

Contributing Paper

Some Evidences on Overall Distribution and Equity Impacts

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**Prepared for Thematic Review I.1:
Social Impacts of Large Dams Equity and Distributional Issues**

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Some Evidences on Overall Distributional and Equity Impacts

Draft of a possible section for the Paper on Social Impacts of Large Dams

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1. The Issue

Concerns with the distributional and equity impact of large development projects in general, and large dams in particular, have focused mostly -- as this review also do-- in the predicament of potentially or actually disfavored groups. This is understandable and correct, and the plight of at-risk groups should continue to be the focus of distributional and equity analysis so as not to overlook the need to redress them. On the other hand it is also important to look into the larger picture of distribution of costs and benefits across all major groups, first to confirm if in fact dams deliver more benefits than costs, and second because the natural sources of funds to compensate the potential losers are the gains of the potential winners.

While it may be straightforward to single out extreme cases : e.g. the predicament of displaced populations, or the large gains accruing to aluminum industries supplied with huge amounts of below-cost power; attempting a full distributional analysis is very complicated. It requires detailed information on the original situation, and on the project's and people performance through time, not only at local but also at regional and national scale, since cost and benefits of large projects are spread throughout the country, and beyond. The first payer is not necessarily the last one: the government will repay itself from tax payers, and producers from final consumers, all this requiring detail modeling. Even if such information is available, as time goes by it is increasingly difficult to isolate the effects of a particular project from its broader context. With the scant information available we have attempted here a very simplified exercise, which does not pretend to put forward exact numbers but to illustrate the range of issues raised by the broader distributional impact of dams.

2. A data base on dams direct and (some) indirect costs

Recently the Operations Evaluation Department of the World Bank updated estimations of direct costs and benefits of 50 large-dam projects and added to them a crude estimation of some of their social and environmental indirect costs. Indirect costs here means simply costs that were not compensated by the project.¹ Tables A-1 and A-2, directly reproduced from the report, present basic data on the 50 dams and the re-estimation of cost and benefits on an annuity base (in 1995 dollars).

In this update, the real final costs replace initial cost estimates, which in itself makes for a large correction, since large cost overruns are endemic in dams' projects. Direct benefits are estimated for the final project design (although few figures are available other than power and irrigation benefits) This again may result in large corrections to initial estimates, since many dams take a long time to deliver the expected benefits (e.g. slow growing irrigation areas).²

Indirect environmental and social costs were estimated as follows: For resettlement costs the last available figures of actually displaced population were multiplied by an "appropriate resettlement cost" of 5 times the country per capita GNP. Sedimentation concerns were included in one case (Kulekhani, Nepal) as a reduction of 2/3 in the dam expected life, and in all other cases as a lump sum of sedimentation control costs. Lump sums (in the range of 10 million dollars) were used to

¹ Operation Evaluation Department (1996) "The World Bank's Experience with Large Dams. A preliminary Review of Impacts, 2 volumes, World Bank, Washington, DC.

² Benefits in table A-2 are net of all costs other than dam costs

escalate costs for health impacts, loss of fisheries, loss of natural habitat and downstream impacts where they were reported. A much larger downstream impact cost was imputed to Sobradinho, Brazil, a well-known case of downstream community's dislocation. A qualitative rating (major positive, positive, negative, major negative was also used).³ Table 1 presents a list of the benefits and costs estimated in the study.

For sure, most are at best gross estimates, and many indirect costs and all indirect benefits have been omitted (like reduced carbon emissions, better local infrastructure, regional or national secondary effects, etc). Nevertheless they provide a base to attempt a similarly rough distributional assessment.

Table 1 Direct and indirect benefits and costs

Direct benefits
(a) Power generation benefits
(b) Irrigation benefits
(c) Urban water supply benefits
(d) Flood control benefits
Direct Costs
(e) total direct costs
(f) Direct investment costs
(g) Direct operation costs
Indirect Costs and impacts
(h) Resettlement indirect costs
(i) Health indirect costs
(j) Fishery losses indirect costs
(k) Natural habitat losses indirect costs
(l) Downstream losses indirect costs

3. The social groups

Due to the lack of project's and country's specific social surveys we can only attempt the most general social grouping that can use the information available in table 1. Since the urban- rural divide has been at the center of the debate regarding who benefits and who loses with large dams, we have choose to emphasize that dimension, and come up with the following grouping.

Table 2. Social groups for the distributional analysis

1. Urban households and businesses, that includes:
Urban households and businesses as tax payers
Urban households and businesses as consumers of energy
Urban households and businesses as consumers of water
Urban households and business as consumers of farm products
2. Urban households and business in the flood protected area
3. Rural households and producers, that include
Rural households and producers as tax payers
Rural households and producers as consumers of farm products
4. Rural households and business in the flood protected area
5. Farmers in the irrigated area
6. Resettled population
7. Downstream population
8. Population in the project's rural area
9. The Country's present and future generations

³ Values in table A-2 and in the distributional matrixes are annuity values: the comparison of all estimated costs and benefits converted to annual figures over a 50 years horizon.

While the data allows allocating information to all these categories we have add the information of the non bolded groups and assigned it to more encompassing group (the bolded one above). This implies, on the one hand, some lost of information but, gives a clearer picture. For example “urban households and businesses as task payers” are roughly the same group of people as “urban households and businesses as consumers of energy” so both are collapsed in “urban households and businesses”. True, some households pay into the tax pool more that what they participate in the energy consumption, but that differences can not be captured with the information available. On the other hand when a particular category of costs or benefits accrue to a small group, it is better not to dilute the figures into a broader one. Sure, downstream population is part of the rural population, but we want to keep track of the impacts upon them instead of adding it to several other costs and benefits under “rural households and producers”. Some further simplifications of table 2 are:

- (a) it does not include “foreign countries” although in some cases they could share in the benefits of the dams (e.g. through purchase of power or food, or sharing the producers benefits) or the costs (e.g. donors, loans at below market rates, losses of environmental world commons)
- (b) We only acknowledge future generations in “present and future generations”, to assign it the costs of natural habitat losses. Otherwise future generations partake of the benefit and cost allocated to the broad categories in urban and rural groups.
- (c) We regret that the above social grouping do not allows isolating impacts by say gender, income level, indigenous non-indigenous, etc. Again this is not an ideal grouping, but simply the one that suits the limited available data.

4. Distribution criteria

Following, table 3, 4 and 5 explain how the costs, benefits and impacts of table 1 are apportioned across the social groups of table 2.

Table 3. A summary of criteria to apportioning dam’s direct costs

<p>The theory:</p> <ul style="list-style-type: none"> • To the extent that construction costs and or operation costs are paid out of the national budget they are supported by the country taxpayers • To the extent that construction and or operation costs are paid back by the users of the services provided by the dam: irrigation water, power, urban water, flood protection, etc. it does not matter who advanced the money, the final payers would be the services user: urban households and businesses, farmers in the irrigation area, population in the flood protected area, and so on. • the fact that intermediate consumers pass costs to final consumers is captured in the allocation of benefits (see table 4) <p>This exercise:</p> <p>Lacking more detailed information the following assumptions are used to apportion the dams direct costs (column 7 in table A.2)</p> <ul style="list-style-type: none"> • For multipurpose dams’ total costs are divided among power, irrigation, water supply and flood control costs, in the same proportion that each of this activities contributes to the total dam primary benefits. • Taxes are supported by rural and urban population in the same proportion as agricultural and non-agricultural GDP contribute to the country’s GDP. • Power costs: It is assumed that all energy is delivered to urban centers, and that as actually happened in the 70s’ and 80s’ consumers pays only 70% of the long term marginal cost of power. Therefore 70% of power costs are repaid by urban households and businesses and tax payers shoulder 30%. • Irrigation water rates in developing countries seldom cover operation costs, Therefore all direct investment costs are apportioned to taxpayers, and farmers in the irrigation area pay operation costs (estimated at 10% of direct investment costs). • Water for urban supply is also subsidize, although to a lesser extent so cost are split with 60% supported by tax payers and 40% repaid by urban households and businesses.
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- No flood protection fees are collected in the two cases where this benefit is quantified, so 100% of these costs are assumed to be supported by the tax payers (although it could be argued that part of these costs will be repaid through higher property taxes in the protected area).

Table 4. A summary of criteria to apportioning dam's direct benefits

The theory:

- In the case of final consumption –e.g. households' power consumption—all net benefits are enjoyed by the service user.
- In the case of intermediate consumption --power used in industry, water used in irrigation-- net benefits are shared among the intermediate user and the final consumers. How much goes to each one depends on the characteristics of the demand and supply .

This exercise:

Lacking more detailed information the following assumptions are used to apportion the dams direct benefits (columns 2,3,4,5, in table A.2)

- All power generation benefits are allocated to urban households and businesses.
- Agricultural irrigation benefits are split as follows: 50% are captured by farmers in the irrigation area, 30% by urban households and businesses, and 20% by rural households, as urban and rural consumers enjoy a larger supply and price reductions. In the case of Latin American projects, where the rate of urbanization is much higher those two last percentage are changed to 45% and 5%.
- Water supply benefits are all allocated to urban households and businesses.
- Flood control benefits are allocated to the households and business in the flood protected area that, depending on the case, may be urban or rural.

Table 5. A summary of criteria to apportioning dam's indirect costs

The theory:

- By definition, indirect costs are initially supported by the affected (or concerned) group. Later they may be shared by others, for instance through governments or donors support to affected groups, intermediate or final consumers facing price increases due to dwindling supply of fish and crops, etc.

This exercise:

Lacking more detailed information, we assigned the dams indirect costs (column 15 in table A-2) fully to the initially affected group as follows:

- Resettlement costs to the resettled population
- Health impacts to the population in the project area
- Fisheries losses to the population in the project area
- Natural habitat losses to the country present and future population
- Downstream effects to the downstream population
- Watershed sedimentation costs are added to the project direct costs and split as indicated in table 1.

4. An equity threshold

The distributional analysis proposed above would give a factual picture: how the dams' direct and indirect costs and benefits of table 1 were distributed among the social groups in table 2. Then, few are interested in the distribution analysis per se, but in what it tells us in terms of social fairness or equity goals. Therefore we want to add an equity dimension to this assessment exercise, namely a normative statement of the form: "any distribution that fails to achieve xxx would be considered unacceptable". We propose here the following: "Any distribution that imposes large losses upon any of social groups 4, 5, 6, 7 or 8 (in table 2) would be considered unacceptable" This particular wording simply tries to adapt to our list of

sociological groups the widespread concern about the predicament of populations in the project area.

Applying this simplified distributional framework to the 50 dams in table A-2, makes for interesting findings and a lot of tables (the full matrix is 11x16) Therefore we limit this presentation to just 5 archetype cases, that follows below. In each case the distributional matrix is reduced to present only the intersections that carry information. The violation of the equity threshold is indicated by a **EA** symbol.

6. A case of overall failure: Chixoy, Guatemala

Chixoy hydropower, completed in 1985 in the Chixoy river, created a reservoir of 13 km² to provide 60MW of capacity and some 1,300GWh per year to Guatemala's, major cities. The project looks in retrospective, as an example of all that can go wrong in a hydropower project. It was proposed and evaluated in the early 70s' when expectations of ever increasing oil prices inflated the prospects of any alternative power sources. Engineer studies failed to anticipate severe geological problems that contributed to cost overruns of 130%, more than three years of construction delays, and serious doubts regarding the useful life of the system. Just on financial terms the project was a failure. But it was much worse on social terms. The resettlement of approximately 2,500 Maya Indians was poorly conceived and managed. It began in 1979 and was still in progress ten years later. Compensation failed to restore pre-project living standards, and the predicament of the local population --resettled and non-resettled-- was tragically worsened by an ongoing civil war.

Not surprisingly everybody seems to have lost in Chixoy distributional Matrix (in table 6 below). All power benefits accrued to urban areas but costs were larger than benefits and since the money to pay for the dams came mostly from urban areas taxpayers they have net losses.⁴ For the rural population the project only had costs: rural taxpayers shoulder part of the project costs, but got no benefits. Then it was the displaced population that suffered the most (even if the monetary measure of their losses is small compared with any other group) and their predicament violates our proposed equity criteria.⁵ Notice finally that if the figures are correct, redressing the resettlers would have added little to the project total costs, but then again since the project was a failure across the board, everybody would have been better off without it.

Table 6. Distributional Matrix of Chixoy Dam, Guatemala

(Dam completed in 1985)

Social Groups	(a) Power Benefits	(e) Total Direct Costs	(h) Resett. Indirect Costs	(k) N.H. Indirect Costs	Net Benefits
(1) Urban all.	+ 108.0	- 176.4			- 68.4
(3) Rural all		- 14.3			- 14.3
(6) Resettled			- 1.4 (EU)		- 1.4 (EU)
(9) Society				- 3.0 (N)	- 3.0 (N)
(10) Total	+ 108.0	- 190.7*	- 1.4 (EU)	- 3.0 (N)	- 87.1

⁴ It can be the case that large power consumers among urban households and businesses are still making a profit, if their participation in power consumption is higher than their participation in the tax base.

⁵ There are also reports of some natural habitat losses.

N: Negative / EU: unacceptable on equity grounds

* Includes 1 million dollars of sedimentation costs

Numbers in rows and letters in columns refer to the full names in tables 1 and 2

7. A case of a successful power dam. Lubuge, China

Contrary to the previous case, Lubuge hydro dam can stand as a success story. Built in the Huang Ni river in Yunnan province it was completed on schedule in 1992 and within budget (actually it cost 7% less than estimated), delivering 600MW of capacity and 2,400GWH per year. It created a relatively small reservoir: 4 km². No negative environmental impacts have been reported, and actually the dam promoted a major reforestation plan in the reservoir surroundings. The resettlement of 2,320 families was reported as a success, it include several options for the displaced households, among them new irrigate farm plots, using water from the reservoir. Social infrastructure was significantly improved in the area and a Reservoir Fund was established, with 80% of it annual budget used by the local government to promote reforestation, fishery, and agricultural development in the reservoir area. According to a report from the project agency the livelihood of the displaced population has improved over pre-project times.

The distributional matrix below shows these positive features of the project, in that there is no negative distribution against the resettled population, and no equity concern is flagged. Nevertheless it shows that if power is fully (or mostly) directed to cities, and rural areas pay part of the taxes to built the utility, any power project will result in redistribution in favor of urban areas, although the larger the urban sector the smaller this effect will be.⁶ In any case the pro-urban bias of power projects can justify a recent trend of benefit sharing, whereby hydropower utilities put up a fund to support rural development, over and above fare resettlement costs.⁷

Table 7. Distributional Matrix of Lubuge Dam, China
(dam completed in 1992)

Social Groups	(a) Power Benefits	(e) Total Direct Costs	(f) Resett. Indirect Costs	Net Benefits
(1) Urban all.	+ 120	- 78.5		+ 41.5
(3) Rural all		- 6.4		- 6.4
(6) Resettled			(P)	(P)
(10) Total	+ 120	- 84.9	(P)	+ 35.1

P: Positive

Numbers in rows and letters in columns refer to the full names in tables 1 and 2

8. High social costs of a hydropower project: Sobradinho Dam, Brazil

While in Chixoy (Guatemala) everyone seems to have lost, and in Lubuge (China), almost everyone seems to have gain, Sobradinho Dam, in Brazil is an extreme case of urban benefits coupled with

⁶ It could be argued that second and third round effects will boost the demand for rural products and rural income that will compensate for the original tax drain.

⁷ Then again the local focus of the fund is only granted if it aims to redress local losses due to the hydropower project. On the other hand, if the issue at stake is to compensate for the urban bias of large power developments then the limits of the targeted rural area should be the limits of the tax contributing area.

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huge rural losses. The project, located on the San Francisco river, and also known as Paulo Alfonso IV, added 3,500 MW capacity to northeastern states of Brazil. It created a reservoir of 4,214 km² stretching over 325 km. and requiring the displacement of 70,000 persons. Downstream changes in the river also resulted in the permanent flooding of 32,000 ha of rice and the displacement of 50,000 persons. The resettlement of the affected population seems to have been poorly planned and carried. Although resettlement costs escalated five folds (resulting on overall costs overruns of 39%) they failed to address the needs of the displaced population. Many of the new settlement failed to attract the target population, a large portion of the moneys were by the better off, land concentration and poverty both grew.

The distributional matrix show that the losses of the displaced population at the reservoir and downstream where large and violated our equity criteria. The distributional matrix also points out that the urban gains were also large, enough to compensate the rural losses, and then more. The bottom line here is that (a) some dams may deliver overall economic benefits but left some part of the population a net losers, and breach equity criteria (b) then there is room to take from the winners and compensate the losers, provided the will to do so exist.

Table 8. Distributional Matrix of Sobradinho Dam, Brazil
(dam completed in 1982)

Social Groups	(a) Power Benefits	(e) Total Direct Costs	(h) Resett. Indirect Costs	(l)Downst. Indirect Costs	Net Benefits
(1) Urban all.	+ 416.3	- 123.4			+ 292.9
(3) Rural all		- 5.4			-5.4
(6) Resettled			-103.5 (EU)		- 103.5 (EU)
(8) Downst.				- 73.9 (EU)	- 73.9 (EU)
(10) Total	+ 416.3	- 128.8	- 103.5 (EU)	- 73.9 (EU)	+ 110.1

EU: unacceptable on equity grounds

Numbers in rows and letters in columns refer to the full names in tables 1 and 2

9. An example of a successful multipurpose dam: Chungju, Korea

The Chungju dam in Korea, completed in 1984 on the South Han river, provides energy (412MW of capacity) and water for Seoul and adjacent urban areas, and irrigation of 22,000 hectares, and flood protection for rural areas. The project was completed on schedule and with modest cost overruns of 8%. The dam resulted in a reservoir of 95 km² and required the resettlement 38,670 people that, according to the information available, were fully compensated and relocated successfully. Additional environmental benefits are attributed to the dam, particularly the regulations of discharges in the dry seasons to avoid saline intrusions in the Lower Han river.

As the distributional matrix displays and contrary to hydropower developments, that may be labeled pro-urban projects, irrigation or multipurpose dams are pro-rural, both regarding their allocation of benefits and costs. Rural areas capture a good portion of the benefits, in the form of flood protection, increased income from irrigated farming, and increased availability of food in the local markets. Regarding the costs, subsidies go in this case from the city taxpayers to the rural population, since most of the rural services of multipurpose dams are offered either for free: flood protection; or at

nominal costs: irrigation rates usually below operation costs, and therefore most of the costs are met by the country tax payers.⁸

Table 9. Distributional Matrix of Chungju Dam, Korea
(dam completed in 1984)

Social Groups	(a) Power Benefits	(b) Irrigation Benefits	(c) Urban Water Benefits	(d) Flood Control Benefits	(f) Direct Invest. Costs	(g) Direct Operation Costs	Net Benefits
(1) Urban all.	+ 59.3	+ 6.7	+21.1		- 114.0	- 9.4	- 36.3
(3) Rural all		+ 4.4			- 8.2	- 0.6	- 4.4
(4) Flood Prot.				+ 24.4			+ 24.4
(5) Irrig.Farms.		+11.2				-2.1	+ 9.1
(10) Total	+ 59.3	+22.3	+ 21.1	+ 24.4	- 122.2	- 12.1	- 7.2

Numbers in rows and letters in columns refer to the full names in tables 1 and 2

10. A multipurpose dam in trouble: Kedung Ombo, Indonesia

Kedung Ombo, dam completed in 1993 on the Seran River, created a reservoir of 46 km² to provide 30MW of power capacity, irrigation water for 132,000 hectares, increased downstream flood protection (from 20 years to a 100 years return period) and increased urban water supply. The project was implemented on time and with moderate cost overruns (39%). The benefits of this development, depicted in the distributional matrix, accrued mostly to rural areas, mainly as increased earnings of farmers in the irrigated area: 87,000 families encompassing 440,000 persons, whose incomes increased between 35% to 150% over pre-project incomes. As food production increases, urban and rural consumers also participate in the benefits.

On the other hand, a large proportion among the 27,000 resettled endure persistent hardships. Compensations were inadequate, and many among the displaced refused the alternatives offered by the government. A monitoring study conducted in 1993 found that 72% of the displaced families were worse off. Six years after resettlement the families that moved to plots provided by the government had incomes 25% below their neighbors.

The distributional matrix below underlines that our proposed equity threshold was not achieved. It also adds that, different to power projects, in the case of irrigation projects chances are that both losers and winners are in the rural areas. This opens up another question: if reparation is attempted, should the moneys to redress the losers come from the gains of farmers in the irrigated area, or from

⁸ Actually figures in Chungju distributional matrix show a negative overall outcome (-7.2) but it is small enough to consider it marginally acceptable in economic terms.

the country taxpayers? Clearly the answer depends on the country's equity policies regarding rural-urban income distribution.

Table 10. Distributional Matrix of Kedung Ombo Dam, Indonesia
(dam completed in 1993)

Social Groups	(a) Power Benefits	(b) Irrigat. Benefits	(c) Urban Water Benefits	(d) Flood Control Benefits	(f) Direct Invest. Costs	(g) Direct Operat. Costs	(h) Resett. Indirect Costs	(i) Fish. Ind. Costs	Net Benefits
(1) Urban all.	+ 3.9	+ 12.5	(P)		- 12.4	- 0.1			+ 3.9
(3) Rural all		+ 8.4	(P)		- 2.8				+ 5.6
(4) Flood Prot.				(VP)					(VP)
(5) Irrig. Farms.		+20.9				- 1.4			+ 19.5
(6) Resettled							-10.1 (EU)		- 10.1 (EU)
(7) Project area								(VP)	(VP)
(10) Total	+ 3.9	+41.8	(P)	(VP)	- 15.2	- 1.5	-10.1 (EU)	(VP)	+18.9

P: Positive / VP: Very Positive /EU: unacceptable on equity grounds

Numbers in rows and letters in columns refer to the full names in tables 1 and 2

9. Some provisory conclusions

The five cases just reviewed can support some provisory conclusions. Provisory because we are aware that the quantity and quality of the information preclude us from addressing many distributional and equity concerns:

- There are dams that have resulted in more costs than benefits, and infringed accepted equity goals. In retrospective they shouldn't have been built (see Chixoy case above). This finding is important because it underlines that better project planing and assessment -- one of the areas where the WCD is called to make recommendations-- may help reduce the number of these costly mistakes.⁹
- In other cases dams outcomes seems to have been mostly satisfactory for all parties involved and render overall benefits. This is more probable to happen in multipurpose dams since in these cases the distribution of cost and benefits is more widespread (see Chungju case above). Hydropower project have an inherent pro-urban bias, but even here well designed hydro projects that care for rural people and environments --e.g. including modest support for rural development-- can also result in a fare distribution (see Lubuge case above)
- There are dams, both hydro or irrigation dams, where benefits have surpassed costs, but some groups have ended as large net losers (see Sobradinho and Kedung Ombo cases above). The worst losers, the ones that will rise equity concerns, are usually among the directly affected population in the project area: resettlers, downstream dwellers, and similar. Urban taxpayers may shoulder large loses too, but since this is a large social group, these losses will usually not rise equity concerns.
- Then, meeting equity standards is financially possible in many cases where the projects benefits offered room to redistribute from the gainers to the losers.

⁹ Although surely not eliminate them, since economic and social change makes perfect forecasting impossible, otherwise there would be no bankruptcies

- This last point is especially significant in that contrary to a view of dams as intrinsically unfair, it underlines that in many cases it is not the dam but the people who are unfair, and that solutions are more in the social than in the technical realm.