9. RECOMMENDATIONS FOR FUTURE RESEARCH

Hydrosalinity processes are complicated since they involve the interaction between various sources and controlling factors, in addition to all the factors impacting water quantity. Hence, the adequate modelling of these processes, especially at a catchment scale, requires a comprehensive approach that accounts for the impacts of the various point and non-point sources of salinity. Most of the non-point sources and the basic hydrosalinity processes are included in the present hydrosalinity module of *ACRU, viz. ACRUSalinity*. Yet, inclusion of some processes and research on deriving the value of input parameters to the module need to be undertaken for more accurate and improved applications of the module in diverse catchments. The following important sources and associated processes of hydrosalinity could be accommodated in *ACRUSalinity* in the future:

- The present hydrosalinity module of *ACRU* does not take into account the impact of fertilizer and gypsum application on the TDS balance. However, this may have a substantial effect on surface and subsurface TDS balance, if the simulated catchment is dominated by irrigated lands. Therefore, the effects of fertilizer and gypsum application may need to be accommodated in the module.

- Industrial and urban effluents are important non-point sources of salt loading. However, the current hydrosalinity module of *ACRU* does not include the impact of urban and industrial effluents. Therefore, the effect of salt loading from these sources on urban runoff TDS concentration and salt loading need also be accommodated in the future.

- Currently *ACRUSalinity* simulates TDS concentration and salt loading of outflows from a reservoir and at river reaches downstream of the reservoir on daily basis. However, in order to capture the intra- daily differences in TDS concentrations and salt loadings, an algorithm needs to be included in the module in order for it to simulate salt routing through reservoirs and rivers at sub-daily time steps.

- Water which flows directly below the root zone through cracks (by-pass flow) on a heavy clay soil is reported to provide an important mechanism for solute leaching. Therefore, the impact of cracking on surface and subsurface TDS balance, in general, and on the delayed stormflow in particular, also needs to be accommodated in the future.

- Further, in order to realistically simulate the movement of salts in sloping topography, *ACRU* needs to consider multiple terracing in the riparian zone and the interactions between these terraces. Thereafter, *ACRUSalinity* also needs to handle the movement of salts between the terraces.

- At present the daily stormflow salinity is assumed to have the same value as rainfall salinity. Therefore, *ACRUSalinity* needs to accommodate in the future for the impact of near surface flows and salt crusting on surface TDS balance.

- The present hydrosalinity module of *ACRU,* uses an irrigation water salinity as inputted by the user on monthly basis. Although it might result to a cumulative error, the module can also get this value from the TDS series generated at each point of abstraction of an irrigation water. Therefore, the module also needs to include an option where salt balance computations can use daily irrigation water salinity from the TDS series generated at each point of abstraction of the irrigation water.

- At this stage, the total stormflow generated in irrigated areas leaves the catchment on the same day. However, similar to the case of non-irrigated areas, stormflow generated from irrigated areas may take many days before the total stormflow leaves the catchment. Therefore, a lag function needs to be included for a stormflow generated from irrigated areas with subsequent incorporation of its impact on surface and subsurface TDS balance.

- In some areas surface dry atmospheric deposition from oceanic aerosols, continental dust, active volcanoes and/or anthropogenic inputs can have substantial impact on surface and subsurface water TDS balance. Therefore, the impact of dry atmospheric deposition on surface and subsurface TDS balance needs to be accommodated in *ACRUSalinity*. Similarly the impact of surface salt accumulation on TDS balance due to a capillary action also needs to be accommodated in the future.

- Finally, research needs to be conducted on the salt saturation (equilibrium) and salt uptake rate constant (*k*) parameters, both of which are employed during salt generation computations in *ACRUSalinity*. These two parameters are the most important parameters in describing salt generation processes in subsurface components. However, it is difficult to obtain values for these parameters through physical measurements. Therefore, research needs to be undertaken to derive a representative value from a combination of geological formations or soil types as well as hydrological and climatic conditions of an area, since the two parameters are expected to be influenced mainly by these factors. An expression with one or more variable from the above factors can then be included in *ACRUSalinity* so that the salt uptake rate and salt saturation parameters can be internally derived from the hydrological inputs of *ACRU*.