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Flood zone mapping of Thanjavur district, Tamilnadu using GIS

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ABSTRACT

This present study flood zone mapping was carried out in GIS. I have taken into Thanjavur district and Tamil Nadu. The study area is mainly for deltaic and plain area and especially the district is 'Rice bowl of Tamil Nadu'. The area is mainly for monsoon area. The monsoon is very very important in this area. So the suitable for the climate and the agricultural activities are well developed in this area. There are two types of monsoon is available in this area. Mainly for North East monsoon and South West monsoon area. North East monsoon is mostly affected in this area mainly for the month of November and December. The monsoon is mainly affected by agricultural lands, buildup lands and 50% of Roadways are mostly affected. I have mainly taken into analyze the flood affected details in this district in the year of 2010. Yearly once this type of natural disaster or heavy rainfall (flood) affected in this area. As Floods continue to pose the greater threat to flora, fauna and properties. An assessment is required to evaluate the flood prone areas. The toposheets on 1:50000 scale used along with auxiliary data to access and map the flood zones in Thanjavur district.

Key words: flood, heavy rainfall, North East monsoon, Paddy damages, settlement damages, Biological damages, flood zone mapping, Thanjavur dt, Tamil Nadu, GIS.

INTRODUCTION

During the JAL cyclone event (November to December 2010), Severe floods, among other areas occurred in Thanjavur District. The taluk of Thanjavur which spreads at the margin of Cauvery River was one of the affected places. As a consequence of the damage caused by the flood the need for hazards assessment and land use planning to reduce the effects of these natural processes arose. Among all kinds of natural hazards of the world flood is probably most devastating, wide spread and frequent. In the humid tropics and sup tropical climates, especially in the realms of monsoon, river flooding is a recurrent natural phenomenon. Floods resulting from excessive Rainfall within a short duration of time and consequent high river discharge damage

crops and infrastructures. They also result in siltation of the reservoirs and hence limit the capacity of existing dams to control floods. One region, which suffers from flood damages on a regular basis, is the Cauvery basin in the Thanjavur district. There losses included damages to houses, agriculture, Roads and Railways, hydraulic structures, loss of domestic animals and Economic activities also mainly losses.

Traditionally, social since research has not made widest spread use of geographical information system (GIS) when measuring damage losses and variable analyses. However using this technology to understand the factors affecting flood damage GIS has a great role to play in flood Zone Mapping. The main advantage of using GIS for flood zone mapping is that it not only generates a visualization of flooding but also creates potential to further analyze this product to estimate probable damage due to flood. There are many investigations in previous study in flood related (Beven KJ, Carling PA (1992), Haussmann et al., (1998), Van der Sande C (2001), Handmer J (2004), Ahmad S, Simonovic SP (2006). The study area mainly for northern side is full of Plain area, southern side full of coastal area.

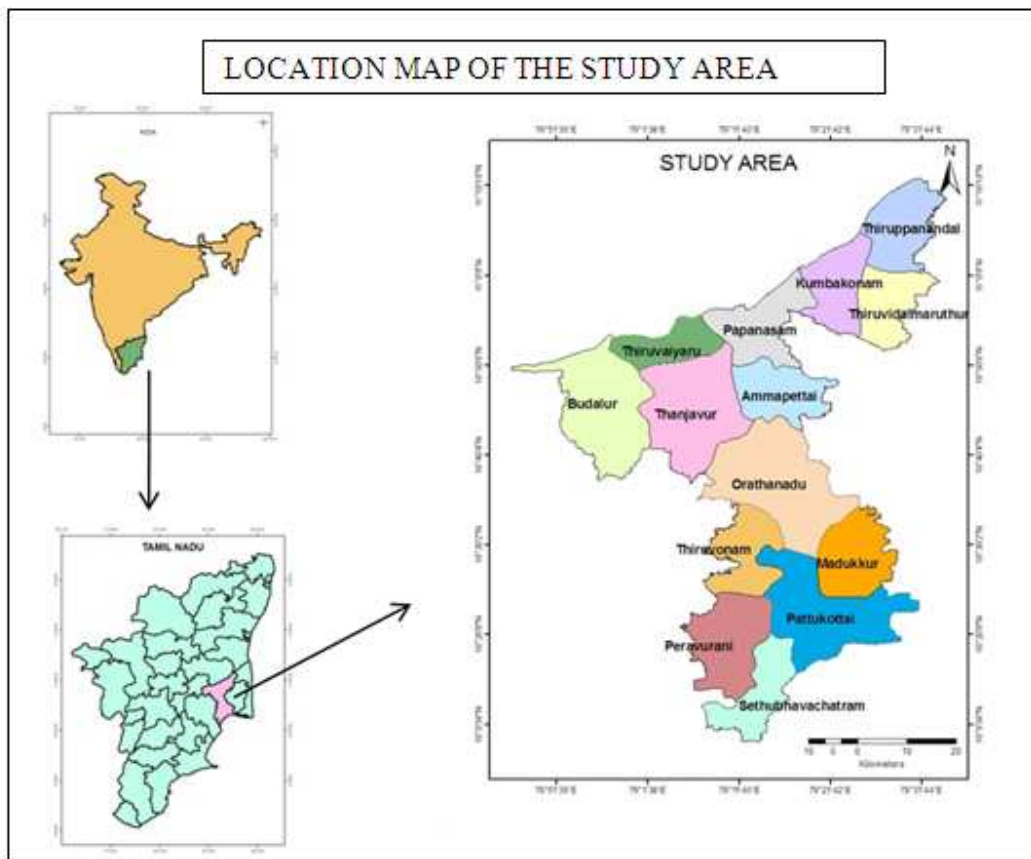


Figure: 1 Location map of the study area

Study Area

The area under investigation lies in between the Long. 78° 45' 50'' E to 79° 35' 55'' E and Lat. 10° 10' 0'' N to 11° 10' 6'' N. Thanjavur is noted for its rapid agricultural, industrialization and urbanization. The city is connected by land, and air transportation. Thanjavur district lies on the East coast of Tamil Nadu. It extends to an area of 3396.57 sq kms. The district is bounded on

the north by the Cuddalore and Perambalur districts and on the east it is bounded by the Thiruvarur and Nagapattinam and on the south by the Palk Strait and west by Pudukkottai and Tiruchirappalli districts. The district can be divided into 3 main divisions and 12 deltaic regions. The upland area is mainly for deltaic region. The district is mainly for 8 Taluks 14 blocks in Thanjavur district. Totally the study area is 950 villages in the district. The Location of study area is shown in (fig. 1)

The aim of the study is to show the flood zone mapping of the plain and coastal area. The amount of rainfall in the study area for various Rainguage station data will be collected from the meteorological department data. The main purpose of the study is mainly for some planning purposes and making reduction strategies, I have taken in the study.

The main objectives are

1. To understand the general topography in the study area.
2. To demarcate the floods affected area and vulnerable area.
3. To demarcate the Agriculture damages in our study area.
4. To demarcate the settlement damages in our study area.
5. To demarcate the Biological damages in our study area.
6. To demarcate the Road ways damages in our study area.
7. To field visit to different parts of the flood affected area in the study.
8. To prepare a floods zone mapping in Thanjavur district using GIS.

METHODOLOGY

For this study, spatial and non spatial data are used. After the visual interpretation of direct field checks are made. Total area of the district is represented in 14 toposheets. In the present study flood maps will be prepared from survey of India toposheets 58N/1, N/2, N/3, N/4, N/5, N/6, N/7, N/8, N/9, N/11, 58J/13, J/14, 58M/8, M/12. The scales are (1:50,000). Filed visit to different parts of the flood affected area in study area. The amount of rainfall in the study area for various Rainguage station data will be collected from the meteorological department data in the damage & an annual average for each season was arrived at huts and agriculture will collected from statistical office in Thanjavur. From the data collected from the PWD in Thanjavur. The drainage map prepared by survey of India toposheets. Flood zone maps are prepared making reduction strategies.

Geology

The district can be broadly divided into four geological zones viz. Mineral resources locally exploited are restricted to brick and tile clays, Kankar and salt and Vallam gravels. Occurrences of Oil drilled by (ONGC 1993) and lignite (by MEC) are recorded in the area.

1. The western and southern zones from a laterite country. The laterites/lateritic soil occur at places over the crystalline rocks viz. migmatite gneisses (Archaean) and also sedimentary formations comprising fossiliferous sandy calcareous clay and limestone of Upper Cretaceous age and grits, ferruginous sandstone and gravel of Mio-Pliocene age.
2. The fluvial deposits (flood plains) of Cauveri and Agninar rivers.
3. The fluvio-marine deltaic sediments.

4. The coastal sediments of marine/Aeolian regions fringing the Palk Strait. Granitic gneisses, migmatite gneisses are seen in the Grand Anicut canal section near Budalur Railway Station. Greysin black, medium to fine grained, compact, quartz magnetite rock is seen 30⁰ w Thiruvengadampalli, west of Thanjavur town, trending NNw-SSE. Presence of granitic rock beneath the laterite was recored in well sections along Thanjavur-Tiruchchirappalli road on the high ground about 1.5km southwest of Tirumalaisamudram. Weathered Upper Cretaceous rocks represented by fossiliferous sandy calcareous rocks represented by fossiliferous sandy calcareous clay and limestone (equivalent of Sillakudi Formation. Ariyalur Group) are exposed below the black loamy soil near Kavirayarpatti in the Grand Anicut canal and under a bed of Kankar in a cutting near Munniyankulapatti.

Geomorphology

Based on the satellite imagery, the area has been delineated into various fluvial and coastal land forms. Additional information's are obtained from the survey of India toposheet with the scale of 1:50,000 (1974). The overall configuration of deltas results from different geomorphic environments to which parts of the delta surface are subjected. According to three major areas of geomorphic influences can be recognized in deltas. The upper delta zone bears testimony to a strong fluvial environment, the intermediate zone to both fluvial and marine influences, and the lower zone to marine environment. These three zones have been recognized in the Cauvery delta. The river regime, coastal processes, structural behavior, and climatic regime are the four dominant geomorphic variables which in numerous combinations produce a great variety of deltaic morphology. The geomorphic units are classified into three groups, namely.

1. Fluvial landforms
2. Coastal landforms (Marine)
3. Structural landforms

Drainage

The Cauvery delta is regionally a triangular shaped delta with its located east of Srirangam. From these, the Cauvery shows a typical distributor net work. But the surface water flow is observed only along the present day Coleroon River and all the distributor channels which exhibit signatures of abandoned courses. There are three distinct features observed from satellite imagery in Cauvery delta. i) the deltaic plains, ii) the distributory channels in the form of Palaeo-Channels, with younger flood plains by the sides of them and iii) the present day Coleroon Course.

The River Cauvery and its tributaries are the most remarkable feature of Thanjavur district. Cauvery is considered to be the best of the river that drain the southern peninsula of India the river flows from Karnataka state and passed through Dharmapuri, Salem, Erode, Thiruchirappalli, Thanjavur, Thiruvarur and Nagapattinam districts covering a distance of about 770 kms draining an area about 72.800 sq.km in all springing from a spot lying on Brahmagiri Mountains on Western Ghats at a height at a height of 1320 meters above sea level. Cauvery meanders its way across Karnataka and Tamil Nadu and showering not only economic property of millions of people but also carried a rich for itself in their lives in historical culture and religious realms.

Flood zone mapping purposes

Flood maps are used for a variety of purposes by governments, mostly for emergency planning (e.g. evacuation) and spatial planning. In spatial planning a distinction can be made between countries or any places where flood maps serve an advisory purpose, and countries where there is a binding legislation to use flood hazard or risk information. Flood zones (either extent or danger zones) can serve as an informative tool for decision makers. The flood zone maps can be used to land use planning, flood control and drainage planning and flood control and warning purposes are mainly used in this map because yearly once year by year this type of disaster (heavy rainfall) affected in this area, so flood zone mapping is very important of this district. This district is mainly for coastal nearer district so flood affection is yearly high. Some planning purposes is very important in this district.

Rainfall

In November -2010 there was a heavy rain falling in our study area. Heavy Rainfall is only main reason due to flood. Due to flood our study area was more damaged on that period. So this year heavy rainfall is the important for this study. The region received rainfall from in two Rainfall seasons. One is the South west monsoon ((June, July, August, September) and another one is the North East monsoon (October, November, December).

Table no.1 Rainfall data in 2010

Date	November – 2010 rainfall in mm	Date	December -2010 rainfall in mm
1-15	Rainfall not	1	116
16	23	2	105
17	19	3	66
18	31	4	40
19	53	5	21.3
20	42	6	11.6
21	26	7	0
22	114	8	0
23	137	9	0
24	143	10	0
25	148	11	0
26	93	12	0
27	156	13	0
28	312	14	0
29	274	15	0
30	301	16	0

Sources of Thanjavur Rainfall station (Table.1)

Yearly the North East monsoons are started in October 20th but that year (2010) the monsoon started from October 29th 2010. November 15th before dates the rainfall is very low. Aft 15th November 2010 heavy rainfall is occurring in this study area. This rainfall compare to other years higher than the year (2010). The heavy rainfall is mostly affected in agriculture field. Many days the water is located in paddy field. So most of the agriculture crop is bad condition and yield also very low because of flood is one of the main reason. Totally this area is hole

water body conditions totally 694 canals 450 wells and ponds and all rivers are high water and extremely bad or higher water conditions are located in this area.

Thanjavur district is benefited more by North-East monsoon because of its heavy rainfall and the Western Ghats in variable feeds the Cauvery and helps greatly for the vast cultivation of the deltaic area. Sometimes the heavy rainfall is affected by agriculture area. Table No: 1 uses to rainfall study in 2010. This data easily utilizes in flood causes in November and December 2010.

Flood hazard management

Flood hazard management is a challenging process as that which is being managed is not static. Since the change in legislation, the limited technical expertise is outdated and insufficient floodplain and hazard information puts strain on the staff and resources at the local government level. This study has collated the opinions of a comprehensive cross-section of flood hazard management practitioners in the province and should be used for future flood hazard management program planning. However, there are significant limitations to the survey approach and this survey should not be taken as a measure of the actual effectiveness of the current flood hazard management model in reducing flood risks. Each village will have a Disaster Management Plan. The process of drafting the plan has already begun.

The Disaster Management Committee which draws up the plans consists of elected representatives at the village level, local authorities; Government functionaries including doctors/paramedics of primary health centers located in the village, primary school teachers etc. The plan encompasses prevention, mitigation and preparedness measures. The Disaster Management Teams at the village level will consist of members of voluntary organizations like Nehru Yuvak Kendra and other non-governmental organizations as well as able bodied volunteers from the village. The teams are provided basic training in evacuation, search and rescue etc. The Disaster Management Committee will review the disaster management plan at least once in a year. It would also generate awareness among the People in the village about dos' and don't for specific hazards depending on the vulnerability of the village. A large number of village level Disaster Management Committees and Disaster Management Teams have already been constituted.

Flood damages in Thanjavur Dt

Thanjavur district is situated in Cauvery delta region. In Thanjavur district is the agrarian region so the agriculture has been well developed especially due to water resources of deltaic region. Thanjavur district also called as "Granary of Tamil Nadu" because of more amount of Rainfall and suitable for climate and agriculture region.

Availability of water resources in Thanjavur district, apart from agriculture there is a good development in all residential areas. Due to this area is transportation facilities are well developed but yearly once this facilities are mostly affected because of heavy rainfall. The district is mainly for plain area so the population is very high. In 2010-November and December months are heavy rainfall in this area. Due to flood was more damaged in this area. Mainly the damages are divided into 4 types. There are agricultural damages, settlement damages, Roadways damages and Biological damages. All the blocks are mostly affected because of this

district is mainly for coastal side of the district so flood affected is more and higer.The damage details are given below.

Table no: 2 Flood damages in Thanjavur district 2010

THANJAVUR DT BLOCKS	AGRICULTURAL DAMAGES IN HEC	THATCHED HOUSES DAMAGES IN NUMBERS	TILED HOUS DAMAGES IN NUMBERS
1. Thanjavur	1,982	337	320
2. Thiruvaiyaru	2,470	620	278
3. Budalur	2,450	643	199
4. Ammapettai	1,750	689	186
5. Papanasam	2,800	605	208
6. Kumbakonam	1,843	430	240
7. Thiruidaimarudur	2,320	650	214
8. Thirupanandal	1986	780	290
9. Orathanadu	1811	240	275
10. Thiruvonam	1425	378	194
11. Madukkur	1489	520	219
12. Peravurani	1695	560	208
13. Pattukottai	1950	735	354
14. Sethubhavachatram	1860	653	235
Total	27,831	7,840	3,420

(Sources of Thanjavur flood damages hand book-2010)

Agricultural Damages In Thanjavur Dt

In Thanjavur district most of the peoples are directly or some peoples are indirectly related into agricultural activities. Thanjavur district is totally 950 villages in the study area. Most of the farmer peoples are affected into flood yearly once. Particularly in Thanjavur district all blocks paddy damages is highly affected. Because of the heavy rainfall water is highly located in paddy area. So In Thanjavur district Northern side of the mostly affected the blocks are Kumbakonam, Thiruidaimarudur, Thiruppanandal, Papanasam, Thiruvaiyaru blocks are mostly affected. The southern sides of the blocks are Pattukottai, Peravurani, Sethubhavachatram, and mid portion of the Orathanadu, blocks also highly affected in crop field, and other blocks of Madukkur and Thiruvonam is center the portion of the study area so this area is compare to other area not more affected in the study area. But overall this district is coastal area nearer so agriculture is mostly affected. All the agriculture affected details are given in the table. The figures are shown in the table 2and figure.2.

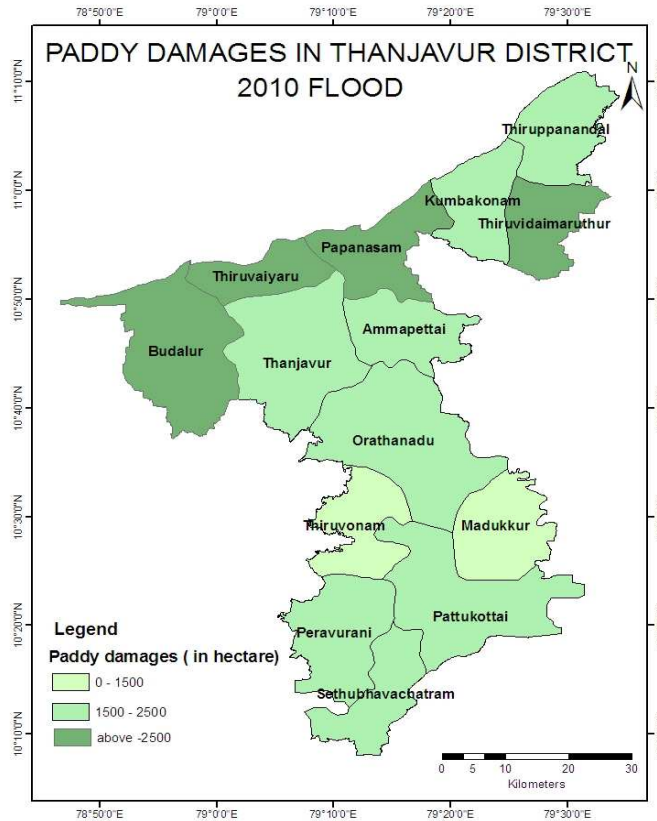


Figure:2, Paddy damages in 2010 flood

Settlement Damages in Thanjavur Dt

Two types of houses were affected in this flood. They are tiled houses and thatched houses. Tilled houses and thatched roof houses were heavily affected due to flood, at November 2010. Mostly the highly tiled houses are affected of the blocks are Thanjavur, Kumbakonam, Pattukottai because of mainly this area is municipal area. In Thanjavur, Kumbakonam and Pattukottai blocks are developed good residential area. The settlements types are shown in scatter settlement, linier settlement, grouping settlement. For the increasing the population there is no sufficient drainage facilities in between settlement areas. So that the rain water cannot drained it this settlement areas. The tiled houses are totally 3420 houses are affected in this block. So the 3 blocks settlements were heavily damaged in flood due to November and December 2010 heavy rainfall. Other blocks are mostly affected in thatched houses because of this area or all blocks are totally rural area. So totally these study area 7,840 thatched houses are affected in this flood. The settlement damages details are given in the table no.2 and figure no.3&4.

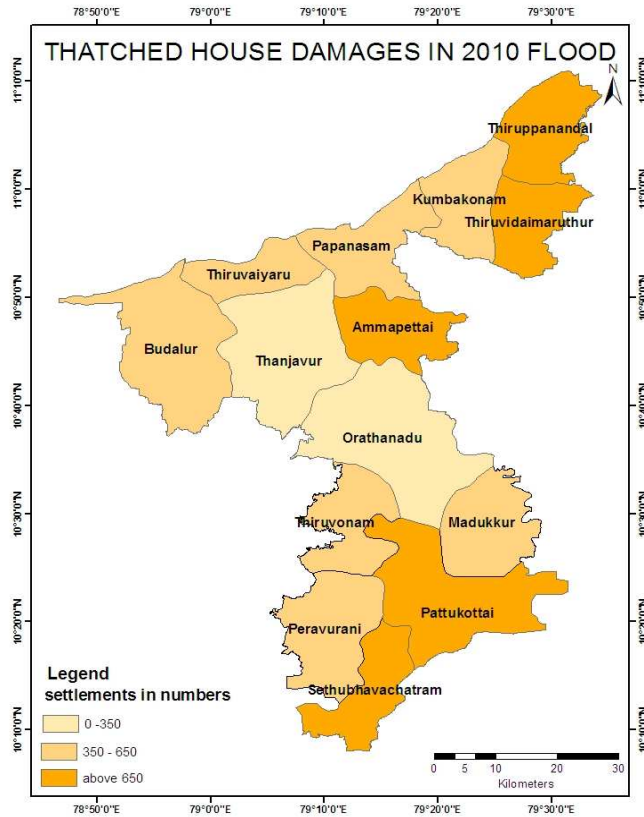


Figure.3, Thatched house damages in 2010 flood

Roadways Damages in Thanjavur Dt

In Thanjavur district is the transportation facilities are well developed. The roadways are connected into National highways. The major roads are connected into southern railway. This district is railways and air transportation also well developed. In 2010 flood the above roads and railways are affected into more damages. The damages are shown in the table .3& figure.5

Table no.3, Roadways damages in Thanjavur district

Name of the Roads	Roadways in k.m.	Roadways damages in k.m
State highway	375	130
District main road	360	195
Other roads	1179	687

Source Thanjavur transportation office

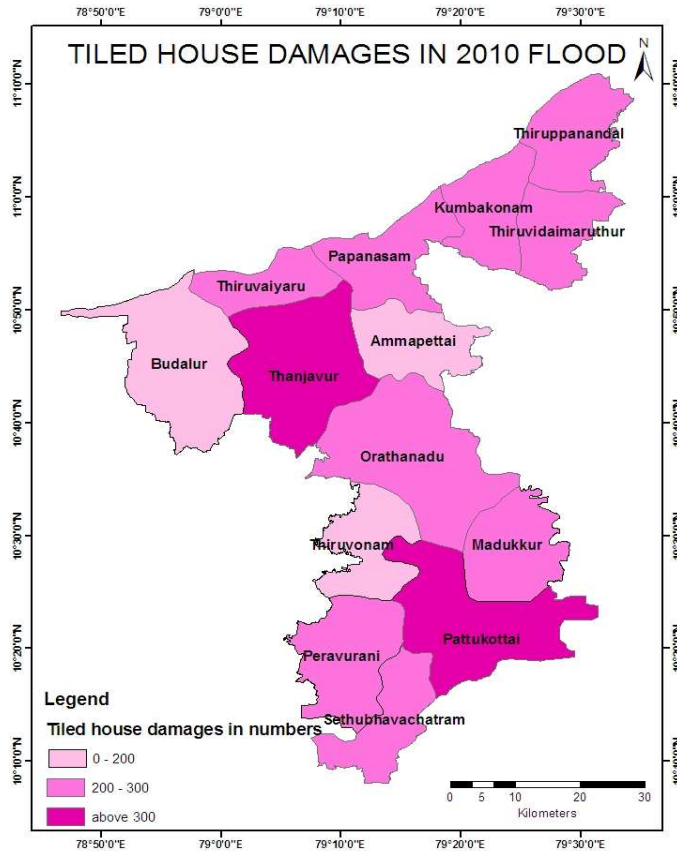


Figure.4, Tiled house damages in 2010 flood

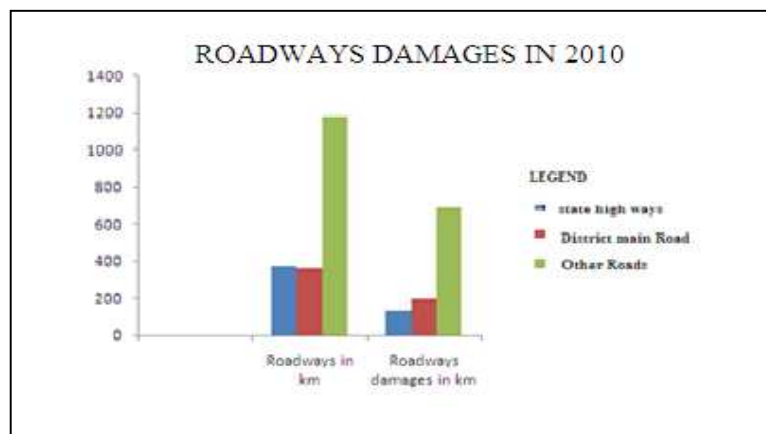


Figure.5, Roadways damages in 2010

Biological Damages in Thanjavur Dt

Biological damages in Thanjavur district due to November 2010 flood Biological damages are very low in our study area compare to other districts for example Nagapattinam and Thiruvavur

areas are high level biological affected. In this area have less amount of vetnary damages in 2010 flood. Damages are shown in the table no: 4 & fig no: 11,

Biological Damages in Thanjavur district

Table.no.4

S. No	Name of the damages	Number of damages
1	Goat	129
2	Duck	60
3	Chicken	85
4	Human being	16

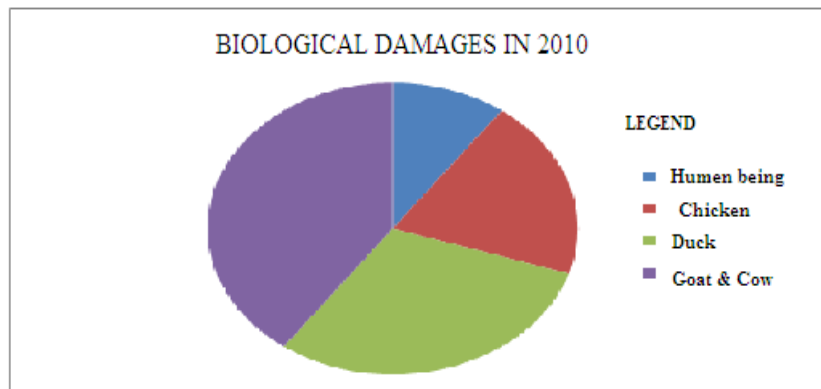


Figure.6 Biological damages in 2010

CONCLUSION

The present study has been carried out in order to identify the flood zone especially agriculture damages, hutment damages, transport damages due to flood in Thanjavur district. Some methods of flood control have been practiced in ancient times. These methods include planting vegetation to retain extra water, terracing hillsides to slow the flow downhill, and the construction of floodways (man-made channels to divert floodwater). Other techniques include the construction of levees, dikes, dams, reservoirs or retention ponds to hold extra water during times of flooding.

Necessary steps pertaining to afforestation and soil conservation in the catchment areas have to be taken in such a way that there will be no scope of occurrence of siltation in the rivers. Secondly, heavy guard walls at least on both sides of the Cauvery should be erected so that the effect of erosion could be minimized. We should keep in mind that making and strengthening of embankments cannot solve the flood problem permanently, rather they will be purely, temporary measures through which no one could expect good benefit excepting wastage of funds. Moreover, such measures will totally fail to safeguard the bank erosion. The importance of guard walls is that they will reduce the width of the river and as such quite a vast area would be recovered from the grab of the river. Further, the removed silt could also be utilized for transforming the barren wet land to promising areas for agricultural and allied uses by filling the same.

Undoubtedly, there will be needed a huge fund to fulfill the suggestions, yet to check the suffering and wastage of money every year, there will be no way out except to adhere to these measures. On the whole, the governments should put stress on taking time-bound effective measures in a planned way to mitigate the miseries of flood and upgrade the economic and social status of the people. A dike is another method of flood protection. Dikes lower the risk of having floods compared to other methods. It can help prevent damage however it is better to combine the dike with other flood control methods to reduce the risk of a collapsed dike.

Dams and Reservoirs should be constructed in order to reduce the channels of flood. These constructions can also help us in reducing the speed of water waves which are causing the chances of flood. Bypass channel should be constructed during the flood, these channels will deviate the path of flood. One spatial- temporal data of remote sensing should be used to forecast the channel of flood and to predict the places where flood can occur, so that preparedness is made. The plantation belt along the water body helps to restrict the water wide it area and chance of flooding and damage of flood can be reduced.

No permanent solution to the flood – problem. At best, it is only a temporary expedient and puts off the evil day to future generations when owing to various vested interests created, and due to deterioration in the drainage system, in public health and productivity of the soil. In consequences of the stoppage of beneficial flood spill from the land by embankments, problems are created which are almost insoluble. Even as a temporary expedient it can hardly be considered as a sufficiently effective protection as it is impossible to avoid breaches in earthen embankments and the destructive effect of concentrated discharge through breaches is more serious than gradual inundation, specially as the flood level relatively to the land gradually rises as a consequences of the embankments.

If no doubt takes years before the evil effects of embankments are actually felt: this very fact makes them rather risky expedients, as vested interests are created which stand in the way of any bold solution being adopted in future. Flood events in recent years resulting in life losses, huge damages, demand urgent reaction. The emergency is also stressed by the fact that we face the threat of climate change.

Success can only be reached if an interdisciplinary approach is adopted. Heavy precipitation cannot be managed neither can extreme floods. The message of the latest flood events is the following: “We have to learn to live with those events”. We have to do everything to avoid anthropogenic augmentation of floods, to behave in a manner to mitigate potential risks for people and valuable goods. We have to make people aware of potential and actual risks in order to induce their precautionary actions. Further-more, fight against flood damages can have positive effects in different other policy fields like nature conservation for instance. For each river basin, a flood management plan should be developed. In setting up such a plan, consideration should be given to the aspect of solidarity within the river basin that is to prevent as much as practicable the passing on of problems in one geographical area into another one.

The plan should be based on an integrated approach covering all relevant aspects of water management, physical planning, land use, agriculture, transport and urban development, nature conservation, at all levels (national, regional and local). In the development of a flood

management plan, decision makers at all levels (local, regional, national and international) as well as stakeholders and civil society should be involved.

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