Safe water supplies, hygienic sanitation and good water management are critical to human health and development. Access to safe drinking water, hygienic sanitation we can prevent one-tenth global disease. Safe water supply can prevent diseases like malaria, diarrhoea, malnutrition etc [1]. Lack of safe water supplies can increase chances of morbidity and mortality, especially for the children below 5. Urban areas in the world have been successful in achieving considerable amount of progress in expanding safe drinking water. However 663 million people still lacks access to improved water supply of which more than 300 million people live in the rural area sub-Saharan Africa are still struggling to get safe water supplies. People living in rural sub-Saharan Africa area have to use unfit water drink and for daily purpose usage. To improve the quality and quantity of water in the area, boreholes with hand pumps were installed in these areas. Hand pumps had been fundamental in increasing the access to safe water supply in rural areas of sub-Saharan Africa between 1990 and 2015. Various Organisation (eg: WHO, BGS etc) are constructing Hand pumps, well and spring for the people living in the rural area. By this means more than half of the people relying on the unsafe access to water like rivers and ponds have start safe water supply.

Safe water supplies is not only problem, non-functionality of hand pumps, communal water supply being the main source of improved water supply are the other problems. According to the research, only 1/3 of these hand pumps are non-functional at any given time. To improve the condition, we need to thoroughly understand the risk failure of water supplies to achieve a goal of improved water supply globally by 2030. Study done by (Juliet Willet, Mike Lane, Patrick Thomson, Jacob Katuva b, Rob Hope) discovered factors that reveals the factor predicting risk failure for the hand pumps installed in the south coast of Kenya. The analysis was conducted based on the cross-sectional dataset having more than 300 water points at the time of installation and predicted to be functional for almost a decade. According to the Cox proportional hazards and accelerated failure time model, we found that static water, groundwater pumped from unconsolidated sand aquifer and saline water are the reason for higher failure risk and small lifespan. Apart from these 3, long distance between pumps and the spare part shop is the one reason behind the non-functionality. Usually to analyse the large water point dataset, methodologies and diagnostic frameworks have used multivariable logistic regression to understand the functionality (Whittington et al., 2009; Foster, 2013; Fisher et al., 2015;

Cronk and Bartram, 2017). Lately, Bayesian network modelling has been proven as better approach over multivariable logistic regression because of ability to accommodate the interdependent nature of explanatory variables. Although theses cross-sectional dataset and model have their own limitations. For eg:

1. They are not able to distinguish between the pump that has been non-functional for quite long have less chances of getting repaired in the future and between the pump which got temporarily broken.
2. They omit the ground reality data such as depth and water quality parameters. To get these information, one had to disable the hand pump, which would require labour and flow of cash. To reduce the expense and time, these type of info is omitted from the dataset.

In comparison to the above research, Bonsor et al. (2015) proposed alternative approaches and diagnostic framework which helps us in digging deeper, considering underlying cause of failure and the role of hydrogeological characteristics. However, these approaches are costlier and time consuming because of regular collection of data. Although, according to the cox and AFT model for every metre of depth, there is a 3% increase in failure and 2% decrease in the operational lifespan of pump. Survival Analysis was proposed as the better approach in comparison to the previous one used. It includes the time until an event occurs. After analysing dataset using survival analysis we got to know that hydrogeological and geographical factors have a negative impact upon the sustainability of rural water supplies. Survival analysis made us understand groundwater depth, water quality, geology and spare part supply factor affecting the sustainability.

High iron concentration in the rural water supplies in sub-Saharan Africa and Asia is another big factor that affects the functionality of hand pumps.This naturally occurring iron in the groundwater plays a big role in corroding the hand pumps.It is advised to not use the galvanized iron pump ground water supplies due to risk of corrosion.High iron concentration in the water can affect the taste, odour and appearance of water.It can promote the growth of the Iron metabolizing bacteria.It can happen because of high iron concentration in water or due to corrosion.Because of these effects the site has to be declared unfit for use.If the site is not declared unfit, then due to corrosion Hand pumps, boreholes can become inoperable.Health problem related to the high iron concentration in the groundwater are well known to the people across the country but not given much importance.To save the local communities from this health hazard, local water bodies have to abandon the water point or declared unsafe for use.In 2011 World Health Organisation (WHO) stated that water having iron concentration above 0.3 mg/l will affect the taste, odour and will leave stain on the clothes if washed with it.

Iron can be found in two states

1. Reduced soluble ferrous iron (Fe+2)
2. Oxidized insoluble ferric ion (Fe+3)

Ferrous Iron is highly soluble in the water. If conditions are right, groundwater pumped will appear clear and clean.But as soon as it comes in contact with the atmosphere, ferrous iron get oxidised and converted into ferric iron.This further react with the components in the water to form iron hydroxides.Sometimes water takes time to oxidised but it discolour.This water when used to wash clothes leave stain on it.

To get rid of high iron concentration, we need to find the source of it.The two possible source of high iron concentration are

1. Natural source
2. Corrosion

If the source the natural source than implementers have to install the iron removal plants in the hand pumps.If the source is corrosion then implementers have to install different type of handpumps.India Mark II are found to be an easy target for the corrosion.According to the online discussion(Furey, 2014) among the water supply specialist and practitioners on the technologies, based on which hand pumps are manufactured. Conclusion derived from the discussion indicated that 13 countries in sub- Saharan Africa, Bolivia and India are facing problems like corrosion and high iron concentration in rural water supplies. Motive of this online discussion was to find the cause of corrosion and the ways by which we can reduce it. There are 2 steps by which it can be controlled.

1. Before installing pumps, ground water should be monitored and tested. If high concentration of iron is found during this course of period, use of galvanized iron (GI) pump should be avoided.
2. Correct prediction of problem whether it is caused by the natural source or the corrosion. And then accordingly changing the GI pipes and pumps rods.

To understand, how corrosion affects the hand pump components World Bank/UNDP Project: did significant contribution between 1981 and 1986 for project ‘Laboratory and field testing and Technological Development of community Water Supply Handpumps’. This project aimed of testing and monitoring the 2700 hand pumps of 75 different types in 17 countries over the period of 5 years.Final report of this project emphasised on the hand pumps affected by corrosion.The effect of the corrosion in the area like africa and asia is far more widespread than the suspected.Final report highlighted the importance of corrosion resistant material. If the pH is above 7 than component is less likely to fall for it but if the ph is less than 6 then it likely to be aggressive to corrosion.Based on this project, Lanenegger further estimated the percentage of handpumps directly or indirectly effected by the groundwater or corrosion. He found that in southern and central ghana 66 percent and in Nigar and Southern Ghana 30 percent of handpumps were effected. These effected hand pumps were rarely used or were abandoned due to excessive iron concentration.Most of the handpumps failed due to deteriot quality of water rather than breakage of handpump components due to corrosion.

langenegger was able to predict the factor effecting the complexity of corrosion.It depend upon a number of factors and the lack of universal index in predicting the corrosion in every level of water quality.On the basis of data collected and analysed, he declared pH as the main factor effecting the corrosion and developed few guidelines for implementer to be followed before implementing handpump in an area.

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| pH | Application of galvanized material | Aggressivity of water |
| pH > 7 | Suitable | Negligible |
| 6.5 < pH ≤ 7 | limited | little to medium |
| 6 < pH ≤ 6.5 | Not recommended | Medium to heavy |
| pH ≤ 6 | Not recommended | Heavy |

(Source:langenegger, 1987)

World bank published one of his extensive and complete research-based resources on hand pump corrosion.This report was based on the research done by research on the field and the experiment carried out in the lab collected by them specially from West Africa. This report further revealed other characteristics of corrosion and the factors( geological, chemical, electrochemical, and biological) effecting it.Some of the important points from the conclusion are:

1. By the help of Simple pumping test, it can be concluded that corrosion is the factor behind the increase in the iron concentration the ground water over a period of time.
2. Galvanization only provide protection where pH lies between 6.5-7, it doesn’t work for pH below 6.5 for pipes and pumps.
3. Stainless steel pump rods work better in comparison to the galvanised pump rods.
4. concentration of natural iron in a region was rarely near 1 mg/L.

Different solutions were adapted in different regions.In Ghana, ghanaian government replaced India Mark II with the fully-corrosion resistant Afridev pump (Harvey et al., 2002) .Not only in Ghana, countries like Mozambique, Nigeria, Tanzania, Ethiopia, and a number of other countries also switched to Afridev pump from India Mark II (Baumann and Furey, 2013).Country like Zambia, replaced all the components of the hand pump with the stainless steel one which have increased the life of equipment and is providing iron free water (Harvey and Skinner, 2002) whereas Malawi has replaced it with PVC pumps and uPVC well chasing(Chilton and Smith-Carington, 1984; Lewis and Chilton, 1989).In India components of India Mark II were replaced from galvanised to PVC Components.

In Uganda, water was unfit to drink or use for daily purpose need to corrosion in the components of pump.To resolve this problem, all the components were replaced with stainless steel.This further helped in the invention of U3M(Uganda modified India MkIII) pump.These pump consists of stainless steel connecting rods and uPVC riser pipes(Harvey, 2003).

1. Ref: <https://www.who.int/features/qa/70/en/>
2. Ref: first paper in the literature folder in the drive