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Towards an integrated model of managing the groundwater and flooding; case study of Taiwan Pingtung Plain

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In many coastal areas around the world, developments in industrial, agricultural and tourist activities together with growing population, have led to the overexploitation of aquifers. In coastal aquifers, there is direct hydraulic contact between saline water bodies and freshwater bodies. Due to the difference in density, there is a dynamic equilibrium between saline water and fresh water with an interface, or zone of dispersion, separating the fresh water from saline water. Overexploitation of aquifers results in sea water intrusion (SWI) by extending the saltwater-freshwater interface towards the land, leading to degradation of quality and quantity of the groundwater resources. Therefore, SWI should be controlled through appropriate management scenarios in a convenient and cost-effective manner in order to protect the groundwater resources in coastal aquifers. On the other hand, flooding occurs frequently in many parts of the world, including the coastal areas and causes casualties and serious damage to properties and infrastructure.

This paper presents the development and application of a method for integrated management of flood water and groundwater to reduce the damage caused by flooding and to increase groundwater resources. The method involves collecting, storing and using flood water to recharge groundwater aquifers. The proposed methodology will effectively use the storm water to control flooding and manage groundwater resources in an integrated manner. An integrated computer model has been developed to study simultaneous and effective control of floodwater and groundwater recharge. A genetic algorithm (GA) optimisation model is used to identify the optimal arrangements in terms of optimal location(s) of storm water collection systems, optimal locations and depths of abstraction wells and optimal rates of abstraction to maximise the water supply and minimise the cost while managing the aquifers in a sustainable manner. The developed models can be used by decision makers in sustainable management of flooding and groundwater resources. The proposed management action is applied to a case study involving the Pingtung Plain coastal aquifer in Taiwan which suffers from the combined effects of over pumping, flooding and sea water intrusion.