the peat can extinguish this type of fire. The presence of ditches (in peatland) which have already been blocked, can reduce or even eliminate the danger of below ground fire in peat, because the peat is wet as a result of water held in the peat. This does not mean, however, that above ground fires can be avoided, because if the flammable material on the surface is blown by strong wind it can move and spread the fire on the peat, but the fire would not go underground. Blocking of ditches does not automatically eliminate the possibility of fire and for this reason it is strongly recommended that fire not be used on peat. (note: additional information on techniques for fighting fires on peat and forested peat can be found in the book: Guide for Controlling Forest and Peat fires, by Adinugroho et al, 2005).

Chapter 6

Examples of Canal/Ditch Blocking Activities in Peatland

Since 2003, Wetlands International Indonesia Programme (WI-IP), through the CCFPI project, has carried out canal/ditch blocking activities in Central Kalimantan and South Sumatra. In Central Kalimantan the blocking activities took place in Block A of the aborted one million hectare mega rice project (ex-MRP), Kapuas District, where five canals (with widths of between 25-30 metres) were blocked. In the Black Water Ecosystem area of Puning River, South Barito District, 14 ditches were blocked (with widths of 1-2 metres). In South Sumatra, the ditches that were blocked (7 units, with a width of 2-4 metres) are in the area of Merang River, Bayung Lincir Sub-District, Musi Banyuasin District. (note: data on the canals/ditches which were blocked by WI-IP is based on reports until March 2005. The activities above are continuing and the number of canals/ditches which will be blocked continues to increase).

In addition to WI-IP, recently the World Wildlife Fund (WWF) Indonesia has also started to block canals in the Sebangau area of Central Kalimantan.

6.1. CANAL BLOCKING ACTIVITIES IN BLOCK A OF THE EX-MRP, CENTRAL KALIMANTAN

In this section the reader is invited to draw from the experience of the CCFPI project in blocking the Main Primary Canal (SPI) in the ex-mega rice project (MRP). The SPI is the biggest canal that has been built in peat in Indonesia (and perhaps in the world). Blocking this canal was a daunting task after the CCPFI project obtained experience from blocking ditches that were much smaller (as much as 20 times smaller) in South Barito District.

The canals in the ex-MRP (totalling 4,470 km) are owned and were built by the Indonesian government, and intended to function as irrigation canals for farming. The dimensions of the canals vary, with widths between 10-30 metres and depths on average of 2-3 metres.

The blocking activities in the ex-MRP were focused on the northern part of Block A, which borders on Block E, and is between the Kapuas River and the Mantangai River in Kapuas District (Illustrations 21 and 22). The canals that were blocked included the Main Primary Canal One and Two (SPI-1 and SPI-2), Primary Canal Seven (SPU-7) and Sub-Primary Canal Seven (SPP-SPU7).

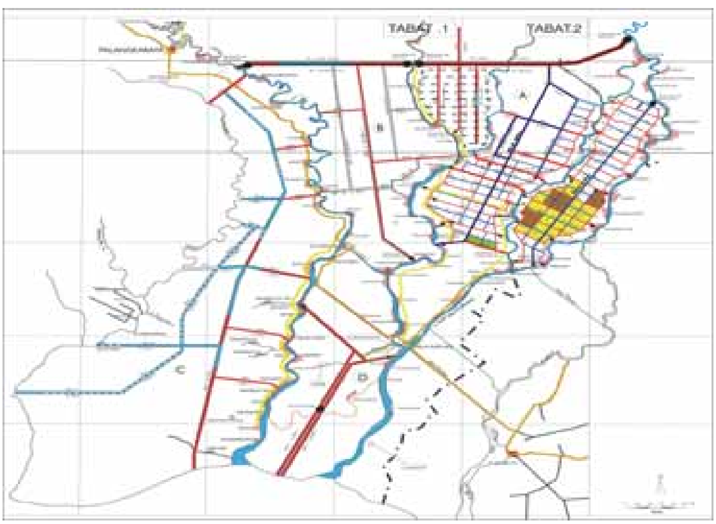


Illustration 21. *Activity Location in Central Kalimantan*

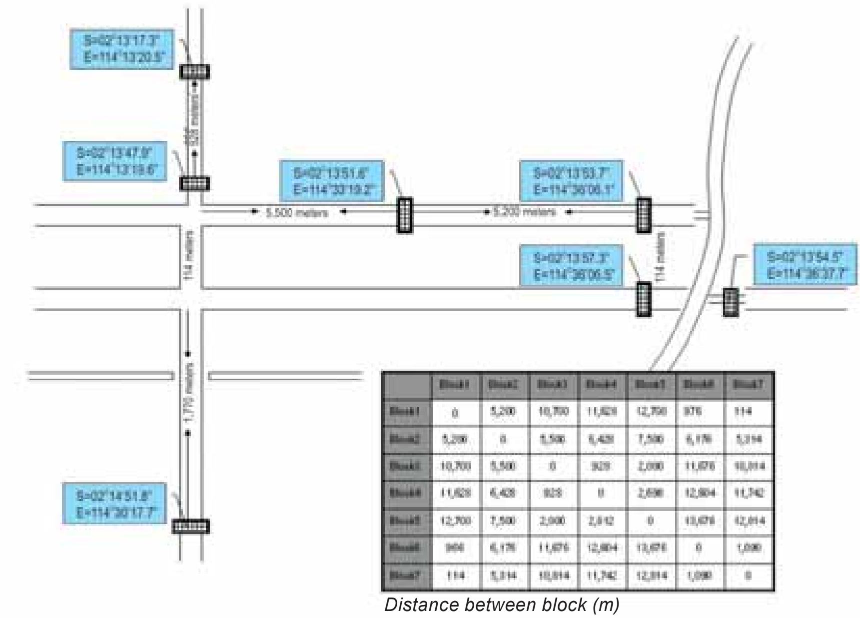


Illustration 22. *Sketch of Location of Blocks Built in Block A of the ex-MRP*

Table 4 below provides a general profile of canals SPI-1, SPI-2, SPP-SU7 and SPU-7:

Table 4. General Profile of Canals SPI-1, SPI-2, SPP-SPU7 and SPU7

No.	Canal	Average Width (m)	Average Depth (m)	Number of Blocks
1.	SPI -1	27	1,95	2 Blocks
2.	SPI-2	27	1,80	2 Blocks
3.	SPP-SPU 7	25	1,60	1 Blocks
4.	SPU-7	14	1,55	2 Blocks

Activities to block canals SPI-1, SPI-2, SPP-SPU7 and SPU-7 were carried out in seven different locations. Coordinates are shown in *Table 5* below.

Table 5. Coordinates of the Blocks in the ex-MRP

Block No.	Block Name	South Latitude (S)	East Longitude (E)
Block No.1	SPI-1	02°13'53.7"	114°36'06.1"
Block No.2	SPI-1	02°13'51.6"	114°33'19.2"
Block No.3	SPU-7 Centre	02°13'47.9"	114°13'19.6"
Block No.4	SPU-7 Upstream	02°13'17.3"	114°13'20.5"
Block No.5	SPP-SPU7 Bottom	02°14'51.8"	114°30'17.7"
Block No.6	SPI-2 East	02°13'54.5"	114°36'37.7"
Block No. 7	SPI-2 (Behind Camp 1)	02°13'57.3"	114°36'06.5"

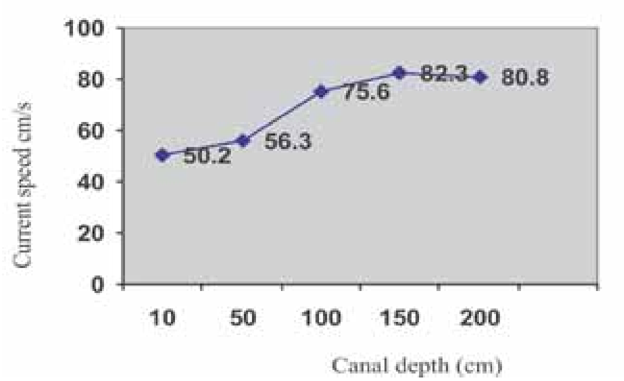


Illustration 23. *Profile of current speed in the SPI-1 canal, ex-MRP at block/dam-1*

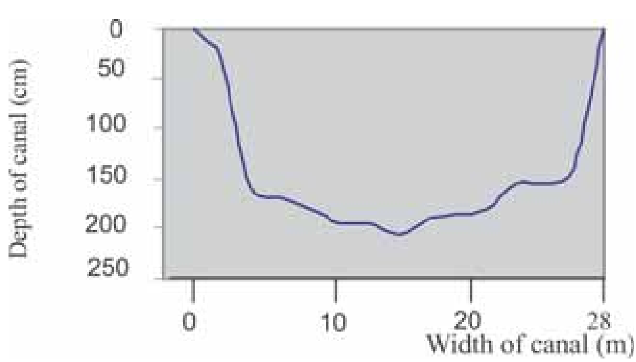


Illustration 24. *Profile of canal depth, SPI-1, ex-MRP, at location of block/ dam 1*

Table 6. Information on location and physical dimensions of block/ dam 1.

Position of block/dam-1, SPI-1:

S 02°13’ 53.7"

E 114° 36’06.1"

Results of measurement 12 Feb. 2004.

Current speed :

50.2 cm/s (near surface)

80.8 cm/s (near bottom)

69.04 cm/s (average)

Depth of canal:

0 cm (near shore)

195 cm (middle)

165 cm (average)

Width of canal : 27 metre

Cross section of canal : 46.2 m2

Discharge rate : 31.90 m3/s.

As with the ditches that were blocked in the Puning River area, the blocking activities in the ex-MRP were divided into three stages: pre-construction, construction and post- construction. Details of the activities in each stage are as follows:

A. PRE-CONSTRUCTION STAGE

The activities which were carried out during the pre-construction stage included:

a) Pre-assessment

Pre-assessment activities were carried out in April and May 2003 through a series of intensive discussions and informal meetings with stakeholders involved with the management of the ex-MRP. The discussions provided input to WI-IP's blocking plans. Among others, representatives from the following agencies and organizations were invited to participate in the discussions: Public Works, Central Kalimantan; Local Government, Pulang Pisau District; Local Government, Kapuas District; Local Government, Barito Selatan District; P2DR (Peatswamp Development Project), Lamunti Dadahup; Mantangai Sub-District.

This pre-assessment process generated recommendations from a number of stakeholders. As a result, it was decided to carry out blocking activities in the northern part of Block A, which borders on Block E. This decision was based on several considerations: i) the canals in that area were not used by either the government or communities; ii) there were no transmigration settlements in the area; iii) the canals are far from settlements, meaning that if the canals were blocked it would not disrupt the socio-economic activities of residents; iv) the canals that were opened in the area were being used to remove illegal wood; and v) the drainage of peat water from the area was very high, leaving the peat land vulnerable to fire in the dry season.

The pre-assessment activities for blocking canals in the ex-MRP area also served to raise the awareness of stakeholders about the functions and uses of peat.

b) Preliminary Survey

After deciding on the location, the next step, in September 2003, was to carry out a preliminary survey, involving a number of experts in relevant disciplines, such as soil, hydrology/limnology, fisheries, hydro-civil-engineering, silviculture, forest fire and socio-economic aspects.

The main task of the team was to gather information and baseline data related to each of their disciplines before the blocking activities began. The results of the survey provided the primary input into the technical design of the dam and the estimated cost of each block.

c) Obtaining Permission

Administratively the canals targeted for blocking were in Kapuas District. The request for permission to build the blocks therefore went to the District Head. Approval was released on the 9th of October 2003 through letter number: 2819/IV.C.2/BPPMD/2003.

d) Technical Design and Cost Estimation

The technical design was prepared in September 2003 using the information/data gathered during the preliminary survey.

In deciding on a model for the blocks, several technical factors were considered, with the main ones being: i) the thickness of the peat; ii) soil pressure on the construction; iii) seepage; iv) rate of water flow; v) availability of materials; and vi) system of work.

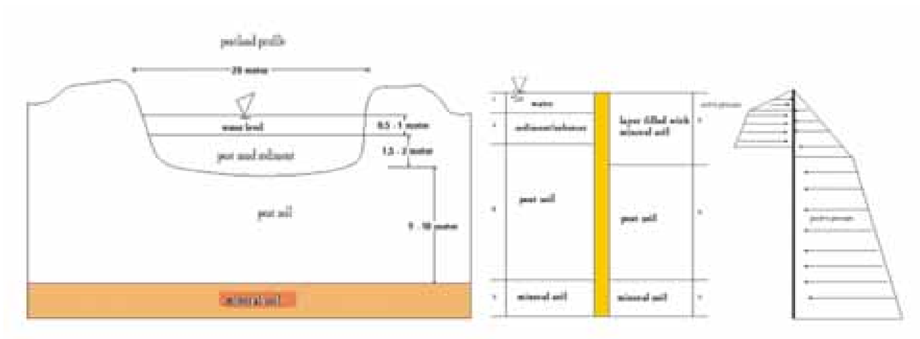


Illustration 25. *Example of Peat Depth Profile and Soil Pressure Profile in SPI*

Based on consideration of the technical data, two designs were prepared for blocking the SPI-1, SPI-2, SPP-SPU7 and SPU-7 canals in the ex-MRP. These were:

(1). Three sheet piles covered with geotextile with a single bracing system (**Technical Design Model One/ TDM-1**).

TDM-1 was based on three layers of belangiran poles with a diameter of approximately 15cm and a length varying between 12-15 metres, depending on the profile of the peat depth in the area, which ranged from 8 to 10 metres on average. The wood poles were embedded vertically in the peat soil in rows until they reached the mineral soil below the peat. To enable the poles to stand upright and increase their strength, two horizontal logs were bolted along the centre and top of the poles using metal bolts with a diameter of ½ inch and length 35-45 cm. The horizontal logs were bolted onto each of the vertical poles. A sheet of non-woven geotextile was placed between each layer of sheet pile in order to reduce water seepage. Additionally, a number of soil bags were placed between each layer of the block.

The TDM-1 did not require a spillway because the height of the block was a little lower than the top of the canal banks and there were cracks between the belangiran logs that indirectly functioned as a spillway if the water level and flow increased. The DTM-1 also allowed the water to pass over the construction if the water flow increased significantly.

The design of the TDM-1 is shown in *Illustration 26.* It was first tried in blocking canal SPI-1, blocks 1 and 2.

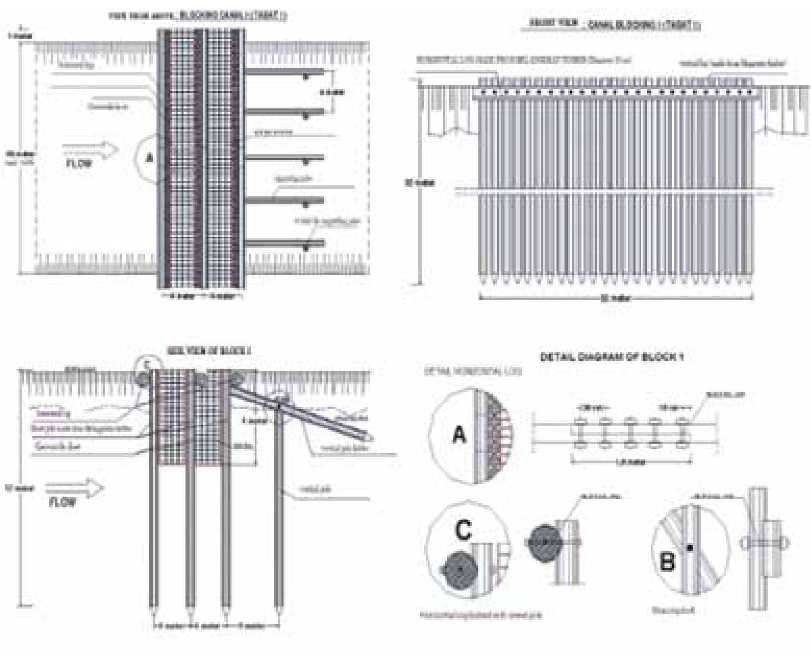


Illustration 26. *TDM-1*

(2). Three sheet piles covered with geotextile with a chamber system and a multiple bracing system (**Technical Design Model Two/ TDM-2**).

TDM-2 was a modification of TDM-1. The space between the sheet piles was divided into chambers and there was additional strengthening through the use of wood to act as bracing. The wood was attached at an angle of approximately 45º at the back of the block with a multiple pole system (*Illustration 27*).

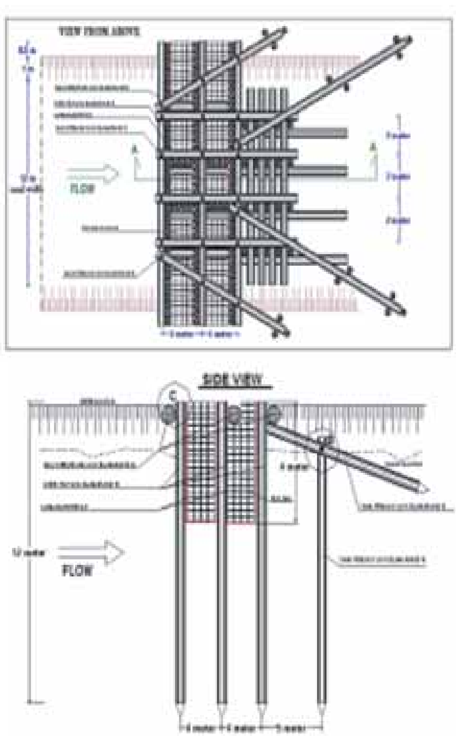


Illustration 27. *TDM-2*

The chambers and bracing on the back were intended to strengthen the construction of the block so that the strong water pressure on the upstream side of the block would not cause the block to bend.

TDM-2 was used on SPU 7 and SPP-SPU7 after it became evident that TDM-1, which was used for blocks 1 and 2 on the SPI, had experienced warping (into a bow shape). The issue of bowing was not a serious problem because of the characteristics of belangiran wood, which is relatively flexible. As long as the wood did not break, there was no need for concern because the block would still withhold the water.

The cost of building a block is highly dependent on the size of the canal, which influences the amount of material and labour required. The cost of the block is also determined by how far the material must be transported. The distances between canals that are to be blocked is another factor, as shelter must be provided up for workers.

The cost of building one block on the SPI-1 canal, with a width of 28 metres, was between Rp90,000,000 and Rp100,000,000. The cost on a smaller canal such as SPU-7 was between Rp60,000,000 and Rp75,000,000. Most of the tools and materials had to be brought in from outside the immediate area, but still in the vicinity of Mentangai village (note: 1USD = Rp9,000).

In order to obtain a clearer picture, the table 7 below provides an indication of the type and total amount of materials and labour required to build blocks SPI-1, numbers 1 and 2.

Table 7. Indicator of Materials and Tools Block SPI-1 Number 1 and SPI-1 Number 2

No.	Material	Block No.1	Block No.2
		S=02^{0}13'53.7"; E=114^{0}36'06.1"	S=02^{0}13'51.6"; E=114^{0}33"19.2"
1.	8-9 metre long belangiran logs	593 (∅ 15 cm)	479 (∅ 15 cm)
		15 (∅ 25 cm)	8 (∅ 25 cm)
3.	Sacks of mineral soil (1 sack approximately 20kg)	24,062 sacks	25,372 sacks
4.	Geotextile	350 M^2	350 M^2
5.	Bolts, nuts and washers (0.5" x 35-40 cm)	160 Kg	150 Kg
6.	Labour (approximate)	20 people	17 people
7.	Wire	400 metre	400 metre
8.	*Tools:*		
	a. Chain Saw	1 unit	1 unit
	b. Electric drill	1 unit	1 unit
	c. Generator	1 unit	1 unit
	d. Axe	as required	as required
	e. Boat	1 unit	1 unit
	f. hammer, hand saw, etc	as required	as required
9.	Labour time	65 days	50 days

e) Technical Meeting

In order to obtain technical input on the proposed design, a technical meeting was held on the 15th of September 2003 in Kuala Kapuas (Illustration 28). The meeting was opened by the Deputy District Head of Kapuas District, Mr. Talinting E. Toepak.

Illustration 28. *Technical Meeting in Kuala Kapuas on Blocking in the ex-MRP*

The Blocking Design Team did not obtain a great deal of input during the meeting, largely because this was the first time that a canal in the ex-MRP was to be blocked, and also because a number of participants felt that the design and technical specifications put forward were already appropriate.

f) Socialization Activities

Socialization activities were focused on communities in Mantangai Sub-District, Kapuas District. Socialization was carried out on the 9th of October 2003 at the sub-district office. Eighty-six people attended, including the head of the sub-district, heads of villages, representatives from non-governmental organizations, community leaders and others from all the villages near the blocking location.

Illustration 29. *Socialization of the ex-MRP blocking program in Mantangai Sub-District(Photograph: Alue Dohong 2003).*

Socialization focused on providing information about the planned blocking activities, including the background, objectives and expected benefits. Participants responded positively to the plans and expressed their hope that the blocking activities would reduce the peat fires that to date had been very damaging. In addition to the blocking activities, there was also the hope that there could be some direct benefit to the local communities through the development of businesses or jobs involving them in the blocking.

g) Building of Base Camp, Mobilization of Workers and Equipment

Permanent base camps were built in two locations. The primary base camp was built at block SPI-1 No. 1 at coordinates 02°13'53.2" S and 114°36'06.5" E, and the secondary base camp was built at the block on SPI-1 No.2 at coordinates 02°13'51.9" S and 114°33'19.2" E. At each of the other blocking locations a temporary camp was built for workers to stay in while construction was underway.

Mobilization of workers and equipment started at the beginning of January 2004 and was adjusted according to the workload in the field. Workers were generally divided into three groups: i) a group responsible for securing the belangiran wood; ii) a group responsible for securing soil; and iii) a group responsible for constructing the block. The total number of people in each group varied between eight to ten individuals.

B. Block Construction Stage

Block construction in the ex-MRP was divided into two stages: i) Stage 1: building blocks SPI-1 No. 1 and SPI-1 No.2 during March – June 2004; ii) Stage 2: building blocks SPU-7 No.3, SPU-7 No.4, SPP-SPU-7 No.5, SPI-2 No.6 and SPI-2 No.7 between July 2004 and January 2005. Monitoring and maintenance activities have been carried out routinely between completion of construction and the writing of this book.

The process of constructing each block was divided into three main activities:

a) Measuring the dimensions of the canal and putting in the bowplank

The width, length and depth of the canal at the point where the poles were going to be inserted was measured. This was followed by installation of the bowplank.

b) Mobilization of Basic Materials

Basic materials that were mobilized included: the primary wood logs for the block, the sacks filled with mineral soil, nuts and bolts, and geotextile. All of the belangiran wood logs were brought in from the downstream end of Mantangai river (approximately seven to nine kilometres from the primary base camp at SPI-1) using a relatively small boat with a motor. The mineral soil that filled the plastic sacks was also brought in from the downstream area of Mantangai River, with a small amount coming from the blocking sites. The nuts, bolts, washers and empty plastic sacks were brought in from Banjarmasin, Central Kalimantan. The geotextile was obtained in Jakarta.

c) Constructing the Block

Constructing the blocks was the most important stage of the process. All of the construction work was carried out manually using local labour and expertise (see: *traditional knowledge in Box 7*) and tools such as an electric drill, axe, hand saw, chain saw, and electricity generator.

KOTAK 7

Application of traditional technology in blocking canals

*The pilot project to block the main primary canal of the ex-mega rice project adopted traditional (Dayak) knowledge known as "*Tabat*". Tabat (in central Kalimantan) or "Tebat" (in south Sumatera)is a word that is used by local people to denote a block in a ditch, which is usually built at the mouth of a ditch. In Kalimantan, ditches are known as* handil*. The purpose of the tabat is to raise the water level in the ditch to the optimal level for transportation of logs or non timber forest products from the forest to nearby rivers. Through studying local practices, the blocking of the main primary canal was carried out along these conventional lines, with direct involvement of local people in construction.*

Illustration 30. *Workers inserting the wood poles (top) and lifting the joining belangiran pole(Photograph: Suryadiputra 2004).*

Main steps in constructing a block:

(1) Simple platforms from belangiran logs which were 25cm in diameter and approximately 15 metres long were built. These platforms were located crosswise, going towards the left and right banks of the canal. The working platforms were used when inserting the vertical belangiran poles and also for the workers to stand on when putting in the poles.

(2) A "tower" was built to assist in lifting the poles to be embedded in the canal. This tower was made from logs with a diameter of 20-25cm and was usually in the centre of the canal, but could be moved as needed.

(3) One end of the vertical poles to be inserted in the peat was sharpened before the work began. The poles were typically sharpened using a chain saw or axe.

(4) The poles were inserted, starting from one shore of the canal moving towards the centre until reaching the other side. The steps in inserting the poles were as follows: i) a rope that was already tied to the tower was tied to the unsharpened end of the belangiran pole; ii) the pole was raised by one or two people pulling the rope while someone else held on to the sharpened end of the pole and directed and inserted it into the peat at the bottom of the canal; iii) once the position and direction of the pole were finalized, it was inserted into the peat by weighing down the top of the pole with the body weight of the workers, while at the same time moving the pole back and forth so that the pole would enter into the peat more easily. The process continued until the pole reached the mineral soil layer or the pole had gone as far as possible, and could not be moved any more. In order to speed up the process of inserting the poles, a horizontal log was used that the workers jumped up and down on to force the pole in (Illustration 31).

Illustration 31. *Workers jump up and down on horizontal log (Photograph: Suryadiputra 2004).*

(5) Fastening the bracing poles to the back of the block. For TDM-1, between six and nine bracing belangiran poles were used, depending on the dimensions of the canal. They were placed at the back of the block and inserted into the soil in a parallel fashion with an average slope of 45°. The bracing system for TDM-2 used five to six parallel rows of poles also with a slope of 45° (Illustration 32) Each row had four to five bracing poles that were tied and bolted together.

Illustration 32. *Belangiran bracing poles at the back of a block (Photograph: Suryadiputra 2004).*

(6) The next step was to drill the vertical and horizontal poles, and to join the two using nuts, bolts and washers (size 0.25" x 35-45cm).

(7) Once the vertical and horizontal poles were joined, the tops of the vertical poles were cut with a chain saw so they were straight and neat.

(8) For TDM-2, the work was increased by the need to make the chambers between the walls of the block. These chambers were made from belangiran poles with a diameter of 15cm, and length of 8-10 metres. They were attached to the horizontal poles using nuts and bolts.

Illustration 33. *TDM-2 with chambers inside and bracing poles on the down-stream side. This block has already been lined with geotextile, and the chambers filled with mineral soil filled sacks (Photograph: Suryadiputra 2004).*

(9) Once the process of fastening the bolts and cutting the tops was completed, the block was ready to be lined with geotextile and then filled with the soil bags.

d) Attaching a Layer of Impermeable Cloth (Geotextile)

After the wooden structure was completed, a layer of impermeable cloth, or geotextile, was attached. Using geotextile was intended to reduce seepage of water through the block. Geotextile was attached to the walls of each chamber of the block.

e) Filling the Block with Earth Filled Sacks

Once the wooden block structure was lined with geotextile, the chambers of the block were filled with sacks of soil that had been prepared ahead of time. These sacks were put into the chambers in an orderly fashion in an attempt to ensure that the entire space of the block was completely filled, right to the top. A total of 24,062 soil sacks were used for block SPI-1 No 1, and 25,372 were used for block SPI-1 No. 2.

f) Finishing

The last stage of construction involved arranging the soil sacks so that they looked orderly.

Illustration 34. *Block SPP-SPU7 after being filled with soil sacks(Photograph: Suryadiputra 2004).*

Illustration 35. *Block SPI-1 No1. after completion (Photograph: Alue Dohong 2004).*

C. Post Construction Stage

a) Monitoring Water Level Change

In order to determine the effectiveness of the block in raising the ground water level of the nearby peatland, a system of simple bores was installed using PVC pipes in the peat on the left and right side of the blocks. Monitoring of the soil water level was carried out near blocks SPI-1 No. 1 and No. 2, as a model. A total of 48 PVC pipes were installed near the two blocks. The distribution is shown in the illustration below.

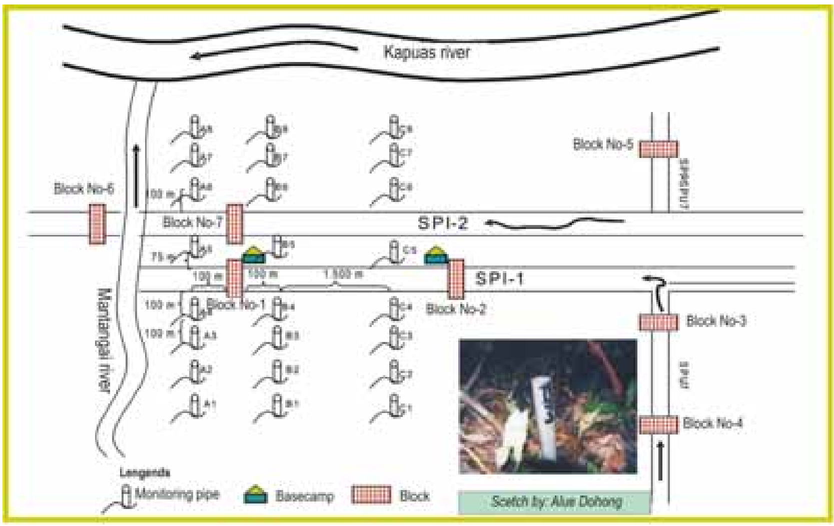


Illustration 36. *Location of the bores/pipes to measure ground water change near the blocks on SPI-1 and SPI-2*

Measuring and noting the fluctuations of water in the monitoring bores was carried out every week by field staff and reported back to the project coordination at the end of every month.

In addition to this, in order to monitor the level of water in the canal both downstream and upstream of the block, measuring meters made from wood were installed both above and below the blocks. Measurements were taken and recorded every day.

The results of the data gathered on the water fluctuation in the monitoring bores between May–July 2004 is shown in *Illustration 37 (note: these activities were on-going at the time this book was published)*.

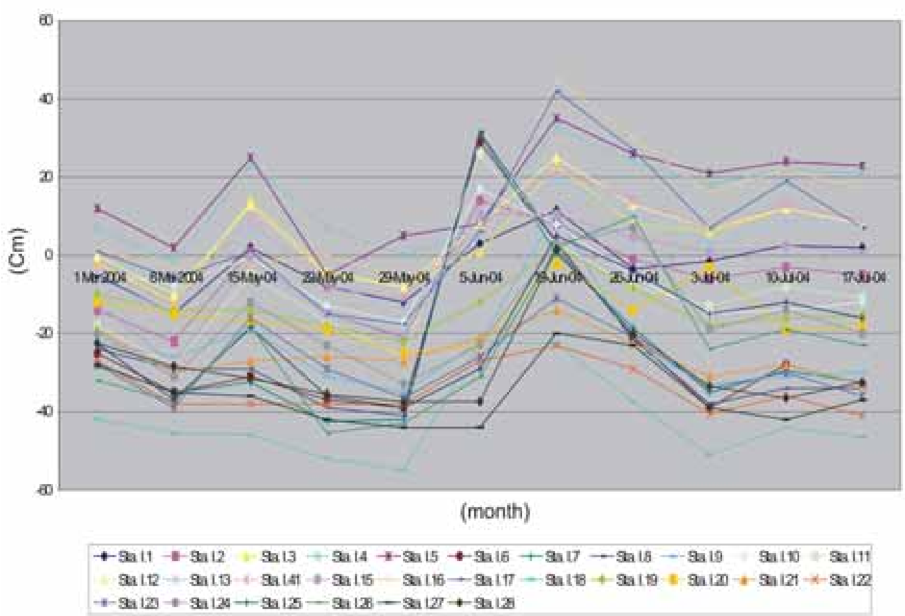


Illustration 37. *Graph Showing the Fluctuation of Water in the Monitoring Pipes Block SPI1 No.1, May – July 2004*

Illustration 38 shows the difference between the water level on the downstream and upstream sides of block SPI-1 No.1 within December 2004 – August 2005.

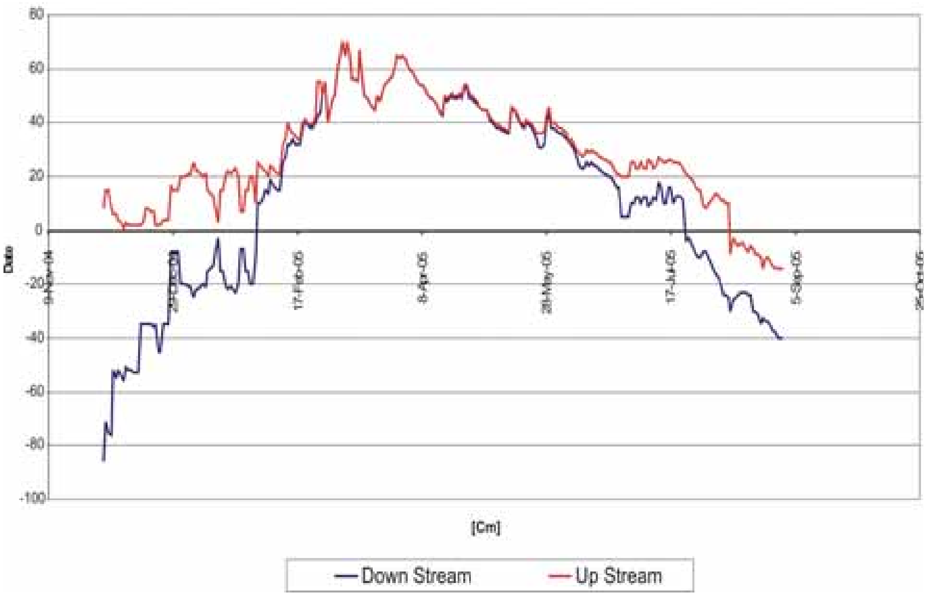


Illustration 38. *Graph Showing the Difference Between the Upstream and Downstream Water Levels at Block SPI-1 No1. During December 2004 – Aug 2005.*

b) Monitoring and Water Quality Analysis

In order to monitor the impact of the blocks on the physical quality and chemical parameters of the water, four sets of samples were drawn (one each in September 2003, February 2004, June 2004 and December 2004). Samples were taken from three locations: station 1 was between blocks 1 and 2; station 2 below block 1; and station 3 at the intersection of the SPI-1 canal and the Mentangai River. The results of the water quality analysis are shown in the table below.

Table 8. Results of Measurement and Analysis of Physical and Chemical Qualities of Water at the Blocking Locations, ex- MRP

Physical Parameters	Station	Sept 03	Feb 04	June 04	Dec 04
Temperature (oC)	*1*	34.00	27.09	26.90	27.08
	2	34.00	28.28	28.67	28.92
	3	30.00	27.19	28.50	28.28
Clarity (cm)	*1*	34.00	40.00	53.00	-
	2	36.00	30.00	80.00	-
	3	35.00	50.00	80.00	-
Electrical Conductivity (µS/cm)	*1*	44.00	53.00	53.00	79.00
	2	37.00	49.00	71.90	78.00
	3	39.00	37.00	67.50	75.00
Turbidity (NTU)	*1*	7.35	24.50	3.70	-
	2	3.20	18.20	31.50	-
	3	4.22	22.20	44.80	-
Total Suspended Solid (mg/l)	*1*	120	89.00	42.00	8.00
	2	70	187.00	53.00	7.00
	3	70	70.00	54.00	3.00
Chemical Parameters	**Station**	**Sept 03**	**Feb 04**	**June 04**	**Dec 04**
pH	*1*	3.98	3.67	3.76	3.56
	2	4.08	3.72	3.68	3.40
	3	4.22	3.8	3.63	3.48
DO (mg/l)	*1*	4.8	3.89	7.4	2.65
	2	4.63	3.93	7.95	3.58
	3	4.92	3.39	7.46	3.03
CO2	*1*	12.48	1.65	0.55	-
	2	9.99	1.10	0.55	-
	3	8.74	2.75	1.10	-
Fe	*1*	0.973	0.31	0.3254	-
	2	0.667	0.32	0.3527	-
	3	0.706	0.29	0.4381	-
Sulphide	*1*	1.44	0.016	0.0092	-
	2	2.72	0.02	0.0116	-
	3	0.96	0.056	0.0085	-
BOD5	*1*	-	6.31	1.3514	-
	2	-	12.61	9.009	-
	3	-	18.02	9.9099	-

Notes: *- = no measurement taken; DO = dissolved oxygen;*
BOD = biological oxygen demand; TSS = total suspended solid;
ST = station where the samples were taken

From the table above it is evident that the majority of water quality parameters during the rainy season (February and December) and the dry season (June and September) do not show any meaningful differences. This is not, however, the case with pH and dissolved oxygen. During the rainy season the pH of the water is slightly more acidic (pH 3.40 – 3.80) and the dissolved oxygen content is lower (2.65 – 3.93 mg) when compared to the dry season (pH 3.63 – 4.22 and DO 4.63 – 7.95). It is thought that this occurs because of the acidic and oxygen poor humic acid that is washed from the peat into the blocked canal during the rainy season.

The blocking (which was completed in June 2004) did not cause a change in the quality of the water between the downstream station (ST2) and the upstream station (ST2), except for the DO parameter, where the concentration was slightly higher downstream (3.58 mg O2/l) than upstream (2.65 mg O2/l). The DO level on the downstream side of block one is thought to be due to the turbulence of the water falling from the upstream side to the downstream side of the block.

The most interesting impact of blocking was the drastic reduction in the TSS value in canal SPI-1. The level fluctuated between 70-187 mg/l prior to blocking (September 2003 – February 2004) and fell to 42-54 mg/l in June 2004, after the block had been built. It went down even further (3-8mg/l) in December 2004 (when the block had been in place for six months). From this, it can be concluded that the presence of the block led to the reduction of the TSS in the water. The suspended solids are thought to have settled in the SPI-1 canal. This will have a positive impact, because over time the depth of the canal which has been blocked will decrease due to the settling of the suspended peat particles, meaning that at some point the entire canal that was blocked will be filled in and the peatland ecosystem that was previously drained will recover more quickly.

The process of accumulating peat material and effectively expanding the block can be expedited by planting water plants (such as pandanus, which is often found in swamp areas) in the blocked canal. The water plants will reduce the water flow, so that the pressure on the block in reduced and suspended material will settle more quickly. In addition to these benefits, the plants will provide habitat for fish spawning, and protection for fish fry and other wildlife.

There are also positive implications from the conductivity parameter (DHL). After blocking, the conductivity value increased to 53-78 μS/cm (June and December 2004) compared to a previous value of only 37 – 53 μS/cm (September 2003 and February 2004, prior to canal blocking). This condition is favourable for rehabilitation activities near the block, because the higher level of dissolved salt in the water is thought to support growth of vegetation planted near the blocked canal.

c) *Monitoring aquatic biota (fish)*

One positive impact of blocking the canal/ditch was that the enclosed area could be used as a fish pond. Physically these ponds resemble the *beje* ponds which are frequently found in peatlands in Central Kalimantan. Like the *beje,* the canal ponds can be used to catch fish. When the nearby river and surrounding areas experience flooding, the fish are carried inland by the flood waters. When the water level falls, fish are trapped in the ponds. These fish can be used as "savings" for the owner of the ponds, meaning that they can be harvested in stages once the dry season arrives. Fish cages where cultivated fish are raised can also be built for use in the blocked canals. This makes harvesting the fish easier. (note: wild fish such as giant snakehead should not be cultivated in the cages by feeding them small fish from the wild, because this will reduce the biodiversity of the fish species in the nearby waters).

Illustration 39. *Fish cages in the canal. The total number should be limited in order not to compromise the water quality in the canal (Photograph: Yus Rusina Noor 2004)*

Canals SPI-1 and SPI-2 cut across the Mentangai River, meaning that studying the fisheries aspect of the two canals also involves the condition of fisheries in the river. Before and after blocking the canals on the SPI-1 canal, a fisheries team carried out a number of surveys. The surveys provided data on fish populations as shown in the table 9 below.

Table 9. Species of fish in the Mentangai River (at the intersection with SPI-1 and SPI-2)*

No.	Common Name	Latin Name	Local Name in Central Kalimantan
1	Giant malayan catfish	*Wallago Leeri*	Tampahas/tapah
2	Giant snakehead	*Channa micropeltes*	Tahoman/toman
3	Snakehead	*Channa pleurophthalmus*	Karandang
4	Snakehead	*Channa melanopterus*	Kihung
5	Snakehead	*Channa sp.*	Mihau
6	Javan combtail	*Belontia hasselti*	Kakapar/kapar

No.	Common Name	Latin Name	Local Name in Central Kalimantan
7	Mud perch	*Pristolepis grootii*	Patung
8	Catfish	*Kryptoterus lais*	Lais
9	River catfish	*Macrones nemurus*	Baung
10	(Grey knife fish, Featherback	*Notopterus lopis/Chitala lopis*	Balida
11	? Babat	?	Babat
12	Striped snakehead	*Channa striata*	Behau
13	Kissing gouramy	*Helostoma temminckii*	Tambakan
14	Climbing perch	*Anabas testudineus*	Papuyu
15	Three-spot gouramy	*Trichogaster trichopterus*	Sapat
16	Rasbora	*Rasbora sp*	Saluang
17	Prawn	?	Undand capit
18	Halfbeak	*Hemirhamphodon* sp.	Jajulung
19	? Tabute	?	Tabute
20	? Tatawun	?	Tatawun
21	Long-nosed spiny eel	*Macrgonathus aculeatus*	Telan/Sili
22	Swamp eel	*Monopterus albus*	Lindung
23	Common walking catfish	*Clarias batrachus*	Pentet
24	Carp	*Osteochilus sp*	Puyau
25	? Tamparahung	?	Tamparahung
26	Fighting fish	*Betta picta*	Tampala
27	Lesser-striped barb	*Puntilus lineatus*	Tambayuk
28	Rasbora	*Parachela oxygastroides*	Saribulu
29	?	?	Dasai

*) Results of a survey by Haryuni, 2004. Progress report, survey of fisheries for the CCFPI Project/ WIIP, 2004 (unpublished)

Fish that were frequently found in canal SPI-1 (results of a field survey by Kembarawati in September 2003, before the blocks were built) included striped snakehead (*Chana striata*), climbing perch (*Anabas testudineus*), rasbora (*Rasbora sp*), three-spot gouramy(*Trichogaster sp*), Javan combtail (*Belontia hasselti*) and common walking catfish (*Clarias sp*). After the blocking was completed in June 2004, it is estimated that the number of species and population density of certain species increased, such as, for example, rasbora, which are found in large numbers near the blocks.

d) *Planting seedlings on the banks of the blocked canals*

In order to speed up the ecological recovery of the peat in the vicinity of the blocked canal, rehabilitation

activities were carried out using seedlings of local trees which were taken from nearby locations or were prepared in a seedling nursery. The rehabilitation activity had two purposes: i) to strengthen the block and ii) to speed up ecological recovery of the area around the blocked canal.

A variety of species were planted in the vicinity of the base camp, near the block itself and along the right and left banks of the blocked SPI-1. A number of the seedlings were prepared several months prior to planting in a semi-permanent nursery. Wild belangiran seedlings, which were abundant near the Mentangai River, were used. The seedlings were not simply uprooted and planted immediately, but were given special treatment, including cutting a large number of the leaves and roots that were too long. The purpose of this was to reduce evaporation. When they were ready, the wild belangiran seedlings were uprooted carefully and planted in the rehabilitation area as quickly as possible. Several days after planting the majority of the belangiran seedlings appeared to have died, but after several more days resprouting became apparent as new shoots appeared from the bottom of the seedlings and spread upward. The appearance of the new shoots indicated that the natural seedlings had passed the critical time and would survive. In addition to belangiran, other wild seedlings that were used included pandanus and sago palm.

<u>*Planting near the camp*</u>

Approximately 200 plants were planted near the camp. These included *Peronema canescens, Hibiscus spp.,* wild rambutan *Nephelium mutabili*, jelutung *Dyera lowii,* pulai *Alstonia pneumatophora* and belangiran *Shorea belangeran*. A number of the plants (especially *Peronema canescens*) were planted on mounds that were built for that purpose. The total survival rate of plants near the camp was estimated to be 95%.

Illustration 40. *Sungkai plants on mounds near the camp at SPI-1 (left, December 2004; right, March 2005). (Photograph: Suryadiputra)*

<u>*Planting near the block*</u>

As the block is constructed of wood, and wood weathers, the blocks have a limited lifespan. In order that the blocks will last longer, it is necessary to plant vegetation on top of the block, and in front and behind and on the nearby land, as shown in the sketch below.

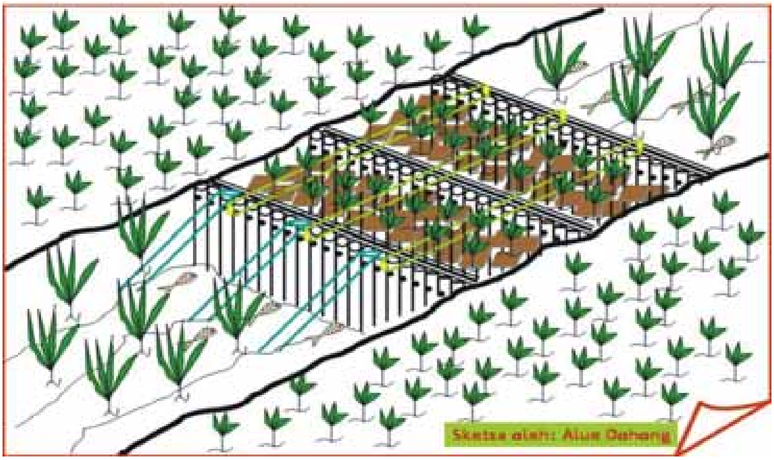


Illustration 41. *Sketch of Planned Rehabilitation near a Block*

The type of vegetation planted above and below the block in the canal included pandanus (*Pandanus atrocarpus*). On the left and right of the block, vegetation planted included belangiran (*Shorea blangiran*), perupuk and tumih (*Combretocarpus retundatus*). Pandanus was chosen because it is good at holding sediment, grows quickly, and is a favoured spawning habitat for fish.

<u>Planting along the length of the canal</u>

Planting took place along the right and left banks of the canal inland for 10-20 metres from the bank with a distance of 4 x 4 metres between plants. Most of the plants were belangiran, with the remainder being terentang *Campnosperma auriculata*. The results of planting in this location were very different from the results close to the camp. Based on monitoring in December 2004, the mortality rate was very high, reaching 70%. Most of the seedlings that survived were planted close to the bank of the canal. Almost all of the seedlings that were planted on piled up peat, or further from the canal (10-20 metres), died. From observing the symptoms, it is evident that a number of the belangiran seedlings were attacked by termites. Several of the dead seedlings were uprooted, and there was termite damage evident on the lower stem running down to the roots. In fact, on some of the plants the termites were seen in action on newly planted seedlings.

Illustration 42. *Belangiran from the wild which were planted close to the banks of the blocked SPI (Photograph: Suryadiputra. Dec 2004)*

<u>*Spread and condition of vegetation near the canal*</u>

The pre-blocking pattern of vegetation spread on the right and left of the SPI-1 was uniform and unusual. A 10-20 metre band along the length of the canal's bank was clear, with almost no vegetation. Shrub land vegetation grew beyond this band. This vegetation was dominated by four types of fern, *Stenochlaena palustris, Blchnum indicum, Lygodium scadens,* and *Gleichnia linearis.* These ferns comprised about 90% of the total vegetation.

Illustration 43. *Condition of vegetation to the left and right of the canal (Photograph: Suryadiputra, March 2005)*

The other original vegetation that survived well and regenerated was *Barringtonia racemosa*.

A monitoring plot of 40m x 100m was made behind the camp. The abundance of vegetation in the plot is shown in Table 10 below.

Table 10. Species and number of trees in the 40m X 100m plot behind the camp at block 1, SPI-1

No	Species	Total	Percentage
1	*Barringtonia racemosa*	157	62.5%
2	*Melastoma malabathricum*	71	28.3%
3	*Eugenia/Zizygium cerina*	11	4.4%
4	*Eugenia/Zizygium spicata*	9	3.56%
5	*Ficus microcarpa*	2	0.7%
6	*Alseodaphne umbeliflora.*	1	0.4%
	Total	251	100%

Climbing vegetation found in the area included *Uncaria*, *Nepenthes spp.* and *Ficus microcarpa.* In addition to these plants, an important finding near the camp was the presence of *Lasia spinhosa,* which lives in colonies.

<u>*Building a nursery and preparing seedlings*</u>

One seedling nursery was built at the camp on SPI-1. The installations and equipment were very limited. The stock of seedlings as of December 2004 included:

❒	Belangiran *Shorea belangiran*	:	2000 plants
❒	Jelutung *Dyera lowii*	:	850 plants
❒	Bintangur *Callophylum spp.*	:	500 plants
❒	Sungkai *Peronema canescens*	:	40 plants
❒	Meranti telur	:	250 plants
❒	Terentang *Campnosperma spp*	:	50 plants
❒	Arang-arang *Dyospiros spp.*	:	50 plants
❒	Rambutan *Nephelium mutabile*	:	50 plants
	Total	:	3790 plants

Illustration 44. *A seedling nursery was set up at the camp on the SPI (Photograph: Suryadiputra. Dec 2004)*

A number of the species above (results of monitoring in March 2005) were planted near the blocked area of the SPI-1. Although at the time of monitoring the water level of the canal was overflowing, flooding the nearby peatland (see Illustration 45 below), a number of the seedlings (especially belangiran, terentang and sungkai) were still growing well. It appears that these species are able to withstand the conditions of land that floods.

Illustration 45. *The nursery during a flooded period (Photograph: Suryadiputra March 2005)*

e) Monitoring and maintenance of the blocks

In addition to monitoring the vegetation that grows near the block, monitoring was also carried out to check the condition of the block itself. This was intended to ascertain the physical condition of the block, and determine whether it was still holding back water. Monitoring should be carried out routinely, within relatively short time spans (for example, once a month). The earlier any damage to the block is identified, the easier and cheaper it will be to repair. Severe damage could severely reduce the ability of the block to hold water or could even eliminate it altogether.

To date a number of technical problems have been found on the blocks on SPI-1 including, among others: i) as a result of water pressure the horizontal poles bent, especially in the central part of the block; ii) there was seepage at the bottom of the block under the layer of soil sacks. This was caused by the sacks swelling, and also by remnants of tree stumps and pieces of wood which caused there to be gaps in the bottom layer of the block; iii) there was erosion/seepage of water past the side of the block, especially when the rate of water flow was strong, resulting in the water eating away at the peat on the side, and ultimately forming new cavities which acted as channels for the water.

Illustration 46. *Strong water flow at block 2, SPI-1 slightly erodes peat on the side (Photograph: Suryadiputra, March 2005)*

To overcome the three technical problems above, the following measures were taken: i) building several chambers when constructing the block (technical design model two/TDM-2) and using a multiple bracing system. In addition, in order to avoid bending, a steel or semi-steel wire can be used to pull from the centre of the block; ii) recompress the soil bags and discard pieces of wood found in the block so that the water no longer seeps out underneath; and iii) make a spillway in the centre of the block by moving several of the soil bags away from the centre so that the excess water can flow out, and/or dig small ditches off to the left and right of the canal that carry away excess water from the canal into the nearby peat.

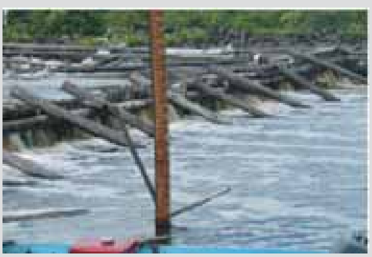
If any of the poles are damaged or break, it is necessary to replace the wood as soon as possible. For example, if one of the horizontal or bracing poles breaks, it must be immediately replaced so that the strength of the entire block is not compromised. If there is seepage at the side of the block, soil sacks should be piled in the area in order to channel the water back to the centre where it can be released by the spillway.

Box 8.

Tabat 1, with a width of 27 metres, used the TDM 1. This was the first block built by the CCFPI project in the SPI-1 and was completed in June 2004 (see picture a). During the rainy season in October 2004, when the discharge rate and current of SPI-1 increased, the block bowed (picture b). However, the current did not break the block. This indicates that the belangeran wood used as the main construction material was strong enough to withstand the pressure of the water. In November 2004, a strengthening cable was attached from either side of the block to stakes in the ground. Several supporting posts were also added to the outside wall of the block, on the downstream side. These actions served to restore the form of the block, so that it was straight and held back water in the canal (picture c). In fact, the blocked section of canal was used for parking the BOSF patrol plane (picture d).

Picture (a)

Picture (b)



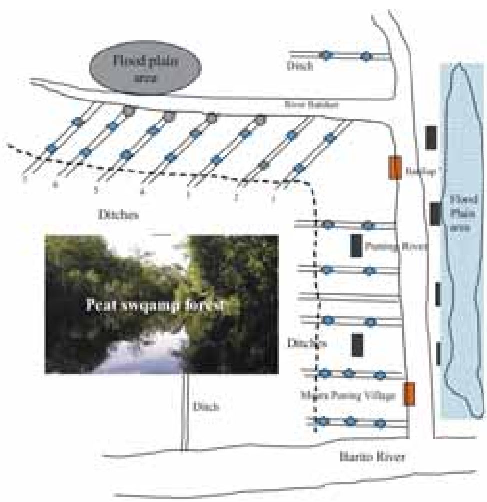
Picture (c)

Picture (d)

6.2 BLOCKING DITCHES IN PUNING AREA, SOUTH BARITO

This section will explain about ditch blocking activities that were undertaken by the CCFPI project in the Black Water Ecosystem of Puning River, specifically in the sub-village of Muara Puning and the village of Batilap. Administratively, Muara Puning and Batilap are part of the Sub-District of Dusun Hilir in the District of South Barito.

Illustration 47. *Map of Sungai Puning (top) and position of ditches (bottom)*



In these two areas there are many small ditches owned by individuals or groups. The main function of these ditches is to facilitate the transport of illegal logs from the peat swamp forest behind the sub-village and village. Ditch owners typically have capital, and act as the intermediaries for the illegal logging trade.

The presence of the ditches leads to a number of problems, including the continuous runoff of large amounts of subsurface and surface water from the peatlands into Puning River. As a result, the peat swamp forest in these two areas is very dry in the dry season and burns almost every year.

Another negative impact is the sedimentation of the “small lakes” and Bateken River (a tributary of Puning River) which are a source of fish for local residents. (note: local residents call the section of the Bateken River where the water spreads out during the rainy season a lake. In fact, it is not a lake but a flood plain). The sedimentation of the small lakes and river occurs because when the ditches are dug, particles of peat are carried by the water into the Bateken River. In addition, material from the peat swamp forest is also carried by the water current in the ditches towards the Bateken River. As a result, the lakes, which used to be a spawning, hiding and rearing ground for fish fry have, over time, become shallower, with the result that the productivity of the fishery has tended to decline year by year.

In order to address the negative impacts of the ditches in sub-village Muara Puning and village Batilap, one approach has been to block the ditches.

Blocking activities in the Black Water Ecosystem of Puning River were carried out in three main stages: **pre-construction, construction** and **post construction (monitoring and maintenance)**. Details of the types of activities and implementation are provided below.

A. Pre-Construction Stage

The pre-construction stage involved:

a) Socialization of the Blocking Programme

Socialization of the ditch blocking concept was carried out during a meeting on the 8th of September 2003 in sub-village Muara Puning and on 11th September 2003 in Batilap village. During the socialization phase, participants in the meetings appeared to understand and have a high awareness of the purpose and importance of blocking the ditches in their area. The level of understanding and awareness was shown by the spontaneous offer from Mr. Husniasyah and Mr. Reno, two residents of Muara Puning, and Mr. Arbani, a resident of Batilap, to block their ditches.

Socialization of the blocking program was also carried out during the yearly meeting of members of the People's Organization (PO) in Buntok on the 29th of April 2004. During this meeting, two villages (Batampang and Batilap) and one sub-village (Muara Puning) put forward their plans for ditch blocking. [note: the PO is part of the organizational structure of Yayasan Komunitas Sungai (Yakomsu). This foundation was formerly named the Sekretariat Bersama (Sekber) Buntok. In the Black Water Ecosystem of Sungai Puning, there are community organizations in Batilap, sub-village Simpang Telo, Batampang and sub-village Muara Puning (Teluk Timbau village). There are also POs in the Black Water Ecosystem of Barito River. The purpose of the POs is to provide a means for the local people to have their aspirations heard. Yakomsu, which is in the town of Buntok, routinely provides direction and support to each of the POs.]

Illustration 48. *Socialization of the Ditch Blocking Program in Muara Puning Sub-Village. Attended by members of the PO (Photograph: Alue Dohong, 2003).*

In addition to meetings, socialization was also carried out by distributing the brochure *Standard Operational Procedure (SOP) for Blocking Ditches,* the book *Manual for Community-Based Blocking of Ditches and Canals in Peatland,* and the comic *Cakra* (the edition which tells the story of Cakra's adventures in peatlands). Distribution of this material to the community was intended to allow people to learn about the ditch blocking program themselves. Socialization does not always have to be formal, but can also be carried out on a one-to-one basis in a relaxed atmosphere. (Note: the *Cakra* comic is a children's comic filled with environmental messages aimed at saving peat swamp forests. The comic also identifies the dangers of ditches in peat and the fact that they can lead to a loss of water, leaving the peat dry and at risk from fire).

b) Identifying the Number, Dimensions and Owners of the Ditches

During the socialization meeting in September 2003, three ditches owned by residents of Muara Puning and Batilap were identified as being ready for blocking. The three ditches were Ramunia ditch, owned by Mr. Husniansyah, the Head of sub-village Sungai Puning, Balunuk ditch, owned by Mr. Reno, and a ditch owned by Mr. Arbani of Batilap village. The ditches were no longer in use and the owners voluntarily put forward their ditches for blocking.

During the yearly meeting of the PO in Buntok on the 29th of April 2004, three more ditches in Muara Puning, one in Batampang and seven in Batilap village were proposed for blocking. The three ditches in Muara Puning were owned collectively, while the one in Batampang and seven in Batilap were owned by individuals.

From the results of the meetings in September 2003 and April 2004, the total number and location of the ditches recommended and ready for blocking in the Black Water Ecosystem of Puning River was identified as shown below in tables 11 and 12.

Table 11. Total Ditches Recommended for Blocking in Black Water Ecosystem, Puning River (2003-2004)

No	Name of Village/ Sub-Village	Number of Ditches
1.	Muara Puning Village	5
2.	Batilap Village (on Bateken River, a tributary of Puning River)	8
3.	Batampang Village	1
4.	Bintang Kurung Sub-Village (ditches in this location were merely blocked by local people initiative after they saw the positive impacts of the ditch blockings in the three villages mentioned above).	4
	Total	18

Table 12. Location, Number and Coordinates of Blocks in Black Water Ecosystem, Puning River

Village/ Sub-village	No./Name of Ditch	Block No.1		Block No.2		Block No.3	
		South Latitude	East Longitude	South Latitude			South Latitude
Batilap/Beteken	Ditch No.1	02°01’44.2”	114°47’26.1”	?	?	✡	✡
	Ditch No.2	02°01’42.6”	114°47’22.4”	?	?	✡	✡
	Ditch No.3	02°01’34.5”	114°47’12.0”	?	?	✡	✡
	Ditch No.4	02°01’06.8”	114°46’31.4”	?	?	✡	✡
	Ditch No.5	02°01’05.4”	114°46’26.4”	?	?	✡	✡
	Ditch No.6	02°01’03.8”	114°46’23.1”	02°01’07.9”	114°46’18.7”	✡	✡
	Ditch No. 7	02°00’59.3”	114°46’17.6”	02°00’58.2”	114°46’11.0”	✡	✡
	Ijul Ditch (no 8)	?	?	?	?	✡	✡
Muara Puning	Ramunia	02°05’48.1”	114°50’46.0”	02°05’47.0”	114°50’37.8”	?	?
	Balunuk	02°05’34.7”	114°50’40.0”	02°05’34.6”	114°50’34.3”	?	?
	Masanggar Bsr	?	?	?	?	?	?
	Masanggar Kcl	?	?	?	?	?	?
	Gergajian	?	?	?	?	?	?
Batampang	Karanen Ditch	?	?	?	?	✡	✡
Explanation:	? = *Block, but coordinates are not available*						
	✡ = *No block.* *Block coordinates at Bintang Kurung sub village not available.*						

The ditches in the locations identified above were relatively small, with a width of between 1 – 2 metres, a depth of between 0.75-1.5 metres and a length of 3-7 kilometres (see illustration 49).


Illustration 49. *Dimensions of the Ditches in the Black Water Ecosystem, Puning River. (Photograph: Suryadiputra 2004)*

c) *Process of Obtaining Permission*

Before blocking the ditches in the Black Water Ecosystem of Puning River two types of permission were obtained, including: i) a letter from the owner of the ditch, and ii) a letter from the village authorities. These documents were obtained for all the ditches that were blocked. The documents provide strong proof that the activity was approved by both the owner of the ditch and the village authorities, if at some point the owner opens the blocks. These documents can be used as reference in following up any violations.

B. Construction Stage

The construction of the blocks did not take much time, and was not as complicated as blocking the canals in the ex-MRP (see the section following this one). The design of the blocks in the Puning River area was relatively simple, and the blocks were easily built by local people. The processes of socialization, negotiation and obtaining permission to build the blocks took a relatively long time.

The blocks were constructed in three stages, as shown in the table 13 below.

Table 13. Stages in Constructing Blocks in the Black Water Ecosystem of Sungai Puning

Stage	Time Required	Village/ Sub-Village	Number of Ditches	Number of Blocks/ Ditch	Total Number of Blocks
Stage I	8-11 September 2003	Muara Puning Sub-Village	2	3	6
		Batilap Village	1	2	2
Stage II	23-24 June 2004	Muara Puning Sub-Village	3	3	9
		Batampang Village	1	2	2
Stage III	30-31 August 2004	Batilap-Sei Bateken Village	7	2	14
Jumlah			14		33

a) Estimation of Labour and Materials

In general between four to six people were needed to build one block. Building three blocks in a ditch needed 12 – 18 people and did not require special qualifications or skills. It was useful, however, for the workers to at least have some knowledge of working with wood.

The material requirements were very much dependent on the dimensions of the ditch to be blocked.

The table 14 below shows the materials used to build one block in the area.

Table 14. Materials and Tools for Building One Block

No	Type of Material	Estimated Amount
1.	Wood Board (20 cm x 2 cm x 400 cm)	10 – 15 planks
2.	Wood Beams (⊘ 15 cm x 400 cm)	3-5
3.	Soil Sack (25 kg)	20-30 sacks
4.	Plastic Tarpaulin (2 metre x 4 metre)	1
5.	Nails	1-2 Kg
6.	Axe	1
7.	Machete	2
8.	Hand Saw	1-2
9.	Hoe	1-2
10.	Tape measure	1
11.	Hammer	1

b) Measuring in the Field

It was necessary to measure the dimensions of the ditch, including the width, depth and cross section. The measurements were needed to determine the quantity of materials required and the most appropriate design. In addition, measuring the dimensions also helped to identify the position and total number of blocks that was most appropriate for the slope of the land and speed of the water current. The steeper the slope the ditch was on or the stronger the current, the greater the number of blocks and the closer the distance between them. This was evident in Ramunia and Balunuk ditches in Muara Puning, where three blocks were built in each ditch.

c) Determining the Design of the Block

Because of the relatively small dimensions of the ditches, the composite dam (as shown in illustration 10 in the previous chapter) was the most appropriate design for the Black Water Ecosystem of Puning River.

d) Mobilization of Materials, Equipment and Labour

Mobilization of materials, equipment and people was carried out as the block was to be constructed.

e) Constructing the Block

The procedure for constructing the blocks consisted of the following steps:

i) Clearing the location to be blocked (twigs, branches and wood stumps in the ditch were removed)

ii) Two wood beams were inserted horizontally in the ditch. One was lowered to the bottom and the other placed across the top of the ditch. These beams were inserted far into the land on both sides of the ditch in order to ensure that they would be strong enough to support the vertical planks that would need to withstand the pressure of the water.

iii) The planks and beams were fastened vertically (slightly tilted upstream) and evenly and attached with nails to the horizontal beams.

iv) Activities ii) and iii) were repeated at a distance of approximately two metres downstream, so the block had the form of the letter U or a trapezoid.

v) The protrusions of wood at the top (see point iii) on both sides of the block were evened up using a saw. After this a plastic sheet was carefully attached, making sure that it did not rip.

vi) The part of the ditch that was blocked ("U" form) was filled with mineral soil or peat taken from a location some distance from the block.

vii) The earth in the block was tidied up so that it was even with the top of the block.

viii) Vegetation or seeds were planted in the soil.

Illustration 50. *Attaching the Plastic or Tarpaulin to the Wall of the Block (Photograph: Alue Dohong, 2003)*

Illustration 51. *Constructing the Block (Photograph: Suryadiputra, 2004).*

The above steps can be modified to reflect the conditions and situation in different locations.

Box 9

The photograph to the side shows ditch blocking activities in the sub-village of Muara Puning, Barito Selatan District, Central Kalimantan. This canal was unused and neglected and caused the surrounding peat to dry out, leaving it prone to fire. The area burned in 1998 and again in 2002. Materials that were easily available nearby were used for the block (wood logs, boards and compressed peat for the filling). Blocks were made at several locations, depending on the topography and slope of the land. The purpose was to raise the ground water level so that the peat would remain wet during the dry season, and therefore be difficult to burn. An rise in the ground water level would also support succession and rehabilitation of vegetation near the ditch. Most of the nearby land has been burnt over.

f) Installing Instruments to Monitor the Change in Ground Water, and to Measure Rainfall and Temperature

In order to evaluate the effectiveness of the block in raising the ground water level in the nearby peat, it was necessary to establish a monitoring system using a measuring board (Illustration 18) and monitoring bores using 1.5'' PVC pipes inserted into the peat (see illustration 17). (note: a ground water monitoring system was not established for all the ditches that were blocked in the Black Water Ecosystem area. This equipment was set up to act as a model near Ramunia ditch and Balunuk ditch in Sungai Puning sub-village.)

The locations of the bores for monitoring fluctuation in the ground water level are shown in Illustrations 52 and 53.

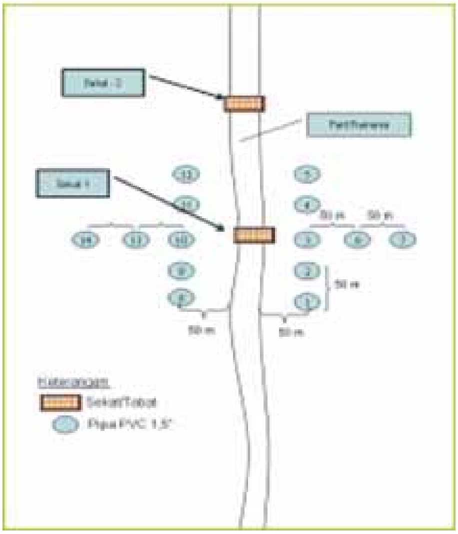


Illustration 52. *Position of ground water monitoring bores, Ramunia ditch*

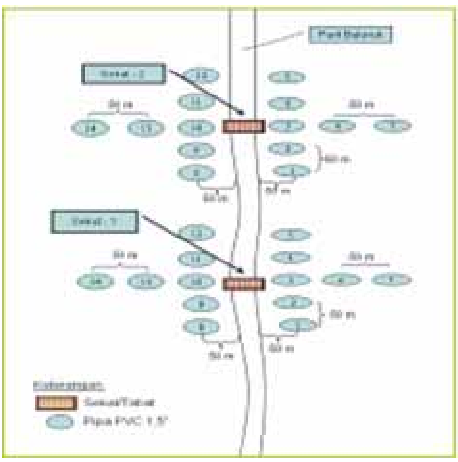


Illustration 53. *Position of ground water monitoring bores, Balunuk Ditch*

In addition to inserting the monitoring pipes, in Muara Puning sub-village a rain gauge and thermometer were also installed.

C. Post Construction Stage (Monitoring and Maintenance)

a) Assigning monitors and data collectors

Four people from the PO of Muara Puning were tasked with carrying out monitoring and hydrological data collection (as described above) near Ramunia ditch and Balunuk River. Data was collected twice a week and sent to the Kalimantan Site Coordinator of the CCFPI Project in Palangkaraya once a month via the office of Yakomsu. Monitoring began in September 2003 and was completed in September 2004. Before they started, the monitors were provided with a short training by a hydrologist on how to measure, record and report data.

Results of Water Level Measurement in the Ditches

The results of the difference in water level between the upstream and downstream sides of the blocks on Ramunia ditch (block 1 and block 2) are shown graphically in Illustration 54 and Illustration 55 below (the data is from September 2003 until July 2004).

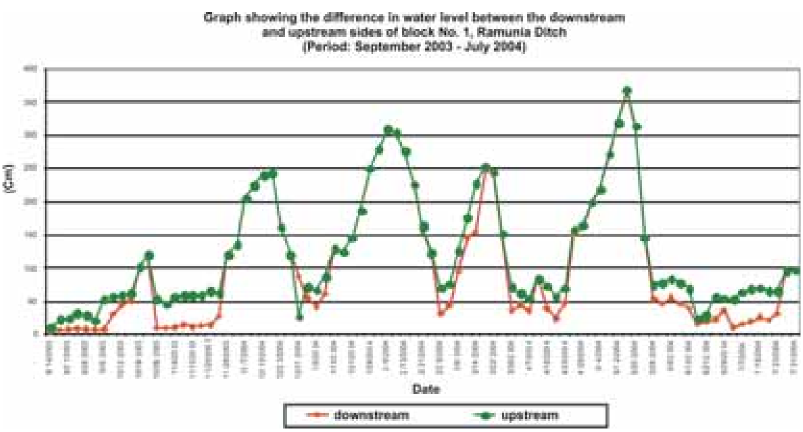


Illustration 54. *Graph showing the difference in water level between the downstream and upstream sides of block No. 1, Ramunia Ditch*

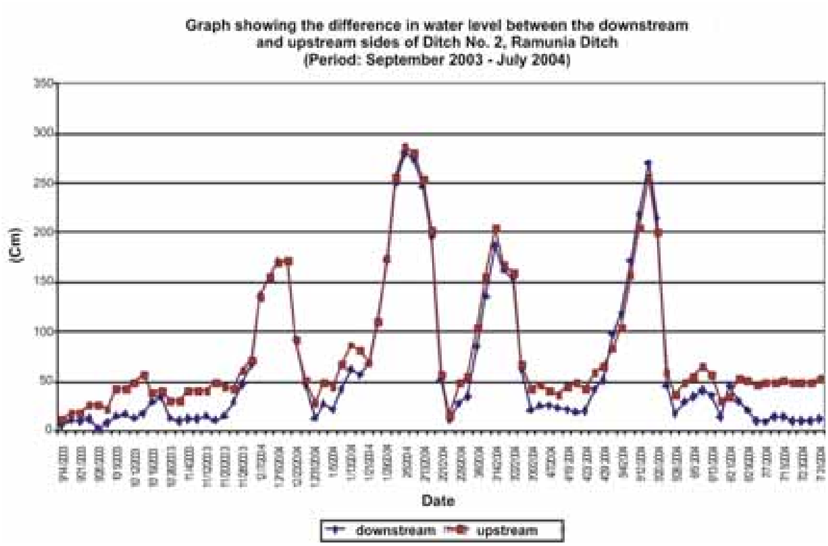


Illustration 55. *Graph showing the difference in water level between the downstream and upstream sides of ditch No. 2, Ramunia Ditch*

From the two graphs above it is evident that during the dry season (end of May until November) there is a difference in the water levels above and below the blocks of up to 40cm and the peat near the blocks remained wet (Illustration 56, left). This had the effect of reducing the likelihood of peatland fires during the dry season. In addition, in the two ditches that were blocked, many fish were trapped during the rainy season. The total number of fish trapped during one rainy season was reported as being more than 200kg for one section of a ditch approximately 500 metres long, 1.5 metres wide, and 70cm deep. More than 16 species were found (please refer to Table 9 for scientific names of the fishes), including: c*hanna striata*, kihung, mehaw, sepat rawa, seluang ekor merah, seluang ekor putih, kakapar, biawan, papuyuh hijau, papauyuh kuning, lele pendek, pentet/lele panjang, julung-julung, lais, kelatau took and tombok bander. (Illustration 56, right).

Illustration 56. *Difference in water level above and below the block (top) and fishing activity in the blocked section of Ramunia ditch (bottom) (Photograph: Suryadiputra, June 2004).*

During the rainy season (especially from December to February) the ditches overflowed to a depth of three metres (Illustration 57).

Illustration 57. *Ramunia ditch flooded during the rainy season (Photograph: Suryadiputra, December 2004).*

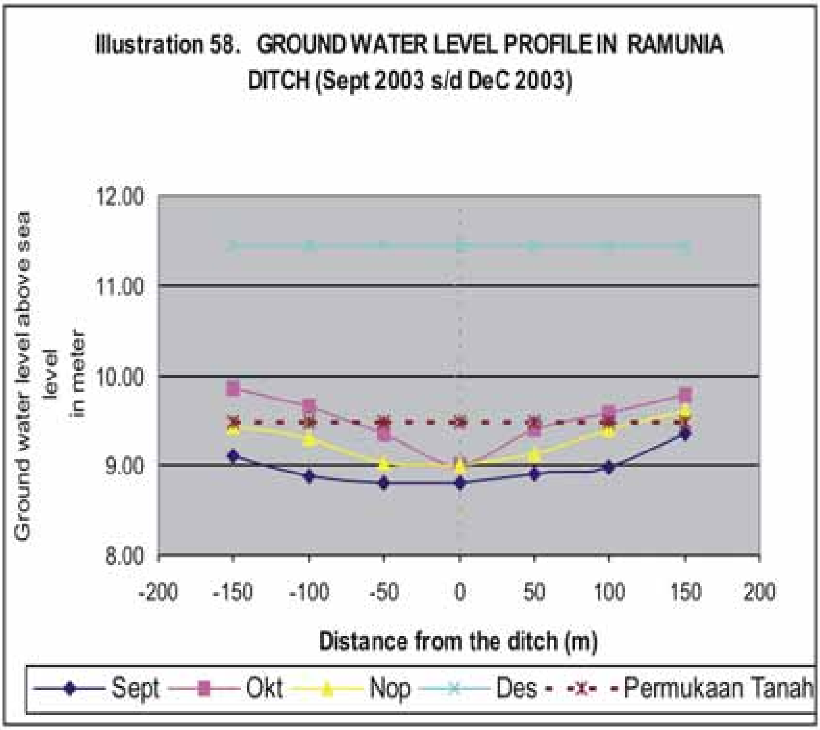


Illustration 58. GROUND WATER LEVEL PROFILE IN RAMUNIA DITCH (Sept 2003 s/d DeC 2003)
Ground water level above sea level in meter
12.00
11.00
10.00
9.00
8.00
-200
-150
-100
-50
0
50
100
150
200
Distance from the ditch (m)
Sept
Okt
Nop
Des
Permukaan Tanah

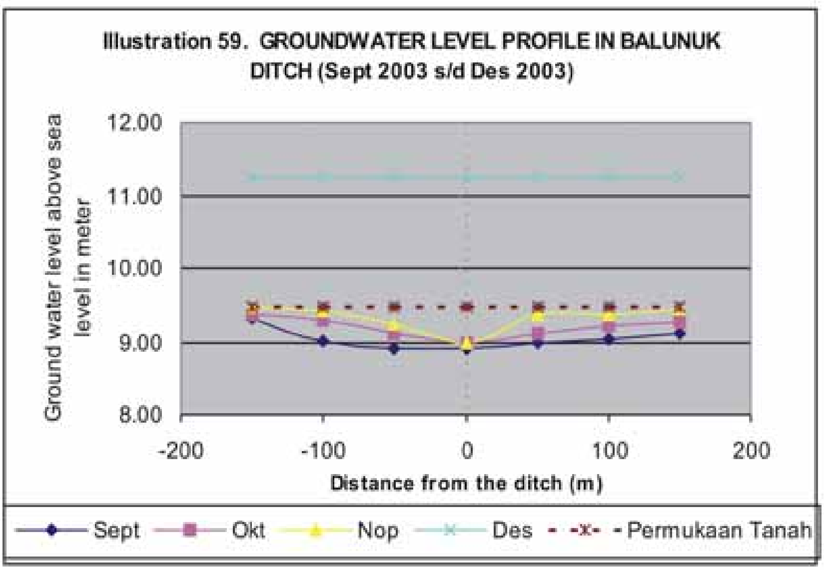


Illustration 59. GROUNDWATER LEVEL PROFILE IN BALUNUK DITCH (Sept 2003 s/d Des 2003)
Ground water level above sea level in meter
12.00
11.00
10.00
9.00
8.00
-200
-100
0
100
200
Distance from the ditch (m)
Sept
Okt
Nop
Des
Permukaan Tanah

The two graphs above show the change in ground water level in the peat near the blocked ditches of Ramunia and Balunuk (the data was collected from September to December 2003). The two graphs show a similarity in the

increase of the water table. The water increased in October (the beginning of the rainy season), and reached its highest level (where the water level was almost two metres above the level of the peat) in December. Although the data does not cover a full year (at the time this book was written not all the data had been analysed), at the time of field visits to the ditches in June and August 2004, the peat near the two locations was still wet as a result of the two blocked ditches (Illustration 56). In December 2004 the water level was three metres above the ditches, which is similar to the information from the year before (see Illustration 57).

b) Monitoring and Maintenance of the Blocks

The four people responsible for collecting data also routinely monitored the physical condition of the block and repaired any damage.

c) Monitoring Forest Fires and Changes in Water Quality

In addition to monitoring changes in the ground water level, there were also other monitoring activities such as monitoring for forest fires.

The collection and analysis of water quality from Balunuk and Ramunia ditches was carried out four times, with results shown in the following table.

Table 15. Frequency of Water Sample Collection from Ramunia and Balunuk Ditches 2003-2004

No.	Ditch	Month of Sampling	Total number of Samples
1.	**Ramunia Ditch**	*September* 2003	3
		February 2004	3
		June 2004	3
		December 2004	3
2.	**Balunuk Ditch**	*September* 2003	3
		February 2004	3
		June 2004	3
		December 2004	3

Samples were taken from three different locations on Ramunia and Balunuk ditches (from between blocks 1 and 2 – station 1; below block 1 – station 2 and from the mouth of the ditch where it flows into the Puning River – station 3). The locations of the sampling points are shown in the diagram 60 below.

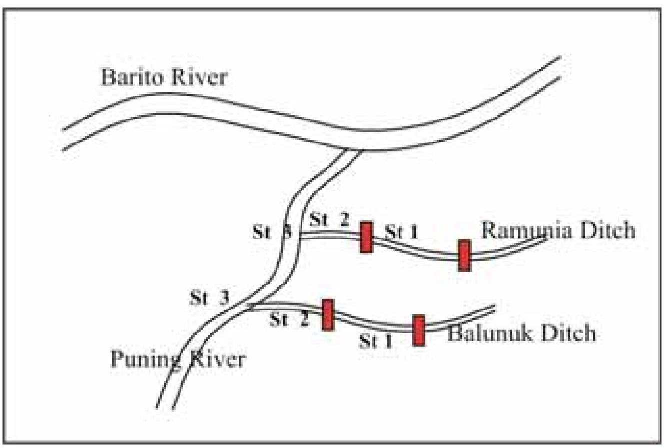


Illustration 60. *Sketch of the sampling points in Balunuk and Ramunia ditches*

The results of the laboratory analysis on the physical and chemical parameters of the four samples from Ramunia and Balunuk ditches are shown in the table 16 and 17 below.

Table 16. Water quality in Ramunia ditch from three sampling locations (above block 1, below block 1, and at the mouth of the ditch)

No	Parameter	Unit	Results of Measurements from Ramunia Ditch											
			St -1 (Between Blocks 1 and 2)				St -2 (Below Block 1)				Mouth of Ramunia Ditch			
			Sep 03	Feb 04	June o4	Range	Sep 03	Feb 04	June o4	Range	Sep 03	Feb 04	June o4	Range
Physical														
	Temperature	° C	28	29,76	26,46	26.5 – 29.8	28,5	28,96	26,72	26.72-28.96	32,0	29,52	29,05	29.05-32.0
	Electrical Conductivity (EC)	µS/cm	7,8	14	84,8	7.8 – 84.5	5,0	13	85,3	5-85.3	3,8	15	15	3.8 – 15
	Turbidity	NTU	7,52	32,1	14,7	7.52-32.1	16,71	40,1	30,3	16.71-40.1	-	26,5	73,9	26.5 – 73.9
	Total Suspended Solids/TSS	Mg/l	66	159	72	66-159	116	262	63	63-262	86	163	97	79 – 163
	Total Dissolved Solids /TDS	Mg/l	-		41	41	-		41	41	-		32,1	32.1
	Substrate		Debris		Debris		Debris		debris		Sand		Silt Clay	
Chemical														
	pH	-	3,82	4,38	3,75	3.75-4.38	4,52	4,71	3,70	3.70-4.71	6,30	4,39	4,20	4.20-6.30
	Dissolved Oxygen	Mg/l	1,0	7,19	7,84	1 – 7.84	1,60	7,54	7,99	1.60-7.99	3,70	5,63	7,85	3.70-7.85
	Free CO2	Mg/l	23,97	1,65	0,55	0,55-23.97	31,96	1,10	0,55	0.55-31.90	10,0	2,75	0,55	0.55-10
	Phosphates	Mg/l	0,529	-		0.529	0,770			0.770	0,551	-		0.551
	Nitrates	Mg/l	2,300	-		2.300	0,480			0.480	0,220	-		0.220
	Fe	Mg/l	0,668	1,03	0,7923	0.66-1.03	0,836	1,01	0,9207	0.836-1.01	1,116	1,17	1,7168	1.11-1.72
	Sulfide	Mg/l	1,280	0,031	0,0159	0.03-1.28	2,240	0,010	0,017	0.010-2.24	2,240	0,022	0,103	0.02-2.24
	BOD 5	Mg/l	-	10,81	11,26	10.81-11.26	-	27,00	11,71	11.71-27.00	-	11,71	8,1081	8.11-11.71
	COD	Mg/l	76,82			76.82	76,05			76.05	25,22			25.22

The table above shows a number of important parameters which merit further discussion. These include:

Water temperature: There was no significant difference in the temperature of the water above and below the blocks. The water at the mouth of Ramunia ditch was slightly warmer than the water near the block. It is postulated that this is because the water at the mouth was mixed with warmer river water.

Electrical Conductivity (EC): The result of the measurements show that at the mouth of the ditch the EC value fell. It is hypothesized that this is due to strong dilution from the Puning River. The data above shown that after the ditch was blocked the EC value in the ditch increased. The EC value in the ditch prior to blocking (September 2003) ranged from 3.8 – 7.8 µS/cm. Five to eight months after blocking (February and June 2004), the EC had increased three to ten times to 14 – 85 µS/cm. This situation is indirectly beneficial for efforts to increase the fertility of the peatland, because the higher the EC in the water, the higher the dissolved salt, which is good for rehabilitation efforts on peat (through, for example, planting of local vegetation) and also serves to increase the productivity of fisheries in the ditch.

Turbidity and suspended solids (TSS). These two parameters are very closely correlated. The higher the level of suspended solids in the water, the higher the turbidity. The data above shows that following the blocking activities the TSS value in the ditches increased. The TSS value prior to blocking (September 2003) was between 66-116 mg/l. Five and eight months after blocking (February and June 2004) the TSS in the ditch had increased 10–25% to 72-159 mg/l. This same trend was evident for turbidity. The value of the two parameters was lower in the blocked ditch and increased towards the mouth of the ditch. This shows that in the section of the ditch that was blocked (between blocks one and two) the characteristics of the water changed. The water was standing rather than flowing, which is thought to cause suspended solids in the ditch to settle. However, downstream of the block, where the overflow from the blocks caused turbulence, the TSS were suspended. The lower TSS level above the block (thought to be the result of sedimentation) compared to below the block is good for rehabilitation of the peatlands ecosystem on the one hand, because ultimately it is expected that the ditch will close naturally as a result of the settling of the suspended solids. However, it is also expected that the blocked ditch will provide a contribution to community livelihoods through an increase in fish catches, and for this reason the sediment should be removed from the ditch so that the blocked ditch can function optimally as a fish trap.

Substrate: The substrate at the bottom of the ditch is typically particles of peat. Closer to the mouth of the ditch (approach Puning river) the substrate is mineral soil. This reflects the small role played by Puning River in distributing mineral mud in the ditch.

pH. The water in the upper part of the ditch tended to be slightly more acidic than that towards the lower part. This might have been caused by the run off of peat water from the surrounding area leading to accumulation of humic acids in the water at the upper end of the blocked ditch. The presence of the block tended to result in an increase in the level of pH of the water. The level increased from 3.82 – 4.52 before the block (September 2003) to 4.38-4.71 five and eight months after the blocking (February and June 2004. The influence of Puning River at the mouth of the ditch is evident from the increase in the pH level of the water.

Dissolved oxygen. The level of dissolved O_2 tended to be higher below the block than above. This makes sense because as the water flows over the block it is agitated resulting in an infusion of O_2 from the air into the water, leading to an increase in the O_2 level in the water.

Free CO_2. The water in the ditch had a higher level of free CO_2 than the water near the mouth of the ditch. However, there was little difference in the level of free CO_2 in the water above and below the block.

Iron and sulfide. The value of these two parameters was relatively low, and does not indicate that there was pyrite oxidization. If there was pyrite oxidization nearby this would typically be indicated by a very low pH value (<2) and the store of sulfide could be hundreds of times higher than the level measured on the surface. The situation indicated that the quality of the water was still appropriate for fish.

BOD and COD. The value of these two parameters was higher in the blocked ditch when compared to the water near Puning River. This could have been caused by the fact that the peat water in the ditch had a higher level of organic matter than is found in the waters of the river.

<u>Conclusions</u>

The presence of the blocks in Ramunia ditch did not have a meaningful impact on the chemical qualities of the water. However, several physical parameters (such as TSS, turbidity and conductivity) were impacted. These three physical parameters showed that the presence of the blocks can speed up the process of sedimentation of suspended particles (generally comprised of fine peat particles) in the blocked ditch and this is ultimately expected to speed up the closing of the ditches and improvements to the nearby peatland ecosystem.

Table 17. Water quality in Balunuk ditch at three sampling points (above and below the block and at the mouth of the ditch)

No	Parameter	Unit	Measurements from Balunuk Ditch											
			St -2 (Below Block 1)				Mouth of Balunuk Ditch				Mouth of Balunuk Ditch			
			Sep 03	Feb 04	June o4	Range	Sep 03	Feb 04	June o4	Range	Sep 03	Feb 04	June o4	Range
Physical														
	Temperature	° C	34,0	29,52	28,53	28.53-34.0	31	28,90	28,79	28.79-31	30	28,90	29,68	28.9-29.68
	Electrical Conductivity	µS/cm	10,1	15	86,4	10.1-86.4	9,4	13	85,8	9.4-85.8	3,7	13	27,3/ 87?	3.7-87
	Turbidity	NTU	9	26,5	50,2	9-50.2	10,44	40,7	83,2	10.44-83.2	4,6	40,7	152	4.6-152
	Total Suspended Solids/TSS	Mg/l	66	163	69	66-163	246	80	86	80-246	204	80	116	80-204
	Total Dissolved Solids/TDS	Mg/l	-		41	41	-		40	40	-		13	13
	Substrate		Srsh				Srsh				Liat			
Chemical														
	pH	-	4,01	4,39	3,76	3.76-4.39	3,97	4,85	3,63	3.63-4.85	6,47	4,85	4,19	4.19-6.47
	Dissolved Oxygen	Mg/l	2,2	5,63	7,65	2.2-7.65	2,1	7,50	7,69	2.1-7.69	4,1	7,50	7,36	4.1-7.5
	Free CO2	Mg/l	29,96	2,75	0,55	0.55-29.96	27,97	1,1	0,55	0.55-27.97	7,99	1,1	0,55	0.55-7.99
	Phosphates	Mg/l	0,880			0.88	0,854	-	-	0.854	0,614			0.614
	Nitrates	Mg/l	1,520			1.52	1,780	-	-	1.780	0,280			0.28
	Fe	Mg/l	0,618	1,17	0,7211	0.618-1.17	0,642	1,30	0,9476	0.642-1.30	1,310	1,30	2,123	1.3-2.12
	Sulfide	Mg/l	0,880	0,022	0,0053	0.005-0.88	0,800	0,017	0,0032	0.0032-0.800	0,640	0,017	0,031	0.03-0.64
	BOD 5	Mg/l	-	11,71	18,018	11.71-18.018	-	25,23	9,009	9.0-25.23	-	25,23	8,108	8.10-25.23
	COD	Mg/l	74,88	-	-	74.88	75,27	-	-	74.88	72,20			72.2

The table above shows that the physical and chemical qualities of Balunuk ditch, both above and below the block, are similar to those in Ramunia ditch. This is due to the fact that Balunuk ditch is relatively close (approximately 500m) to Ramunia ditch. However, the value of TSS below the block in Balunuk ditch is higher than that in Ramunia, but the TSS value above the block is quite similar (66 – 159 mg/l).

Based on the conditions above, it can be concluded that the situation of Balunuk ditch is the same as that in Ramunia ditch. The blocking of Balunuk ditch did not in general affect the water quality, except the TSS value, which tended to be lower above the block. This indicates that there is a speeding up of sedimentation with the peat particles in the ditch, meaning that the ecological function of the peatland will improve more quickly.

[Note: The change in the movement of water in a canal/ditch from flowing to standing as a result of a block is hypothesized to increase the rate of sedimentation of peat particles. Over time this will lead to a sedimentation between the blocks, until finally the canal/ ditch will close naturally. From the perspective of the peatland ecosystem, this is beneficial. However, if the primary use of the blocked ditch is for fishing activities, as for example, with the *beje* ponds, then it is better that the sediment be removed from the ditch. This latter situation can also be beneficial for the peatland ecosystem because the presence of the water in the ditch, in addition to being good for fisheries, can also function during the dry season as a fire break].

d) Condition of Fisheries in the Blocked Ditches

Interviews with a number of fishers in the Black Water Ecosystem area of Puning River revealed that the area has a very high fish biodiversity (see Table 18).

Table 18. Species of fish in the river and swamp water and in the Black Water Lake of Puning River and nearby, South Barito District

No	Local Name	Where Found	No	Local Name	Where Found
	Snake head type			Rasbora types	
1	Kihung (*Channa melanopterus)/* Snakehead	R, L, D	21	Saluang Barik (*Rasbora* sp./ Rasbora)	R, L, D
2	Mihau (*Channa micropeltes* / Giant snakehead)	R, D	22	Saluang Sapapirang (*Rasbora* sp./ Rasbora)	R, L
3	Peyang (Snakehead)	R	23	Saluang Janah (*Rasbora* sp./ Rasbora)	R, L
4	Tahoman/toman (*Channa micropeltes)*/ Snakehead)	R, L, D	24	Saluang Bambayung (*Rasbora* sp. / Rasbora)	R, L
			25	Saluang Batang (*Rasbora* sp./ Rasbora)	R, L
	Catfish types		26	Saluang Juar (*Rasbora* sp./ Rasbora)	R, L
5	Baung Kopa (*Leiocassis* sp./ Catfish)	R	27	Saluang Tengak (*Rasbora* sp./ Rasbora)	R, L
6	Baung Langkai (*Leiocassis fuscus* / Bumblebee catfish)	R, L		Other types	*
			28	Tangkalasa (*Sclerophages formosus / Asian arowana*)	
7	Baung Gurai (*Leiocassis stenomus* / Bumblebee catfish)	R, L	29	Kalabau (*Osteochilus melanopleura*)	R, L, D
8	Baung Bangku (*Leiocassis* sp./ Catfish)	R, L	30	Tatumbuk Baner (*Luciocephalus pulcher*)	R, L, D
9	Baung Karangkam (*Leiocassis* sp./ Catfish)	R, L	31	Janjulung (*Hemirhamphodon* sp./ Halfbeak)	R, L, D
			32	Papuyu/ *Anabas testudineus*	R, L, D
	Pangasius Types		33	Kakapar/ *Belontia hasselti*	R, L, D
10	Lawang (*Pangasius* sp./ Pangasius)	R	34	Pentet / Lele (*Clarias batrachus* / Common walking catfish)	R, L, D
11	Riyu (*Pangasius* sp./ Pangasius)	R	35	Puhing (*Cyclocheilichthys armatus* / Chemperas)	R, L
12	Patin Sabun (*Pangasius* sp./ Pangasius)	R	36	Sangguringan	S,D
			37	Junu / Botia	R, L
	Other catfish types		38	Pipih (*Notopterus notopterus* / Common knife fish, featherback)	R
13	Lais Banto (*Kryptopterus* sp./ Catfish)	R, L	39	Barbus (*Leptobarbus*)	R, L
14	Lais Bamban (*Kryptopterus apogon* / Catfish)	R	40	Darah manginang	R, L
15	Lais Celeng (*Kriptopterus* sp./ Catfish)	R, L	41	Jajela	R, L
16	Lais Nipis (*Ompok eugeneiatus* / Ompok, catfish)	R, L	42	Pahi/pari (*Rasbora argyrotaenia* / Rasbora)	R
			43	Patan/patin (*Pangasius nasutus)*	R, L
17	Tapah (*Wallago leeri* / Giant Malayan catfish)	R, L	44	Jalawat (*Leptobarbus hoevenii* / Sultan fish)	R, L
18	Biawan (*Pristolepis groitii /* Mud perch)	R, L, D	45	Jalawat batu (*Neobarynotus microlepis*)	R, L
19	Sasapat (*Trichogaster trichopterus* /Three- spot gouramy)	R, L, D	46	Belut/lindung (*Monopterus albus* / Swamp eel)	L
20	Kalui /Tambakang (*Helostoma temminckii* / Kissing gouramy)	R	47	Karandang (Channidae)	*

R = River (black water) *L = Lake/swamp (black water)*
D = Ditches that were blocked ** = very rarely found, almost extinct*

The information above was gathered through interviews with fishers in Muara Puning sub-village (Mr. Yulius, 2002; Mr Amat, 2004; Mr Husniayansyah, 2004), South Barito District.

The majority of the population in this area (Batilap village, Batampang, Simpang Telo and Muara Puning sub-village) are reliant on fisheries activities (both catching fish and cultivating them in *beje* ponds). Over the past five years, since the digging of ditches to transport illegal logs became widespread in the area, it is estimated that the population of fish has fallen quite dramatically. The decrease is due both to the sedimentation of rivers (such as the Bateken River) and the use of destructive fishing techniques such as electricity and nets with a very small mesh size (such as the *salambau* fishing net). If these types of activities are not controlled immediately, they will cause further damage to the fisheries sector, increasing the difficulties of people in the area.

One way to restore the productivity of fisheries is to use the ditches already in place by blocking them and removing the peat sediment and pieces of wood which are abundant in the Bateken River. In addition to keeping the nearby peat wet so that it does not burn, blocking the ditches will stop the peat particles from travelling into the Bateken River. The ditches that have been blocked can then be used as fish ponds, similar to the *beje* ponds (see box 10 and also the section above on the results of water measurement levels in the ditches).

Box 10

A number of people in the sub-village of Muara Puning have built long ponds in the peatland (length: 10-50m; width 1.5-3 m; depth: 1-2m), see pictures below. The ponds, known locally as beje*, trap wild fish when the river overflows during the rainy season (October – February). The fish are left in the pond for several months, and are harvested (while at the same time scooping out sediment) throughout the dry season, from July to September.*

Blocking the ditches results in the formation of a number of ponds which are similar to beje *ponds. In addition to this, the work of blocking the ditches is expected to bring other benefits, such as acting as a fire break, improving the hydrology in order to improve rejuvenation, and reducing fires in the dry season. The results of monitoring throughout 2004 showed that there were at least 16 species of fish (including* Chana sp., Clarias sp., Anabas testidineus, Trichogaster sp., *among others) in the blocked section of the ditches. Community members harvested the fish to increase their income (see the explanation under "Results of Water Level Measurement").*


e) Condition of Biodiversity, Fauna

In addition to activities related to ditch blocking, water quality, and aquatic biodiversity in the Black Water Ecosystem area of Puning River, the CCFPI project also studied the biodiversity of fauna in the area. The fieldwork for this took place during September 9 – 12, 2003 (Hasudungan, F. 2003). During this period, the survey team recorded and identified 16 species of mammals, 68 species of birds and no less that 12 species of herpetofauna.

<u>Mammals</u>

Six of the 16 species of mammals recorded were identified by their specific sound. Six other species were identified by their tracks or faeces, and the remaining four were recorded based on information from people living in the Puning River area.

Eight of the species are protected by law in Indonesia. Based on the criteria of the IUCN Red Data List, three of these are on the endangered species list.

Referring to the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES), four of the species are listed in ***Appendix 1***, meaning that they are *species which are threatened with extinction and trade is only allowed under exceptional circumstances, for example, for research*. Three of the species are in ***Appendix II*** which means that at the current time they are *not necessarily threatened with extinction if trade is controlled by a quota that is agreed during an international conference of the countries that have ratified CITES (COP).*

Table 19. Important Mammals near Puning River

No.	Indonesian/Local Name	Scientific Name	How Identified	STATUS
1	Malu-malu, kukang	*Nycticebus coucang*	Direct	P, App II
2	Lutung, cekong	*Presbytis cristatus*	Direct	P, App II
3	Beruk	*Macaca nemestrina*	Tracks	P, App II
4	Ungko	*Hylobates agilis*	Voice	P, App I, EN
5	Kelawat	*Hylobates mulleri*	Information	P, App I, EN
6	Rusa sambar	*Cervus unicolor*	Tracks	P
7	Kijang	*Muntiacus muntjak*	Information	P
8	Kucing kuwuk	*Felis bengalensis cf.*	Tracks	P, App I
9	Beruang madu	*Helarctos malayanus*	Information	P, App I, EN

Note: *P = protected by law in Indonesia*
App I and App II = Appendix I and II (CITES)
EN = Endangered species

Avifauna

A total of 68 species of birds were identified, with most of them being observed directly. Some species were identified by their songs although there were also several species which could not be identified by song.

A total of 14 of the species are protected by law in Indonesia. The protected species come from the following groups: herons/storks (one species), predators (five species), kingfishers (two species), and hornbills (four species). Based on IUCN's criteria for the Red Data List, only one species, the bangau tongtong, is on the list, and it falls into the category of *vulnerable*.

Table 20. Important Avifauna Species in the Puning River Area

No.	Indonesian Name	Scientific Name	How Identified	STATUS
1	Bangau tongtong	*Leptoptilos javanicus*	Direct	P, VU
2	Elang bondol	*Haliastur Indus*	Direct	P, App II
3	Elang-laut perut-putih	*Haliaeetus leucogaster*	Direct	P, App II
4	Elang-ular Bido	*Spilornis cheela*	Direct	P, App II
5	Alap-alap capung	*Microhierax fringilarius*	Direct	P, App II
6	Raja-udang meninting	*Alcedo meninting*	Direct	P
7	Pekaka emas	*Pelargopsis capensis*	Direct	P
8	Kangkareng perut-putih	*Anthracoceros albirostris*	Direct	P, App II
9	Kelompok Burung madu	*Nectariniidae*	Direct	P

Note: *P = Protected by Law in Indonesia*
App I and App II = Appendix I and II (CITES)
VU = Vulnerable (IUCN criteria)

<u>Herpetofauna</u>

Twelve species of the herpetofauna group were identified in the area. Two of these – false gharial (*Tomistoma schlegelii)* and freshwater turtle (*Orlitia borneensis*) – are protected by law in Indonesia.

Based on the criteria of the IUCN Red Data List, only one species falls into the *Endangered* list (false gharial).

Table 21. Important Herpetofauna Species in the Puning River Area

No.	Indonesian/Local Name	Scientific Name	How Identified	STATUS
1	Buaya Senyulong	*Tomistoma schlegelii*	Direct	P, EN, App I
2	Beyuku, Bajuku	*Orlitia borneensis*	Information	P, App II; nt
3	Labi-labi	*Amida cartalaginea*	Information	App II
4	Ular sawah	*Phyton reticulatus*	Information	App II
5	Ular Kobra, tedung	*Ophiophagus hannah*	Information	App II

Note: *P = Protected by Indonesian law*
App I and App II = Appendices I and II (CITES)
EN = Endangered species
nt = near threatened (IUCN criteria)

False Gharial (Tomistoma schlegelii)

Three false gharial were found in the Puning area during the observation period, but all were in wooden cages. One was in Batampang Village and two were in the Buntal Lake area (on the upstream part of Puning River).

The false gharial, which were bought by the owners and originated from the local area, were fed fresh fish every day.

Table 22. Total length of each false gharial found in the Puning Area

Individual	Location	Length (feet)	Condition	Where Found
A	*Batampang village*	5-6	Healthy	2002, Batampang
B	*Buntal lake*	6-7	Healthy	2001, Buntal Lake
C	*Buntal Lake*	8-9	Swollen snout	1988, bought in Batampang

False gharial C, which was the largest of the three, had laid eggs three times. The first time was in 2002 (three eggs), then in 2003 (18 eggs) and 2004 (23 eggs). The information was provided by the owner of the false gharial (Mr. Midi). Individuals C and B were kept in separate yet adjoining wooden cages. The most recent eggs were found in August 2004 (see illustration).

According to Mr. Jum'at (resident of Muara Puning), over the period 1980-1990 it was quite common for the residents of Muara Puning to care for these false gharial. They used to look for eggs near Timbau Bay (downriver from Muara Puning) and then raise them in wooden cages. Now, however, there are no longer reports of finding this species of false gharial in the wild (in the area of Batampang and Buntal Lake).

Illustration 61. *Individual A, in Batampang Village (Photograph: Hasudungan 2004)*

Illustration 62. *Individual C, in Buntal Lake(Photograph: Hasudungan 2004)*

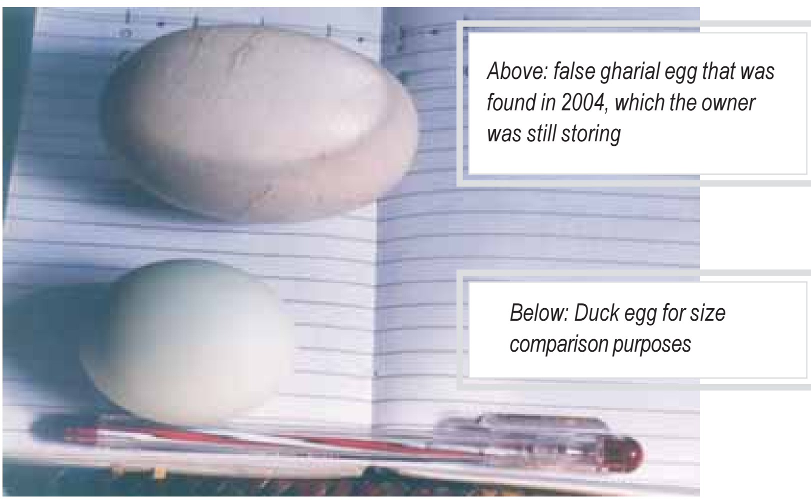


Illustration 63. *Comparison between false gharial egg and duck egg (Photograph: Hasudungan 2004)*

Although no individuals were found in the wild, finding the individuals in captivity indicates that the Puning River area is important for false gharial (or at least it was until the 1990s). It is important to conduct a further survey for this rare species in order to determine the condition of the population.

Threats

Based on field observations and interviews with local residents or individuals who often visit Puning River, a number of threats, both direct and indirect, to wildlife in the area were identified.

These threats include:

- **Illegal logging.** This activity leads to the reduction in a number of species of high economic value. Habitat damage, especially to the forest along the shores of the rivers, which is an important area for the false gharial, which need closed forest to breed, has a very negative impact.

- **Opening of Ditches**. Digging of ditches, followed by felling of nearby trees of high economic value, presents a high threat to wildlife in the Puning River area. In addition to the loss of trees, the opening of ditches between three to seven kilometres in length will have a serious effect on the composition of tree crowns. This will have a serious impact on arboreal fauna such as the agile gibbon *Hylobates agilis.*

- **Hunting.** Proof of hunting in the Puning River area was evident from fauna which were being kept by residents and caught to be sold. A captive long-tailed macaque was observed in Muara Puning village where it was being cared for by residents. In addition, several species of birds such as cattle egret(*Bubulcus ibis*) and little egret (*Egretta garzetta*) were observed in captivity without cages. Several slow loris (*Nycticebus coucang*) had also been captured and were going to be sold outside the area.

Illustration 64. *A slow loris (Nycticebus coucang) which was captured in Batilap, for sale in Batubara. (Photograph: Hasudungan 2004)*

Hunting traps were observed near the inhabited area of Muara Puning. The traps were very simple, consisting of stretched nylon rope and bent wood. The target species was white-breasted waterhen **(*Amaurornis phoenicurus*)**.

Illustration 65. *White-breasted waterhen (Amauromis phoenicurus), a target species of hunters (Photograph: Hasudungan 2004)*

Illustration 66. *A trap used to catch White-breasted waterhen (Amaurornis phoenicurus). (Photograph: Hasudungan 2004)*

- **Fire.** As with most peat swamp forest, the most critical threat is fire, which can start easily in the dry season. In addition to damaging wildlife habitat, the fires can also reduce the total population of wildlife because food sources are eliminated or the wildlife itself is killed in the fire.

- **Fishing using electricity** is acknowledged by the population of Muara Puning. In addition to threatening the fish population, using electricity threatens other wildlife such as false gharial and fresh water turtle, whose main food is fish.

From the threats listed above, in order to protect the biodiversity of fauna in the Black Water Ecosystem of Puning River, the following actions should be taken:

- Illegal logging activities should be stopped, and ditches should be blocked as a first step to halting unconditional damage to the peat swamp forest. These activities should be followed up by planting local species in ex-burnt areas so that the damaged peatland ecosystem can recover quickly.

- ❒ Information on sustainable use of natural resources is another preliminary step that needs to be taken immediately so that unsustainable practices, such as using electricity for catching fish, are stopped as soon as possible.

6.3. CANAL BLOCKING ACTIVITIES IN THE SEBANGAU AREA, PULANG PISAU DISTRICT, CENTRAL KALIMANTAN

In March 2004 WWF Indonesia (WWF-I), through the Conservation of Orangutan Habitat in Sebangau, Central Kalimantan Project carried out a study on canal blocking in the Sebangau peatswamp forest (Illustration 67). This preliminary study was carried out by a team consisting of a hydrologist, a soil specialist and a forester. The goal was to understand the characteristics of the peatlands of Sebangau by gathering bio-physical environmental data (and also socio-economic data) as a baseline for determining the location of the canals to be blocked and the design of the blocks. The peat swamp forests of Sebangau (568,700ha of which were designated as a National Park on the 19th of October 2004) include a peat dome of between four to twelve metres (Illustration 68). Forest in the area is still in relatively good condition, although in some locations there has been serious damage due to forest fires and on-going illegal logging. A satellite image from 2001 (Illustration 67) shows that the condition of Sebangau was relatively healthy when compared to Block A and B of the ex-MRP.

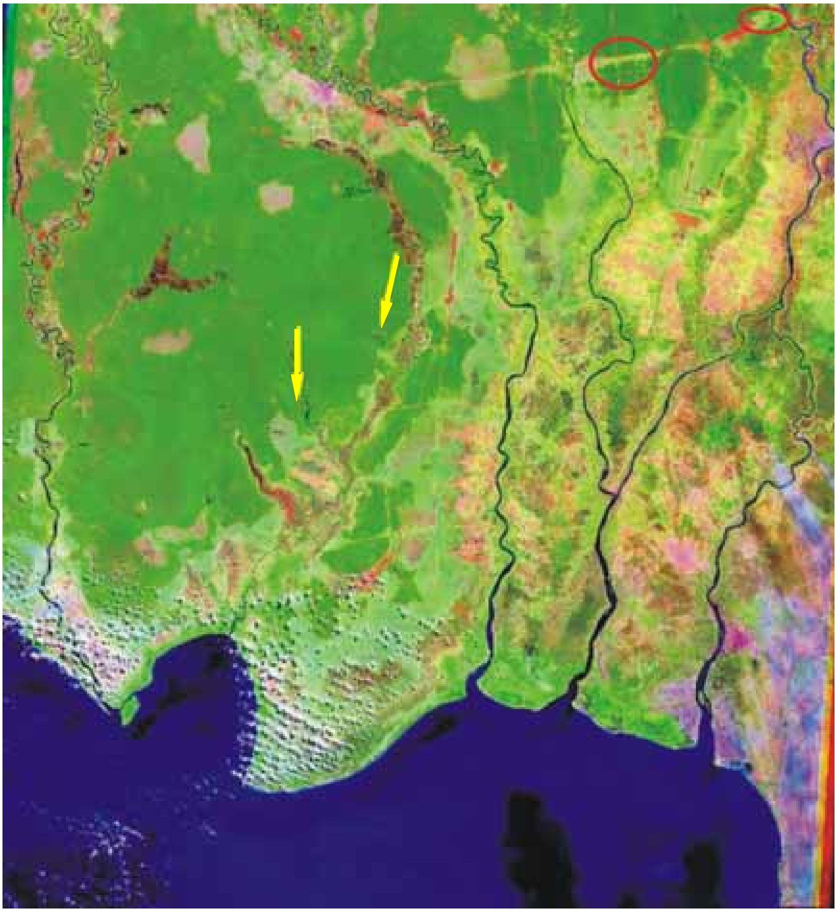


Illustration 67. *Satellite image of Sebangau National Park, 2001 and position of the canals (yellow arrows) that were blocked by WWF in October/November 2004. The red circles are the canals that were blocked by WI-IP, starting in September 2003.*

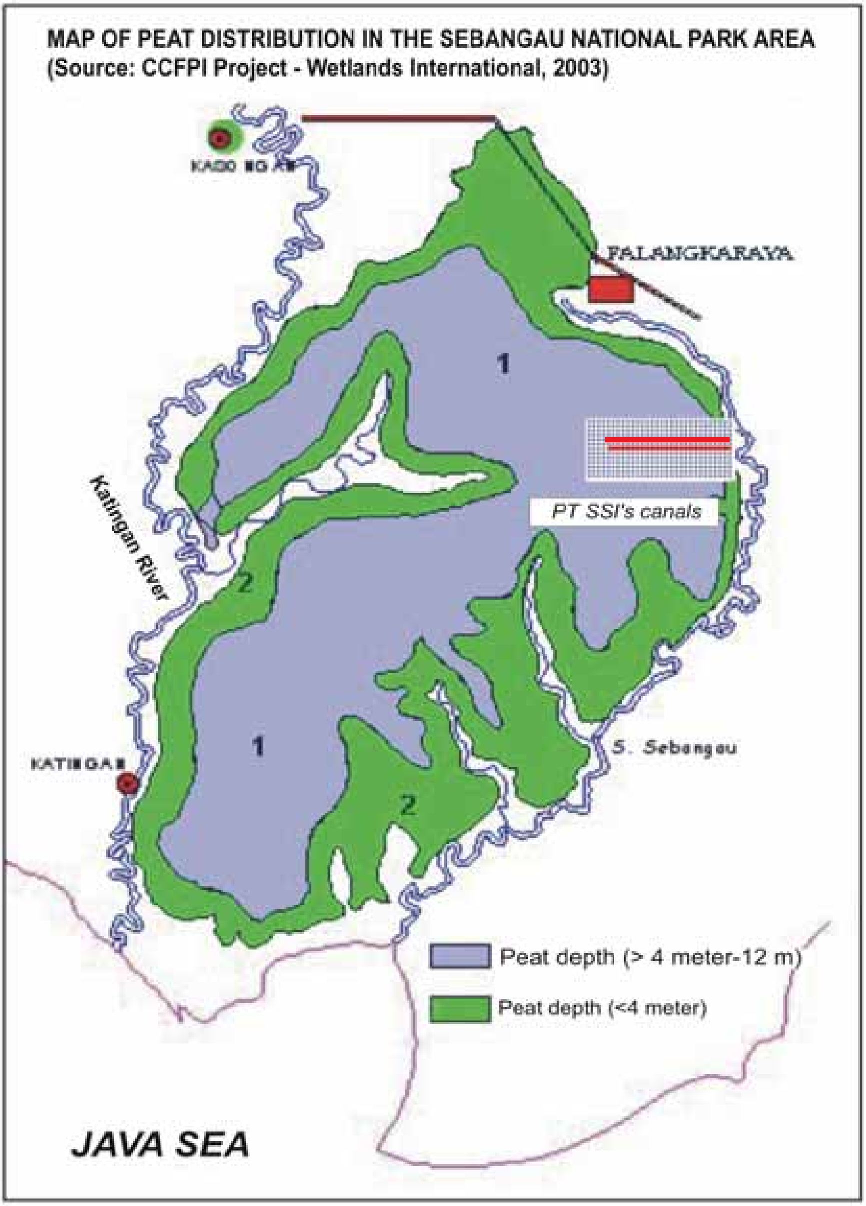


Illustration 68. *Map of peat distribution in the Sebangau National Park area*

Socialization, Land Tenure and Determining the Location of the Blocks

Before WWF started blocking canals in the former concession area of PT SSI, socialization activities were carried out with canals' users. This involved providing information on the purpose of the blocking activities, the type of construction, and plans for the maintenance and rehabilitation of degraded land near the canal. Socialization activities, in the form of seminars and field visits, were also carried out for the local government, from the village through to the district levels.

The main threat to land in the vicinity of the canals was the fact that the forest was degraded and the ground water level had fallen, leaving the peat dry and prone to fire in the dry season. This in turn resulted in the destruction of habitat for fauna and flora and disturbances to the ecosystem and hydrology of the peatlands. Logging, both legal and illegal, was on-going. If this situation continued without efforts to protect and rehabilitate the land, the peat forest of Sebangau, together with its associated flora and fauna, were at risk of being destroyed.

Identification of the canals formerly controlled by PT SSI as the target for blocking was carried out with people who used the canal, and took into consideration the condition of the nearby land. The land near the canals, which was previously managed by PT SSI, was no longer under the control of the concession company. It was riddled with small ditches which were used by loggers to clear the land, leaving the forest degraded. The area has also burnt several times. On the 19th of October 2004, ministerial decree SK No.423/Nenhut-II/2004 from the Minister of Forestry designated 568,700 ha of the peat swamp forest of Sebangau as a National Park. With this change, the management status of the area is now clear.

Number and dimensions of canals

From the forestry survey made by Noveriawan et al in 2003, it was reported that there were a number of canals with various dimensions/sizes found in the Sebangau area. In September 2004, some of these canals were identified and the result is provided in Table 23.

Table 23. Results of identification of a number of canals in Sebangau National Park

No.	Location of Canal	Owner	Dimensions	Year Dug	First use for Transportation Related to	Now used for Transportation Related to
1	PT SSI	Ex-HPH PT.SSI	L=20 km W=4 – 9 m D=1.7 – 2.5 m	1998-1999	Legal Logging	Illegal Logging
2.	S.Bangah	Sami	L=5 km W=1.5 m D=0.7-1 m	1999	Logging *Jelutung* *Gemor*	-
3.	S. Rasau	Cakun	L=11 km W=1. D=0. – 1 m	1997	Logging *Gemor*	Logging
4.	S.Koran	Hamli	L=7 km W=1. m D=0.-1 m	1997	Logging *Jelutung* *Gemor*	Logging
5.	S.Akah-M.Bulan	Gani	L= 26 km W= 1.5 m	1998	Logging *Jelutung*	Logging
6.	S. Bulan	Kamto	L= 9 Km W= 1.5 m	1997	Logging *Gemor*	Logging

Note: L=length; W=width and D=depth; gemor (Alseodaphne umbeliflora, Lesser Devil's Laurel) is a type of wood cut by local people, who burn the bark as a mosquito repellent; the sap from the Jelutung tree is extracted and used in making chewing gum. Recently, however, the tree itself has increasingly been cut down to be used as building material.

Of all the canals identified above, two were ready to be blocked by WWF-I: the ex-HPH-PT SSI canal which is on the east side of the National Park at S 02^0 34' 48.9" – E 114^0 02' 35.3", and the canal owned by Mr. Sami, which is in the up river section of the Bangah River at S 02^0 40' 57.5" – E 113^0 58' 29.9" (the dimensions and water conditions of the two canals are shown in Table 24). The ex-concession canal exits directly into Sebangau River, whereas Mr. Sami's canal, exits into the Bangah River. Mr. Sami's canal is no longer used by the owner as there is little remaining wood in the area. The canal of the ex-PT SSI is still actively used by loggers.

The land of the ex-HPH PT SSI was designated plantation area, with *Jelutung* being the primary crop. However, to date these plans have not been realized, and the area is being plundered by a group of illegal loggers. As a result, the peat swamp forest in this area (and also in the location of Mr. Sami's canal in Bangah River) is extremely degraded and often burns. The degraded land is covered with shrubs and, very occasionally, with trees (diameter d" 25 cm) such as: Belangiran (*Shorea blangeran*), meranti (Shorea pauciflora), perepat (*Combretocarpus rotuodatus*), bintangur (*Calophyllum sclerophyllum*), among others.

Table 24. Dimensions of ex-ST SSI and Sami canals to be blocked

Location	Ex-PT SSI Area	Sami Canal
Position	S 02^0 34' 48.9" E 114^0 02' 35.3"	S 02^0 40' 57.5" E 113^0 58' 29.9"
1. Dimensions of the block to be built		
- Length	12 m	2.5 m
- Width (= width of the canal)	9 m	2 m
- Peat depth	1.5 m	0.60 m
2. Water conditions (rainy season)		
- Depth of water in the canal	3.15 m	0.9 m
- Water current speed	0.14 m/sec	0.08 m/sec
- Water discharge rate	3.60 m^3/sec	0.10 m^3/sec
3. Water conditions (dry season)		
- Depth of water in the canal	0.72 m	-
- Water current speed	0.19 m/sec	-
- Water discharge rate	0.51 m^3/sec	-

Illustration 69. *Location of the canal in the ex PT SSI – Sebangau area (water conditions during the dry season) (Documentation: WWF- Indonesia/Drasospolino, 2004)*

Block design and number of blocks in a canal

The design, construction techniques and location of the blocks is very much dependent on the size and characteristics of the canal (length, width, water speed and water volume) as shown in Table 24. These factors influence the type and amount of materials needed and the total number of blocks in the canal. In both the PT SSI and Sami canals two blocks were built (see Illustration 70) using a combination of wood beams and wood planks. On the right and left sides of the blocks on the PT SSI canal three 2x2m chambers were built and then filled with sacks of mineral soil. In the middle of the block there was a four metre spillway (see Illustration 71).

The blocks in Sami canal were quite simple, consisting of two wood boards (made from belangiran wood) which were lined with a plastic sheet and then filled with mineral soil and peat (Illustration 73).

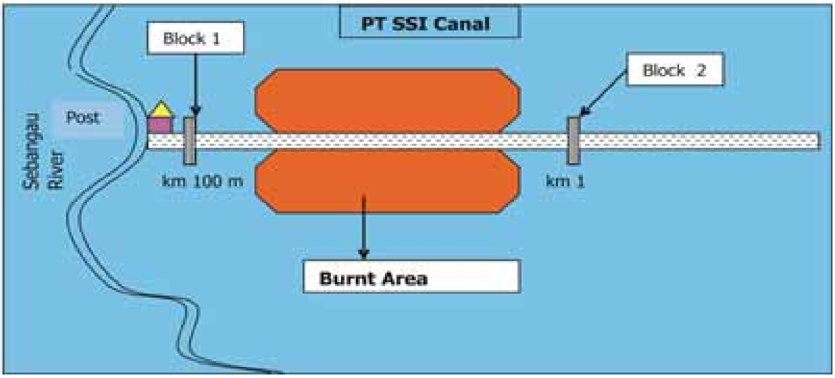


Illustration 70. *Location of Blocks on PT SSI Canal*

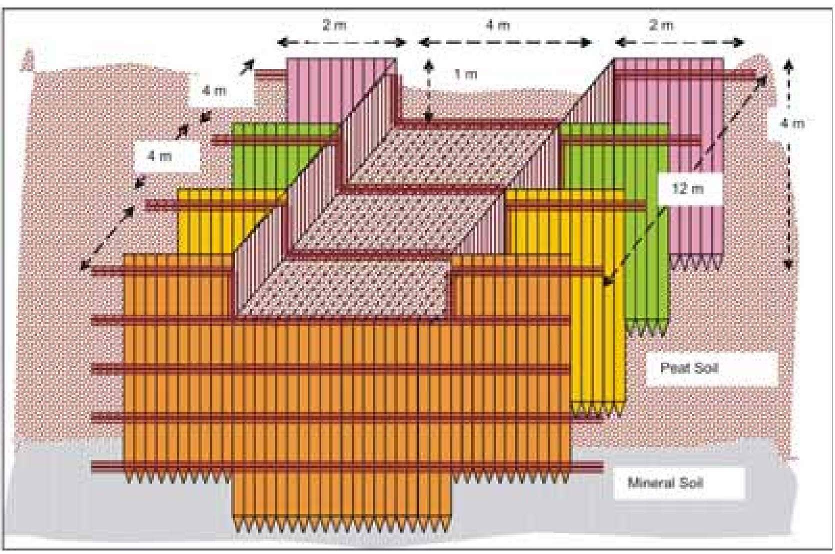


Illustration 71. *Design of Block, PT SSI Canal (three dimensions), four parts*

Timing of blocking activities and labour

The blocking activities were carried out in October – November 2004, at the end of the dry season, as the wet season was starting. At this time the water current was not too strong, making it easier to work. However, the water level in the canals was very low, meaning that work on the upstream side of the canal was difficult, particularly when it involved moving materials to the site. One lesson learned from this is that the schedule for blocking should be well planned and take into account the level of water in the canal. For the ex-PT SSI canal it took approximately 15 weeks to make the blocks, from preparing the labourers to gathering local material such as soil, wood and boards. Ten labourers were needed, broken down as follows: two coordinators to prepare the materials and lead the others, and eight people as assistants to drive in the stakes and carry the materials for the block.

Results of Canal Blocking

Following the blocking the water level of the ex-PT SSI canal increased (the water level in Sami canal was not measured). The increase in water level at the downstream block averaged 65 cm and at the upstream block it averaged 90 cm (these values come from the difference in water level above and below each block); see Table 25, Illustration 72. The increase in the water level in the canal (total 155cm) resulted in the water backing up 3km on the upstream reach of the canal and in several locations the water overflowed the left and right banks of the canal, inundating the nearby peat. The increase in water level makes the peat wet, thereby reducing the risk of fire in the dry season (author's note: unfortunately, this situation did not continue for long, as three months after the block was built it was damaged as a result of a very strong current. See Box 11)

Table 25. Results of water level measurement in the ex-PT SSI canal after blocking

Down Stream Block				Up Stream Block			Comments
Measurement	Above	Below	Increase	Below	Above	Increase	
1. 02/11/2004	70 cm	125	55 cm	125 cm	205 cm	80 cm	No water overflow
2. 25/11/2004	70 cm	145	75 cm	145	245 cm	100 cm	Water overflowed and moistened the soil
Average increase of water level in the canal			65 cm	Average increase of water level in the canal		90 cm	Total increase = 155 cm

Illustration 72. *Construction of Block in ex-PT SSI Canal after Completion (Documentation: WWF-Indonesia/ Drasospolino, 2004)*

Illustration 73. *Construction of Block in Sami Canal after Completion (Documentation: WWF-Indonesia/Eko Manjela,2004)*

Box 11

In November 2004 WWF-Indonesia completed two blocks in the ex PT-SSI canal in the Sebangau area. As with the blocks built by WI-IP in the SPI-1 (see box 8), not long after construction the blocks were damaged. The causes of the damage to the Sebangau blocks include:

1. *Before the blocks were completed and filled with soil sacks a flood occurred with very strong currents and a discharge rate of approximately 3.60m^3/second (when the blocks were being built the discharge rate was only 0.51 m^3/second). This caused damage to the walls of the blocks.*
2. *The poles in the peat were not deeply enough embedded into the underlying mineral soil. They only went in about 50cm.*
3. *There were no supporting poles for the lower outside walls of the block, which left the block weaker than desirable.*
4. *The ends of the construction on the left and right sides of the block were not implanted deeply enough into the peat on the canal banks. Erosion as a result of the strong water current meant that the ends on the right and left side came loose from the peat.*
5. *The form of the beams that were implanted was not as strong as logs in holding back the water in the canal, as can be seen in box 8.*

Blocks that were built on the upstream (left) and downstream (right) of the ex-canal of PT SSI were damaged by strong currents in January 2005 (Documentation WWF-I, Sebangau 2005).

[note: reconstruction of the damage block will soon be made by WWF Indonesia, after the root causes of the damage have been identified. Apart from reconstruction, in order to obtain more effective results caused by the blockings to the increase of ground water levels and peat wetness, additional blocks will also be built in the upstream of PT SSI canal. Pers comm.. with Drasospolino].

6.4. DITCH BLOCKING IN MERANG AREA, SOUTH SUMATRA

On the left and right banks of the Merang River, Bayung Lincir sub-district, Musi Banyuasin District, South Sumatra, there are at least 113 ditches. These ditches consist of small tributaries, natural ditches which have been modified and human-made ditches. The large number of ditches made it difficult to choose which ones to block. The decision was based on the following considerations:

- ❐ Current land use near the ditch;
- ❐ History of fire near the ditch;
- ❐ Whether the location of the ditch would allow for on-going monitoring;
- ❐ The type of soil near the ditch (peat and/or non-peat);
- ❐ Agreement from the ditch owner.

Of all of these considerations, the most difficult to address was the final one, obtaining permission from the owner.

Based on these criteria, the CCFPI project identified four ditches in which to build *temporary blocks* (in June 2004) in order to protect against loss of peat water from the peat swamp forest of Merang Kepahyang during the long dry season that was anticipated over the period July – September 2004 (see the map of the location of the ditches). During November 2004, with the agreement of the owners, two other ditches were blocked with permanent blocks.

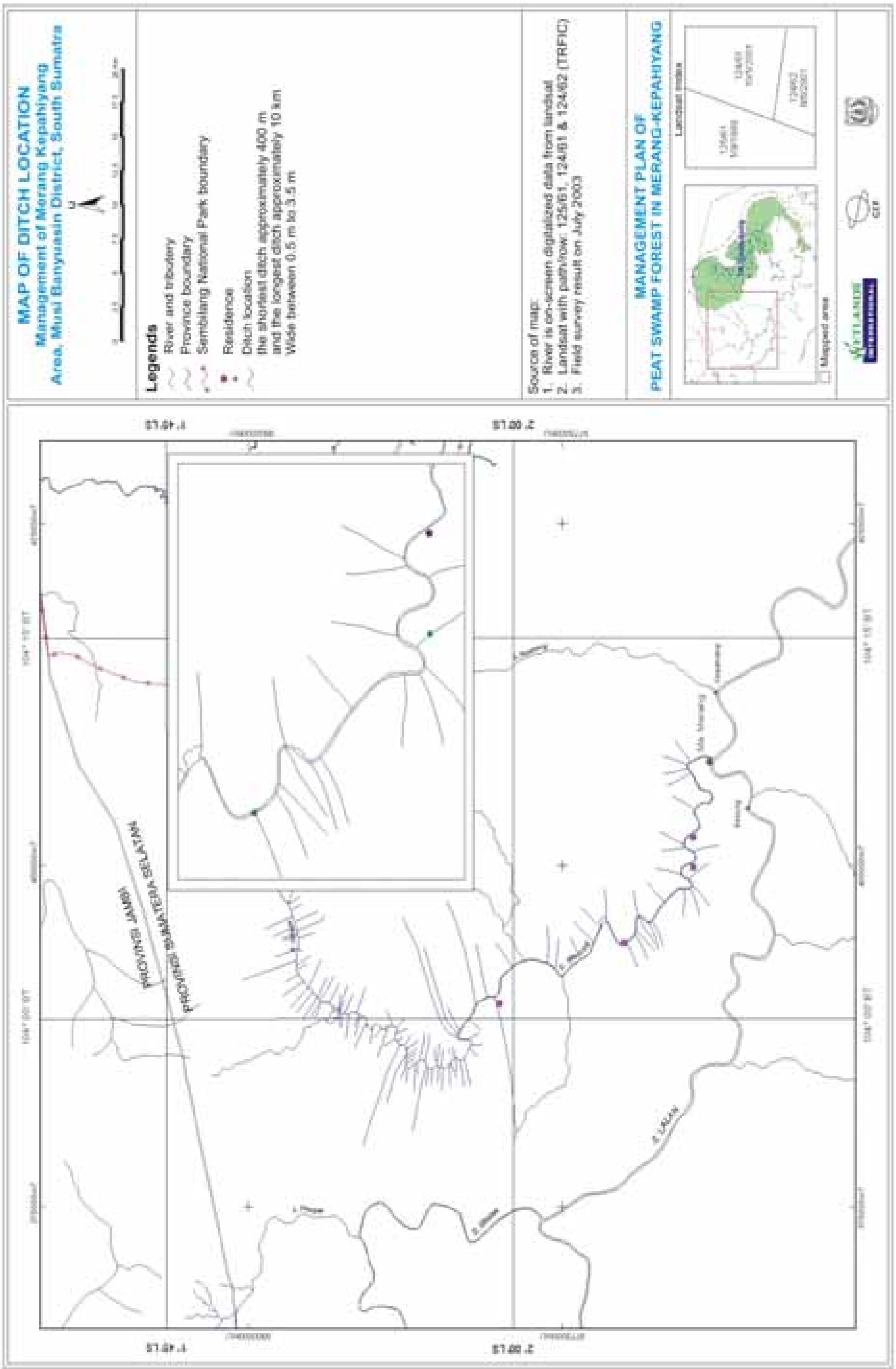


Illustration 74. *Distribution of ditches on the Merang River and location of ditches with permanent blocks*

Temporary Blocks near the Merang River area

Illegal loggers make use of temporary blocks to facilitate the extraction of wood from the peat swamp forests of the Merang-Kepahyang (also known as the Merang peat swamp forest). In order to retain water in the ditch, temporary blocks made of removable planks are constructed at specific distances along the length of the ditch. Logs are then floated down the ditch, and when they are close to the river the final blocks are removed. Removing the blocks is detrimental as it causes the peat water to drain out into the river Merang(see Illustration 75). This method of extracting logs typically lasts until the start of the dry season at which point there is no longer enough water in the peat to fill the ditches, even if they are blocked.

Illustration 75. *System of opening and closing temporary blocks in ditches near the Merang River. Left: Closed block with a log being floated down. Right: Open block so the log can float by. (Photograph: Suryadiputra, June 2004)*

Through the CCFPI project, information was provided to the owners of the ditches and illegal loggers that highlighted the dangers of draining water from the peat, leaving it vulnerable to fire. In addition, it was stressed that removing logs in this way was an illegal activity. To address this situation, the project adopted a number of approaches, including recommending permanent blocks that would retain the peat water. This suggestion was not, however, well received, as users said that it would increase the difficulty of removing the logs from the forest. For this reason, the project then suggested that several blocks at the mouth of the ditch (near the Merang River) should remain in place to hold back water so that during the dry season the risk of fire would be reduced. This option was also rejected by some of the loggers. Another issue was the large number of ditches going off the Merang River and the fact that for many of them ownership was unclear. Finally, through a long process of negotiation, the CCFPI project was able to convince four ditch owners to agreed to temporary blocks near the mouth of their ditches. In June 2004 three blocks were built in each of the ditches. These ditches were two to three metres wide, and two to three metres deep (see Illustration 76). The agreement with the ditch owners stated that the blocks would be kept closed during the dry season to reduce the risk of fires. Unfortunately, several blocks (coordinates: S $01^{0}57'34.0''$, E $103^{0}59'08.7''$) were opened by illegal loggers. A side effect of the opening of the blocks was the burning in September 2004 of the area upriver and on the left and right sides of the ditches that had been blocked.

Based on this experience, the CCFPI project renewed efforts to convince the illegal loggers and owners of the ditches that their activities not only damaged the natural resources of the peatlands (including trees and fish), but that smoke from the fires was also damaging to their health. In order to avoid draining and increased risk of fire, it was recommended that permanent blocks be built (this is discussed in more detail below).

Illustration 76. *Stages of building the temporary blocks by CCFPI in the ditch owned by Nasir (coordinates: S 01°57’34.0", E 103°59’08.7"). This block was later damaged by unknown illegal loggers. (Photograph: Suryadiputra, 2004)*

[Note: The CCFPI project frequently took the opportunity at meetings of different levels of government to request the participation of village, sub-district and district representatives in handling the problem of illegal logging in the Merang area. Ultimately these efforts had little effect. Luckily, following President Susilo Bambang Yudoyono’s announcement of a national programme to stop illegal logging, which was one of the priorities of his first 100 days in office, the level of illegal logging in Merang decreased. This is evident from a reduction in the activities of illegal loggers and the closing of a number of illegal sawmills (private communication with residents of Merang village and officers of Muba District in March 2005). Hopefully this Presidential initiative will be on-going and will be complimented by a programme of restoring peatlands through closing the many illegal ditches that are found in Sumatra and Kalimantan].

Permanent Blocks Near Merang River

From the explanation above, it is clear that the temporary blocks (made from a few stakes and wood) did not lead to the hoped-for results. The blocks were too easily opened by illegal loggers. In order to address this, the decision was made to build permanent blocks, as explained below.

The CCFPI project supported the construction of two permanent blocks in the Merang River area in November and December 2004. Work to block the Penyamakan ditch was carried out during 6th–10th of November and the Perjanjian ditch 7th–13th December 2004. Blocking was carried out following socialization and agreement from the residents of Bina Desa, which is in the area known as Tebing Merana (Pantai Harapan), 2.7km from Penyamakan ditch. The Village Head of Muara Merang Village also agreed.

Blocking the ditches involved building dams using poles of cajuput wood (*Melaleuca sp*) inserted vertically in two rows that were two metres apart. These were supported by cross beams from tembusu wood. The space between the two rows of wood was lined with a tarpaulin and then filled with mineral soil.

In each ditch two dams were built, approximately 100 metres apart. A total of 120-140 cajuput poles were used, with a diameter of six to nine centimetres and a length of between three and five metres. The spaces between the cajuput poles was closed using wood with a smaller diameter to prevent water and earth from seeping through. It was expected that the body of water between the two dams could be used by nearby residents to store and raise fish.

A. PRE-CONSTRUCTION STAGE

a) Socialization

The permanent blocks were a follow-up to the semi-permanent blocks which did not achieve the intended results. The following three ditches were identified for permanent blocking: Penyamakan ditch, Perjanjian ditch and Lebua Sebatang ditch. All three of these ditches were originally small natural tributaries to the Merang River. They were widened and deepened using heavy equipment by the forest concession company PT Bumi Raya to facilitate removal of logs. After the concession ran out, local people and outsiders started to use the ditches to extract illegal logs.

Socialization of the planned blocking activities was carried out at the same time as the ditches were being identified. The Village Head of Muara Merang was the first target of socialization, followed by people living near the ditches. The nearest settlement is Tebing Merana, which is approximately 2.7 km from the Penyamakan ditch and 13.2 km from Perjanjian ditch (see Illustration 74, the map showing the location of the ditches).

b) Final determination of location of ditches to be blocked

In October 2004 it was determined that Penyamakan and Perjanjian ditches were ready for permanent blocks (see Illustration 74). Parit Labuai Sebatang was not ready yet for a number of non-technical reasons.

The main considerations in deciding to include the two ditches above included:

- ❒ Legal: ownership of the ditches was clear, and the owners supported blocking the ditch.
- ❒ Logging activities: very low or non-existent.

- ❐ Monitoring: presence of people near the ditches who were ready to monitor and manage the ditches (which would become reservoirs/ fish ponds).

c) Total number and dimensions of ditches that were blocked

The dimensions of Penyamakan and Perjanjian ditches are shown below.

Table 26. Dimensions of Penyamakan and Perjanjian ditches

Location	Penyamakan	Perjanjian
Position	S 02^0 07’ 49.1” E 104^0 06’ 36.0”	S 02^0 04’ 48,0” E 104^0 02’ 60.0”
1. Dimensions of block		
- Length	3.5 m	4.5 m
- width (=width of ditch)	2 m	2 m
- Thickness of peat near the block	<0.5 m	<0.5 m
2. Water conditions (rainy season)		
- Water level	1-1.5 m	1-2.5 m
- Speed of current	0.01 m/sec	0.33 m/sec
- Discharge rate	0.03 m^3/sec	1.485 m^3/c
- Water colour	Dark brown (peat water)	Dark brown (peat water)
3. Water conditions (dry season)		
- Water level	< 1 m	< 1 m
- Water colour	Black (peat water)	Black (peat water)

d) Ownership status

The residents of Bina Desa in the area of Tebing Merana (Pantai Harapan), 2.7 km from Penyamakan ditch acknowledged control of the ditch. Perjanjian ditch was controlled by an outsider who was living in Kenten Laut, Palembang. There was acknowledgement that logging activities were ongoing in Perjanjian ditch, and were led by a relative of the person who controlled the ditch. It was verbally agreed that the two ditches would be blocked but that there would be a gap of 1.2 metres at the top of the blocks that would remain open.

e) Number and type of blocks

Both Penyamakan and Perjanjian ditches were blocked with two dams approximately 100m apart. The diagram below shows the location of the permanent blocks on Penyamakan ditch. The designs of the dams on the two ditches were very similar. They were composite dams with a slight difference in the spillway on the top.

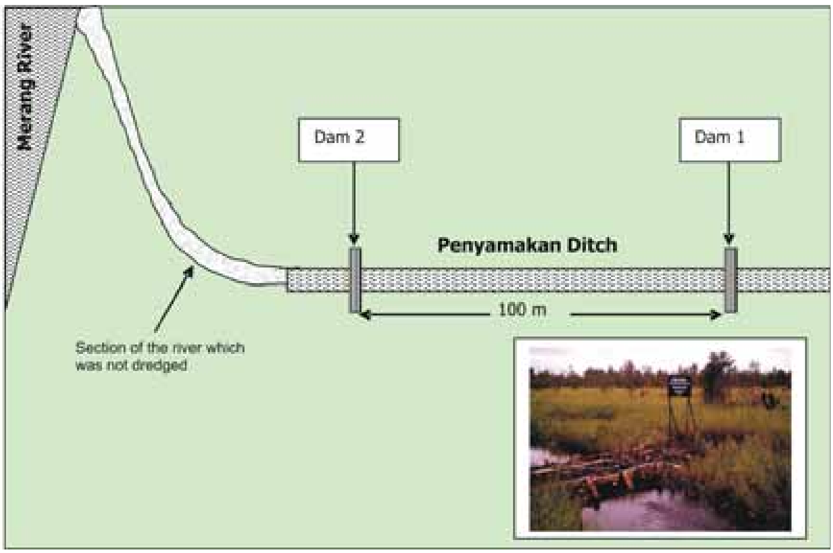


Illustration 77. *Location of Blocks on Penyamakan Ditch*

f) Identification of Materials

Identification of materials was carried out through interviews and consultation with the owners, users and people who had dug ditches previously, either in the Merang River area or elsewhere. It was determined that the main materials for blocking, such as cajuput and tembusu wood, were available in the locality. Other materials, such as nails, hammers, saws and plastic tarpaulins were purchased from Muara Merang village or Palembang.

g) Cost Analysis

The estimated costs of building one permanent dam three metres in length by three metres in depth by two metres in width are shown below.

Table 27. The estimated costs of building one permanent dam

No.	Item	Total	Unit	Cost/Unit Rp	Sub-total	Comment
Materials and Equipment						
1	Boards	4	Board	15,000	60,000	Water channel
2	Tools	1	Lump sum	220,000	220,000	
Transportation						
3	Return transportation from Palembang to Merang	2	Person	100,000	200,000	Implementer & Team Leader
4	Operational, Speedboat	5	Day	200,000	1,000,000	Speed-boat owned by WI-IP
Consumption and Accommodation						
5	Food	1	Lump sum	250,000	250,000	
6	Accommodation	1	Lump sum	250,000	250,000	
Documentation						
7	Photo (Film + Processing)	1	Roll	75,000	75,000	
Salary						
8	Local labour	30 (6 people, five days)	Person days	35,000	1,050,000	Including food for lunch
9	Construction supervisor	6	Person/day	50,000	300,000	
10	Implementer	6	Person/day	60,000	360,000	
Sub-total:					**3,765,000**	
Contingency (10%)					**376,500**	
Total Requirements					**4,141,500**	

Note: *The primary materials were cajuput and tembusu wood cut near the location. For this reason, there was no cost for buying wood, but the labour requirements increased.*

B. CONSTRUCTION STAGE (Blocking of the Ditches)

a) Preparation

- Preparation of equipment. Most of the material and equipment was bought in Palembang and transported by water to Dusun Bakung (across the river from Muara Merang) before being moved to the target ditches.

- Recruitment of labourers. The majority of the people who worked on this activity came from Dusun Bina Desa (neighbouring Dusun Bakung). Note: The Village of Muara Merang consists of Dusun Bakung and Dusun Bina Desa.

b) Materials

The materials needed to build permanent dam are shown below.

Table 28. Materials needed to build a permanent dam

Item	Type	Total
Tools: • Wood saws • Hammers • Tape measures • Hoes & shovels • Machetes	Standard	 2 2 2 2 2
Nails 5" & 7"	Metal nails	3 & 5 kg
Gloves	Cloth	5
Plastic tarpaulin (4 m x 6 m)	Super	1 sheet / block
Planks (2 cm x 20 cm) x 4 m	Meranti wood	8 pieces / block
Cross supports (D: 15-20 cm) X 6 m	Tembusu/Cajuput	6 pieces / block
Upright supports (D: 15 cm) X 6 m	Tembusu/Cajuput	8 pieces / block
Supports (D: 15-20 cm) X 6 m	Tembusu/Cajuput	8 pieces / block
Wood stakes (D: 8-12 cm) X p: 4-6 m	Cajuput	120 pieces / block
Mineral soil	-	10-12 m^3 / block
Speed-boat, 40hp engine	Yamaha	1 unit
Name boards	Meranti wood	2 /ditch
First Aid Kit	-	1

c) *Determining the timing of blocking activities*

The best time to undertake blocking activities is during the dry season when the water is low or dry. The constraint with this, however, is that it is difficult to transport the materials. When Penyamakan ditch was blocked in November the water level was not too high and did not hinder construction. However, when Perjanjian ditch was blocked in December the high water level made blocking activities more difficult.

d) *Ditch blocking activities*

Below are the steps that were carried out in building the permanent blocks:

- *Collection of materials*. The first stage was to gather the main materials for constructing the dam, including: wood cross supports from tembusu wood and stakes from cajuput wood. This wood was gathered from various locations in the forest near the ditches, in order to avoid one area being damaged.

Illustration 78. *Collection of materials for constructing the dam.*

❒ *Installing Top and Bottom Cross Supports*. The top and bottom cross supports (from tembusu wood) were installed across the centre of the ditch. Before the two supports were installed, indents were made on the right and left bank of the ditch so the supports could be inserted. The top and bottom cross supports were each six metres long, with a diameter of approximately 15-20 cm.

Illustration 79. *Installing Top and Bottom Cross Supports*

❒ *Inserting the Stakes.* After all the cross supports had been put in, the next step was to insert the cajuput wood stakes, which were eight centimetres in diameter and three to five metres long. The stakes were planted vertically along the length of the cross supports, and then nailed at the top. At the bottom, which was submerged in the water, they were tied with plastic string.

Illustration 80. Inserting the Stakes

- *Installing Upright Supports.* After the vertical stakes were inserted, the cross supports were strengthened with three to four vertical supports for each cross support. The vertical supports were approximately six metres in length with a diameter of 15-20 cm. They were embedded and clamped to the cross supports from two sides.

Illustration 81. *Installing Upright Supports*

- *Inserting Supporting Posts*. To strengthen the blocks four supporting posts were installed on the outside of the downstream side of the block. The posts were approximately six metres long with a diameter of 15-20 cm, and were installed at an angle of approximately 45°

Illustration 82. *Inserting Supporting Posts*

- *Tidying up the tops of the stakes*. The tops of the stakes were cut with a saw so that the top of the dam was even.

❒ *Installing plastic*. A four by six metre tarpaulin was installed once the frame of the block was in place and evened up. Care was taken when attaching the plastic to make sure it did not rip, and that the frame of the dam was well planted at the bottom of the ditch. If the dam was not strong enough, there was a risk of the bottom of the ditch being eroded by the strength of the water current and that the plastic might then float up and be washed away.

Illustration 83. *Installing plastic.*

❒ *Filling with Soil.* The earth to fill the dam (it is best to use mineral rather than peat soil) was taken from far downstream of the dam. The dam was filled in immediately after the plastic was attached. The earth was not taken from the vicinity of the block, because the cavities that would have been created from digging the earth would easily be eroded by water in the rainy season thus damaging the dam.

Illustration 84. *Filling with Soil*

- *Spillway.* The spillway was built in the middle of the block. In addition to reducing the pressure of water from the upstream part of the ditch on the dam, it was also necessary because the two ditches that were blocked were natural streams that had been widened and deepened by humans. The spillway in the middle of the block was to act as a migration route for aquatic wildlife (if present). The forms of the spillways in the centre of the dams on Penyamakan ditch (illustration on the left: box form) and Perjanjian ditch (illustration on the right: sliding form) were very different. The model used in the Perjanjian ditch reflected the strong desire of the owner (from outside the area) to continue to use the ditch as a transportation route into the forest (with indications being that this was to continue to extract wood). This was confirmed by the most recent information from the field (beginning of April 2005), which showed that the blocks on Perjanjian ditch had been damaged by wood going through them. The blocks on Penyamakan ditch were still intact.

Illustration 85. *The spillway was built in the middle of the block*

- *Information board.* After all the dams were completed, information signs were put up. These were installed in two locations, one near the dam and one at the mouth of the ditch (on the bank of the Merang River). This was considered important so that people who were carrying out activities in the area would not damage the dams.

Illustration 86.
Information board

C. POST CONSTRUCTION STAGE

The post construction stage involved:

- ❒ Socializing the results of the activities so that the people living near the blocks knew of their presence. An appeal to protect the blocks was put out to people living near the ditches Tebing Merana.
- ❒ Monitoring and maintenance to ensure that the blocks were in good condition and functioning optimally.
- ❒ In case of damage, repairs were carried out as soon as possible. Stakes or posts needed to be installed if it appeared that the strength of the dam was reduced.

D. BENEFITS

A number of benefits were observed after the blocking activities were completed, including:

- ❒ People living near the ditches (Tebing Merana) said that the body of water between the blocks in the two ditches could be used to store fish in the dry season (fish that were trapped during the rainy season, when the water in the Merang River overflows). Mr. Guntur, who helped block the ditches, estimated that approximately one ton of fish could be caught from the waters between the ditches. (Author's note: This claim has not yet been proven. At the time this book was written in March 2005, no information had yet been provided to the author.)

❒ Fish aquaculture in the blocked ditches was not yet an area of interest for local residents as they ordinarily catch fish from the wild, an approach considered to be easier and as providing quicker results.

❒ Illegal logging activities, and in particular the removal of logs, was hindered in Penyamakan ditch, but not in Perjanjian ditch. Because of the spillway on Perjanjian ditch, it was still possible to remove logs when the water was high enough.

❒ The presence of the dam will increase the water level in the ditch, and retain it longer into the dry season. On the one hand this is beneficial because it can restrict the incidence of nearby forest and peatland fires. On the other hand, caution is needed to avoid the ditches being used for extracting illegal logs from the forest.

E. SUGGESTIONS

❒ Permanent blocking of ditches in the Merang River area is still in the very early stages (two of the 113 ditches). There needs to be follow-up by the government of Musi Banyuasin District, involving local communities and private sector interests in the area.

❒ Private sector companies, such as the oil company Conoco Philips, much of whose pipe network crosses the fire prone Merang Kepahyang forest, must also be involved and assist in blocking the ditches in the area. The same holds true for other private sector interests such as the oil plantation company PT Pinangwitmas as well as other forest concessions and plantations in the area.

- The district government of Musi Banyuasin needs to socialize to the wider community the importance of blocking the ditches of Merang River as part of the effort to control peat forest fires in the area.

- It is important that the district government build on and continue the cooperation that has been developed by the CCFPI project and the NGO Wahana Bumi Hijau (WBH) with the communities of Dusun Bakung, Bina Desa and Merang village. This will greatly assist on-going protection of the ditches that have been blocked, and will also draw on the experience of the communities in blocking additional ditches.

- From the experience above it can be concluded that blocking the ditches of Merang River (South Sumatra) was more difficult, with more obstacles, than the blocking activities in the Black Water Ecosystem of Puning River and the ex-MRP in Central Kalimantan. It is thought that this has to do with the fact that the illegal loggers in the Merang River come mainly from Selapan sub-district (Ogan Komering Ilir – OKI – district), and not from among the communities of Merang River. For this reason, the feeling of ownership of the forest is very low. Damage to the peat forest of Merang Kepahyang does not influence the environment of their home area in OKI, which is far from Merang. Another reason might be because there is still enough wood in the Merang Kepahyang forest to capture the interest of the loggers, while in the Puning River area in Central Kalimantan interest might be lower. These reasons need to be explored in more depth.

Chapter 7

Recommendations for Canal and Ditch Blocking

As described in the previous chapters, through facilitating the blocking of ditches and canals in Central Kalimantan, many lessons have been learned. These are summarized below:

SURVEY OF THE LOCATION AND STATUS OF CANALS/ DITCHES

1. Before a canal/ditch is blocked, an integrated survey involving a number of experts from different disciplines should be carried out. Experts in the following disciplines should be included: soil, biodiversity, limnology, civil engineering, hydrology, fisheries, forestry/silviculture, sociology, socio-economics, among others. The purpose of the survey is to map the bio-physical conditions of the canal/ditch and surrounding location, and to understand the interaction of nearby communities with the ditch/canal (socio-economic aspect). If the canals are part of a complex network, such as in the ex-MRP in Central Kalimantan, a more detailed study should be carried out to identify which canals need to be blocked, and where the blocks should be located in order to optimise the positive impacts and minimize any negative impacts.

2. It must be ensured that the ditch/canal is not in use (either as a general transportation route, or to remove forest products). If the status is unclear, it is better not to block the ditch/canal because it is likely that the block will be opened by the owner or another party who feels the block is restricting their access.

3. Written support for the activity should be obtained from the owner of the ditch/canal. This should be backed up by permission from authorities from the village where the ditch/canal is located. It is preferable that this support be witnessed by a representative of the local community, so that following blocking the community will participate in protecting the block (so that is not opened by other people).

4. The blocking activities should be socialized to the local community and government. This involves clarifying the goals and usage of the blocked canals/ditches, both from the ecological and socio-economic perspectives.

5. A number of ditches in South Sumatra are near oil and gas pipes owned by private companies, and on or near the land of oil palm and other plantations. This is a dangerous situation, because there are often land and forest fires near the location of ditches. To respond to this, it is recommended that private sector interests help support blocking of ditches near their operations. Assistance should not only go to the physical activities, but should also be directed towards development activities for the communities which use and own the ditches. For example, a community development programme can promote farming, fisheries, and animal husbandry as an alternative to forest-related activities.

BLOCKING TECHNIQUE

1. Blocking activities should start at the upstream side of the ditch/ canal, and move downstream, with not too much distance between blocks. This will allow for more effective retention of water in order to improve conditions and prevent peatland fires.

2. Season is a factor affecting the timing of blocking activities. Preparation and mobilization of materials to the blocking site should be carried out at the end of the rainy season (or the beginning of the dry season). Once the materials are on site, the blocking can take place during the dry season. Construction of the blocks during the rainy season is difficult and requires additional labour.

3. There is an increased risk of damage to large blocks (with a width of more than five metres). Damage is typically caused by erosion of the peat layer on the sides and under the block. The horizontal support poles, and the poles which are inserted vertically, should be easily removed from the loose peat substrate. To reduce the risk of erosion, the following actions should be taken:

    - ❐ The wooden poles which are embedded into the peat of the canal should go all the way down to the mineral soil layer.

    - ❐ An appropriately sized spillway should be built in the middle of the block and/or lateral release routes should be dug between two blocks to the right and left of the canal so that the water pressure in the canal can be released into the nearby peatland.

    - ❐ The chambers in the blocks should be filled with mineral soil sacks immediately after the walls have been built. These sacks should be made from a strong material, such as geotextile. It has been shown that plastic sacks are quickly damaged by the sun and acidic peat water.

- ❒ Poles should be used to support the outside downstream wall of the block in order to strengthen the block. This is especially important for blocks that are wider than five meters.

- ❒ The supporting poles installed on the right and left sides of the block should be deeply implanted in the peat on the canal's banks. This will strengthen the construction and protect against strong water currents in the canal.

- ❒ Wood planks which are used as vertical supports are not as strong as logs in withstanding the water current in the canal. For this reason, it is recommended that logs with the ends sharpened to allow for easier insertion into the mineral soil, be used. Belangeran wood is particularly suitable for the vertical poles due to its elasticity (it is not brittle) and the fact that it can withstand the peat water (it does not rot easily).

MONITORING AND MAINTENANCE OF THE BLOCKS

1. After the blocks have been built they will need on-going attention. They should be monitored at minimum once a month in order to determine their physical condition. If the block is damaged or leaking it must be repaired immediately. Damage that is allowed to escalate will be more expensive and difficult to repair.

2. Even though the canal has been blocked and the peat below and surrounding it is wet, the threat of above ground fire must still be considered. To address this, a campaign of fire prevention and training for village level fire brigades should be undertaken.

OTHER ACTIVITIES NEAR THE BLOCKED CANAL

To optimise the benefits from blocking a canal/ditch, the following activities can be carried out in and surrounding the canal/ditch:

1. The blocks in the canal will create fragmented bodies of water. These can be used for fish aquaculture (either for fish in cages, or for fish that are trapped during high water periods – similar to the *beje* ponds).

2. Blocking the canal will raise the water table in the nearby peatlands. This is very beneficial as wild and planted vegetation will grow more easily. The following are peat swamp trees that are recommended for planting near blocked canals: belangiran *shorea belangiran,* jelutung *Dyera lowii*, laurel *Callophylum spp.,* False Elder *Peronema canescens*, meranti and terentang *Campnosperma spp.* (note: as with a reforestation program, regreening on peatland must be preceded by hydrological restoration. If the peat is dry because water has been drained by canals/ditches, it is certain that the reforestation activities will fail).

3. In addition to land vegetation, water plants such as *pandanus spp* which are found in peat water, can also be planted. In addition to strengthening the block, this vegetation acts as a place for fish to hide, find food and spawn.

4. Animal husbandry activities (for example, chickens and ducks) also provide the opportunity to increase the income of people near the blocked canal. These activities bring direct economic benefits, while at the same time waste can be used as fertilizer for the area that has been replanted with rehabilitation vegetation.

RECOMMENDED FOLLOW-UP

Through the CCFPI project, which was fully funded by CIDA and implemented by Wetlands International Indonesia Programme, during 2002-2005 in South Sumatra and Central Kalimantan no less than 26 canal/ditches were blocked, with a total of 57 blocks. Given the number of canals and ditches that have been dug (note: in the Merang-Kepahyang area, Musi Banyuasin District in South Sumatra, there are no less than 250 “wild” ditches. In the ex-MRP in Central Kalimantan, there are canals totalling 4,470km), the challenge ahead to save the peatlands from fire indirectly resulting from these canals/ditches (which cause over-drainage), is not a small one.

To address this situation, and in order to save the peat swamp forests of Indonesia (and especially those in Kalimantan and Sumatra), there needs to be an intense effort involving a variety of stakeholders to IMMEDIATELY block canals and ditches in peat. It is hoped that the examples of blocking activities described in this book can be used as a reference for saving the peat swamp forests and the life which is on and near it. Good luck!!

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A Guide to the Blocking of Canals and Ditches
in Conjunction with the Community

A large part of Indonesia's peatlands and peatland forests are currently experiencing extremely serious damage as a result of human activities which lack any concept of the environment. Such activities include the burning of peatland in preparation for agriculture and plantations, the uncontrolled felling of peatland forest (both legal and illegal) for timber, the construction of canals and ditches for agricultural irrigation and drainage as well as for transportation, and the clearing of peatland to make way for agriculture, industrial estate crops, housing, etc. All of these activities not only cause physical damage to the peatland and its forests (such as subsidence, fire and a reduction in peat area), but also result in the loss of the peat's functions as a carbon sequester and sink, as a water recharging area capable of preventing the flooding of surrounding regions in the wet season and also of preventing the intrusion of saltwater in the dry season. In addition, damage to the peat land and forest also results in the loss of the biodiversity and natural resources which they contain.

The main purpose of writing this book is to provide a guide on methods of repairing the condition and hydrology of peatland so that the peat will be prevented from drying out and becoming susceptible to fire, and thus that damage to the peat can be minimized and the rehabilitation activities (such as replanting) there stand a better chance of success. This book is an improvement upon its predecessor published in April 2004, entitled: Konservasi Air Tanah di Lahan Gambu: panduan penyekatan parit dan saluran di lahan gambut bersama masyarakat (Ground water Conservation in Peat Land (a guide to the blocking of canals and ditches in conjunction with the community).

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