

# **The Role of Small Diesel Engines in Rural Bangladesh During the 1998 Flood**

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## ***Abstract***

*Bangladesh faced its worst flood in the recent history in 1998. During this flood was that the water level got almost stagnant in large areas of the country for a long period of time. This study is a part of the post-flood research works carried out to assess the effect of flood, focusing on small diesel engines used specially in rural Bangladesh. Most of the small diesel engines are used for irrigation purpose in non-electrified areas of Bangladesh. The damages were found to be far less compared to their electrical counterparts in such applications. The study results showed that small diesel engines, although being easily transportable, were still vulnerable to sudden rise of water levels during flood. This was most apparent in areas which were completely inundated, leaving no safe ground. In most cases such engines were damaged only partially, as the users applied various indigenous techniques to protect them. Lack of funds, rather than spares or expertise, was found to be the major cause hindering the repair of partially damaged engines. Although some of the users made alternative uses of the engines, mostly engines were unutilized resulting in loss of productivity. The situation was, however, different in areas moderately affected by flood. In these areas most of the engines were moved to safety and many of them were used for alternative purposes e.g., in mechanized boats.*

## **INTRODUCTION**

Bangladesh faced its worst flood in the recent history in 1998. This devastating flood affected 49 out of the 64 districts of the country. The worst aspect of this

flood was that the water level got almost stagnant in large areas of the country for a long period of time. In some worst effected areas the floodwater remained for a period of up to 74 days, starting from end of June to the end of September, brining catastrophic consequence to life and property. About a million households were damaged or destroyed and crops of about 1.4 million acres of land was ruined. Even conservative estimates showed that the flood affected about 2.5 million people. About 16,000 km of road networks, 4,500 km of river embankment and thousands of culverts and bridges were damaged. Although the water level did not cross the 1988 mark (the other devastating flood in recent history of Bangladesh) in many cases, the long duration made the 1998 flood one of the worst natural calamities the country has ever faced. Preliminary observations have suggested that unusual rainfall both in amount and distribution pattern inside the country, as well as in the upstream areas of the major rivers were primarily responsible for the flood in 1998.

After the flood, various government and non-government organizations carried out research works to assess the losses suffered by the various sectors during the flood. These research works were aimed at getting a clear picture of both short- and long-term losses caused by the flood, as well as suggesting policies/options for avoiding such losses in the event of a future flood. The present research work is such an effort, carried out by Bangladesh University of Engineering and Technology (BUET), where the role of small diesel engines in rural Bangladesh during the 1998 flood was investigated.

## **OBJECTIVES**

Small diesel engines are used for multiple purposes such as irrigation, rice-mills, power generation and transportation in rural areas of Bangladesh. In regions experiencing quick rise of floodwater many such units have been damaged. On the other hand, many engines have been used for alternative purposes during the flood. The two major objectives of this study were: (i) to assess the damage of diesel engines and the resulting productivity loss in some flood-affected areas, and (ii) to assess the alternative use of diesel engines in the flood-affected areas.

## **METHODOLOGY**

The project team consisted of one co-coordinator, an advisor and two field researchers. The team carried out the survey from the end of October until mid December 1998 in various parts of rural Bangladesh. Taking into consideration the limitations of time, fund and logistics, especially during the post-flood period,

the survey work was carried out only in the worst affected regions where floodwater rose significantly above danger level (FFWC/BWDB, 1998). Nearly one hundred and fifty engines were inspected in twelve districts. Figure 1 shows the worst affected regions where engines were inspected. Instead of relying on information supplied from the government offices or company dealers, first hand information were gathered from the users to ensure reliability of data. This also helped in getting a better understanding of the role of these small diesel engines in the rural life of Bangladesh.

### **Preparation of the Questioner**

First a model questioner was developed for gathering necessary information and the field research workers visited few engine sites with it. As most of the end users of the small diesel engines are illiterate people, the inspections needed to be carried out in most informal manner and often the field researcher had to fill up the questioner on behalf of the users. Some modifications were made in the questioner, taking into consideration the feedback from the preliminary field visits. The questioner included the following:

#### ***Location Information***

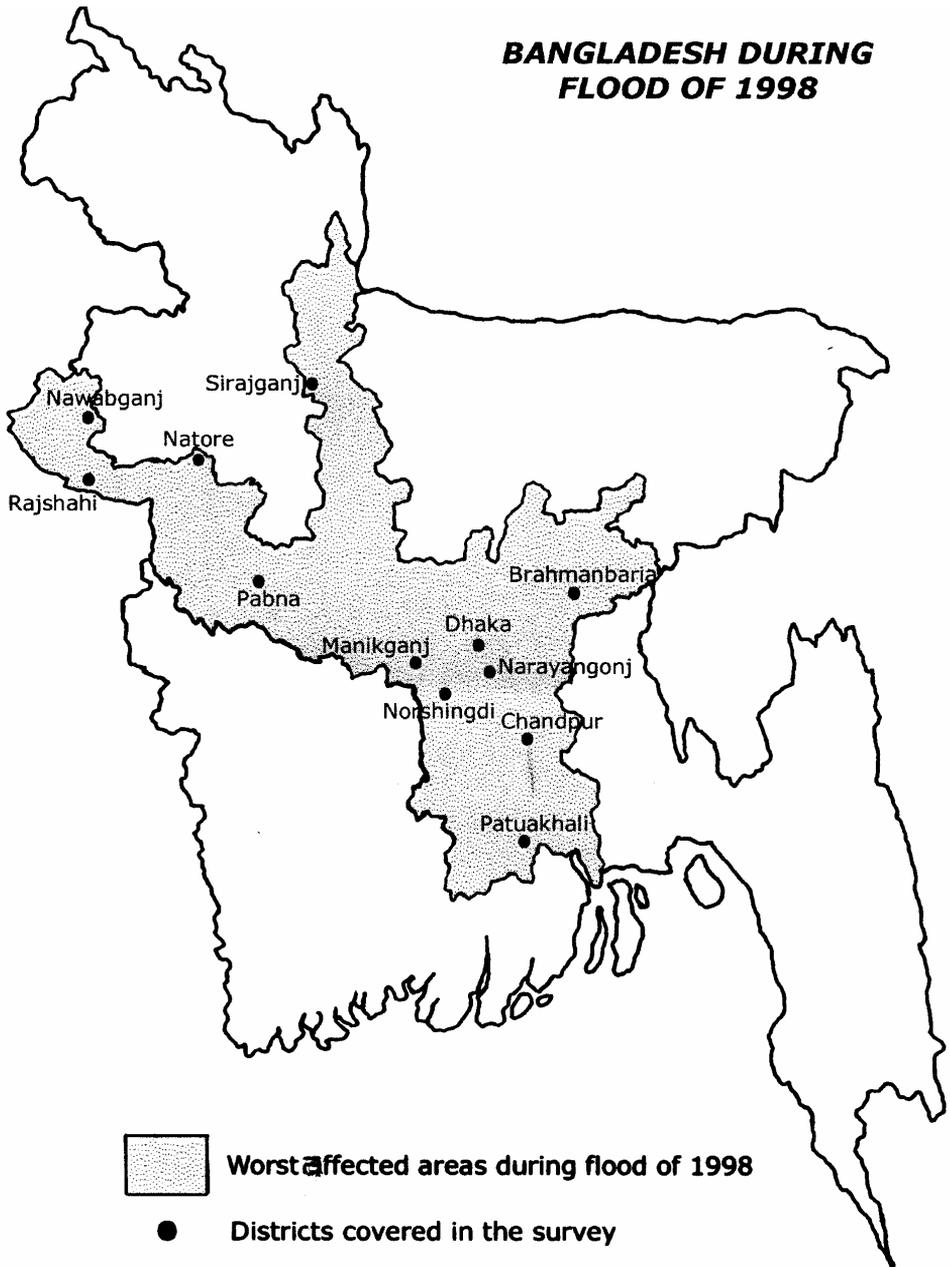
These included: (i) Name of village/town, post office, upazilla, district; (ii) Details of how the engine was mounted, portable/stationary fixtures, etc.; (iii) Brief history of flood in the location, when the water level rose and when receded, rate of rise/fall of floodwater, duration and approximate height of water level, comparison with 1988 flood level, etc.; (iv) Whether the area has electricity; (v) General geography of the location.

#### ***User Information***

These included: (i) Name and address of the user/owner; (ii) When was it bought and in which condition - new/reconditioned/used; (iii) how the maintenance of the engine is done; (iv) The intended purpose of the engine; (v) Alternative use (if any) of the engine during the flood.

#### ***Engine Information***

These included: (i) Rated engine power and speed; (ii) Brand name, model number, country of manufacture; (iii) Number of cylinders and engine dimensions; (iii) Availability of spare parts and maintenance schedule; (iv) Fuel consumption and fuel cost; (v) Repair costs and difficulties (if any).



**Figure 1: Location of the districts covered in the study**

## Data Collection

The field researchers collected data from different worst affected areas of the country. The small diesel engines are mainly used in rural areas where there is no electricity. Due to time and resource constraints, only a limited number of spots could be covered. In spite of these limitations, efforts were made to cover areas throughout the flood-affected region. Data on a total of 147 engines were collected from twelve flood-affected districts.

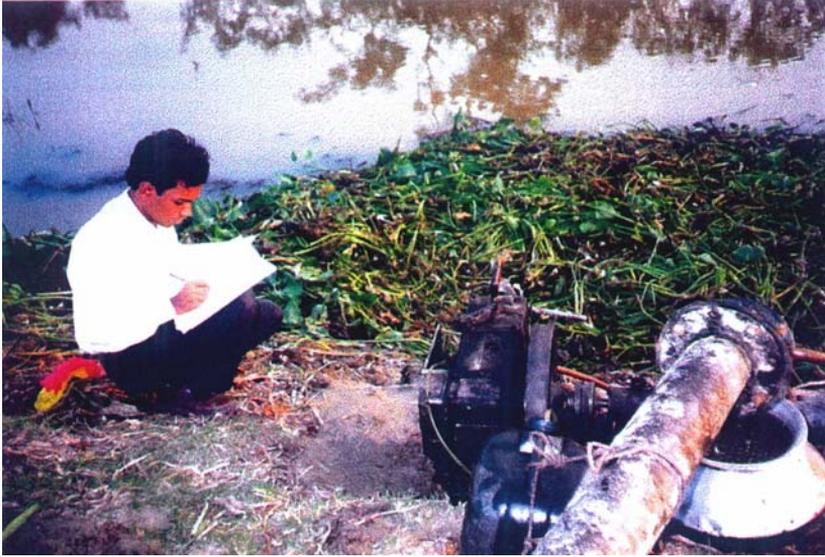
In the data collection procedure, the first step in each trip was to identify areas where the diesel engines were affected by the flood. Local engine repairing workshops, district BADC offices and public representatives like union chairman/members were found to be good sources of such information. Once the prospective areas were identified, the research engineers visited the engine sites (often in very remote areas which they had to reach on foot or by using country boats) and gathered first hand information from the users, who were very cooperative. The technical data of the engine was taken from its nameplate in most cases. The users also gave information regarding the productivity loss, repair cost and alternative use of the engines during the flood. Figures 2 and 3 show damaged engines at Chandpur and Manikgonj, respectively. Figures 4 and 5 show alternative uses of engines during the flood.

## FINDINGS OF THE STUDY

The results of the survey are presented in Figs. 6 through 12. Figures 6 through 8 show different aspects of the 1998 flood in the worst affected areas. Nearly half of the engine sites were flooded for 8 to 12 weeks. The peak water level in the flood affected areas reached as high as 20 feet from the ground. Although the water level reached unusually high levels, in many places these were similar to the levels reached during the 1988 flood. Although the people of Bangladesh are used to limited flood during the rainy season, it was the unusually long duration of the flood that caused the devastation in 1998.

Figures 9 through 12 show the effect of flood on the small diesel engines throughout rural Bangladesh. Figure 9 shows the district wise distribution of the inspected engines. The number of engines affected by the flood increased as more and more area became flooded, starting from the beginning of August and continuing to the end of September. During this period almost all the sites were affected.

Most of the engines used had rated power of 5-10 hp with rated speed near 2000 rpm. Although having good transportability, more than 80% of the engines suffered at least partial damage during the flood period. This was partly due to unexpected quick rise of water level, which the owners were not prepared for, and partly due to the unavailability of any dry ground at all in many sites.



**Figure 2: Inspection of a damaged engine that was used for irrigation in Chandpur**



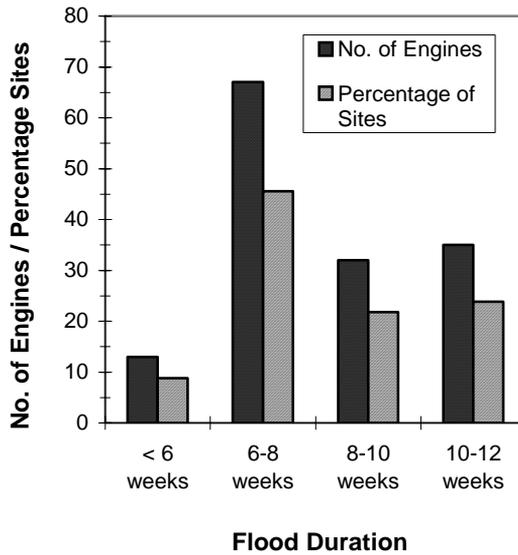
**Figure 3: A partially damaged engine in Manikgonj**



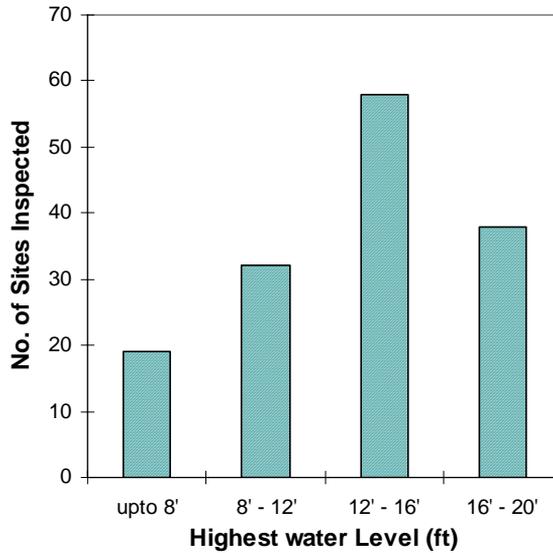
**Figure 4: Alternative use of an engine in a rice mill in Narshindgi**



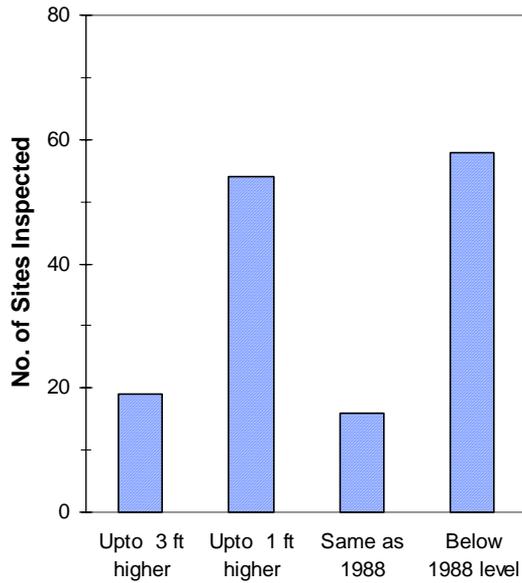
**Figure 5: Alternative use of an engine in a rice mill in Patuakhali**



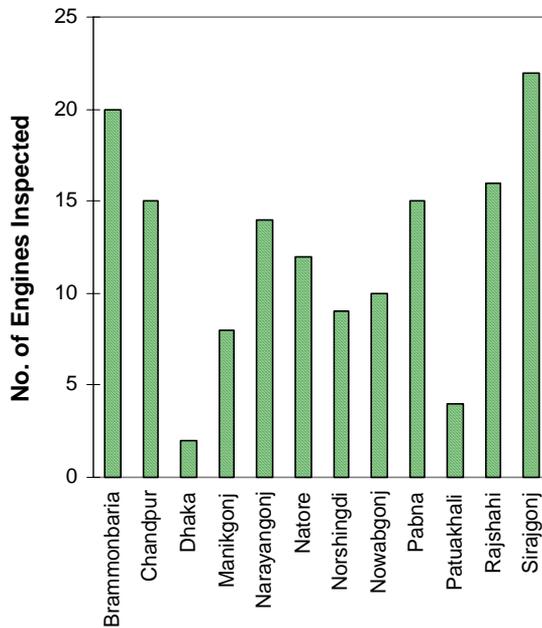
**Figure 6: Duration of the 1998 flood at the inspected sites**



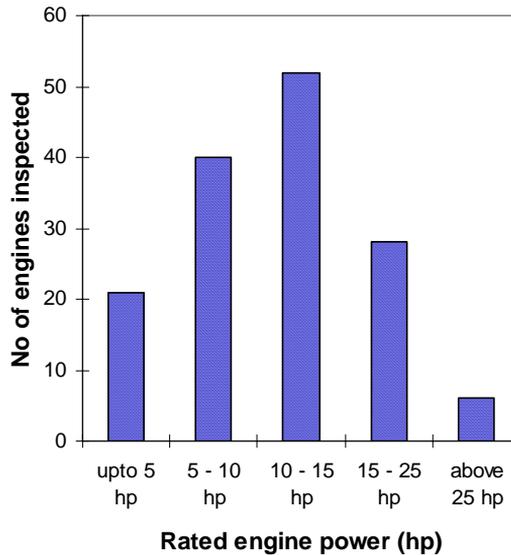
**Figure 7: Peak water levels recorded at the inspected sites**



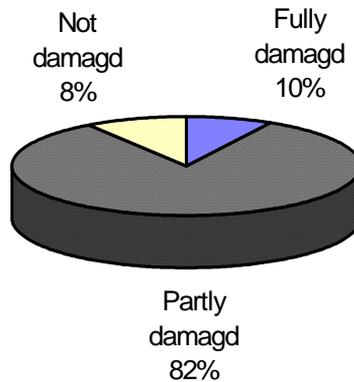
**Figure 8: Comparison of the flood situation in 1998 with that in 1988**



**Figure 9: District-wise distribution of inspected engines**



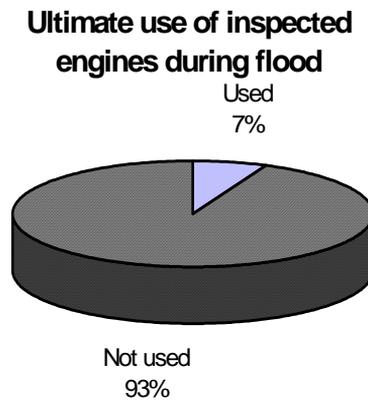
**Figure 10: Distribution of rated engine power**



**Figure 11: Damage analysis of inspected engines**

Most of the small diesel engines are used for irrigation purpose in rural areas without electricity. These are seldom used in areas with electricity, where electric motors running deep tube-well pumps are common. Such electric motors suffered even more damage during the flood. Most of the diesel engines in worst affected areas were not used during the flood (see Fig. 12), although at some places these engines were used for different purposes (see Figs. 4, 5). The main alternative

use has been in small rice mills. But most of the partly effected engines could not be repaired during the flood and many were still out of order due to lack of funds. In worst affected areas, cases were recorded where engines were saved by placing them on top of boats, but could not be used as the owner with his family was also stranded on it. This situation was however different in moderately affected regions where such engines were effectively used in mechanized boats and for other purposes. In this study, the estimates of loss of productivity have been calculated from the owners/users information.



**Figure 12: Ultimate use of inspected engines**

The important findings from the survey carried out can be summarized as the follows: (i) The study was limited to the worst affected areas where large rise of water level was experienced; (ii) A total of 147 engines located in 12 districts were inspected in this study throughout the worst flood-affected areas; (iii) The duration of the flood was different at different places; (iv) Water levels as high as 20 ft above ground level was recorded; (v) The 1998 flood exceeded the 1988 flood mainly in respect of duration; (vi) Diesel engines are mostly used in rural having no electricity; (vii) Most of the engines are used for irrigation purpose, although there are some other uses; (viii) The small diesel engines mostly have rated power of less than 20 horse power; (ix) The price of fuel varies from Tk. 13.7 to 15 per liter, depending on location; (x) These engines are in most cases maintained by mechanics from nearby town and spare parts are generally available; (xi) Most of the engines are imported and Chinese brands constitute the bulk of these engines; (xii) Although these engines generally have easy transportability, most (above 80%) suffered partial damage during the rapid rise of floodwater in the worst affected areas; (xiii) Although for most engines, the

degree of damage was limited and some were effectively protected from flood, in worst affected areas only about 7% of the engines could be used for productive purposes during the flood. The situation was different for moderately affected regions where such engines were effectively used in mechanized boats and for other purposes; (xiv) Repair costs for most of the partly damaged engines have been estimated at about Tk. 2000-5000/-. In many cases, lack of availability of funds for repairing kept the engines out of order even after the flood; (xv) Approximate daily productivity of most of such engines ranged between Tk. 100-300/- per day, which was lost in most cases during the 1998 flood.

## **CONCLUSIONS**

The small diesel engines although being easily transportable, are still vulnerable to sudden rise of water levels during flood. This is most apparent in areas completely inundated, leaving no safe ground. In most cases such engines were damaged only partially, as the users used various techniques to protect them. Many of the damaged engines could not be repaired, even after the flood, mainly due to lack of funds. Most of the engines in the worst effected areas were out of use during the flood resulting in loss of productivity. Some of the users however made alternative use of the engines, mostly in small rice mills. The situation was different in areas moderately affected by the flood. In these areas most of the engines were moved to safety and many of them had alternative uses especially in mechanized boats. Most of the small diesel engines are used for irrigation in rural areas without electricity. The damages to the diesel engines were found to be far less compared to those suffered by electric motors that were in use in the flood-affected areas with electrical connection.

## **REFERENCES**

FFWC/BWDB (1998) Total Flood Situation 1998, Bangladesh Water Development, Dhaka.