# Effects of Dam Building on The Utilization and Management of River Resources, Tinau, Nepal

## I. INTRODUCTION

This paper focuses on the sociological aspect of an attempt to integrate the socio-economic conditions of local people to the biological conditions and the dam (physical structure) of the river, an interdisciplinary approach in the field of natural resource management. A broader scale of interdisciplinary or multi disciplinary approaches, e.g., the ecosystem approach, are becoming recognised as essential in the emerging field for the holistic management for long-term ecological sustainability (Cortner, 2000; Szaro et al., 1998). This approach has recently been practiced to manage many small-scale rivers at watershed levels (Freeman and Ray, 2001). On the other hand, the case study approach has also been gaining in popularity as it links global and local environments in the context that 'a healthy biosphere is built upon healthy local environments' (Alfsen-Norodom and Lane, 2002). In either approaches the main focus has been given on the active participation of the local users and managers, i.e., an importance of local level initiative for the management of natural resources. In this way, the focus of study in the natural sciences is tending towards the human-dominated ecosystems from its traditional focus on nature or pristine ecosystem (Liu, 2001).

Damming of rivers may contribute to water pollution especially when they are not maintained to the water quality standards and it finally becomes responsible for the causes of health problem consequences (Donohoe, 2003). Public awareness about the quality of water and the causes of water quality degradation is necessary so that locals become able to utilize safe water for their household purposes. Strengthening human resources development by awareness creating programs as a part of integrated water resources management helps to satisfy the freshwater need in sustainable way (Radif, 1999). More public participation (or stake holder participation) in decision making directly or indirectly for the management of river resources is therefore a necessity (Abu-Zeid, 1998; House, 1999; Veelen and Zyl, 1995).

Environmental management problems mainly exist due to mismatch between different stakeholders, e.g., decision makers and locally affected communities (Faust and Smardon, 2001). It is, therefore, recommended that public participation should be given due consideration for an effective way to achieve sustainable development of the local community (Tran et al., 2002). Such problems also exist in the global context, and the participation of the scientists from a wide range of regions is essential to legitimise the global environmental assessments (Biermann, 2001). This is essential because the environmental policy successes in the developed countries cannot directly be used as guidelines for addressing the crisis in developing nations (Sankovski, 2000).

Nepal is one of the richest countries in the world in terms of fresh water resources attracting international attention as resources of world-class proportions (Gyawali, 1989). This statement is supported by having annual runoff from all rivers over 200 billion $m^3$ (Bhattarai et al. 2000). There is enormous potential for hydropower generation (35000 mw estimated out of which only 555 mw has been produced) but extremely uneven distribution of water resources across time and location does not allow us to use them easily (Bhattarai et al. 2000). Uneven distribution of the rainfall is also another cause for the difficulty in harnessing potential water resources efficiently (Thapa and Khanal, 2002).

The main purpose of the present study was to support the biological study carried out in parallel, about the effects of dam on the river water quality, from the sociological aspect. Therefore, following objectives were set for the investigation.

1. To investigate the river resources used by the local people and
2. Impacts of dam on the utilisation of these resources by the local people.

# II. METHODOLOGY

## 2.1 Selection of the Study Area

The present study has been carried out in the watershed of Tinau River, west Nepal. The river is originated from the watershed of fragile Himalayas called Mahabharat Range, Palpa district, Nepal. The river has high socio-economic values for the local people of the area in terms of drinking water, irrigation, fishing, cleaning, washing, bathing, and extraction of sand and stones etc. The study was mainly focused on interviewing the users of river in a stretch of 4 km where the dam is located. This site selection was mainly done to conduct the study in connection with the parallel biological study. The area has very rough terrain of the mountains due to which very less human settlements were located in this part of the river. This condition forced us to limit our survey to conduct interviews to the users who visited the area during our study period.

## 2.2 Data Collection

Information about the utilization of the river resources was collected through interviewing 30 local people visiting the river with a set of structured questionnaire data-sheet form (Annex 1). Information on the impact of dam on the utilization of river resources was also collected through the same set of questionnaire. Few related supplement questions were also asked for each question when it was felt necessary. Two group discussions were organised near the study area to know the perception of local people about the existing dam constructed in the river. Three key informants (guard of the hydropower plant, Ex-Chair Person of the Dovan Village Development Committee and a contractor for fishing in the area) were consulted to verify as well as to get more reliable information for the present study. Though much information can be gathered by using key informants, Bergeron et al. (1998) suggested that special precautions must be taken while using informants and their ratings regarding the reliability. Direct observations and informal discussions with other visitors were also employed during the present investigation period. In addition, secondary information was also collected to fulfil the purpose of the study.

## III. RESULTS

### 3.1 Background of the Respondents:

Out of the total 30 respondents interviewed, 90 % were male and 10 percent were female river users. Most of them (70 percent) were between the ages of 10-30 years. Fifty percent of the river visitors were just able to read and write but did not attend the schools (Figure 1). Educated people with the college education rarely found visiting the study area for direct benefits, e.g., fishing, sand and stone collection etc.

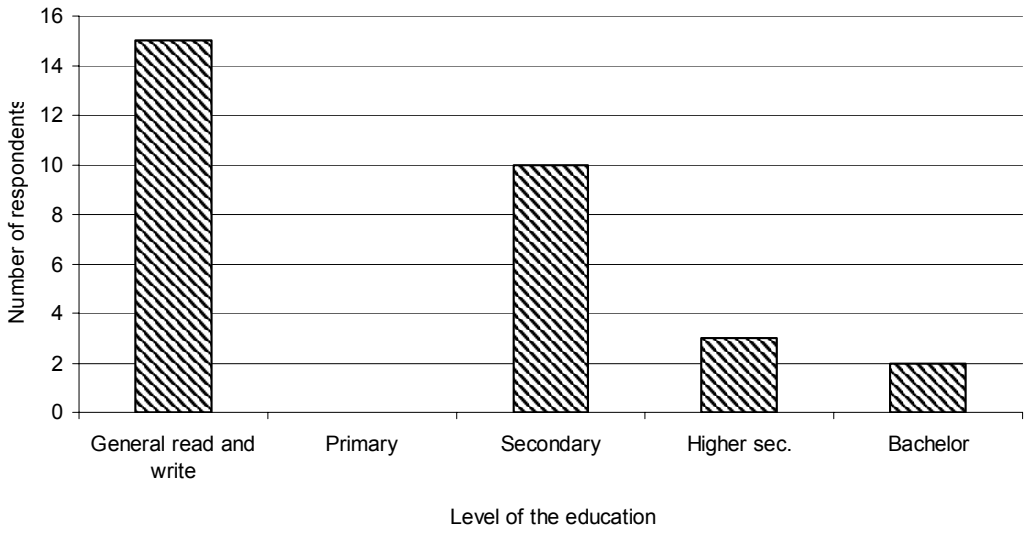


**Figure 1: Educational background of the respondents**

The main ethnic groups visiting the study area (those who were interviewed) belonged to Magar, Newar, Tharu, Chhetri, Bishwakarma, Brahman and Tamang (Figure 2). Professionally and occupationally, most of the users belonged to government services, students, and labourers. None of the surveyed people were found engaged in fishery or agriculture profession fully. This was the reason why none of the respondents reported their own fish farms.

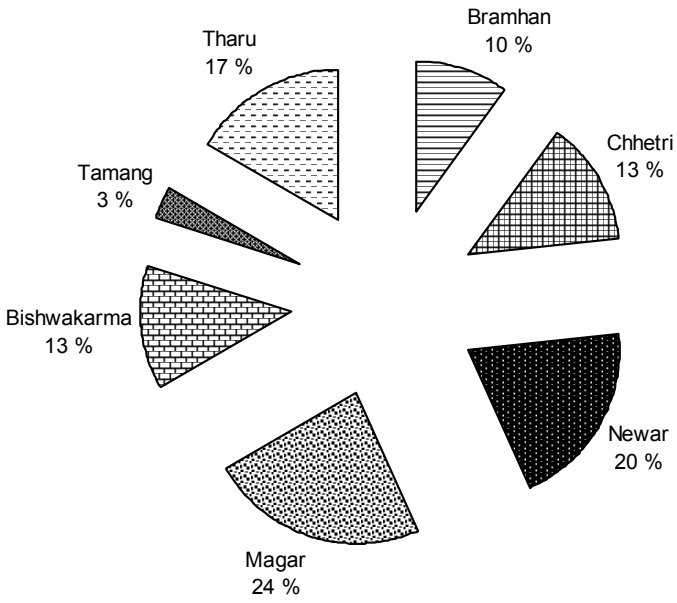


**Figure 2: Ethnic composition of the respondents**

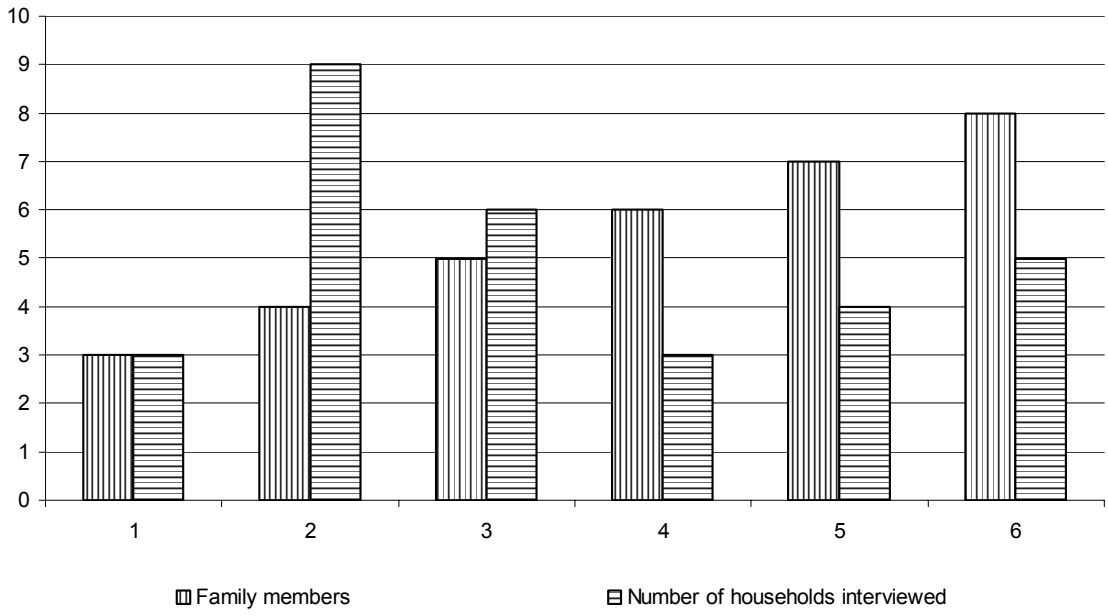


**Figure 3: Number of family members corresponding to the number of interviewed respondents**

A wide variation was found among the respondents regarding their family size that ranged from 3 to 8. Five respondents from lower class labourer groups were having 8 family members in each household (Figure 3).

Fifty seven percent of respondents fished in the river to utilize the catch for their own families. Twenty percent used river water for irrigation from nearby areas of the study area. The main materials used for making dykes to divert river water to their farm were stones and tree branches. The respondents had no knowledge of the existence of other dams in the area.

### 3.2 Locally Available River Resources

#### 3.2.1 Sand and Stones

Forty seven percent of the respondents were using sand and stones for domestic purposes, e.g., construction of houses, trails, fences etc. Forty percent knew about the extraction of sand and stones from the river though they did not directly involve. Similarly, 30 % did not extract the sand and stones from this area. Thirty three percent of users extracted sand and stones from nearby areas whereas 20 % are using these things from the market. It was said that local people themselves were engaged in extraction of these materials (57 % of the respondents agreed). One of the key informants mentioned that sand and stones were extracted by the contractors to sale in the market for which they had to bid in an auction organised by the local government. The extraction of sand and stones were prohibited from infrastructures like bridges, roadsides, and dams etc. a key informant (ex-chairman of VDC) mentioned.

#### 3.2.2 Fishing: Who, Where and How?

Two third of the respondents were fishing in the river whereas one third of them did not fish at all. It was reported that no one was using other places for fishing, e.g., paddy fields, ditches, swamps and ponds etc. Most of the respondents had sufficient knowledge of fishing implements used in the river. Hundred percent of them knew the hook and line, 93 % were aware of the electric fishing, 77 % had the knowledge of cast net and hammering, 73 % knew poisoning activities, 37 % knew about dynamiting, 27 % knew duwalo thunne (divert the channel for fishing), and only 10 %

responded positively towards Khunga (made of bamboo) as the fishing implements used in the river (Figure 4).

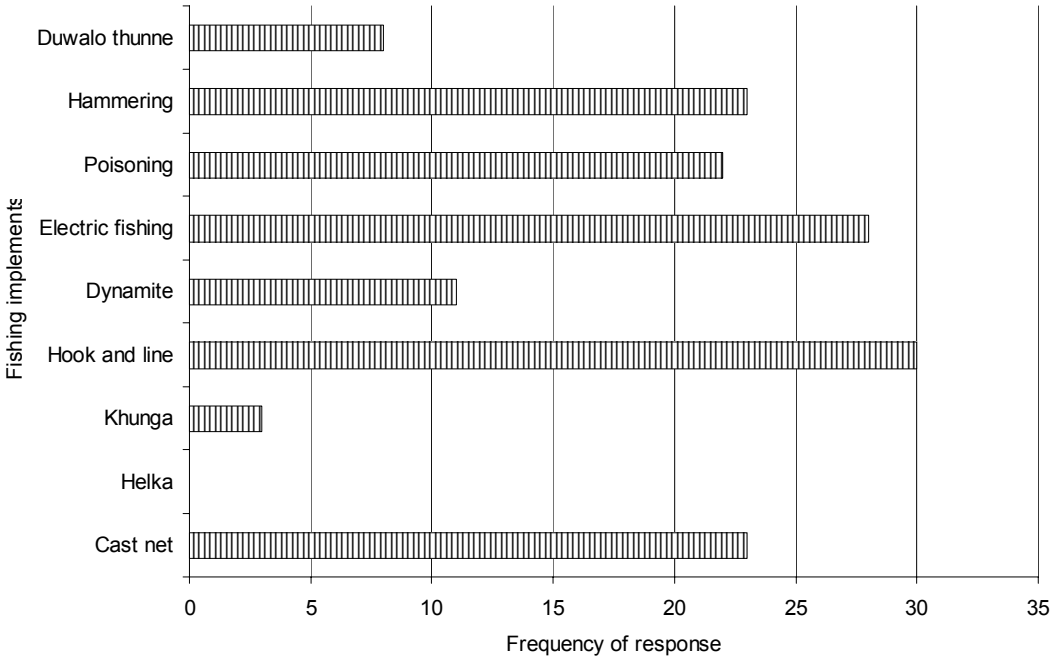


**Figure 4: Local peoples' knowledge about the fishing implements used in the river**

There were some special fish collecting vessels like Dhadiya (a special kind of bamboo basket) and seel (a rope of wire), besides most common things like bags of any kind and buckets.

The most dominant group of people fishing in the river were adult men. There were overlapping responses from the people regarding the frequent visitors for the purpose of fishing. Ninety seven percent of the respondents agreed that men are engaged in fishing. Similarly, 40 % mentioned as children and 13 % as women involve for the fishing activities in addition to men. The total time spent for fishing activities vary considerably depending on who were engaged in the fishing. Generally local people spent 1 to 2 hours in fishing whereas professional fishers devoted more time.

Sixty percent of the respondents were unaware of the place where they could get the maximum catch but others felt that the stone crevices and pool regions, which they thought as breeding places for fishes, were the good places for getting maximum catch. Thirteen percent had a preference for fishing below the dam. Fifty seven percent agreed that they preferred Sahar fish (*Tor sp.*), 37 % like Buduna fish (*Garra*

*sp.*) and the rest prefer Rohu (*Labeo sp.*). All respondents had a common voice for the good fishing season that was April. Most of the people, who involved themselves in fishing, utilized their catch for their own consumption and did not sell the catch in the market.

### 3.2.3 Local Perceptions of the Dam Building

All interviewed respondents had known about the existence of hydroelectric dam in the study area. Most of them (80 %) were happy with the dam and the rest (20 %) were not so happy. It was found that the benefits to the local people from the river were: cleaning and washing, drinking, fishing, irrigation, extraction of stones and sand, and recreation etc. Thirty seven percent agreed that there is no difference in benefits they get today and they used to get before the establishment of the dam. But three percent did not know about all these benefits before the establishment of the dam mainly because they born after the establishment of the dam. Most of the respondents (83 %) felt that there was no reduction in the water level downstream to the dam but 13 % answered negatively; and the rest did not know.

Thirty three percent did not feel that dam was causing harm in the upstream migration of fishes. Eighty percent felt that there was no reduction in the total fish catch before and after the establishment of the dam. Twenty percent suspect the use of poison might be the main cause for reduction in the total catch in fish, if any. There were very few (7 %) who regarded dam as the cause for change in the amount of fish catch.

### 3.2.4 Managing the Resources Locally

Local people were very much conscious about the river resources and their benefit to them. They were involved in the management of existing resources through the local government, the Dovan Village Development Committee (VDC). Their direct involvement was mainly found in the management of river resources like fishing activities, sand and stones collection. The VDC did not provide free access for the sand and stones extraction and fishing activities. There was a provision of collecting a fee of Rupees 50 per day for the fishing throughout the day. Thus collected revenue would be the property of VDC that could be used for the development activities in the

area. Fishers from outside also reported to visit the area for fishing thus contributing in the income of the VDC. Fishers were not allowed to use the destructive methods of fishing, e.g., poisoning, electro fishing and dynamiting. Village Development Committee was the authorised body for monitoring these activities (personal communication to the VDC authority).

## IV. DISCUSSION

The need for an ecosystem approach towards the management of natural resources has been felt necessary in a way that can bring scientists, managers and public together to share an integrated understanding of the environment (Szaro et al., 1998). For the conservation of natural resources, appreciation of local peoples' values is essential in addition to the ecological understanding (Ryan, 1998; Tran et al., 2002). Local people's involvement in the present study in the management of river resources (for example, sand and stone collection and fishing activities) shows that traditional management practices have been influenced towards the scientific approach of participation.

The negative impacts of the Tinau dam on the utilisation of river resources were very small. Most of the surveyed people were happy with the establishment of hydropower dam because the positive side outweigh the negative impacts. Besides dam, they have their own kind of perception for the fishing implements used in the river. Their awareness towards most of the destructive fishing techniques, e.g., poisoning, electro fishing and dynamiting etc. gave some hints about the existence of these fishing methods in the area. The blame to these methods (mainly poisoning) for the degradation of river water quality (if any) by the locals could be described as their positive attitude in managing the river resources in a good way.

The most important and direct benefits of the river to locals were sand and stone extraction and the fishing activities. But it is also true that river water was used for drinking and other household purposes but locals do not count them for monetary-value, which they consider as a natural good. The valuation of natural resource differs according the valuators who try to valuate from their own perspective and perception (Lansing et al., 1998; Szaro et al., 1998). Some professional fishers visit the area and spend the whole day and rest are locals (mostly men) who generally devote few hours for fishing activities. The fishing in the breeding places, as mentioned by few respondents, though increase the catch for a day will prove harm for the future catch because such a practice destroys fingerlings if they use harmful fishing methods. The most delicious fish of the river include Sahar (*Tor sp.*), Buduna

(*Garra sp.*) and Rohu (*Labeo sp.*) from local peoples' views. There is really not controversy in the best fishing season, which is April.

There are some problems in the dissemination and application of study reports carried out by the professionals. In most of the cases professionals write the study reports for themselves and there is a dissemination problem to reach the report to the decision makers that makes the implementation (and management) difficult (Alton and Underwood, 2003). Such kind of scientific study for the management of surface water quality has just begun in Nepal and the government has set up the criteria for releasing waste water and industrial effluents into the surface water recently (MOPE, 2002).

Co-management believes in creating a collaborative institutional arrangement among diverse stakeholders for managing and sharing common property resources (Castro and Nielsen, 2001; Notzke, 1995). Despite its sound logical and democratic views, the anticipated outcomes of the co-management were surprisingly low (Kearney, 2002). Conflict management over the natural resources by co-management agreements among the local people and the government agencies in a participatory and equitable manner seems a promising way of dealing; but it further worsen the condition by marginalizing the local people in the context of South Asia (Castro and Nielsen, 2001). The river resources, in the present context, were managed by the local people through the local government. This kind of management practice can be put somewhere in between top-down and participation approach continuum.

## V. CONCLUSION

The management practice in the study area is tending towards a participatory approach through local government. The results of this study indicate that people have been deriving resources from this river for a long time and there is no significant impact on the utilization of these resources due to the establishment of the dam in the river. The bad practices of the fishing methods such as poisoning, electro-fishing, and dynamiting are serious problems that can degrade river water quality which in turn may affect the health of the local people who are utilizing the river water for drinking and other household purposes. The important direct benefits are the extraction of sand and stones; and the fishing from the river resource. Other benefits like drinking water, irrigation, washing and bathing etc are equally important though they do not get monetary value for the locals. As a final statement, regular monitoring for the water quality, accumulation of a good scientific data and dissemination of such studies for the planning and management of river resources are necessary for the good governance locally.

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**Annex 1: Research on the Effects of Dam on the Whole River Integrity**

QUESTIONNAIRE DATA –SHEET FORM

Date:

V.D.C.: Ward: Tole:

Personal Background:

1. Age group
   below 10 yrs 10-20 yrs
   21-30 yrs 31-40 yrs
   41-50 yrs 51-60 yrs
   60 yrs above

2. Sex: Male/Female

3. Ethnic Origin:

4. Education: General reading and writing: ———————————
   School: Primary/Secondary/ Higher Secondary
   College: Bachelor/Masters
   Other (Specify): ———————————

5. Occupation: Farming Fishing
   Labour Service
   Others (Specify)

6. Family Size:

7. Agricultural Background

7.1 Do you have your own fish farm? Yes/No
If yes, Size:
Which kind of fishes do you produce?

If no, do you fish in the river? Yes/No

7.2 Do you utilize river water in irrigation? Yes/No

If you yes,

Where did you build the dam?

Is the dam permanent or temporary?

If permanent, how much water flows in the canal (in $m^3$)?

Did you see any fish in canal? Yes/no if yes, can you give the names?

Can you guess the number of such dams in the river?

If the dam is temporary,

Which materials are you using to build the dam?

Do you feel that such dams have some effects on the number of fishes present?

7.3 Do you take stones/sand from the river? Yes/no

If yes, from where do you extract more?

If no, what kind of people are involved in such activities

8. Where do you catch your fishes?

– Paddy fields – Rivers

– Ditches – Swamps

- Others (Specify)

Fishing Techniques and gender involvement in fishing :

9. Which kind of fishing implements do you use?

| Fishing implements used | Place of use |
|---|---|
| Cast net | |
| Helka | |
| Khunga | |
| Hook and line | |
| Dynamite | |
| Electric fishing | |
| Poisoning | |
| Hammering the stone | |
| Others (Specify) | |

10. Collecting vessels:

– Dhadiya – Pans

– Bucket – Others (Specify)

11. Who are most involved in fishing?

Men/Women/Children

12. Which age group of men/women/children most involve in fishing?

13. How much time do you devote in fishing in a day?

14. From where do you get the maximum catch?

15. How do you utilize the rest time period?

16. What is the most preferred fish for you?

17. What is the best fishing season?

18. Who are involved in fishing in your family?

Questions related to Dam:

19. Do you know that electricity is generated in Tinau River? Yes/No

20. Are you happy with this dam? Yes/No

21. What kind of benefits did you get from the river before the establishment of the dam?
- Cleaning/Washing
- Irrigation
- Fishing
- Stones/Sand
- Recreation/swimming
- Others (Specify)

22. Is there any difference in those benefits after the establishment of dam? Yes/No

If yes, what are the differences? Can you explain?

23. Is there reduction in water level to down stream?
Yes/no/ do not know.

24. How many kinds of fishes do you know? Can you give names?

25. Do you know extinction of fishes/or change in number due to the construction of dam? Yes/no
If yes, can you give names?

26. How many fishes could you catch before the establishment of dam?

27. Can you catch the same amount of fishes at present?Yes/no

28. Is your income from fishing sufficient to your family? Yes/No

29. How do you utilize your catch?
- Utilize in the family
- Sell to the broker

- Sell to the market by myself.
- Used to produce new technology in fish production.
- Others (Specify):

30. Which kind of fishes are the preferences of customers?
- Carnivorous
- Herbivorous
- Others (Specify)

31. Do you have knowledge of long distant migratory fishes? Yes/no

If you yes, can you give names?

32. Do you believe that the dam has negative effects on these fishes? Yes/no

If yes, what may be the reason?

(e.g. obstruction of the way etc.)

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