- **Lack of common standards and interoperability:** No proper standards are in place to store, manage and access data using analytical techniques.
- **Sharing of data:** Sharing data between departments and across ministries is a challenge, given the jurisdictional boundaries that exist.

Despite these challenges, big data analytics is transforming the way government is using sophisticated information technologies to frame policies and deliver services.

11. *Elaborate on the concept, methodology and applications of DNA Fingerprinting.*

Approach:

- Briefly define the concept of DNA Fingerprinting.
- Bring out the methodology of DNA Fingerprinting technique.
- Highlight the application of DNA Fingerprinting.

Answer:

DNA fingerprinting is a molecular genetics technology that enables identification of individuals using hair, blood, semen, or other biological samples, based on unique patterns (polymorphisms) in their DNA. The technique was developed in 1984 by British geneticist Alec Jeffreys and is also called genetic fingerprinting, DNA typing, and DNA profiling.

- **Medical definition** of DNA fingerprinting: A technique used especially for identification (as for forensic purposes) by extracting and identifying the base-pair pattern of an individual's DNA.
- **Legal definition** of DNA fingerprinting: A method of identification especially for evidentiary purposes by analyzing and comparing the DNA from tissue samples.

Methodology of DNA Fingerprinting:

- The DNA fingerprinting methodology either uses Restriction Fragment Length Polymorphism (RFLP), Polymerase Chain Reaction (PCR), or both.
- Each method targets different repeating polymorphic regions of DNA, including single nucleotide polymorphisms (SNPs) and short tandem repeats (STRs).
- The procedure for creating a DNA fingerprint consists of first obtaining a sample of cells, such as skin, hair, or blood cells, which contain DNA. The DNA is extracted from the cells and purified.
- One small DNA fragment can used to make a thousand to million copies. This amplified DNA sample then undergoes a technique called **Gel Electrophoresis**, which splits it into different visible bands.
- The band pattern formed by an individual's DNA is unique. The bands of two or more DNA samples can then be compared using software.

Applications of DNA Fingerprinting:

- **Criminal identification**: It can be used to determine whether a particular individual's DNA matches with the DNA found at a crime scene.
- **Noncriminal identification:** To resolve disputes of maternity /paternity i.e., to establish a blood relationship between two people, identifying missing persons and unidentified decedents, mutilated remains and body
- **Biological classification**: It can help in establishing evolutionary change and relationships on the molecular level.
- **Medicine:** DNA fingerprinting can used in identifying good genetic matches for organ or marrow donation. It is also used as a tool for designing personalized medical treatments for cancer patients.
- **Agriculture:** DNA fingerprinting can be used to identify genetically modified plants or plants that are likely to have therapeutic value.

Globally various government agencies are using DNA fingerprinting to identify individuals for legal and medical purposes. The Combined DNA Index System (CODIS), of Department of Justice and the FBI in US combines computer technology with forensics, enabling investigators to compare DNA samples against a database of DNA records of convicted offenders and others.