Wave equations with logarithmic nonlinearity find fruitful applications in different branches of physics - from nuclear physics and condensed-matter theory to particle physics, theory of quantum gravity and models of physical vacuum. In order to derive this nonlinearity from basic principles, we apply statistical-mechanics arguments and Madelung hydrodynamical presentation for an effective description of strongly-interacting many-body systems of a condensate type, such as quantum Bose liquids or Korteweg-type materials. We show the relationship between the "logarithmic" fluids and those described by polynomially nonlinear wave equations, such as the Gross-Pitaevskii equation. We discuss the notion of quantum entropy and temperature from the viewpoint of the approach.