The earthquake that occurred in Palu City in September 2018 caused an avalanche of marine sediments in Palu Bay that leads to a tsunami generation which impacted the Palu City and its surrounding areas. Nevertheless, there is no information regarding the location, precise shape, and mechanism of the landslide event that generated the tsunami in Palu Bay. In this study, the initial condition of water elevation which is generated by the landslide in Palu Bay is estimated by using a machine learning approach, i.e. Artificial Neural Network (ANN). To apply this approach, sets of training data are needed for the ANN model. Here, we use numerical wave simulations with various initial conditions that are performed to build the training data. We use the SWASH model as the wave model to perform numerical simulation. The obtained training data are then used for tsunami inversion by using ANN. Although there is only one measured water elevation in Palu Bay during the 2018 tsunami, i.e. in Pantoloan port, in this paper, we use four signals at different locations that are used as input for the ANN inversion model, in order to estimate the initial shape and location of the tsunami. We observe that by using four points of observation for tsunami inversion give best result compared to results by using 1 to 3 observation points. Using four points, we obtain R2 score of 0.98347 and RMSE score of 0.115345.