ABSTRACT. In the first part of this work, the Poisson equation on complete noncompact manifolds with nonnegative Ricci curvature is studied. Sufficient and necessary conditions for the existence of solutions with certain growth rates are obtained. Sharp estimates on the solutions are also derived. In the second part, these results are applied to the study of curvature decay on complete Kähler manifolds. In particular, the Poincaré-Lelong equation on complete noncompact Kähler manifolds with nonnegative holomorphic bisectional curvature is studied. Several applications are then derived, which include the Steinness of the complete Kähler manifolds with nonnegative curvature and the flatness of a class of complete Kähler manifolds satisfying a curvature pinching condition. Liouville type results for plurisubharmonic functions are also obtained.