Benefit Cost Analysis of Decommissioning the Pak Mun Dam by Wayne C. White
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Contents

Executive Summary

Conventional wisdom Thailand, has long regarded damming river electricity production beneficial progressive. Pak Mun Dam has emerged critical challenge assumed premium dam development over preservation an existing river ecology. has been suggested Dam decommissioned, is, removed active generating service, allow river flow free. report compares economics continuing operate dam has been since its construction, versus benef decommissioning restore river's ecology.

There are several factors which combine make decommissioning option credible. project has markedly lower generating output than projected. Thailand does have alternative sources electrical generation. Mun River has been found have very rich aquatic culture, its fisheries, related fish populations Mekong, are significantly degraded dam channel works. Local populations are traditionally heavily dependent on fishing sustenance well income. Alternatives affected persons earn income farming or fishing elsewhere are conditioned pressure on Thailand's land river resources.

The present value benef operating dam electricity production calculated within range $43.9 million $57.2 million, with $43.9 million figure most closely representing present operation parameters. average value $50.6 million.

The present value benef restoring river on livelihood alone calculated within range $43.7 million $117.3 million, with narrower range $88 $117.3 million representing total number affected families (6,202) identified an independent commission. average value calculation covering total number families $102.7 million.

This calculation indicates benef decommissioning Pak Mun Dam exceeds value leaving operation.

I. Introduction

Conventional wisdom Thailand, many countries, has long regarded damming river electricity production beneficial progressive. resulting power generation welcomed, since electrification viewed benchmark development prerequisite industrialization. Consumption alteration natural resource base, including rivers, has been largely accepted regular accompaniment nation's rapid economic growth.

The Pak Mun Dam has emerged critical challenge assumed premium dam development over preservation an existing river ecology. Thousands persons affected dam have mounted campaign sustained protest, advocating river restoration. Although dam's construction complete it's turbines have been on-line since late 1994, have demanded its gates permanently raised river allowed run free. Doing so would effectively decommission, is, remove active service, dam, which requires water impoundment order generate power.

While abandoning an expensive new generating system may seem drastic, are several factors which combine make challenge Pak Mun Dam's overall benef credible. project has markedly lower generating output than projected, function design limitations streamflow. Thailand does have alternative sources electrical generation, value electricity produced must taken on comparative basis. Mun River has been found have very rich aquatic culture, its fisheries, related fish populations Mekong, are significantly degraded dam channel works. Local populations are traditionally heavily dependent on fishing sustenance well income. Alternatives affected persons to earn income farming fishing elsewhere are precluded overall competition and pressure on Thailand's land river resources.

To advance discussion whether would better cease allowing Pak Mun Dam to restrict river's flow, application benefit/cost methodology helpful rationally compare options. report compares economics continuing operate dam has been since its construction, versus benef decommissioning restore river's ecology.

II. Calculating economic benef Pak Mun Dam

In examining economic benef Pak Mun Dam, necessary first identify range of contributory factors, then derive value them. will, course, true the following section, which examines benefits decommissioning dam.

Survey Pak Mun Dam's benefits yields single factor electricity production. As the project submitted appraisal World Bank 1991, its purposes included electricity, irrigation, increased fish production; some mention made recreation/tourism value. (1) Following implementation, tourism fish harvests have fallen due dam, so is not possible accrue any benef on account. project built has irrigation component.

The value electricity benef will calculated applying appropriate rates dam's observed power output. A survey country's electrical tariffs has been compiled the National Energy Policy Office Thailand, rates source, specifically those known as generation marginal costs, will applied electricity production quantities.(2)

Dependable capacity. Calculating value dam's annual generation method requires know dependable capacity facility, expressed kilowatts (or megawatts, etc), annual production, expressed kilowatt-hours (or megawatt-hours, etc). Pak Mun has turbines with total capacity 136 Megawatts, but number not the dependable capacity. Dependable capacity an industry term describes amount of power can relied upon available high percentage time; hydropower it depends not just on equipment size, but on availability water move turbines. EGAT, like utilities, has definition dependable capacity, will referenced below.

The World Commission on Dams report on Pak Mun (3) looks into question defining the project's dependable capacity. A long quotation justified on important point, including a table:

.... Using EGAT's definition Dependable Capacity, based on daily power output data between 1995-98, Pak Mun hydropower project Dependable Capacity 20.81 MW if one assigns available power 4-hour peak demand period.

This most likely an overestimation Dependable Capacity....According the definition Dependable Capacity used EGAT Pak Mun dam, taking into account likelihood being able generate Peak Power, Dependable Capacity is 16.16 MW

.... sharp, 4 hour long demand peak past has been replaced 13 hour plateau that lasts 0900 2200

hours, Monday Saturday....It clear Pak Mun does not have enough water flow dependable 13-hour peaking plant.[(4)]

Summary Dependable Capacity calculations 1995 - 98[(5)]

Dependable capacity assumed EGAT its 1988 presentation Cabinet of Ministers	75 MW
Dependable capacity calculated simulated mean monthly data based on 1967-81 Pak Mun run off record assuming 4 hour peak.	40.9 MW
Dependable capacity calculated daily power output 1995-98, assuming all available power gets assigned 4 hour peak demand period. calculation the three summarised below follow rules Dependable Capacity Calculations officially declared EGAT March 1988	20.81 MW
Dependable capacity calculated daily power output 1995-98, assuming as much possible available power gets assigned 4 hour peak demand period, taking account likelihood EGAT able assign maximum amount power the peak period.	16.16 MW
Dependable capacity calculated daily power output 1995-98, assuming all available power gets assigned 13 hour peak demand period	6.40 MW
Dependable capacity calculated daily power output 1995-98, assuming as much possible available power gets assigned 13 hour peak demand period, taking account likelihood EGAT able assign maximum amount power the peak period.	4.97 MW

Production value. With determination dependable capacity WCD, knowing the total annual energy production Pak Mun 1998 1999 (listed below), are ready to calculate annual value electricity production Pak Mun. National Energy Planning Office document lists marginal energy cost .85 baht/kwh, capacity cost 1290 baht per kw. To perform calculation multiply annual production kwh rate of .85 baht/kwh, multiply dependable capacity 1290 baht per kw, then add two together. calculation presented tabular form below, converts result into US dollars.

Table 1.1, Annual Value, Dependable Capacity 16.16 MW (4 hour peak)

Year	Total Prod'n GwH	Energy benefit, production multiplied by marginal cost .85 baht/kwh	Capacity benef at 16.16 MW multiplied 1290 baht per kw	Total annual benef baht	Total benefit in dollars 37 baht the dollar
1998	283	240,550,000	20,846,400	261,396,400	7,064,768
1999	189	160,650,000	20,846,400	181,496,400	4,905,308
Average					5,985,038

The values table 1.1 are case four hour daily peak period. Thailand now manages its electric grid on basis 13 hour peak (or plateau), so case will represented in Table 1.2.

Table 1.2, Annual Value, Dependable Capacity 4.97 MW (13 hour peak)

Year	Total Prod'n GwH	Energy benefit, production multiplied by marginal cost .85 baht/kwh	Capacity benef at 4.97 MW multiplied 1290 baht per kw	Total annual benef baht	Total benefit in dollars 37 baht the dollar

1998	283	240,550,000	6,411,300	246,961,300	6,674,630
1999	189	160,650,000	6,411,300	167,061,300	4,515,170
Average					5,594,900

These calculations yield an annual value electricity Pak Mun Dam US$6.0 million, and US$5.6 million, with lower value being correct conjunction with actual length of the peak period.

With annual value quantified, possible calculate present value electricity produced over service life dam. opportunity cost capital 12 percent. We will assume service life project 25 years without major overhaul reservoir dredging. For sensitivity will look longer periods 30 35 years.

Table 1.3, Present value calculation service life electricity generation

Annual value	25 years	30 years	35 years
$5,985,038.00	$46,941,485.63	$48,210,582.14	$48,930,701.59
$5,594,900.00	**$43,881,579.02**	$45,067,948.78	$45,741,126.84

The case reflective 13 hour peaking period presently used Thailand, present value 25 years operation, yields US$43.9 million. sensitivity value longer service life not great, rising only four percent, less than $2 million case 35 year life.

III. Benefits decommissioning Pak Mun Dam

As case maintaining dam, benefits decommissioning must identified, then valued. Pak Mun dam has had negative impacts on fisheries, aquatic biodiversity, tourism, social welfare, livelihood; decommissioning intended reverse these effects.

A primary impact dam has been on fish populations, that, turn, has caused many of the livelihood social effects:

The Pak Mun Dam has affected aquatic biodiversity relative abundance fish populations up downstream dam. headpond has inundated destroyed significant spawning habitats such rapids....Of 265 species recorded Mun watershed before 1994, 77 species were migratory. Furthermore 35 species depended on rapid habitats, now inundated Pak Mun reservoir. latest survey after dam construction recorded only 96 species upstream dam. has been an apparent impact on 169 fish species. A total 56 fish species have disappeared known catch since construction dam.[(6)]

Many persons affected dam complain lost fisheries, which not only curtailed their traditional source cash income, but major component their dietary sustenance. Fishing was form safety net, since rice farming practiced locally rain-fed, vulnerable to dry weather years. Some persons experienced partial total loss land. riverside formerly acted commons predominant grazing area; now underwater the reservoir banks are not suitable use. Some farmers who had accumulated buffalo an investment form savings had sell them lack pasturage. [(7)]

A social effect dam break up family structures. Many young able bodied affected areas have relocated order find work. Some these have gone to the nearby city Ubon Ratchatani, some Bangkok, some abroad Middle East.[(8)]

It would very difficult tabulate values each dam's effects, especially over long periods time. Fortunately one method available us can render value the bulk benefits restoration. An accepted method deriving value identification of the cost substitution. Indeed, of-a-kind with how markets work: example, market value house determined based on evidence what similar houses have sold for. the case Pak Mun, commission, acting with inputs stakeholders, has determined value for replacing lost livelihood affected persons. Although compensation has not been made, may never be, useful, appropriate calculation.

Livelihood valuation. January 1995 Committee providing Assistance Developing Occupation Fisherman (CAODFF) areas affected Pak Mun appointed.[(9)] The CAODFF ultimately determined 6,202 families had their livelihoods affected dam.

An affected persons group determined compensation rose level allowing the affected families new source livelihood would best met award 20 rai land per family. requested such compensation 3301 households. government, on April 29, 1997 decided award 3,080 families with 15 rai land each. Later concept changed to monetary compensation, calculated 35,000 baht per rai, 525,000 baht.

We can tabulate implications these numbers on total value.

Table 1.4

	baht/family @ 35,000 baht per rai	total value, baht	total value, dollars @ 37 baht per $
3,301 households per January 1997 request affected persons			
15 rai land/family	525,000.00	1,733,025,000.00	46,838,513.51
20 rai land/family	700,000.00	2,310,700,000.00	62,451,351.35
3,080 households per April 1997 government ruling			
15 rai land/family	525,000.00	1,617,000,000.00	43,702,702.70
20 rai land/family	700,000.00	2,156,000,000.00	58,270,270.27
6,202 households per CAODFF total finding			
15 rai land/family	525,000.00	3,256,050,000.00	88,001,351.35
20 rai land/family	700,000.00	4,341,400,000.00	117,335,135.14

As stated above, compensation may never actually paid[(10)], but purpose use to express value, very useful. As such, apply compensating amount, the lower range figure being 525,000 baht, entire 6,202 households, derive low value of US$ 88 million, upper range US$ 117 million.

Limits valuation. An advantage livelihood compensation valuation method used that also treats social effects: alternative livelihood rice farming presents prospect for preserving family structure.

The livelihood compensation method does not account biodiversity survival benefits within the Mun River ecosystem, sustenance downstream Mekong ecosystem, recreation and tourism benefits. Thus actual benef dam decommissioning would higher than the calculated amount.

IV. Benef Comparison

Benefit/cost ratio. The present value benef operating dam electricity production calculated within range $43.9 million $57.2 million, with $43.9 million figure most closely representing present

operation parameters. average value $50.6 million.

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Restoration river may allow recovery tourism, survival river shoreline ecosystem, protect health Mekong ecosystem, reverse social disruption, reduce pressure on forests, allow resumption family structures, benef public health preventing development schistosomiasis. Globally, evidenced real spending, preservation a single species has been valued millions dollars more; benefits decommissioning in addition livelihood may possibly tens millions dollars.

Assuming number $20 million benefits river restoration over above livelihood compensation, taking average values $50.6 million dam operation $102.7 million dam decommissioning, calculation benef cost ratio decommissioning as follows:

($102.7 mil + $20 mil) / ($50.6 mil) = 2.4.

For construction project benef cost ratio greater than 1.0 generally taken sufficient justification. Under set assumptions, decommissioning has benef cost ratio 2.4. This comparison can represented graphically, using value ranges (not their averages), taking arbitrary assumption $20 million present value non-monetized environmental existence similar factors discussed above:

This calculation indicates decommissioning Pak Mun dam realistic option for maximizing Thailand=s national best interest.

Sensitivity. study short streamlined; sensitivities factors may included a more detailed analysis, however, predominately lie direction emphasizing its primary conclusion. factors which might known more specifically with more detailed study include optimal steps river restoration, dam decommissioning costs, future electricity market costs, and environmental recovery rate.

Factors affect benef dam operation are unlikely gain value. dependable capacity facility its maximum annual generation are fixed its physical characteristics and flow quantities river; governing physical laws will not change. value of electricity Thailand unlikely rise; with number new installations coming online, and the competitive force independent power producers entering market, trend lower electricity tariffs.

The value protected restored habitat can expected rise with time; continuing stresses on Thailand's natural resource base make remaining assets more valuable.

Costs benefits performing actual decommissioning are mixed, but need not high and may net positive value. Removal generators should result net income if can be resold; if their resale value does not exceed cost removal, can simply left in place. Likewise gates: if scrap value steel does not exceed removal costs they can simply left an open position. submerged rapids can restored simply opening dam letting water return natural level. Some work would required to restore rapids were removed blasting. A specific benef cost study could be performed determine whether rebuilding each these worthwhile. If are rebuilt simply by dumping broken stone (possibly removed material), into place, cost should low.

The value restoration will affected how quickly fish stocks rebound. thought that remnants

migrating species still exist downstream mainstream Mekong areas sufficient allow recovery within few years.

Endnotes

1. Annez, Philippe under contract with Thai Development Research Institute, *The Hydropower Benefits Pak Mun Hydropower Dam Related aspects Mekong River Basin Thailand, Circulation Draft*, 15 December 1999, p. 12.

2. PricewaterhouseCoopers, London, *Review Electric Power Tariffs*, *for National Energy Policy Office, Thailand*, January 2000. http://www.nepo.go.th/index-T.html

3. Amornsakchai, Sakchai et al, *WCD Case Study: Pak Mun Dam Mekong River Basin, Thailand, Final Draft,* May 2000.

4. Ibid, pp 24, 25.

5. Ibid

6. World Commission on Dams, *WCD Case Studies, Pak Mun Dam & Mekong River Basin, Thailand, Executive Summary*, 22 March 2000, pp 5,6.

7. Field interviews author, March 2, 2000.

8. Ibid

9. Amornsakchai et al, p 76.

10. One reason compensation will not paid government experienced a change policy. Even before that, however, many families expressed their lack preference for undertaking labor intensive livelihood rice production. possible explanation of why only 3,301 households applied compensation so might change their livelihood from fishing rice farming: others were unwilling contemplate change occupation. Other economic realities would come into play actual practice. If 6,000, even 3,000, families sought buy good farmland similar time period, scarcity would cause price land to escalate rapidly.