We perform long-term general relativistic neutrino radiation hydrodynamics simulations (in axisymmetry) for a massive neutron star surrounded by a disk, which is a canonical remnant formed after the binary neutron star merger. We take into account the effects of viscosity, which is likely to arise in the merger remnant due to magnetohydrodynamical turbulence. For the long-term evolution over seconds, a significant fraction of the disk material is ejected due to viscous heating. We find that the total mass of the viscosity-driven ejecta could dominate over that of the dynamical ejecta. The electron fraction of the ejecta is always high enough that this post-merger ejecta is lanthanide-poor due to neutrino irradiation. Hence, the opacity of the ejecta is likely to be 10-100 times lower than that of the dynamical ejecta. This indicates that the electromagnetic signal from the ejecta would be rapidly evolving, bright, and blue, if it is observed from a small viewing angle for which the effect of the dynamical ejecta is minor. We also discuss the dependence of the ejecta properties on the poorly unknown nuclear equation of state and the total mass of the binary.