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Drinking water for Gunung Sewu

R J Cullen, A Young and Soedaryanto

BACKGROUND

Gunung Sewu, which translates from Javenese as 1 000 hills, rises north from the coastline of the Special Province (or Daerah Istimewa) of Yogyakarta (DIY) in southern central Java. It is part of Kabupaten (K) Gunung Kidul, one of the four administrative units which, with Yogyakarta City, comprise the DIY.

Development of G.Sewu has lagged behind much of the province; with very poor quality land and relatively high population density, the area will always remain economically poor,(Figure 1).Extreme difficulty in obtaining dry season water is a major constraint.

The area covers some 700 km2 and 237 000 people are expected to live there in 1985 in 636 villages; an overall density of 340/km2 compared with 1 300/km2 in the fertile Yogyakarta plain. Another 53 000 people live in the northern fringe areas which are also very dry.

The median household income is probably less than Rp 25 000 per month. (US$1 = Rp 1 000). A typical household comprises five people and owns three goats and 1.2 cattle.

Geologically, the area consists of a mature cone karst limestone system with an associated network of sink holes, underground rivers and caves. Most of the conical limestone hills have been deforested and then severely eroded. The intervening valleys are generally covered with a mantle of red terra rosa clays. Ground elevations seldom exceed 400 m. (Figure 2).

Annual rainfall in G.Sewu averages just less than 2 000 mm, with less than 50 mm per month between June and September. There are no surface streams; virtually all runoff drains directly into the underlying karst.

EXISTING POTABLE WATER SOURCES

Provincial Setting

In the province there are only 36 piped water supply systems . These serve about 160 000 people,(4.3 % of the DIY total). However, most of the inhabitants of DIY have access to nearby open dug wells which provide readily available water. About 75% of all rural households obtain their water from dug wells. In G. Sewu the problem is far more acute.

Hydrogeology

The G.Sewu karst limestone originates from the accumulation of massive reefs when the area was once submerged. The watertable in G.Sewu normally exceeds 100 m depth, and there are no perennial dug wells.

Underground Rivers

An underground river system, which traverses from north to south, discharges large dry season flows to sea (6 m3/s at Baron alone). Runoff drains into the Baron system via a network of sink holes, of which 264 have recently been identified and surveyed. Most are not developable as water supply sources without very complex engineering works; the sink holes are often very deep and linked ultimately to the flowing river courses via a system of horizontal caves and vertical shafts. To date 45 potential underground source sites have been identified, but access infeasibility will probably rule out development of all but a few. (Figure 2).

There is a series of springs which discharge along the coastline and at the higher area to the west of G.Sewu. Some of these are tapped for water supply.

One important underground river abstraction scheme has been installed by the Health Department and UNICEF at Bribin: water is pumped to the surface from the sump created behind an underground weir built across the Bribin stream. The scheme presently serves 3 000 people, but could be expanded to 8 000.

Boreholes

Nine exploratory boreholes have been drilled in G.Sewu at depths between 100 and 250 m. Only two have been successful; generally the watertable, as mapped during the recent cave survey, is too deep. One hole, at Kanigoro, is 172 m deep with SWL at 104 m. However, improved piezometric mapping in the area indicates a band of unexpectedly shallow groundwater along the northern fringe of the area; as a result successful "fringe" wells yielding between 5 and 10 l/s have been sunk

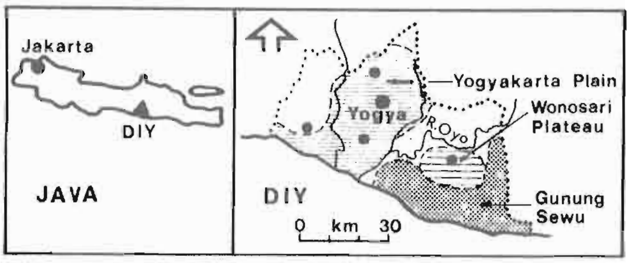


Figure 1. Location

with static water at about 25 m. Four of these have been commissioned with diesel driven Mono pumps for joint water supply and small scale irrigation use. The financial production cost of the water is about Rp 50/m3, but the consumers actually receive it for about Rp 5/m3. Three wells drilled at Krakal on the coast were also successful, although one was saline.

Telagas

Small lakes called "telagas" occur in the valleys of G.Sewu, and are sealed by accumulated clay which prevents leakage into the underlying karst.This drainage may be naturally or artificially blocked. Typical telagas occupy between 0.5 and 2.0 ha when full. Apart from providing domestic water, telagas are also vital for watering livestock.

There are some 250 telagas in G.Sewu, of which about 50 are perennial. Telagas are the most important single source of dry season water in G.Sewu, and suffer progressively from annual siltation with erosion material washed from the surrounding limestone hills. Storage is often limited by horizontal leakage into limestone fissures which starts once the telaga has filled to a certain level.

Even in perennial telagas, water becomes very polluted in the dry season. A telaga will only normally remain perennial if its maximum wet season depth exceeds about four metres.

Rainwater Tanks

A programme of installing rainwater tanks has been underway for some five years, supported by World Bank, UNICEF and other donors. Typical installations store 9 m3 which can be expected to provide about 60 l/d over a five month drought; 4 lcd for three households. Typical costs are Rp 200 000 per 9 m3 tank; (about Rp 22 per litre stored). Once empty, rainwater tanks are frequently used to store dry season telaga water.

Tankers

Areas with most acute dry season water shortage have to be supplied with water from adjacent areas; it was estimated in 1982 that 400 m3/d was being trucked into G.Sewu at a cost to most consumers of between Rp 2 500 and Rp 3 000/m3. Trucked deliveries between June and December 1982 , which peaked near 12 000 m3/month, were estimated at 40 000 m3; the total cost was some Rp 108 million.

The Problem

In G.Sewu there is a variety of alternative water sources, but all have drawbacks either for technical, cost, reliability or quality reasons. Many people walk further than 3 km to the nearest water source - telaga, spring, well or cave - and, ironically, those in the province who can least afford it are forced to pay the highest water charges for water imported by truck or tanker. The effect of the effort required to collect water on people's actual consumption is shown thus:

Daily household consumption (litres)		Distance to nearest perennial telaga (km) 0.5	5.0
Carried for people	(l)	95	15
Carried for livestock	(l)	30	8
Purchased for people	(l)	10	45
Purchased for livestock	(l)	0	18

(Source: Survey at T. Soko, October 1982)

Excluding private and government tanker operators, there are at least six government and four non-government agencies and charities directly involved with G.Sewu water supply.

Many of these agencies are concerned with providing one type of source, such as fringe area spring collectors or rainwater tanks. Their work also tends to be directed at specific community types and associated levels of water supply service. These range from the planned piped systems for the 5 main towns, to wet season dug wells for single families.

Apart from the larger schemes, widespread effort has been made to install schemes not requiring diesel driven pumps. This is understandable because most attempts to install pumping schemes have failed, often for basic reasons. Also, most villagers can barely afford to buy fuel to run pumps, let alone the cost of maintaining them.

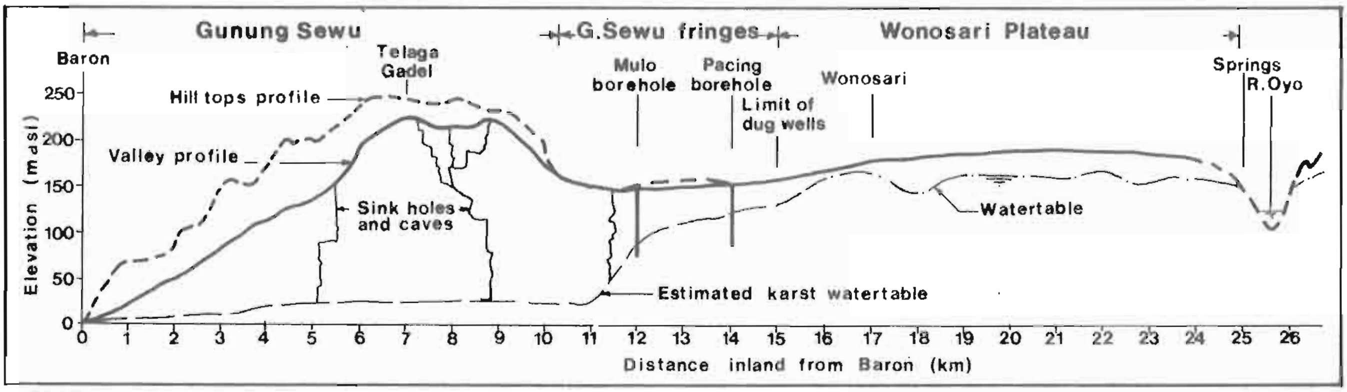


Figure 2. South-North Section through G. Sewu

However, scope for major improvements to water supply in G.Sewu is extremely limited without recourse to power pumps. Even the gravity fed piped systems in G.Sewu and the rest of DIY suffer from relatively trivial maintenance or organisational needs. What is really needed is a unified approach to maintaining schemes, an organisation capable of fielding the required mechanical expertise, and adequate funding. The latter point begs the question of financial viability of rural water supply systems: should, as is often the case, water continue to be provided totally free?

THE FUTURE

Levels of Technology

Clearly, much effort is already being directed at alleviating G.Sewu's water supply problems, but collectively it suffers from lack of co-ordination, duplication of effort, lack of preparatory work and insufficient definition of priorities. Moreover, until recently, work has often been aimed at low cost solutions which, in a marginal area, may not work.

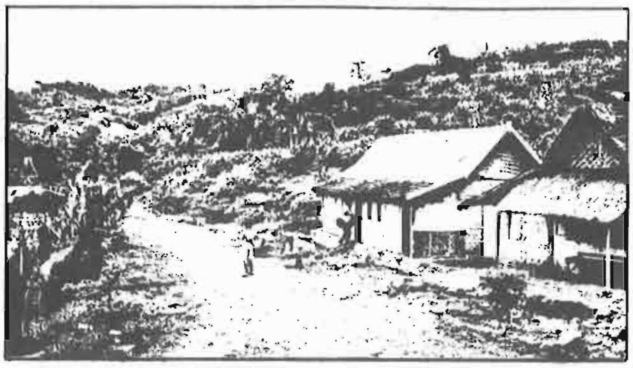
Given that except for telagas,isolated caves or springs, the only major sources are restricted to the northern and southern limits of G.Sewu, the full solution to its water supply problems will be to pump from these points into the central area. Mains up to 9 km long, pumped at heads up to 250 m, would be needed. Clearly such options will not be cheap and, to keep operating costs low, require generous pipe sizing. The costs of triple stage pumping to villages in central G.Sewu are expected to raise water costs by Rp 200 - Rp 300/m3; about Rp 1 500 per family per month.

Development Resources

More recently however, three government agencies which routinely work at higher levels of technology have become involved at the area: these will accelerate the introduction of some of the technical innovation which is really needed to progress in G.Sewu. These are :-

(a) the Groundwater Development Project (P2AT) under the Directorate-General of Water Resources Development (DGWRD);
(b) the Small Towns Water Supply Project (PAB) under the Directorate-General of Cipta Karya, which has installed a piped scheme to exploit the major spring at Baron;
(c) the IKK Water Supply Project, also under Cipta Karya, which is working towards providing piped systems for several kecamatan towns including Panggang,Tepus, Ponjong and Rongkop in G.Sewu.These will become very important schemes, and will be vital for the surrounding rural inhabitants; it is important that their need be recognised when sizing the system capacities and associated levels of service.

DGWRD's involvement in rural water supply through P2AT has developed from an exploratory



G.Sewu from Krakal

drilling programme associated with a UK Overseas Development Adminstration (ODA) funded groundwater irrigation project on the Wonosari Plateau (to the north) which then extended into G.Sewu. At the same time, communal washing facilities were built into the wellhead systems of the G.Kidul (GK) irrigation wells. Some of these have been used by people coming from 10 km away and more in G.Sewu to to wash clothes. In 1982,the 28 original GK wells (typically 30 l/s) averaged 2 200 hours each.

The successful boreholes on the G. Sewu fringes are adjacent to areas of acute dry season shortage, and a typical yield of 10 l/s makes a tremendous impact as clearly illustrated by the four wells commissioned so far.In 1983 (their first complete year) these wells served a total of some 2 500 people coming from up to 3 km. One well also supplies up to 100 m3/d at a bowsering point for trucks delivering water to G.Sewu, and is 10 km closer than the previously used sources.

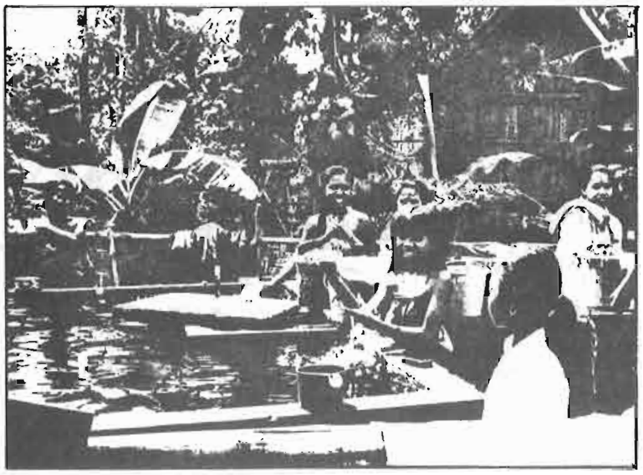
DGWRD has also become involved in a programme of rehabilitating telagas. Coupled with this has been a survey of the G.Sewu caves and work on improving selected caves as water sources. With ODA assistance, DGWRD is also carrying out groundwater resources assessment and associated development planning for the province. From this work is developing an integrated plan for water supply to G.Sewu.

The major source components of the G.Sewu plan are expected to be :-

(a) telagas;
(b) pumped springs;
(c) pumped boreholes;
(d) rainwater tanks;
(e) tankers and bowsers.

The associated questions are:-

(a) which sources should be used and where?
(b) who should implement and operate them?
(c) which are the truly needy areas, where more costly methods must be considered?
(d) how to avoid duplication of effort?
(e) how to get necessary technical advice?
(f) how much, if at all, should the actual operation of the systems be subsidised?



Washing Place near Fringe Area Borehole

THE PLAN

The major source components being considered are shown on Figure 3.The main foci are recently drilled fringe area wells. These will feed pipelines routed inland. Inaccessible areas would be supported, where possible, by perennial telagas; otherwise by rainwater tanks.

The overall development would be on a step by step basis, and DGWRD's contribution could be to provide wells, sometimes install pumphouse, standpipe, washing and bowsering facilities, and then hand them over to Cipta Karya for use in its own piped schemes; also to continue with the telaga rehabiltation schemes and with monitoring groundwater use and cave schemes.

The authors are encouraged by the fact that the GK wells have been operated successfully for over five years, and that the recipient farmers now pay the whole diesel cost. Since 1982, these wells have been operated reasonably successfully by local government authorities. Also,a water authority (PDAM) has recently been set up to run Wonosari water supply and it is believed that this will also look after PAB's Baron scheme.

There is considerable scope for improving rural water supply facilities in G.Sewu. However higher technology levels must be used, and provision made to operate and maintain them.

We suggest that consideration be given to expanding the mandate of PDAM Wonosari to include rural water supplies throughout K. Gunung Kidul. To support this effectively, some revenue would be essential and a unified approach must be adopted to rural water charging; tariffs would be related to ability to pay, and a specific subsidy level set to finance and staff the operation and maintenance of rural schemes.

Close inter-agency liaison on both implementing and operating rural water supply schemes is essential: rainwater tanks really should be restricted to areas without alternative sources. We suggest a committee be set up to integrate rural water supply development.

We gladly acknowledge the interest and support of the Directorate-General of Water Resources Development of the Government of Indonesia and the Overseas Development Administration of the British Government under whose auspices this work is being carried out; the contents of this paper do not necessarily reflect the opinions or policy of the DGWRD or the ODA.

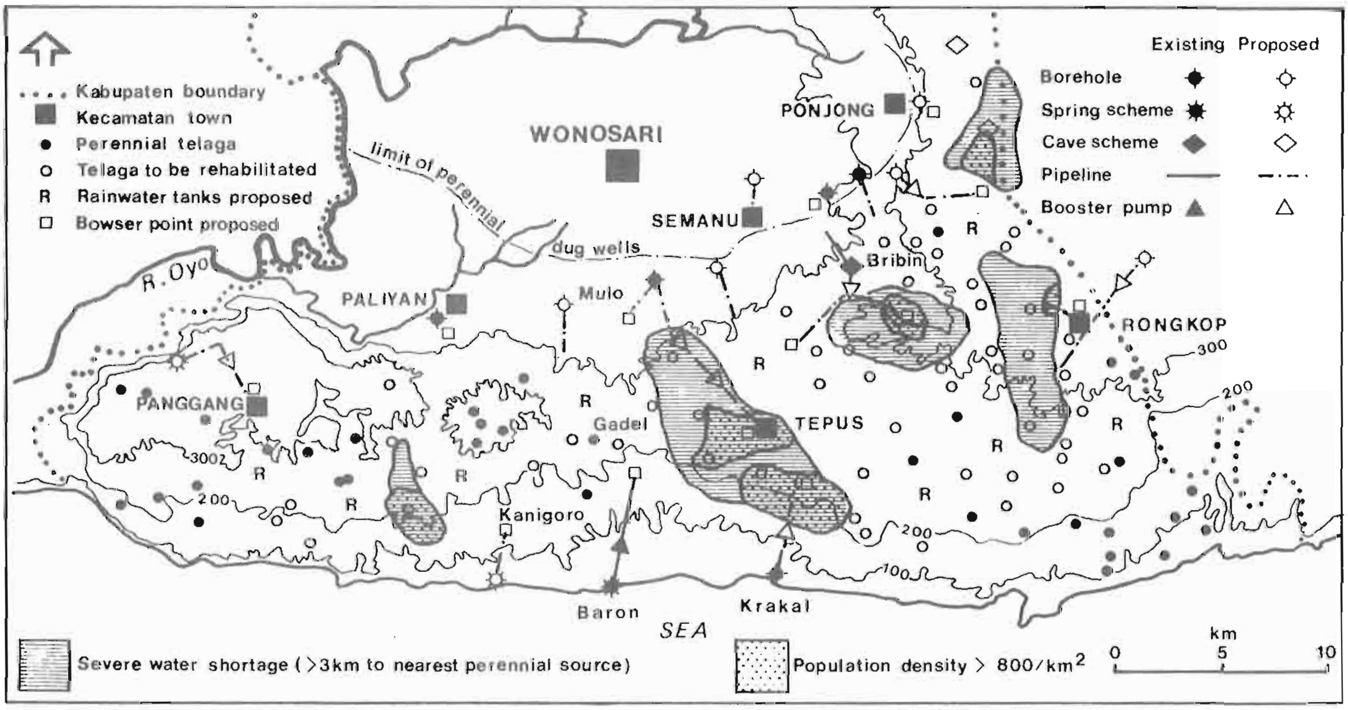


Figure 3. Gunung Sewu Development Components