

PROPOSAL TO OPTIMIZE THE BENEFITS OF SAMANALA WEWA WATERS

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35 years and under 35 years of age.

by

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1.0 Introduction

1.1 Introduction to the geography

Samanala Wewa Reservoir is built at the confluence of the rivers Walawe and Belihull Oya and is situated at a place called Kumbalgama. This water is taken initially along a 5.5 km long underground tunnel and finally along a surface penstock to the 120MW Power Station at Kapugala. After Power is generated, the Power Station discharge is released along the Tail Race canal into a stream called Katupath Oya and from there, back to Walawe Ganga, but at a place several kms down stream of the point where we block the river to form the reservoir. Refer Figure 01.

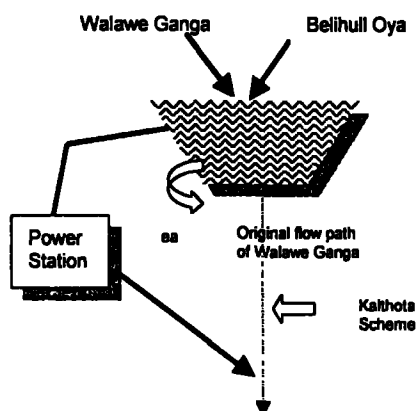


Figure 01

(Location diagram of Samanala Wewa Reservoir, Power Station and Kalthota Scheme.)

A large irrigation settlement exists in between the points where the water is initially tapped and the point where water is finally released to after generating power. The Kalthota Project, as it is called, has over 2000 families whose sole lively hood is agriculture and that too is from the water discharged from the reservoir.

There also exists a water leak from the Right Bank of Samanala Wewa Reservoir. This water meets the original flow path of the river Walawe (and Belihull Oya) before reaching Kalthota. (See figure 01)

In addition to any discharge from the dam through bottom irrigation outlets, the water from this leak is the only guaranteed source of water for the farmer settlement at Kalthota. However, as the water from the leak is not adequate to meet their total demand, from time to time, water is released through the bottom outlets of Samanala Wewa dam too to meet the balance.

1.2 Methodology of Water releases

Every year, water is released from Samanala Wewa reservoir for Irrigation purposes through irrigation outlets for the aforesaid purpose. There is an Irrigation Officer stationed at Kalthota who comes under the purview of the Irrigation Engineer Rathnapura. Twice every year, a meeting is held at Kalthota, which is represented by the Div Secretary, Irrigation Engineer Rathnapura, Officers of the Agriculture Department and representatives of the farmer community. At this meeting, a decision is taken as to the dates of commencement of water releases to farmers at Kalthota for the next season and also in what quantities. Later, these details were further discussed at a meeting held at the water management secretariat, which is represented by officials from C.E.B, the director and deputy director of Water Management Secretariat, Officers from the Mahaweli Head works, and Representatives from Water Board. As per the results of this meeting, a schedule is made as to how water from the Samanala Wewa reservoir should be released.

The water management meetings there after are held every week. They review the entire water situation in Sri Lanka both for agriculture and Power generation. Upon the outcome of these meeting, Samanala Wewa Power Station is informed via the System Control Center of the Ceylon Electricity Board the amount of water that

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is authorized to be released for Irrigation for the next week. Usually a discharge is determined for a week. Any subsequent variations if required has to be sanctioned by the water management Engineer of the system control center of C.E.B. If any change to the existing water discharge is to be done according to the knowledge of the Irrigation Officer Stationed at Kalthota, first his request has to be conveyed to Samanala Wewa Power Station via a radio message link. Then, the shift Engineer at Samanala Wewa Power Station informs the water management engineer of the system control center about the request. Based on his decision, the water discharge from the Dam can be varied.

The Samanala Wewa dam too is unmanned and is situated about 25km away from the Power Station. Thus, usually it takes about 1 hour to execute such request upon the receipt of the instructions.

2.0 Evaluating the value of Dischatge, Direct and Indirect

2.1 Direct value of discharge

The water released from the Samanala Wewa dam for irrigation has a very high "Opportunity cost" attached as mentioned before since the option of generating power out of this has to be forgone. The following outlines the basis of the calculation to determine the value of 1m3 of water in the reservoir. This forms the basis to determine the value of water discharged.

Let reservoir height from sea level =H (meters)

Let G be the avg number of Energy units per 1m³ of water at reservoir level H. (kWh/m³)

Let C be the avg selling price per unit of electricity for the year under concern. (Rs/kWh)

Then, the value of one m³ of water in the reservoir at height H = CxG

Value of C for each year is given in table 1 and value of G vs H is given in the table 2. below

Also, a historical report of the value attached to the water

Table 01

Year	Avg. Selling price (Rs)per kWh (C)
1993	2.64
1994	3.68
1995	3.70
1996	4.02
1997	4.15
1998	4.46
1999	4.43
200	4.53

Table 2
(Energy and water storage at different levels of Samanala Wewa reservoir)

Reservoir level (m) H	Live Storage (MCM)	Energy Storage at level H (Gwh)	Energy Storage (kWh) per m³ of water in the reservoir at level H (G)
424	0	0	.7605
425	2.067	1.558	.07537
426	5.601	4.228	.07549
427	9.274	7.012	.7561
428	13.086	9.911	.7574
429	17.036	12.923	.7586
430	21.123	16.049	.7598
431	25.344	19.288	.7610
432	29.700	22.639	.7623
433	34.185	26.100	.7635
434	37.801	29.672	.7647
435	43.543	33.351	.7659
436	48.409	37.137	.7672
437	53.397	41.029	.7684
438	58.505	45.026	.7696
439	63.732	49.127	.7708
440	69.077	53.332	.7721
441	74.542	57.642	.7733
442	80.126	62.058	.7745
443	85.834	66.584	.7757
444	91.669	71.224	.7770
445	97.639	75.982	.7732
446	103.753	80.866	.7794
447	110.021	85.886	.7806
448	116.458	91.054	.7819
449	123.081	96.384	.7831
450	129.914	101.893	.7843
451	136.980	107.603	.7855
452	144.311	113.539	.7868
453	151.942	119.728	.7880
454	159.914	126.206	.7892
455	168.274	133.011	.7904
456	177.077	140.186	.7917
457	186.384	147.782	.7929
458	196.264	155.857	.7941
459	206.795	164.473	.7953
460	218.064	173.703	.7966

released from the Irrigation valves is calculated and tabulated as table 3. See figure 03 for a comparison of the value of energy lost each year due to the Irrigation discharge.

Table 03

Year	Money lost due to Irrigation Discharge (Rs. Million)
1993	51
1994	102
1995	66
1996	48
1997	15
1998	24
1999	97
2000	148

2.2 Indirect value of discharge

For every unit of water released from the Samanala Wewa reservoir without generating power, the Ceylon Electricity Board have to find alternative means to generate and supply that energy by some other means. Since the Hydro Electric generating capacity of the country is not sufficient to meet the entire energy demand of the country, the alternative is to look for thermal power to meet the short fall.

Assuming that every energy unit lost as a result of the water discharge from Samanala Wewa reservoir is met by thermal power generation, the summary below gives the results of the calculations thus obtained (for 1999). It gives the amount of energy units lost, avg fuel cost per unit of generation for that year and the value of fuel imports as a result of the loss. It should be kept in mind that the figures only give the value in terms of fuel only. The operating cost and other overheads are not considered for this calculation.

Amount of Energy Units lost in 1999 due to Irrigation discharge = 21.89 GWh

Avg. Fuel cost per unit of energy (in 1999) = 2.42 Rs/kWh

Value of Fuel imports in 1999 to cover up the loss = 53 million Rs

3.0 Agricultural Production and Import Costs

3.1 The agricultural production at Kalthota utilizing Samanala Wewa water. A cost analysis.

The water discharged from the Samanala Wewa dam (from the leak and/or from irrigation discharge from the outlets) are received by the Kalthota scheme and diverted to either sides of the Walawe river through channels to irrigate the right and left bank.

From this point onwards, lets take the year 1999 as an example and do all the analysis with respect to that year.

Some statistical details of the Kalthota scheme, their agricultural production and water utilized by them for the purpose in 1999 are given below.

1. Total land extent cultivated = 865.5 Hectares
2. Total number of families = 1501 as per official records
3. Total yield in 1999 = 8308.8 Metric Tons
4. Cost of production up to harvesting per kg of paddy = 7 Rs.
5. Selling price per kg of paddy in 1999 = 12 Rs.
6. Total water released for irrigation purposes from Samanala Wewa reservoir in 1999 = 118
7. Total discharge from the Irrigation outlets = 28 MCM
8. Total discharge from the leak = 90 MCM

In 1999, a total of yield of 8308 Metric Tons of Paddy was received as mentioned above. However, it must be noted that this yield is due to the water received from the leak (90 MCM) as well as the release from the irrigation outlets (28 MCM).

If assumed a linear relationship between water used and harvest received,

Proportion of harvest that is directly due to the Irrigation discharge = $8308 \times 28 / (90 + 28)$
= 2617 M Tons

Amount of water utilized for that purpose
= 28 MMC

Thus per unit water consumption
= $28 \times 106 / (2617 \times 103)$
= 10.86 m³/kg

Using an average reservoir height for the year 1999 and using the data in table 02

Equivalent Number of energy units in 10.86 m³ of water
= 8.3 kWh

Selling price of 8.3 kWhs of Energy (as per 1999 avg C.E.B rate)
= 37 Rs.

3.2 Statistics of Sri Lanka's Agriculture Sector for 1999

Total number of rice imports (paddy equivalent)
= 306,000 MT

Avg. Import price per kg of paddy
= Rs. 10.7

Value of rice imports
= Rs. 3.276 billion

4.0 Summary of Findings

- Each kg of paddy not produced in the country, Rs 10.7 will be lost to the nation
- Each unit of Electricity not produced using Hydro Power; Rs 2.42 will be lost to the nation in terms of fuel imports for Thermal Power Generation.
- Each kg of rice produced at Kalthota using the irrigation discharge alone causes the country to forgo 8.3 units (kWh) of electricity. This is equivalent to importing Rs 20.09 worth of Oil.
- Each kg of rice produced at Kalthota causes a loss of Rs.36.77 to the C.E.B in terms of revenue lost.
- In 1999, water releases of the order of 97 million Rupees has produced a paddy harvest of only Rs 31.4 million resulting in a net profit of only Rs.13.08 million to farmers. However, this release had caused the nation to import Rs. 53 million worth of fuel to meet the lost Energy as a result.

5.0 Proposed Solutions

5.1 Re organizing the structure of water release methodology

As mentioned under section 1.2, a complicated inefficient and time-consuming mechanism existed to determine and carryout water releases for irrigation purposes

from the Samanala Wewa dam. The authority to determine the commencement, termination, and volume of water to be discharged was bestowed to authorities based away from either Samanala Wewa Power Station or Kalthota scheme. Thus, there was a fair amount of delay in executing a request to either terminate or commence water releases.

This had an unforeseen effect on the efficiency of water utilization too. Since there is a considerable time gap in between a request to commence or increase water discharge and the actual increase, Irrigation department officers at Kalthota too had acted in a very self-protective manner in requesting either a decrease or termination to an existing discharge particularly for a short duration. To elaborate this further, let's assume that there is a sudden rainfall while a certain discharge (say 2 m³) is being released. Due to this rain and subsequent inflows as a result to Kalthota along small streams downstream of the Samanala Wewa dam may cause a situation where the irrigation release can now be reduced to say 1 m³ for a shorter duration. But, when the rain ceases and the additional inflows stop, when the earlier discharge is required back again, getting the discharge increased from 1 m³ to the earlier level of 2 m³ can now take quite a some time. (Unlike decreases or terminations, every increase to the discharge must first be sanctioned by water management Engineer). First, the request from Kalthota has to be conveyed to Samanala Wewa Power Station. Then the Shift Engineer at Samanala Wewa Power Station is required to convey this message to the system control center. The system control center then consults the water management Engineer who as mentioned above, has the authority to sanction the request. This message then will be conveyed back to Samanala Wewa Power Station via the system control Center. Upon the receipt of this message, an operator is sent from The Power Station at Kapugala to Dam at Kumbalgama (25 km away) in order to execute the request. Also, even after the irrigation valve is opened, it can take a few hours before this water finally reaches Kalthota farmlands. This whole exercise can take several hours, during all of which farmlands at Kalthota are fed with an inadequate water supply. Thus, understandably, the irrigation officer at Kalthota was reluctant to make any requests to decrease the discharge, even if that is possible, especially for shorter durations.

We identified this major flow and the subsequent losses as a result. Then we put forward a proposal to the higher authorities of the C.E.B enlightening them of the situation. Then, we requested for the authority to carryout minor variations to the irrigation discharge immediately upon request and get the covering approvals for the same later on. We then briefed the irrigation Officer stationed at Kalthota of our proposals and requested him to inform us of any probable reductions to discharge

even for very short durations. We also gave him the assurance that once the discharge is required to be increased back once again, we will act upon his request without any delays what so ever on our part. We briefed him of the value attached to water too. He fully complied with this request. After this scheme was implemented, within the first 10 days alone, we were able to save over 1 million rupees worth of water at zero investment.

5.2 Better utilize the discharge from the leak

When the volume of water releases from the reservoir is analyzed, it can be seen that more than 2/3rd of the water discharged from the dam each year was due to the leak. See figure 02. Only the remainder was from the Irrigation discharge. Also, when the farming patterns of Kalthota farmers were studied, it can be found that about 4 months of the year, even the water released from the leak too is not utilized for any productive purpose. Thus, a staggered farming pattern instead of the traditional two Kanna method could utilize the discharge from the leak better there by reducing the dependency of an additional Irrigation discharge. But, staggering the farming patterns can have certain undesirable effects too on the yield such as rain during harvesting and increased vulnerability to pests. Thus, we put forward some proposals to stagger the farming pattern while ensuring that farmers will not be at a loss.

Following were the salient features of our proposal in brief.

- a) Part of the benefits due to saving of water to be transferred to farmers as an incentive
- b) There should not be any loss of revenue or loss of benefits both economical and social to farmers.
- c) If there are any, they should be properly compensated out of gains to the Energy sector.
- d) All monetary benefits must be directly transferred to farmers or farmer organizations without 3rd party involvement.
- e) The overall living standards of Kalthota farmers to be uplifted and the efficiency and productivity of farming should be improved so that as an indirect benefit this will bring some reduction to water utilization.

5.3 Transferring funds from the energy sector (C.E.B) to agriculture sector so that the overall benefits will be maximized.

5.3.1 Increase productivity by using better technology.

It was observed that lot of water is consumed during the ground preparation period due to lack of mechanization. If technology is used better, it was thought that the ground preparation period could be brought down further by about five days there by saving some water. Thus, it was proposed to provide farmers with tractors using funds from the C.E.B so that the C.E.B will get indirect benefits in terms of saved water as a result of an increase in productivity of farmers.

5.3.2 Better conservation of water

A fare amount of water is wasted along the channeling system itself due to leaks and spillage. Due to lack of funds to maintain the channels, a considerable quantity of water was lost in the channels itself. Also, due to improper de-silting, some water was spilled over the channel banks. Thus, we made proposals to help the Irrigation department to better maintain the channeling system by providing some assistance such as providing backhoes and other machinery to do de-silting.

5.3.3 Switching on to alternative crops that use less water

As water released from Samanala Wewa has a high opportunity cost, it should not be used for a highly water intensive crop like paddy. Instead, the possibility of cultivation of other crops (that can be cultivated using only the water from the leak) should be explored in detail. But, if finding a market for such crops is a problem, necessary capital should be provided to help the farmers to do further processing at village level before reaching the final market places. Also, fruits like Papaw, that have a better market than other crops like Soya or Green Grams can be cultivated using methods like "Drip Sprinkle Irrigation". The necessary capital for such a scheme can be provided by the Power Sector.

5.3.4 Using less water intensive paddy cultivation methods

If paddy should be cultivated, emphasis should be made to promote newer cultivation methods that use considerably less water. One such method termed the "Madagascar Method" should be introduced to Kalthota farmers as a pilot project. Though this is very successfully practiced abroad and also very successfully tested in

certain schemes in Sri Lanka like Hurulu Wewa, local farmers are unaware of this technique.

6.0 Conclusion

From the above findings, it can be seen that the competitive usage of water in the Samanala Wewa reservoir for two competing purposes had given a high opportunity cost for water. It can be clearly seen that sub optimizing each sector individually does not give the best combination of benefits to the country. Thus, we feel that a detailed study taking in to consideration both the economical and social cost is required before deciding as to how water resources in the Samanala Wewa region could be best utilized for Power Generation and Agriculture.

The above situation is not unique to Samanala Wewa project alone. There can be several other projects too in Sri Lanka that faces a similar situation as Samanala Wewa does. This study we believe will act as a catalyst for similar studies in those areas too in the future.

7.0 Acknowledgement

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8.0 Reference

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