"Tale of Cancer Town from Malwa"
Analysis of Pesticides usage and Cancer cases in Malwa Belt

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Abstract: This paper offers a comprehensive overview of cancer cases and the specific types of cancers prevalent in a particular region of the world, with a focus on the environmental factors contributing to this issue. It delves into the extensive use of pesticides in the Malwa belt, providing statistical data on the number of cancer cases in the area. The study presents solid evidence supporting the correlation between the rising incidence of cancer and environmental pollution, specifically air and soil contamination resulting from pesticide usage and the burning of crop waste. The findings underscore the urgent need for addressing these environmental concerns to mitigate the health risks posed to the local population and reduce the incidence of cancer in the affected region.

KEY WORDS: Cancer, Pesticides, environmental, Carcinogens

Why I chose this topic:

I decided to write about the usage of pesticides and cancer cases in the Malwa district in order to raise awareness of a serious public health concern that has important environmental ramifications. The concerning increase in cancer cases that may be related to pesticide exposure highlights the urgent need for intervention. By researching this subject, I hope to increase public knowledge and promote better healthcare policies, sustainable farming methods, and community protection.

1. Introduction:

Cancer is developed when some group of cells have uncontrolled growth and spread in human body. It is complex group of disease which affects some part of human body ex. Skin, breast, lung, prostate etc. Main causes of cancer are genetic mutations, environment factors or lifestyle factors. The capacity of cancer to spread to other parts of the body, infiltrate neighbouring tissues, and develop out of control are some of its key traits. Cancer can take a lot of forms in your body, some common forms being Sarcomas, lymphomas, leukaemia, and carcinomas. Prolong Exposure to carcinogens is one of the most common ways to initiate cancer in human body. Carcinogens are those biological and chemical substances that alter the genetic material (DNA) within cells leading to uncontrolled cell group or cancer formation. Some carcinogens straight away don't alter DNA, they promote rapid cell division increasing chances of genetic errors.

We can divided carcinogens based on their nature:

1. Physical carcinogens include ultraviolet radiation from the sun, ionizing radiation from medical imaging tests, radon in dwellings, and X-rays.
2. Chemical carcinogens include arsenic, which is found naturally in the air, water, and soil,

   asbestos, tobacco smoke, alcohol-containing drinks, and aflatoxin, a fungus that contaminates food.
3. Biological carcinogens include parasitic, bacterial, and viral infections.

2. Risk Factors of Cancer:

Cancer is not like communicable disease that can communicate with human using touch or contact. Cancer can have various risk factors such as:

1. Genetic Factors: Cancer can be passed on to generations cause share DNA mutation caused by other factors. But it is not always true that cancer can pass through generations. There are some evidences in some types of cancers such as breast, ovarian etc.

2. Environmental Factors: Environmental factors are one of the major risk factors to cause cancer in humans. Exposure of radiation such as UV Radiation can cause serious issues. Carcinogens are again one of the major issue, where biological and chemical products can be contained with cancer causing carcinogens. Pollution is also another reason.

3. Lifestyle: Excess tobacco and alcohol consumption can cause mutation in lungs and liver respectively causing cancer. Heavy carnivore diet can increase chances of colorectal cancer. Less physical activity and obesity can also affect your body and produce cancer.

4. Biological factors and hormonal factors: Gender can be another reason as some cancers are basically connected with single gender like breast in women and prostate cancer in men. Age is also a factor as in old age, mutation due to carcinogens as body don't have high immunity. Hormone replacement therapy that is becoming common nowadays can lead to gender oriented cancers. Bad reproduction history like early menopause, early birth etc can cause gender related cancers.

3. Examples of Cancer in particular regions of world:

As we got to know that cancer can be cause by environmental reasons so in different places in world, environmental factors like climate, radiation, temperature, pollution can be different giving rise to high cases of cancer in that particular regions. For example:

a. Lung Cancer in China:

China being one of the biggest industrial countries of world, has some severe pollution issues. Due to high air pollution in major industrial towns or cities, there are quite a lot number of lung cancer cases. Additionally high tobacco smoking population is also an add-on factor.

b. Skin Cancer in Australia:

Australia being situated in southern hemispheres of earth experienced depletion of ozone layer. Ozone layer don't allow harmful UV rays to enter earth, but depletion of ozone layer due to CFCs in southern part of earth has caused skin cancer. There are a lot of skin cancer cases in Australia due to this reason.

c. Colorectal Cancer in United States:

United States being home to red meat eating population, is one of the major target of colorectal cancer. High body mass index and meat eating habits are the some main reasons of high number of colorectal cases in US.

d. Cervical Cancer in Sub Sahara Africa and India:

Presence of HPV (human papillomavirus) in these regions along with less awareness and vaccination of these infection has caused a lot of cases of cancer in these regions.

One of these region is Malwa district of Punjab, India where in recent time number of cancer cases have increased.

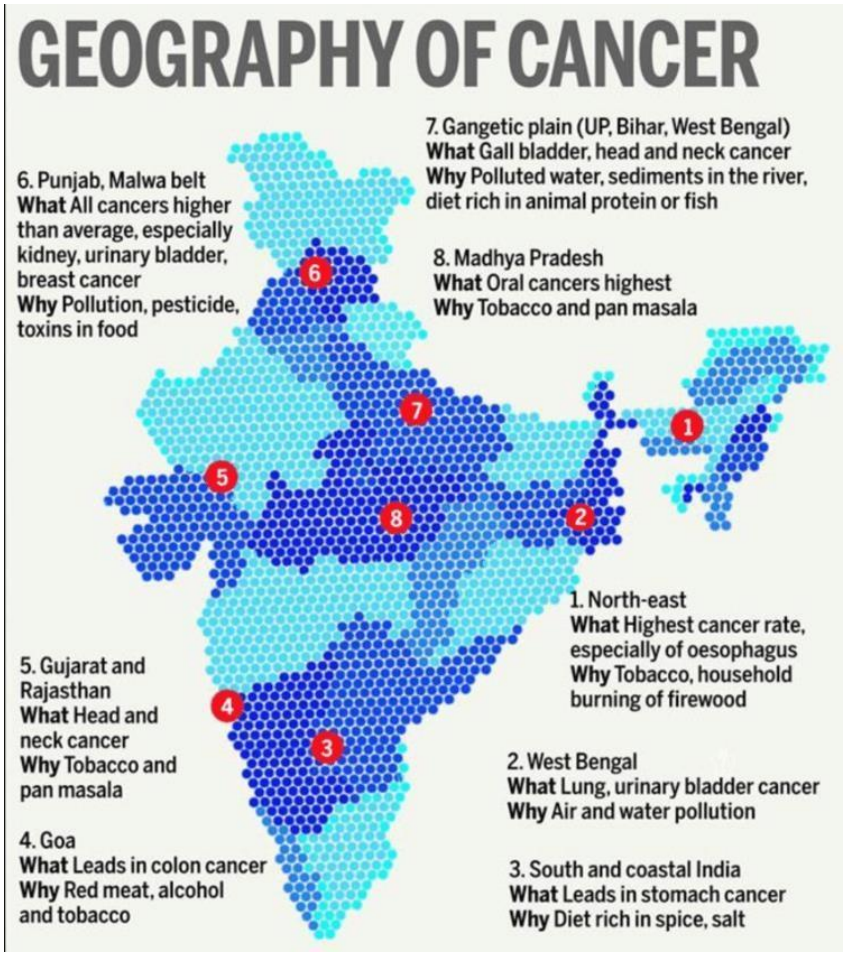


Figure 1: State wise cancer causes in India.

Citation - https://www.researchgate.net/figure/State-wise-Distribution-of-Cancer-and-Risk-Factors-Source-Ref_fig1_326930434

4. Cancer in Malwa Region:

Malwa region in Punjab, India consist places like Bathinda, Mansa and Muktsar. In recent time, there is an increase in number of cancer cases here and that's why it is also called 'Cancer belt of India'.

Malwa belt is also known as cotton belt and is a major agricultural area. There are major factors that are the reason for high number of cancer cases.

According to 2013 media report, there is average at least 90 cases per 100,000 people in Punjab. In Malwa belt, the number being 107 per 100,000 people which higher than average cases of India.

Average cancer cases in India is 80 per 100,000 and comparing it with cases in Malwa region, there is a significant increase.

What is causing cancer in Malwa Region?

a. Being agricultural land for so long, chemical and pesticides are being used in this area at alarming rates. Excessive and inappropriate use of chemical have contaminated soil and water of the region impacting rural population.

b. Presence of heavy metals in pesticides and fertilizers like Cd, Cr, Zn, Fe, Ni and Pb has been linked to increasing cases of breast cancer cases in the region.

c. Along with agriculture land, there are a lot of industries in these region. So due to not treating the pollutants from the factories properly, carcinogens materials like benzene, asbestos, and polycyclic aromatic hydrocarbons (PAH).

Bhatinda is a major city in this region and is also called 'Cancer capital of India'. Overall concentration of uranium, over usage of pesticides and excess usage of alcohol and tobacco are some major reasons.

A survey conducted by Government of Punjab in the region found:

S. No.	District	Population	No. of cancer patients	No. of cancer patients per lakh population
1	Muktsar	827906	453	54.7
2	Bathinda	1200736	711	59.2
3	Faridkot	585500	164	28
4	Mansa	731535	420	57.4

This number has increased significant in the past years.

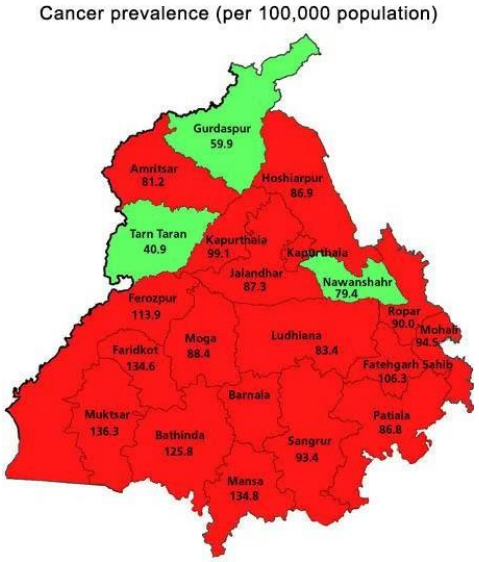


Figure 2: Number of cancer patients per 100,000 people.

Citation- *https://www.downtoearth.org.in/environment/punjab-cancer-capital-of-india-40255*

From above figure you can decode that major districts under Malwa region has the highest number ofcancer cases.

5. Prevention of Cancer in the region:

a. Primary:

- Alcohol & Tobacco consumption: The best chance of lowering the number of cancer fatalities from alcohol and tobacco use is through primary prevention of cancer. Primary prevention also controls alcohol and tobacco intake.

  It's been calculated that quitting smoking would cut the annual cancer burden by more than a million cases.

- Personal Hygiene: Reductions in certain cancers, such as cervical cancer, may result from improved personal hygiene.

- Radiation: Extra care should be taken to minimize each person's exposure to radiation,especially medical radiation, while maintaining the desired level of health.
- Occupational exposures: Industries should implement policies that shield employees from industrial carcinogen exposure.
- Immunization: Vaccination against the Hepatitis B virus may be effective in cases of primary liver cancer.
- Cosmetics, medications, and foods: They should all be examined for carcinogens.
- Air Pollution: Another preventive step is to control air pollution.
- Treatment of Precancerous Lesions: One of the most crucial phases in cancer prevention is the early identification and timely treatment of precancerous lesions such as intestinal polyps, warts, chronic gastritis, chronic cervicitis, and cervical tears.
- Law: Law has a part in primary prevention as well. Legislation to restrict environmental carcinogens like alcohol, tobacco, and air pollution is one example of how legislatures might address the cancer problem instead of research labs.
- Health Education: A crucial component of primary prevention is health education. Its goal isto encourage people to seek out early diagnosis and expensive treatment. Among the key indicators of cancer warning signs are:
    - A hard spot or lump in the breast; a transition to a mole or wartAn ongoing shift in bowel and digestive patterns
    - A chronic cough or hoarse voice
    - An excessive loss of blood during the monthly period or blood loss outside of the regular periods
    - A swelling or sore that does not go away
    - Blood loss from any natural orifice (Opening)
    - Inexplicable weight loss

b. Secondary:

- Registration for Cancer: It offers a foundation for determining the scope of the issue and fororganizing the required services. There are essentially two kinds of cancer registries:
    - Registries located in hospitals: This covers every patient seen by a certain both inpatients and outpatients at the facility. The population in hospitals is always chosen, hence there is limited value of these registries for epidemiological research.
    - Registries based on population: Covering the whole cancer population in a specific geographic area is the goal of this. These registries' data can be used to calculate the incidence rate of cancer and as a helpful epidemiological tool.
- Early Case Identification: The primary method for identifying cancer early, before it becomes intrusive or malignant, is cancer screening. A successful screening program has been established for oral, breast, and cervical cancer.
- Treatment: Palliative care, chemotherapy, radiotherapy, and surgery are available for the treatment of cancer.

6. Cancer Train of India:

Around 9 pm every day, a train runs from Bhatinda Station of Malwa region to Bikaner in Rajasthan. The foremost exceptional include of this prepare is that 60% of its populace are cancer patients of all ages who come from all over

Punjab. This 12-coach prepare has picked up its title from a sudden increment in cancer cases in Punjab that numerous fault on pesticide utilize, developing contamination and barely any reaction by specialists.

On an normal, this prepare is the help of 100 cancer patients day by day, beside 200 other co-travellers and is nearly continuously pressed to approach capacity.

The ticket is estimated at Rs 210, but for cancer patients the eight hour travel to Bikaner is free,whereas one going with orderly gets a concession of 75 percent.

All the patients on board the prepare attempt this travel to visit Acharya Tulsi Territorial Cancer Clinic and Investigate Middle in Ruler Bijay Singh Dedication Clinic, in Bikaner, which like numerous clinics in Punjab is additionally secured for benefits beneath the Mukh Mantri Punjab Cancer Raahat Kosh Conspire (MMPCRKS).

7. Correlation and Regression in Statistics :

Correlation in statistics is a fundamental concept used to quantify and describe the relationships between variables. It allows us to understand how two or more variables are related and to what extent changes in one variable correspond to changes in another. At its core, correlation provides valuable insights into patterns and associations within data.

The most commonly used measure of correlation is the Pearson correlation coefficient, denoted as "r." This coefficient assesses the strength and direction of the linear relationship between two continuous variables.

A positive value of "r" suggests a positive linear correlation, meaning that as one variable increases, the other tends to increase as well.

Conversely, a negative value of "r" indicates a negative linear correlation, where one variable tends to decrease as the other increases.

A correlation coefficient of zero signifies no linear relationship between the variables.

The formula for the Pearson correlation coefficient (commonly denoted as "r") in statistics is as follows:

$$r = \frac{n(\sum xy) - (\sum x) - (\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2]} * \sqrt{[n\sum y^2 - (\sum y)^2]}}$$

In this formula:

- 'r' represents the Pearson correlation coefficient, which measures the strength and direction of the linear relationship between two variables.
- 'n' is the number of data points (observations).
- 'x' and 'y' are the two variables for which you want to calculate the correlation.
- ∑xy represents the sum of the products of the corresponding values of x and y.
- ∑x and ∑y represent the sums of all the values of x and y respectively.
- $\sum x^2$ and $\sum y^2$ represent the sums of the squares of all the values of x and y respectively.

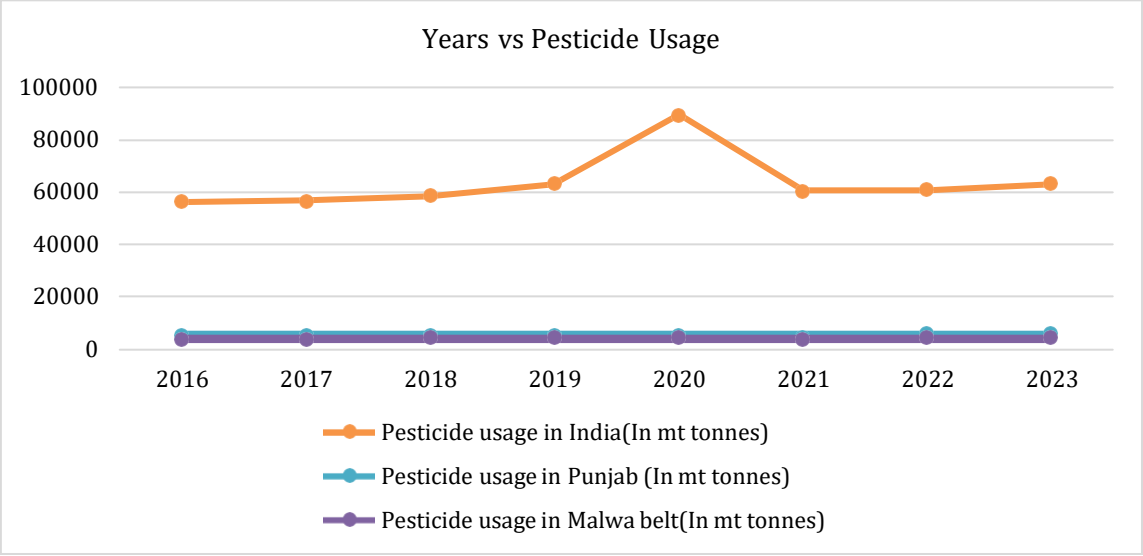
Regression analysis is a vital statistical tool that plays a central role in understanding and quantifying relationships between variables. At its core, regression seeks to model and predict the behaviour of a dependent variable based on the values of one or more independent variables. It provides a systematic way to explore and measure the impact of these independent variables on the outcome of interest. The most common form of regression is linear regression, which assumes a linear relationship between thevariables.

8. Analysis and Calculations:

a. Pesticide usage in India, Punjab and Malwa Belt:

Year	Pesticide usage in India (In mt tonnes)	Pesticide usage in Punjab (In mt tonnes)	Pesticide usage in Malwa belt (In mt tonnes)
2016	56268	5689	4266.75
2017	56720	5743	4307.25
2018	58634	5843	4382.25
2019	63406	5835	4376.25
2020	89676	5843	4382.25
2021	60599	4930	3697.5
2022	61000	5950	4462.5
2023	63130	6135	4601.25

- 75 % of pesticides in Punjab is used in Malwa Belt due to high percentage of cotton production.



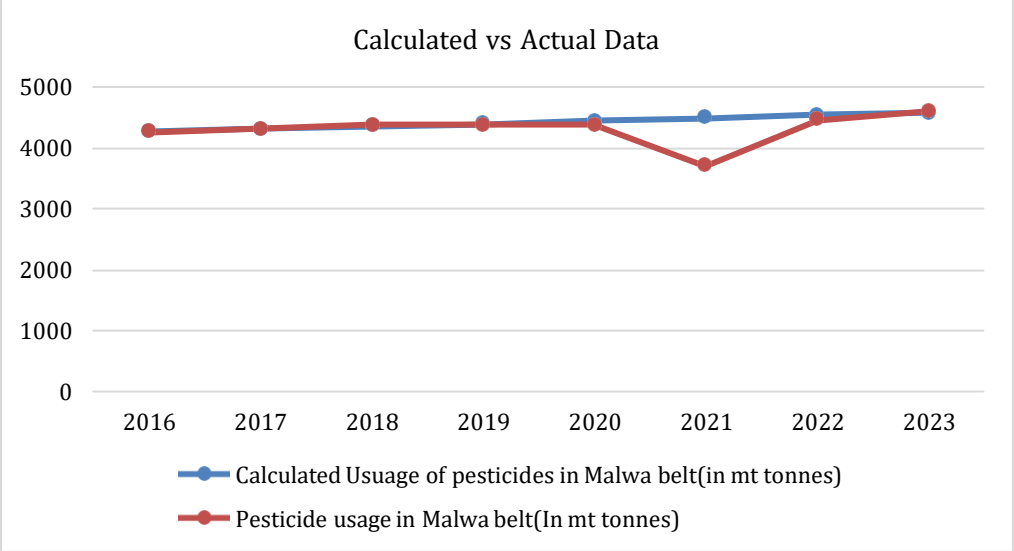
b. Calculated usage of Pesticides in Malwa Belt:

In graph, x-axis as years from 2016 to 2023 and Y-axis will show usage of pesticides in Malwa Belt (in mt. tonnes)

Let's consider 2016 as 1, 2015 as 2 .... 2023 as 8.

After manually drawing graph and on excel.

We concluded exponential equation covers maximum number of plots considering $y=a*b^x$



Formula: $y = 4227*(1.01)^x$

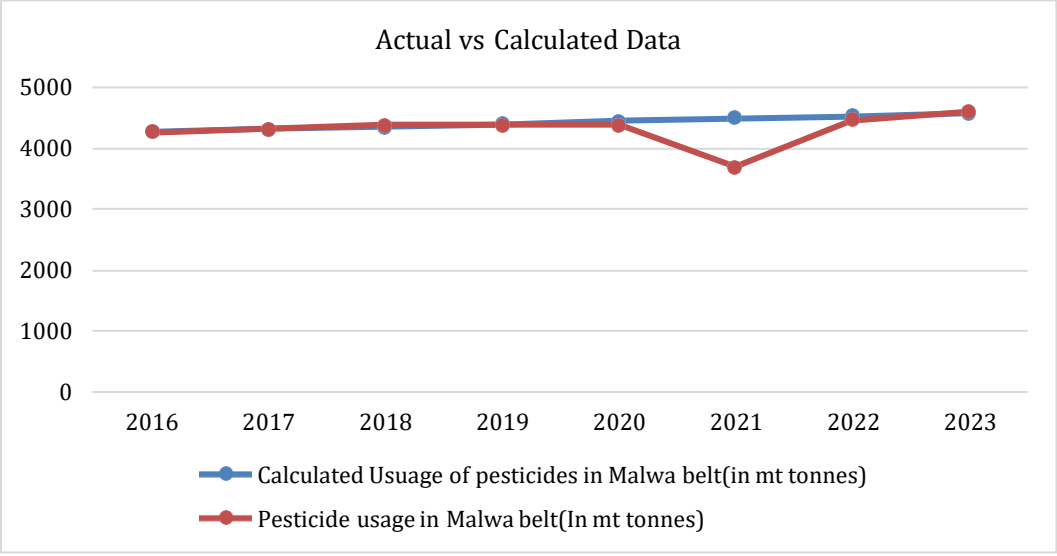
Where "y" represents usage of pesticides (in mt. tonnes) and "x" represents 1, 2,3……(1 represents 2016, 2 represents 2015 and so on).

c. Cancer cases in Bhatinda District (Major district in Malwa Belt):

In graph, x-axis as years from 2016 to 2023 and Y-axis will show no. of cancer cases (in '000). Let's consider 2016 as 1, 2015 as 2 ..... 2023 as 8.

After manually drawing graph and on excel.

We concluded quadratic equation covers maximum number of plots considering $y=ax^2+bx+c$

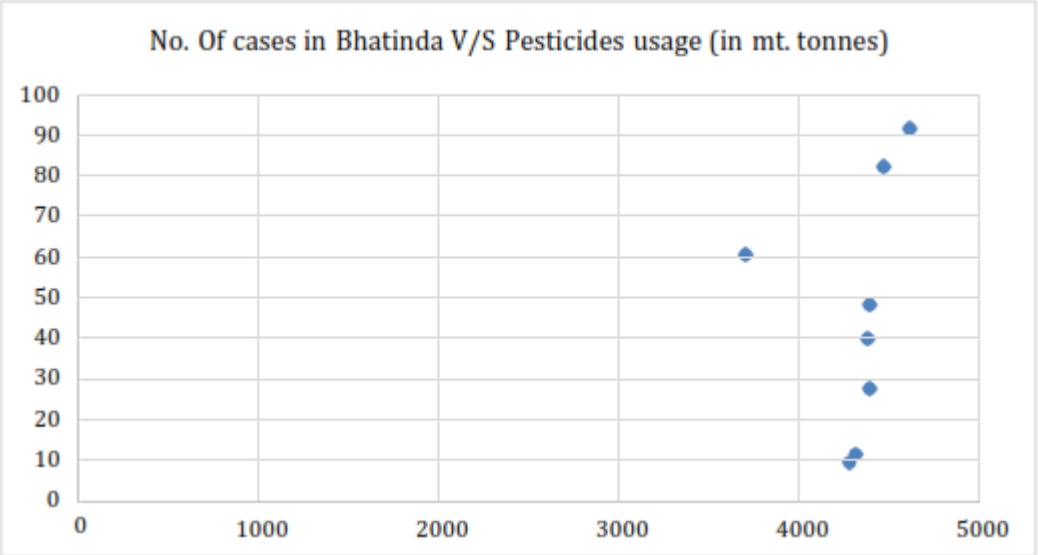


Formula: y= =0.5654*x²+7.2511*x-1.125

Where "y" represents no. of cancer cases (in '000) and "x" represents 1, 2,3……(1 represents 2016, 2 represents 2015 and so on).

d. Correlation between pesticides usage (in mt. tonnes) and number of cancer cases:

Graph between pesticides usage in Malwa Belt (in mt. tonnes) at X-Axis and number of cancer cases in Bhatinda District (in '000) at Y-Axis.



Correlation factor = r = 0.9314

9. Conclusion:

There may be a connection between pesticide use and public health because the Malwa region of Punjab, India, has seen a sharp increase in cancer cases. This district has a higher than average cancer incidence rate, according to a number of studies and reports, which has led to inquiries into farming methods and environmental variables. It has been determined that pesticides, which are widely utilized in the area to increase crop yields, are probably a factor in the growing health crisis. Despite their effectiveness in controlling pests, these pesticides leave behind hazardous residues that can contaminate the air, water, and soil, seriously endangering the health of the local population.

Solving this problem requires a multimodal strategy. Important actions include encouraging organic and sustainable farming methods, tightening regulations and monitoring of pesticide usage, and raising public knowledge of the risks associated with pesticide exposure. In the Malwa district, frequent health examinations and the provision of healthcare facilities can also aid in the early diagnosis and treatment of cancer, hence lowering death rates.

In conclusion, Malwa's startling cancer rates underscore the pressing need for all-encompassing steps to lessen the negative consequences of pesticide use. The region can strive to protect its people from the devastation caused by cancer by implementing safer farming techniques and fortifying its healthcare system.

10. References:

1. https://www.cancer.gov/about-cancer/understanding/what-is-cancer
2. https://my.clevelandclinic.org/health/diseases/12194-cancer

3. https://stanfordhealthcare.org/medical-conditions/cancer/cancer/cancer-types.html
4. https://ncdirindia.org/display/wcd.aspx
5. https://pubmed.ncbi.nlm.nih.gov/36510887/
6. https://timesofindia.indiatimes.com/life-style/health-fitness/health-news/whats-driving- cancer-rate-in-malwa-the-cotton-belt-of-the-country/articleshow/108362171.cms
7. https://www.downtoearth.org.in/environment/punjab-cancer-capital-of-india-40255
8. https://www.ijcrm.com/publish_article/edition_3/I0134145.pdf
9. https://www.hindustantimes.com/health-and-fitness/how-pesticides-use-have-led-to-high- cases-of-cancer-in-punjab/story-Kkt6ocFttvZ5SlCzo260qL.html
10. https://www.businessinsider.in/the-shocking-tale-of-indias-cancer- train/articleshow/52690219.cms

11. Biographies:

Mihir Gupta

- Being a 17-year-old entrepreneur. I am driven by my keen interest in economics and business. I am excited to pursue business for my undergraduate studies.
- My love for the environment inspires me to do my bit for society.
- Founder-Amore Le Bain
- My first venture which was a hobby converted into a homegrown business is a soap brand called Amore Le Bain by M .It is a platform for me to sell organic soaps and use the money for a good cause.
- I am a nature enthusiast and foodie and I have developed a website FoodThyMedicine.com.
- I am also very fond of robotics and have won two records at the India Book of Records in 2021 and 2024, I have also won many robotics competitions worldwide and I hope to continue all these activities at university.

Under the guidance of:

Dr. Mamta Jain

- M.Sc (Mathematics) (Double gold medalist)
- M.Phil (Computer Applications) with honors From University of Roorkee (now IIT Roorkee)
- PhD (Mathematics) -Various papers published in international journals
- Former Lead Auditor ISO 9001,ISO -22000 School Accreditation Examiner by QCI
- 26 years of teaching experience
- Various Research Paper Published

Er. Raunaq Jain

- B.E Mechanical Engineering From Thapar Institute of Engineering and Technology
- District Physics Topper
- Content Writer and graphic designer
- Mechanical Mentor from session 2019-2020
- Technical Data Analyst at Deloitte