Using New Techniques for measuring outcomes

RAJ G VISWANATHAN, DEPUTY CAG, SAI INDIA

Part 1: Measuring Outcomes in Higher Education

Part 2: Use of Technology Tools

Measuring Outcomes in Higher Education....
.....setting the context

- **Numbers**: Total no of Universities in India 993, No of Colleges 39,932
- **Gross Enrolment Ratio** of population between 18 to 23 years: **India-27** and the Global Average is 37
- **Audit of Higher Education by SAI India**: Most of the Audit Reports on Higher Education Institutions previously focussed mainly on compliance to parameters of manpower, funds, infrastructure, access, equity, management and governance

The **widening gap between the expectation of stakeholders and policies and initiatives of the Government** warranted a change in the Audit approach of SAI India to **move towards Outcome Based Auditing**

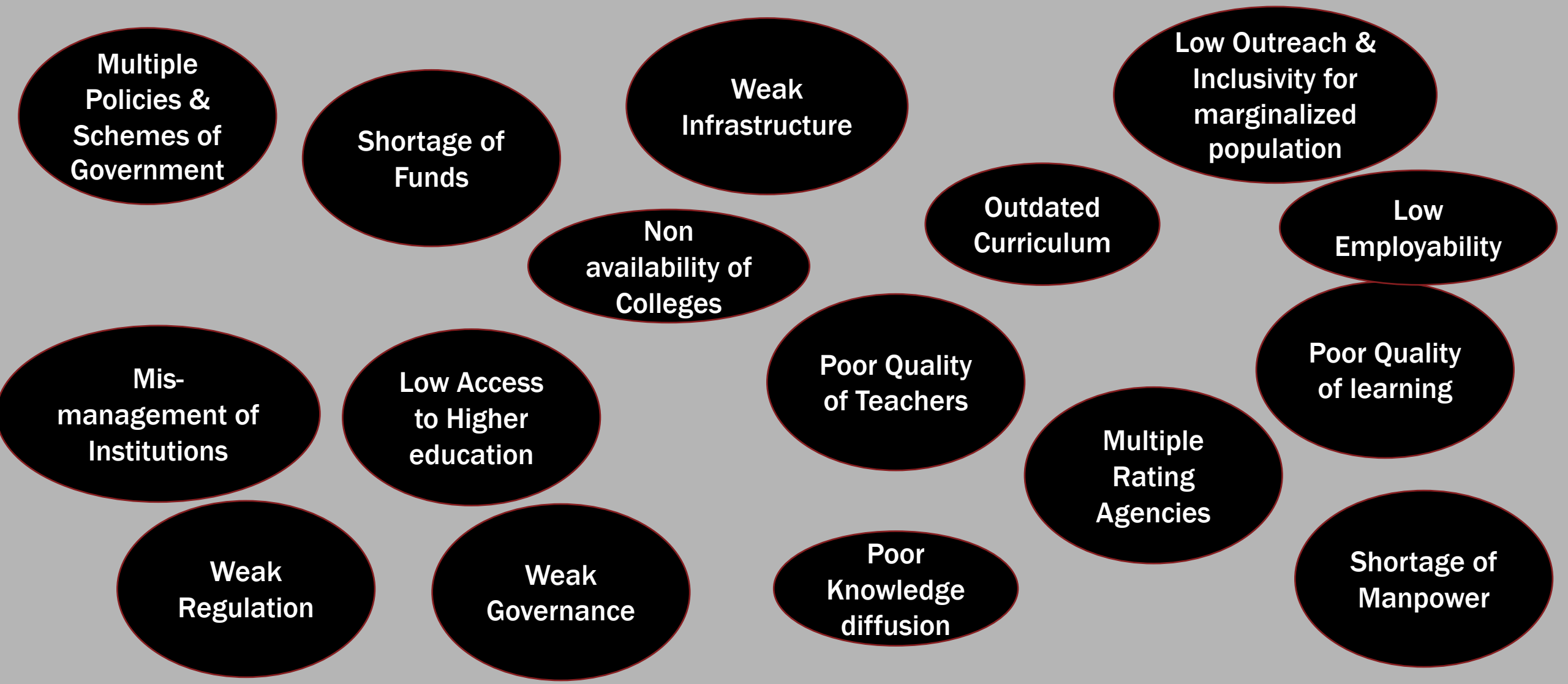
Methodology adopted for measuring Outcomes in Higher Education

1. Comprehensive understanding of policy, governmental programmes & analysis of data
2. **Identifying Inputs, Outputs and Outcomes of Higher Education**
3. **Developing Benchmarks and criteria/proxy criteria for evaluation of Outcomes**

Stakeholders Consultations

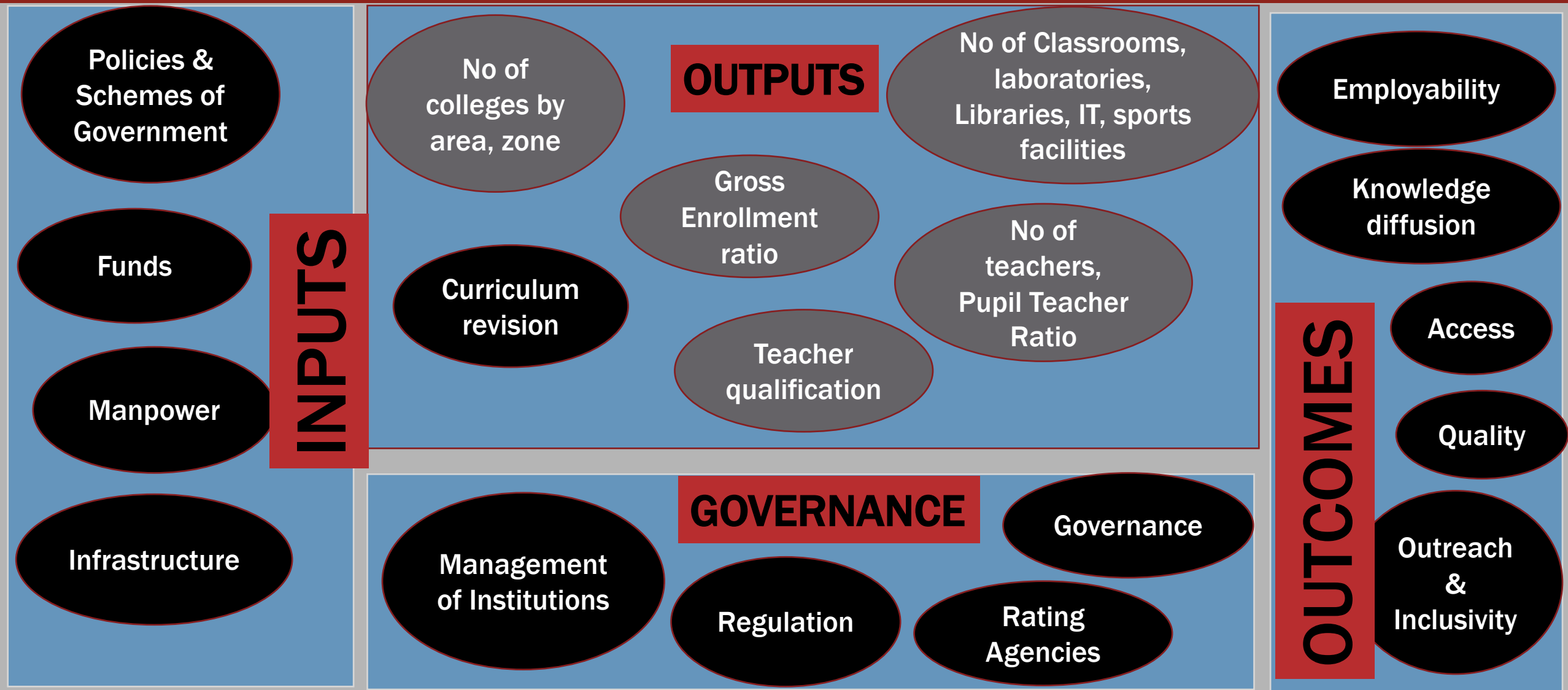
Concerns of stakeholder

Students, Teachers, Industry, Research Bodies, Government Education Departments, Regulatory Agencies, Rating Agencies, General Public, Subject matter experts

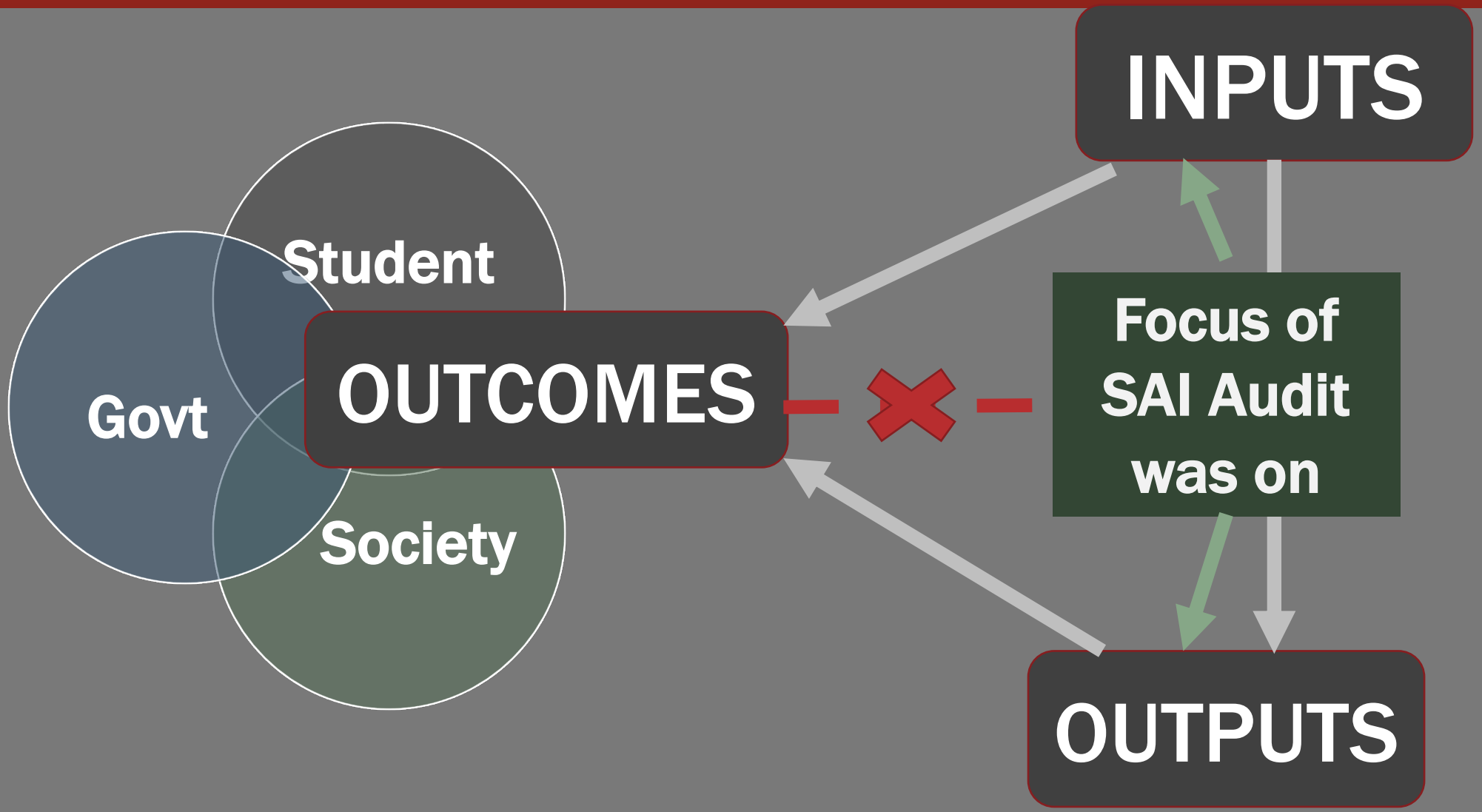


Developing Audit approach

...based on concerns of stakeholder, subject matter experts and our experience

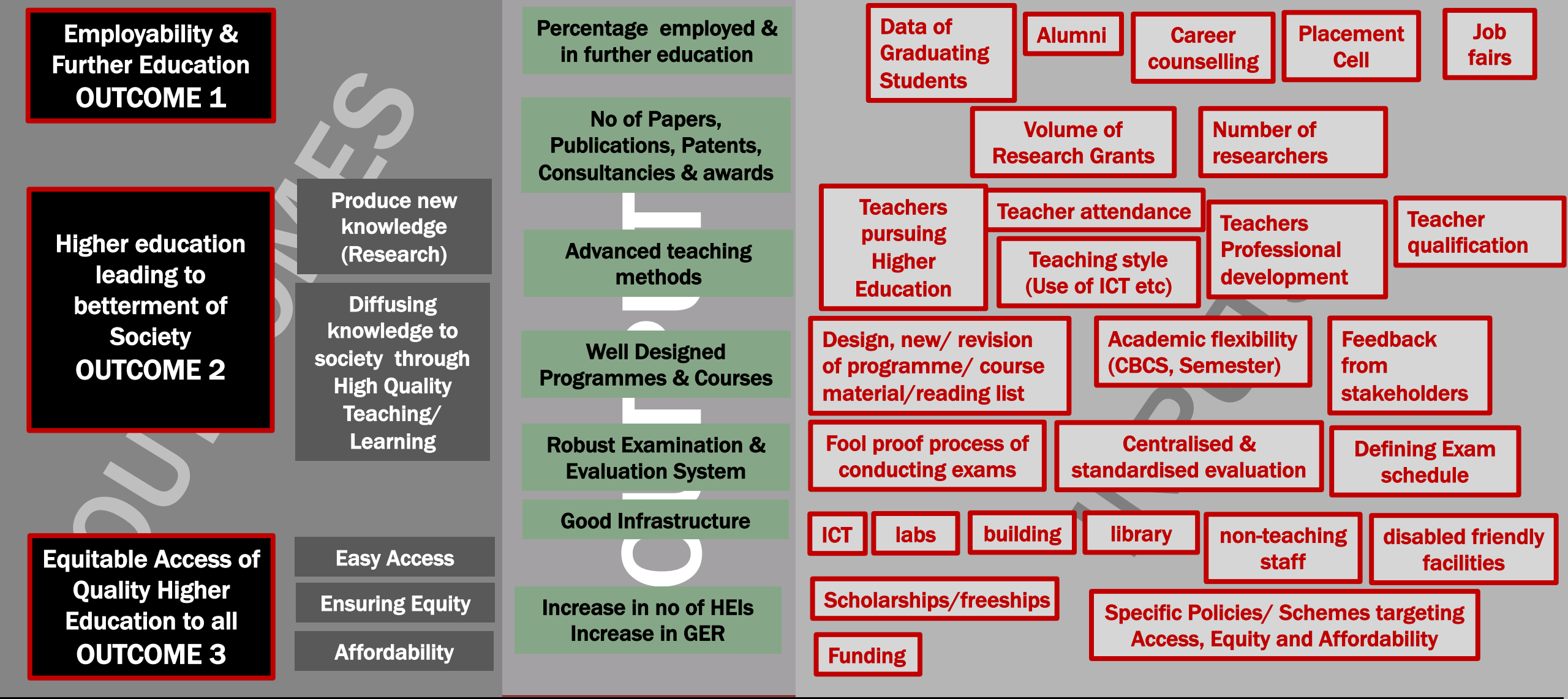


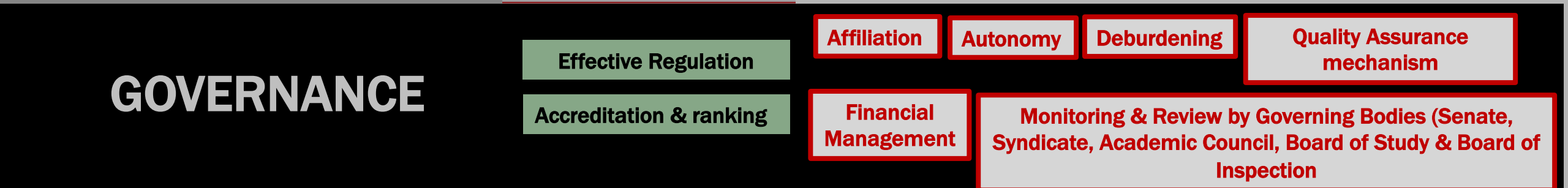
Developing Audit approach.... Understanding outcomes

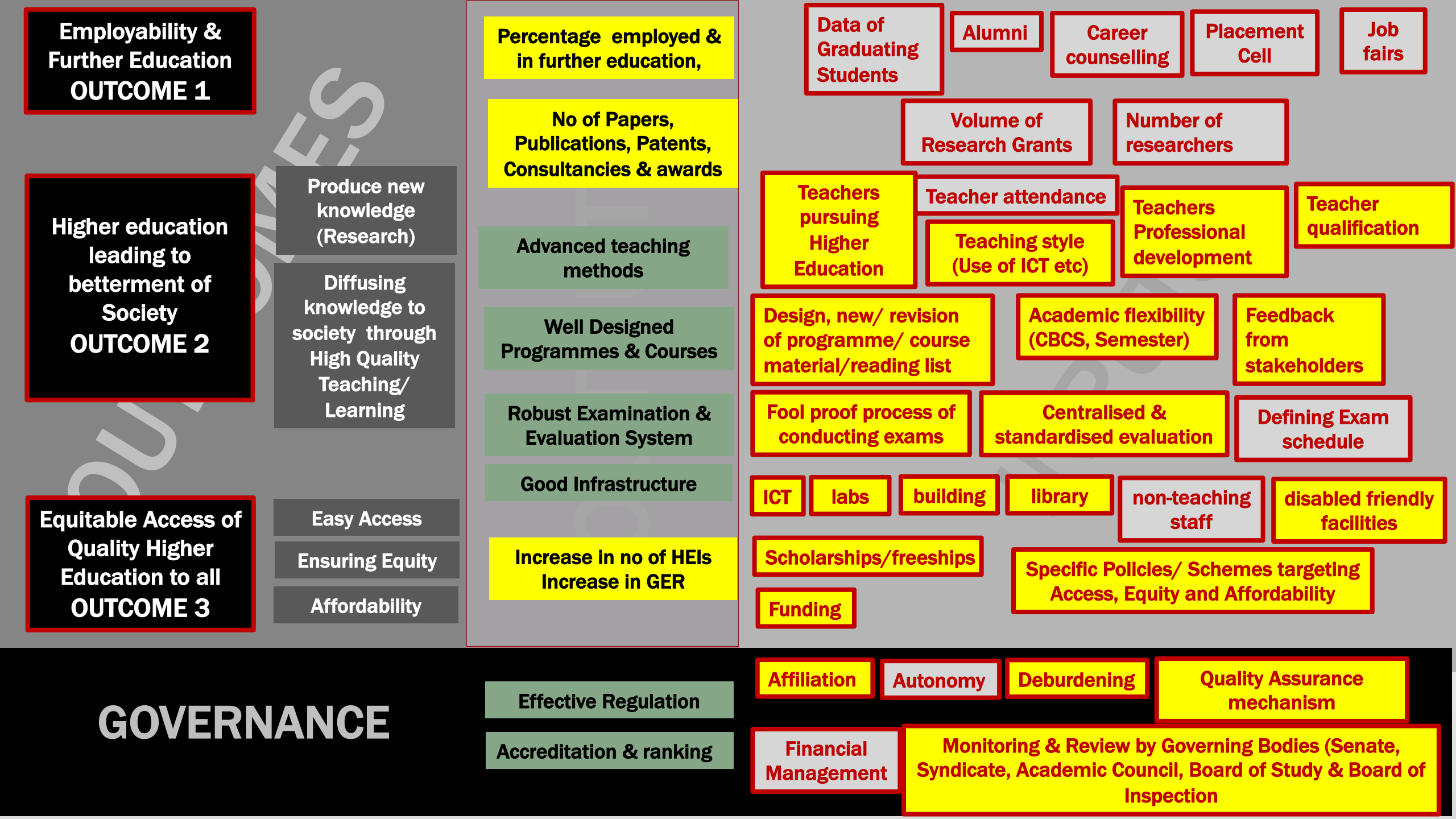


and finally based on our stakeholders and all the ground work, ... we embarked on our detailed Audit Design Matrix

PS: Each country would have its own policies, nuances and stakeholder requirements. Hence this modal may not be universally replicable


Employability & Further Education OUTCOME 1
Higher education leading to betterment of Society OUTCOME 2
Equitable Access of Quality Higher Education to all OUTCOME 3
Produce new knowledge (Research)
Diffusing knowledge to society through High Quality Teaching/ Learning
Easy Access
Ensuring Equity
Affordability
Percentage employed & in further education
No of Papers, Publications, Patents, Consultancies & awards
Advanced teaching methods
Well Designed Programmes & Courses
Robust Examination & Evaluation System
Good Infrastructure
Increase in no of HEIs Increase in GER
Data of Graduating Students
Alumni
Career counselling
Placement Cell
Job fairs
Volume of Research Grants
Number of researchers
Teachers pursuing Higher Education
Teacher attendance
Teaching style (Use of ICT etc)
Teachers Professional development
Teacher qualification
Design, new/ revision of programme/ course material/reading list
Academic flexibility (CBCS, Semester)
Feedback from stakeholders
Fool proof process of conducting exams
Centralised & standardised evaluation
Defining Exam schedule
ICT
labs
building
library
non-teaching staff
disabled friendly facilities
Scholarships/freeships
Funding
Specific Policies/ Schemes targeting Access, Equity and Affordability
OUTCOMES
OUTPUT


GOVERNANCE
Effective Regulation
Accreditation & ranking
Affiliation
Autonomy
Deburdening
Quality Assurance mechanism
Financial Management
Monitoring & Review by Governing Bodies (Senate, Syndicate, Academic Council, Board of Study & Board of Inspection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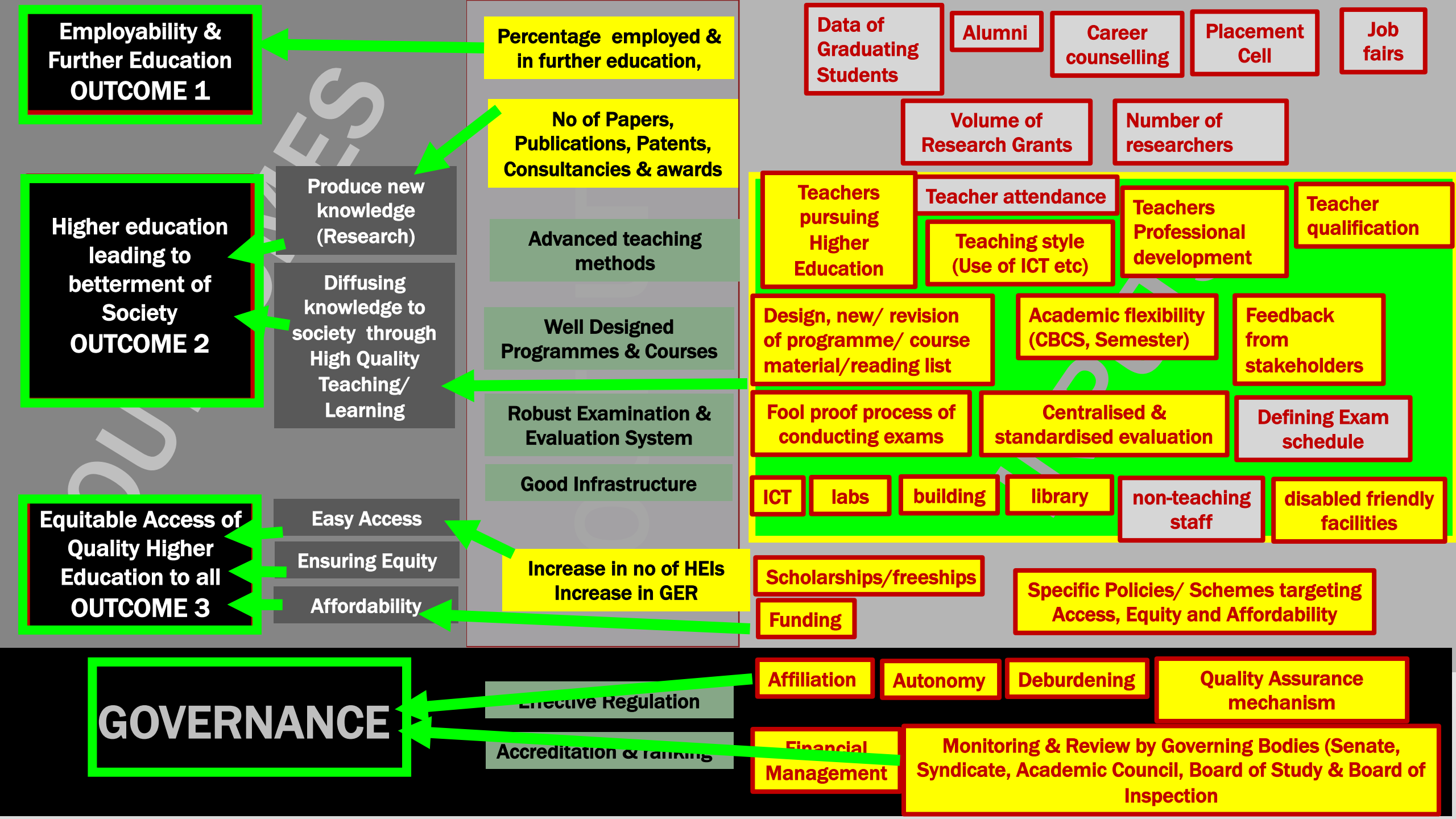
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Methods adopted and status

1. Extensive consultations with stakeholder and subject matter experts for identifying outcomes
2. Comprehensive understanding of policy statements and data from governments, municipalities, colleges & universities for identifying inputs, outputs and governance mechanisms
3. Detail analysis including methodologies adopted by rating agencies for identifying input, output indicators for measuring outcomes
4. Development of criteria/proxy criteria to measure outcomes where direct benchmarked criteria not available
5. SAI India has published many state level reports on Outcomes in Higher Education from 2021-22 onwards.

(Rajasthan: https://cag.gov.in/en/audit-report/details/114378)

1. Measuring Outcomes in Higher Education

2. Use of Technology Tools for measurement of Outcomes

Use of Technology Tools

- Constant innovation in SAI, India in pursuit of excellence
- High priority accorded to advanced tools in Performance/ Complaince audits for improving efficiency and effectiveness
- Tools such as Remote Sensing Technology using satellite imaging, Geographic Information System (GIS), Google Earth imaging, Unmanned Aerial Vehicles (UAVs), Quad copters, Multi-frequency receivers etc

Storm water management

Illegal sand mining

Illegal quarrying

Encroachments in National Parks

Performance Audits conducted using innovative technologies with assistance from reputed institutions, experts.

Use of remote sensing and GIS in storm water management

- **Audit objective:** Examine storm water management in Bengaluru city to tackle urban flooding and water scarcity.
- One of the main causes of flooding in Bengaluru was **inadequate management of storm water drains**. Absence of complete maps was a major constraint.
- **Technology:** Time-series satellite imagery and geospatial analysis tools like ArcGIS (Geographic Information System) software were utilised to clearly visualise and analyse very large areas of the city.
- Time Series maps were used effectively to depict changes in lakes, drainage and land use between 1965 and 2017.

CAG Report: Performance Audit of Management of storm water in Bengaluru Urban area .... Government of Karnataka Report no. 2 of the year 2021

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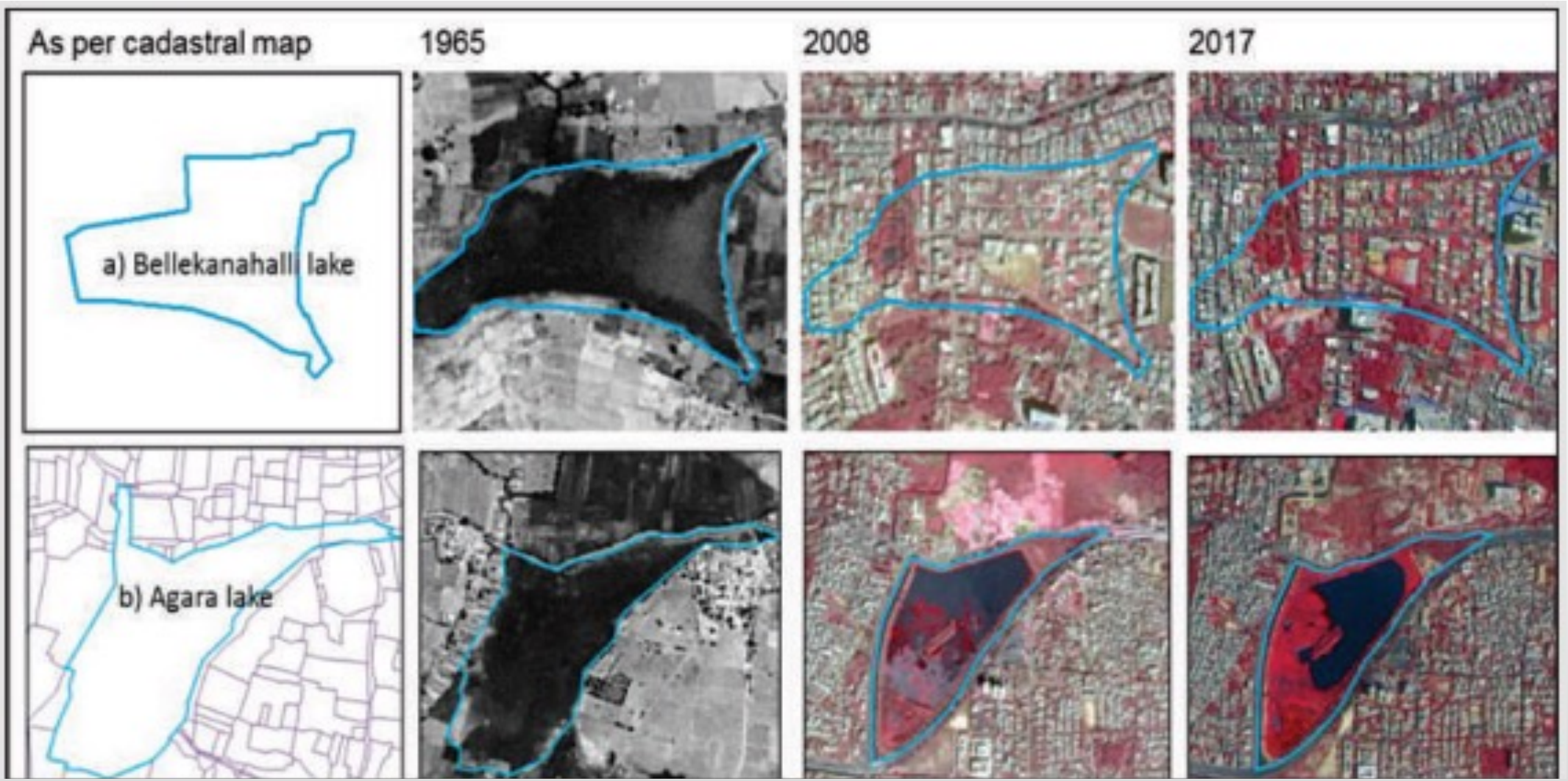
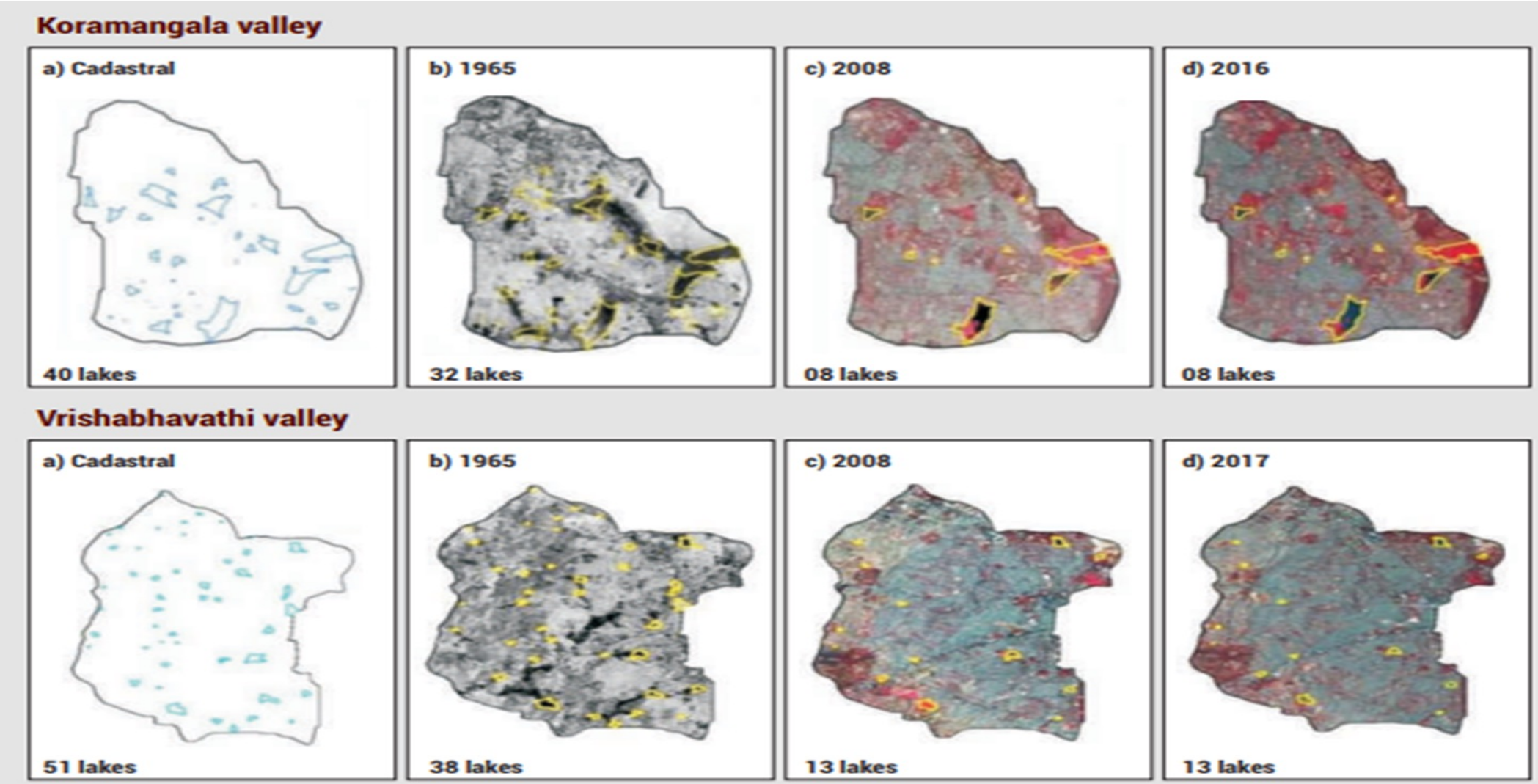
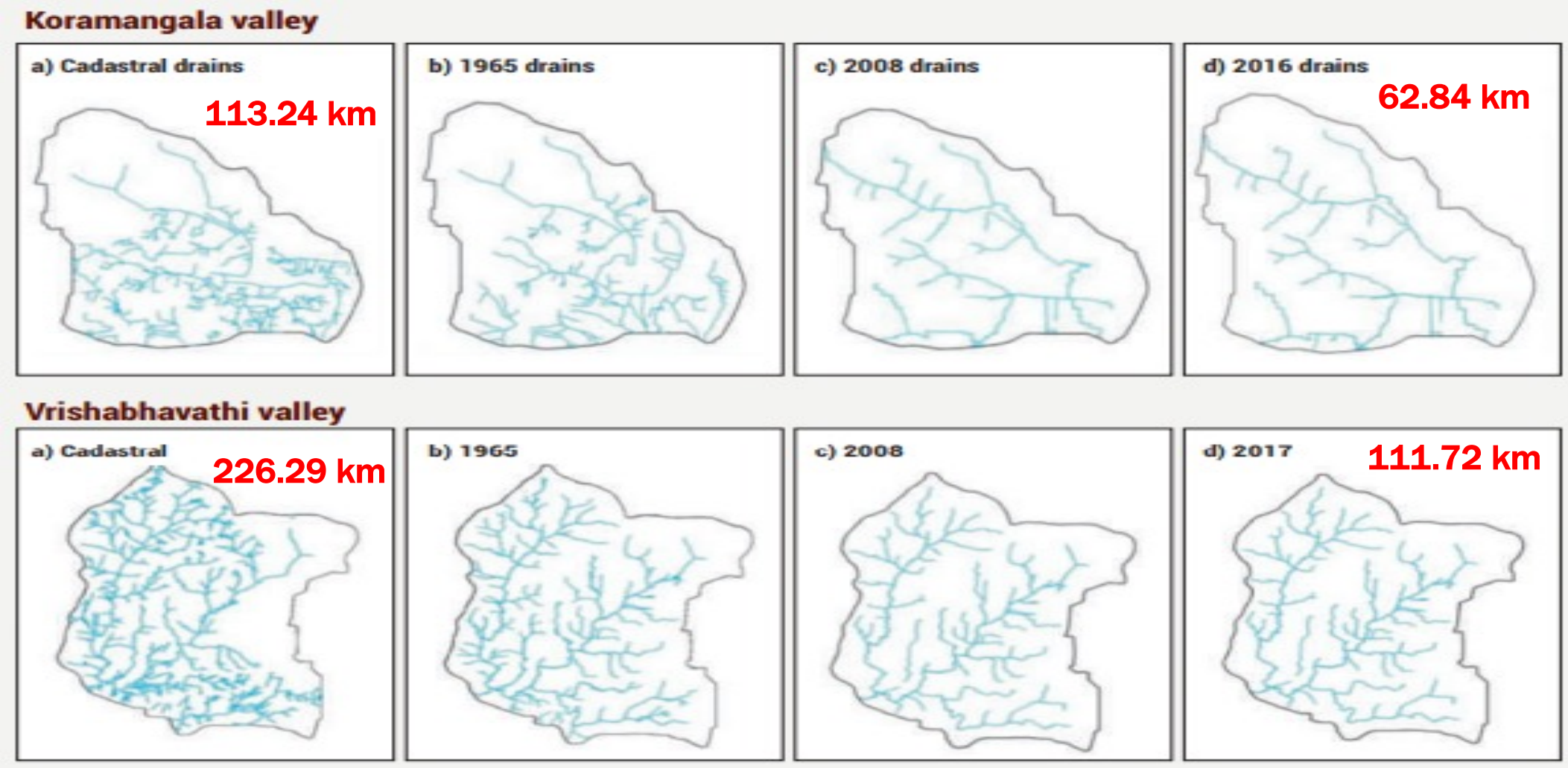
Audit Finding: Encroachment of lakes/drains and depletion of natural drainage systems resulting in loss of inter-connectivity between water bodies and increase in runoff of storm water



Audit Finding: Time-series map showing decreasing numbers of lakes /tanks; Cadastral maps pertain to early 1900s



Audit Finding: Time-series drainage maps show that in Koramangala Valley the length of drains reduced from 113.24 km as per cadastral maps to 62.84 km by 2016 and in Vrishabhavathi valleys from 226.29 km to 111.72 km by 2017



Significant impact of the Report of 2021

Bengaluru Rains: Did IT capital ignore warnings that could have avoided rain mess? (timesofindia.indiatimes.com) SEPT 09, 2022

Heavy rainfall paralyzed the IT city, Bengaluru in the past few days. Posh residences, luxurious cars were all under water and the owners were evacuated in tractors. **The CAG had warned the authorities but no one paid heed to it. The CAG talked about a report of IISc in which it stressed on two key points- shrinking lakes and drains and on land use.**

Video Link: https://timesofindia.indiatimes.com/videos/toi-original/bengaluru-rains-did-it-capital-ignore-warnings-that-could-have-avoided-rain-mess/videoshow/94105143.cms

Use of Unmanned Aerial Vehicles in detecting illegal sand mining

- **Audit objective:** Quantify extent of area & volume of sand mining in Tamil Nadu
- **Technology:** Fixed Wing UAV (High-resolution camera mounted), Quadcopters & Multifrequency DGPS receivers were used for survey of entire study area.
- **Audit Findings:** Discrepancies between Geo co-ordinates of mines reported in the approved mining plans and environmental clearances. **Actual quarrying more than the licensed Area, Depth, Volume of sand and Number of permitted Excavators.**

CAG Report: Performance Audit on Tamil Nadu Biodiversity Conservation and Greening Project .... Government of Tamil Nadu Report No. 7 of the year 2017

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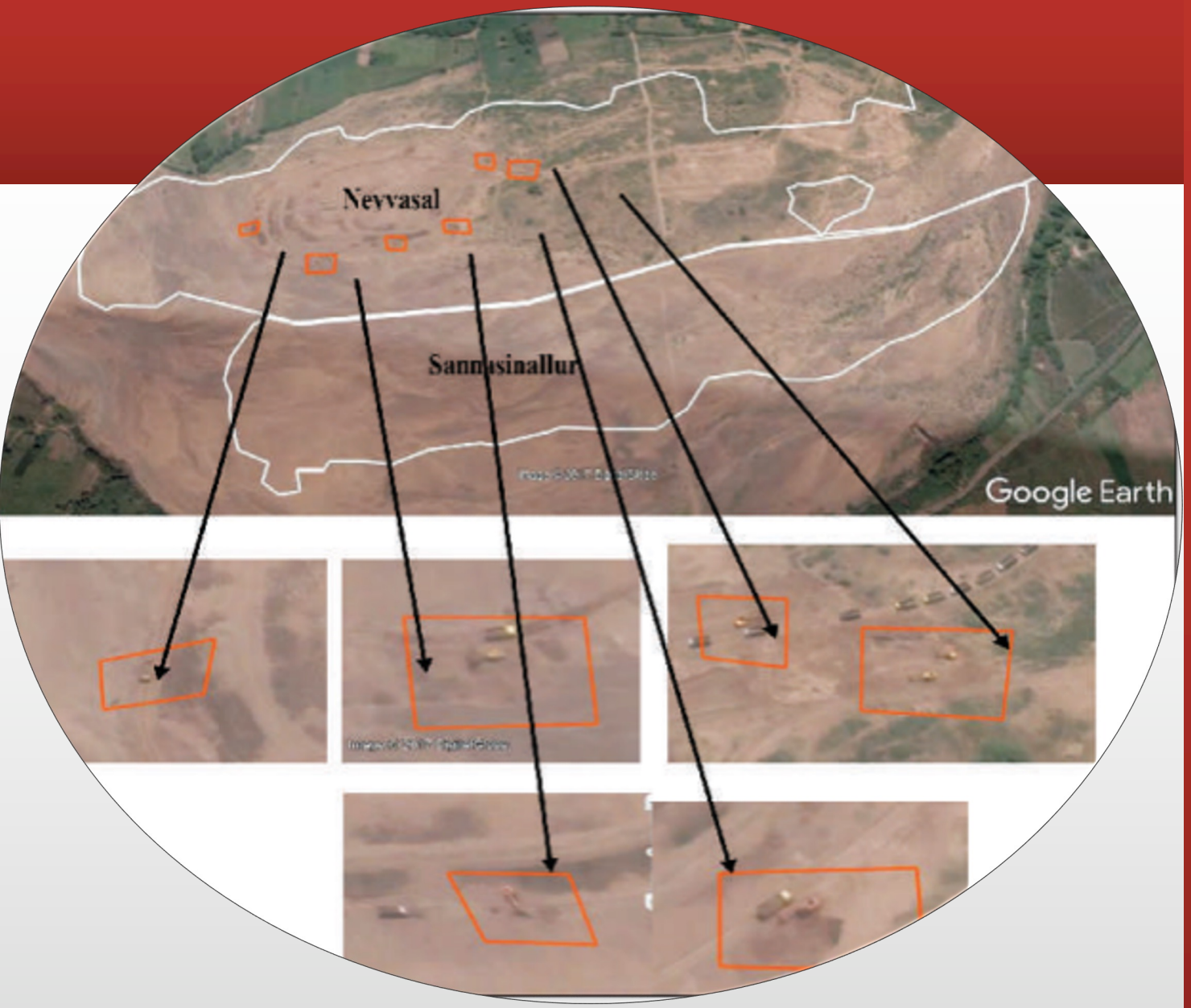
Audit Finding

Differences in area for quarrying as per Geo coordinates in: (A) Mining plan and (B) Environmental Clearance

Audit Finding

UAV Ortho image showing excess sand mining without permit



Audit Finding

Excess sand mining: Seven Excavators were used against two permitted

Based on Google Earth maps on 2 different days

Audit Finding

Excess sand mining: 3D image showing depth of sand excavated (5.9 m to 6.23 m) against permitted depth of 1 m

Use of Unmanned Aerial Vehicles in detecting illegal quarrying

- **Audit objective:** Assess extent of illegal quarrying in Chikkaballapura Taluk, Karnataka
- **Technology:** Use of UAVs to study quarrying activities, identify unauthorised quarry sites.
- The data received from the UAV images was processed and the actual quantity of mineral mined was calculated using different software modules.

CAG Report: Performance Audit on "Systematic and Scientific Mining and Protection of Environment in respect of Quarry Leases of Minor Minerals....Government of Karnataka Report No.1 of the year 2019

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Satellite images of Quarrying at non-licenced locations

(B) 1.44 acres illegally quarried.

(A) 8.15 acres illegally quarried.

Audit Finding:

- 532 locations over 11.45 lakh sqm identified as unauthorised quarrying sites against Department's report of 63 locations
- As a follow-up to the Audit, the Government of Karnataka conducted drone survey in the presence of quarry lease owners for quantifying the amount of minerals dispatched without permits during 2020-21

Use of Remote Sensing and GIS in detecting encroachments and land use land cover changes in National Parks and Wildlife Sanctuaries

- **Audit objective:** Assess impact of intrusive activities in 14 National Parks & Wildlife sanctuaries of Western Ghat Nilgiri Biosphere Region
- **Technology:** Remote sensing & GIS to detect changes in land use and land cover

CAG Report: Performance Audit on Administration of National Parks and Wildlife Sanctuaries in Karnataka ....Government of Karnataka Report No. 6 of the year 2017

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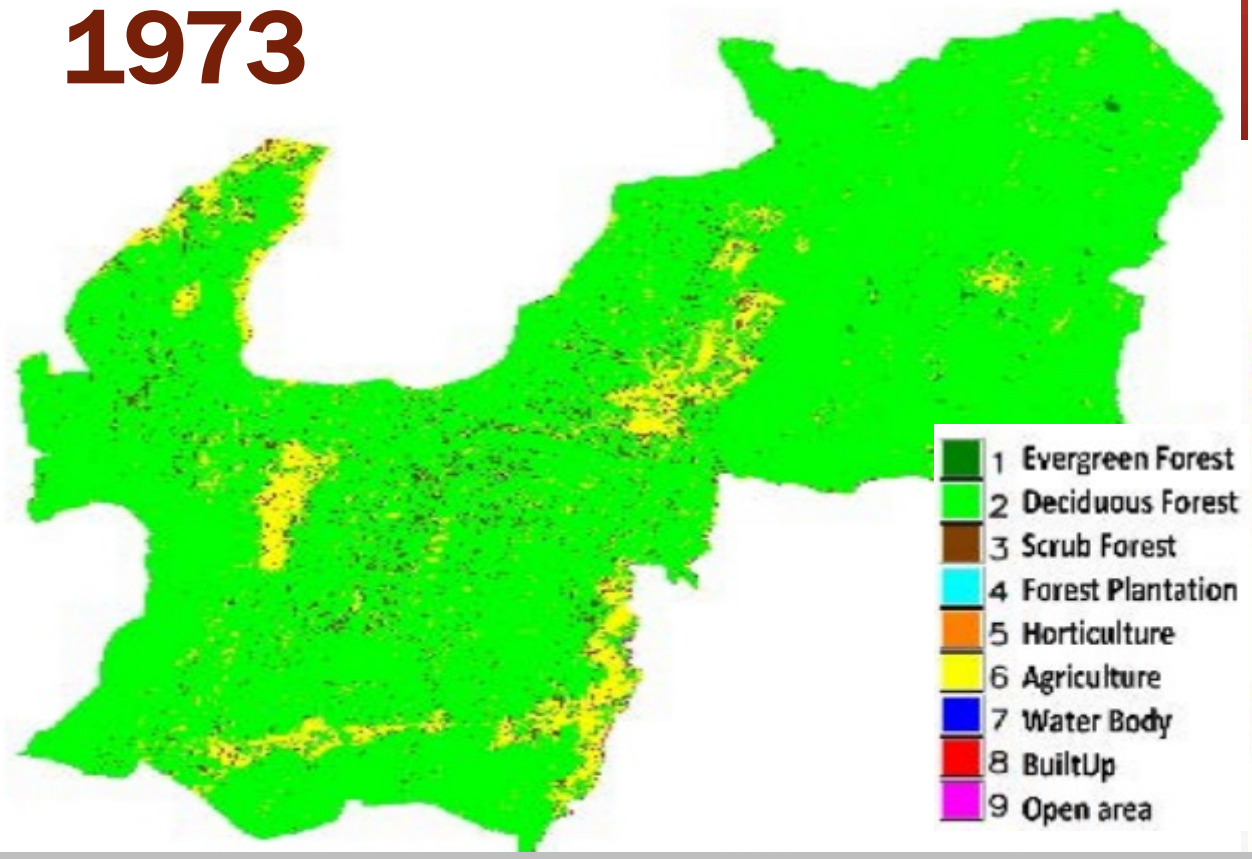
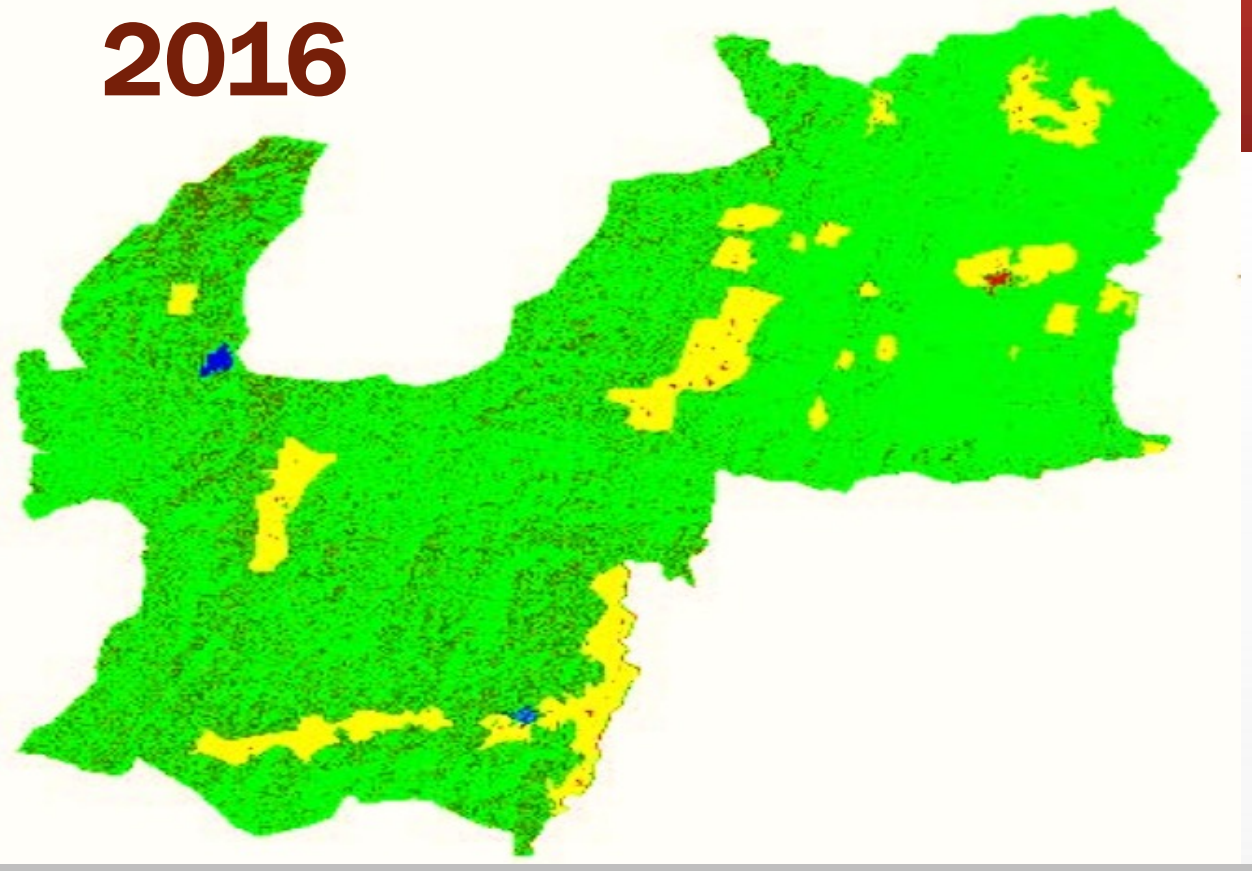
MM Hills wildlife sanctuary: Land Use Land Cover changes

1973

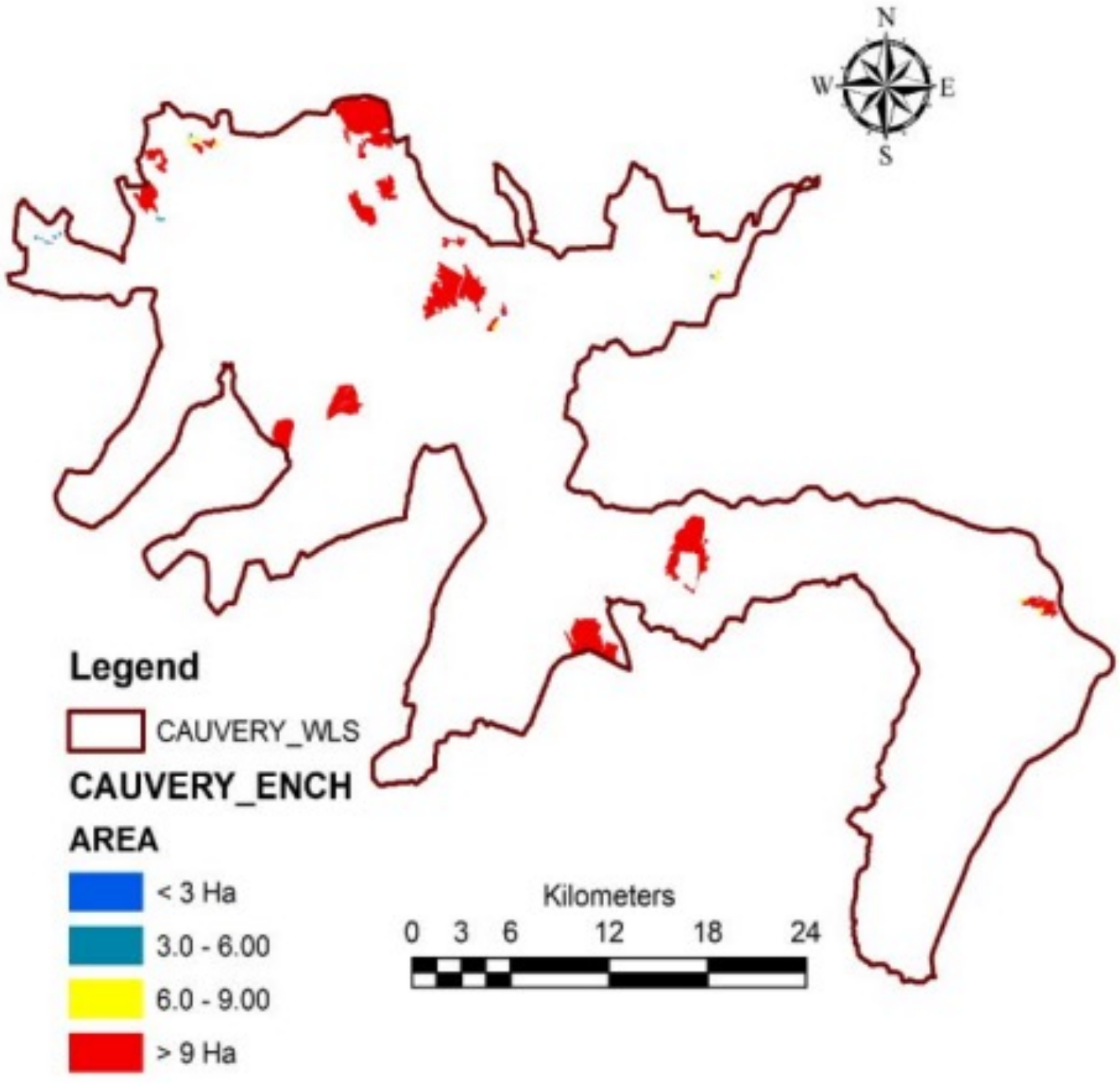


2016



Audit Finding:

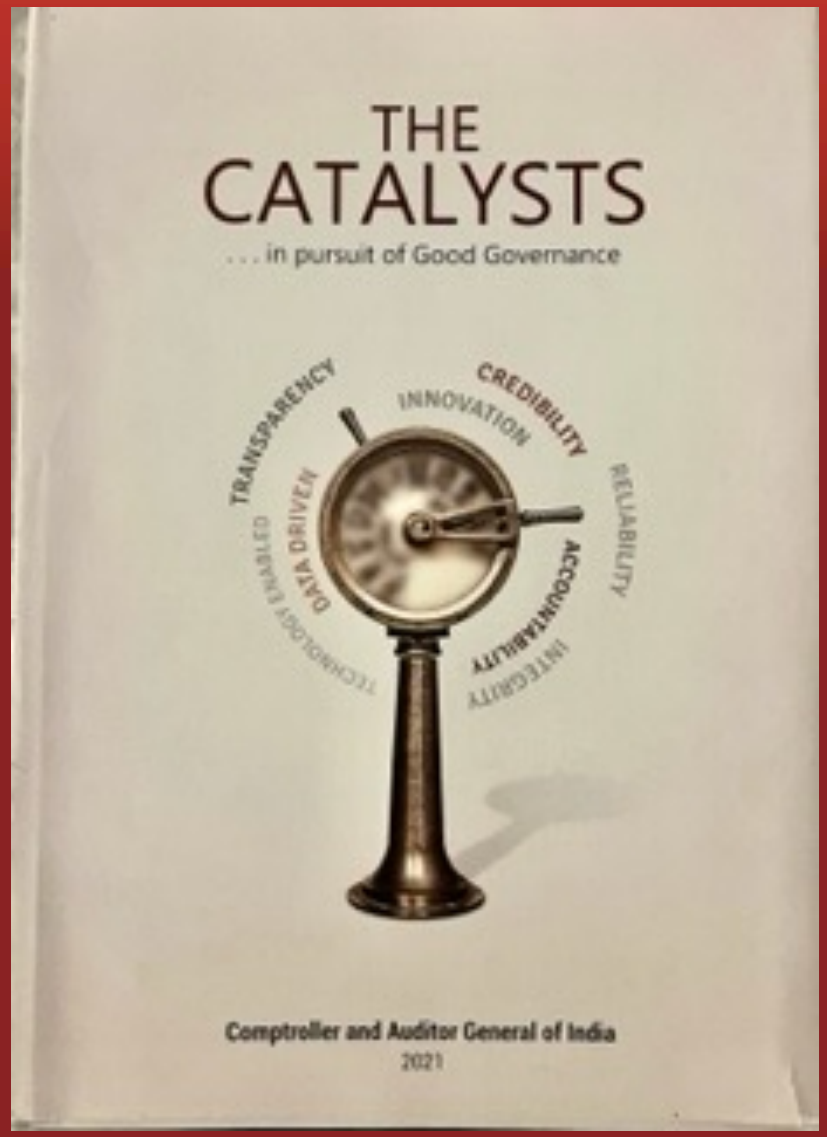
- Increase in scrub forests and area under agriculture over a period of time. Decrease in Evergreen and Deciduous Forest area which indicated degradation of forests.



Encroachments in Cauvery wildlife sanctuary

Cadestral maps were superimposed on Satellite imagery to find out the extent of Encroachment

<u>Audit Finding</u>:
Encroachments recorded by satellite images were 6 times that recorded by the State Forest department



https://cag.gov.in/uploads/StudyReports/SR-SR-StudyReports-new-061a467d5d795e5-80229005.pdf

A compendium of New Initiatives and Good Practices in the CAG's organisation

So as an SAI. We have been encouraging the use of new innovative methods to carry out outcome audits
and
also the use to new technology tools to help the auditors in driving home the point

Thank You