2024 നവംബർ

ലക്കം 9

അമൃത്
വാർത്താ പത്രിക

ആലപ്പുഴ ജനറൽ ഹോസ്പ്പിറ്റൽ കോമ്പൗണ്ടിൽ അമൃത് പദ്ധതിയിലുൾപ്പെടുത്തി പൂർത്തീകരിച്ച 240 കെ.എൽ.ഡി. ശേഷിയുള്ള മലിന ജല സംസ്കരണ പ്ലാന്റിന്റെ ഉദ്ഘാടനം ബഹു. കാർഷിക വികസന കർഷക ക്ഷേമ വകുപ്പ് മന്ത്രി ശ്രീ. പി. പ്രസാദ് നിർവ്വഹിക്കുന്നു

ആലപ്പുഴ ജനറൽ ഹോസ്പ്പിറ്റൽ കോമ്പൗണ്ടിൽ അമൃത് പദ്ധതിയിലുൾപ്പെടുത്തി പൂർത്തീകരിച്ച 240 കെ.എൽ.ഡി. ശേഷിയുള്ള മലിന ജല സംസ്കരണ പ്ലാന്റ്

അമൃത് വാർത്താ പത്രിക

നവംബർ 2024 | പുസ്തകം 3 | ലക്കം 9

എഡിറ്റോറിയൽ

അമൃത് ഒന്നാം ഘട്ട പദ്ധതികൾ വളരെയധികം കാര്യക്ഷമമായി നടന്നുവരികയാണ്. ആകെ അംഗീകരിക്കപ്പെട്ട 1111 പദ്ധതികളിൽ 972 പദ്ധതികൾ പൂർത്തീകരിച്ചു. പദ്ധതി തുകയുടെ 83.47% വിനിയോഗിച്ചുകഴിഞ്ഞു. ശേഷിക്കുന്ന പദ്ധതികൾ 2024 ഡിസംബർ 31 നകം പൂർത്തീകരിക്കേണ്ടതിനാൽ പദ്ധതികളുടെ പൂർത്തീകരണ ത്തിൽ നഗരസഭകൾ പ്രത്യേകം ശ്രദ്ധ പതിപ്പിക്കേണ്ടതുണ്ട്. പദ്ധതി കൾ യഥാസമയം പൂർത്തീകരിക്കാൻ സാധിക്കാതെ വന്നാൽ അതിൻമേൽ ഉണ്ടാകുന്ന സാമ്പത്തിക ബാധ്യത അതാത് നഗരസഭകൾക്കായിരിക്കും എന്ന കാര്യം പ്രത്യേകം ശ്രദ്ധിക്കേണ്ട താണ്.

സംസ്ഥാന സർക്കാരിന്റെ 100 ദിന പരിപാടിയിലുൾപ്പെടുത്തി അമൃത് പദ്ധതികളുടെ ഭാഗമായി 12 പദ്ധതികളാണ് നടപ്പിലാക്കുന്നത്.ഇതിൽ 8 പദ്ധതികൾ പൂർത്തീകരണ ഉദ്ഘാടനത്തിനും 4 പദ്ധതികൾ നിർമാണ ഉദ്ഘാടനത്തിനും തയ്യാറാണ്. അമൃത് 2.0 പദ്ധതിയുടെ മുഖമുദ്രയായ 'ജന ആന്ദോളൻ' പ്രവർത്തനങ്ങൾക്ക് സംസ്ഥാനം തുടക്കം കുറിച്ചുകഴിഞ്ഞു. ഗുരുവായൂർ നഗരസഭയിൽ അമൃത് പദ്ധതിയുടെ ഭാഗമായി പൂർത്തീകരിച്ച പാർക്കുകളുടെ പരിപാലനവും സംരക്ഷണവും വനിതാ സ്വയം സഹായ സംഘങ്ങൾക്ക് കൈമാറി. അമൃത് മിത്രയുടെ ഭാഗമായി ജലത്തിന്റെ ഗുണനിലവാര പരിശോ ധന നിർണയം നടത്തുന്നതിന് വനിതാ സ്വയംസഹായ സംഘങ്ങൾക്കായി നടത്തുന്ന പരിശീലന പരിപാടി തൃശ്ശൂർ, കോഴിക്കോട് ജില്ലകളിൽ പൂർത്തിയാക്കി. ശേഷിക്കുന്ന സ്ഥലങ്ങളിൽ പരിശീലന പരിപാടികൾ സംഘടിപ്പിക്കുന്നതിന് തദ്ദേശ സ്ഥാപനങ്ങൾ മുൻകൈ എടുക്കേണ്ടതാണ്.

അമൃത് പദ്ധതികൾ സമയബന്ധിതമായി പൂർത്തീകരിക്കേണ്ട തിനാവശ്യമായ പ്രവർത്തനങ്ങൾ നടത്തുന്നതോടൊപ്പം പദ്ധതി കളുടെ തൽസ്ഥിതി യഥാസമയം പോർട്ടലിൽ അപ് ലോഡ് ചെയ്യുന്നതിനും പ്രത്യേക ശ്രദ്ധ നൽകേണ്ടതാണ്. പോർട്ടലിൽ വിവരങ്ങൾ ലഭ്യമായാൽ മാത്രമെ അതിനനുസരണമായി കേന്ദ്ര സഹായം ലഭിക്കുകയുള്ളൂ. എല്ലാ സിറ്റി മിഷൻ മാനേജ്മെന്റ് യൂണിറ്റുകളും ഇക്കാര്യത്തിൽ സവിശേഷ ശ്രദ്ധ പുലർത്തണമെന്ന് ഓർമ്മപ്പെടുത്തുന്നു.

മിഷൻ ഡയറക്ടർ

തദ്ദേശസ്വയംഭരണ വകുപ്പ്
കേരള സർക്കാർ

ചീഫ് എഡിറ്റർ
സൂരജ് ഷാജി ഐ.എ.എസ്സ്
മിഷൻ ഡയറക്ടർ

എഡിറ്റർ
മുരളി കൊച്ചുകൃഷ്ണൻ
എൻവിയോൺമെന്റ് എക്‌പർട്ട് കം
ഹൈഡ്രോ ജിയോളജിസ്റ്റ്

അസിസ്റ്റന്റ് എഡിറ്റർ
സാവിയോ സജി ഇ.ആർ.

Atal Mission for Rejuvenation and Urban Transformation

സ്റ്റേറ്റ് മിഷൻ മാനേജ്മെന്റ് യൂണിറ്റ് (അമൃത്)
നാലാം നില, മീനാക്ഷിപ്ലാസാ,
ആർടെക് ബിൽഡിംഗ്,
ഗവ. ആശുപത്രിക്ക് എതിർവശം,
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(സ്വകാര്യ വിതരണത്തിന് മാത്രം)

അർബൻ മൊബിലിറ്റി ഇന്ത്യാ കോൺഫറൻസിൽ പങ്കെടുത്ത തൃശ്ശൂർ കോർപ്പറേഷൻ മേയറും ഉദ്യോഗസ്ഥരും

അമൃത് മിത്ര പദ്ധതിയുടെ ഭാഗമായി ഗുരുവായൂർ മുനിസിപ്പാലിറ്റിയിൽ അമൃത് പദ്ധതിയിൽ ഉൾപ്പെടുത്തി നവീകരിച്ച പാർക്കിന്റെ പരിപാലനത്തിനുള്ള ഉപകരണങ്ങളും ഐ.ഡി. കാർഡുകളും മുനിസിപ്പൽ ചെയർമാൻ വനിതാ സ്വയം സഹായ സംഘത്തിന് നൽകുന്നു

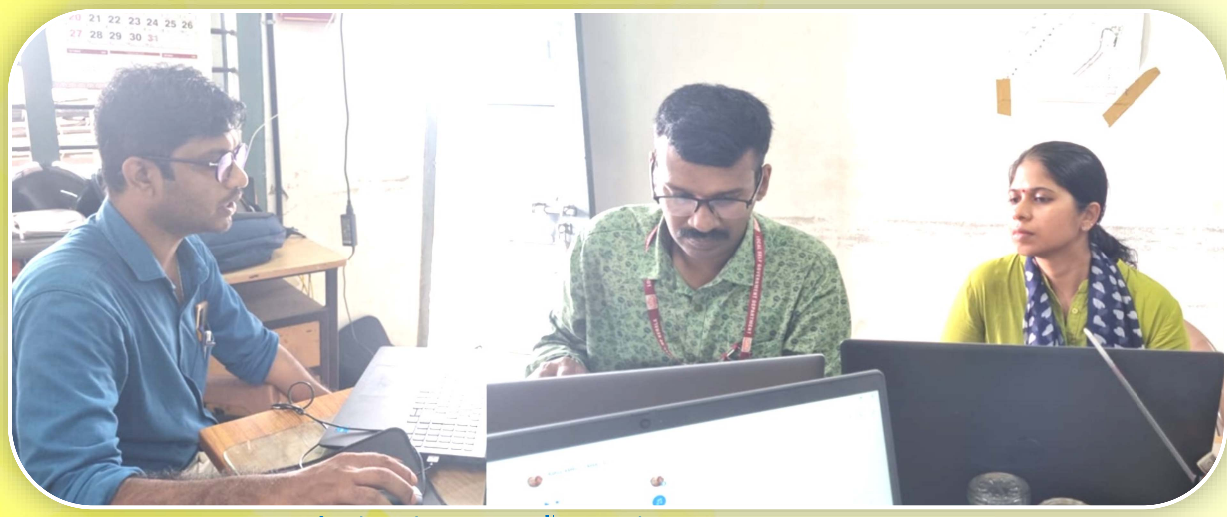
അമൃത് വാർത്താ പത്രിക

നവംബർ 2024

ഉള്ളടക്കം

അമൃത് 2.0 പദ്ധതിയിൽ ഉൾപ്പെടുത്തി നവീകരണ പ്രവർത്തനങ്ങൾ പുരോഗമിക്കുന്ന കൂത്താട്ടുകുളം മുനിസിപ്പാലിറ്റിയിലെ വെൺകുളം

വനിതാ സ്വയം സഹായ സംഘങ്ങൾക്കായി കോഴിക്കോട് ജില്ലയിൽ നടത്തിയ ജലത്തിന്റെ ഗുണനിലവാര പരിശോധന നിർണ്ണയ പരിശീലന പരിപാടി



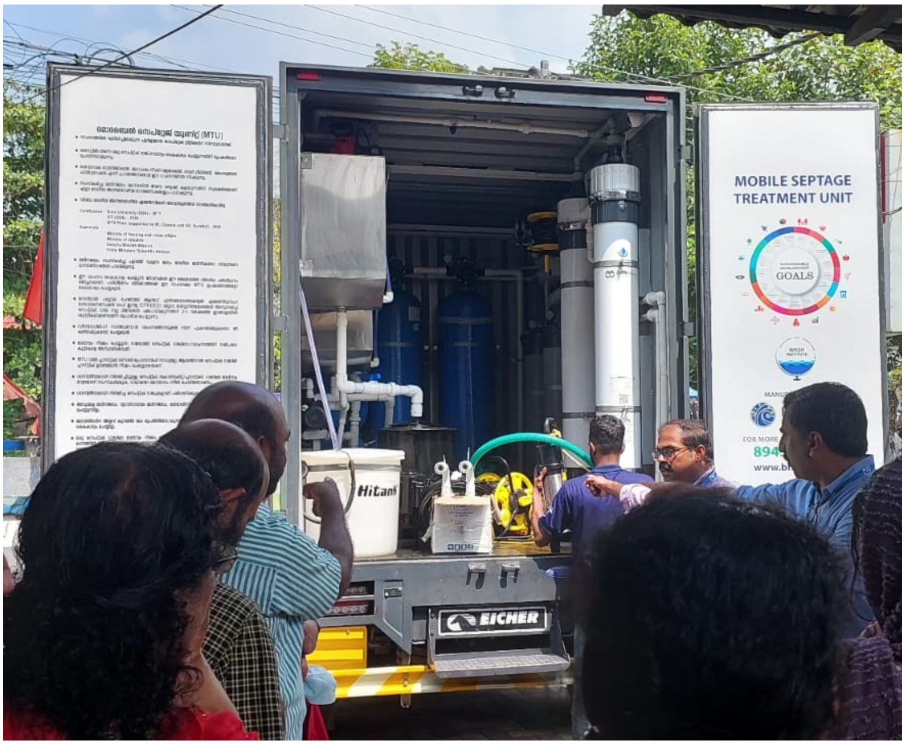
തൃശ്ശൂർ ജില്ലയിലെ അമൃത് പദ്ധതികളുടെ അവലോകന യോഗം

അമൃത് 2.0 പദ്ധതിയിലുൾപ്പെടുത്തി കാസർഗോഡ് ജില്ലയിൽ നവീകരിക്കുന്ന കുളങ്ങൾ അമൃത് മിഷൻ ഉദ്യോഗസ്ഥർ സന്ദർശിച്ചു

ആലപ്പുഴയിൽ മൊബൈൽ സെപ്റ്റേജ് ട്രീറ്റ്മെന്റ് യൂണിറ്റ് ഉദ്ഘാടനം ചെയ്തു

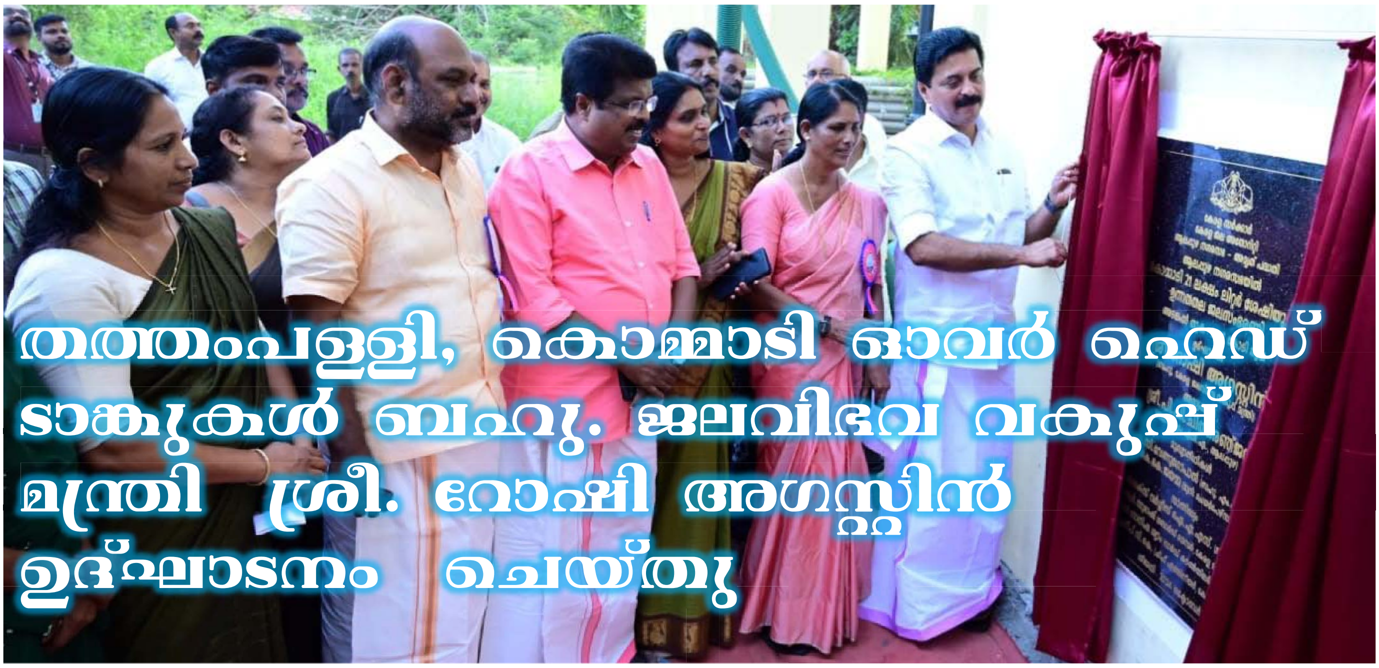
സംസ്ഥാനത്തെ നഗരങ്ങളിലെ ദ്രവ മാലിന്യ സംസ്കരണം ശാസ്ത്രീയമായി നടപ്പിലാക്കേണ്ടത് വളരെയധികം ശ്രദ്ധ ചെലുത്തേണ്ട ഒരു മേഖലയാണ്. സംസ്ഥാനത്തെ നഗരങ്ങളൊന്നും തന്നെ ശാസ്ത്രീയമായ ആസൂത്രണത്തിലൂടെ രൂപപ്പെട്ടു വന്നതല്ല. അതുകൊണ്ടുതന്നെ ശാസ്ത്രീയമായ മാലിന്യ സംസ്കരണ മാർഗ്ഗങ്ങളൊന്നും തന്നെ നമ്മുടെ നഗരങ്ങളിൽ പര്യാപ്തമായ അളവിൽ നിലവിലില്ലാത്ത സാഹചര്യമാണുള്ളത്. ജനത്തിന്റെ ആരോഗ്യത്തെയും പരിസ്ഥിതിയെയും സംസ്ഥാനത്തിന്റെ ടൂറിസം സാധ്യതകളെയും ഇത് പ്രതികൂലമായി ബാധിക്കുന്നു. സംസ്ഥാനത്തെ മറ്റു ജില്ലകളെ അപേക്ഷിച്ച് ജനസാന്ദ്രത കൂടിയ പ്രദേശമാണ് ആലപ്പുഴ. വെള്ളത്താൽ ചുറ്റപ്പെട്ടുകിടക്കുന്ന പ്രദേശമായതിനാലും അടിക്കടി ഉണ്ടാകുന്ന വെള്ളക്കെട്ടും ഉയർന്ന ഭൂഗർഭ ജല തോതും ആലപ്പുഴ നഗരസഭ നേരിടുന്ന പ്രധാന പ്രശ്നങ്ങളിലൊന്നാണ് ദ്രവമാലിന്യ സംസ്കരണം.

നഗരസഭയുടെ ഗൗരവതരമായ ഈ പ്രശ്നത്തിന് ഒരു പരിധിവരെ പരിഹാരമാകുന്നതിന് അമൃത് പദ്ധതിയിലെ സിവേജ് സെക്ടറിൽ ഉൾപ്പെടുത്തി 2 മൊബൈൽ സെപ്റ്റേജ് ട്രീറ്റ്മെന്റ് യൂണിറ്റുകൾ സ്ഥാപിച്ചു. ഒരു യൂണിറ്റിൽ മണിക്കൂറിൽ 6000 ലിറ്റർ ശുചിമുറി മാലിന്യം സംസ്കരിക്കുന്നതിന് സാധിക്കും. സെപ്റ്റേജ് ടാങ്ക് മലിനജലം ശാസ്ത്രീയമായി സംസ്കരിക്കുവാനും, അനധികൃത മാലിന്യ നിക്ഷേപം ഇല്ലാതാക്കുന്നതിനും, കൃത്യമായ ഇടവേളകളിലെ സെപ്റ്റിക് ടാങ്ക് ക്ലീനിംഗും, വിനോദ സഞ്ചാര മേഖലയിൽ നേരിടുന്ന പ്രധാന പ്രശ്നമായ ഹൗസ് ബോട്ടുകളിലെ കക്കൂസ് മാലിന്യം സംസ്കരിക്കുന്നതിനും മൊബൈൽ സെപ്റ്റേജ് ട്രീറ്റ്മെന്റ് യൂണിറ്റിലൂടെ സാധിക്കും.



മൊബൈൽ സെപ്റ്റേജ് ട്രീറ്റ്മെന്റ് യൂണിറ്റ് ഒരു മലിനജല ഫിൽട്രേഷൻ യൂണിറ്റാണ്. ദ്രവ രൂപത്തിലുള്ള മാലിന്യം മാത്രമെ മൊബൈൽ സെപ്റ്റേജ് ട്രീറ്റ്മെന്റ് യൂണിറ്റിന് സംസ്കരിക്കാൻ കഴിയൂ. സെപ്റ്റിക് ടാങ്കുകളിൽ നിന്ന് പമ്പ് ചെയ്യുന്ന ദ്രവ രൂപത്തിലുള്ള മാലിന്യം ആദ്യം സോളിഡ് ലിക്വിഡ് സെപ്പറേഷൻ യൂണിറ്റിൽ കടത്തിവിട്ട് ഖരമാലിന്യം വേർതിരിച്ച് സ്ലഡ്ജ് ടാങ്കിൽ സൂക്ഷിക്കുകയും വേർതിരിച്ച ജലം വിവിധ ഫിൽറ്ററുകളിൽ കൂടി കടത്തിവിട്ട് ശുദ്ധീകരിച്ച ശേഷം ക്ലോറിനേഷൻ നടത്തി മാലിന്യ നിയന്ത്രണ മാനദണ്ഡങ്ങൾ അനുസരിച്ച് പുറത്തേയ്ക്ക് വിടുന്ന രീതിയിലാണ് യൂണിറ്റ് സജ്ജമാക്കിയിരിക്കുന്നത്.

ഡൽഹി ആസ്ഥാനമായുള്ള വാഷ് ഇൻസ്റ്റിറ്റ്യൂട്ട് രൂപകൽപന ചെയ്ത ടെക്നോളജി ആണ് മൊബൈൽ യൂണിറ്റിൽ പ്രാവർത്തികമാക്കിയിരിക്കുന്നത്. മൊബൈൽ ട്രീറ്റ്മെന്റ് യൂണിറ്റ് ഉപയോഗിക്കുന്നത് കൊണ്ട് രോഗകാരിയായ അണുക്കളോ, ദുർഗന്ധമോ ഇല്ലാത്ത ജലമാണ് സംസ്കരണത്തിനുശേഷം പുറത്തേയ്ക്ക് തള്ളുക. സംസ്കരിക്കുമ്പോൾ ലഭിക്കുന്ന ഖരമാലിന്യം ഖരമാലിന്യ സംസ്കരണ യൂണിറ്റിൽ കൊണ്ടുപോയി വളമാക്കുന്നു. ശുചിമുറി മാലിന്യം യാതൊരം സംസ്കരണ സങ്കേതങ്ങളുമില്ലാതെ ജലാശയങ്ങളിലേയ്ക്ക് ഒഴുക്കുന്നത് തടയുവാൻ മൊബൈൽ സെപ്റ്റേജ് ട്രീറ്റ്മെന്റ് യൂണിറ്റിന്റെ പ്രവർത്തനത്തിലൂടെ സാധിക്കും.



തത്തംപള്ളി, കൊമ്മാടി ഓവർ ഹെഡ് ടാങ്കുകൾ ബഹു. ജലവിഭവ വകുപ്പ് മന്ത്രി ശ്രീ. റോഷി അഗസ്റ്റിൻ ഉദ്ഘാടനം ചെയ്തു

ആലപ്പുഴ നഗരസഭയിൽ അമൃത് പദ്ധതിയുടെ ഭാഗമായി തത്തംപള്ളി, കൊമ്മാടി എന്നിവിടങ്ങളിൽ നിർമ്മിച്ച ഓവർ ഹെഡ് ടാങ്ക് ബഹു. ജലവിഭവ വകുപ്പ് മന്ത്രി ശ്രീ. റോഷി അഗസ്റ്റിൻ ഉദ്ഘാടനം ചെയ്തു.

ആലപ്പുഴ നഗരത്തിലെ 4 മേഖലകളിലെയും കുടിവെള്ള വിതരണ ശൃംഖലകളിലെ പഴയ പൈപ്പുകൾ മാറ്റി പുതിയ പൈപ്പുകൾ സ്ഥാപിക്കുന്ന പ്രവൃത്തിക്കും ഓവർ ഹെഡ് ടാങ്കുകൾ സ്ഥാപിക്കുന്നതിനുമായി 148.30 കോടി രൂപ യുടെ പദ്ധതികളാണ് നടപ്പിലാക്കി വരുന്നത്.

ഇതിന്റെ ഭാഗമായി തത്തംപള്ളി പു ന്നമട റോഡിൽ കാപ്പിമുക്കിന് സമീപം 12 ലക്ഷം ലിറ്റർ ജലസംഭരണിയുടെ പ്രവൃത്തി 3.327 കോടി രൂപ ചിലവഴിച്ച് നിർമാണം പൂർത്തീകരിച്ചു. ഇതിൽ നിന്ന് നഗരസഭയിലെ കിഴക്കൻ പ്രദേശങ്ങളായ നെഹ്റുട്രോഫി, ജില്ലാക്കോടതി, കരളകം, തത്തം പള്ളി കിടങ്ങാംപറമ്പ് എന്നീ വാർഡു കളിൽ ശുദ്ധജലമെത്തിക്കാൻ സാധിക്കും. 3724 കുടുംബങ്ങൾക്ക് ഇതിന്റെ പ്രയോജനം ലഭിക്കും..

കൊമ്മാടിയിൽ നിലവിലുണ്ടായിരുന്ന 16 ലക്ഷം ലിറ്റർ ശേഷിയുള്ള ടാങ്ക് കാലപ്പഴക്കം കൊണ്ട് ശോചനീയവസ്ഥയിലായിരുന്നു. കൂടാതെ വർദ്ധിച്ചുവന്ന ജലവിതരണാവശ്യ ങ്ങൾക്ക് പര്യാപ്തവുമായിരുന്നില്ല. ജലം സംഭരിക്കാൻ കഴിയാത്ത അവസ്ഥയിലാ യതിനാൽ പ്രദേശത്ത് ശുദ്ധജല ക്ഷാമം രൂക്ഷമായിരുന്നു. പുതിയ ടാങ്ക് പൂർത്തിയായ തോടെ നഗരസഭയിലെ തീരദേശത്തെ 1,2,46,47,49,50,51,52 എന്നീ വാർഡുകളിലേയ്ക്ക് ശുദ്ധജലമെത്തിക്കുന്നതിലെ ബുദ്ധിമുട്ട് പരിഹരിക്കുവാൻ സാധിച്ചിട്ടുണ്ട്. 7044 കുടും ബങ്ങളിലായി 27909 പേർക്ക് ഈ പദ്ധതിയുടെ പ്രയോജനം ലഭിക്കും.

ജലത്തിന്റെ ഗുണനിലവാര പരിശോധന - മധ്യ, ഉത്തര മേഖല ജില്ലകളിലെ വനിത സ്വയം സഹായ സംഘാംഗങ്ങൾക്ക് പരിശീലനം നൽകി

ജലത്തിന്റെ ഗുണനിലവാര പരിശോധന നടത്തുന്നതിന് കുടുംബശ്രീ സ്വയം സഹായ സംഘാംഗങ്ങളെ പ്രാപ്തരാക്കുന്നതിന് വാഷ് ഇൻസ്റ്റിറ്റ്യൂട്ടിന്റെയും എസ്.സി.എം.എസ്. കോളേജ്, എറണാകുളത്തിന്റെയും സഹായത്തോടെ അമൃത് മിഷൻ പരിശീലന പരിപാടി സംഘടിപ്പിച്ചു. ഒക്ടോബർ മാസത്തിൽ തൃശ്ശൂർ, കോഴിക്കോട് എന്നിവിടങ്ങളിലാണ് പരിപാടി നടന്നത്. നഗരങ്ങളെ ജല ഭദ്രമാക്കുക എന്ന ലക്ഷ്യത്തോടെ നടപ്പിലാക്കുന്ന അമൃത് 2.0 പദ്ധതിയുടെ അമൃത് മിത്ര എന്ന പരിപാടിയുടെ ഭാഗമായാണ് പരിശീലനം നടത്തുന്നത്. തൃശ്ശൂരിലെ പരി ശീലന പരിപാടി തൃശ്ശൂർ കോർപ്പറേഷൻ മേയർ ഉദ്ഘാടനം ചെയ്തു.

നഗര പ്രദേശങ്ങളിലെ ലഭിക്കുന്ന ജലത്തിന്റെ ഗുണനിലവാരം നിർണ്ണയിക്കുകയും ഉറപ്പ് വരുത്തുകയും ചെയ്യേണ്ടത് വളരെ ഗൗരവതരമായ കാര്യമാണ്. വളരെ വേഗത്തിൽ നഗരവത്ക്കരണത്തിന് വിധേയമാകുന്ന കേരളം പോലുള്ള സംസ്ഥാനത്ത് നിലവിലെ സംവിധാനങ്ങൾ കൊണ്ടുമാത്രം ജലത്തിന്റെ ഗുണനിലവാരം ഉറപ്പ് വരുത്തുക എന്നത് വളരെ ശ്രമകരമാണ്. ഇക്കാര്യത്തിന് സാമുഹ്യാധിഷ്ഠതമായ മേൽനോട്ടം കൂടുതൽ അനുയോജ്യമാകും എന്ന നിഗമനത്തിന്റെ അടിസ്ഥാനത്തിലാണ് അമൃത് മിഷൻ സ്വയം സഹായ സംഘാംഗങ്ങൾക്ക് ജലത്തിന്റെ ഗുണനിലവാരം പരിശോധിക്കുന്നതിനാവശ്യമായ സാങ്കേതിക പരിജ്ഞാനം നൽകുന്നതിന് പരിശീലന പരിപാടി സംഘടിപ്പിച്ചത്.

ജലത്തിന്റെ ഗുണനിലവാരത്തിന്റെ ആവശ്യകത, ജലം പരിശോധന നടത്തുന്നതിനുള്ള മാർഗ്ഗങ്ങൾ, തുടങ്ങിയവ സംബന്ധിച്ച വിവരങ്ങൾ നൽകി കാര്യശേഷി വിപുലീകരിക്കുക, പ്രായോഗിക വൈദഗ്ദ്ധ്യം വികസിപ്പിക്കുക, ശുദ്ധജല ലഭ്യതയ്ക്കായി സമൂഹത്തിന്റെ പങ്കാളിത്തം ഉറപ്പുവരുത്തുക, സുസ്ഥിരമായ ജല പരിപാലനം നടപ്പിൽ വരുത്തുക എന്നിവയാണ് പരിശീലന പരിപാടി ലക്ഷ്യമിടുന്നത്. ഇതിലൂടെ ജലത്തിന്റെ ഗുണനിലവാരം നിർണ്ണയിക്കാനും, ഗുണനിലവാര നിർണ്ണയ ഘടകങ്ങൾ മനസ്സിലാക്കാനും തദ്ദേശീയമായി ജലത്തിന്റെ ഗുണനിലവാര പരിശോധന നടത്തുന്നതിനും സംഘാംഗങ്ങൾ പ്രാപ്തരാകും.

ഡോ. സണ്ണി ജോർജ്ജ്, അഖിലേഷ്, ശ്രീധർ, ഡോ. രതീഷ് മേനോൻ, സതി കുമാരി പി. തുടങ്ങിവർ പരിശീലനത്തിന് നേതൃത്വം നൽകി.

REPORT TOWARDS "PARTICIPATORY AQUIFER MANAGEMENT" IN INDIA

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Introduction:

Water is "**Elixir of life**" and all developmental and conservation activities enhance the demand and supply of water, whether it is agriculture or industry or for domestic usages. The ever-increasing population also results in the increase towards domestic demand. The water resources are available either as surface water or groundwater and the principal source for both the resources is precipitation. The erratic nature of precipitation and near utilization of surface water resources has turned the onus on groundwater. The groundwater occurrence and movement vary spatially and temporally and it is also not uniform in nature. Thus, the strategy for sustainable development and management becomes a challenging task. **India is the largest user of groundwater in the world.** India accounts for **16-17% per cent of the world's population living in less than 5 per cent of the global area, and has just 4 per cent of the global water resources**. Groundwater has been the prime source of fresh water sustaining life and livelihood in most states of India. Groundwater is one of the most important freshwater resources in the country that caters for more than **63% irrigation water and more than 80% of Rural & Urban water supplies**. The dependency on groundwater for irrigation water needs has increased many folds since the green revolution. This has led to situation wherein the groundwater withdrawal is more than natural recharge resulting declining in groundwater level, desaturation of shallow aquifers, increased energy consumption for lifting water from progressively deeper levels, quality deterioration, issues like reduction in groundwater flow to rivers, contamination and no flow in rivers. These scenarios not only have adverse devastating effects on the environment but have also led to subdued economic growth of the country. This has necessitated for a paradigm shift from "**Groundwater development**" to "**Groundwater management** "The Share of groundwater in irrigation has increased from **61%** in 2007-08 to **64%** in 2016-17 as per the data of Directorate of Economics & Statistics Ministry of Agriculture & Farmers Welfare. Dependence on ground water is increasing day by day as groundwater accounts for most of the increase in net irrigated area in the country. This hasn't come without a price. As per the latest assessment of **Dynamic Ground Water Resources (2023), out of the total 7084 assessment units (Blocks/Taluks/Mandals/Districts/Firkas/Valleys)**, **1006 (14.2%)** have been categorized as **'Over-exploited', 260 (4%) as 'Critical'**, **885 (12.4%) as 'Semi-critical'**. About **4933 (69%) units as SAFE ZONE categorization**.

Alongside over-exploitation there are also areas where existing groundwater resources have not been tapped properly. Further, there are well documented issues of ground water contamination also. Climate change is likely to bring in more challenges in terms of decreasing availability, increasing demand for irrigation (because of increase in atmospheric temperature) and increase in coastal salinity (because of rise in sea level). The Govt. of India, the various State Governments and many other agencies are doing their best to augment and manage ground water resources. However, understanding of the aquifers is the first prerequisite to prepare effective management interventions. 'Sustainable Ground Water Management aspect promoted by the Government has highlighted the need for comprehensive mapping of India's aquifers, on priority, that would form the cornerstone of developing any groundwater management programme. In this backdrop, Central Ground Water Board (CGWB), under the Ground Water Management and Regulation Plan Scheme (XII plan) initiated the **National Aquifer Mapping and Management (NAQUIM)** programme in the year 2012, which is one of the largest endeavours of its kind in the World and the detailed aquifer mapping has been happening at block levels over every state in India recently.

Participatory Aquifer Management Study Objective:

- Our focused study objective should provide detailed information to support groundwater management decisions at **micro ULB/ Panchayat level**. Since the issues are different in different areas, the studies under the proposed **"Participatory Aquifer Management"** are to be issue specific and should be undertaken in prioritized focus areas initially and other micro levels in due course of time.
- **Understanding the Aquifer dynamics and analyzing the aquifer's hydrology, including recharge rates, seasonal fluctuations, and long-term sustainability. Also, its effective management requires understanding the aquifer's capacity, groundwater flow, and interactions with surface water systems to avoid over-extraction.**

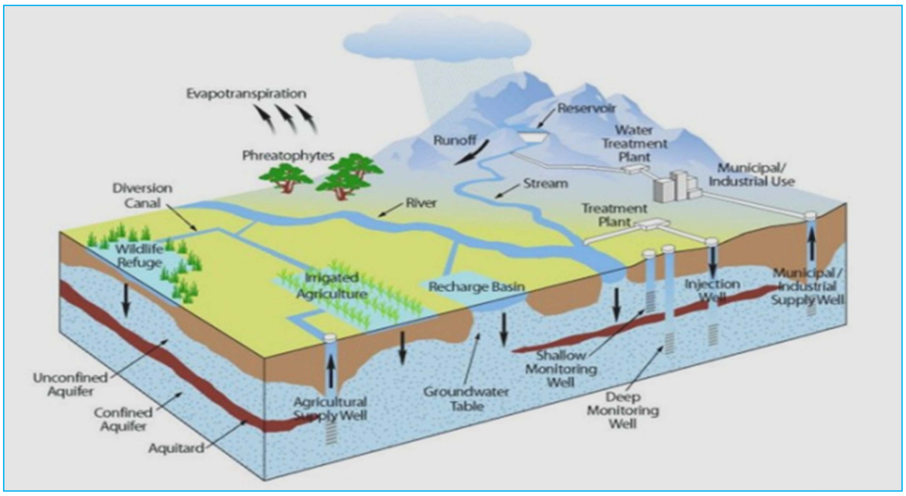
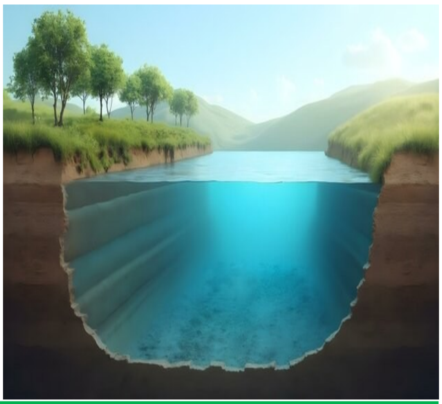


Fig:1 Schematic Sketch Towards Aquifer Management

- Broadly Priority areas shall be identified based on ground water related issues and the present study should focus with specific priority areas like **effects of urbanization and industrialization on ground water system in the study area, Ground water Overexploited and critical regions, problematic areas on water quality and index.**
- **Water budgeting along with source sustainability measures** specifically for each ward/village as micro level assessment.
- Change detection in **LULC (land use land cover) over a period of time and its effect on Ground Water scenario and its improvements.**
- Improvising **issue based scientific inputs for groundwater management up to ward/ village level.**
- Developing **Site –specific Aquifer Management Interventions and scope for Managed Aquifer Recharge. (MAR) in both Urban and Rural areas**
- Providing **digital/ printed maps** to the users and easy understanding of the groundwater regime at various stake holder's levels.
- Estimation of grey water production of Industrial and Domestic sector. **Recommend ETP/STP based proper treated water reuse for utilization of the same for Irrigation, industries along green belt and other utility to ensure the water circularity aspects are dealt appropriately reducing the fresh groundwater utilization loads.**
- **Finding location specific micro level remedial measures/ solutions to enhance Quantity and Quality of the groundwater resources and its regime.**
- **Collaborating with local governments to develop groundwater usage regulations and enforcement mechanisms. Apt Policy frameworks are essential for controlling over-extraction, encouraging sustainable practices, and ensuring equitable access to groundwater resources.**
- **Implementing participatory approaches for resolving conflicts over groundwater use, particularly in regions with competing demands (agriculture, industry, domestic use). A transparent, inclusive conflict resolution mechanism should be ensured that all voices are heard, and competing interests are balanced, leading to long-term sustainability.**

These objectives collectively address the technical, social, and regulatory aspects of managing Aquifers



HYDRO-GEOLOGICAL FORMATION AND AQUIFER SYSTEM OF INDIA

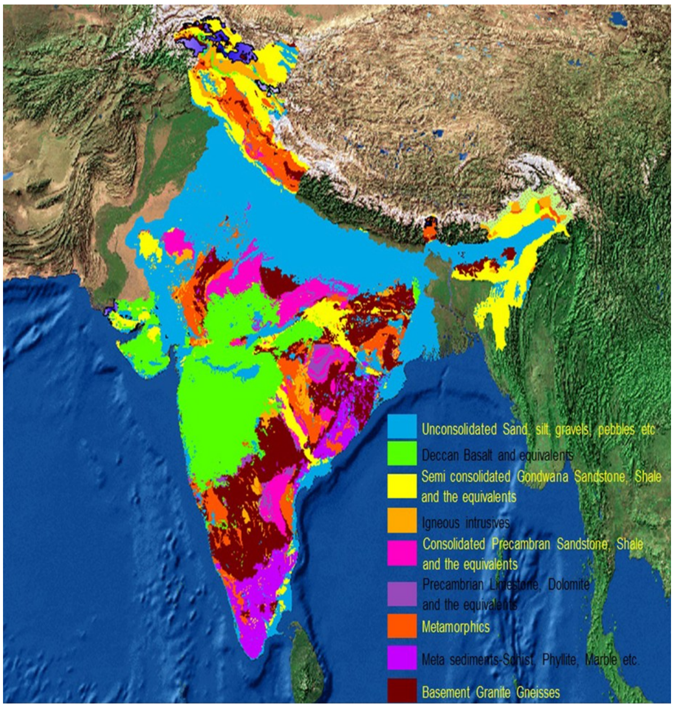


Fig: 2 Hydrogeology Provenance Map of India
Source: CGWB.

Aquifer System in India

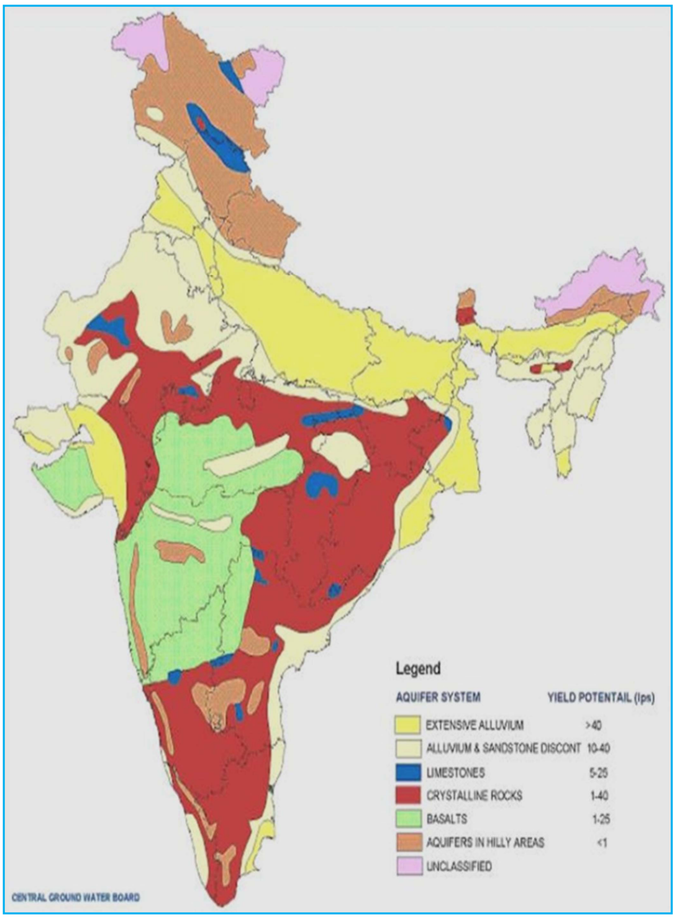


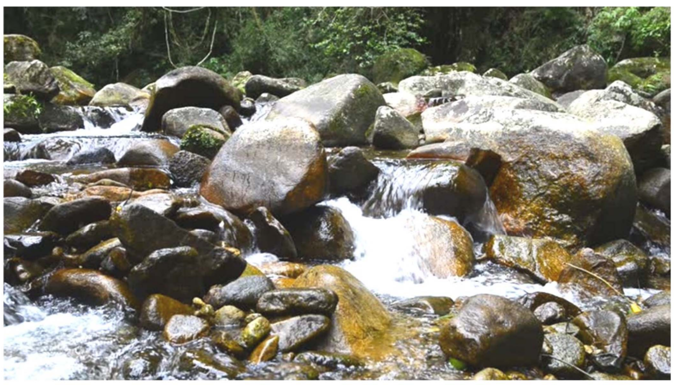
Fig: 3 Aquifer System Map of India.
Source : CGWB

Based on the hydrogeological characteristics, the entire country has been classified into **14 principal aquifer systems and 42 major aquifers. Alluvium** is the major aquifer system which covers maximum area of **around 31 per cent** of the entire country and is available in Uttar Pradesh, Bihar, West Bengal, Assam, Odisha and Rajasthan. The **sandstone aquifer** covers around **8 per cent area in the country** and is available in Chhattisgarh, Andhra Pradesh, Madhya Pradesh, Gujarat, Karnataka and Rajasthan. The rest of the country is covered with the other formations that cover **around 60 per cent of the area**. Among these, **basalt aquifer covers maximum of around 17 per cent area of the country** and is available mostly in Chhattisgarh, Andhra Pradesh, Madhya Pradesh, Rajasthan and in the north eastern states as well as in the Himalayan terrain. **Limestone aquifer** covers a very **small area of around 2 per cent in the country** and is mainly available in the states of Chhattisgarh, Andhra Pradesh, Karnataka and Gujarat and in the Himalayan states. **Around 20 per cent of the area of the country is covered by banded gneissic complex (BGC) and gneiss aquifers which are available almost in all the peninsular states as well as the Himalayan states**. **The rest 15 per cent of the entire area is covered by aquifers namely; schist, granite, quartzite, charnocktite, khondalite, laterites and intrusive.**

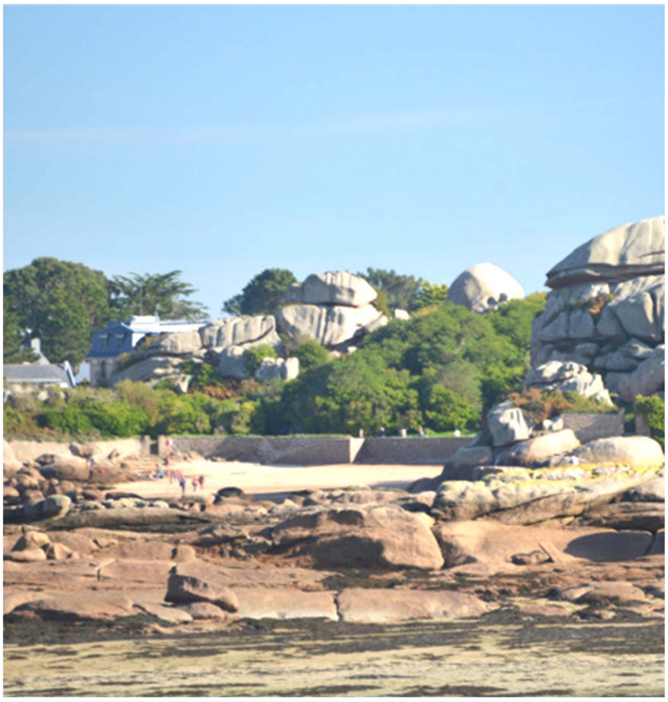
The detailing of the Various Hydrogeological system which are classified as Hard rocks, soft rock aquifers, Hills and Islands aquifers are as follows:

Hard rock aquifers:

The common rock types categorized under crystalline aquifers are **granites, gneisses, charnockites, khondalites, quartzites, schist and associated phyllite, slate**, etc. These rocks possess negligible primary porosity but are rendered porous and permeable due to weathering and due to the presence of fractures and joints. The crystalline aquifers cover **major parts of the States of Andhra Pradesh, Chhattisgarh, Karnataka, Kerala, Odisha, Tamilnadu, Telangana and Jharkhand**. The upper weathered part and the fractured zone below form the aquifers. The fracture zones are connected along some alignments (lineaments) and when they are well-connected with the top weathered zone form potential aquifers (Saha et al. 2013). Potential aquifers are restricted mostly up to a depth of 150 m. Transmissivity of these aquifers remain mostly within **100 m2/day**, though occasional values up to 600 m2/day has also been reported.



Though of limited potential, these aquifers occur widely and act as the principal source of freshwater in the country. **The Precambrian sedimentary rocks are encountered mostly in parts of Andhra Pradesh, Chhattisgarh, Madhya Pradesh and Rajasthan. Major rock formations include sandstones and shale**. Usually, the Precambrian sandstones are highly silicified and the shales are compact (Ray et al. 2017). Both sandstones and shale have very limited aquifer potential with specific yield value of around 0.0038 (Ray et al. 2014). Basaltic aquifers occupy most part of Maharashtra and large geographical areas in Gujarat and Madhya Pradesh. They comprise multiple flows (traps). Each flow is marked by a potential vesicular zone at the top and a massive rock unit at the bottom (Saha and Agrawal 2006). The weathered part of the top flow and the vesicular zone of the successive flows below and the inter-trappeans form aquifers. The weathered zone mostly remains within 15 m though in some parts of Karnataka and Gujarat 40 m thick weathered zones have also been reported (CGWB 2012). Transmissivity of these aquifers remain mostly within 70 m2/day. Patches of basaltic aquifers are also reported from other parts of India like Chhattisgarh, Rajmahal Traps in Eastern parts of Jharkhand etc. Carbonates ranging in age from Precambrian (as in Chhattisgarh State) to Tertiary (as in Rajasthan) make potential aquifers owing to various degrees of karstification. Most prominent carbonate aquifers are in the central part of Chhattisgarh. These carbonate units belong to the Precambrian Chhattisgarh Group of rocks (Mukherjee et al. 2014). Dar et al. (2014) provide a review of the karst (carbonate) aquifers in India. Potential water bearing zones in these carbonate aquifers are mostly restricted to 80 m below ground level. Usually, degree of karstification and consequent groundwater potential decrease with depth. Rainfall Infiltration factor and specific yield of the carbonate aquifers in Chhattisgarh has been estimated to be **4.5%** (Ray 91 et al. 2017) and 3.7% (Ray et al. 2014) respectively.



Soft Rock Aquifers:

Soft rock aquifers can be further subdivided into unconsolidated sediments and semi-consolidated sedimentaries. The unconsolidated sediments in turn can be grouped into three broad categories: (i) alluvial deposits in Indo-Ganga-Bramhaputra Plains and along tracts of major rives, (ii) Coastal deposits, most prominent along the East-coast and (iii) aeolian deposits in the NorthWestern part. The Indo-Ganga-Brahmaputra plains hold one of the most potential soft rock aquifers in the world. The unconfined aquifers occurring at the top sometimes extend down to 125 m bgl. Deeper aquifers are mostly leaky-confined/confined (Saha et al. 2007; Saha et al.2011; Saha et al. 2013). The unconfined aquifers generally show storage coefficients between 5% and 25% (Saha et al. 2009). Transmissivity values vary widely from 1000 to 5000 m2/day (CGWB 2012). Transmissivity values of deeper aquifers may go up to 12,000 m2/day (Saha et al. 2010). These aquifers may yield as high as **70 litres per second**. The potential of alluvial aquifers along the peninsular rivers are rather moderate with yield up to 14 litres per second. But the alluvial deposits (~100 m thick) of Narmada, Tapi, Purna basins may yield up to 28 litres per second. The alluvial sequences in deltas of major rivers on the eastern coast and in Gujarat estuarine tracts have their hydrogeological potential limited by salinity hazards. The aeolian deposits occurring in West Rajasthan, Gujarat, Haryana, Delhi and Punjab are well sorted and permeable and have moderate to high yield potentials. However, natural recharge is poor because of scanty rainfall in the area and water table is deep. The semi-consolidated formations mainly comprise shales, sandstones and lime-stones. The sedimentary deposits belonging to Gondwana and Tertiary formations are included under this category. The sandstones form potential aquifers locally, particularly in Peninsular India, but at places they have only moderate potential.

Under favourable situations, these sediments give rise to artesian conditions as in parts of Godavari Valley, Cambay Basin and parts of West Coast, Puducherry, Neyveli in Tamil Nadu and Tertiary belt in Tripura. Potential aquifers particularl those belonging to Gondwanas and Tertiaries have transmissivity values from 100 to 2300 m2/day (CGWB 2012)

Hills and islands aquifer system:

Hills and Islands Hydrogeological units in the Himalayan terrain are complex and have not yet been explored properly. The aquifers are discontinuous. Information about extent of the aquifers, their hydraulic properties, recharge areas, recharge mechanism, pathways of recharge etc. are scanty. The Himalayas occupy nearly 500,000 square km covering major parts of the States of Jammu and Kashmir, Uttarakhand, Himachal Pradesh, Sikkim and the northeastern States. Valleys within the hilly terrain are the areas with significant groundwater potential. Because of highly undulating terrain and structurally complex nature owing to tectonic disturbances, groundwater often oozes out in the form of springs. These springs form potential sources of freshwater in this terrain. Islands have unique hydrogeological characteristics, where fresh groundwater floats as a lens over saline water within the aquifers. Fresh groundwater lenses of small islands, in particular, are more vulnerable to external factors than continental coastal aquifers, and require additional attention (White and Falkland 2010; Ketabchi and Ataie-Ashtiani 2015). Two major islands in India are the Andaman and Nicobar Islands and the Lakshadweep Islands. Weathered and fractured ophiolites, calcareous marl and shell-coralline limestone are the major water baring formations in the Andaman and Nicobar Islands (CGWB 2012b). Coral sand and coral limestone are the main water bearing formations in Lakshadweep Islands (Najeeb and Vinaychandran 2011). In addition to the above two groups of islands (Archipelago), groundwater also forms the major source of fresh water in the islands in other parts of India such as those in Andhra Pradesh, Assam, Daman and Diu, Goa, Gujarat, Karnataka, Kerala, Maharashtra, Odisha, Puducherry and West Bengal.

Categorization of Groundwater:

The periodic estimation of groundwater resources is being carried out by the concerned State Groundwater Department jointly with the Central Groundwater Board. The Groundwater Resource computations and its categorization are worked as follows In the States having predominantly hard rocks, the assessment unit is the watershed whereas in the States covered predominantly with alluvium and/ or soft rocks, administrative blocks are chosen as assessment units. These assessment units are categorized for ground water development based on stage of ground water extraction. There are four categories, namely - '**Safe**' **areas** which have ground water potential for development; '**Semi-critical**' areas where cautious groundwater development is recommended; '**Critical**' **Areas; and** '**Over-exploited**' **areas**, where there should be intensive monitoring and evaluation and future ground development be linked with water conservation measures. The criteria for categorisation of assessment units are listed below:

Categorization of Groundwater Development Status:

S. No	Stages of water development	Significant Long-Term Decline in Water Levels		Categorization
		Pre- monsoon	Post monsoon	
1	<=70%	No	No	Safe
2	>70%and <=90%	No	No	safe
		Yes/No	No/Yes	Semi critical
3	>90% and <=100%	Yes/No	No/Yes	Semi critical
		Yes	yes	Critical
4	>100%	Yes/No	No/Yes	Over exploited
		Yes	yes	Over exploited.

Table: 1:Categorization of Groundwater Development.

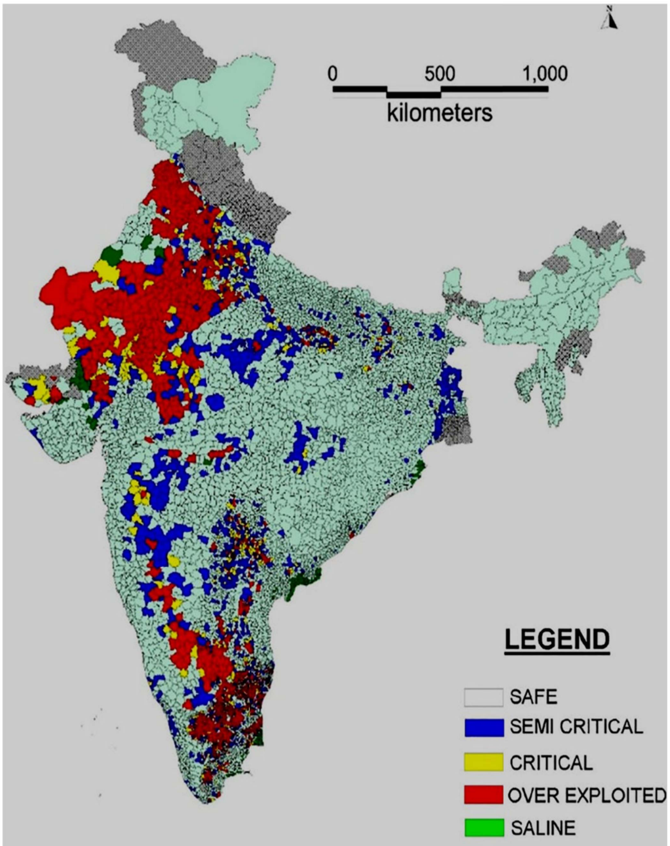


Fig:4 Ground water Categorization Map of India. Source: CGWB

CGWA for regulation of ground water development and management. Accordingly, in **"notified areas"**, abstraction of ground water is not permissible for any purpose other than drinking and domestic use. The Blocks /Talukas/Mandals/areas, other than those notified by CGWA for regulation of ground water development and management are "**non-notified areas"**. In these areas, **CGWA issues NOC to industrial/ infrastructural / mining projects for ground water withdrawal.**

Challenges of Groundwater Management in India.

- Lowering of the water table.
- Reduction of water flow/base flow in streams and bathymetric levels in lakes.
- Land subsidence's are caused by lack of groundwater limits/ regulatory wherein the biodiversity is affected by dangerous sinkholes resulted from depleted aquifers.
- Increased costs for the user due to energy requirements for pumping groundwater from deeper fracture zones.
- Deterioration of water quality.
- Saltwater intrusion and contamination may occur along the coastal aquifers.
- Crop production decrease from lack of water availability.
- Groundwater depletion interrupts the 'natural' water cycle putting disproportionately more water into the sea.
- As large aquifers are depleted, food supply and people will suffer. Also, the domestic and drinking water and irrigation water from groundwater and other source of water will be depleting.
- Inability to conserve the surplus run-off available water during the monsoons, due to topographic characteristics and destruction of traditional water storage structures such as ponds, tanks and wet lands.
- Rapid urbanization resulting in increased water consumption and reduced water conservation and ground water recharge.
- Recent changes in land use and cropping pattern, resulting in conversion of land from agricultural to non-agricultural uses and consequent reduction in water conservation and ground water recharge measures.
- Challenges related to management of water-related extremes like flood and drought, source sustainability, and to improve the quantity **and quality of usable water availability are the major challenges envisaged.**

SWOT Analysis Towards Aquifer Management in India:

Table :2

Strength:	Weakness:
♦ **Many of the required Data has already been collated up to some extent under the NAQUIM (National Aquifer Management Management) report of various states.** ♦ **GIS technology has already been implemented and is presently at completion level by NAQUIM/ CGWB** ♦ **Methodology of Aquifer mapping has already been developed for many a block/district by NAQUIM/CGWB** ♦ **Capacity development of state agencies in terms of Aquifer management is done through various schemes** ♦ **Both Rural and Urban population is aware of the depletion of groundwater** ♦ **Willingness for improvements in groundwater is currently present within the community** ♦ **Both Urban/ Rural areas have strong and resourceful community groups to promptly implement the strategies.**	♦ Unavailability of maps at 1:10,000 scale useful to develop aquifer management strategies at micro level in Urban and rural areas. ♦ Over-exploitation of Groundwater ♦ Water logging condition ♦ Gap in availability of a standard location specific approach for aquifer management in Urban areas and rural areas. ♦ Specific roles and responsibilities need to be assigned at ULB/Panchayat level for aquifer management at Micro levels. ♦ Most of the proposed Interventions in areas are driven by availability of space and further based on demand of water. ♦ Urban areas lack integration of surface water and groundwater but in rural context the integration is possible. ♦ Weak institutional linkages amongst water -based line departments which leads to lack of an integrated approaches towards water in both rural and urban scenario. ♦ Lack of identification and assessment of GW recharge areas ♦ No guidelines, enforcement or monitoring for dried up wells/ recharge aspect of defunct bore wells etc in both rural and urban scenario. ♦ Lack of groundwater experts at ULB and state level. ♦ Administrative overlaps amongst stakeholders ♦ Lack of coordination and communication amongst stakeholders ♦ Financial constraints ♦ Inadequate staff for implementation of activities ♦ Lack of technical know-how for M&E framework development and implementation

Efforts of Government in Securing Water Resources and Management:

Government of India is implementing **Jal Shakti Abhiyan (JSA)** in the country. First JSA was launched in 2019 in water stressed blocks of 256 districts which continued during the years 2021 and 2022 also (across entire country both rural and urban areas) **The Catch the Rain" (JSA:CTR) - 2022 campaign** with the primary aim to cover all the blocks of all districts (rural as well as urban areas) across the country. The focused interventions of the campaign include (1) water conservation and rainwater harvesting (2) enumerating, geo-tagging & making inventory of all water bodies; preparation of scientific plans for water conservation based on it (3) Setting up of Jal Shakti Kendra's in all districts (4) intensive afforestation and (5) awareness generation. JSA for the year 2023 have been launched by Hon'ble President of India on 04 Mar 2023 with the theme **"Source Sustainability for Drinking Water".** Hon'ble Prime Minister has launched **Amrit Sarovar Mission on 24th April 2022**. The Mission is aimed at developing and rejuvenating 75 water bodies in each district of the country as a part of celebration of Azadi ka Amrit Mahotsav.

SWOT Analysis Towards Aquifer Management in India:

Table :2

Opportunity:	Threat:
♦ Aquifer mapping at micro level scale can be done at both Rural and Urban areas. ♦ In due concern as per Amrut 2.0 guidelines, all 500 class 1 cities are mandated to recycle used water by catering to 20% of city water demand and 40% industrial demand at state level by following all statute measures. Hence, there is an opportunity to recharge the aquifers by injecting recycle used water into the aquifer in compliance with the water quality prescribed by CPCB guidelines. Such a groundwater strategy shall create a circularity of water. Likewise, from the perspective of rural sector can be worked out. ♦ Identifying and delineate the different aquifers, nature of the aquifers, yield potential of different aquifers and their vertical interconnectivity Spatial behaviour of water level in different seasons and understand the long-term water level trend, Annual replenishable resource, availability in the deeper aquifers Recharge mechanism and potential of different aquifers ♦ Identifying areas suitable for rainwater harvesting and artificial recharge, Identifying treated wastewater as a resource. ♦ Change in consumer behaviours, Mainstream protection and sustainability of ground water/surface water resources in the urban / rural planning process ♦ Provide a step-by-step approach to identify, prioritize, and prepare a management plan for sustainability of groundwater resources and water bodies in both urban and rural areas. ♦ To create an iterative database for adapting time to time changes. ♦ Water saving agricultural practices by drip/ sprinkler irrigation, ♦ Change in cropping pattern at less groundwater available regime.	♦ Establishment of Aquifer characteristics and GW assessment of densely populated areas shall be a difficult task. ♦ Inadequate assessment for impact of transboundary aquifers. ♦ The urban density of activities/land use categories increases likelihood and frequency of contamination incidents compared to peri-urban and rural areas. ♦ Over exploitation of groundwater resources for irrigation purposes is a big threat. ♦ Over use of fertilizers and manures also will be a threat to groundwater recourses. ♦ Food – Water- Energy nexus needs to be thoroughly studied and provisioning of free electricity should be curtailed to avoid over utilization of groundwater recourses.

The Central Government is implementing **Atal Bhujal Yojana** with an outlay of Rs. 6,000 crores, in collaboration with States, in certain water stressed areas of Gujarat, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan and Uttar Pradesh. The primary aim of the scheme is demanding side management through scientific means involving the local communities at village levels leading to sustainable groundwater management in the targeted areas.

Central Ground Water Authority (CGWA) has been constituted under Section 3(3) of the "Environment (Protection) Act, 1986" for the purpose of regulation and control of ground water by industries, mining projects, infrastructure projects etc in the country. The latest guideline in this regard with pan-India applicability was notified by the Ministry on 24 September 2020. CGWA and States issue No Objection Certificate (NOC) for extraction of groundwater to various industries/project proponents as per their jurisdiction and as per the extant guidelines.

CGWB is implementing National Aquifer Mapping Program (NAQUIM) in the country and an area of 25.15 lakh sq km (the available mappable area) has been covered under the NAQUIM studies. The NAQUIM study report alongwith management plans are shared with States/UTs for suitable interventions.

NAQUIM, with an aim to support effective management of ground water resources in the country, the NAQUIM programme was taken up with the following objectives:

- Delineation of aquifers in terms of their horizontal and vertical extent.
- Characterization of aquifers in terms of their hydrogeological properties.
- Resource availability and quality
- Preparation of aquifer maps.
- Identification and quantification of issues
- Developing management strategies to ensure sustainability of ground water resources

A multidisciplinary approach including geological, geophysical, hydrogeological, hydrological and water quality studies is being followed for preparation of aquifer maps and management plans. Four major sets of activities being undertaken for the purpose are: **(i) data compilation & data gap analysis (ii) Generation and integration of data (iii) Preparation of aquifer maps and (iv) Formulation of aquifer management plans**. Data available in the domain of ground water is collected from various sources. The data are screened so that they can be used as per the objective of the study. On the basis of that, the gap in availability of data is estimated. Various type of data is generated on the type of aquifers, their physical properties, geophysical properties, hydraulic properties, chemical quality etc. Then the useful data from existing sources and data generated are integrated for further processing. The physical dimensions of aquifers are delineated. The water level behaviour, ground water resource availability, well sustainability, chemical quality, inter-aquifer interaction, yield of the aquifer etc. are ascertained.

Government of India has launched AMRUT 2.0 on 1st October, 2021, covering all the statutory towns of the country to ensure universal coverage of water supply & make cities 'water secure'. It envisages rejuvenation of water bodies, urban aquifer management, promote recycle & reuse and rainwater harvesting to augment freshwater resources. The Aquifer Management Plan will also be prepared to focus on maintaining positive groundwater balance in urban aquifer systems.

The Bureau of Water Use Efficiency (BWUE) has been set up for promotion, regulation and control of efficient use of water in irrigation, industrial and domestic sector. The Bureau will be a facilitator for promotion of improving water use efficiency across various sectors namely irrigation, drinking water supply, power generation, industries, etc. in the country.

"Sahi Fasal" campaign was launched to nudge farmers in the water stressed areas to grow crops which are not water intensive, but use water very efficiently; and are economically remunerative; are healthy and nutritious; suited to the agro-climatic-hydro characteristics of the area; and are environmentally friendly.

Ministry of Housing & Urban Affairs (MoHUA) has formulated Model Building Bye Laws (MBBL), 2016 for the States/UTs, wherein adequate focus has been given on requirement of rainwater harvesting and water conservation measures. As per MBBL, all buildings having a plot size of 100 Sq.m. or, more shall mandatorily include the complete proposal of rainwater harvesting. 35 States/ UTs, including Karnataka, have adopted the features of the Bye Laws.

AMRUT 2.0 (Atal Mission for Rejuvenation and Urban Transformation) : is an extension of the AMRUT program, focused on urban water body rejuvenation and aquifer management. The goal is to enhance water security and sustainability in Indian cities through various initiatives like:

Water Body Rejuvenation: Revival of urban lakes, ponds, and other water bodies to restore their ecological balance.

Aquifer Recharge: Promoting techniques like rainwater harvesting and percolation ponds to recharge groundwater.

Sustainable Water Management: Focus on reducing water loss, improving water use efficiency, and promoting recycling and reuse.

Catchment Area Treatment: Addressing pollution sources and improving natural drainage systems to enhance water quality.

Capacity Building: Training local governments and communities in water conservation techniques.

Technology Integration: Use of GIS mapping, IoT, and smart sensors for real-time monitoring of water bodies and groundwater levels.

Community Participation: Encouraging local communities to engage in water conservation and restoration efforts.

Pollution Control: Reducing contamination from untreated sewage and industrial waste through infrastructure improvements.

Urban Planning: Incorporating water body rejuvenation and aquifer recharge into city development plans.

Green Spaces: Enhancing vegetation around water bodies for improved microclimates and biodiversity.

Financial Support: Offering funds to cities and towns for project implementation.

Inter-departmental Coordination: Facilitating cooperation between municipal bodies, water authorities, and environmental agencies.

Public Awareness: Campaigns to educate citizens about the importance of water conservation.

Policy Framework: Developing guidelines and policies for sustainable water management.

Monitoring and Evaluation: Regular audits to assess the impact of water body rejuvenation and aquifer management efforts.

AMRUT 2.0 basically aims to make urban water management sustainable by leveraging both modern technology and traditional conservation practices

Methodology and Approaches to be followed:

The major priority areas to be included for the study are i) Water Stressed Areas (Over exploited and Critical areas) ii) Coastal Areas iii) Urban Agglomerates iv) Spring sheds v) Industrial/Mining Areas Command Areas vi) Deep-seated Aquifers vii) Auto-flow Areas viii) Poor Ground Water Quality Areas etc. The deliverables should be different for location specific priority areas, it should be planned to develop priority area specific outputs. Further, it should be planned to design the outputs and the knowledge products depending on specific requirements of the various different user groups at large.

Multi-disciplinary approach including: Geological, Geophysical, Hydro-geological, Hydrological and water quality studies are to be followed for preparation of aquifer maps and management plans. Four major sets of activities shall be undertaken for the purpose are: (i) data compilation & data gap analysis (ii) Generation and integration of data (iii) Preparation of aquifer maps and (iv) Formulation of aquifer management plans. Data available in the domain of ground water is collected from various sources. The data should be screened so that they can be used as per the objective of the study. On the basis of that, the gap in availability of data is to estimated. Various type of data shall be generated on the type of aquifers, their physical properties, geophysical properties, hydraulic properties, chemical quality etc. Then the useful data from existing sources and data generated are integrated for further processing. The physical dimensions of aquifers shall be delineated. The water level behaviour, ground water resource availability, well sustainability, chemical quality, inter-aquifer interaction, yield of the aquifer etc. are to be ascertained perfectly.

Preparation of aquifer maps and (iv) Formulation of aquifer management plans. Data available in the domain of ground water is collected from various sources. The data should be screened so that they can be used as per the objective of the study.

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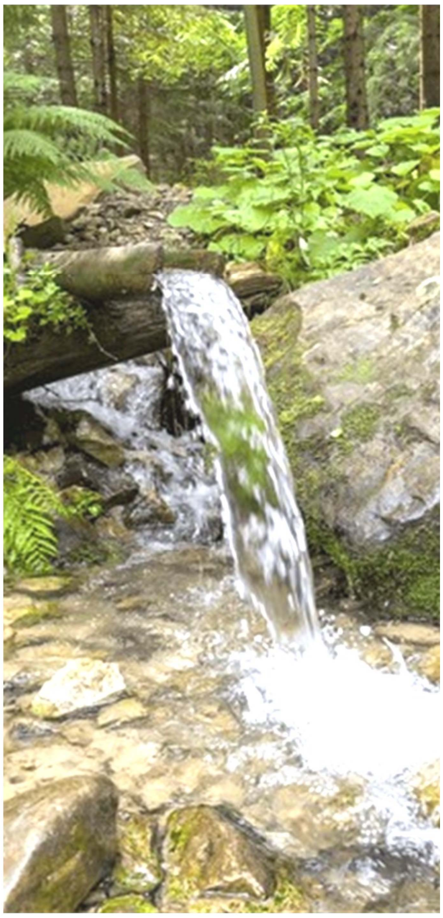
Aquifer mapping is an attempt to combine **Geological, geophysical, hydrologic, and chemical fields to adopt a sustainable approach for groundwater management**. Field level analyses are to be applied to characterize groundwater's **quantity, quality, and stability in aquifers**. The essential objectives of aquifer mapping are to delineate aquifer's lateral and vertical displacement and their characteristics generally at a scale of **1: 50,000** and further delineation up to a scale of **1:10,000.**



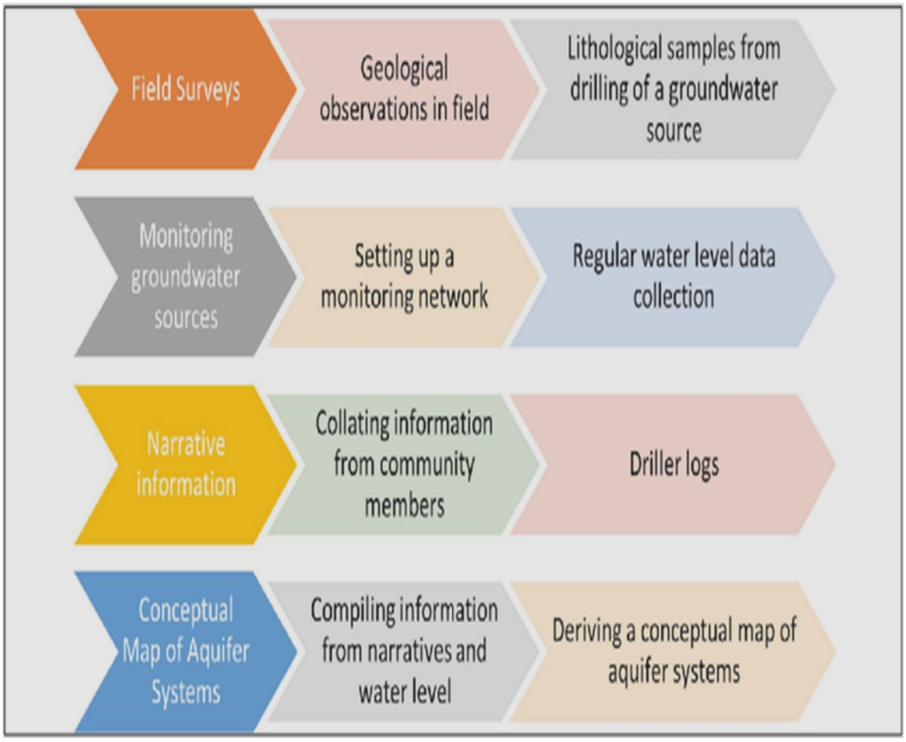


Fig: 5 .Frame work towards deriving Conceptual map of aquifer systems

The following activities are being taken up towards the aquifer management study.

- **To define aquifer geometry, aquifer type, groundwater behaviors, hydraulic properties, and geochemistry of multi-layered aquifer systems at 1:10,000 scale.**
- **Establishing the intervention and utility of new geophysical techniques and capacity**
- **The adaptability of aquifer management techniques in different hydrogeological conditions.**
- **Finalize policy and methodology for effective implementation of the National Aquifer Mapping Program initially in the selected states of concern and further replicating the same.**

Central Ground Water Board (CGWB) has undertaken the National Aquifer Mapping and Management Program (NAQUIM), mapping major aquifers, characterization, and formulation of aquifer management plans to ensure resource sustainability. Currently, aquifer management plans are almost completed to maximum district levels of India. In addition, Atal Bhujal Yojana has also been implemented to improve groundwater management in identified water-stressed areas in seven states Emphasis on demand management and participatory groundwater management. In the last decade, many other initiatives have been taken, focusing on rainwater harvesting measures in urban, hilly, and coastal areas.

Macro-level (district-level) investigations and assessments for aquifers in India have been carried out in the past under the **National Project on Aquifer Management (NAQUIM) program. Therefore, as a next step urban aquifer management is to be undertaken under the Atal Mission for Rejuvenation and Urban Transformation (AMRUT) 2.0 to enhance sustainable freshwater supply. All urban-level bodies (ULBs)** shall be taken up as urban watershed management plans under the AMRUT 2.0 mission. And panchayat body at rural levels through **JJM or Atal bhujal Yogna**. The experiences gained can be used to scale up activities for **micro-level aquifer mapping in the Urban and rural scenario for apt local governance-oriented planning and groundwater categorization.**

Detailed Study plan:
The detailed studies are to be planned to cover following topics:

- Aquifer Dispositions in the area
- Aquifer-wise Ground water levels.
- Delineation of Recharge Areas.
- Estimation/Refinement of parameters used for resource assessment.
- Assessment of ground water resources.
- Ground Water Quality issue and remedial measures.
- Ground Water Quality Management Interventions including demarcation of safer aquifer zones
- Artificial Recharge Plan
- Identification of potential aquifers for drinking water supply
- A plan for drinking water source sustainability
- Plan for **Conjunctive use of surface water and ground water.**
- Recommendations for tackling water logging and saline condition.
- Demand driven studies like- Source Finding, Development of new cities, Waste disposal sites, liquid waste management scenario.
- Precise assessment of functional wells for agriculture, industries, drinking water purposes (modified well census as village wise by public participation to be translated into aquifer wise & then administrative unit) Identification of Clusters of Aquifers (layers)
- Vertical-horizontal flow of recharged water from source - rainfall, canal, applied irrigation etc. Formation of Aquifer Management Unit (clustering of villages & depth units),
- Detailed Preparation of Aquifer Management Plans for sustainable groundwater management.
- The AMPs need to be prepared in a simplified manner so that they are easily understood and implementable by the stakeholders at Micro ULB/Panchayat levels and ensuring wider acceptability.
- Studies towards Ensuring Sustainability necessarily means the **reliability, resilience and the vulnerability** of the resources. Reliability is the ability of system to meet demands; resilience is the measure of the ability of the system to recover from failure and vulnerability is the measure of loss/damage incurred because of failure are to be studied and detailed thoroughly.

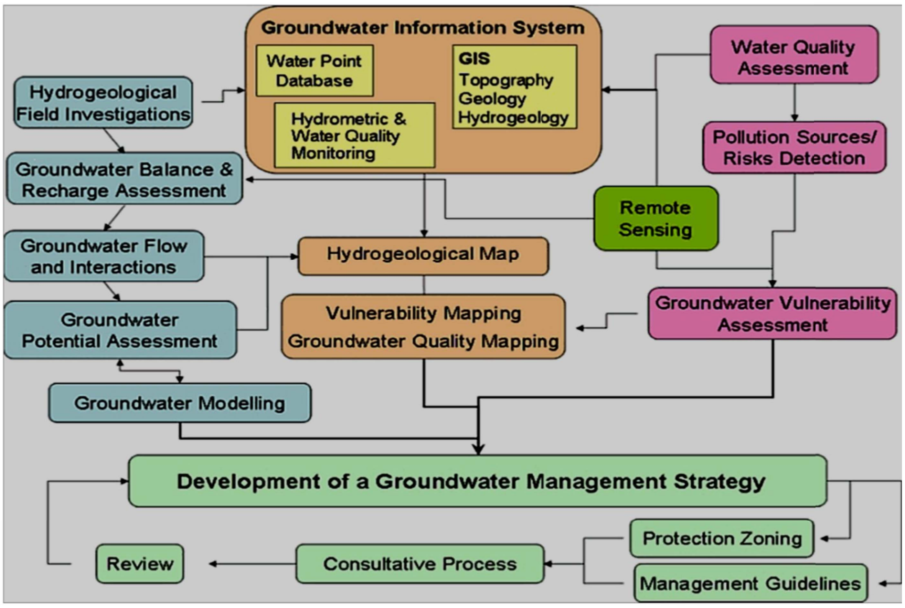


Fig: 6 Groundwater Management strategy

Institutional Linkages and Coherence Required:

Central Government Department
CGWB, MOHUA, CPCB, CWC, NDMA, NAQUIM, SOI, GSI, NATIONAL BUREAU OF SOIL, NRSC, AGRICULTURAL DEPARTMENT, WATER RESOURCES DEPARTMENT,
State Government Department
SGWB, SPCB, ULB, PANCHAYAT, STATE WATER RESOURSES DEPT, AGRICULTURAL DEPT, IRRIGATION DEPT, INDUSTRIES DEPT, MSME, STATE REMOTE SENSING AGENCY…ETC..
Institutions
Private agencies, Government Technical and Research institutions and organizations, drilling contractors, farmers union, etc… GIS mapping agencies, NABET accredited labs for water quality assessment.

Multitude Ecosystem Services Associated with Groundwater:
Groundwater plays a critical role in providing a multitude of ecosystem services at a landscape scale, benefiting both natural ecosystems and human societies. These services can be broadly categorized into four types: provisioning, regulating, supporting, and cultural services. Below is an overview of these services associated with groundwater. In a river basin or wetland ecosystem, groundwater provides a wide range of interconnected services, In agriculture, groundwater supports irrigation, ensuring food production during dry seasons. For aquatic ecosystems, groundwater maintains baseflows in rivers, preserving habitats for fish and other species. In wetlands, groundwater sustains biodiversity and acts as a natural water purification system. For local communities, groundwater-fed springs and lakes offer drinking water, cultural significance, and tourism opportunities. At the landscape scale, groundwater helps regulate climate by influencing local vegetation and ecosystem processes. At the landscape scale, groundwater provides diverse and critical ecosystem services that support human well-being, biodiversity, and environmental health. Proper groundwater management is essential to maintaining these services, particularly as challenges such as over-extraction, pollution, and climate change increasingly threaten groundwater resources.

1. Provisioning Services

Groundwater provides direct resources that are essential for human survival and economic activities:

Freshwater Supply: Groundwater is a vital source of drinking water for rural and urban populations, particularly in arid and semi-arid regions.

Irrigation for Agriculture: It supports agricultural productivity by providing reliable irrigation, especially in dry seasons or areas with scarce surface water.

Industrial and Commercial Use: Groundwater is used in various industries (e.g., food processing, pharmaceuticals, manufacturing) for production processes and cooling systems.

Livestock and Wildlife Watering: Groundwater sustains watering points for livestock and wildlife, especially in ecosystems where surface water is limited or seasonal.

2. Regulating Services

Groundwater helps maintain ecological balance and regulates various environmental processes:

Flood Mitigation: Groundwater systems can reduce surface runoff by absorbing excess water during heavy rains, reducing the risk of floods and protecting downstream ecosystems.

Drought Resilience: During dry periods, groundwater provides a buffer by maintaining river flows and wetlands, helping ecosystems and human activities withstand droughts.

Water Purification: As groundwater moves through soil and aquifers, it naturally filters out contaminants, improving water quality before it reaches springs, rivers, and lakes.

Climate Regulation: Groundwater contributes to regulating microclimates, especially through its connection to evapotranspiration processes in groundwater-dependent ecosystems (GDEs), which influence local and regional climate patterns.

3. Supporting Services

Groundwater provides fundamental services that support other ecosystem functions and processes:

Sustaining Baseflow for Rivers and Lakes: Groundwater feeds rivers, lakes, and wetlands during dry periods, maintaining baseflows that are essential for aquatic habitats and biodiversity.

Wetland and Riparian Habitat Support: Many wetlands and riparian ecosystems are sustained by groundwater flows, supporting diverse flora and fauna, including migratory birds, fish, and amphibians.

Soil Moisture Recharge: Groundwater recharge helps maintain soil moisture, which is critical for vegetation growth, forest ecosystems, and agriculture.

Nutrient Cycling: Groundwater plays a role in transporting nutrients through the landscape, supporting soil health and plant growth in various ecosystems.

4. Cultural Services

Groundwater contributes to cultural, spiritual, and recreational values in different landscapes:

Cultural and Spiritual Significance: In many regions, groundwater sources such as springs, rivers, and lakes have deep cultural or spiritual meaning for local communities, often considered sacred or symbolic.

Recreation and Tourism: Groundwater-fed lakes, rivers, and wetlands provide recreational opportunities, including boating, fishing, and ecotourism, which contribute to local economies and cultural identities.

Aesthetic and Scenic Value: Groundwater contributes to maintaining landscapes that are aesthetically pleasing, such as lush wetlands, flowing rivers, and vibrant riparian zones, which are valued for their beauty and tranquility.

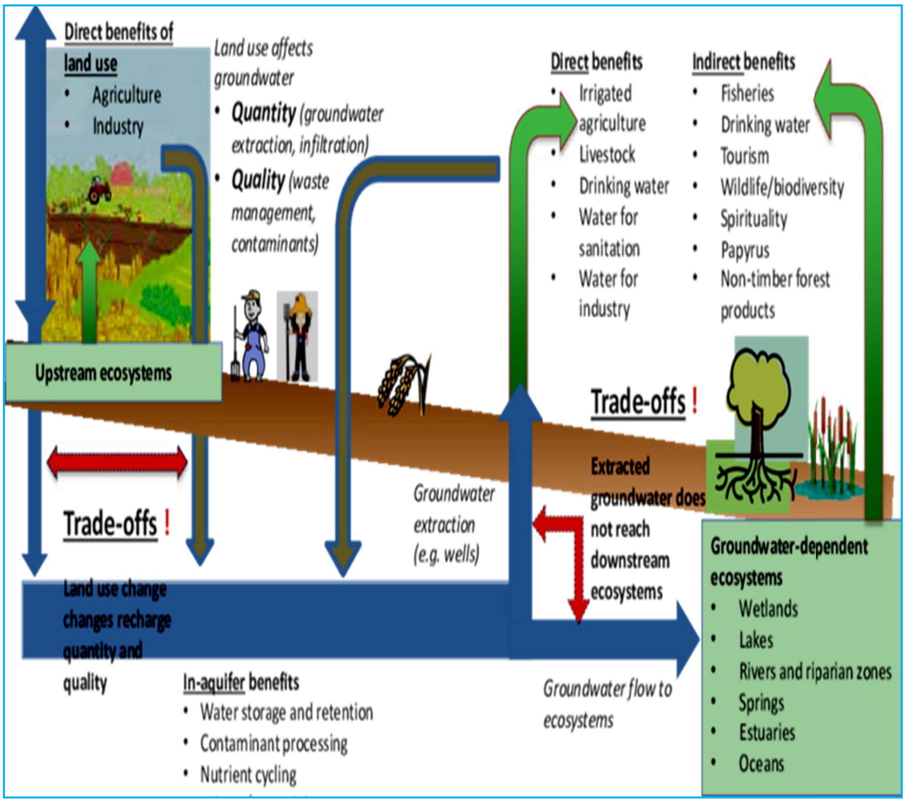


Fig: 7, Conceptual diagram of the multitude of ecosystem services associated with groundwater over a landscape scale.

Groundwater Sustainability Assessment:

Groundwater sustainability assessment involves evaluating various indicators and components across three key dimensions: Environmental, Economic, and Socio-political factors. Each dimension plays a critical role in ensuring long-term groundwater viability. Below is a representation of these indicators and components:

1. Environmental Factors

Groundwater Quantity:

Indicator: Recharge rates vs. extraction rates (groundwater balance).

Component: Ensures the replenishment of groundwater through natural or artificial means.

Groundwater Quality:

Indicator: Contaminant levels (nitrates, arsenic, salinity).

Component: Monitors pollution sources and water quality standards to prevent degradation.

Aquifer Health:

Indicator: Aquifer recharge and depletion trends.

Component: Assesses aquifer storage, subsidence, and ecosystem impacts.

Ecosystem Services:

Indicator: Wetland and river flow dependency on groundwater.

Component: Protects groundwater -dependent ecosystems (GDEs).

2. Economic Factors

Cost of Groundwater Extraction:

Indicator: Energy costs (electricity or diesel) for pumping groundwater.

Component: Higher energy requirements make groundwater use less economically viable in the long term.

Agricultural Productivity:

Indicator: Yield per unit of groundwater used.

Component: Measures how efficiently groundwater is used in agricultural practices.

Economic Value of Groundwater:

Indicator: Market pricing or subsidies for groundwater.

Component: Reflects the value placed on groundwater resources in different sectors (agriculture, industry).

Infrastructure Investment:

Indicator: Spending on groundwater recharge structures, monitoring technologies.

Component: Ensures the availability of funds to develop sustainable groundwater practices.

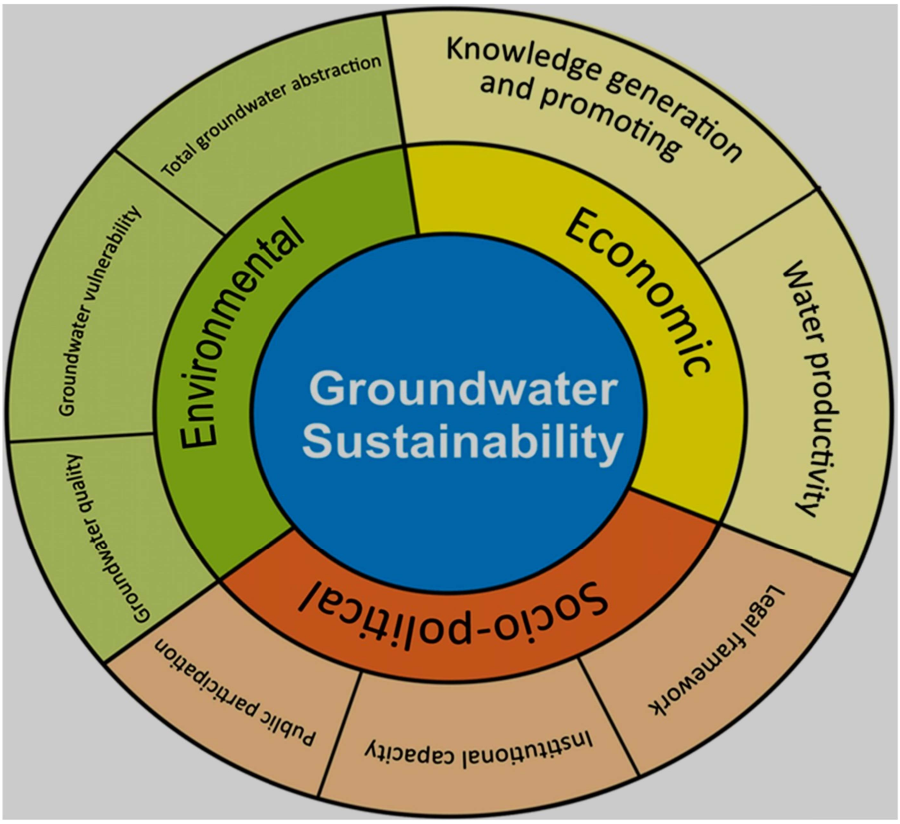


Fig: 7.A representation of indicators and components of groundwater sustainability assessment in India

3. Socio-Political Factors

Access and Equity:

Indicator: Proportion of households with reliable groundwater access.

Component: Assesses equitable distribution and access, especially for marginalized communities.

Institutional Frameworks:

Indicator: Strength of groundwater governance policies and regulations.

Component: Effective regulations and policies at national, state, and local levels.

Community Participation:

Indicator: Community involvement in groundwater management (e.g., Water User Associations).

Component: Promotes bottom-up approaches, ensuring local stakeholders are involved in decision-making.

Political Will:

Indicator: Government prioritization of groundwater issues.

Component: Reflects the extent of governmental efforts and policies to address groundwater sustainability.

Representation of Groundwater Sustainability Assessment:

This framework integrates key environmental, economic, and socio-political indicators to comprehensively assess groundwater sustainability. A balanced approach ensures groundwater resources are managed effectively for future generations while supporting current needs.

Groundwater Management and Adaptation strategies:

Groundwater management in India involves a combination of approaches aimed at balancing supply and demand while ensuring sustainability. These approaches can be classified into six broad categories:

1. Command and Control system:

Regulatory Frameworks: Enforcing strict groundwater extraction limits, especially in over-exploited regions, with penalties for violations.

Permitting Systems: Requiring permits for large-scale groundwater use, mainly for agriculture and industry, ensuring controlled extraction.

Bans and Restrictions: Prohibiting groundwater extraction in critical areas through zoning laws and designated no-extraction zones.

2. Community Management

Participatory Groundwater Management: Empowering local communities to monitor and manage their own groundwater resources through collective decision-making.

Water User Associations (WUA): Forming local groups that ensure equitable distribution and sustainable usage of groundwater among farmers and households.

Education and Awareness Campaigns: Informing communities about groundwater conservation techniques and the importance of sustainable use.

3. Market Instruments

Water Pricing: Introducing tariffs on groundwater extraction to discourage wasteful usage and encourage water conservation practices.

Tradable Water Rights: Establishing markets for groundwater rights where users can trade the rights to extract groundwater, promoting efficient allocation.

Subsidies and Incentives: Providing financial incentives for adopting water-saving technologies such as drip irrigation or low-water-use crops.

4. Supply Augmentation

Rainwater Harvesting: Encouraging the construction of recharge structures like percolation ponds, check dams, and recharge wells to augment groundwater levels.

Artificial Groundwater Recharge: Diverting surplus surface water into aquifers through engineered methods like injection wells and spreading basins.

Recycled Water: Promoting the reuse of treated wastewater for agriculture and industrial purposes to reduce reliance on fresh groundwater.

5. Demand Management

Water-Efficient Technologies: Promoting the use of drip and sprinkler irrigation systems to reduce water consumption in agriculture, which is the largest groundwater user in India.

Crop Diversification: Encouraging farmers to switch from water-intensive crops (e.g., rice, sugarcane) to less water-demanding crops.

Leakage Reduction: Improving water distribution infrastructure to minimize losses and optimize usage.

6. Indirect Approaches

Land Use Planning: Managing land use in recharge zones to prevent over-development and ensure aquifer replenishment.

Climate-Resilient Agriculture: Promoting practices that align with changing rainfall patterns, reducing over-dependence on groundwater during droughts.

Sustainable Urban Planning: Integrating groundwater management in urban development plans, reducing over-extraction in cities through better planning and infrastructure.

These approaches together form a comprehensive strategy for addressing groundwater depletion while promoting adaptation and resilience in the face of growing water stress in India.

Fig:8, Groundwater management and adaptation strategies.

Way Forward Towards Participatory Water Resources and aquifer Management

- Provision of adequate safe water for **drinking, cooking, and other domestic basic requirements and for irrigation and industrial requirements on a sustainable basis, at all times and in all situations.**
- Design and execution of a number of interventions at the **basin/micro catchment levels that fall under the panchayat domain / or ward-wise domain to conserve, protect, enhance, and manage surface and groundwater resources in a sustainable way, including both quantity and quality**.
- **Formulation of Aquifer Management Plan to quantify water availability and water quality in various aquifers for facilitating sustainable management of ground water resources at regional and local level through participatory management approach.**

- **Capacity building of functionaries of PRIs, local community and grass root workers.**
- It is of utmost importance to **map the local aquifers in the study area to determine the quantity and quality of groundwater resources, both replenishable and non-replenishable, at the micro level**. This should be done through a participatory approach involving the local communities and all the stakeholders. The data should be periodically updated on a common data entry platform.
- It is crucial to use water judiciously for **domestic, irrigation, commercial/institutional, and industrial purposes by adhering to all water-saving protocols based on location-specific conditions and requirements.**
- Stakeholders should be made aware of various aspects of sustainable water resource management and capacity building should be provided. In all the above objectives, **community participation and involvement are essential factors that should be prioritized, putting people first in all development measures.**
- **To ensure sustainable water security plans, appropriate water balance studies and aquifer management studies should be conducted following all technical and social protocols**. This can be achieved through various community-friendly development measures.
- We need to implement the **concept of water security at the village level and extend it to the ward level or micro-level to understand the exact water resources spread and ensure its effective and sustainable management through community/PRI-centric demand-driven models on a participatory basis. This approach should be practiced from micro to macro level in a bottom-up manner.**
- To **ensure accountability, there should be a focus on PRI (Public-Related Institutions) with a decentralization approach based on subsidiarity principles and equality.**
- In order to bring about institutional change, the government's **role should shift from being a provider to being a policy maker, regulator, and facilitator**. Responsibility should be decentralized to local agencies, including the private sector.
- It is important to **prioritize Technical and Financial sustainability,** which can be achieved through the use of appropriate hardware that is maintained and managed by community-driven decentralized delivery models. This will ensure improved cost recovery processes, and proper procedures must be established to make it happen.
- **Climate change is already causing increased risks to water sources,** which is a fundamental issue that the sector must address. To do so, appropriate convergence and action plans must be mutually charted out by various line departments.
- For better understanding and appreciation of the **groundwater regime at micro levels, a participatory aquifer (groundwater) monitoring system and water balance must be developed.** Management strategies must also be worked out in a simplistic way, keeping in mind the micro-levels, in order to effectively manage the groundwater regime over time.
- It is crucial to **conduct community-based water quality surveillance and monitoring to understand the quality of groundwater and surface water for various purposes, with a particular focus on drinking water**. **The water quality should be periodically tested at NABL accredited and other government laboratories, and bacteriological tests and surveillance should be carried out using a community-centric approach.** The system should also consider inclusion, equity, transparency, and gender dimensions of water security in terms of both water quality and quantity. It is essential to conduct these tests both before and after the monsoon season to ensure that the water quality is constantly monitored.
- To meet the integration requirements of all sectorial requirements, it's important to develop a framework that all line departments and actors can rally around for effective and efficient Aquifer management plan at micro level.
- The plan should aim to improve sustainability processes towards ensuring water security at the micro ward/village level by using a bottom-up convergence framework to develop, test, and demonstrate an adaptive, holistic model of water security plans at the ward/village level.
- **Grassroots capacities should be built to operationalize the water security framework and ensure sustainable scaling up of the model in various regions of India**

- **Over-withdrawal, Climate change, and cultivation of water-intensive crops with unplanned means of irrigation or over-irrigation are causing problems.** Therefore, it's essential to deal with the runoff from rainfall by increasing water storage in various forms, such as soil moisture retention structures, ponds, artificial recharge of groundwater, and de-silting and upkeep of small and large ponds and tanks. These steps should be taken every year to ensure appropriate filling of water in to the structures and their recharge capability.
- **The Panchayat/ ULB should be encouraged to increase its water storage capacity, including the revival of traditional water harvesting structures and water bodies.** This can be done by allocating appropriate funds and making them available.
- To address declining groundwater levels in over-extracted areas, **improved technologies for water use should be introduced, efficient water use should be incentivized, and community-based management of aquifers should be encouraged**. In addition, artificial recharging projects should be undertaken where necessary to ensure that the extraction is less than the recharge. This will allow the aquifers to provide base flows to the surface system and maintain the river flow ecology.
- Working towards water conservation in irrigation through judicious and scientific use is of paramount importance. Recycling canal seepage water and using conjunctive groundwater techniques can also help in saving water. A concurrent mechanism involving users should be in place to monitor the water usage pattern to avoid unacceptable depletion or building up of groundwaters, salinity, alkalinity, or similar quality problems.
- To plan appropriate interventions, strategic measures must be taken to minimize the over-drawal of groundwater by regulating the use of electricity for its extraction. Considering separate electric feeders for pumping groundwater for agricultural use can also be useful.
- **Groundwater is difficult to clean up, so quality conservation and improvement are even more critical.** It needs to be ensured that industrial effluents, local cesspools, residues of fertilizers and chemicals, etc., do not reach the groundwater.
- **Industries in water-deficient regions may be allowed to withdraw only the makeup water or should have an obligation to return treated effluent to a specified standard back to the hydrologic system.**
- Statutes need to be in place to prevent tendencies to unnecessarily use more water within the industrial plant to avoid treatment or to pollute groundwater.
- **In order to manage water resources efficiently, it is necessary to develop appropriate institutional arrangements for each river basin and micro watershed**. This includes collecting data on a regular basis regarding rainfall, river flows, area irrigated by crops, and utilization of both surface and groundwater. **Water accounts should be published every year for each micro river basin or water shed, or even ward level basin, with appropriate water budgets and accounts based on hydrologic balances. Similarly, water budgeting and accounting should be carried out for each aquifer.**
- At the micro basin level, appropriate institutional arrangements should also be developed for monitoring water quality in both surface and groundwater within the panchayat preview**. The occurrence and movement of groundwater is controlled by a complexity of factors, including hydro-geological, hydrological, and climatological factors.**
- **Assessing recharge and discharge levels accurately can be challenging, but a simple box model method can be employed for estimating groundwater resources on a yearly basis. This estimation can be based on factors such as rainfall, recharge aspects, usage of surface and subsurface water, RWHS and artificial recharge plans and executions, canal-based irrigation potential, and recharge and seepage aspects. In some study areas, canal-based water utility systems for irrigation and domestic use act as a lifeline for water resources upkeep.**
- For evaluating the methods used to quantify discharge and recharge from different sources and establishing the rainfall recharge coefficient, the water balance approach, which is essentially a lumped model study, is a viable method. To properly assess the potential, present use, and additional exploitability of water resources, a water balance study is necessary. This should be done by following the groundwater resource estimation methodology recommended by the Groundwater Resource Estimation Committee (2015 revised). Groundwater exploitation should be done in such a way that it provides protection from depletion and pollution, reduces negative ecological effects to a minimum, and attains economic efficiency of exploitation. Hydrological investigations should be used to determine exploitable resources. A mathematical model of the groundwater system should be used for analyzing and solving problems. Accordingly, a study of water balance is a prerequisite for all groundwater modelling, and village-wise or panchayat-wise water security plans can be developed with perfection.
- **The panchayat should regularly de-silt existing check dams, ponds, and tanks that are suggested for augmenting recharge to the phreatic aquifers.** The canal system in the area needs to be improved and repaired to ensure water distribution to the tail ends. This way, the ongoing irrigation draft from the deeper fracture system can be reduced, and at the same time, groundwater recharge can be augmented.
- There are certain **agricultural practices like SRI (System of Rice intensification) and changes in cropping patterns that are followed by various water-conserving measures and technologies. These may reduce the existing water demand and thereby reduce the utilization of groundwater resources considerably.**

- Optimum utilization of groundwater should be ensured through regulation of pumping and incentives for switching over to low-water crops and adoption of water-use efficient irrigation practices such as sprinkler and drip irrigation in plantations. Groundwater-sensitive and other feasible regions can be put under advanced irrigation practices like sprinkler or drip irrigation.
- The existing open wells in the fields and at the household level can be covered under rooftop rainwater harvesting and artificial recharge systems to enhance the groundwater regime.
- There are many unused/defunct bore wells in the study areas which can be used for artificial or induced recharging practices. These bore wells can be utilized for rainwater harvesting and roof water can be diverted to them. Farmers should be encouraged to practice bore well recharge and rainwater harvesting. Similarly, canal water can be diverted to nearby ponds and tanks for increased groundwater recharge.
- It is crucial to establish a participatory mechanism in which farmer groups or associations control the irrigation draft and crop choices, with support from the local administration for technical guidance, incentives, marketing, and setting base-level prices for products.
- **De-fluoridation and iron removal plants should be installed at sites with high fluoride contamination in drinking water, with proper backwash arrangements.**
- Adoption of **Water Use Efficient (WUE) irrigation techniques, regulation of groundwater draft, and irrigation conservation methods, including drip irrigation and sprinkler irrigation, are highly recommended, with government incentives.**
- More emphasis should be placed on **integrated watershed development with an integrated approach to conserve soil and moisture and augment groundwater recharge methodologies by appropriate RWHS**. Settlement purposes encroach many surface water structures like ponds, tanks, irrigation canal, and cultivable land, reducing natural recharge in project sites. Existing dug wells, ponds, tanks, streams, canals, etc., should be desilted, cleaned, protected, and conserved to augment groundwater and surface resources in the area.
- **Improving water sector governance is crucial for sustainable economic growth and the welfare of various states. Unfortunately, in many states water challenges are increasing at an alarming rate, exacerbated by the impact of climate change. However, through strategic planning, investment, scientific management, and conservation, the sector's sustainability can be improved.**
- **The water crisis in many states of India is primarily a governance crisis,** and water governance is a critical overarching issue that requires intensified efforts in the promotion of institutional frameworks and inter-sectoral convergence in development plans at the local, state, and national levels. The shift in approaches towards service delivery includes moving towards demand-responsive approaches, a change process focused on decentralized governance, a role change for governments (from provider to facilitator), and an emphasis on financial and technical sustainability. Convergence is crucial to achieving and sustaining water security and safety.
- Access to safe and potable water is a fundamental element of sustainable development because it ensures ongoing availability of the resource, referred to as water security and appropriate water governance. Strategic planning, investment, scientific management, and conservation are all necessary elements to improve the water sector's performances shall be the need of the hour.
- Discouraging the **water guzzling crops** in water sensitive area towards cultivation of sugarcanes, paddy etc...
- As aquifers and other groundwater sources are depleted at a rate greater than the recharge rate, **artificial recharge is needed** to maintain a lasting water supply to prevent complete withdrawal of groundwater in the near future.
- To **combat over pumping of groundwater and achieve stability in the water table, artificial recharge is another water source that will help alleviate the stress on groundwater supply**. For arid climates with little precipitation, recharging groundwater can be achieved through using treated wastewater after good treatment processes, natural runoff, and runoff from irrigation.
- The **primary challenge of desalination is its high cost and energy consumption. Electricity makes up 63 per cent of the operational costs of seawater desalination plants. The plants contribute to water security but add stresses to the energy security.**
- Some of the other methods and techniques for groundwater recharge as already mentioned and are detailed here are:
  - ***Roof Top Rain Water and artificial recharge***
  - ***Runoff harvesting through Recharge Pit***
  - ***Recharge Trenches, recharge through defunct Tubewell / open wells.***
  - ***Rain Water Harvesting through Gully Plug, Contour Bund, Gabion Structure, Percolation tank, Check Dam, Cement Plug, Nala Bund, Recharge shaft, Dug well Recharge Ground Water Dams, Subsurface Dykes etc***

- Restoration of ecosystem services, flood plain zonation, vulnerability assessment, and adaptation of nature-based flood management practices are necessary steps to address flood-related disasters.
- In recent years, there is stress on implementing nature-based flood protection measures or a hybrid of nature-based and structural measures for flood management across the world as purely structural measures are found to be inadequate.
- The nature-based measures stress system scale perspectives, including spatial scale, time scale, integration with ecosystem conservation and restoration, adaptive management, and people 's participation.
- Room for rivers and increasing water holding capacity of the catchments are some of the new initiatives to be looked in to.
- Increasing sectoral water use efficiency. There are two options to increase water use efficiency in agriculture, reduction of water losses and increase of productivity per unit of water use.
- Reduction of water losses should be attained through agronomic practices, changing crop calendar and irrigation management, such as the use of precision irrigation and participatory irrigation.
- The second option refers to increasing crop productivity i.e., producing more crops or value per volume of water used. Irrigation of high value crops is important in this context. Besides, there are several other measures including use of technology to increase water use efficiency.
- It is important to understand the real potential of reducing water losses to avoid devising costly and ineffective demand management strategies. A large proportion of the water abstracted in irrigation systems will return to the system.

- **In this case, an improvement in irrigation efficiency, whereby a smaller volume of water is abstracted and an even smaller volume returned**, will mean a better quality of water is available for the next downstream user. If these systems are adopted, the pollution in the downstream water bodies can be controlled.
- **Water being a state subject, steps for augmentation, conservation and efficient management of water resources are primarily undertaken by the respective State Governments**. In order to supplement the efforts of the State Governments, Central Government provides technical and financial assistance to them through various schemes and programmes.
- **Resilience to Climate Change:** With climate change leading to increased weather variability, aquifer mapping assists cities in adapting to changing precipitation patterns and water availability. It enables informed decision-making to secure water resources in times of drought or extreme weather events.
- **Mitigation of Land Subsidence:** Over-extraction of groundwater can lead to land subsidence, causing infrastructure damage and flood susceptibility. Aquifer mapping helps in identifying areas at risk and implementing measures to mitigate subsidence.
- **Legal and Regulatory Compliance:** Compliance with water resource management laws and regulations is vital. Aquifer mapping provides data and insights necessary for aligning city-level water management plans with national and regional water policies.
- **Urban Development Planning:** Urban expansion can encroach upon recharge areas and overburden aquifers. Aquifer mapping informs land-use planning, ensuring that new developments do not compromise groundwater resources.
- **Community Engagement:** Communities often play a significant role in groundwater management. Aquifer mapping, when shared with local communities, can enhance their awareness and active participation in protecting and conserving groundwater.
- **Data-Driven Decision-Making: Reliable aquifer data helps cities make informed decisions on water resource allocation, conservation measures**, and infrastructure investments. It minimizes uncertainty and improves the efficiency of urban water management.
- **Long-Term Resilience: Aquifer mapping is essential for building resilience in cities against water-related challenges.** It allows cities to develop long-term strategies to address water availability and quality concerns, mitigating potential crises.
- The aquifer mapping is a critical component of sustainable urban water management in Indian cities. It provides essential data and insights needed to manage groundwater resources effectively, protect water quality, and adapt to the changing climate, ultimately ensuring a resilient and water-secure future for urban and Rural areas.

Conclusion:

India, host to 16% of total population of world, has only 4% of total freshwater resources of the world. There is huge inequality in distribution of water resources within the country. Groundwater, which is the main source of fresh water in the country, is unevenly distributed. While over-exploitation is a major issue in the country, there are also areas where enough scope exists for further groundwater development. Adding to the woes is contamination of sources. **Contaminants like arsenic, fluoride, nitrate, iron and salinity have been reported from groundwater in many parts of the country**. Further, climate change is feared to contribute towards increased vagaries of monsoon affecting intra annual availabilities. Climate change induced sea level rise may increase saline ingress and increase in salinity of coastal aquifers. **Groundwater is very much susceptible to deterioration in terms of quantity and quality due to unplanned and uniformed anthropogenic interventions and the results usually do not show until it is too late.**

Artificial recharge, rainwater harvesting, treatment and recycling of wastewater are some of the supply side interventions that can help in augmenting resources. **Reducing demand of groundwater through increasing water use efficiency, choosing less water intensive crops and regulating extractions are also effective management tools**. Management interventions are a big challenge especially in view of the fact that more than 25 million abstraction structures are in operation in the country and most of them are private owned. **Water is a 'state subject' in India and management interventions are implemented primarily by the respective State Governments. The Union Government plays a supportive role**. The National Water Policy of India recognizes that water is a scarce natural resource and is fundamental to life, livelihood, food security and sustainable development. It proposes a framework for creation of a system of laws and institutions and for a plan of action with unified national perspective. The most important link in ensuring effective management is awareness and community participation.

The prime focus will be on arresting the rate of decline of groundwater levels as well as water consumption in terms of irrigation, industries and institutional usages. Leveraging schemes like Atal Bhujal Yojana which seeks to strengthen the institutional framework and bring about behavioural changes at community level for sustainable groundwater resource management is vital. We need to have more **community-led Water Security Plans with absolute aquifer management plans, water budgeting etc.** Thus, a need was felt for scientific management of groundwater resources with all stakeholder's participation. **There should be a paradigm shift from "Groundwater development" to "Groundwater management".** The importance of groundwater for national development has deemed it necessary to be more specific; from the **"Groundwater management"** at Micro level having "**Aquifer Management"** as the major criteria to ensure the **Groundwater Regime and its sustainability.**

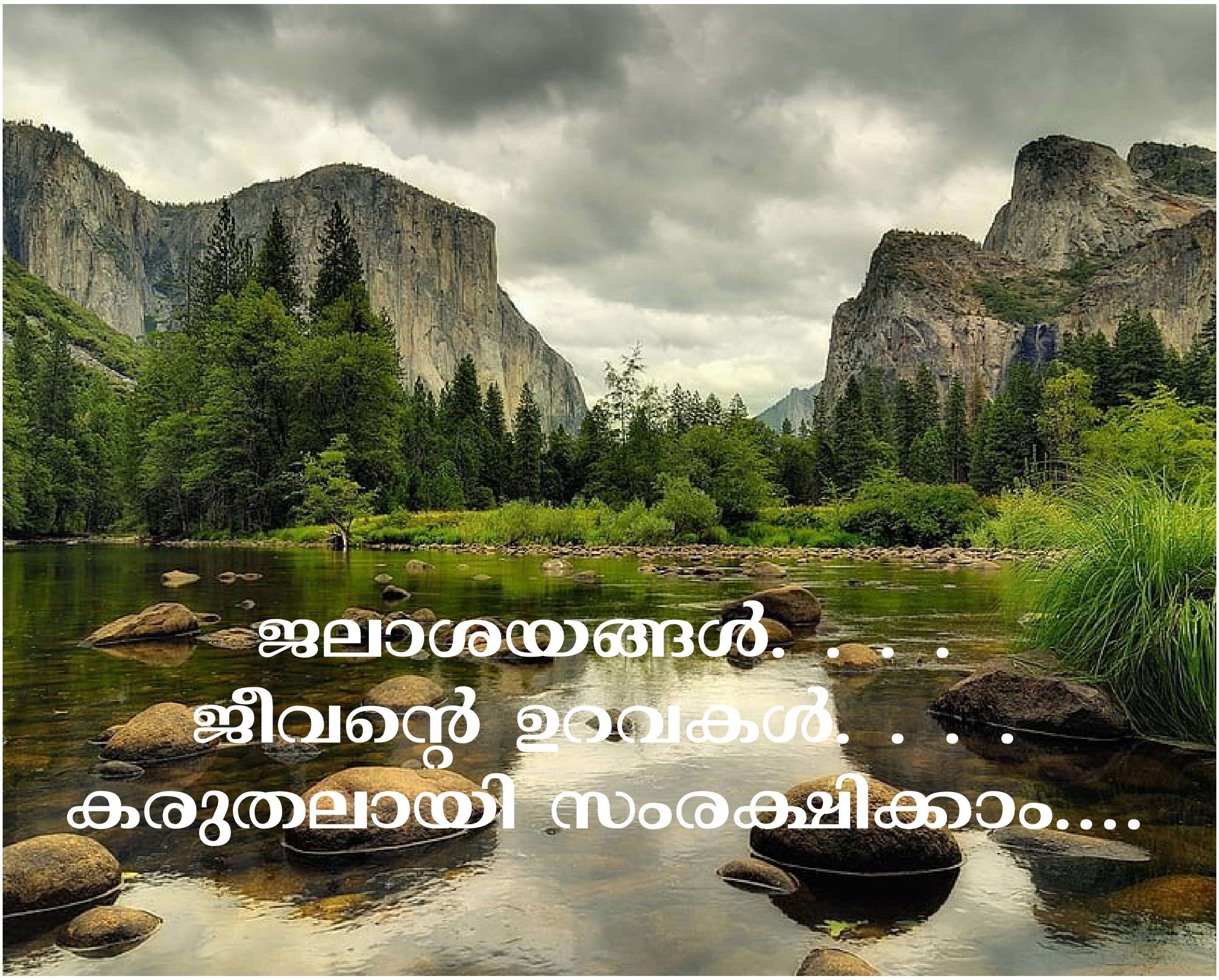
The water is always Deeper than what it reflects. It's a gift of God whereby We always need to Protect it, respect it and save it.

AMRUT 1 - CITY WISE PROGRESS AS ON 31.10.2024

City	Total Project		AS Accorded		TS Issued		Tendered		Work Awarded		Work Started		Work Not Started		Work Completed		Expenditure	
	Nos.	Cost	Nos.	Amount	Nos.	Amount	Nos.	Amount	Nos.	Amount	Nos.	Amount	Nos.	Amount	Nos.	Amount	Amount	%
Trivandrum	317	357.5	317	415.07	317	391.07	317	388.23	314	388.74	314	388.74	0	0	271	246.5	333.34	93.24%
Thrissur	136	269.93	136	283.44	136	283.44	136	283.44	136	283.44	135	279.94	1	3.5	121	166.6	249.72	92.51%
Palakkad	147	221.75	147	225.94	147	227.22	147	225.33	147	215.57	146	215.18	1	0.39	134	187.99	181.9	82.03%
Kozhikode	57	274.76	57	276.23	57	276.23	57	276.23	55	262.67	55	262.67	0	0	47	115.64	251.34	91.48%
Kannur	40	225.72	40	244.67	40	243.88	40	237.58	40	236.89	40	236.89	0	0	35	185.03	224.93	99.65%
Kollam	56	253.45	56	196.9	56	202.52	56	202.52	56	183.26	56	183.26	0	0	49	56.28	126.01	49.72%
Kochi	113	328.78	113	288.69	113	279.91	113	279.91	113	270.51	112	270.26	1	0.25	94	114.82	212.55	64.65%
Guruvayur	33	203.1	33	213.78	33	213.78	33	213.78	33	213.78	33	213.78	0	0	27	152.56	184.19	90.69%
Alappuzha	212	222.7	212	242.2	212	223.62	212	223.62	211	223.24	211	223.24	0	0	194	138.11	203.87	91.55%
Grand Total	**1111**	**2357.7**	**1111**	**2386.9**	**1111**	**2341.7**	**1111**	**2330.6**	**1105**	**2278.1**	**1102**	**2274**	**3**	**4.14**	**972**	**1363.5**	**1,967.86**	**83.47%**

AMRUT 2.0 - DISTRICTWISE PROGRESS AS ON 31.10.2024

District	Projects	AS Issued		TS Issued		NIT Issued		Awarded		Completed	Expenditure	
	No.	No.	Amount	No.	Amount	No.	Amount	No.	Amount	No.	Amount	%
Alappuzha	31	31	66.75	27	67.5	27	63.66	23	41.94	3	14.98	22.44%
Ernakulam	63	62	392.88	57	383.49	55	297.58	38	65.6	8	27.77	7.07%
Idukki	5	5	25.35	5	26.18	5	23.78	3	23.52	0	7.99	31.52%
Kannur	30	26	150.33	24	135.29	24	123.04	17	119.3	1	43.16	28.71%
Kasaragod	11	8	13.11	6	12.21	6	9.97	6	13.05	3	4.2	32.04%
Kollam	50	49	276.1	41	236.94	41	184.14	36	90.75	8	17.37	6.29%
Kottayam	23	23	101.1	22	76.04	22	71.77	20	75.88	2	26.53	26.24%
Kozhikode	35	34	388.35	30	214.39	30	140.68	29	88.42	12	6.8	1.75%
Malappuram	38	36	119.24	35	114.58	35	97.94	33	99.36	2	11.47	9.62%
Palakkad	25	25	60.03	21	50.47	21	50.01	17	46.2	2	19.22	32.02%
Pathanamthitta	36	35	56.8	34	50.66	34	49.88	26	26.8	8	15.8	27.82%
Thiruvananthapuram	41	39	317.72	39	267.87	39	225.46	37	168.16	1	63.1	19.86%
Thrissur	45	41	233.26	37	154.19	35	125.04	31	101.34	3	15.23	6.53%
Wayanad	8	8	35.66	6	34.62	5	28.02	5	28.74	2	21.29	59.70%
Grand Total	**441**	**422**	**2236.68**	**384**	**1824.42**	**379**	**1490.95**	**321**	**989.06**	**55**	**294.9**	**13.18%**



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