BUREAU OF INDIAN STANDARDS
DRAFT FOR COMMENTS ONLY

भारतीय मानक मसौदा

बाढ़ से हुई क्षति का निर्धारण करना — दिशानिर्देश

(IS 13739 *का पहला पुनरीक्षण*)

Draft Indian Standard

ESTIMATION OF FLOOD DAMAGES — GUIDELINES

(*First Revision of* IS 13739)

ICS 93.160

Water Resources Planning, Management and Evaluation Sectional Committee, WRD 06

Last Date for Comments: 02/11/2025

FOREWORD
(*Formal Clause of the foreword will be added later*)

Occurrences of flood damages is a natural phenomenon and man had to cope with flood situations from the very beginning. Floods have ravaged portions of India from time immemorial even before the population of India grew up and economic activities developed, Earlier, the flood waters spread over the flood plains, flowed back to the streams/rivers and emptied into the sea in course of time without causing much of problems. However, as human settlements started growing close to the riverbanks and with increased population pressure and greater economic development, more and more of the flood plains got occupied leading to adverse flood effect being felt in an acute manner by people. Flood hazard is thus a dynamic quantity as it changes in response both to the magnitude of the flood event and to the nature and scale of the development on the flood plain.

This standard was first published in 1993. This revision has been brought out to bring the standard in the latest style and format of the Indian Standards. In addition, clause 4.2 has been modified to include new sampling techniques such as the use of satellite maps and drone surveys to cover large areas of flood damage.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Draft Indian Standard

ESTIMATION OF FLOOD DAMAGES — GUIDELINES

(*First Revision of* IS 13739)

Water Resources Planning, Management and Evaluation Sectional Committee, WRD 06

Last Date for Comments: 02/11/2025

1 SCOPE

This standard lays down a detailed scientific procedure for collection of flood damages (other than loss of human life) data under various categories and also methods of translating them to monetary terms. It also recommends methods by which indirect flood losses could be estimated in monetary terms.

2 CONCEPT OF FLOOD DAMAGES

Flood damages may be defined as all adverse effects caused by rising stage and spilling of water over the banks of rivers in an area, such events occurring at times and in magnitudes that cannot be predicted accurately, and as a consequence of which the serviceability of properties is impaired or lost and by which productive or service activities and processes are delayed or interrupted. These damages may be caused by rivers, canal breaches and rainstorms, inundating the adjacent areas. The nature and quantum of the damage depends upon the season, frequency, duration and intensity of the flood.

3 CLASSIFICATION OF FLOOD DAMAGES

Damages caused by the flood can be broadly, categorized into the following:

a) Agricultural crops;
b) Private and public properties;
c) Business and other secondary activities;
d) Spread of epidemics, ill health and loss of livestock; and
e) Fear, anxiety and distress.

4 DAMAGE TO AGRICULTURAL CROPS

4.1 General

In India, agricultural crop damages constitute the major portion of the total flood damage. Since such damages would obviously be the basis for the benefit-cost analysis of flood protection measures, it is important that data on crop damage is collected on scientific basis. To devise a scientific method of data collection and

evaluation, it is necessary to identify the influencing factors and understand the process by which damages are caused. Crop damages due to floods are influenced by area, location and crops affected; the timing, duration, depth and other physical characteristics of the flood. Because of variations in some of these influencing factors, the impact of flood is not uniform over the entire crop area affected by a flood.

4.2 Methodology of Data Collection

The standard methods of data collection are either through complete enumeration or through sample surveys. The methodology based on sample surveys, is however normally adopted and followed. This involves an elaborate procedure under which the states are divided into zones on the basis of their exposure to flood risk and subsequent selection of sample villages large enough to provide a fairly accurate estimate of crop damages. The field work involves past flood, pre-flood, inter-flood and post-flood enquiry. The damage data of the selected village is then to be used to make an estimate of crop damages for the district or part of the district concerned. Such sampling techniques be applied only under expert statistical guidance. Surveys and Sampling of affected areas should be carried out using modern techniques and tools such as use of Drones and the latest Satellite maps, to assess the damages more correctly.

4.3 Field Investigation

The actual field work to be carried out may be categorized into four distinct parts:

a) Primary Investigation into the nature of plots;
b) Pre-flood enquiry;
c) Field work during floods; and
d) Assessment of damages.

4.3.1 *Primary Investigation into the Nature of Plots*

The initial work should be started prior to floods with the identification of plots, their nature and the respective respondents with the help of the cadastral maps of the village and the field registers. The respondent is the person who takes the responsibility for carrying out the operations in the field and who would give as accurate information as possible; he might be an owner-cultivator or a tenant cultivator. The main classes according to the nature of plots are listed below:

a) Cultivable;
b) Cultivable waste;
c) Orchards;
d) Residential;
e) Ponds or tanks;
f) Bushes and pastures;
g) Public institutions and parks;

h) Rivers, drains and embankments;

j) Religious institutions;

k) Roads and railway lines; and

m) Others.

A plot might fall under more than one class, or more than one respondent may share a sample plot. In such cases, the subplots are duly numbered serially.

4.3.2 *Pre-Flood Enquiry*

Pre-flood enquiry is made to have a typical picture of the cropping pattern and the dates of sowing of the crops. Apart from the identification particulars such as the area of the plot, the proportion of the area under different crops, information regarding the aspects listed below should also be collected.

4.3.2.1 *Date of sowing of crops*

This information is necessary because of the distinction between damages to crops and losses (in respect of crops only) to the cultivators. Damage to crop constitutes the complete non-recoverable loss, which would have otherwise been produced had there been no floods. However, as the crop has been damaged by floods, it is not required on the part of the cultivator to spend anything more on the land on operations like harvesting, threshing, etc. Thus, the actual loss to the cultivator is the value of the crop (now damaged) minus the cost he is not obliged to incur, on further operations in the field. The loss is thus always less than the value of the damaged crop. Given the age of the crop at a point of time, it is possible to determine roughly the various operations so far undertaken by the respondent as well as those yet to be carried out. Deducting the approximate cost of operations which would have been undertaken in the absence of floods from the total value of the crops damaged, the loss to the cultivator can be worked out. Such is the case when the plot is not resowable with the same or some other crop in the same season. If it is resowable, the cultivator obtains the yield due to him for the season and the loss to him is the cost he has incurred in growing the previous crop up to the stage of its damage. In either situation, only this actual loss should form the basis for any compensation by the Government. A person who has just started growing his crops cannot be equated for purpose of compensation with another whose plots bear pre-harvest ripe crop, if both had their crops damaged in floods. Hence, the age of the crop is vital information to be collected. The age of the crop is reckoned from the time of the germination of the seeds. For transplanted crop, however, the age is to be considered from the date when the seedlings sprouted on the seedbed.

4.3.2.2 *Whether transplanted or broadcast*

Usually the yield rate of transplanted crop is higher than that of the crop by broadcast, by nearly 16 to 20 percent. Hence with equal area grown under transplanted paddy and broadcast paddy, the damage is more in the case of the former and as such this information should be collected.

4.3.2.3 *Crop season*

There is a season for every crop according to the time of sowing and harvest; for some crops, there are two seasons. Sometimes the crop season permits re-sowing or re-planting of the later than a certain specific time. The crop season does have some effect on the possibility of the recovery of the crop, depending on the time of the occurrence of floods. Also the time of the occurrence of floods has a great effect on the magnitude of the damage caused. An early flood may allow for a period for regrowth and save the agriculturist from some loss, whereas a late flood when the crops are near mature may cause complete loss.

4.3.2.4 *Normal yield*

This is the crop yield of the plot under normal conditions when there are no floods and when agricultural operations are not hampered by adverse weather. Normal yield for various crops is usually estimated by the agricultural university of the region and notified by the revenue authorities of the district for the various areas falling within their jurisdiction. The normal yield figure is usually revised once in 10 years so as per procedure laid down in the manuals of the respective state administrations.

4.3.2.5 *Miscellaneous*

Pre-flood enquiry also seeks to investigate the expenses for the various inputs incurred by the respondent on his plot. This involves repeat visits to the cultivators' homes. The main objective is to ensure that at the time of the onset of the flood, the answers to the questionnaire are up to date; enumerating all operations thus far undertaken in the field and presenting the amount spent on them, operation-wise, right from the stage of preparation of the soil. The human labour, both self and hired, and animal labour are to be separately evaluated, if necessary, by estimation. The expenses incurred on seeds, seedlings, manures, fertilizers, pesticides, etc, are also to be obtained in separate columns designated for the purpose.

4.3.3 *Field Work During Floods*

The main field work during floods consists of the drawing of flood lines on maps; the measurement of the depth of floods and recording duration of flood water in the fields. Recurring floods increase the gross flooded areas and introduce complications in the assessment of damages. Till the flood season is off, the possibility of refolding of fields cannot be ruled out. Some plots where there is cent percent damage in the first flood may be re-sown but again be exposed to the risk of subsequent floods. However, one can anticipate very few such cases if the interval (which of course, cannot be foretold) between successive floods is too small to permit growing of any new crop. The necessity of covering the possibility of subsequent flood risks points to the need for extension of pre-flood enquiry to such plots, where there can be likely changes of crops after the attack of the first flood. In short, throughout the flood season, it is required to be watchful and be ready to note down any change in the crop position of plots.

4.3.4 *Assessment of Damages*

Assessment of damages is possible only after the recession of water from the fields. Many plots which appear to have sustained damage at the time of floods may later be

found to have their crops reviving. The normal yield should be published by states as assessed. In the case of partial damage, the physical loss is the difference between the normal yield and the realized yield. Partial damage in a plot can occur in two situations when (i) only a portion of the plot is completely damaged, the other remaining more or less intact, and (ii) the damage is spread uniformly throughout the plot not easily discernible but is later discovered by a sharp decrease in the actual yield of the plot. The former is more often the case with plots on the banks of the river; during floods, crops in some portion of such plots are swept away.

4.4 Losses Incurred by Cultivators

4.4.1 When the crop grown is completely damaged and the plot is not capable of being resown, the loss to the cultivator is equal to the value of the crops damaged minus the expenses he has not incurred on some agricultural operations like harvesting, threshing, etc. If the revival of the same crop or sowing some other crop in the same season is possible on the same plot, the loss to the cultivator is simply the cost he has so far (up to the time of flood event) incurred on all inputs and operations.

Continuous stagnation of water may sometimes result in late sowing of crops of the current or the next season. This means that the survey has to be carried through to the next season also to estimate the reduction in yield on account of late sowing. Some plots are permanently damaged on account of river erosion or due to sand deposits. Cultivation of such plots is possible only after effective reclamation. This loss can be evaluated on the basis of factual data of the cost of reclamation.

4.5 Flood Damages and Hydrological Factors

Flood damages can be attributed to two sets of independent factors:

a) Natural factors like topography of the plot its proximity to the river, the water level in the river discharge, the velocity of the movement of water on the plot, the rainfall and a number of other climatic factors; and

b) Factors attributed to the crops like capacity of the plot to withstand water (to certain depth and duration), the height of the crop at the time of occurrence of flood, and its hold on the soil etc. It is evident that if the depth of flooding is more than the height of a plant for a certain duration, then the plant does not survive the depths of flooding and the duration of stagnation fairly well represents the combined effect of the variables like topography of the plot, water flow, rainfall, water level in the river etc.

The following variables have a bearing upon the extent of damage:

a) Maximum depth of flood water in plot;

b) Duration of flood water; and

c) Age of the crop in days.

Duration of flooding is reckoned to be the period between the date of onset of the flood and date of complete recession from the plot. Depth and duration of flood water are

generally indicative of the plot being low lying or at a higher level. Greater depth and longer duration of flooding in a plot imply that the plot is at low level.

4.6 Determination of Standard Damages for the Villages as a Whole

If any village is regularly flooded due to overflowing of river water and not due to the occurrence of any kind of breach, then it may be possible to anticipate some relationship between the highest flood level or maximum water discharge and the damages occurring in the village. But to establish any such relationship, time series data over a number of years on water level readings (or discharge) and damages in the village evaluated at constant prices is required.

4.7 Monetary Evaluation of Crop Damages

From the assessed crop damages of the sample village, district-wise and zonal estimates of damages of every crop can be prepared. For monentary evaluation, the farm price in the next harvest season is taken into account. But the harvest price is not available at the time of the initial assessment of damages. Hence is suggested that the price prevailing at the time of field enquiry be deflated on past years' experience for arriving at the (farm) harvest price. This deflated price of crop may be used for the evaluation of crop damage. For monetary evaluation of the physical damage to the crop either at the district or zonal level, the simple average of prices (whether deflated or prevailing during harvests) of the crop in the selected villages may be used. Neither the wholesale price nor the retail price, but only the price prevailing at the farm, is to be used for evaluation purposes.

5 DAMAGES TO PRIVATE AND PUBLIC PROPERTIES

5.1 Damages to Private Properties

5.1.1 Assessment of damages to house and buildings in physical terms and their conversion to monetary terms for the buildings owned by government, or local authorities presents no difficulty. Before any repair or restorations are done, estimates for these works are prepared. These estimates fairly represent the amount of damage caused.

5.1.2 To have a survey of the magnitude of the expenses incurred by the private households on some of the items like cleaning after floods, reconstruction of damaged structures, etc., a small survey to be conducted in some sample villages surrounded by flood waters for varying lengths of time. The householders of these villages are to be contacted and interrogated about the expenses they incurred due to floods on various items as mentioned above.

5.2 Damages to Public Utilities

5.2.1 Damages to public utilities though in absolute terms are quite substantial, relatively form the least proportion of the total flood losses. Such damages are to the communication system -the highways and the roads, telegraph and telephone lines and to navigation. There may also be damage to other public utilities, that is, irrigation and flood control works, water supply, drainage, electricity and road transport services

both for passengers and goods. Out of these, the railways, roadways, and irrigation and flood control works suffer comparatively significant losses. The industries and businesses spread in the area also suffer losses due to the damage to property.

5.2.2 These damages can be assessed by actual estimates prepared for the repairs and restoration. The loss is the same as the amount spent on repairs or restoration. But, it should be ensured by exercise of proper checks that the estimates are not exaggerated. The damage to the industrial properties, can be seen by the same local official collecting the data for the agricultural losses and assessed by local enquiries. Such losses will be insignificant compared to the total loss.

6 LOSSES OF BUSINESS AND OTHER SECONDARY ACTIVITIES

Besides the direct losses mentioned supra, the railways, the communication system, the road transport system, civil aviation, the power system and irrigation works are also affected indirectly, because of suspension or diversion of services. The industries and business also suffer indirectly due to the partial closure or suspension of works because of the interruption to normal work caused by floods and due to non-availability of raw materials. Such type of indirect losses should also be assessed.

7 SPREAD OF EPIDEMICS, ILL HEALTH AND LOSS OF LIVESTOCK

Due to floods, diseases are spread resulting in ill health besides loss of livestock. The loss of livestock can be enumerated and evaluated at the prevailing prices. This can be done by the village official carrying out the survey for assessing the damages to the agricultural produce in 1he prescribed proforma.

8 FEAR, ANXIETY AND DISTRESS

Floods also cause considerable human suffering in the form of fear, anxiety and distress which are not emanable to precise assessment.