Crustal pore pressure, which could trigger seismicity and volcanic activity, varies with fluid invasion. Various studies have discussed the potential of using seismic velocity changes from ambient noise to evaluate pore pressure conditions, especially due to rainfall perturbations. Although the influence of rainfall on seismic velocity changes has been reported, consideration of the spatial influence on rainfall towards seismic velocity and its mechanism have not been well understood. We investigated the mechanism of rainfall-induced pore pressure diffusion in southwestern Japan, using seismic velocity change (Vs) inferred from ambient noise. We modeled pore pressure changes from rainfall data based on a diffusion mechanism at the locations where infiltration is indicated. By calculating the correlation between Vs changes and the modeled pore pressure with various hydraulic diffusion parameters, the optimum hydraulic diffusion parameter was obtained. We estimated the diffusion parameters with the highest negative correlation between pore pressure and Vs change because a negative correlation indicates pore pressure increase due to diffusion induced by groundwater load. Furthermore, the spatial variation of the hydraulic diffusivity infers the heterogeneity of the rocks in different locations. This finding suggests that the response of pore pressure induced by rainfall percolation depends on location. We show that seismic velocity monitoring can be used to evaluate the status of pore pressure at different locations, which is useful for fluid injection, CO$_2$ wellbore storage, and geothermal development.