Appendix III:- Set of 12 Simultaneous Non-linear Equations for the Derivation of Mathematical Model

$$\frac{\left(\frac{0.3205w_{11}+0.4591w_{12}+0.3805w_{13}+w_0}{1+|0.3205w_{11}+0.4591w_{12}+0.3805w_{13}+w_0|}\right)\Delta\overline{w}_1+\left(\frac{0.3793w_{21}+0.5774w_{22}+0.3372w_{23}+w_0}{1+|0.3793w_{21}+0.5774w_{22}+0.3372w_{23}+w_0|}\right)\Delta\overline{w}_2+\left(\frac{0.3819w_3+w_0}{1+|0.3819w_3+w_0|}\right)\Delta\overline{w}_3+b}{1+\left|\left(\frac{0.3205w_{11}+0.4591w_{12}+0.3805w_{13}+w_0}{1+|0.3205w_{11}+0.4591w_{12}+0.3805w_{13}+w_0|}\right)\Delta\overline{w}_1+\left(\frac{0.3793w_{21}+0.5774w_{22}+0.3372w_{23}+w_0}{1+|0.3793w_{21}+0.5774w_{22}+0.3372w_{23}+w_0|}\right)\Delta\overline{w}_2+\left(\frac{0.3819w_3+w_0}{1+|0.3819w_3+w_0|}\right)\Delta\overline{w}_3+b\right|}=0.3927 \quad (3.16)$$

$$\frac{\left(\frac{0.3274w_{11}+0.3780w_{12}+0.4512w_{13}+w_0}{1+|0.3274w_{11}+0.3780w_{12}+0.4512w_{13}+w_0|}\right)\Delta\overline{w}_1+\left(\frac{0.3205w_{21}+0.4591w_{22}+0.3805w_{23}+w_0}{1+|0.3205w_{21}+0.4591w_{22}+0.3805w_{23}+w_0|}\right)\Delta\overline{w}_2+\left(\frac{0.3927w_3+w_0}{1+|0.3927w_3+w_0|}\right)\Delta\overline{w}_3+b}{1+\left|\left(\frac{0.3274w_{11}+0.3780w_{12}+0.4512w_{13}+w_0}{1+|0.3274w_{11}+0.3780w_{12}+0.4512w_{13}+w_0|}\right)\Delta\overline{w}_1+\left(\frac{0.3205w_{21}+0.4591w_{22}+0.3805w_{23}+w_0}{1+|0.3205w_{21}+0.4591w_{22}+0.3805w_{23}+w_0|}\right)\Delta\overline{w}_2+\left(\frac{0.3927w_3+w_0}{1+|0.3927w_3+w_0|}\right)\Delta\overline{w}_3+b\right|}=0.3956 \quad (3.17)$$

$$\frac{\left(\frac{0.3454w_{11}+0.5032w_{12}+0.4744w_{13}+w_0}{1+|0.3454w_{11}+0.5032w_{12}+0.4744w_{13}+w_0|}\right)\Delta\overline{w}_1+\left(\frac{0.3274w_{21}+0.3780w_{22}+0.4512w_{23}+w_0}{1+|0.3274w_{21}+0.3780w_{22}+0.4512w_{23}+w_0|}\right)\Delta\overline{w}_2+\left(\frac{0.3956w_3+w_0}{1+|0.3956w_3+w_0|}\right)\Delta\overline{w}_3+b}{1+\left|\left(\frac{0.3454w_{11}+0.5032w_{12}+0.4744w_{13}+w_0}{1+|0.3454w_{11}+0.5032w_{12}+0.4744w_{13}+w_0|}\right)\Delta\overline{w}_1+\left(\frac{0.3274w_{21}+0.3780w_{22}+0.4512w_{23}+w_0}{1+|0.3274w_{21}+0.3780w_{22}+0.4512w_{23}+w_0|}\right)\Delta\overline{w}_2+\left(\frac{0.3956w_3+w_0}{1+|0.3956w_3+w_0|}\right)\Delta\overline{w}_3+b\right|}=0.3963 \quad (3.18)$$

$$\frac{\left(\frac{0.4349w_{11}+0.4935w_{12}+0.5626w_{13}+w_0}{1+|0.4349w_{11}+0.4935w_{12}+0.5626w_{13}+w_0|}\right)\Delta\overline{w}_1+\left(\frac{0.3454w_{21}+0.5032w_{22}+0.4744w_{23}+w_0}{1+|0.3454w_{21}+0.5032w_{22}+0.4744w_{23}+w_0|}\right)\Delta\overline{w}_2+\left(\frac{0.3963w_3+w_0}{1+|0.3963w_3+w_0|}\right)\Delta\overline{w}_3+b}{1+\left|\left(\frac{0.4349w_{11}+0.4935w_{12}+0.5626w_{13}+w_0}{1+|0.4349w_{11}+0.4935w_{12}+0.5626w_{13}+w_0|}\right)\Delta\overline{w}_1+\left(\frac{0.3454w_{21}+0.5032w_{22}+0.4744w_{23}+w_0}{1+|0.3454w_{21}+0.5032w_{22}+0.4744w_{23}+w_0|}\right)\Delta\overline{w}_2+\left(\frac{0.3963w_3+w_0}{1+|0.3963w_3+w_0|}\right)\Delta\overline{w}_3+b\right|}=0.3972 \quad (3.19)$$

$$\frac{\left(\frac{0.4209w_{11}+0.5155w_{12}+0.5531w_{13}+w_0}{1+|0.4209w_{11}+0.5155w_{12}+0.5531w_{13}+w_0|}\right)\Delta\bar{w}_1+\left(\frac{0.4349w_{21}+0.4935w_{22}+0.5626w_{23}+w_0}{1+|0.4349w_{21}+0.4935w_{22}+0.5626w_{23}+w_0|}\right)\Delta\bar{w}_2+\left(\frac{0.3972w_3+w_0}{1+|0.3972w_3+w_0|}\right)\Delta\bar{w}_3+b}{1+\left|\left(\frac{0.4209w_{11}+0.5155w_{12}+0.5531w_{13}+w_0}{1+|0.4209w_{11}+0.5155w_{12}+0.5531w_{13}+w_0|}\right)\Delta\bar{w}_1+\left(\frac{0.4349w_{21}+0.4935w_{22}+0.5626w_{23}+w_0}{1+|0.4349w_{21}+0.4935w_{22}+0.5626w_{23}+w_0|}\right)\Delta\bar{w}_2+\left(\frac{0.3972w_3+w_0}{1+|0.3972w_3+w_0|}\right)\Delta\bar{w}_3+b\right|}=0.4011 \quad (3.20)$$

$$\frac{\left(\frac{0.4028w_{11}+0.5092w_{12}+0.5006w_{13}+w_0}{1+|0.4028w_{11}+0.5092w_{12}+0.5006w_{13}+w_0|}\right)\Delta\bar{w}_1+\left(\frac{0.4209w_{21}+0.5155w_{22}+0.5531w_{23}+w_0}{1+|0.4209w_{21}+0.5155w_{22}+0.5531w_{23}+w_0|}\right)\Delta\bar{w}_2+\left(\frac{0.4011w_3+w_0}{1+|0.4011w_3+w_0|}\right)\Delta\bar{w}_3+b}{1+\left|\left(\frac{0.4028w_{11}+0.5092w_{12}+0.5006w_{13}+w_0}{1+|0.4028w_{11}+0.5092w_{12}+0.5006w_{13}+w_0|}\right)\Delta\bar{w}_1+\left(\frac{0.4209w_{21}+0.5155w_{22}+0.5531w_{23}+w_0}{1+|0.4209w_{21}+0.5155w_{22}+0.5531w_{23}+w_0|}\right)\Delta\bar{w}_2+\left(\frac{0.4011w_3+w_0}{1+|0.4011w_3+w_0|}\right)\Delta\bar{w}_3+b\right|}=0.4116 \quad (3.21)$$

$$\frac{\left(\frac{0.3748w_{11}+0.4597w_{12}+0.5014w_{13}+w_0}{1+|0.3748w_{11}+0.4597w_{12}+0.5014w_{13}+w_0|}\right)\Delta\bar{w}_1+\left(\frac{0.4028w_{21}+0.5092w_{22}+0.5006w_{23}+w_0}{1+|0.4028w_{21}+0.5092w_{22}+0.5006w_{23}+w_0|}\right)\Delta\bar{w}_2+\left(\frac{0.4116w_3+w_0}{1+|0.4116w_3+w_0|}\right)\Delta\bar{w}_3+b}{1+\left|\left(\frac{0.3748w_{11}+0.4597w_{12}+0.5014w_{13}+w_0}{1+|0.3748w_{11}+0.4597w_{12}+0.5014w_{13}+w_0|}\right)\Delta\bar{w}_1+\left(\frac{0.4028w_{21}+0.5092w_{22}+0.5006w_{23}+w_0}{1+|0.4028w_{21}+0.5092w_{22}+0.5006w_{23}+w_0|}\right)\Delta\bar{w}_2+\left(\frac{0.4116w_3+w_0}{1+|0.4116w_3+w_0|}\right)\Delta\bar{w}_3+b\right|}=0.4208 \quad (3.22)$$

$$\frac{\left(\frac{0.3670w_{11}+0.5394w_{12}+0.4713w_{13}+w_0}{1+|0.3670w_{11}+0.5394w_{12}+0.4713w_{13}+w_0|}\right)\Delta\bar{w}_1+\left(\frac{0.3748w_{21}+0.4597w_{22}+0.5014w_{23}+w_0}{1+|0.3748w_{21}+0.4597w_{22}+0.5014w_{23}+w_0|}\right)\Delta\bar{w}_2+\left(\frac{0.4208w_3+w_0}{1+|0.4208w_3+w_0|}\right)\Delta\bar{w}_3+b}{1+\left|\left(\frac{0.3670w_{11}+0.5394w_{12}+0.4713w_{13}+w_0}{1+|0.3670w_{11}+0.5394w_{12}+0.4713w_{13}+w_0|}\right)\Delta\bar{w}_1+\left(\frac{0.3748w_{21}+0.4597w_{22}+0.5014w_{23}+w_0}{1+|0.3748w_{21}+0.4597w_{22}+0.5014w_{23}+w_0|}\right)\Delta\bar{w}_2+\left(\frac{0.4208w_3+w_0}{1+|0.4208w_3+w_0|}\right)\Delta\bar{w}_3+b\right|}=0.4225 \quad (3.23)$$

$$\frac{\left(\frac{0.3603w_{11}+0.3944w_{12}+0.4508w_{13}+w_0}{1+|0.3603w_{11}+0.3944w_{12}+0.4508w_{13}+w_0|}\right)\Delta\bar{w}_1+\left(\frac{0.3670w_{21}+0.5394w_{22}+0.4713w_{23}+w_0}{1+|0.3670w_{21}+0.5394w_{22}+0.4713w_{23}+w_0|}\right)\Delta\bar{w}_2+\left(\frac{0.4225w_3+w_0}{1+|0.4225w_3+w_0|}\right)\Delta\bar{w}_3+b}{1+\left|\left(\frac{0.3603w_{11}+0.3944w_{12}+0.4508w_{13}+w_0}{1+|0.3603w_{11}+0.3944w_{12}+0.4508w_{13}+w_0|}\right)\Delta\bar{w}_1+\left(\frac{0.3670w_{21}+0.5394w_{22}+0.4713w_{23}+w_0}{1+|0.3670w_{21}+0.5394w_{22}+0.4713w_{23}+w_0|}\right)\Delta\bar{w}_2+\left(\frac{0.4225w_3+w_0}{1+|0.4225w_3+w_0|}\right)\Delta\bar{w}_3+b\right|}=0.4423 \quad (3.24)$$

$$\frac{\left(\frac{0.3240w_{11}+0.5647w_{12}+0.4177w_{13}+w_0}{1+|0.3240w_{11}+0.5647w_{12}+0.4177w_{13}+w_0|}\right)\Delta\bar{w}_1+\left(\frac{0.3603w_{21}+0.3944w_{22}+0.4508w_{23}+w_0}{1+|0.3603w_{21}+0.3944w_{22}+0.4508w_{23}+w_0|}\right)\Delta\bar{w}_2+\left(\frac{0.4423w_3+w_0}{1+|0.4423w_3+w_0|}\right)\Delta\bar{w}_3+b}{1+\left|\left(\frac{0.3240w_{11}+0.5647w_{12}+0.4177w_{13}+w_0}{1+|0.3240w_{11}+0.5647w_{12}+0.4177w_{13}+w_0|}\right)\Delta\bar{w}_1+\left(\frac{0.3603w_{21}+0.3944w_{22}+0.4508w_{23}+w_0}{1+|0.3603w_{21}+0.3944w_{22}+0.4508w_{23}+w_0|}\right)\Delta\bar{w}_2+\left(\frac{0.4423w_3+w_0}{1+|0.4423w_3+w_0|}\right)\Delta\bar{w}_3+b\right|}=0.4523 \quad (3.25)$$

$$\frac{\left(\frac{0.3755w_{11}+0.4745w_{12}+0.4911w_{13}+w_0}{1+|0.3755w_{11}+0.4745w_{12}+0.4911w_{13}+w_0|}\right)\Delta\bar{w}_1+\left(\frac{0.3240w_{21}+0.5647w_{22}+0.4177w_{23}+w_0}{1+|0.3240w_{21}+0.5647w_{22}+0.4177w_{23}+w_0|}\right)\Delta\bar{w}_2+\left(\frac{0.4523w_3+w_0}{1+|0.4523w_3+w_0|}\right)\Delta\bar{w}_3+b}{1+\left|\left(\frac{0.3755w_{11}+0.4745w_{12}+0.4911w_{13}+w_0}{1+|0.3755w_{11}+0.4745w_{12}+0.4911w_{13}+w_0|}\right)\Delta\bar{w}_1+\left(\frac{0.3240w_{21}+0.5647w_{22}+0.4177w_{23}+w_0}{1+|0.3240w_{21}+0.5647w_{22}+0.4177w_{23}+w_0|}\right)\Delta\bar{w}_2+\left(\frac{0.4523w_3+w_0}{1+|0.4523w_3+w_0|}\right)\Delta\bar{w}_3+b\right|}=0.4683 \quad (3.26)$$

$$\frac{\left(\frac{04124w_{11}+0.5137w_{12}+0.5369w_{13}+w_0}{1+|04124w_{11}+0.5137w_{12}+0.5369w_{13}+w_0|}\right)\Delta\bar{w}_1+\left(\frac{0.3755w_{21}+0.4745w_{22}+0.4911w_{23}+w_0}{1+|0.3755w_{21}+0.4745w_{22}+0.4911w_{23}+w_0|}\right)\Delta\bar{w}_2+\left(\frac{0.4683w_3+w_0}{1+|0.4683w_3+w_0|}\right)\Delta\bar{w}_3+b}{1+\left|\left(\frac{04124w_{11}+0.5137w_{12}+0.5369w_{13}+w_0}{1+|04124w_{11}+0.5137w_{12}+0.5369w_{13}+w_0|}\right)\Delta\bar{w}_1+\left(\frac{0.3755w_{21}+0.4745w_{22}+0.4911w_{23}+w_0}{1+|0.3755w_{21}+0.4745w_{22}+0.4911w_{23}+w_0|}\right)\Delta\bar{w}_2+\left(\frac{0.4683w_3+w_0}{1+|0.4683w_3+w_0|}\right)\Delta\bar{w}_3+b\right|}=0.6289 \quad (3.27)$$

$$y =$$

$$\frac{\left(\frac{-0.0091x_i+0.0035x_r+0.0072x_c-0.0315}{1+|-0.0091x_i+0.0035x_r+0.0072x_c-0.0315|}\right)-0.1250+\left(\frac{-8.2344x_{i(k-n)}+5.3519x_{c(k-n)}-2.3217x_{r(k-n)}-0.0315}{1+|-8.2344x_{i(k-n)}+5.3519x_{c(k-n)}-2.3217x_{r(k-n)}-0.0315|}\right)-0.1088+\left(\frac{0.0674y_{(k-m)}-0.0315}{1+|0.0674y_{(k-m)}-0.0315|}\right)0.0008-0.2299}{1+\left|\left(\frac{-0.0091x_i+0.0035x_r+0.0072x_c-0.0315}{1+|-0.0091x_i+0.0035x_r+0.0072x_c-0.0315|}\right)-0.1250+\left(\frac{-8.2344x_{i(k-n)}+5.3519x_{c(k-n)}-2.3217x_{r(k-n)}-0.0315}{1+|-8.2344x_{i(k-n)}+5.3519x_{c(k-n)}-2.3217x_{r(k-n)}-0.0315|}\right)-0.1088+\left(\frac{0.0674y_{(k-m)}-0.0315}{1+|0.0674y_{(k-m)}-0.0315|}\right)0.0008-0.2299\right|}$$

$$(4.4)$$