Interlinking of Rivers in India

Dimensions of Social Impacts

There is a convincing case that ILR is neither desirable, nor needed for India's water needs of 21st Century. This paper concludes that the serious nature of social impacts of the project only reinforce that case. This exercise of estimating the social impacts of the Inter Linking Rivers (ILR) does not assume or agree that ILR is either desirable or inevitable. It only tries to give an estimate about the kind of social impacts that ILR may bring about, if implemented.

Track record on addressing social issues The first issue that confronts us when looking at the social impact of any new projects is the track record of the govt and project developers in addressing the social impacts of the past projects. After displacing millions (the govt and the project developers do not even have a credible figure about the number of people displaced by river valley projects in the past, some of the more credible estimates put the figure between 33 and 50 millions) the project developers cannot claim to have satisfactorily resettled the people displaced by even a medium size project. The people displaced by the dams like the Bhakra, the Hirakud, the Pong, the Gandhisagar and so on remain to be resettled even as per the norms accepted by the official agencies when these projects were taken up. Nor do we have proper policy, law or institutional mechanism to ensure that resettlement actually happens. Most importantly, even the appraisal of the social impacts of the projects has been shoddy.

In such a situation, it becomes important to map the possible social impacts of the mammoth project like the ILR, as the official agencies call it. This paper attempts to do just that. It does not mean that in the ILR project becomes justifiable in the unlikely scenario that the social impacts are adequately addressed.

Broad contours of ILR The Table 1 below gives broad contours of the Himalayan and the Peninsular Components of the ILR in terms of number of links, number of reservoirs, cost, water transfer, claimed benefits and so on.

Table 1. Broad Contours of ILR

	Himalayan Component	Peninsular component	Total
Links	14	16	30
Reservoirs	16	58	74
Power Installed Capacity	30 000 MW	4 000 MW	34 000 MW
Cost, crores	454 000	106 000	560 000
Water Transfer	141.3 BCM	33 BCM	174 BCM
Additional Irrigation	22 M ha	13 M ha	35 M ha
Link Canal Length*	6100 km	4777 km	10877 km
Drought mitigation*	1.7 m ha	0.85 m ha	2.55 m ha

Source: NWDA 2005-I (183) and II (173)

*: PK Sikdar in *Interlinking of Indian Rivers: An impact assessment* edited by Mamata Desai et al, ACB publications, Sept 2005 (p146-7)

Dimensions of Social Impacts There are many kinds of social impacts of a typical large river valley project like a dam or a hydropower project. The social impacts are experienced in the upstream, downstream and the command areas of the projects. The reservoirs behind the dams bring displacement for the upstream communities. Those affected upto the Full Reservoir Level (FRL) are generally considered when talking about Resettlement and Rehabilitation (R&R). However, the impact due to the reservoir is higher considering the fact that water level is expected to go to Maximum water level and there is also the backwater effect as the water flows in sloping profile. The dam and the related structures also require colonies, roads, fine aggregates, coarse aggregates, steel and cement and each of which would bring its

own impacts. Generally, these additional impacts are not included by the official agencies in estimations of displacement.

In the downstream areas, there are many dimensions of social impacts. Firstly, since the dams divert or stop all the water in the river at least in the non monsoon months, the river is taken away from the downstream people. Their source of drinking water, irrigation water and water for other needs is taken away. Secondly, the groundwater is also affected as the recharge function of the river for the downstream areas is destroyed. Thirdly, fisheries and other bio diversity in the downstream river is destroyed. Fourthly, the concentration of pollution in the downstream stream increases due to stoppage/ diversion of freshwater flow. Fifthly, in absence of freshwater flows, the river no longer can act for navigation for the downstream communities. Sixthly, the construction of the dam changes the character of floods in the downstream areas and the floods becomes sudden and many times more destructive. Seventhly, the geomorphological behaviour of the river changes as the silt in the river water gets trapped in the upstream dam. The eroding capacity of the silt free water flows increases significantly, which can bring fresh social impacts for the downstream communities. Lastly, with the drastic reduction in freshwater flows at the mouths of the rivers, the salinity ingress increases, which can affect the remaining freshwater in the river, the groundwater in the coastal zones, and also the soil in the coastal areas. All these impacts need to be appraised and estimated for each of the links. None of this has been done for any of the links, and hence our estimates do not include them here.

The whole canal networks include the main canals, the branch canals, the distributaries, the minor, sub minors and the field channels. Moreover, the impacts due to the structures along the canals, the drainage network required to compensate for the drainage congestion and the additional capacity required to drain away the water added in the area by the canals, and also the land required for the coarse and the fine aggregates and the earth required for the canals should be included in the social impact assessment. However, the National Water Development Agency (NWDA) has not included these impacts in the feasibility studies for the 14 links that it have made public.

Information about how much forest land will be required for the ILR is even less satisfactory. Available information suggests that the ILR will require at least 104 000 ha of forest land, but actual requirement is likely be much larger. The destruction of such large quantity of forests will bring large scale social impacts. In addition, the related works like the compensatory afforestation, the catchment area treatment, wildlife protection measures are also likely to have significant social impacts. However, sufficient information is not available to put numbers for these impacts.

Another class of impacts includes the impacts due to land slides, soil erosion and floods due to the ILR dams and link canals. Similarly, the land required for the resettlement and rehabilitation of the affected people will bring its own impacts. There is insufficient information about these impacts of ILR.

The social impacts will also be experienced in the neighbouring countries of Nepal, Bhutan and Bangladesh due to the ILR, but we do not have sufficient information to assess these impacts.

Lack of Information Like in case of all water resources development projects, very little information has been made public by the govt in case of ILR. It was a struggle to get the report of the National Commission for Integrated Water Resources Development, which was set up by the Govt of India and which submitted the report in Sept 1999. After a lot of struggle, the first volume of the report could be made available only in 2002. Then following repeated orders from the Supreme Court of India, the feasibility reports of only the 14 Peninsular links were made public in 2005. However, this still leaves out the remaining 16 links, about which NWDA has not made any of its reports public. Moreover, the reports of the 14 peninsular links is far from complete. To illustrate, the Ken Betwa link is supposed to involve at least five big dams, but the feasibility report of the link includes detailed information about only one of these. Similarly, the Parbati-Kalisindh-Chamal link is to include ten large dams, but the feasibility report includes some detailed information only

about three of these dams. The NWDA has refused to make the pre-feasibility reports, the water balance studies and so on public for any of the links.

Previous estimates of Displacement due to ILR In several ways the govt has indicated how non serious it is about the issues of Displacement, Resettlement and Rehabilitation. One of them has been the ridiculous estimates put forward by the government officials. Let us look at the some such instances.

In a paper by the National Water Development Agency in the volume published at the time of Eleventh National Water Convention on May 11, 2005, three senior officials of the Central Water Commission (SK Sinha (a Chief Engineer), AK Sinha (Director) and Sharad Chandra (Deputy Director) have said, "It is estimated that about 4 to 5 lakh people may get affected or displaced due to creation of reservoirs and due to canals". These senior govt officials go on to say, "It is expected that due to construction of storages about 79 000 ha forest land will come under submergence". Available information shows that these figures are going to be several fold larger.

Maj Gen (Retd) S Vombatkere (Medha Patkar, Jan 2004, p 46-7) estimates that total land requirement for ILR will be 8 lakh ha, including 4.4 lakh ha for canals.

B Senapati and LM Garnayak from Orissa University for Agriculture Technology (NWDA 2005-II p 386) estimate that 3.5 lakh ha of land of which 1.2 lakh ha will be forest land, will be submerged due to ILR.

Dr HH Uliveppa of Karnataka University estimates that the 10 500 km long canals of ILR will displace about 5.5 million people. (Singh and Shrivastava, 2006, p 104)

Rainer Horig (*Water Management on a Grand Scale: India's Programme of Interlinking of Rivers*, Reuters Foundation Paper no 260, July 2005) had made estimates of displacement due to ILR based on assumption that ILR has 60 large dams and each dam submerges 8748 ha (based on figures of 213 dams in India Country Study for the World Commission on Dams) or 13 000 ha (based on a World Bank study of 11 large dams) or 24 555 ha (based on a 1992 study by Central Water Commission involving 54 dams). Horig estimates that depending on the basis that you select, the ILR dams would submerge 5250 sq km, 7800 sq km or 14750 sq km land. If each sq km involves displacement of 151 persons per sq km land acquired (India country study for the WCD), the ILR dams would displace between 7.93 to 22.25 lakh people. Horig also estimated that the 12500 km long main canal of ILR will need 625[1] sq km land assuming 50 m width of land acquisition for the link canals. It further estimated that this will displace about 1962 lakh persons (considering average population density of 314 per sq km in India). Thus he estimates that ILR will take away 5875 to 15375 sq km land and displace between 9.9 lakh and 24.21 lakh people. This is the most elaborate estimate available so far on the issue of displacement due to ILR.

Available Information As mentioned earlier, sufficient information is not available to arrive at accurate estimates of likely displacement due to ILR. We have relied mostly on official reports for this paper, where available. Thus, we have relied on the feasibility reports of the 14 peninsular river links that have been made public by the NWDA following orders of the Supreme Court of India. For the Himalayan links, we have relied on the reports of the Bihar Govt and papers by officials of the W Bengal govt, where available. The available relevant information about the Himalayan links is described in the following sections.

Himalayan Links Available information about Himalayan Links:

⇒ **Sharda-Yamuna-Rajasthan-Sabarmati Link** 1835 km long link canal, of which 75 km is in Gujarat state. Total 14.52 MAF (Million Acre Feet), (or 17.906 Billion Cubic Meters (BCM)) of water to be

[1] Here it should be noted that there is a slight error in Horig's calculation, which has been corrected. Horiq estimated that if 50 m width of land is acquired for canals, every km of link canal will require 0.5 sq km or 50 ha of land, where as the correct figure is that every km of link canal will require 5 ha. Accordingly, corrected figures are given in the paragraph.

diverted, of which, Gujarat to get 1.32 MAF to irrigate 2.03 lakh ha in Gujarat. Rajasthan-Sabarmati link to irrigate 7.38 lakh ha, of which 5.35 lakh lakh ha is in Rajasthan. (NWDA 2005 p 86)

- **Sarda Yamuna link** The 384 km long link canal will start from a major barrage on Sarda River near Tanakpur town (Nainital district). The canal will have a bed width of 43.5 m and full supply depth of 7.8 m. (NWDA 2005-II p 192)
- **Yamuna Rajasthan Link** The link involves a barrage on Yamuna and a 786 km long canal off taking from Right side of the barrage. 196 km of the link length lies in Haryana and 590 km in Rajasthan. The full supply depth and bed width of the canal at head are 7 m and 53 m respectively.
- **Rajasthan Sabarmati Link** The total length of the proposed canal is 725 km, of which 650 km is in Rajasthan and 75 km in Gujarat. The fully supply depth and bed width of the canal at head is 6 m and 39 m respectively. (NWDA 2005 p 145-6)

Ghaghra-Yamuna Link The link is to divert water from the proposed Chisapani reservoir on Ghaghra River (the river is called Karnali in Nepal), The height of the proposed Chisapani dam above mean bed level is 175 m. A regulating dam is also proposed downstream of the Chisapani dam site with FRL 200 m and MDDL of 193 m. The 417 km long link canal will tail into Yamuna River at Etawah district in UP. The canal width would vary from 85.5 m in the head reach to 18 at the tail end and depth would vary from 8 m to 5 m in the same stretch. The canal is expected to irrigate additional 11.7 lakh ha in India and 2.54 lakh ha in Nepal. (NWDA 2005 p 123) The link also involves construction of two barrages. (NWDA 2005-II p 328)

Manas Sankosh Teesta Ganga Link Water from Manas and Sankosh dams to go to existing Teesta and Mahananda barrages through a link canal. The link canal outfalls into Ganga 60 km upstream of the Farakka Barrage. From here through another link canal, water will go to a barrage on Subernarekha River. A link canal from here will transfer the water to proposed Manibhadra dam on Mahanadi in Orissa. (NWDA 2005-II p 218) The 457 km link canal (full supply depth 10 m and slope 1:20 000 for the entire canal) comprises of: Manas-Sankosh canal – 114 km (the design discharge 1370 cumecs and the bed width of canal 66 m); Sankos-Teesta canal – 137 km (design discharge 2355 cumecs, canal bed width 121 m) and Teesta-Ganga canal 206 km (design discharge 2355 cumecs, canal bed width 121 m). 151.2 km of the canal will be in Bihar. The requirement of land in Bihar alone will be 7000 ha in thickly populated areas. "The acquisition of such vast area of land in this thickly populated area will be difficult… will create a big problem of rehabilitation", says Govt of Bihar. (Govt of Bihar 2003 p V-1)

According to Biswatosh Sarkar, the then secretary, Irrigation and Waterways Dept, Govt of W Bengal, 192 km of the MSTG link will pass through W Bengal, and 4327 ha of land will be required for the same, including 2133 ha of forest land and 2194 ha of private, tea garden and state govt land. "The cutting of the canal will create huge amount of spoil to the tune of 1.8-2.5 million cum. This will create disposal problem because it will require 13500 ha of land for disposal, 40% of which likely to be forest area, 30% tea garden area… The canal will cut across the natural drainage of the area and so may cause drainage congestion as well as flooding of the area". (The Institute of Engineers, Sept 2004, p 121-2)

PK Basu, the then advisor, State Planning Board and former secretary, Irrigation & Waterways dept, Govt of W Bengal, noted (WBAST 2004, p 62) some conclusions from the West Bengal govt study of the Sankosh Teesta Link in 1997, "The alignment of the proposed S-T link canal would follow the foothills so that the transferred waters have necessary elevation to reach the level of the existing Teesta barrage (113 m) without pumping. Enroute, it would cross 22 tea gardens requiring acquisition of 530 ha of land. This would mean sure death of tea gardens. It would pass through the Buxa Tiger Reserve and reserve forests of Raidak, Upper Tandu and Appalchand, requiring 770 ha of land of the reserve forests. It would virtually separate the Himalayan foothills from the N Bengal plains, creating very adverse impact on the flora and fauna of the fragile forest cover that W Bengal still has in its northern parts. Land acquisition would lead to displacement of indigenous peoples who live in these areas and is likely to highten the already existing social tension between the tribals and non tribals."

In another article, PK Basu estimates, "Total area of land to be acquired for the present proposal of MSTG link is 27 020 ha, out of which forestland accounts for 20505 ha" (South Madras Cultural Association, July 2003, p 36). It is not clear what components Basu includes in this estimates and if the land requirement is only in W Bengal or it also includes land requirement in Bihar, Assam and Bhutan.

According to the Feasibility study of the Sankosh Project by the Central Water Commission (1997), totally 2834 ha of land will be required for the main canal from the Sankosh project, of which 260 ha is in Bhutan (including 174 ha of forest land) and 2574 ha in India (including 1145 ha forest land). A strip of 200 m width will be acquired for a canal bed width of 121 m and about 178 houses/ building will come in the way of the canal.

Farakka Sunderbans Link This link involves use of 9000 MCM of water, out of which 2000 MCM is to be used for activating moribund Jamuna & development of Kestopur Bhangarakata Khal and 7000 MCM for diverting water to Hooghly to improve navigability of Kolkata Port. This link will require widening of the Feeder Canal and acquisition of land in Murshidabad, not known to what extent. (Inst of Engineers Sept 2004 p 123)

Ganga Damodar Subarnarekha link This 394 km long link to transfer 28913 MCM will require about 8300 ha of land in W Bengal. (Inst of Engineers, Sept 2004, p 124)

Jogighopa Alternative In this option for the upper reach of MSTG link, there would be barrage on Brahmaputra at Jogighopa, from where a 97.53 km long canal will take water to Sankosh barrage, rest of the link from thereon remaining same as in MSTG proposal. In this proposal, it is proposed to have a 300 MW power plant at Jogighopa and a five stage 100 m lift involving pumping capacity of 1059 MW.

Kosi Mechi Link The 112.55 km long canal will have fully supply depth of 6.5 m and bed width of 155 m and slope of 1 in 20 000 and velocity of 1.3 m/s. (GoB 2003, p V-8)

Kosi Ghaghra Link The canal is to off take from Chatra barrage, downstream of the proposed Kosi High Dam, to outfall into river Gaura, a tributary of River Rapti, which joins Ghaghra. Out of the 428.76 km link canal, 278.22 km is in Nepal and 150.47 km is in India. The canal bed slope is 1: 20 000. (GoB 2003 p V-15)

Gandak Ganga The live storage of proposed diversion dam on Gandak is 1960 MCM. In addition, NWDA envisages storage facilities on tributaries of Gandak to the extent of 13954 MCM. This total of 15 914 MCM of storage capacity is for utilisation of 53 828 MCM of water. The link canal will be 639 km long, starting from the right side of the proposed dam across Gandak in Nepal, falling in Ganga river near Mustafabad in Rai Bareli district in UP. (GoB 2003, p V-37)

Chunnar Sone Barrage Link The link envisages transfer of 6 BCM water from Ganga at Chunar to River Sone at Sone barrage. (NWDA 2005-II p 330) The link canal is to be 149.1 km long, 98 km being in Bihar, the rest in UP. The Link canal has three lifts, of 38.8 m, 16.1 m and 4.4 m. About 251 MW of power will be required for these lifts. A new barrage on Kudra Nadi is proposed. The link will require 92.25 ha forest land in UP portion. Total 1614 ha land will be required in Bihar, including 42 ha for Kudra barrage. About 40 families (200 people) will be displaced due to the Kudra barrage. (GoB 2003 p V-39)

Sone Dam STG (Southern Tributaries of Ganga) link The proposed link canal is to off take from the tail race of Kadwan HEP and outfall into Badua Left Bank canal after traversing a distance of 339 km. The link includes a 32 m high dam across river Sone with gross storage capacity of 3100 MCM, having a power house of 90 MW. The bed width and full supply depth of the canal are 30 m and 5 m respectively, with a slope of 1:20000. The water velocity would be 0.986 m/s at the head. Kadwan reservoir will submerge 19300 ha (25 100 ha mentioned at another place), of which forest land is 4300 ha. Barrages are planned on North Koel and Sakri Rivers, for which about 160 ha of land will be required. For the link canal, 4100 ha of

land will be needed. About 40 000 persons from 40 villages are to be displaced by Kadwan reservoir. (GoB 2003 p V-56-61)

Yamuna-Sarda Dams As MS Reddy, former secretary, Ministry of Water Resources, Govt of India states (NWDA 2005-II, p 99), Pancheshwar, Purnagiri, Kishau, Lakhwar, Vyasi, Renuka dams are imperative for ILR, though they may not be mentioned separately in a Link project. [Similarly, Bodhghat and Bhopalpattanam are imperative for the peninsular component of ILR, Reddy adds.]

Displacement in Nepal As a Superintending Engineer, NWDA (NWDA 2005-II p 55) notes, the Himalayan component depends on construction of dams on the tributaries of Ganga in Nepal. Some of these dams in Nepal include the following.

⇒ **Pancheswar (Sarda)** about 12 000 ha of land is likely to be submerged in Nepal due to this dam. This dam and the downstream Purnagiri dam are crucial for the Sarda Yamuna and related links.

⇒ **Chisapani Dam (Ghagra)** This big dam is entirely in Nepal and will submerge only Nepali lands. At least 34000 ha of land will be required only for the dam. The land required for the link canal in Nepal will be additional.

⇒ **Kosi High Dam (Kosi)** The dam, part of the Kosi Mechi Link, is to be in Morang Dist in Nepal, 1.6 km upstream of village Barahkshetra. The 269 m high dam with FRL of 335.25 m will submerge 19063 ha, all in Nepal. It will have gross storage capacity of 13450 MCM and Live storage capacity of 9370 MCM. A barrage near Chatra village 8 km downstream of Barahkshetra dam site is also planned. (GoB 2003 p V-7-8) It will submerge the habitat of Rai tribals and that of Gorkhas. (NWDA 2005-II p 214-5) In addition, at least 278 km of the Kosi Ghagra link canal would be in Nepal.

⇒ **Gandak Dam** The Gandak dam would be entirely in Nepal and will submerge significant amount land, it is not clear how much. In addition, a number of reservoirs are planned on Gandak tributaries, no information is available about them, but most submergence due to these reservoirs is likely to be in Nepal. In addition, part of the Gandak-Ganga canal would also be in Nepal.

⇒ **Link Canals** Parts of Kosi-Ghagra, Kosi-Mechi, Gandak-Ganga and Ghagra-Yamuna link canals would be in Nepal, requiring significant amounts of lands in that country.

Displacement in Bhutan

⇒ **Manas Dam** A 250 m high dam on the Manas River, a tributary of Brahmaputra in Bhutan, 4 km upstream from Indo-Bhutan border is proposed with Live storage capacity of 8750 MCM.

⇒ **Sankosh Dam** A 253 m high dam with live storage of 4930 MCM on Sankosh river, a tributary of Brahmaputra in Bhutan, 12 km upstream of India-Bhutan border is proposed. (GoB 2003, WBAST 2004, p 62) However, the 1983 Indo Bhutan pre feasibility study had fixed 239 m as the height of the dam with gross storage capacity of 4700 MCM and submergence area of 4700 ha. The proposal included 1400 MW power house at the main dam and a component of 125 MW lift dam. However the Feasibility study of the project by the Central Water Commission in 1997 conceived the project as 265 m high and included 62.5 m (above the deepest foundation level) high regulating dam in the downstream. The main dam (4000 MW installed capacity) is to have a gross storage capacity of 6325 MCM and submergence area of 6178 ha. (CWC 1997, p 1.1)

⇒ **Sankosh regulating dam** This 60 m high barrage will be 11 km downstream of the Sankosh Dam. (GoB 2003, WBAST 2004, p 62) The dam height proposed was 62.5 m in CWC feasibility study in 1997. the dam will gross storage of 144 MCM and live storage of 24 MCM would have submergence area of 821 ha. (CWC 1997)

⇒ **The Link canal** The Manas Sankosh link is entirely in Bhutan. In addition, part of the Sankosh Teesta link canal would be in Bhutan.

Estimated displacement due to the Dams and the Canals Based on firm information about how much land will be required for the various dams and link canals of ILR (see the Tables 3-6 at the end of this paper for details), we arrive at the following table for the land requirement for the Himalayan and the Peninsular components of ILR, for the dams and the link canals (only the main canals). Next step is to estimate how many people will be displaced for these components of ILR. For dams, the most reliable figure one can use

is 1.51 persons per ha, based on a study of 213 dams done as part of India Country Study for the World Commission on Dams. For canals, we have used the figure of population density in India (3.14 persons per ha), as canals pass through more areas with greater population density and canals are spread all over India. The figures in the last column in Table 2 are thus arrived at based on these norms.

Table 2. Displacement due to Dams and Link Canals of ILR

	Forest Land required, ha	Total Land required, ha	Estimated number of people that may be displaced
Himalayan Dams	4 300	162 304	245 079
Himalayan Link Canals	16 758	99 315	311 849
Peninsular Dams	73 646	404 843	611 313
Peninsular Link Canals	9 165	99 046	311 004
Total	**103 869**	**765 508**	**1 479 245**

These estimates suffer from a number of limitations. Firstly, even for the two main components, there is no information from the official agencies about a number of dams. Similarly, there is no official information about the link canals for at least two of the Himalayan links: the Subernarekha Mahanadi link and the Farakka Sunderbans link. Thus, while table 1 gives total length of the link canals as 10877 kms, the information available is only for 9677.34 km (4833.31 km in Himalayan component and 4844.03 km in Peninsular component) link canals.

Secondly, the estimates include land required only for the main canals, which would be around 0.8% of the expected command area (from surface water use) of 25 million ha expected from the ILR. In reality, such long distance canal based projects are likely to take up between 7.5 and 10% of the land projected to be getting irrigation. Thus, ILR is likely to require 2 to 2.5 m ha for the total canal network.

Thirdly, these estimates do not include other dimensions of the social impacts like downstream impacts, the impacts due to drainage network (or lack of drainage), the impacts due to water logging and salinisation, the impacts due to "conservation" measures like the catchment area treatment, the compensatory afforestation, the creation of new wildlife protection areas and the impacts due to the land slides.

Fourthly, these estimates do not include impacts due to the requirement of land for sand, fine and coarse aggregates, the steel and cement that would be required on massive scale for these projects and the impacts thereof. Following figures of requirements of fine, coarse aggregates and earth for three of the link canals (all from NWDA feasibility studies) shows that this component of the project too will bring big social impacts.

⇒ The Ken Betwa link will require fine aggregates of 2 million cubic meters and coarse aggregates of 8 million cubic meters.

⇒ The Krishna (Almatti) Pennar link will require 61.355 million cubic meters earth for canals.

⇒ The Cauvery Vaigai Gundar link will require 0.518 million cubic meters fine aggregates, 1.035 m cubic meters coarse aggregates and 17.39 million cubic meters of earth.

Fifthly, this does not include the substantial impacts that the project construction brings in the surrounding areas in the form of land slides, erosion, flooding and also tremors.

Finally, whatever resettlement and rehabilitation consequent to the projects would require land, which in turn could bring fresh social impacts.

So the figures in table 2 provide far from full and complete picture about social impacts due to the ILR, but they possibly give some idea of the situation, when taken with the above mentioned provisos.

NWDA on R&R The NWDA reports provide at best very sketchy information about what is planned about the resettlement and rehabilitation of the people to be affected by the ILR. In the sections on R&R, there is no provision of land for farmers and others affected by the projects. Only provision is land for housing plot

for the people who will lose their homes to ILR. The provision of cash compensation for the people who will lose land due to the ILR shows that the govts do not intend to provide land for the displaced. The NWDA reports do not mention the National R&R policy norms, but they state that each state will deal with the affected as per the state policies.

The first objective of the current National policy on Resettlement and Rehabilitation (NRP 2003) is "To minimize displacement and to identify non-displacing or least-displacing alternatives". If this objective were to be applied to ILR, than we won't need the ILR projects at all, as less displacing options for India's water needs even for the justifiable demands projected for the 21st century exists. Thus, even if the current National Policy (with all the huge inadequacies it suffers from) were to be applied to ILR in an honest, objective way, we won't need the ILR.

Conclusion The govt and the NWDA have not made public any of the hundreds of studies done over the last 24 years with public resources till recently. Recently, after repeated Supreme Court orders, the govt has made public the feasibility reports of 14 of the ILR proposals. These reports suffer from serious inadequacies.

This paper estimates that based on available information, the ILR will require at least 7.66 lakh ha land and will displace at least 14.8 lakh people. In addition, ILR will need at least 20 lakh ha of land for the canal network. ILR will also need at least 1.04 lakh ha of forest land as per available official information. ILR will bring about significant displacement in Nepal and Bhutan due to the dams and link canals. The ILR will also bring about significant social impacts in Bangladesh.

This exercise only helps get a picture of some dimensions of the possible social impacts of the ILR. However, the exercise of doing such estimation does not mean that ILR is either necessary or desirable. As said at the outset, there is sufficient case to show that ILR is neither desirable, nor necessary and we have less expensive options for taking care of justifiable water needs of the 21st century.

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Table 3. The Dams in the Himalayan links

Link	Dam	River	Location (country, state, district)	Gross Water storage (Live)	Height of the dam	Submergence area, Ha	Displacement, No of persons
MSTG	Manas	Manas	**Bhutan**	(8750 MCM)	250 m	8000 ha[2]	
	Sankosh	Sankosh	**Bhutan**	6325 MCM (LS of 4930 MCM for 253 m high dam)	265 m	6178 ha	
	Sankosh barrage	Sankosh	**Bhutan**	144 MCM (24 MCM)	62.5 m	821 ha	
Sarda-Yamuna	Pancheswar	Kali River	Pithoragarh, Uttaranchal, India & **Nepal**	(6.56 BCM)	315	26000 ha (12186 in Nepal)	15400 people, 65 vil in Nepal
	Purnagiri	Kali			145	5000 ha	
	Sarda Barrage	Sarda	Uttaranchal, Tanakpur town (Nainital Dist)				
Yamuna Rajasthan	Yamuna barrage						
Rajasthan Sabarmati							
Ghagra Yamuna	Chisapani	Ghagra (Karnali in Nepal)	**Nepa**l	20 BCM (16.2 BCM)	175 m (above bed level); 270 m (Bapa '04)	33900 ha%	Over 60 000 in Nepal (Dhungel et al, Nepal)
	Karnali barrage-1	Ghagra (Karnali)			FRL 200 m; MDDL 193 m		
	Barrage-2						
Kosi Ghagra (proposal to construct barrages on enroute rivers at Kamla (121 km), Bagmati (202.8 km) and Gandak (333.7 km)	Kosi High Dam		**Nepal, Morang dist, 1.6 km u/s of barahkshetra**	13450 MCM (9370 MCM)	269 m (FRL 335.25 m; MDDL 259)	19603 ha	
	Chatra barrage		**Nepal, 8 km d/s of barahkshetra**		Pond level 113.4		
Gandak Ganga	Gandak dam		**Nepa**l	(1960 MCM)		6000 ha	
	More dams on Gandak tributaries			13954 MCM		20000 ha	
Chunnar Sone Barrage link	Kudra Nadi barrage (129.2 km)	Kudra Nadi	Bihar			42 ha	200
Inter connecting reservoirs	Jirgo		UP (12.9 km)	(140)	FRL 98	(4000 ha)	
	Ahroura		UP (20.9 km)	(58.2)	FRL 110		
	Musakhand		UP (46.55 km)	(110.5)	FRL 110.7		
	Kohira		Bihar (67.3)	(25.5)	FRL 104.4		
Sone Dam STG	Kadwan HEP	Sone		3100 MCM	32 m (FRL 165)	25100 ha (4300 ha FL)	40 000 (from 40 villages)
	Barrage	N Koel				160 ha	
	Barrage	Sakri					
Yamuna dams not direct part of ILR but imperative for the same (totally 11.98 bcm water available in Upper Yamuna basin)	Kishau	Tons (Yamuna)	Dehradun dist, Uttaranchal	(1230)	253	3000 ha	
	Lakhwar	Yamuna	Dehradun, before Tons meets Y	(333.04)	173 (above riverbed)	2000 ha	
	Vyasi	Yamuna	5 km d/s of Lakhwar		80	500 ha	
	Renuka	Giri (Yamuna)	Sirmour dist, HP	542 (498)	148 (above river bed)	2000 ha	

%: (www.english.ohmy news.com, 091106)

[2]

Table 4. The link canals in the Himalayan Links

Link	Canal Length, km	Canal bed width at head, m (slope)	Supply Water depth at head, m (velocity)	Canal carrying capacity at head, cumecs	Water to be diverted, BCM	Approximate land requirement for the link canal	Irrigated Area, lakh ha
Kosi Mechi	112.55	155 (10 at tail) (1: 20 000)	6.5 (1.3 m/s)	1407.8 (98 at tail)	23.702 (0.883 trasfer to Mahananda basin)	2624 ha	4.74 (1.75 in Nepal; 2.99 in India)
Kosi Ghagra	428.76 (278.22 km in Nepal and 150.47 km in India)	(1: 20 000)		928	7.482	6992 ha: 4661 in Nepal and 2331 in India	10.58 (1.74 in Nepal; 8.84 in India)
Gandak Ganga	639 (tailing in Ganga river near Mustafabad in Rai Bareli district in UP)			3000	53.828 (15.27 MCM for Enroute use)	23170 ha	17.49 [CCA 14.34 (9.95 in Bihar, 3.75 in UP, 0.44 in Nepal)]
Ghagra Yamuna	417 (to tail in Etawah district in UP)	85.5 (18 at tail)	8 (5 at tail)			5796 ha	11.7 in India & 2.54 in Nepal
Sarda Yamuna	384	43.5	7.8		17.906 to be diverted, of which Gujarat to get 1.628	4909 ha	
Yamuna Rajasthan	786: 196 in Haryana and 590 in Rajasthan	53	7			9360 ha	
Rajasthan Sabarmati	725: 650 km in Rajasthan and 75 km in Gujarat	39	6			4325 ha	7.38 - 5.35 in Raj and 2.03 in Guj
Chunar Sone	149.1 (98 km in Bihar and 51.1 km in UP)			405.09 (85.18 at tail)	5.92	1572 ha in Bihar; 800 ha in UP (92 ha FL - UP)	0.668 new area
Sone-STG	339 (terminate in Badua reservoir)	30 (1: 20 000)	5 (0.986 m/s)	190.43 (14.02 at tail)	2.512	4100 ha	3.07 (2.39 new area)
MSTG: Manas-Sankosh	114	66 (1:20 000)	10	1370	43.208 (22.56 from Manas, 12.433 from Snkosh and 8.215 from intermediate major streams; 37.913 transferred to Ganga; 4027 used for Enroute irrigation and 1.268 transmission losses; 15 to be used at Farakka)	2280 ha	6.536 (2.64 in Bihar
MSTG: Sankosh-Teesta	137	121 (1:20 000)	10	2355		192 km of Sankosh Ganga Canal in W Bengal, for which 4327 ha land (2133 ha FL) for canal and 13500 ha for disposal of soil (40% land in FL); in addition, 260 ha in Bhutan	
MSTG: Teesta-Ganga	206 (151.2 km in Bihar)	121 (1:20 000)	10			7000 ha in Bihar	
Farakka Subderbans					9 BCM, of which 7 BCM for Kolkata port	Widening of feeder canal will need land in Murshidabad	
Ganga Damodar Subarnarekha	394			1864	28.913	8300 ha in W Bengal	
Subarnarekhs Mahanadi							

FL: Forest Land; PL: Private Land

Table 5. The dams in the Peninsular links

Link	Dam	River	Location (district, state)	Gross storage (Live) mcm	Height of the dam (annual Irrigation – l ha)	Submergence area, Ha	Displacement, No of persons
Mahanadi (Manibhadra)– Godavari (d/s)	Manibhadra	Mahanadi	Nayagarh, Cuttack dist, Orissa	6000 (4290); for FRL 86 m; for FRL 91 m, 8520 (6608)	86 m FRL (MDDL 73.15 m) figures given here, NWDA proposal is for FRL 91 m	63043 (4040 ha FL + 5520 ha village FL); 70 000 ha at FRL 91 m	110 000 (2001 census) 15120 PAFs, 266 villages; at MWL 91.5 m, 218 vil fully & 114 villages partially affected
	Salim Dam (increase FRL)	Salia	Khurda dist, Orissa	59.5 (52.1)	FRL up from 58.52 m to 63.3 m)	92 ha additional sub, totally 1365 ha	44 PAFs (300 people)
Godavari (Inchampalli) – Krishna (Nagarjunsagar)	Inchampalli	Godavari		10374 (4285)	FRL 112.77; MDDL 106.98	94620 ha (30170 ha FL)	10080, 229 villages (1991 census)
	D/s dam for pump storage	Godavari		34.2			
	Peddavagu				Pond level 140 m	4113 ha FL	
	Upper Tummalagutta				Pond level 197 m		
	Lower Tummalagutta				Pond Level 176 m		
	Nusi				Pond level 140 m		
Godavari (Inchampalli) – Krishna (Pulichintala)	Pulichintala	Krishna	Guntur Dist, AP	1296 (1026)	FRL 53.34 m; MDDL 42.7 m	14399 ha	25000; 5000 PAFs; 16 vil (1991 census)
	Bhopalpatanam	Indravati	Sironcha tehsil, Mah	9494 (8421)	FRL 200.25; MDDL 174.5; MWL 201.1	77380 (10000+ ha FL) [CSE 1985 p117-8]	Displacement in Mah and CG
	Bodhghat	Indravati	CG		90 m high dam	13783 ha (5704 FL) (CSE 1999 p 156; UNEP)	10 000 tribal families; 42 vil
Godavari (Polavaram) – Krishna (Vijaywada)	Polavaram	Godavari	W Godavari dist, AP	5511 (2130)	FRL 45.72 m Dead level 41.15 m	63691 (3705 ha FL)	144812; 16207 PAF; 250 vil; 23095 houses
Krishna (Almatti) – Pennar	Kalvapalli	Pennar	Anantpur, AP	83 (73)	FRL 473 MDDL 466	1323 ha (2 villages)	1333 (Anantpur dist), 249 houses affected
Krishna (Nagarjunsagar) – Pennar (Somasila)							
Krishna (Srisailam) – Pennar	Four balancing reservoirs are planned: Gorakullu (50.22 km) & Owk (112.73 km – tail) on SRBC and Velugoda (7.78 km) and Sri Pothuluri Veera Brahmedra Swamy (106.66 km) on Telugu Ganga Canal. However no details are given about these reservoirs.						
Pennar (Somasila) – Cauvery (Grand Anicut)							
Cauvery (Kattalai) – Vaigai – Gundar	Kattalai barrage	Cauvery	Karur (TN)		Pond level 101.2)	910 ha (40 ha FL)	

The dams in the Peninsular links (cont from previous page)

Link	Dam	River	Location (district, state)	Gross Water storage (Live) mcm	Height of the dam (annual Irrigation – l ha)	Submergence area, Ha	Displacement, No of persons
Ken – Betwa	Greater Gangau	Ken	Chhatarpur dist, MP	2755 (2753 - DSL)	FRL 287; MDDL 268; DSL 238	8650 (6400 ha FL)	8550; 900 PAFs; 750 houses , 10 vil
	Berari barrage	(Betwa)			(0.87009)	4350	
	Neemkhera	(Betwa)			(0.01053)	150	
	Richhan	(Betwa)			(0.36828)	1842	
	Kesari	(Betwa)			(0.1840)	920	
Damanganga – Pinjal (for transfer of what to Mumbai as mentioned in bracket with the names of the dams)	Bhugad (1181 mld)	Damangang a	Peint Taluk, Nasik Dist	426.4 (400)	FRL 163.87; MDDL 124.83	1903 ha (890 ha FL) in Guj (916) & Mah	3046 (1991 census); 14 vil; 503 PAFs
	Khargihill (1181+1193 mld)	Vagh	Behadpada, Mokhana Taluk, Thane	460.8 (420.5)	FRL 154.52; MDDL 109.75	1558 ha (734 ha FL) in Mah	1484; 10 villages – 220 PAFs
	Pinjal (2374+1367 mld)	Pinjal (T of Vaitarna)	Jawahar Taluk, Thane	413.57 (401.6)	FRL 141; MDDL 92.4	1500 ha	
Parbati – Kalisindh – Chambal	Patanpur	Parbati	Rajgarh dist, MP	156 (110)	FRL 419; MDDL 407	2998 ha (69 ha FL)	4255 (1991 census); 22 vil, 851 PAFs
	Mohanpura	Newaj (T of Kalisindh)		140 (87.5)	FRL 400; MDDL 390	2510	2530 (1991); 506 PAFs; 8 vil
	Kundaliya	Kalisindh		1234 (959)	FRL 378; MDDL 369.2	11800 ha (176 ha FL)	20270; 4054 PAFs, 35 vil
	Chitabad			(200)	(0.52957)	6200	19 vil
	Sonechiri			(52)	(0.14359)	2240	11 vil
	Padunia			(42)	(0.11881)	1640	10 vil
	Sewarkheri			(37)	(0.10066)	1150	9 vil
	Sekri-Sultanpura			(36)	(0.10232)	2600	12 vil
	Ramwasa			(21.25)	(0.05778)	650	3 vill
	Bachora			(15)	(0.04127)	1280	7 vil
Par – Tapi – Narmada	Jheri	Par	Peint Taluk, Nasik Dist, Mah	203 (187)	FRL 246; MDDL 203.7	836 ha in Mah	14832; 75 villages (24 fully and 51 partially); 2247 houses; out of 7559 ha, 3572 ha is FL
	Mohankavchali	Par	Dharampur Taluka, Valsad Dist, Guj	372 (158)	FRL 158; MDDL 143	1494 ha (1372 ha in Mah; 122 ha in Guj)	
	Paikhad	Nar (T of Par)		229 (218)	FRL 248; MDDL 190.22	994 ha (894 ha-Mah, 100 ha-Guj)	
	Weir D/s of Parikhad				Crest level 143		
	Chasmandva	Tan (T of Auranga)		82 (75)	FRL 214; MDDL 75.08	615 ha (32 ha in Mah, 583 ha in Guj)	
	Weir D/s of Chasmandva				Crest level 132		
	Chikkar	Ambica	Ahwa Taluka, Dangs Dist, Guj	142 (130)	FRL 210; MDDL 130	1249 ha (Guj)	
	Weir D/s of Chikkar				Crest level 129		
	Dabdar	Kapri (T of Ambica)		223 (205)	FRL 169; MDDL 137.1	1629 ha (Guj)	
	Kelwan	Purna		284 (258)	FRL 164; MDDL 136.1		

The dams in the Peninsular links (cont from previous page)

Link	Dam	River	Location (district, state)	Gross Water storage (Live) mcm	Height of the dam (annual Irrigation – l ha)	Submergence area, Ha	Displacement, No of persons
Bedti – Varda	Pattanadahalla	Bedti basin	North Kanara dist, Karnataka	18 (13)	512.75 FRL	1005 ha (787 ha FL)	1 vil, 967 PAPs
	Shalamalahalla			80 (72.5)	480.4 FRL		
Netravati – Hemavati	Yattinhole	Sekleshpr Taluk, Hassan Dist, Karnataka			900 m FRL	295 ha (78 ha FL)	No displacement, says NWDA website
	Kerihole				866 m FRL	120 ha (33 ha FL)	
	Hongadhhalladhole				866 m FRL	350 ha (97 ha FL)	
Pamba – Achankovil – Vaippar	Punnamedu	Pamba Kal Ar		208 (118.5)	FRL 246; MDDL 212.7	440 ha	
	Achankovil	Achankovil Kal Ar		496.9 (184.9)	FRL 210; MDDL 192.2	1241 ha (871.67 ha FL); 1270 ha at MWL	
	Achankovil PS dam			30.6 (27.8)	FRL 65; MDDL 50	323 ha (218 ha FL); 340 ha at MWL	10 villages, 297 PAPs

T: Tributary; D/s: downstream; FRL: full reservoir level; MWL: maximum water level; FL: forest land; PAPs: project affected persons; PAFs: project affected families; PS: pump storage; vil: villages

Table 6. The link canals in the Peninsular Links

Link	Canal Length, km	Canal bed width at head, m (slope)	Supply Water depth at head, m (velocity)	Canal carrying capacity at head, cumecs	Water to be diverted, BCM	Approximate land requirement for the link canal	Irrigated Area, lakh ha
Mahanadi (Manibhadra)– Godavari (d/s)	210.45 m (Manibhadra-Rushikulya)	73.5 (1:20 000 through out)	7	801.98	12.165	22267 ha (1098 ha FL) 6048 PAPs to be resettled due to LC	3.52 in Orissa: 0.91 in AP; 4.43 total
	436.05 (Rushikulya-Sarada)	43	7	500.23			
	181.2 (Sarada-Godavari)	28	7	352.79			
Godavari (Inchampalli) – Krishna (Nagarjunsagar)	299.256	109.6 (1: 20 000 through out)	7.4	1090	16.426	7567 (661 ha FL + 300 ha FL for colony/road)	2.87
	21.8 km lead canal	9 (1:7500)	1.9	16	0.218		0.5686
Godavari (Inchampalli) – Krishna (Pulichintala)	312.2 (12.5 km Tunnel)	33.4 (17.9 m at Tail) (1:20 000)	6.75 (1.183 m/s)	304 cumecs (187 cumecs at tail)	4.37	4555; Pop Density in Command area: 6.7 per ha (2001 census)	6.13
Godavari (Polavaram) – Krishna (Vijaywada)	174 (Right)	68.5 (1: 20 000)	4.9 (3.95 at tail) (1.05 m/s)	405.12 (280 at tail)	8.233	24000* (pop density in command area is 4.97 persons per ha)	2.096 (CCA of 1.4 l ha in RBC and transfter to 2265 mcm; CCA of 1.75 l ha in LBC)
	208 (Left)						
Krishna (Almatti) – Pennar	587.175	32 (1: 20 000 then 15 000 and then 12 000)	5.25	230	1.98 (population density in command: 1.11 per ha)	8500 ha; 71 ha FL, 178 villages along the canal alignment	2.58 (1.46 in Krishna basin and 1.12 in U Pnnr basin)
Krishna (Srisilam) – Pennar	204 (existing) (180 th natural streams)			186	2.31	80 ha (embankment & power house)	
Krishna (Nagarjunsagar) – Pennar (Somasila)	Offtake	21.3	7	488	12.146 (slope varies from 1: 2200 to 1: 20 000)	9823.8 ha (895 ha FL) 5148 PAPs, 9 villages	5.81 (4.13 existing area u NSRBC; 1.68 proposed)
	202.75	67.5	6	565			
	393.02 (tail)	58.9	6	498			
Pennar (Somasila) – Cauvery (Grand Anicut)	529.19 (1: 20 000)	72.4 (39.55 – tail)	6	603.33 (351.02 at tail)	8.565	12708 ha (1025 ha FL)	4.91
Cauvery (Kattalai) – Vaigai – Gundar	255.6 (1: 13 000)	20.4 (4.1 m at tail)	5 (3.4 m at tail)	180.3 (30.03 at tail)	2.252	3146 ha for main canal, 28 ha for colony+offices, includes 40 ha FL	3.38
Ken – Betwa (1: 10 000)	134 km	12	3.56	72	1.02	820	0.47 enroute & 1.27 Betwa basin
	61	9.7	3.56	62			
	36.5	8.5	3.56	57			
Parbati – Kalisindh – Chambal	55.37 (Patanpur-Mohanpura)	19.5 (1: 10 000)	5 (1.331 m/s)	199.3	1.36	3449 ha	2.3 (1.19 enroute; 1.09 upper Chambal; 0.0215 Ex Kota Barrage)
	73.17 (Mohanpura-Kundaliya)	21.3 (1: 8 000)	5 (1.502 m/s)	238			
	98.09 (Kundaliya-G'sagar)	7 (1: 10 000)	3.4 (1.07 m/s)	49.1			

The link canals in the Peninsular Links (Cond from previous page)

Link	Canal Length, km	Canal bed width at head, m (slope)	Supply Water depth at head, m (velocity)	Canal carrying capacity at head, cumecs	Water to be diverted, BCM	Approximate land requirement for the link canal	Irrigated Area, lakh ha
Par – Tapi – Narmada	205.34 km (Par Tapi)	6.6	3.12	44.13 – 90.9	1.35	1700	3.04 (0.52 enroute and 2.50 in Narmada command)
	190.14 (Tapi-Narmada)	12.5	3.5	196 (75 at tail end)	1.554		
	33.27 km feeder canals from Chikkar, Dabdar and Kelwan dams)						
Damanganga – Pinjal	16.85 + 25.7 km tunnels				0.287 ex Bhugad+ 0.29 ex Khargihill+ 0.332 ex Pinjal		
Bedti – Varda	23.33 km (9 km tunnel)				0.242		0.60200 (Tungabhadra IP)
Netravati – Hemavati	11 km (8.4 km Tunnel)				0.188		0.33813 (Hemavati IP)
Pamba – Achankovil – Vaippar	51 km (+ 17 km tunnel)	13.8 (1: 10 000 to 1: 7500)	3.6	72	0.634	210 (125 ha FL for roads, colonies)	0.914

FL: Forest Land; PL: Private Land

*: As estimated by Venkat (see *Dams, Rivers & People* Feb-Mar '06)

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