

ആഗസ്റ്റ് 2025



ലക്കം 6

അമൃതം

വാർത്താ പത്രിക



സ്വാതന്ത്ര്യ ദിനാശംസകൾ.....



ഏലൂർ നഗരസഭയിൽ അമൃത് പദ്ധതിയിൽ ഉൾപ്പെടുത്തി സ്ഥാപിക്കുന്ന ഓവർ ഹെഡ് ടാങ്കിന്റെ നിർമ്മാണ ഉദ്ഘാടനം





അമൃത് വാർത്താ പത്രിക

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**തദ്ദേശസ്വയംഭരണ വകുപ്പ്
കേരള സർക്കാർ**

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സുരേഷ് ഷാജി ഐ.എ.എസ്.
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എൻവിയോൺമെന്റ് എക്സ്പർട്ട് കം
ഹൈഡ്രോ ജിയോളജിസ്റ്റ്**

**അസിസ്റ്റന്റ് എഡിറ്റർ
സാവിത്രി സജി ഇ.ആർ.**



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യൂണിറ്റ് (അമൃത്)**

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എഡിറ്റോറിയൽ

നഗരങ്ങളുടെ ജല ഭദ്രത ലക്ഷ്യമിട്ട് നടപ്പിലാക്കി വരുന്ന അമൃത് 2.0 പദ്ധതി സംസ്ഥാനത്തിലെ എല്ലാ നഗരസഭകളിലും പുരോഗമിച്ചു വരികയാണ്. അമൃത് 2.0 പദ്ധതിയുടെ ഭാഗമായി നഗരസഭകൾ നടപ്പിലാക്കേണ്ട പരിഷ്കരണ പദ്ധതികളും നടപടികളും ഇതിനോടകം പല നഗരസഭകളും പൂർത്തീകരിച്ചുകഴിഞ്ഞു. ഇനിയും പൂർത്തീകരിക്കാനുള്ള നഗരസഭകൾ അതിനുള്ള നടപടികൾ സ്വീകരിക്കേണ്ടതാണ്. അമൃത് 2.0 യുടെ അനുബന്ധ പദ്ധതിയായ അമൃത് മിത്ര പദ്ധതി വളരെ കാര്യക്ഷമമായി തന്നെ നടന്നു വരികയാണ്. ഇതിന്റെ ഭാഗമായി നടപ്പിലാക്കി വരുന്ന 'വിമെൻ ഫോർ ട്രീസ്, ട്രീ ഫോർ വിമെൻ' പദ്ധതി സംസ്ഥാനത്തെ എല്ലാ നഗരസഭകളിലും പൂർത്തീകരിച്ചു വരികയാണ്. പദ്ധതി അനുശാസിക്കുന്ന രീതിയിൽ വൃക്ഷ തൈകളുടെ പരിപാലനം നടക്കുന്നുണ്ടെന്ന് നഗരസഭകൾ ഉറപ്പ് വരുത്തേണ്ടതുണ്ട്.

അമൃത് പദ്ധതിയിൽ ഉൾപ്പെടുത്തി പൂർത്തീകരിച്ച പദ്ധതികളുടെ പരിപാലനം കൃത്യതയോടെ നടക്കുന്നുവെന്ന് അതാത് നഗരസഭകൾ ഉറപ്പ് വരുത്തേണ്ടതാണ്. ആയതിലേക്ക് അമൃത് മിത്ര പദ്ധതി ഉപയോഗപ്പെടുത്തി പരിപാലനവും പ്രവർത്തനവും പൊതുജനങ്ങൾക്ക് ഉപകാരപ്രദമായ രീതിയിലാക്കുവാൻ ശ്രമിക്കേണ്ടതാണ്. പദ്ധതി പ്രവർത്തനങ്ങൾ നടപ്പിലാക്കുന്നതിനോടൊപ്പം നടത്തിയ പ്രവർത്തനങ്ങളുടെ പുരോഗതി പ്രോജക്ട് മോണിറ്ററിംഗ് സംവിധാനത്തിൽ, പി.എം.എസ്. പോർട്ടലിൽ അപ്ഡേറ്റ് ചെയ്യാൻ സിറ്റി മിഷൻ മാനേജ്മെന്റ് യൂണിറ്റുകൾ ശ്രമിക്കേണ്ടതാണ്. പൊതുജനങ്ങൾക്ക് പദ്ധതി സംബന്ധമായ വിവരങ്ങൾ ലഭ്യമാകുന്നത് പോർട്ടൽ വഴിയാണ്. ആയതിനാൽ പദ്ധതി സംബന്ധിച്ച വിവരങ്ങൾ അതാത് സമയങ്ങളിൽ തന്നെ അപ്ഡേറ്റ് ചെയ്യേണ്ടതാണ്. 2025-26 സ്പെഷ്യൽ അസിസ്റ്റന്റ് റിഫോംസ് വഴിയായി പരമാവധി പരിഷ്കരണ നടപടികൾ നടത്തി രേഖകൾ സമർപ്പിച്ച് സംസ്ഥാനത്തിന്റെ ആസ്തി വികസനത്തിനാവശ്യമായ തുക കേന്ദ്ര സർക്കാരിൽ നിന്ന് നേടിയെടുക്കുന്നതിനായി എല്ലാവരും ഒന്നുചേർന്ന് പരിശ്രമിക്കേണ്ടതുണ്ട് എന്ന കാര്യം പ്രത്യേകം ഓർമ്മിപ്പിക്കുന്നു. ഏവർക്കും സ്വാതന്ത്ര്യ ദിനാശസകൾ നേരുന്നു.

മിഷൻ ഡയറക്ടർ



എറണാകുളം ജില്ല - ദിശ മിറ്റിംഗ്



ലോക ബാങ്ക് പ്രതിനിധികൾ അമൃത് മിഷൻ ഡയറക്ടറുമായി ചർച്ച നടത്തുന്നു

അമൃത് വാർത്താ പത്രിക

ഉള്ളടക്കം

ആഗസ്റ്റ് 2025



- 5 അർബൻ പ്ലാനിംഗ് റിഫോംസ് ഏകദിന ശിൽപ്പശാല
- 7 GARIMA ദേശീയ ശിൽപ്പശാല
- 8 തദ്ദേശ നഗര സ്ഥാപനങ്ങളിലെ അദ്ധ്യക്ഷൻമാർക്കായി ദേശീയ കോൺഫറൻസ്
- 10 അമൃത് മിഷൻ ഡയറക്ടറുടെ കണ്ണൂർ ജില്ലാ സന്ദർശനം
- 12 Tiger Worm Toilets: An Alternative to Pit Toilets for Kerala
- 16 ARTICLE ON GROUNDWATER AND SURFACE WATER INTERACTIONS....







അർബൻ പ്ലാനിംഗ് റിഫോംസ് ഏകദിന ശില്പശാല ബഹു. തദ്ദേശ സ്വയംഭരണ വകുപ്പ് മന്ത്രി ഉദ്ഘാടനം ചെയ്തു



കേന്ദ്ര ധനകാര്യ മന്ത്രാലയം സംസ്ഥാനങ്ങൾക്കുള്ള സ്പെഷ്യൽ അസിസ്റ്റൻസ് 2025 - 26 മാർഗ്ഗരേഖയിൽ പാർട്ട് X - അർബൻ പ്ലാനിംഗ് റിഫോംസ് സംബന്ധിച്ച് അമൃത് മിഷൻ 18.07.2025 ന് തിരുവനന്തപുരത്ത് സംഘടിപ്പിച്ച ഏകദിന ശില്പശാല ബഹു. തദ്ദേശ സ്വയംഭരണ വകുപ്പ് മന്ത്രി ശ്രീ. എം.ബി രാജേഷ് ഉദ്ഘാടനം ചെയ്തു. മിഷൻ ഡയറക്ടർ ശ്രീ. സുരജ് ഷാജി ഐ.എ.എസ്. സ്വാഗതം ആശംസിച്ചു. ശ്രീ. നരേഷ് കുമാർ ദിരൻ (ചീഫ് പ്ലാനർ, ടി.സി.പി.ഒ., കേന്ദ്ര ഭവന നഗരകാര്യ മന്ത്രാലയം) മുഖ്യ പ്രഭാഷണം നടത്തി. ശ്രീ. മുഹമ്മദ് മോനിസ്ഖാൻ (അഡീഷണൽ ചീഫ് പ്ലാനർ, ടി.സി.പി.ഒ., കേന്ദ്ര ഭവന നഗരകാര്യ മന്ത്രാലയം), ശ്രീമതി ഷിജി ഇ. ചന്ദ്രൻ (ചീഫ് ടൗൺ പ്ലാനർ, തദ്ദേശ സ്വയംഭരണ വകുപ്പ്) ശ്രീ. കിഷോർ അവാർ (കൺസൾട്ടന്റ്, കേന്ദ്ര ഭവന നഗരകാര്യ മന്ത്രാലയം) എന്നിവർ ചടങ്ങിൽ പ്രസംഗിച്ചു. ശ്രീ. പ്രശാന്ത് എച്ച്. (പ്ലാനർ കൺസൾട്ടന്റ്, എസ്.ഐ.യു., അമൃത് & ചീഫ് ടൗൺ പ്ലാനർ (റിട്ട.)) കൃതജ്ഞത അർപ്പിച്ചു. തുടർന്ന് ശ്രീ. മുഹമ്മദ് മോനിസ്ഖാൻ (അഡീഷണൽ ചീഫ് പ്ലാനർ, ടി.സി.പി.ഒ., കേന്ദ്ര ഭവന നഗരകാര്യ മന്ത്രാലയം) ശ്രീ. കിഷോർ അവാർ (കൺസൾട്ടന്റ്, കേന്ദ്ര ഭവന നഗരകാര്യ മന്ത്രാലയം), ശ്രീമതി ആശാ അജോയ് ഘോഷ്, (ചീഫ് ടൗൺ പ്ലാനർ (പ്ലാനിംഗ്) ഇൻ ചാർജ്ജ്) എന്നിവർ വിവിധ വിഷയങ്ങളിൽ പ്രസന്റേഷൻ നടത്തി. പരിഷ്കരണ നടപടികളിൽ പങ്കാളിത്തം വഹിക്കുന്ന വിവിധ വകുപ്പുകളിലെ ഉദ്യോഗസ്ഥർ സെമിനാറിൽ പങ്കെടുത്തു.



കേന്ദ്ര ധനകാര്യ മന്ത്രാലയം സംസ്ഥാനങ്ങൾക്കുള്ള സ്പെഷ്യൽ അസിസ്റ്റൻസ് 2025 - 26 മാർഗ്ഗരേഖയിൽ പാർട്ട് X - അർബൻ പ്ലാനിംഗ് റിഫോംസ് നടപ്പിലാക്കുന്നതിന് ഭരണ പരിഷ്കാരങ്ങളും, ധനപരമായ പരിഷ്കാരങ്ങളും, ആസൂത്രണ പരിഷ്കാരങ്ങളും ഉൾപ്പെടെ വിവിധങ്ങളായ പരിഷ്കരണ നടപടികളാണ് നിഷ്കർഷിച്ചിട്ടുള്ളത്. ഈ പദ്ധതി പ്രകാരം സംസ്ഥാനത്തിന് 2000 കോടി രൂപയാണ് വകയിരുത്തിയിട്ടുള്ളത്. ഈ പ്രോത്സാഹന തുക ലഭിക്കുന്നതിന് പരിഷ്കരണ നടപടികൾ 2025 -26 വർഷം നടപ്പിലാക്കുന്നതിനുള്ള ഒരു കർമ്മ രേഖ സമർപ്പിക്കേണ്ടതുണ്ട്. പരിഷ്കരണങ്ങൾ നടപ്പിലാക്കുന്നതിന്റെ പുരോഗതി റിപ്പോർട്ടും അനുബന്ധ രേഖകളും കേന്ദ്ര ഭവന നഗര കാര്യ വകുപ്പിന് സമർപ്പിച്ച് അവർ വിലയിരുത്തിയശേഷം ശുപാർശ സഹിതം കേന്ദ്ര ധനകാര്യ മന്ത്രാലയത്തിന് സമർപ്പിച്ചാൽ മാത്രമെ ഈ പരിഷ്കരണ തുക ലഭിക്കുകയുള്ളൂ. ലഭിക്കുന്ന തുക സംസ്ഥാനത്തിന്റെ ആസ്തി വികസനത്തിനായി ഉപയോഗിക്കാവുന്നതാണ്.





പ്രത്യേക ധന
സഹായത്തിനായുള്ള കേന്ദ്ര
ഭവന നഗരകാര്യ മന്ത്രാലയം
ഉദ്യോഗസ്ഥരുടെ ഫീൽഡ്
സന്ദർശനം.





സാനിറ്റേഷൻ പ്രവർത്തനങ്ങൾ സുരക്ഷിതവും സ്വീകാര്യവും ആയിരിക്കേണ്ടതും അത്തരം പ്രവർത്തനങ്ങളിൽ ഏർപ്പെടുന്ന തൊഴിലാളികൾക്ക് സമൂഹത്തിൽ മാനുതയും ലഭിക്കുന്നതിനുള്ള അവബോധം സൃഷ്ടിക്കുന്നതിനും പുതിയ സാങ്കേതിക വിദ്യകൾ പരിചയപ്പെടുത്തുന്നതിനുമായി ഗരിമ (GARIMA) എന്ന പേരിൽ 2025 ജൂലൈ 26, 27 തീയതികളിൽ ദേശീയ ശില്പശാല സംഘടിപ്പിച്ചു. ഒഡീഷയിലെ ഭുവനേശ്വറിലാണ് ശില്പശാല നടന്നത്. ഒഡീഷാ മുഖ്യമന്ത്രി ശ്രീ. മോഹൻ ചരൺ മാജി ശില്പശാല ഉദ്ഘാടനം ചെയ്തു. സാനിറ്റേഷൻ പ്രവർത്തനങ്ങൾക്ക് ഉപയോഗിക്കുന്ന റോബോട്ടിക് ഉപകരണങ്ങളുടെ പ്രദർശനവും ശില്പശാലയോടനുബന്ധിച്ച് സംഘടിപ്പിച്ചിരുന്നു. 12 സംസ്ഥാനങ്ങളിൽ നിന്നുള്ള പ്രതിനിധികൾ ശില്പശാലയിൽ പങ്കെടുത്തു. കേരളത്തെ പ്രതിനിധീകരിച്ച് അർബൻ സ്റ്റാൻ കം വാട്ടർ എക്സപർട്ട് ശ്രീ. രാഹുൽ ശില്പശാലയിൽ പങ്കെടുത്തു.





തദ്ദേശ നഗര സ്ഥാപനങ്ങളിലെ അദ്ധ്യക്ഷൻമാർക്കായി പ്രഥമ ദേശീയ കോൺഫറൻസ്

തദ്ദേശ നഗര സ്ഥാപനങ്ങളിലെ അദ്ധ്യക്ഷൻമാർക്കായി 2025 ജൂലൈ 3, 4 തീയതികളിൽ ഗുരുഗ്രാമിൽ വച്ച് പ്രഥമ ദേശീയ കോൺഫറൻസ് സംഘടിപ്പിച്ചു. രാജ്യ നിർമ്മിതിയിലും ഭരണഘടനാധിഷ്ഠിതമായി ജനാധിപത്യം സംരക്ഷിക്കുന്നതിലും തദ്ദേശ സ്ഥാപനങ്ങളുടെ പങ്ക് എന്ന വിഷയത്തിലാണ് കോൺഫറൻസ് സംഘടിപ്പിച്ചത്. ഒരു മികച്ച സാമാജികൻ എന്ത് ചെയ്യണം? എന്ത് ചെയ്യരുത്? എങ്ങനെ പ്രവർത്തിക്കണം? എന്നീ പ്രമേയങ്ങൾ മുൻനിർത്തി ക്ലാസ്സുകൾ നടന്നു. ലോക്സഭയും ഹരിയാനാ വിധാൻ സഭയും സംയുക്തമായാണ് കോൺഫറൻസ് സംഘടിപ്പിച്ചത്. ലോക്സഭാ സ്പീക്കർ ശ്രീ. ഓം ബിർജ കോൺഫറൻസ് ഉദ്ഘാടനം ചെയ്തു. ബഹു. കേന്ദ്ര ഭവന നഗരകാര്യ മന്ത്രാലയം മന്ത്രി ശ്രീ. മനോഹർ ലാൽ, ഹരിയാനാ സംസ്ഥാന ഗവർണ്ണർ, സ്പീക്കർ, മുഖ്യമന്ത്രി, മന്ത്രിമാർ, നിയമസഭാ സാമാജികർ എന്നിവരും കോൺഫറൻസിൽ പങ്കെടുത്തു. അമൃത് മിഷന്റെ ആഭിമുഖ്യത്തിൽ കേരളത്തിലെ വിവിധ നഗരസഭകളിൽ നിന്നുള്ള ചെയർമാൻമാർ കോൺഫറൻസിൽ പങ്കെടുത്തു.







അമൃത് മിഷൻ ഡയറക്ടറുടെ കണ്ണൂർ ജില്ലാ സന്ദർശനം







Tiger Worm Toilets:

An Alternative to Pit Toilets for Kerala

Introduction

For many communities, especially in places like Kerala, finding a good toilet solution that's both affordable and easy to maintain can be a real challenge. Traditional pit toilets, while common, often come with issues like frequent emptying, unpleasant smells, and the risk of spreading disease. But there's a natural and eco-friendly solution that uses tiny helpers—**composting worms**.

This paper explores **Tiger Worm Toilets (TWTs)**, also known as vermifilter toilets. These innovative systems use special composting worms to break down human waste, drastically reducing its volume and making the toilets last much longer. We'll explain how these toilets work, why they're better than traditional toilets, and why they are a great fit for places like Kerala.

How TWTs Work: The magic of TWTs lies in the power of composting worms, primarily species like the Red (Tiger) Worm (*Eisenia Fetida* or *Eisenia Andrei*), the African Nightcrawler (*Eudrilus Eugeniae*), and the Indian Blue (*Perionyx Excavatus*). These worms are housed in a specially designed pit with a bedding layer (e.g., woodchip, coconut fibre) and a drainage layer. As faeces enter the pit, the worms actively consume it, converting it into carbon dioxide, water, ammonia, and nutrient-rich vermicompost (worm faeces). This aerobic process makes the TWT less odorous and less attractive to flies than traditional pit latrines.

Key Advantages of TWTs:

- **Reduced Emptying Frequency:** TWTs typically require emptying only every 3 to 5 years, a significant improvement over traditional latrines which may need desludging every 6 months. This dramatically reduces long-term operational costs and the logistical burden of sludge management.
- **Easier Emptying:** The vermicompost produced by the worms is a dense, soil-like material that accumulates at the top of the pit, making it easy to remove with a spade. This eliminates the need for specialized desludging equipment.
- **Cost-Effectiveness:** While initial construction costs are similar to conventional latrines, the reduced emptying frequency and elimination of desludging infrastructure lead to a much lower overall lifecycle cost.
- **Odor and Fly Reduction:** The aerobic decomposition process minimizes foul odors and deters flies, contributing to a more pleasant and hygienic user experience and reducing the risk of disease transmission.
- **Resource Recovery Potential:** The vermicompost, though currently not recommended for use as a fertilizer on food crops due to pathogen concerns, has potential for safe disposal or future use as a soil conditioner in non-food applications.



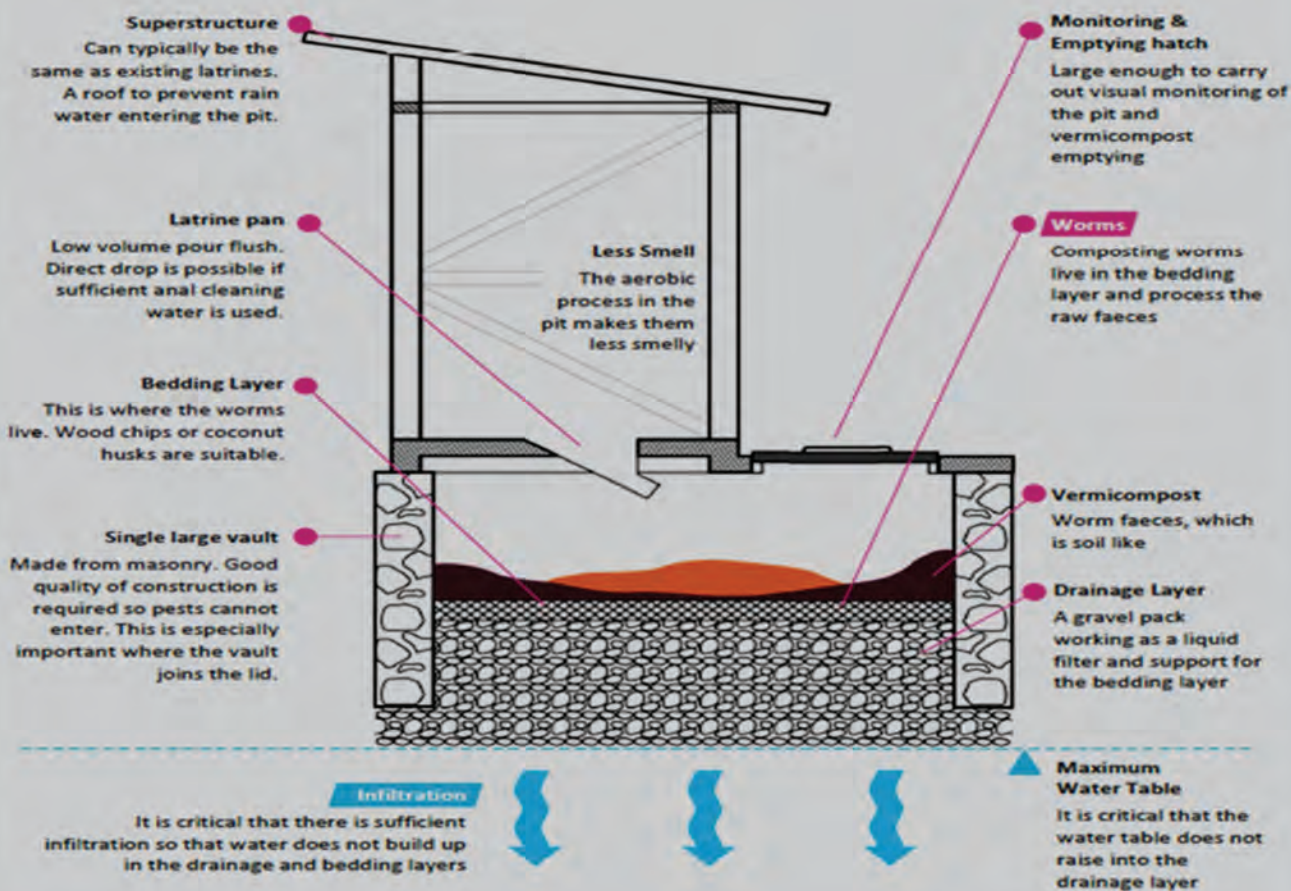
Smt. Ashida A G
Urban Infrastructure cum
Water Expert

Environmental Conditions for Worms: Maintaining the correct environmental conditions within the TWT is crucial for the worms' survival and optimal performance. Key parameters include:

- **Temperature:** An optimal range of 20–25° C is ideal, though worms can survive between 5–35° C. The pit's construction helps in maintaining a stable temperature.
- **Humidity:** A humidity level of 60–80% is optimal, with a permissible range of 50–96%. Adequate water input from flushing is vital to maintain moisture.

KEY FEATURES

Of a direct drop 'Pour Flush' model



- **Aeration:** The bedding layer's porous structure and flushing contribute to an aerobic environment, which is essential for the worms.
- **Feed Rate:** Worms can consume up to their own body weight in faeces daily. Approximately 200g of worms are needed per person. To support the worms, each person using the toilet requires about 0.1 square meters (0.1m²) of bedding surface area. Overall, for every 1 kg of worms, we need at least 0.5 square meters (0.5 m²) of bedding. The smallest recommended total area for a TWT is 0.7 square meters (0.7 m²).

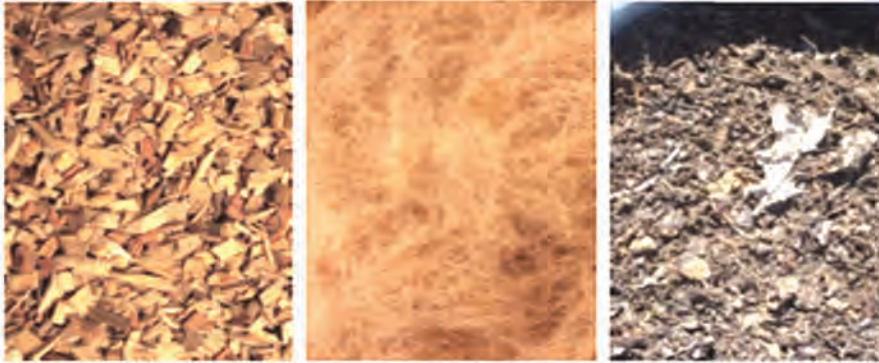
Bedding Layer Depth: A 10cm deep bedding layer (woodchip, coir) is required for the worms to live and move.





Design Considerations:

- **Drainage Layer:** A 40cm deep drainage layer of gravel or hard-core supports the bedding and allows water infiltration.



Possible bedding layers: woodchip, coconut fibre (coir) or compost

- **Space:** At least 40cm of space above the bedding layer is needed for vermicompost accumulation.
- **Inlet Pipe:** Positioned to ensure faeces lands centrally.
- **Latrine Pan:** Low-volume pour flush pans are ideal; direct drop pans require sufficient water for anal cleansing and pan cleaning (1–1.5 litres per use).
- **Pit Construction:** Must be properly mortared and sealed to prevent water and predator entry.
- **Monitoring and Emptying Hatch:** A minimum 0.6m×0.6m sealed hatch for inspection and emptying.

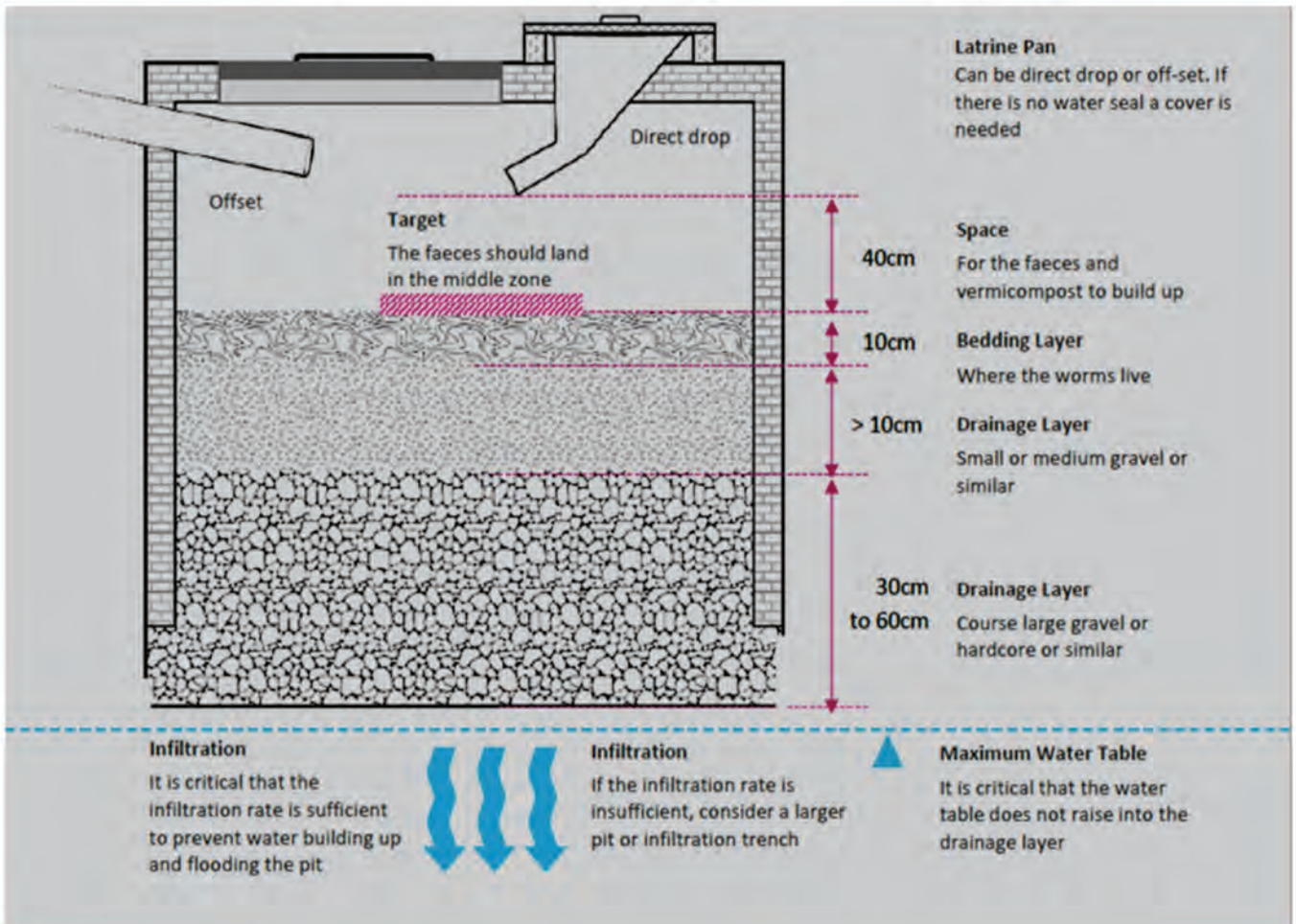
Maintenance and Troubleshooting:

Regular monitoring (every 3 months) is recommended to check for fresh faeces buildup and worm presence. If problems arise, troubleshooting involves checking water quantity, bedding layer condition, absence of detergents, user numbers, and potential clogging or flooding. Re-seeding with worms may be necessary if the colony is compromised.

Kerala's Suitability for Tiger Worm Toilets:

Kerala, with its unique geographical, climatic, and socio-cultural characteristics, presents a highly suitable environment for the widespread adoption of Tiger Worm Toilets.

- **Abundant Water Availability:** Kerala receives significant rainfall and has a high-water table in many areas. TWTs require a consistent water input (1.0–1.5 litres per person per flush) to maintain the worms' moist environment.





ARTICLE ON GROUNDWATER AND SURFACE WATER INTERACTIONS....

Introduction:

Groundwater and surface water are two critical components of the hydrologic system, closely linked through various physical processes. Their interaction governs the availability and sustainability of freshwater resources for agricultural, industrial, and domestic use. The diagram below illustrates the interconnected flow of water between surface sources like rivers, streams, and reservoirs, and subsurface elements such as aquifers and wells.

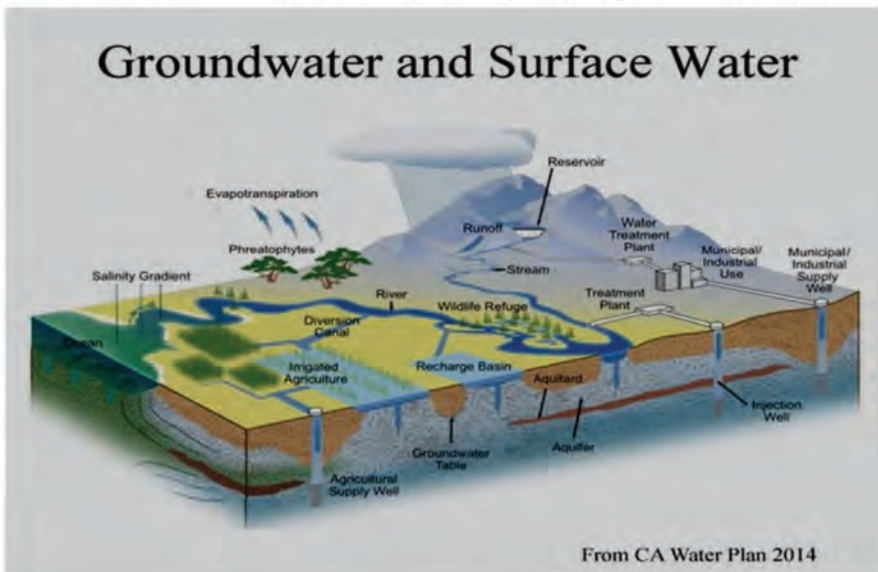


Figure: 1 Groundwater and Surface water interactions:

Understanding the Significance of Groundwater- Surface water Interaction:

Understanding the dynamics between groundwater and surface water is essential **in water resource management, drought mitigation, and ecological conservation**. This integrated approach ensures the long-term sustainability of water for both human and environmental needs. Groundwater and surface water interact in various ways, influencing each other's quantity and quality. Surface water can infiltrate into the ground to recharge groundwater, while groundwater can discharge into surface water bodies. These interactions are crucial for maintaining healthy ecosystems, managing water resources, and understanding the spread of contamination.



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The Hydrological cycle Defined:

The hydrological cycle, also known as the water cycle, is a continuous and dynamic process by which water moves through the Earth's atmosphere, surface, and subsurface. It plays a critical role in sustaining life, regulating climate, and shaping the environment. The cycle begins with evaporation, where solar energy heats surface water from oceans, lakes, and rivers, turning it into water vapor. Alongside this, evapotranspiration—the combination of evaporation from soil and transpiration from plants—adds moisture to the atmosphere. The moist air rises, cools, and undergoes condensation, forming clouds as the water vapor turns into tiny droplets. When these droplets grow large and heavy enough, precipitation occurs in the form of rain, snow, or hail. Upon reaching the ground, water follows several pathways. Surface runoff occurs when precipitation flows over land, often entering rivers and eventually returning to oceans. Part of this water seeps into the soil through infiltration, moving downward through porous layers in a process called percolation. This contributes to subsurface flow and eventually replenishes groundwater aquifers. Groundwater flow transports water slowly through underground formations and can resurface through springs or be tapped via wells. In coastal regions, excessive extraction of groundwater can lead to sea water intrusion, where saline water encroaches into fresh water aquifers, degrading water quality. Overall, the hydrological cycle is a finely balanced system influenced by climatic, geological, and human factors, and is essential for maintaining ecological and hydrological stability.

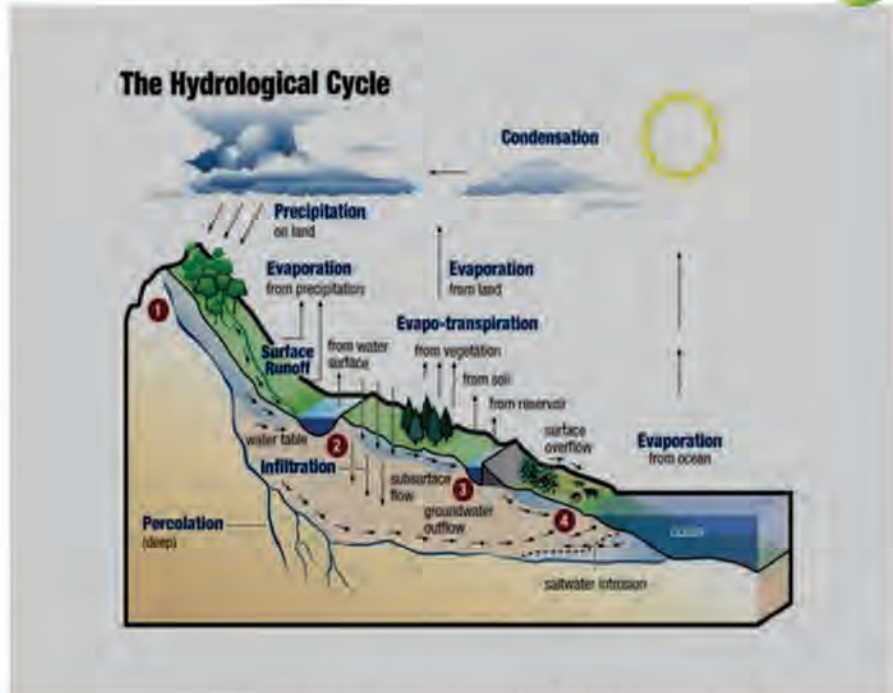


Figure:2 Elaboration of The Hydrological Cycle

Key aspects of Groundwater-Surface water interaction:

Recharge:

Surface water, such as rivers, lakes, and rainfall, can seep into the ground, replenishing groundwater aquifers.

Discharge:

Groundwater can flow back into surface water bodies, contributing to streamflow, lake levels, and wetland ecosystems.

Hyporheic Zone:

The area beneath and beside a stream where groundwater and surface water mix are called the “**hyporheic zone**”. This zone plays a vital role in biogeochemical processes and supports aquatic life.

Water Quality:

Interactions between groundwater and surface water can affect water quality by transporting pollutants or nutrients between the two systems. For example, contaminants from industrial or agricultural runoff can pollute both surface and groundwater.

Ecosystems:

Many ecosystems, like wetlands and some riverine habitats, rely on the continuous exchange between groundwater and surface water for their survival.

Regional Scale:

Groundwater and surface water interactions occur at various scales, from the local level (e.g., a stream reach) to the regional level (e.g., a watershed).

Human Impacts:

Human activities, such as pumping groundwater for irrigation or construction near rivers, can significantly alter these interactions.

Climate Change:

Climate change can also impact groundwater and surface water interactions by altering precipitation patterns, leading to changes in recharge and discharge rates.



Groundwater Meets Surface Water

Groundwater and surface water can be connected (no separation between the waters) or disconnected (space exists between the waters). Whatever the situation, water still moves between them. Most of the regional rivers have a direct connection to our groundwater. Depending on the season, the direction of water exchange may switch. Groundwater– surface water interactions play an important role in the water availability of both surface water bodies, like rivers and lakes, and underground water resources we call aquifers. The interaction of GW–SW takes place in various ways in all landscapes of the earth. The interaction phenomenon commences as the water enters the “**hyporheic zone**” from either of the sources. The term hyporheic is derived from Greek roots—“hypo” meaning under or beneath, and “rheos, meaning a stream (‘rheo’ means ‘to flow’). The hyporheic zone as the region below streams and rivers that exchanges water with the surface sources. The hyporheic zone contains high levels of organic carbon and microbes, facilitating the breakdown of pollutants from the surface or groundwater into simpler and harmless byproducts. This interaction between water, nutrients, and biodegrading organisms occurs via bio-films and is influenced by sediment quality and properties, affecting the residence time. The hyporheic zone also alters the chemical composition of incoming water and plays a crucial role in contaminant transport and stream processes.

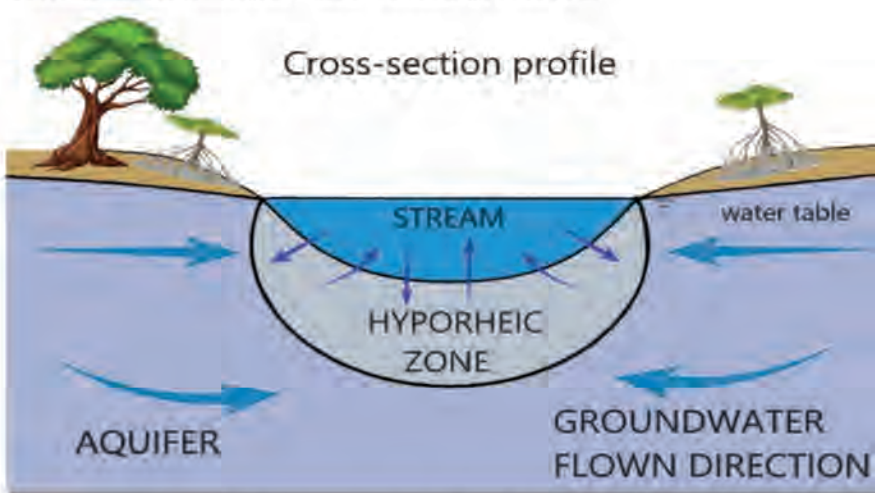


Figure:3- Cross section profile of SW- GW interaction and Hyporheic Zone detailing

Natural Flow and Analogous Loss in Surface and Groundwater Interaction:

Natural Flow:

Natural flow in surface and groundwater systems refers to the unregulated movement of water through the hydrological cycle without anthropogenic interference. This includes Surface Water Flow in terms of Runoff generated from precipitation that moves over the land into streams, rivers, lakes, or wetlands, The Groundwater Flows wherein water that infiltrates the soil, percolates through the vadose zone, and moves through aquifers under gravity and hydraulic gradient. The Interaction Zones is also of equal importance in areas where groundwater discharges into surface water (gaining streams) or surface water recharges groundwater (losing streams). These flows are governed by natural gradients, permeability of soils and rocks, vegetation cover, and climatic conditions.

Analogous Loss in Surface and Groundwater Interaction:

Analogous loss refers to the loss of water from one domain to another—often leading to reduction or depletion in one system due to interactions, akin to losses in electrical or energy systems. The Key types of analogous losses are basically Evaporation and Evapotranspiration Losses were Loss from surface water bodies and shallow groundwater tables due to direct evaporation or plant uptake.

Further the percolation Losses where water lost from surface (ponds, canals, etc.) into deeper soil layers, contributing to groundwater but reducing surface water availability.

The Seepage Losses are also a part of analogous losses where water leaking from unlined canals, rivers, or reservoirs into the subsurface, often resulting in unintentional recharge.

The Bank Storage Losses is also of equal importance as during flood events, water enters riverbanks (temporary groundwater gain), which later slowly releases back or is lost via evapotranspiration.

Also, the capillary Rise Losses of water rising to the root zone from shallow groundwater can be lost through transpiration, reducing groundwater storages.

In natural systems, surface and groundwater flows are dynamically interconnected, and analogous losses represent transfers and reductions in water volumes due to physical, biological, or climatic processes. Understanding these would always help in integrated water resource management (IWRM), especially under stress from climate change or overexploitation of water resources.

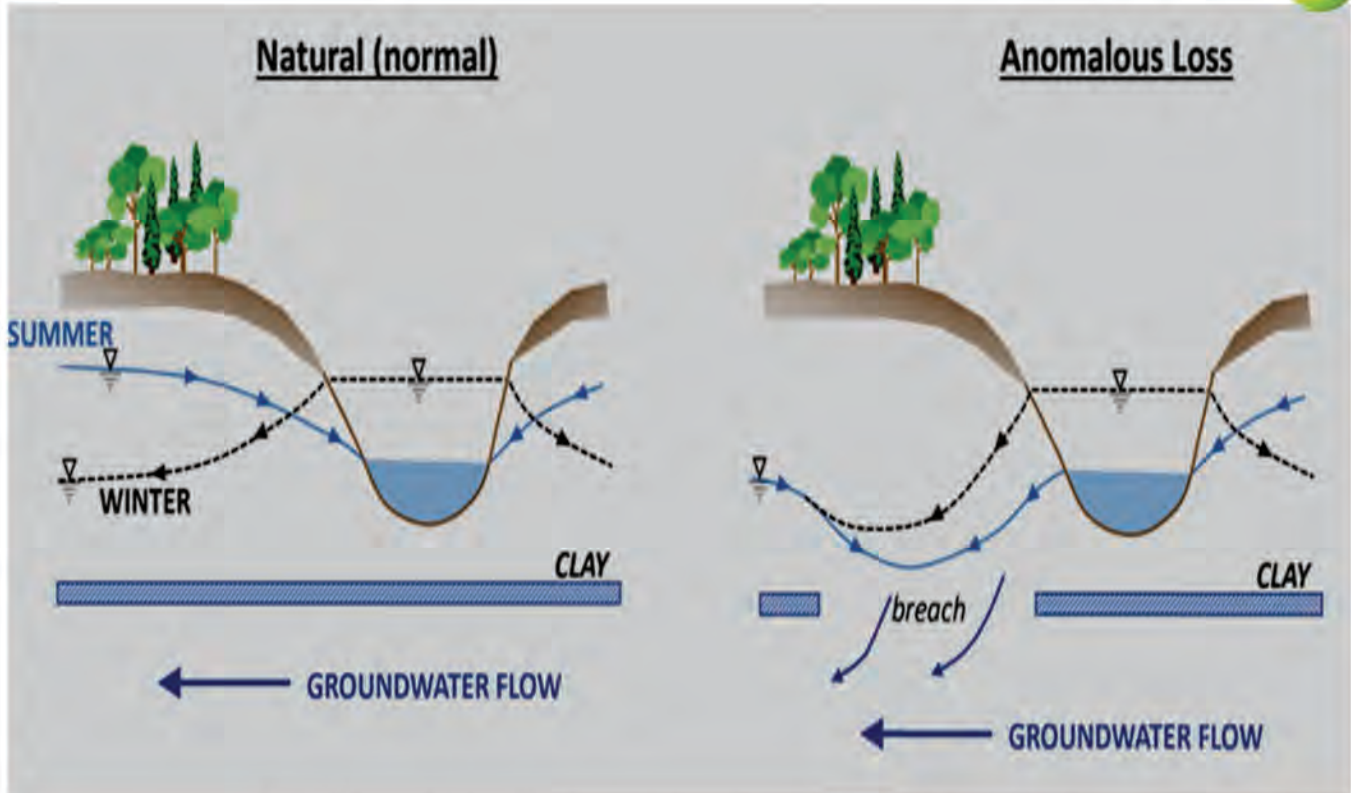


Figure:4 Natural and analogous losses in surface and Groundwater interaction

Interaction types of surfaces and Groundwater.

Groundwater and surface water are two expressions of the same hydrologic system, hydraulically linked through the saturated-unsaturated zone continuum. Wherever a stream channel intersects the water table, the hydraulic gradient between the stream and the adjacent aquifer controls the direction and magnitude of exchange. Researchers have found out that there is a constant give and take of water between rivers and shallow aquifers. It is important to study these interactions to enhance ecosystem vitality and minimize harmful alterations to water quality. The water flowing in the rivers is most likely groundwater being transmitted from an aquifer to the rivers. Rivers create channels that dig into the aquifers, and when there is no rain providing water to the rivers, the aquifer's water level is exposed, giving water to the rivers and creating their baseflow. Four classic interaction types capture most field situations as detailed below:

During wet seasons, the river stage increases. If it goes significantly above the aquifer's water levels, the hydraulic pressure in the river increases, changing the direction of this interaction. Now the river recharges the aquifer. From the river's standpoint, these two situations are **called gaining or losing conditions**. When the river receives water from the aquifer, it is called a **gaining stream**, and when the river recharges the aquifer, it is called a **losing stream**. The flow direction depends on the difference in the water levels between the river and aquifer, which is known as the **hydraulic gradient**. A **disconnected stream** occurs when the streambed is separated from the water table by an unsaturated zone, preventing direct interaction; water from the stream infiltrates downward but does not immediately recharge the aquifer.

Bank storage refers to the temporary infiltration of stream water into adjacent banks during high flows, which later returns to the stream as levels recede. Disconnected streams are typical in arid zones or ephemeral channels with thick unsaturated sediments. Bank storage helps regulate streamflow, reduces flood peaks, and sustains baseflow during dry periods.

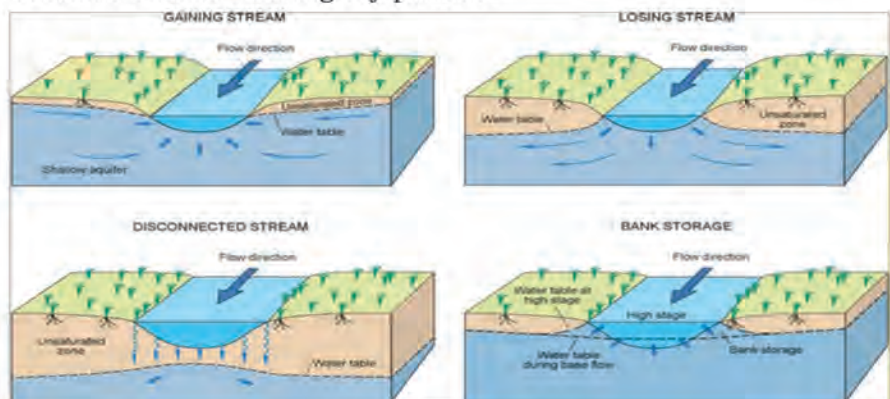


Figure:5 Interaction Types of Surface water and Groundwater



Interaction type	Water-table position & hydraulic gradient	Key hydrologic behaviour	Typical setting & implications
Gaining (effluent) stream	Water table sits above the streambed; gradient slopes toward the channel	Groundwater discharges into the stream, sustaining baseflow during dry periods; stream temperature often reflects groundwater (cooler in summer, warmer in winter)	Humid regions, downstream of recharge areas; provides perennial flow and nutrients, but vulnerable to groundwater contamination that can quickly reach the channel
Losing (influent) stream	Water table lies below the streambed; gradient slopes away from channel	Stream water percolates through the bed to recharge the underlying aquifer; channel flow diminishes with distance	Stream water percolates through the bed to recharge the underlying aquifer; channel flow diminishes with distance
Disconnected (perched-losing) stream	Unsaturated zone separates streambed from regional water table; downward seepage first wets an unsaturated lens, then slowly percolates to the deep aquifer	Hydraulic connection is broken; seepage loss is governed by soil-moisture storage, not aquifer head	Alluvial valleys with thick unsaturated deposits, ephemeral channels; surface flow can vanish rapidly, complicating water-budget estimates
Bank storage	Short-term, reversible exchange caused by stage fluctuations (e.g., floods, dam releases) rather than long-term gradient	Short-term, reversible exchange caused by stage fluctuations (e.g., floods, dam releases) rather than long-term gradient	Meandering flood-plain rivers, regulated streams; dampens flood peaks, sustains recession flow, but may transmit contaminants (e.g., agricultural chemicals) with a time lag.

Table: 1 Various types of SW-GW Interactions

Importance of SW-GW Interaction:

Surface water (SW) and groundwater (GW) interactions are crucial for maintaining water resources, supporting ecosystems, and understanding the impacts of climate change and human activities. These interactions influence streamflow, water quality, and the health of aquatic habitats. Understanding these interactions is essential for effective water resource management and ecological protection.

The Importance of Surface Water and Groundwater Interaction are as detailed below:

- ♦ Water Balance Maintenance ensuring the hydrological connectivity and sustains baseflow in rivers and streams during dry periods.
- ♦ Supports Ecosystem Health of wetlands, riparian habitats, and aquatic life by regulating flow and other temperature regimes.

- ♦ Upkeep of water Quality and Control measures in Influencing lower nutrient transport, dilution of pollutants, and other natural attenuation processes.
- ♦ Sustainable water resource management towards effective planning for drinking water, agriculture, and industrial usages by understanding the recharge and discharge zones.
- ♦ Flood and Drought Mitigation by enhancing resilience against extreme events through natural storage and release mechanisms.
- ♦ Climate Change Adaptation by Integrated management helps buffer the impacts of climate variability on water availability.
- ♦ Prevention of Overextraction and Helps to identify areas at risk of groundwater depletion/ over exploited areas or surface water drying due to unsustainable usage.
- ♦ Bank Storage Utilization through temporary storage of floodwaters in aquifers which can later contribute to streamflow.

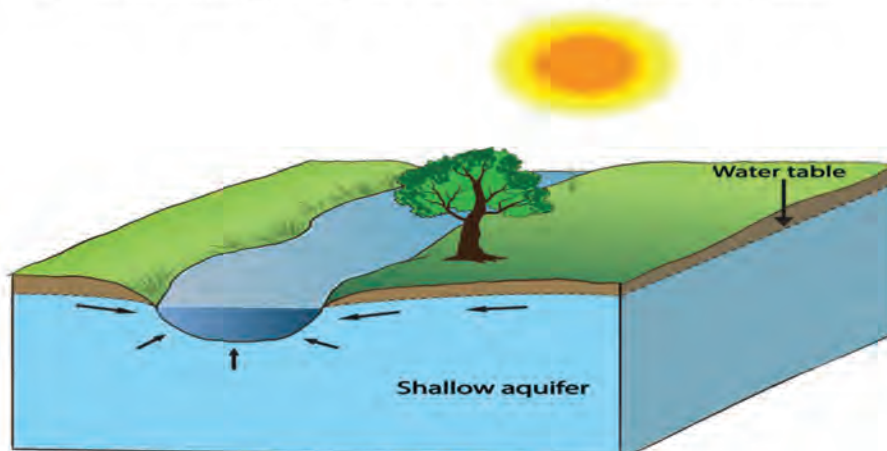


Figure: 6 Importance of Surface water and Groundwater Interactions:

♦ Absolute care on the Contaminant Pathways via interaction zones often acts as conduit or barriers for the movement of contaminants, requiring careful monitoring and time to time assessments.

♦ Various Policy and Planning Integration are absolutely crucial for implementing Integrated Water Resources Management (IWRM) strategies.

Basic understanding SW-GW interactions is fundamental for managing water resources sustainably, protecting ecosystems, and mitigating the impacts of environmental changes.

Mechanisms of GW-SW Interaction:

Surface and subsurface water interact through water infiltration from the surface to the subsurface water table or exfiltration from the saturated zones, as well as the lateral flow of water in the subsurface zone that emerges into a surface water body. The interaction flow is classified in to **Translatory flow, Macropore flow, Groundwater ridging and Return flow.**

Translatory Flow:

Occurs when new rainfall displaces pre-existing groundwater in the saturated zone. Water moves downslope without much mixing. This is Common in humid, forested catchments with shallow water tables. It Contributes to streamflow quickly during rainfall events. This refers to the movement of groundwater from higher elevations (recharge areas) to lower elevations (discharge areas) where it can reach surface water bodies. Water moves through the saturated zone, and this flow can be influenced by the permeability of the subsurface and the hydraulic gradient.



Figure:7 Groundwater recharge Zones

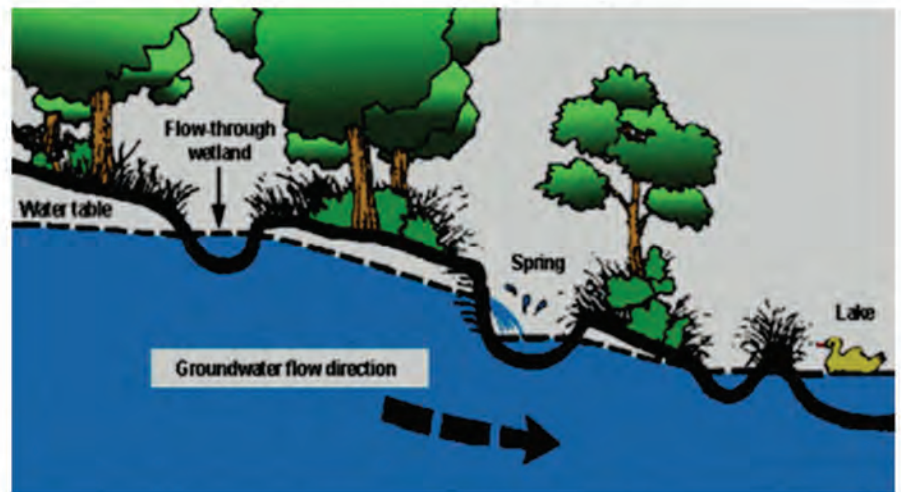


Figure:7A Groundwater Discharge Zones

Macropore Flow:

Water moves rapidly through large pores (e.g., root channels, wormholes, fractures). Bypasses the soil matrix, reaching the water table or streams quickly. It Enhances infiltration and quick subsurface connectivity. Quite Significant during intense rainfall

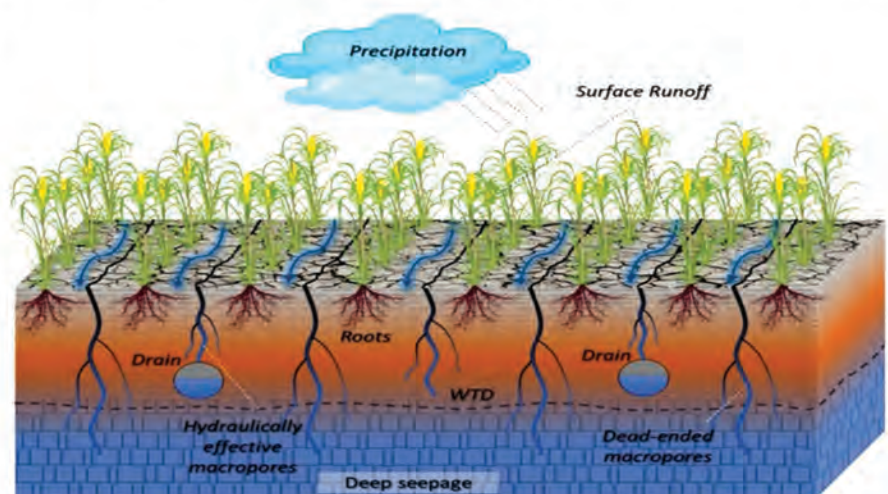


Figure:8 Macropore flow



Groundwater Ridging:

Groundwater ridging is a phenomenon where the water table rises disproportionately and rapidly in response to recharge events, particularly in shallow groundwater systems. This rapid rise often occurs in areas where the capillary fringe extends close to the ground surface, such as near stream or riverbanks, or at the base of slopes. The process is influenced by factors like soil type, antecedent moisture conditions, and the slope's topography. It affects stream physical and chemical water quality parameters and flow rates.

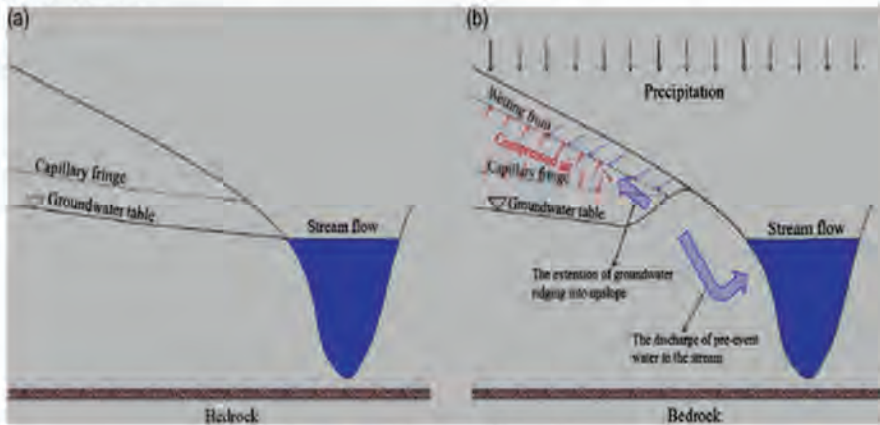


Figure:9 Groundwater ridging phenomena

Return Flow:

"Return flow" in the context of water management refers to water that has been diverted for a specific use and then returns to its original source (river, lake, or aquifer). This includes water used in irrigation, industrial processes, or even for domestic purposes. Return flow is a crucial aspect of the water cycle, as it can be a valuable source of water for downstream users or for replenishing groundwater resources. Previously infiltrated water returns to the surface, often as overland or baseflow. Happens when the water table intersects the land surface. Common in irrigated fields or floodplains. Plays a role in sustaining streamflow during dry periods. However, return flows can also pose challenges, especially when they carry pollutants or have a negative impact on water quality.

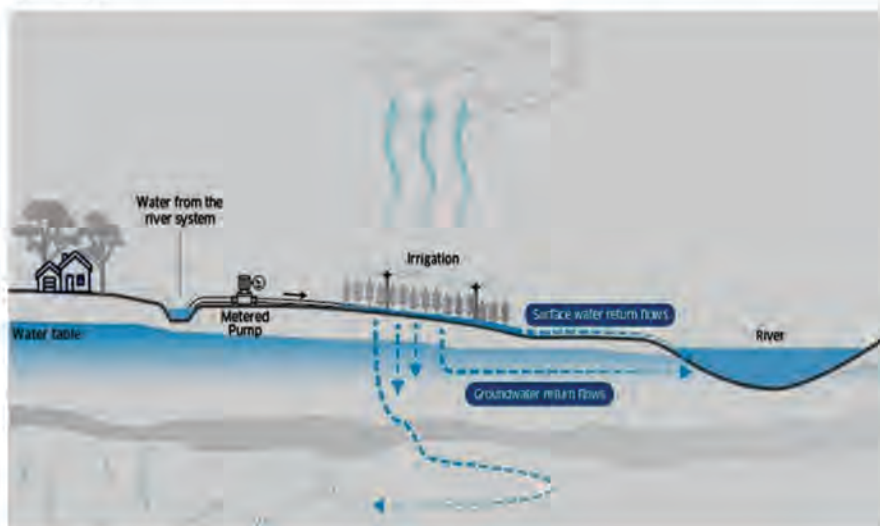


Figure:10 Return flow Phenomenon

Scales of GW-SW Interactions:

Groundwater Flow Systems for the classification of ground water, which is a set of aquifers having similar characteristics that exhibit a definite pattern to the flow of water through them. For an area of a few hundred square kilometers with a mild slope and lower-order outlet stream, Tripathi has differentiated the flow scales into local, intermediate, and regional for unconfined groundwater systems. Noted Hydrologist **Toth** have stated that the scales that come into the picture depends upon local and regional geomorphology. Local flow systems depend upon the local slope of an area and diminish or even get extinct if the regional slope is increased, which caters to the formation of other flow systems. In local systems, discharge fluctuates widely, and water flux has higher penetration depth and residence. The hydrologic properties also change according to the scale of the flow. Groundwater and surface water interaction highly depend on the scale through which their interaction occurs.

The scales of GW-SW interactions were separated into two types, namely large-scale and local-scale interactions. Large-scale interaction was used when the whole of the catchment was actively participating in the interaction process, whereas local-scale interaction was used when only the hyporheic zone was influencing the interaction processes.

Groundwater flow depends on the water table elevation relative to surface water-bed elevation. However, it has been observed that sometimes, even with a higher water table elevation, surface water discharges water to groundwater. The local groundwater flow system boundary controls these processes.

Also, research work found that seepage through a streambed occurs when there is no continuous local groundwater flow system boundary or stagnation point under the surface water body. There is no seepage if there is a continuous local groundwater flow system boundary or a stagnation. The head difference between the surface water body and a stagnation point determines the amount of seepage.

The ground water and surface water interact throughout all types of landscapes from mountain to sea. The ground water moves along flow paths of varying lengths in transmitting water from area of recharge to discharge. The small-scale geologic features in the bed of surface water bodies & lakes affect recharge patterns. The size, shape and orientation of sediments & grain sizes in surface waterbeds affect seepage pattern. Often the surface waterbed consists of sand; the inflow seepage is greatest at the shoreline & decreases away from it.

The geology of land units of varying permeabilities also affect water seepage in surface waterbeds. The ground water seepage to surface water is greatest near shore. Infiltrating rain water passes rapidly through a thin unsaturated zone adjacent to the shoreline which produces a mound of water table adjacent to surface water body as “focussed recharge”, which results in increased ground water inflow to surface water bodies. The ground water recharge therefore is commonly focused initially where unsaturated zone is relatively thin at the edges of surface water bodies and beneath depressions in the land surface.

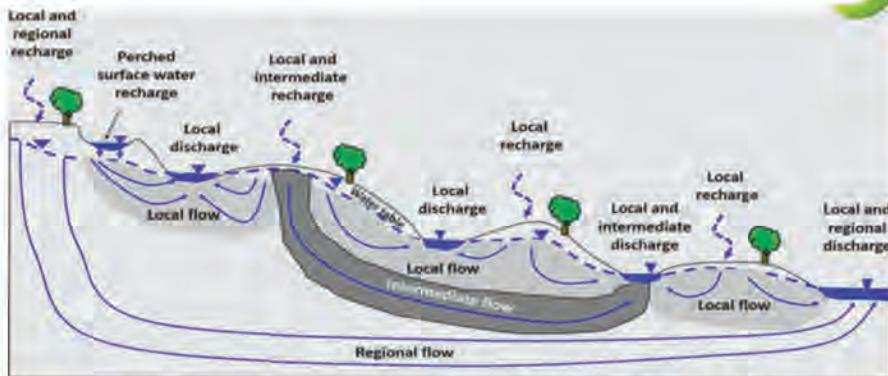


Figure:11. Groundwater flow systems: Local, Intermediate and Regional, as described by Toth.

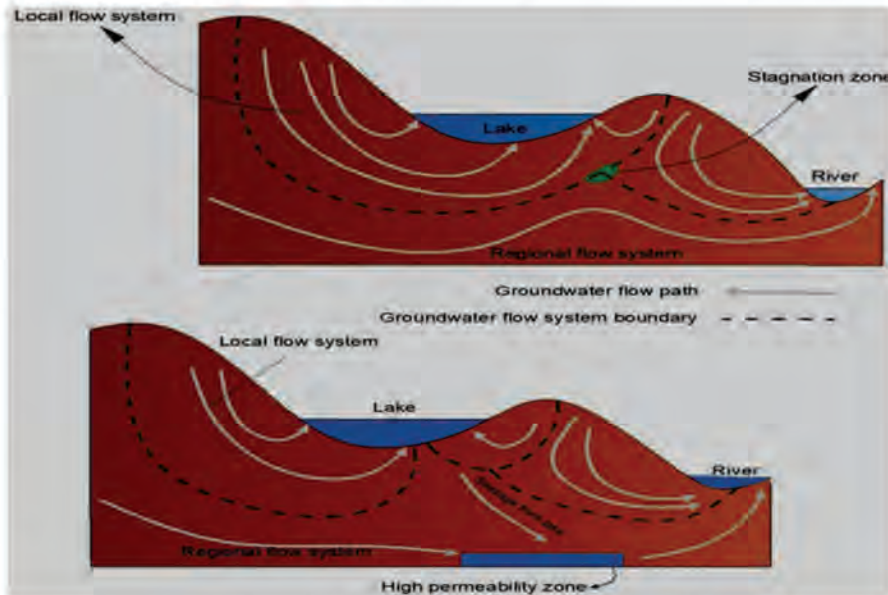


Figure:12 Ground Water flow systems Boundary

Interaction of Groundwater and Streams:

The streams interact with ground water in all types of landscapes. The streams lose water to ground water by outflow through the streambed. For surface water to seep into ground water, the altitude of water table in the vicinity of stream should be lower than the altitude of stream water surface. The interaction between ground water and stream takes place in nearly all streams. Depending upon the magnitude, intensity, and frequency of stream flow and increase in stream stage, some streams and adjacent aquifers are in continuous interaction. If level of water in stream is more than its bank, the flood water recharges ground water throughout the flooded area. The reservoirs behind check dams are designed primarily to control flow & proper distribution of surface water. Like stream, such reservoir (lakes) also has fluctuating water levels & also loose water to water table to recharge ground water. Groundwater and surface water (like streams) interact in various ways, influencing each other's flow and water quality. Streams can gain water from groundwater discharge through the streambed, or lose water to groundwater through infiltration. The direction of water flow depends on the water table elevation relative to the stream surface. The effects and interaction of groundwater utilization and streams are diagrammatically represented as follows:

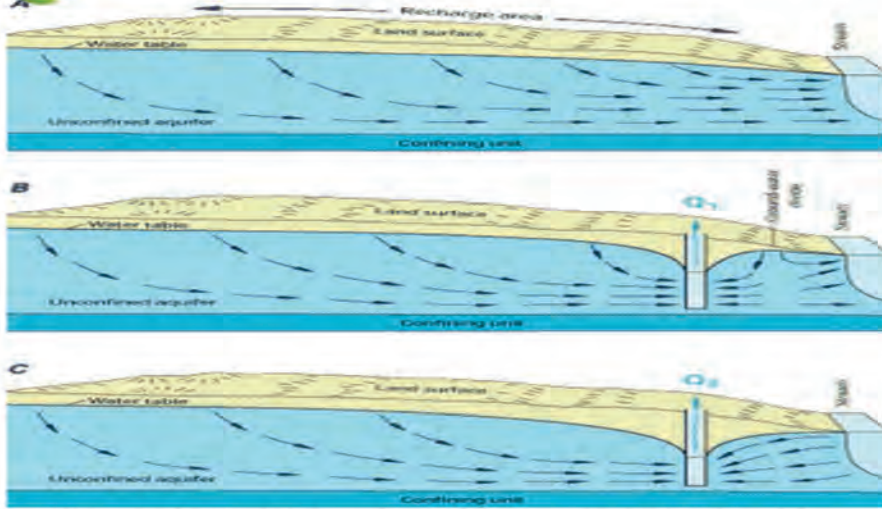


Figure:13- Effects of GW development on ground water flow to and from streams

Wetlands as a Hydrological Interface with Groundwater:

Groundwater-surface-water interactions, therefore, are not static classifications but dynamic responses to climate, geomorphology, and human stressors. Sound river-basin management demands monitoring and modelling these exchanges as a coupled system.

Wetlands and groundwater interact in complex ways, influencing each other's hydrology and ecological functions. Wetlands can act as both sources and sinks for groundwater, and these interactions are crucial for maintaining water balance, biodiversity, and water quality within a watershed.



Figure:14 Wetlands interface with Groundwater

Groundwater Discharge to Wetlands:

Wetlands often form in areas where groundwater naturally discharges to the surface. This discharge can be a primary source of water for the wetland, influencing its water levels and supporting its unique ecosystem.

Wetland Recharge to Groundwater:

Wetlands can also act as recharge areas for groundwater aquifers. Water from the wetland can seep downwards, replenishing the groundwater supply. This is especially important in arid and semi-arid regions where groundwater is a critical water resource.

Flow-Through Wetlands:

Some wetlands experience both recharge and discharge within the same area, with water entering from groundwater in some locations and leaving to groundwater in others.

Impacts on Water Quality:

Interactions between surface water and groundwater can alter the chemical composition of both, affecting the overall water quality within the wetland and the surrounding areas.

Hydrological Connectivity:

Understanding these interactions is vital for managing water resources effectively. For example, managing ground water pumping near wetlands is crucial to prevent wetland drying, and considering the impacts of upstream land use changes on both surface water and groundwater is important for sustainable water management.

Management Implications:

Integrated water Resource Management:

Recognizing the interconnectedness of surface water and groundwater is essential for effective water resource management. Integrated approaches that consider the needs of both wetlands and groundwater resources are necessary to ensure sustainable water use.

Impact Assessment:

When considering changes to water management, it's important to assess the potential impacts on both the wetland and the groundwater system. This includes evaluating the potential effects of changes in land use, water diversions, and groundwater pumping on the hydrological balance.

Conservation and Restoration:

Understanding the interactions between wetlands and groundwater can help identify areas where wetlands can be restored or created to improve water quality, enhance biodiversity, and mitigate flood risks.

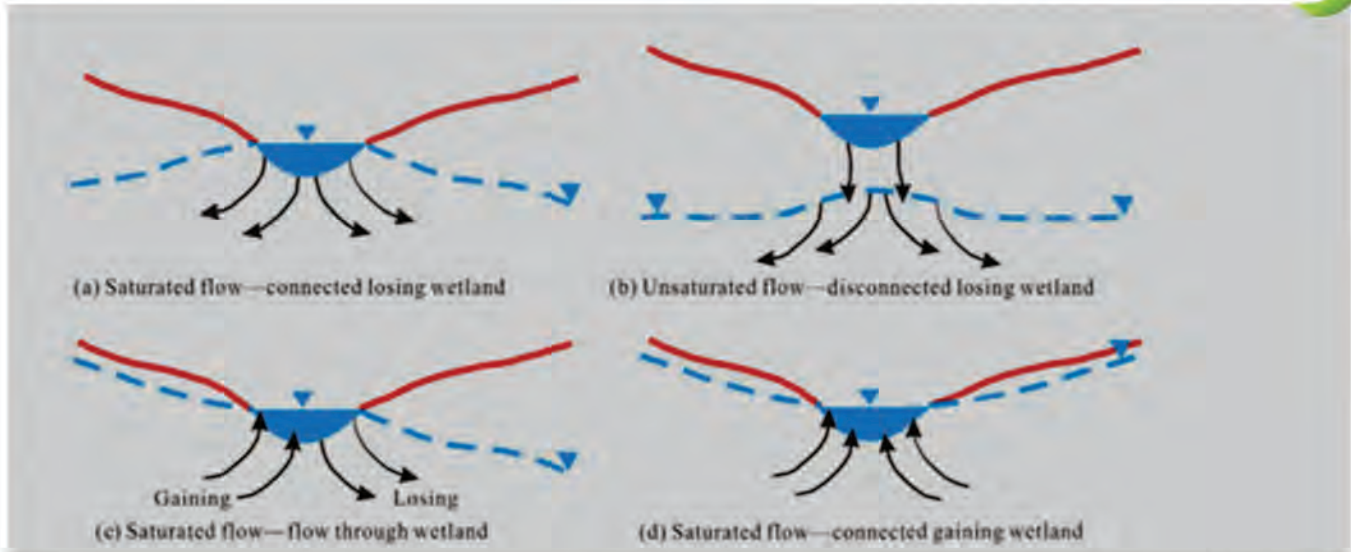


Figure:15 Wet land Interaction with Groundwater scenario

1. Recharge Zones (Groundwater Gain)

- ♦ Wetlands **infiltrate** surface water (rain, runoff, stream overflow) down into the **groundwater system**.
- ♦ **Permeable soils** in some wetlands allow water to percolate downward, recharging aquifers.
- ♦ This often happens in **seasonal wetlands** or in areas with **high hydraulic conductivity**.

2. Discharge Zones (Groundwater Feed)

- ♦ In some wetlands, **groundwater flows upward** into the wetland, maintaining water levels especially during dry periods.
- ♦ This is common in **riparian wetlands** near rivers or **valley bottom wetlands** where the water table is close to the surface.

3. Bi-directional Flow

- ♦ Wetlands may switch between recharge and discharge depending on **season, rainfall, or water table fluctuations**.
- ♦ The **hydraulic gradient** (difference in water pressure) determines the **direction** of the exchange.

Importance of Wetland-Ground Water Interactions:

- ♦ **Water Quality Improvement**
- ♦ Wetlands **filter pollutants, trap sediments, and denitrify** groundwater through microbial action.
- ♦ **Flood Control**
- ♦ They **store excess surface water**, reducing flood peaks and providing **slow-release recharge** to groundwater.
- ♦ **Drought Resilience**
- ♦ By **storing groundwater** and allowing **baseflow** to streams, wetlands sustain ecosystems during dry periods.

Habitat Support:

Aquatic and semi-aquatic species **depend on the stable hydrological regime** provided by this interaction.

Key Factors Affecting Interaction:

Factors	Role
Soil type	Controls permeability and infiltration capacity.
Vegetation	Roots create macropores and aid infiltration/ evapotranspiration.
Topography	Determines flow paths for both surface and sub-surface water.
Hydraulic gradient	Drives water movement into or out of the wet-land.
Climate	Affects evapotranspiration, precipitation, and seasonality.

Table:2 Key Natural Factors Affecting Interaction



Controlling Factors:

Attributes:	Description:
Hydraulic Gradient	Dictates flow direction (into or out of wetland).
Soil Permeability	High permeability enhances recharge potential.
Vegetation	Root systems influence infiltration and water retention.
Topography	Affects drainage patterns and interaction intensity.
Climatic Conditions	Seasonal changes impact recharge and discharge cycles

Table:3 Key controlling Factors towards wetlands and Groundwater Interaction.

Significance of Wetland-Groundwater Interaction:

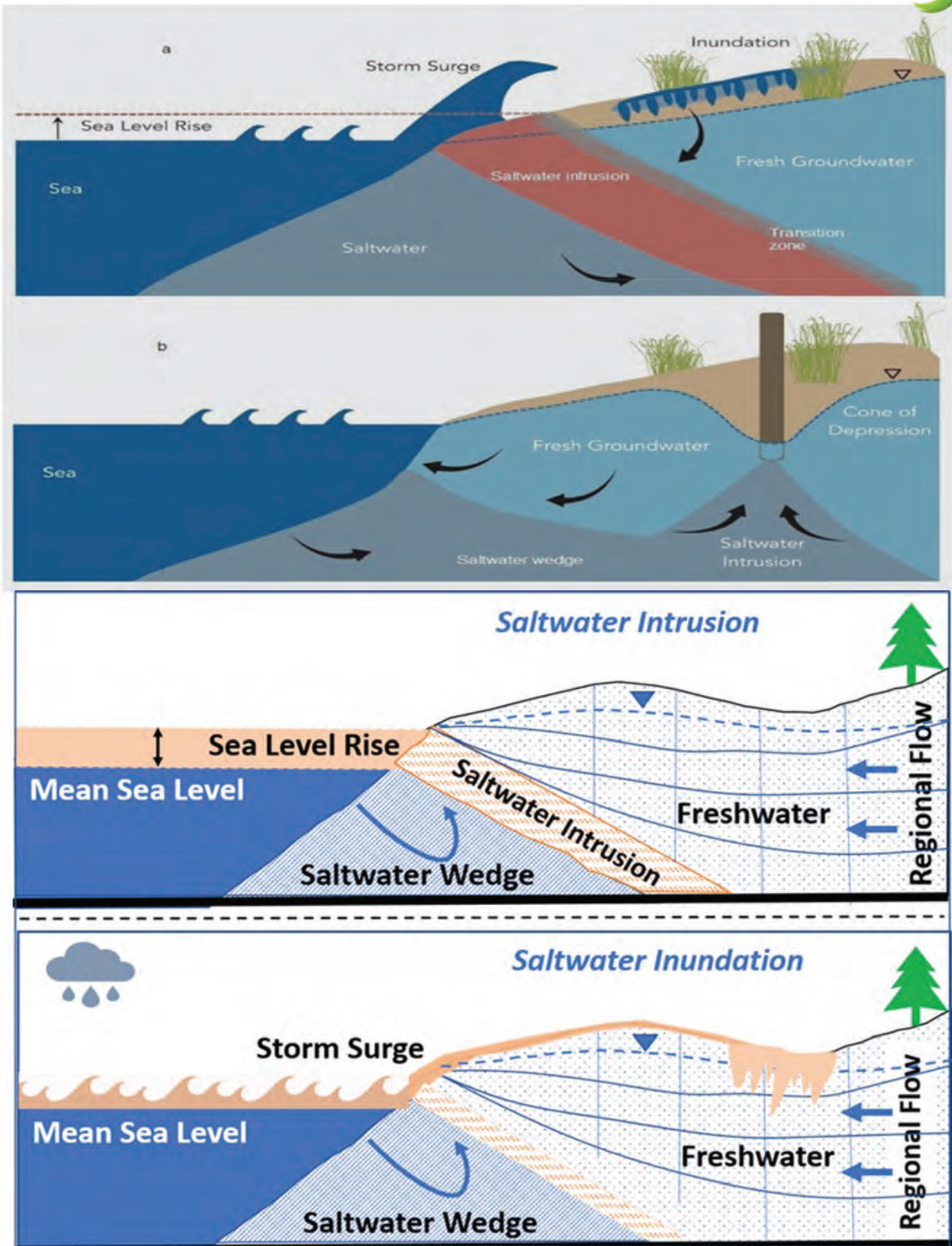
Benefit	Description
Baseflow Maintenance	Groundwater-fed wetlands sustain streamflow's in dry periods.
Water Purification	Wetland soils and biota filter nutrients, heavy metals, and pathogens.
Flood Mitigation	Wetlands absorb runoff, reducing surface water stress and groundwater recharge variability.
Aquifer Recharge	Infiltration from wetlands helps maintain or raise groundwater levels

Table:4 Significant Factors of wetland and Groundwater Interaction

Sea Water Intrusion as Surface Water and Groundwater Interaction:

Sea water intrusion is a critical phenomenon that exemplifies the dynamic interaction between surface water and groundwater in coastal regions. It occurs when saline sea water encroaches into freshwater aquifers, primarily due to excessive groundwater extraction or a natural lowering of groundwater levels. Normally, freshwater aquifers discharge into the sea, maintaining a delicate hydraulic balance. However, when this balance is disturbed—such as by over-pumping or reduced recharge from rainfall or rivers—the pressure in the aquifer drops, allowing saltwater to move inland.

This interaction shall be intensified by tidal fluctuations, storm surges, and sea level rise, which further push saline water into coastal estuaries and aquifers. Surface water bodies like rivers and wetlands, especially near the coast, can become conduits for saline intrusion if their flow weakens. The intrusion not only degrades groundwater quality but also affects soil health, agriculture, and freshwater ecosystems. Understanding this surface-groundwater linkage is essential for developing effective coastal aquifer management, including artificial recharge, regulated pumping, and monitoring salinity levels to ensure long-term water security in coastal zones.



Not to scale

Figure No: 16 Saline water Intrusion as part of surface and groundwater interaction in coastal areas



Springs as Surface Water and Groundwater Interaction:

Springs are natural discharge points where groundwater flows to the surface, often forming the headwaters of streams or rivers. They are key indicators of the interaction between groundwater and surface water systems. Springs occur where the water table intersects the land surface, releasing groundwater as surface flow. They are the visible outlets of aquifers, often found in hilly or sloping terrains. The recharge to springs comes from rainfall infiltration, river leakage, or percolation through soil and rock. Water emerging from springs contributes to streams, lakes, and wetlands, maintaining base flow during dry periods. Perennial springs provide constant flow, while seasonal springs depend on the water table level. This interaction supports ecosystem health, biodiversity, and rural water supplies. Human activities like groundwater over-extraction or land use and land cover (LULC) changes can reduce spring discharge. Springs reflect groundwater quality, as pollutants can travel through the subsurface and emerge at spring sites.

Effective spring shed management protects both the aquifer and the surface systems it supports. Thus, springs act as critical connectors in the hydrological cycle, demonstrating the seamless exchange between groundwater and surface water. In a spring shed, surface water infiltrates through permeable soils and rocks, replenishing aquifers. These aquifers then discharge at lower elevations through springs, which may feed streams, rivers, or wetlands. This process reflects a translatory flow system, where old and new water mix and move underground before emerging.



Figure:17- Springs as Surface water and Groundwater Interactions

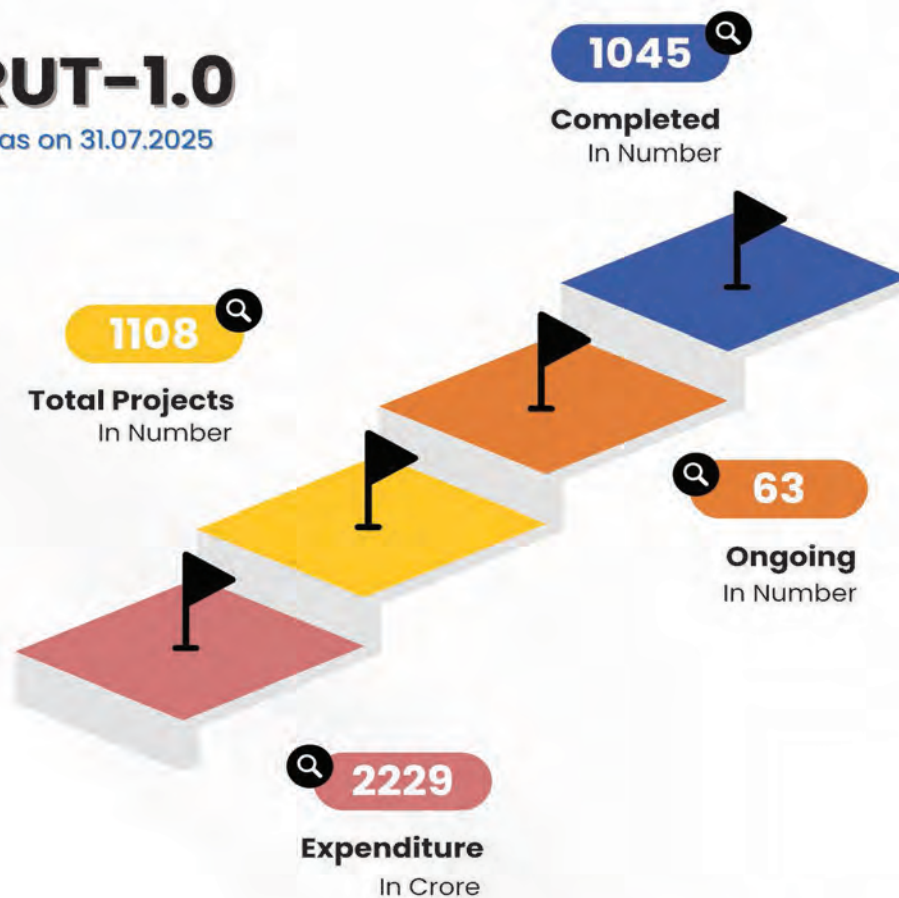
Conclusion:

Surface water and groundwater are integral components of the hydrological cycle and are intricately connected through various physical, chemical, and biological processes. Their interaction plays a crucial role in maintaining the Ecological health of aquatic systems, supporting water supply, sustaining wetlands, and influencing water quality. These interactions can occur through mechanisms such as **infiltration, percolation, baseflow contribution, bank storage, and seepage**, which vary **spatially and temporally based on geology, land use, and climatic conditions**. Understanding and managing these interactions is essential for sustainable water resource planning, especially in the face of increasing anthropogenic pressures, land-use changes, and climate variability. **Integrated water resource management (IWRM) approaches that consider both surface and subsurface water systems are vital for achieving water security, ecosystem protection, and resilience to hydrological extremes such as floods and droughts.**

*Raindrops race through mountain streams,
Merging where the river gleams.
Silently infiltrates in to the hidden groundwater deep,
In every drop, their secrets sinks and seeps.*

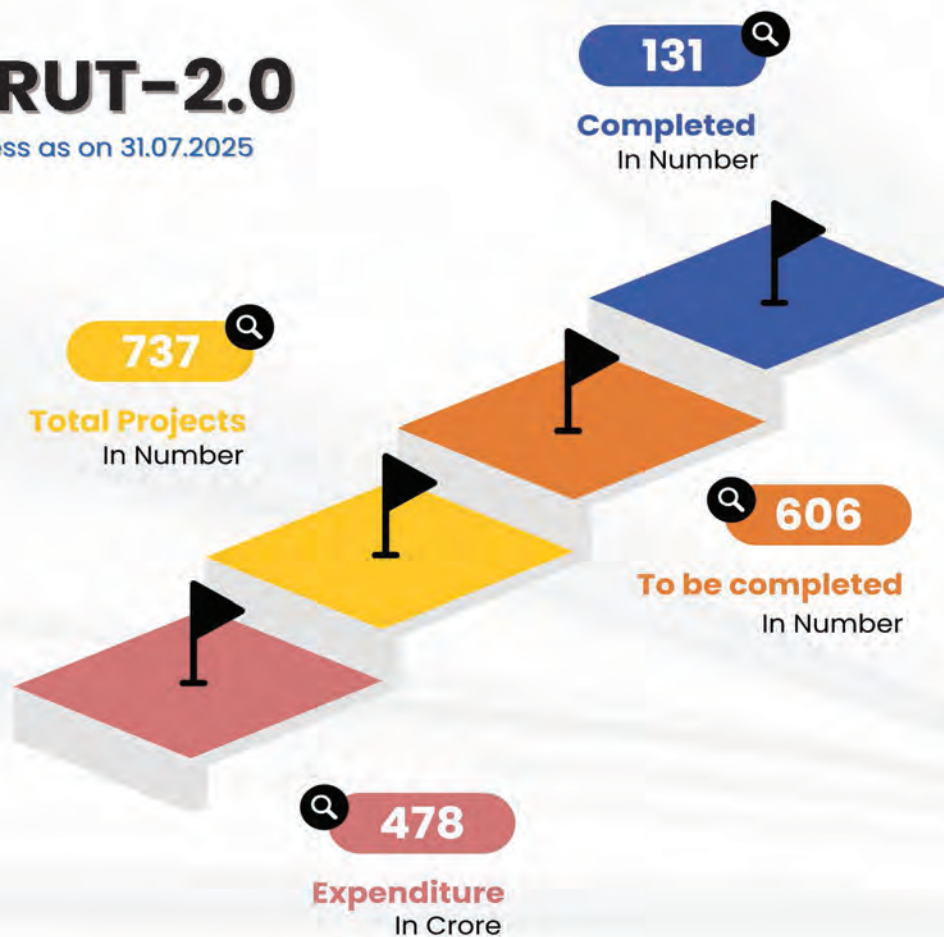
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