



## 2. MATERIALS AND METHODOLOGY

To study the effect and extent of damage to cattle livestock due to floods in India, data for affected area during floods, death of cattle due to floods and cattle population from 1950 to 2015 were analyzed. The trends for each set of data were obtained from MS Excel and the trends for cattle death due to floods from 1950 to 2015 were analyzed for different initial start points to determine the change point in the overall trend. The data for major floods (*Compendium of Environmental Statistics India, 2016*) was also taken for the same time periods and is mentioned below. Furthermore additional data such as government policies and programmes were studied to help explain the behavior of the trends and data. The data used in the study was obtained from the National Dairy Development Board which had been recorded in the livestock census conducted by the Government of India and the ICAR databook of year 2019.

**Table -1:** Major Flood Years and Damage in India

YEAR	AREA AFFECTED (MHA)	YEAR	AREA AFFECTED (MHA)
1953	2.29	2000	5.38
1960	7.53	2001	6.18
1965	1.46	2002	7.09
1970	8.46	2003	6.12
1975	6.17	2004	5.31
1980	11.46	2005	12.56
1985	8.38	2006	1.10
1990	9.30	2007	7.10
1991	6.36	2008	3.43
1992	2.64	2009	3.84
1993	11.44	2010	2.62
1994	4.81	2011	1.90
1995	5.24	2012	2.14
1996	8.05	2013	3.64
1997	4.57	2014	10.24
1998	10.85	2015	0.26
1999	7.77		

(Source:ICAR)

**Table -2:** Cattle Population in India

YEAR	CATTLE POPULATION (MILLIONS)
1951	155.3
1956	158.7
1961	175.6
1966	176.2
1972	178.3
1977	180.0
1982	192.5
1987	199.7
1992	204.6
1997	198.9
2003	185.2
2007	199.1
2012	190.9

(Source: NDDB)

Generally animal deaths due to floods are classified as intangible damage (Merz *et al.*, 2004), but due to their economic value to the agricultural sector cattle deaths have been considered as tangible damage for the case of this study.

In addition to this average number of cattle deaths as a percentage of total cattle population was also obtained for the period of the study with the help of interpolation of values of cattle population for the time points between the census years. This was done in order to estimate the impact that the deaths might have had on the overall population and whether it was significant enough in terms of raw numbers.

**Table -3:** Cattle Deaths due to Flood in India

YEAR	CATTLE DEATH	YEAR	CATTLE DEATH
1953	47000	2000	123000
1960	14000	2001	33000
1965	7000	2002	22000
1970	119000	2003	15000
1975	17000	2004	134000
1980	59000	2005	120000
1985	43000	2006	267000
1990	134000	2007	89000
1991	41000	2008	102000
1992	79000	2009	63000
1993	211000	2010	40000
1994	52000	2011	36000
1995	62000	2012	32000
1996	73000	2013	157000
1997	28000	2014	17000
1998	107000	2015	26000
1999	91000		

(Source: ICAR)

## 3. RESULTS AND CONCLUSION

As per the data obtained for the cattle population in India, graphs were drawn and trendlines were plotted for the analysis of the overall trends. The maximum number of cattle deaths were observed in the year 2006 which recorded 267,000 cattle deaths, while the least number of cattle deaths was recorded as 7,000 in 1965. The maximum cattle population was 204.6 million in 1992 which was the peak of the curve post which the population has been decreasing with fluctuating increase in alternate census years. It was observed that cattle deaths in major flood years due to floods amounted to 0.0387% of the cattle population. The average cattle deaths due to floods can then be estimated, assuming equal intensity of floods as 0.0387% of the average cattle population for the time period of the study as 71,297.

It was found from the chart of the total cattle population of India that the cattle population has an incremental trend overall with fluctuations in between corresponding to natural disasters, diseases etc. This indicates that inspite of the odd anomalies the cattle population has seen growth from 1950 and is still considered a viable financial investment in the agricultural sector (Bettencourt *et al.*, 2015), especially among the small and medium scale farmers.

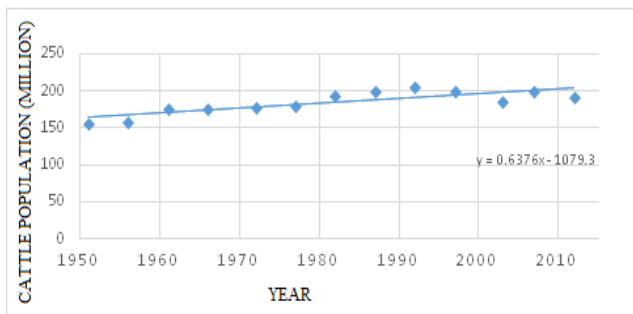


Chart -1: Cattle Population Trend in India Post 1950

The chart for cattle deaths due to floods in India from 1950 to 2015 has an incremental trend. This is indicative of the fact that in the time period mentioned the number of cattle lost to major flood events has increased.

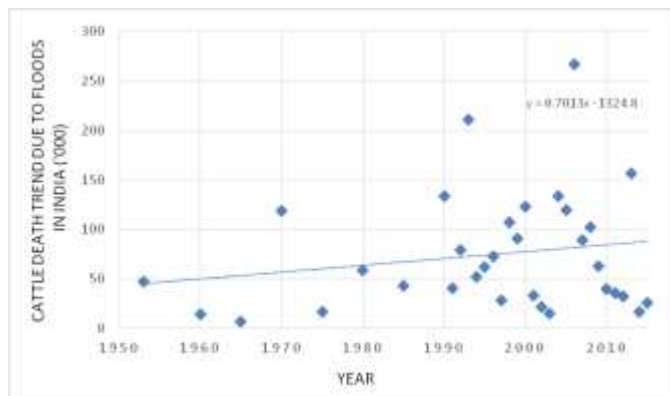


Chart -2: Cattle Deaths due to Floods in India Post 1950

Furthermore, to get a more accurate picture of the trend, the data for cattle loss was broken into different time periods and then analyzed separately. In doing so it was observed that the trend shows a decreasing behavior for the time period of 1980 to 2015.

In addition to this a net increase of 10.82 million in the cattle population was also observed from 1980 to 1985.

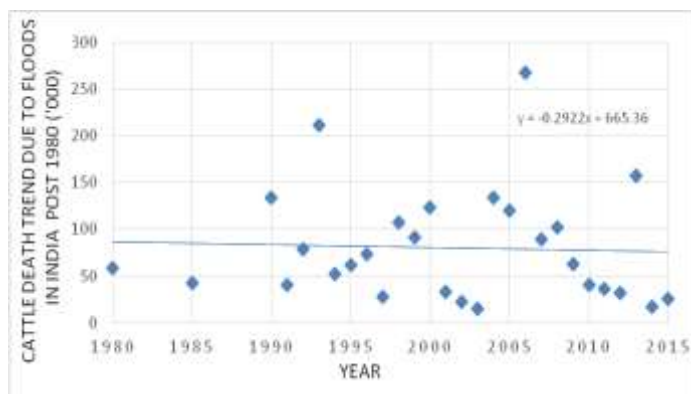


Chart -3: Cattle Deaths due to Floods in India Post 1980

The trendlines clearly point to a shift in cattle handling, especially during times of crisis. The corresponding increase in the cattle population in the same time frame also suggests wider acceptability of the financial incentive of cattle farming. In looking for policies, initiatives and programmes it was found that the period of 1981 to 1985 was the time for implementation of Phase II of Operation Flood which focused on increasing milk sheds from 18 to 136. This also created a self-sustaining system of nearly 43,000 village cooperatives with close to 42,50,000 milk producers. This could have been a nudge for cattle and dairy farmers to benefit from their cattle, leading to better care and protective measures during natural disasters. 8,039 villages were provided with 172 regular mobile veterinary clinics and 103 emergency mobile veterinary clinics. (National Dairy Development Board, 1997) This would have meant fewer cattle deaths due to after effects of floods such as spread of diseases such as pneumonia, foot rot and leptospirosis as veterinary support would have been readily available. In addition to this the proper guidelines in the form of Transport of Animals, rules, 1978 laid out by the Government of India in clause (h) of subsection (2) of section 38 of the Prevention of Cruelty to Animals Act, 1960 can also be considered of importance by providing proper methodology for the transport of cattle which might have helped farmers move their cattle from flood prone areas with minimal damage and loss.

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