ESEKS..ESEKS..UDUG..UDUG
(Nyanyian Ujung Gang)
Lirik: Iwan Fals/Sawung Jabo/Naniel

Menangis embun pagi yang tak lagi bersih
Jubahnya yang putih tak berseri pernoda
Daun-daun mulai segan menerima
Apa daya tetes embun terus berjatuhan

Mengalir sungai-sungai plastik jantung kota
Menjadi hasan yang harus tak ada
Udara penuh dengan serbuk tembaga
Topeng-topeng pelindung harus dikenakan

Ini desaku
Ini kotaku
Ini negriku..ya!!!

Robot-robot bernyawa tersenyum menyapaku
Selamat datang kawan di belantara batu

Robot-robot bernyawa tersenyum menyapaku
Selamat datang kawan di belantara batu
Kulanjutkan melangkah antara bising malam
Mencari tempat, mencari harapan

Aku melihat
Aku bertanya
Aku terluka..ya!!!

Wahai kawan hei kawan, bangunlah dari tidurmu

Masih ada waktu untuk kita berbuat
Luka di bumi ini milik bersama
Bakarlah mimpi-mimpi..bakarlah
mimpi-mimpi

Klender, April '89
(Iwan Fals - Swami)

ESEKS..ESEKS..UDUG..UDUG
(Back Street Song)
Lyrics: Iwan Fals/Sawung Jabo/Naniel

The morning dew cries because it's dirty again
The white turban is still grubby
The leafs start to dislike themselves
Keeps the strength of the dew deteriorating

Plastic rivers flow through the hart of the city
being an ornament they shouldn't
The air is full of copper dust
The gasmasks are felt

This is my village
This is my city
This is my country..yeah!!!

Living robots address me smiling
Welcome friend, in this stone jungle

Living robots address me smiling
Welcome friend, in this stone jungle
I continue my stride through the noise of the night
In search of a place, in search of hope

I look
I ask
I'm hurt..yeah!!!

Wow my friend, hey my friend, wake up from your sleep

There is still time to
Heal the wounds of this world we own
Burn your dreams..burn
your dreams

Klender, '89
(free translation by Bart van Assen)

The "Watershed-Ecosystem" on Central Java

a case study of three projects

Bart W van Assen
Herbert Schuurmans
Maarten Thiels
Wageningen Agricultural University, October 1991

Edited by Bart W van Assen, October 2000

WITH THE COVER

Two major art forms in the Javanese society today that have enormous influences on the environmental awareness. The first is the ancient 'Wayang' (puppet) play and the other is the modern 'Indopop' music.

In the Wayang play, gods discuss the problems of the people (like overpopulation, floods, failing harvests, and decreasing yields) and send messengers to help and inform the people to overcome these problems (by birth control, river control, construction of water reservoirs, other cropping regimes, etc). The Kayon on the cover is the base of the Wayang Kulit (leather puppet play). It has a magical function and the Dalang (puppet player) starts his play with the Kayon to bring the puppets to life and ends with it, warning the spectators not to harm the Kayon of the world (and enraging the gods that way). On the Kayon the gate of heaven and the tree of life are shown (source: Buurman, 1980).

Indopop, only recently (and barely legal) started to be society critical and is distributed by radio and music cassettes. This way even the youth (and hope of the future) in the outback is reached with it, ensuring the sounds of Dankdut, Sundapop, and so on to be heard everywhere in the jungle. Iwan Fals is one of the most popular singers of Indopop and also one of the forerunners in society critical pop music. The release of his album 'Swami" (1990) almost caused a major national crisis and was almost banned from the market because of rumors stating the first song of the album "Bento" is about Tommy Soeharto, son of president Soeharto.

Everywhere on Java the sounds and characters of Wayang and Indopop are known, and people start to be aware of the mismanagement of their environment. So, depending on their means, they start to manage their environment in a more, ecological, stable way (by introducing better crop species, using erosion conservative measures, etc.). The authors of this article would like to emphasize the importance of the local arts as changing agents in management of tropical ecosystems through the use of both in the cover (picture of the Kayon is taken from Buurman (1980).

The actual text of this article has been edited where needed and prepared for PDF-format in October 2000.

ABSTRACT

The main goal of this article is to answer the following question: Is it possible to integrate management of an ecosystem in watershed management? A discussion with definitions of both kinds of management is raised to answer this question. Three projects in Central Java are reviewed and compared to management of an ecosystem, namely: the Kali Konto Project (near Malang, Java), the B3PDAS Project, and the Upper Solo River (Wonogiri) Watershed Protection Project (both near Solo, Java).

An ecosystem is a complicated definition in ecology. The definition used in this article is as follows: An ecosystem is a, more or less, self-sufficient, biological system in which interactions exist between the a-biotic basis, the community, and their elements and organisms. Between these points are many mutual relations. Some requirements for proper management are: not disturbing the food chain relationships, neither the niches of the organisms existing, nor creating an imbalance of import and export rate of nutrients through destruction of the ecosystem.

The definitions of watershed management vary considerably. In this article the definitions of the Kali Konto Project are used because they are the clearest definitions. These definitions are as follows. Watershed management as a process is defined as the separate but closely linked stages of screening, planning, and implementing the conservation through rehabilitation and protection measures of the watersheds natural resources, especially soil,

land, and water and watershed. Management as a system (or management plan) can be defined as the system of planned control of (a) natural resource consisting of:

- Resource control actions;
- The tools to implement these actions;
- The institutional arrangement to support the implementation of the resource control action.

In the authors' eyes, watershed management is closely related to management of an ecosystem because a watershed can be seen as an ecosystem or a complex of interrelating ecosystems. However, based on the points mentioned in the discussion the authors have the opinion management of an ecosystem can not be integrated in watershed management. The differences between management of an ecosystem and watershed management are too big; management of an ecosystem enhances much more than what in this article and by the projects is considered as watershed management.

INTRODUCTION

In much literature watershed management is treated as equivalent to management of an ecosystem. Because both management systems are rather complicated, it is surprising this is done so easily. This article therefore focuses on the question: Can management of an ecosystem be integrated in watershed management? By comparing three watershed management projects in Central Java against the definition of an ecosystem and its management, a discussion is raised to answer this question. This is done the following way:

- First of all definitions of management of an ecosystem and watershed (management) are given. More emphasis is placed on watershed (management) as on management of an ecosystem, because the authors assume the latter known whereas the first might need more attention.
- Secondly the three projects are referred to as to their aims and objectives. This is done to get insight in the different projects. However, this article is not meant as a comparison of the different projects, they are merely chosen examples of watershed management on Central Java!
- Next, in a discussion an answer is sought to the question whether management of an ecosystem can be integrated in watershed management.

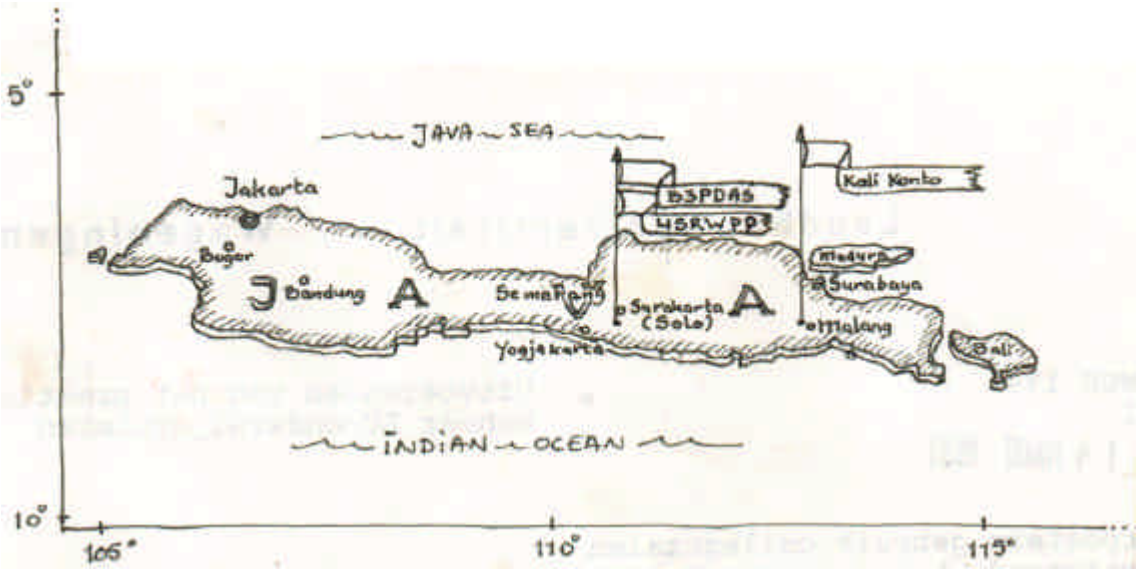

Figure 1 Location of the projects

The three projects referred to in the text are: The (late) Kali Konto Project near Malang, the (late) Upper Solo Watershed Management through Peoples Participation and Income Generation Project near Surakarta (often referred to as the B3PDAS Project) and the Upper Solo River (Wonogiri) Watershed Protection Project, a continuation of the B3PDAS Project (see Figure 1). (No detailed topographical, climatic, social, etc. data on Java and the projects will be given because such data can be found in other literature. See, for instance, Government of Indonesia, Ministry of Forestry, 1983 - 1985, 1990 and Kali Konto Project 1984 - 1987).

Because of the large amount of information on the three projects (especially on the Kali Konto Project) it was possible to use the necessary data from the available reports. These quotations are kept as genuine as possible, but scare brackets - [] - have been used to clarify them.

Furthermore personal information was available through Mr van Assen, who has been in the area twice, in 1989 and 1990, and has been active in the B3PDAS Project and the Upper Solo (Wonogiri) River Watershed Protection Project.

THE ECOSYSTEM AND ITS MANAGEMENT

Many authors adapt the definition of an ecosystem to their own needs: "a unit that includes all of the organisms (i.e., the "community") in a given area interacting with the physical environment so that a flow of energy leads to clearly defined trophic structure, biotic diversity, and material cycles (i.e., exchange of materials between living and nonliving parts) within the system" (Odum, 1971), "the interacting system which is moulded by a community together with it's a-biotic environment" (free after Zonneveld, 1985), "an ecosystem is a natural area, where organisms and their physical and chemical environment interact dynamically and within which balance can be struck between inflow and outflow of materials and energy" (Carsels et al, 1983). The definition used in this article is as follows: An ecosystem is a, more or less, self-sufficient, biological system in which interactions exist between the a-biotic basis, the community, and their elements and organisms.

An ecosystem consists of an a-biotic basis. This basis contains (an)organic elements like CO_2, H_20, proteins, lipids, etc. but also e.g. the climate (temperature, precipitation, etc.). Furthermore an ecosystem has to include a bio-community, a community that is defined as the total amount of each other influencing, to different species belonging, organisms together committed to a particular environment (Best and Haeck, 1984). A bio-community can i.a. be written as a food chain which shows the relation between producers, consumers and decomposers. Between the a-biotic basis and the community are many mutual relations. Not only has the a-biotic basis influences on the composition of the community but there are also feedbacks by the community on the a-biotic basis.

CONDITIONS FOR MANAGEMENT OF AN ECOSYSTEM

Some of the conditions to which management has to meet certain requirements are:

- In an ecosystem mostly 3 categories of organisms can be distinguished according to function, namely: producers, consumers and decomposers. The consumers can further be divided into herbivores, carnivores (and omnivores). These organisms are related to each other by a food chain. Where an organism is placed in the food chain can be expressed in the trophic level (see figure 2). With mismanagement man can play a negative role in a food chain so that the relations between organisms are disturbed.
- Every organism has its own niche in a system. Man can disturb this by mismanaging, like we see in Africa where wild animals are scared away by cattle.

- As stated in the definition, an ecosystem is a more or less closed and self-sufficient system. Man has the attitude to transport different kind of products (food, etc.), which leads to an imbalanced import and export rate of nutrients.
- There is an upper limit to the number of individuals that can use a specific area. Important is the long-term preservation of a system in which plants and herbivores are living. This means that there has to be a balance between plant and animal. In case of a balance, growth of the changing vegetation is equal to the consumption by grazing. It is clear that man can influence this by managing the area incorrectly.

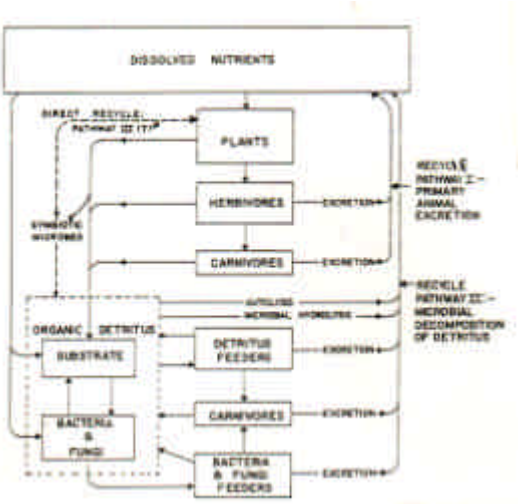

Figure 2 Example of a nutrient cycle (source: Odum, 1971)

WATERSHED, MANAGEMENT (AND PLANNING)

The definitions of a watershed are quite homogeneous, so only a few are mentioned. The Kali Konto Project (1986/1987-I) states: "A watershed, also called river basin, drainage basin or catchment area is defined as the land surface from which water flows to a primairy watercourse" (see figure 3) and also "that area of land that drains water, sediment, and dissolved materials to a common point along a stream or river" (Kali Konto Project, 1985-I). Easter & Hufschmidt define a watershed as "a topographically delineated area that is drained by a stream system". Furthermore some authors divide the terms watershed, river basin, etc. in the size of the area, e.g. "A river basin... is of larger scale (than a watershed, authors)" (Easter & Hufschmidt, 1985). Focused on the objective of this article, it is not necessary to use this division.
It should be noted, however, that the topographical delineation, used by Easter & Hufschmidt (1985), and the watershed delineations used as boundaries don't necessarily coincide with the real watershed boundaries; a fact that is often not noted!!! The figures 4 and 5 clarify this statement. Therefore it was decided to define a watershed as the land surface from which water, sediment, and dissolved materials mainly flow to a common point along a primary watercourse.

The definitions of watershed management, on the other hand, vary considerably more.

Figure 3 Experimental watersheds at the Coweeta Hydrologic Laboratory in the mountains of Western North Carolina. All trees have been cleared from the watershed in the centre of the picture in order to compare water input (rainfall) and output (stream run-off) with that of the undisturbed forested watersheds on either side. Insert shows the V-notch weir and recording equipment used to measure the amount of water flowing out of each watershed area (source: Odum, 1971).

Kittredge (1948) defines watershed management as "the administration and regulation of the aggregate resources of a drainage basin for the production of water and the control of erosion, stream flow, and floods". Bongers (1990-1991) states "watershed management can be defined as the comprehensive management of the natural resources water, soil and vegetation within a river basin, so as to make productive use of all these nature resources and also to protect them. Or: the management of all resources of a river basin to meet the total sustained needs of land and water use for that basin, taking into account the interdependence between the different resources and uses". Other authors define watershed management as "the process of formulating and implementing a course of action involving natural, agricultural, and human resources of a watershed, taking into account the social, economic and institutional factors operating within the watershed and the surrounding river basin and other relevant regions to achieve specific objectives" (Easter & Hufschmidt, 1985).

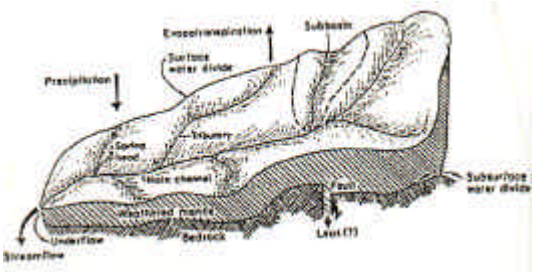

Figure 4 A topographical watershed can contain a leak, thus not corresponding to the definitions mentioned above (source: Hewlett 1982).

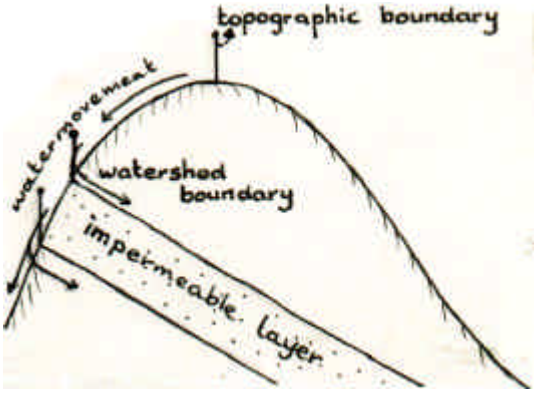

Figure 5 A difference can exist between the topographical delineation and the watershed.

The Kali Konto Project acknowledges two definitions as to watershed management (as a process and a system), namely: "Watershed management as a process is defined as the separate but closely linked stages of screening, planning, and implementing the conservation through rehabilitation and protection measures of the watersheds natural resources, especially soil, land, and water... Watershed management as a system (or management plan) can be defined as the system of planned control of (a) natural resource consisting of:

- Resource control actions;
- Tools to implement these actions;
- Institutional arrangement to support the implementation of the resource control action" (Kali Konto Project, 1986/1987-I).

The Kali Konto Project also uses a definition for watershed planning: "Watershed planning is defined as the systematic gathering, processing and analysis of data to prepare a plan with the primary objective to ensure a sustainable utilization of the watersheds land and water resources, with maximum benefits as a whole" (Kali Konto Project, 1986/1987-I). Furthermore Lemckert states watershed planning "seeks the safe use of land" (1989) and "entails the wise use of land and water... (it) aims at securing the sustainable use of land and water, with maximum benefits for society as a whole" (date unknown).

In this article the definitions of the Kali Konto Project are used because they are the clearest definitions.

WATERSHED MANAGEMENT ON (CENTRAL) JAVA; THE GENERAL HISTORY

"In Indonesia, and on Java in particularly, there is a growing imbalance between population and carrying capacities of agricultural as well as state forest lands, causing gross disturbances in the ecological balance. This has resulted in:

- Deforestation and inadequate fuel wood supply;
- Increasing erosion levels;
- Decreasing water availability for irrigation as well as drinking water purposes" (Kali Konto Project, 1985-I).

Watershed management is seen as a mean to overcome this imbalance; "it is logical for Indonesia to try to solve its environmental problem through the development of these river basins" (Salim 1979). "In Indonesia the concept of watershed management has been officially acknowledged, as evidenced by the inclusion of this concept in the state policy on integrated and long-term development of critical land areas in many major river basins" (Manan and Wiersum, 1984). For instance, the B3PDAS Project was started as a result of several major floodings (last one 1967) of the Solo River, causing (mainly erosion related) problems over a length of more than 200 kilometres. So, in Indonesia, an official cooperation decree was erected between the Ministry of Home Affairs, the Ministry of Forestry, and the Ministry of Public Works trying to solve this imbalance. This was a major step forward because a watershed "must be viewed as a whole" (Lemckert, 1989).

The decree "identifies 22 watersheds which are given priority for conservation works during the fourth five year development plan (Repelita IV 1984/85-1988/89)" (Kali Konto Project, 1986/87-I). "36 watersheds throughout Indonesia (are, authors) under rehabilitation projects. 22 of them have been recognized as super priority watersheds" (Manan and Wiersum, 1984). But "in the past the problem (erosion, authors) was approached as an individual technical problem in the form of reforestation or construction of sediment traps (check dams). This approach yielded no solutions or only temporary solutions" (Kali Konto Project, 1986/1987-I). "Originally, watershed management was viewed as the treatment of individual pieces of land, with no particular regard to the present and future needs of the entire watershed" (Manan and Wiersum, 1984). "Over the years, however the thinking of the problem changed and made the government aware of the fact, that only through comprehensive and integrated approach within the natural boundaries of a watershed can optimum results be obtained. In other words, for physical development to be effective, it must be based on a plan integrating the topographical, soils and hydrological aspects of a watershed with a systematic development of its human resources" (Kali Konto Project, 1986/1987-I); "the current concept lays emphasis on the needs of the watershed as a whole" (Manan and Wiersum, 1984). Furthermore, the B3PDAS Project (1983) states explicitly "watershed development involves a number of disciplines, people, institutions, and organizations", a watershed management plan "is a compromise among the planners' expertise, people's wishes, the government policy and the area potential" (Panhuys, 1991), and watershed management "covers a wide range of activities, the responsibility for which is divided among a large number of agencies and different levels of government" (Kali Konto Project, 1986/87-I).

But despite the complexity of watershed management, the present approach is still rather simple. "An overall approach to river basin development will involve the following activities:

- Reforestation of bare land in the upstream areas for the purpose of establishing protection forests;
- Planting of different vegetation (not necessarily forest trees) such as plants for commercial use, fuel wood and fruit trees with quick yield abilities;
- Agriculture involving a combination of agricultural and forestry crops;
- Silvipasture, combining silviculture of fast growing tree species and grasses for forage;
- Construction of terraces;

- Engineering approach by building small check dams, levees and other flood control devices;
- Extension" (Manan and Wiersum, 1984).

One more point should be stressed explicitly, namely: The local people, that is the people of the watershed, should actively be involved (through information, courses, etc.) in the planning and management of projects!!! "The participation of the local population is of utmost importance for the success of soil and water conservation measures both on State Forest Land and on village land areas" (Kali Konto Project, 1986/1987-4). Already too often projects have failed of not acknowledging this fact.

WATERSHED MANAGEMENT ON (CENTRAL) JAVA; AIMS AND OBJECTIVES OF THE KALI KONTO PROJECT

"In June 1978 and February 1979 teams of Dutch experts visited Indonesia, in response to a request from the Indonesian Government to the Government of the Netherlands: "for technical cooperation to evolve a plan for forestry as a base for rural community development in one of the catchment areas of the Brantas river basin (East Java)". The second mission resulted in a proposal for the Project Kali Konto "Forestry for rural communities". This proposal, dated July 1979, became the official document for the operation of the project and in September 1979 the project was officially started.

The following broader objectives were formulated: "A planning and management model has to be drawn up for a study area on Java as an example for all watersheds in densely populated areas of Indonesia. It should stress on the following priorities:

- Improving living conditions of the local people, encouraging self reliance and maintaining and increasing their standard of living;
- Creating sound and stable ecological systems;
- Creating a forest system based upon multipurpose management fitting in the national forest policy".

To meet these broader objectives the following project objective is given in the above mentioned proposal: "To draw up a master plan for forestry and agro-forestry for the upper watershed of the Kali Konto in such a way that a proper balance is achieved and can be maintained between the functions of the forest and the needs of the population". It is further mentioned that for future development the following aspects must be realized:

- Sustained protection of the soil, also accounting for proper hydrological techniques;
- Sustained production of food and fodder;
- Sustained production of wood for fuel;
- Sustained production of timber for industrial and other purposes.

The first stage of the project included an inventory of the project area, the procedure for which was described in detail in the project's "Final Schedule of Operations and Terms of Reference", dated June 1981. Preliminary results of this inventory were given in the Interception Report, dated June 1982. After about one year of backstopping of vegetation inventory work undertaken by Proyek Kali Konto team members in the study area, the Dutch Research Institute for Nature Management (Rijksinstituut voor Natuurbeheer) was requested early in 1983 to assume, together with experts of the Dutch State Forest Service (Staatsbosbeheer) and Kali Konto personnel (Pegawai Kali Konto), the responsibility for a land evaluation of the forest lands of the project area (for information on Land Evaluation see references). The evaluation was to be based on all relevant data collected in recent years and was expected, together with similar studies on the village lands and the socio-economic conditions in the project area, to provide the basic documents for a master plan for the area.

In May 1983 a proposal for the evaluation was submitted and accepted" (Kali Konto Upper Watershed 1984-I).

The main conclusions drawn from this evaluation provide openings for integrated management options combining `conservation' and `exploitation' land utilization types (LUTs):

- Some 54% of the total forestland area (8.385 ha) is suitable for forest plantations in some form or other. This includes virtually the entire shrub area.
- The scope for exploitation of natural forests is very limited. Only about 10% is suitable for this use.
- The areas most suitable for conservation forest are least suitable for any of the `expliotation' LUTs.

"The main conclusion to be drawn from the data collected is that the forest land has the potential to meet various demands from society, provided that forest management is adjusted to include an extension of the plantation area and to raise the level of management" (Kali Konto Upper Watershed 1985-VI).

WATERSHED MANAGEMENT ON (CENTRAL) JAVA; AIMS AND OBJECTIVES OF THE UPPER SOLO WATERSHED MANAGEMENT THROUGH PEOPLES PARTICIPATION AND INCOME GENERATION (B3PDAS) PROJECT

"Under the Directorate General for Reforestation and Land Rehabilitation, which was newly created in April 1983, the present activity of [Watershed Management Development Centre] in the Upper Solo watershed is to develop a management plan of the 125000 hectare portion of the Wonogiri reservoir watershed located on the upper slopes of Mountain Walu. This watershed, originally forested, has been changed to traditional cultivation including very steep slopes for subsistence food crops. The new multi-purpose reservoir at Wonogiri is in danger of being filled with sediment unless soil conservation measures are applied, especially on slopes more than 50 percent. The Government's Ministry of Public Works predicted that if sedimentation remains continuous, the projected life span of the dam will be shortened by 50 percent (about 50 years). This will paralyze the provision of irrigation water for lowland rice below the dam side; it's flood control storage capacity and potential for generating of electricity. In this connection, a plan of action to eliminate the hazards of flooding and sedimentation is being launched by the WMDC through proper management of the Wonogiri reservoir watershed with the cooperation and participation of the farmers, involved in implementing the recommended measures for soil erosion control, rehabilitation of degraded lands, and afforestation" (Indonesia, 1984-II).

"The policy [of the WMDC's] may be summarized as follows:

- To arrest the deterioration of the watershed caused by dry land farming on steep slopes;
- To upgrade the quality of life of the community including health, nutrition and education;
- To increase agricultural production to overcome the malnourished state of much of the population and for the country to become self sufficient in food supplies;
- To develop industries to reduce the pressure on the land and to absorb manpower beneficially to generate income" (Indonesia, 1983-II).

In these two reports (Indonesia, 1983-II and 1984-II) the following measures and activities as to watershed management are suggested:

- Improving utilization of surface water for irrigation (water conservation);
- Controlling soil erosion (soil conservation; by stabilizing new formed gullies, building terrace risers, etc.);

- Research activities for measuring soil loss from runoff plots;
- Alternate method of field mapping;
- Improved agriculture (e.g. "keeping the land clean to avoid competition for weeds" (Indonesia 1983-II);
- Education of the local people.

One suggestion should be more emphasized, namely education. In all the used literature, Indonesia (1983-II) is the only reference as to educate the local people to improve watershed management. Yet the proposal only speaks of formal kinds of education like school education. No emphasize is placed on the informal kinds of education, a reason for the authors to do this on the cover.

WATERSHED MANAGEMENT ON (CENTRAL) JAVA; AIMS AND OBJECTIVES OF THE UPPER SOLO (WONOGIRI) WATERSHED PROTECTION PROJECT

The main targets of the Upper Solo River (Wonogiri) Watershed Protection Project are "to reduce or stop erosion and prevent sediment transport to the Gajah Mungkur reservoir... [and] to increase the farmers income and improve the quality of people's life" (Panhuys, 1991). This is done through (physical) evaluation of the watershed and plan erosion control measures.

"After assessment of all physical and human resources and of all existing erosion and erosion-related problems (critical land), agricultural, social and communication problems, it is possible to compile all data and make a plan with recommendations for improvements... The most important agricultural soil conservation method should be the immediate introduction of intercropping of cassava with a groundcover of peanuts or soybeans. The priority areas are dry land terraces on hill slopes of over 45 to 50%. The terraces need permanent monitoring by the PLP (a sub-division of the Ministry of Agriculture) since these areas are the areas with the highest susceptibility to erosion. The maintenance of the terraces, terrace drainage channels, terrace risers etc. is of eminent importance. If some stones of the terrace risers are displaced, then they should be placed back as soon as possible. Also the drop structures of gullies going through these areas need regular observation... All these measures have one great aim: stabilization of the soil resources" (Panhuys, 1990).

DISCUSSION

Watershed management is closely related to management of an ecosystem, because a watershed can be seen as an ecosystem. It clearly defines areas of land with different and relatively closed energy cycles. The major disadvantage of a watershed, however, is that "the sectors and institutions involved in watershed management, work by administrative provinces, which almost never coincide with the watershed. This is certainly a drawback" (Lemckert, 1989). Still, it is appropriate to see a watershed as an ecosystem. The main objection to the present watershed management is that it is too much focused on physical properties only. "The water or hydrologic cycle is commonly of most concern because it integrates vegetation, soil and water, the key components of many resource developments" (Kali Konto Project, 1986/1987-V) and "measures on village land are primarily directed at soil conservation" (Kali Konto Project, 1986/1987-IV). Therefore most suggested measures of management are erosion control related (even though they yielded no solution or only temporary ones), in the form of gully plugs, check dams, reforestation, intercropping, etc. The other (like social, biological and ecological) properties are not considered relevant to watershed management ("The work of the ecologist/ biologist is related to the protection

forest... and is closely related to the activities in forestry" (Kali Konto Project, 1986/1987-III).

Another objection is time horizon used in watershed management. "Forestry planning and management (and that of an ecosystem, authors) often use time horizons of more than 40 years" (Kali Konto Project, 1985-I) but "the forty year time horizon has to be reduced to not more than a decade (in the watershed planning of the Kali Konto Project, authors)" (Kali Konto Project, 1985-I). This time horizon is much too short to be used in sound management of an ecosystem, since a project will have ecological influences that last longer than the used time horizon of a decade.

CONCLUSIONS

Based on the points mentioned in the discussion the authors are of opinion management of an ecosystem cannot be integrated in watershed management. Like management of an ecosystem, watershed management depends on the aim of the management, the possibilities (financial, political) and the knowledge available, but watershed management "is mainly concerned with physical aspects" (Lemckert, date unknown) and focuses on specific processes of (an) ecosystem(s) only, while sound management of an ecosystem needs a much broader approach. Although there are many, the differences between management of an ecosystem and watershed management are too big; management of an ecosystem enhances much more than what in this article and by the projects is considered as watershed management.

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APPENDIX 1 TABLE OF THE THREE PROJECTS COMPARED

Project	**1**	**2**	**3**
Project area (ha)	25000	125000	125,000
Forest area (%)	61	13	13
Agricultural land (%)	6	58	58
Urban area (%)	33	32	32
Activities			
Reasons to start a project:			
- Erosion by river flooding	±	+	+
- Forestry as a base for rural development	+	-	-
Participation of local people	+	+	-
Pure erosion control methods for stabilization of the soil resources	±	±	+
Improving living conditions of the local people (and encouraging self-reliance)	+	+	+
Creating sound, stable ecological systems by:			
- Rehabilitation of degraded lands	+	+	+
- Afforestation	+	+	?
Creating a forest system based on multi-purpose management	+	+	?
Use of Land Utilization Types	+	?	?
Erosion control through afforestation	+	+	?
Erosion control by intercropping	-	-	+

1. Kali Konto Project; goal: To draw up a master plan for forestry and agro-forestry for the upper watershed of the Kali Konto river in such a way that a proper balance is achieved and can be maintained between the functions of the forest and the needs of the people.
2. B3PDAS Project; goal: Saving the multipurpose reservoir at Wonogiri from getting filled with sediment by soil conservation in a watershed management plan.
3. Upper Solo River (Wonogiri) Watershed Protection Project; goal: To reduce or stop erosion and prevent sediment transport to the Gajah Mungkur reservoir and to increase the farmers' income and improve the quality of people's life.

- + = High priority, ± = Intermediate priority, - = Low priority, ? = Unknown