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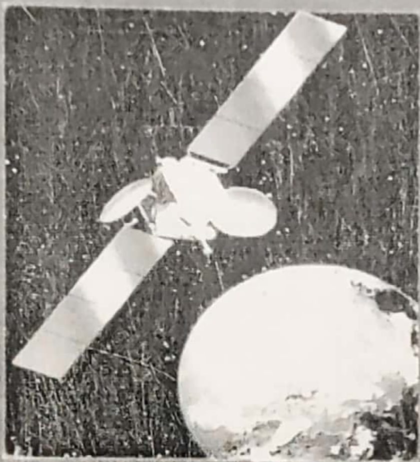

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Control and Management of Wainganaga flood in Maharashtra

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Introduction:

Floods are the most common natural disasters. Floods can be caused by anthropogenic activities and human intervention in the natural process such as increase in settlement areas, population growth, and economic assets over low lying plains prone to flooding leading to alteration in the natural drainage and river basin pattern, deforestation and climate change (EC,2007;Balabanova,2008; Kwak, 2008 ; Kondoh, 2008; Vassilev,2010). All through history it is evident that man has constructed his settlement along the streams, rivers or coasts. Stream or river water has been a source for consumption, agriculture or industry. Small settlements are converted into big cities as population is fast increasing and at the same time constructions are also increasing which has reduced the percentage of available land. This has increased the tendency of encroachment in river flood plain areas. Floods have caused immense economic and social losses, mainly as a result of unplanned urbanization, uncontrolled population density and not strictly inspected construction by authorities.

In Maharashtra Flooding in the Wainganga sub basin has been a major problem in the past. As agriculture is not grooming-up in the area, the farmers' suicides have been on rise in Vidarbha region. So the main aim of this study is to generate a composite map for decision makers and identified flood vulnerable zone by using some effective factors causing flood and some strategy to follow the how flood intensity to decrease into next year. The study reviewed the role of the GIS in decision-making and then outlined the evaluation approach for many criteria in decision process

Study area:

The Wainganga River rises at El 640.0 m in the Seoni District of Madhya Pradesh from the Western slopes of Maikala Ranges which is continuation of the Satpura Ranges in Central India. The Wainganga River receives numerous tributaries on either bank and drains the western, central and eastern regions of the Chandrapur, Gadchiroli, Bhandara, Gondia and Nagpur districts of Maharashtra. The total length of the river is 638.91 km of which 270.21 km lies in Madhya Pradesh and about 368.7 km in Maharashtra state.

The total river basin area in Maharashtra – 26,347.01 Sq. km., Latitude extension- $19^0$30'N to $22^0$30 N', Longitude extension- $79^0$00'E to $80^0$30 E'. The river in it's the initial reaches flow westwards and thereafter southwards in M.P. State and continues to flow Southwards in Maharashtra State. It is joined by the Wardha River at a place called Gundapet flowing from

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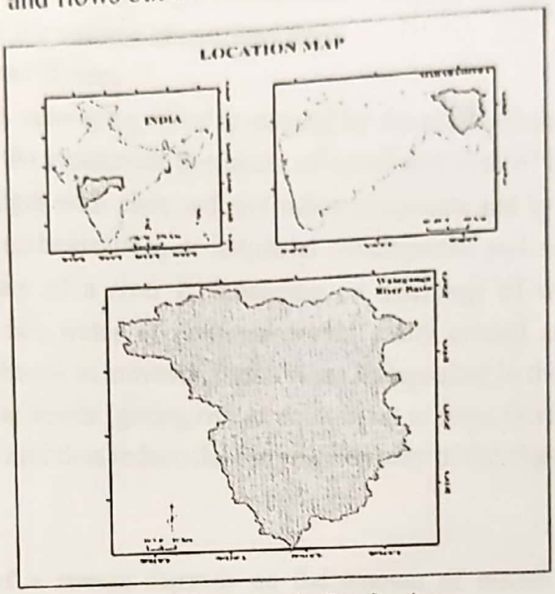
the west, draining the major portion of the Maharashtra Plateau. Thereafter the river is known as Pranhita River. The climate of the sub-basin is characterized by hot summer from March to May with rainy season from June to September although the area has some rains in post monsoon season also. The upper catchment area lies in the high rainfall range of 2000-4000 mm. The Prahnita River joins the Godavari River on the left bank which drains the Eastern Coast in Andhra Pradesh and flows out to the Bay of Bengal.



Map no.1: Study Area

Objective

1) To delineate reliable existing situation of the flood situation in Vidarbha region.
2) To study about Management of flood study.
3) To suggest measures and strategies to counter future problems regarding flood situation.

Methodology

This work covers the Wainganga River catchment area. The prepare of flood map have obtained from one inch topographic map of Survey of India (1:63360 or 1:250000). They are toposheet No. 55J, 55K, 55N, 55O, 55P, 56M, 64B, 64C, 64D, 65A. Includes sorting of data, digitization of various layers, preparation of maps, statistical analysis and with the help of GIS & RS technique land use and land cover classification through supervised classification method based on the field knowledge.

Causes of flood in the Wainganga River Basin

Flood is the result of unfavorable combination of meteorological conditions and physical structure. Situation of flood is caused by rains in excess of disposal capacity of its catchment area. Mainly, nature is responsible for flood but flood is also caused due to human activities.

Thus, the following reasons are responsible for floods:

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1. Excess Flows

There can be several causes of excess flow, heavy rainfall and cloudburst, the melting of snows on a large scale with attendant bursting of dams built of ice blocks, sudden and excess release of impounded water behind dams, and bursting of man-made or landslide built dams. The inability of the ground to absorb a sizeable part of this amount of water would naturally cause excess over / and flow or runoff. The larger the catchment area as well as the greater the magnitude of rainfall, the greater the volume of overland flow.

2. Reduced Carrying Capacity of Rivers

The capacity of channels conveying water is reduced by the accumulation of sediments derived from severe erosion in the catchment formation of cones and fans of landslide debris and by such impediments as bridges with piers and protruding abutments and by the occupation of the floodway for habitation (urbanization) or industrial development and so on. It is well known that the carrying capacity of a river is depending on discharge of water (including sediment load) that it carries. So, water or sediment would easily eroded and resulting in spilling over the banks. The sediment in movement with water is deposited in the channel either on the bed (to form riffles) or on bends (giving rise to point-bars) to form fluvial deposits that restrict the passage of the water and thus reduce the carrying capacity of the channel.

3. Runoff versus Infiltration

The flood discharge of a stream depends on the amount of runoff. The runoff is determined by the amount of infiltration of water into the soil, which is in depends on the texture of soil, nature of vegetation, and length and steepness of slope.

Table No.1 Distribution of Soil Depth in the Wainganga Basin

Sr. No.	Soil Depth	Area Sq.km.
01	Deep Soil Depth	3735.03
02	Marginal Soil Depth	10024.71
03	Moderate Soil Depth	1101.28
04	Shallow Soil Depth	7299.50
05	Thin Soil Depth	3628.28
06	Water bodies	558.21
	Total	**26347.01**

Source: Computed by Researcher

4. Large Catchment Area

The Wainganga river basin total river basin area is 26347.01 Sq. Km. in Maharashtra. Large catchment areas conserve water in vast areas, due to which they receive water from different sources at different rates. When there is excess water, it results in flood situation.

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5. Heavy Rainfall

Heavy rainfall for long duration also causes flood situation because increase of quantity of water in upper Wainganga River catchment area cause flood in lower places. If time of concentration for water is less, severity of flood increases.

Table No.2 Distribution of Annual Rainfall variability

Sr. No.	Annual Rainfall	Area km^2
1	1,123 - 1,210	5707.92
2	683 - 770	611.00
3	594 - 682	414.88
4	771 - 858	823.01
5	859 - 946	2419.41
6	947 - 1,034	3133.54
7	1,035 - 1,122	11263.23
8	1,211 - 1,298	1904.46
9	1,299 - 1,386	69.35
	Total	26347

Source: Computed by Researcher

Management of Floods

The management of floods is measures taken intended to reduce the proportion of runoff by increasing infiltration, spreading the excess water that manages to get into the channels and depositing it through channel. The study is based entirely on the measures taken by occupants through their perception of floods to adjust and abate with flood hazard. So certain major several measures of flood problems are discussed below:

1. Flood Frequency

Over 70 to 80 % of the total rainfall in Wainganga basin arises in four months, June to September, and this is the period when spells of downpour cause a high flood generating water discharge in channels of rivers and stream. With the help of Meteorological data indicate increase in precipitation in the last fifty four years, but the frequency of floods and their intensity have been increasing, the flood frequency of any river is determined from the curve expressing relationship of its discharge and recurrence intervals in years.

2. Treatment of Watersheds

The most actual measure of flood management includes reduction of runoff by inducing and increasing infiltration into the ground in the catchment area. In the study region actually soil is found in the Gondia district shallow but well drained, loamy and severe erosion took place because of densely drainage network. In the same way along the Wainganga River some of the area the soil is very deep that's why moderately well drained and some part having clay particles. Soils remain very gently sloping plains with slight erosion. Both the bank along the downstream of Wainganga River deep and moderated clay soils are found.

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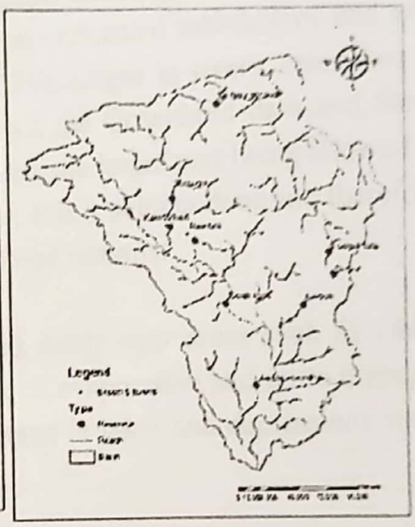
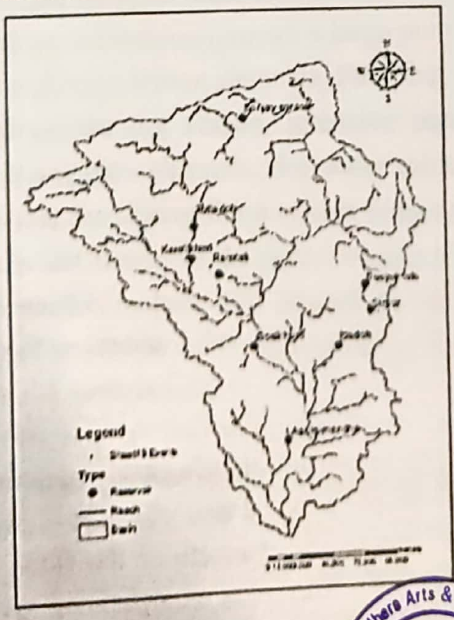
3. Watershed Delineation

Watershed delineation, defined in terms of an identified outlet point, is carried out through terrain processing of the DEM, and, in addition, also yields its stream network. The watershed boundary of Wainganga sub-basin delineated using the ArcView interface is shown along with important drainage features in Map no.2 and 3 for reference. Map 2 depicts the generated drainage network and the points (based on the confluence of drains) where the basin shall be subdivided into sub-basins. The Map 3 depicts the location of the manmade structures such as dams.



Map no 2 : Drainage Network Point

Map no.3 Manmade structure Dams



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4. Reservoirs

The river Wainganga is a major tributary of Godavari basin. The total catchment area intercepted at Goseikhurd dam site is 34,863 km^2, out of which, 24,243 km^2 lies in Madhya Pradesh and 10,619 km^2 lies in Maharashtra. The gross storage capacities of the reservoir Gosekhurd and Asolamendha tank will be 1,146.075 Mm^3 and 334.14 Mm^3 respectively. The live storage capacity of the reservoir at Gosekhurd at 50 years silt planning will be 740.168 Mm^3. The Gosekhurd mega dam has been under construction since 1988, and 200 villages were identified.

Map No.4 Reservoirs in Wainganga sub-basin

to lie in the submergence zone of the reservoir. 85 villages in the Nagpur and Bhandara district were identified in the complete submergence zone. By 2012, only 5 villages from complete submergence zone have been relocated satisfactory and another six are in the final stage of relocation. To reduce flood discharges in rivers, reservoirs are developed by putting small check dams or major dams such the Gosekhurd dam ănd Sarovar dam. Portion of the flood water is retained behind the dams, the larger part being allowed to flow down the channel under controlled conditions. However, this is seldom done and therefore the so called 'multipurpose' reservoirs have failed to abate flood hazards.

5. Water Spreading

Flood water can be distributed thinly over areas such as paddy fields and dry- lands where a part of the water is lost due to evaporation and quite a proportion infiltrates into the soil. Floodwaters can likewise be spread in lakes and depressions such as those dug along the railway lines and highways.

6. Groundwater Recharge

The simplest and cheapest most effective method of reducing flow on the ground would be to artificially induce, infiltration through a large number of dug wells sunk along the beds of ephemeral streams and rainy season channels. Pumping can augment and quicken infiltration of excess flows if during the dry season, intensive pumping is carried out along the rivers, streams, canals and irrigation channels, the water table will sink considerably so that a large space is made available for storing flood waters induced to infiltrate through recharge wells. A network of dug wells can also serve the purpose quite well. The quantity of water that would be stored underground in this manner will depend on the thickness and holding capacity of the permeable aquifer. This method of flood control is doubtless the most effective, most useful and least harmful to the environment.

7. Stream Channelization

A network of canals is quite capable of reducing flood hazards, although the use of canals for flood control is not a commonly adopted or recognized measure. The canals support as temporary storage. Water is held in the channels as the flood wave's move downstream. Channel improvement (by widening, deepening, straightening and clearing out of vegetation

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and debris) increases the flood carrying capacity of the rivers. These measures are supplemented by bank stabilization through construction of riprups, dykes or spurs and planting of deep-root trees on the embankments. Channelization in the upstream part may increase flood hazard downstream, for the floodwater would now quickly reach downstream much faster than the lower reaches can discharge their own water. Also, the flood peaks of the tributaries may now coincide with that of the main river and thus aggravate the situation. The flood management programme must take into consideration the fact that it is compulsively natural for rivers to meander in their belts.

8. Flood Embankments

Building embankments or 'bunds' parallel to the river banks to prevent spilling of excess water appears to be widely adopted in flood management nearby the city area. Raising the flood-prone area above the probable high water level by placing artificial landfills is another way of protection against floods, but this is a very costly measure.

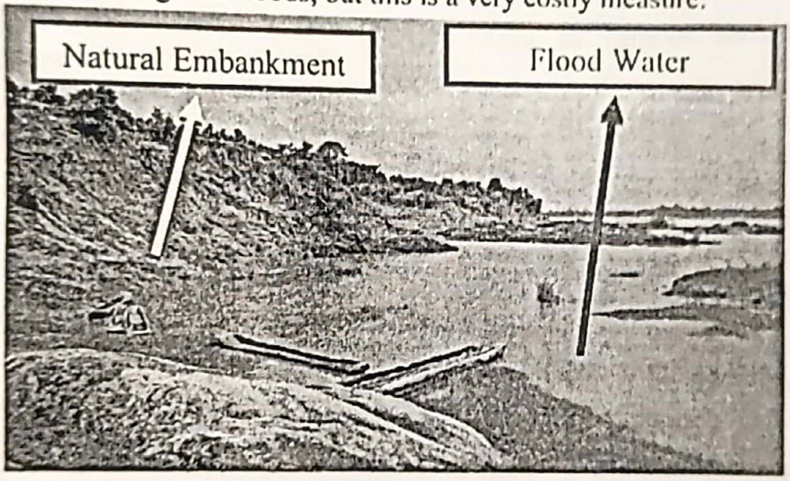

Fig. No.1 Natural Embankment along the Wainganga River

9. Forecasting and Warning

Forecasting floods and giving timely warning to the threatened people and relief agencies is an essential part of rational flood management. This calls for the development of an efficient network of warning systems. The pre-requisite is monitoring

(i) The volume of discharge (ii) Flood height, depth of flooding,
(iii) Velocity of flow (iv) The amount of rain water
(v) The duration of inundation.

The warning stage and highest recorded flood levels of rivers should serve to plan flood management in different river valleys including expansion of urbanization and industrial encroachment on agricultural lands. There is an urgent need for wide application of remote sensing techniques and aerial photography in the prediction of floods and collection of data on flood damages.

Conclusion:

This study envisioned to demarcate the flood impact of risk zone areas along Wainganga river basin by using Survey of India toposheet, Cartosat DEM and satellite data. GIS technology is being used to identify the danger zones for flood vulnerability. The result from the study can be useful to the people residing in the villages which are prone. Therefore, the potential flood risk area need to take into consideration for any type of disaster and preparedness plan and pre-warning notice. This will empower individuals and officials to take suitable preliminary and response measures, which will help them for taking decision.

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