IMPACTS OF SOCIO-ECONOMIC ENVIRONMENTS ON MARIGOLD FLORICULTURE IN RANAGHAT-II, INDIA

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ABSTRACT

Marigold floriculture is the main source and livelihood for farmers in almost all parts of the rural world. This flower grows in all tropical regions of the countries from temperate regions. This cultivation is widespread in Ranaghat-II block of Nadia district in the Indian state of West Bengal. Flower production is one of the main tools of the farmers here. This is where we want to look at exactly how the socioeconomic indicators affect marigold floriculture. For this, a total of 400 farmers from 105 villages and periphery areas of the census and statutory towns in this entire block have been selected for the questionnaire survey of socioeconomic conditions of farmers during 2019. These indicators are marigold cultivation lands (MCL), average marigold production (AMP), total income (TI), lands under cultivation (LUC), land purchase or lease(LP), family member (FM), education (E), mobile (M), internet (I), expensive goods (EG), electricity (El), food consumption (FC), cloth expenditure (CE), health expenditure (HE), working days (WD), housing (H), toilet (T), furniture (F), and debt (D). All socioeconomic conditions define marigold floriculture or marigold income (MI). Our results of multiple linear regression exhibit that beside MCL (0.888) and AMP (0.733), TI (0.632), LUC (0.659), H (0.612), T (0.612), F (0.607) and EG (0.568) have a strong positive effect on marigold income than other socioeconomic indicators. Although the socioeconomic indicators are auto-correlated, the Residual statistics prove overall indicators have a strong linear positive correlation to marigold floriculture and these are well distributed. Farmers have been practising such input-intensive marigold cultivation to a great degree than traditional cultivation like paddy, jute, etc. because it serves better livelihood. But if this cultivation continues day after day, the balance of both natural and socio-economic environment will be lost. So to preserve sustainable marigold floriculture and society, the relevant policies and future research topics are suggested.

1 INTRODUCTION

Marigold is one of the most colourful, hardy and popular ornamental flowers (Aslam et al., 2016) with its short and long cultivars like *Tagetes patula L.* and *T. erecta L*. Farmers grow marigold abundantly in almost any country situating cold temperate to hot humid tropics (Ahmed et al., 2017). The flower is used mainly many socio-religious functions on the one hand, and the other one is pharmaceuticals, food supplements, insect fly repellents, colouring agents for cosmetics and poultry industry etc. Therefore, it has an immense regular demand of cut

flowers for global markets (Priyanka et al., 2013). The world-leading marigold producing countries are USA, Europe, China, India, Pakistan (Kumara et al., 2019) and Bangladesh (Haque et al., 2012). The role of the socio-economic environment in marigold cultivation is as undeniable as the role nature of the environment. Just as agriculture affects the socio-economic environment, so does the socio-economic environment. Every aspect of society takes marigold farming forward. People need work and money for their livelihood and it depends on agriculture in developing countries because of the large population (Gawle et al., 2012).

By producing marigold farmers get average Rs. 1.84 per investment of one rupee (Singh, 2013). The average input-output ratio of marigold is 1:2.18. Net income (Rs. 100557.99/ha) is always higher than the cost of cultivation (Rs. 84594.04/ha.). Family labour income and farm business income are also high Rs 105317.94/ha and Rs 113377.87/ha (Sai et al., 2018). As the size of the land increases, so does the amount of money earned from this cultivation. Farm size of marginal (0.72ha) and small (1.51ha) farmers is small (Singh, 2013) to medium (Gawle et al., 2012). So, marigold is cultivated in almost the entire cropped area i. e. average 1.12ha (Singh, 2013). Marigold cultivation yields more income than other crops i. e. lentil, potato, mustard, paddy etc. (Haque et al., 2012, Sahu et al., 2011). Education is the main tool to improve people's lives. The connection between education and agriculture is great. As the scope of human knowledge increases, agriculture will improve. Food, clothing, shelter, health facilities, electricity and daily necessities (T.V., freeze, bike etc.) push people towards their work. Marigold has helped increase in a very nice way (Sahu et al., 2011). Family members and their education are especially important for their labour for marigold cultivation along with other indicators (Gawle et al, 2012).

There has been a lot of research on social and economic development as a result of marigold cultivation. But no one has discussed the issues of society and economy which have affected the cultivation of marigold. And in Ranaghat-II Block in the Nadia district of West Bengal, both discussions have not been special before. Farmers of every village have been growing marigold tirelessly since the 1960s (Figure 1A). Our question: are the socio-economic environments of the Ranaghat-II help to produce marigold floriculture? If so, how much it affects the marigold floriculture? That's why all the farmers of the entire block depend on marigold farming for their livelihood. In this perspective, the objectives of this study are to (1) identify the marigold cultivated village and boundary areas of towns; (2) assess the marigold income from every family's land and (3) inspect the impacts of socioeconomic environments on marigold floriculture or marigold income during 2019.

2 MATERIALS AND METHODS

2.1 Study area

Ranaghat-II is a community development block in Nadia district of West Bengal, India (Figure 1B). According to the Census of India, 2011its total area and population are 279.03 km^2 and 364,405. The total average and actual rainfall are 1447mm and 1128mm. The minimum and maximum temperatures are 7^0C and 42^0C. Cold winter (November to February), hot-humid summer and the South-West Monsoon with ample rainfall are climatic phenomena. Soil forms from new alluvium (Gangetic alluvium) making Inceptisols and Ustochrepts. The irrigation

comes off rivers (Churni, and Ichhamati), canals, tubewell and shallow machines. Almost all crops are grown in this block but economic activities mainly depend on floriculture.

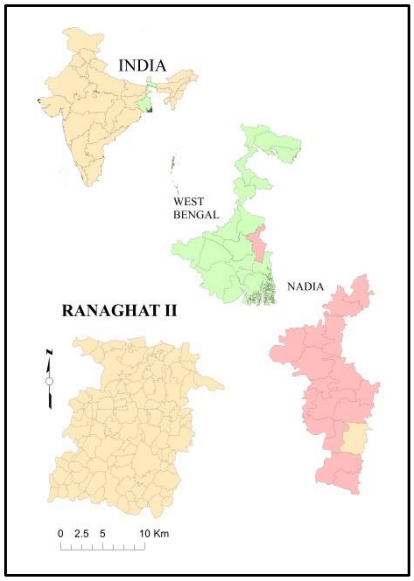
(A)  (B) 

Figure 1 (A) Farmer is working on marigold land at Andulpota village in Ranaghat-II, (B) Ranaghat-II is located in Nadia district in West Bengal, India

2.2 Research framework

2.2.1 Questionnaire survey

Randomly we select 400 farmers for the socioeconomic survey from 105 village and boundary areas of towns. They have been practising marigold for more than 10 to 20 years. For the first time, all the farmers surveyed were taken by the second and third time also to get a clear picture of the socioeconomic environment's outline of the whole year. The farmers have flowers all year round so they have income in hands all time to sustain their livelihood. We surveyed throughout the year in 2019. In all, we surveyed three times. The first time was January to February; second time April to May and third time august to September. We make an average from all three times data for statistical analyses.

2.2.2 Statistical methods

To address research objectives, different descriptive statistical methods such as minimum, maximum, mean and standard deviation are calculating where mean is signifying average of the data and Standard Deviation (SD) is to determine the central distribution of variables (Rahman et al., 2017) of spatial distribution socioeconomic environments and marigold floriculture. Multiple Linear Regression (MLR) are analysing multiple independent variables (socioeconomic environments) jointly direct the value of a dependent variable (marigold income). An equation of multiple relation regression equations is (Uyanik and Guler, 2013) following:

$$y = \beta_0 + \beta_1 x_1 + \ldots + \beta_n x_n + \varepsilon$$

y = Dependent variable

X_i =*Independent variable*

β_i = *parameter*

ε = *Error* (i)

Pearson correlation coefficient also refers to as Pearson's r (Isaac and Chikweru, 2018) is computed to make a linear correlation of continuous socioeconomic environments and continuous marigold income. The coefficient of determination, r^2 is to investigate the level of dependency of the response of variables (Nimon, 2013) on outcomes. ANOVA explains general differences among means than specific means of two groups of the sample (Good and Lunneborg, 2006; Gravetter and Wallnau, 2003). The autocorrelation is tested in Durbin Watson (DW) statistics. The value of Durbin-Watson statistics is from 0 to 4. The no autocorrelation is when the value is fixed 2.0. The positive and negative autocorrelations are bellow, and above 2.0 (Lee, 2013). Collinearity is a correlation of how the independent variables associated with each other define the dependent variable. One independent variable can change the other independent variable to dependent variables (Uyanik and Guler, 2013; Issac and Chikweru, 2018). 'Zero-order', 'Partial' and 'Part' correlation are calculating how a single socioeconomic parameter places separate contribution to the total flower production. Variance inflation factor (VIF) and Tolerance also explain autocorrelation. The value of tolerance is below 1.0 or 2.0 the value of VIF is 10 or above creating multicollinearity [Uyanik and Guler, 2013]. To remove collinearity, collinearity diagnostics measure correlation matrix, the coefficient of determination, R^2 of each independent variable measured based on Eigenstructure, condition indices' values (Good and Lunneborg, 2006; Friedman and Wall, 2005). If the Eigenvalues are near to 0 and condition index above 30, then it may raise a complexity. The Residuals in a statistical model analyse the difference between the predicted value of data and the observed value of data (Friedman and Wall, 2005; Midi et al., 2015). The difference is the tool to explain how much the socioeconomic environment effects on the marigold floriculture.

We prepare a Composite Zscore of all indicators of 400 families for standardised normal distribution. All calculations are performed in IBM SPSS 21.

3 RESULTS AND DISCUSSION

3.1 Present Location of marigold producing lands

Marigolds are grown in almost any type of soils in any agro-climatic condition (Aslam et al., 2016, Ahmed et al., 2017, Priyanka et al., 2013). Marigold is widely cultivated across all over the block. There are 109 out of 110 villages, and 4 boundaries of 7 towns are producing these ornamental cultivars in vast agricultural land in the Block. Farmers choose marigold than paddy (Sahu et al., 2011) jute, potato (Haque et al., 2012) etc. because it opens up jobs and huge continuous income throughout the year. Florist farmers (Figure 1A) cultivate all types of marigolds: African marigold (*Tagetes erecta Linn*.), French marigold (*Tagetes patula Linn*.), *Yellow Climax* and others with short and taller cultivars.

3.2 Impacts of socioeconomic environments on marigold floriculture

3.2.1 Marigold income (MI) analysis

Marigold floriculture refers to marigold income (dependent variable) because the net income (MI) from any crop is the real outcome. The last step is return or income regardless of the amount of land and the amount of crop produced. Sai et al. 2018 report that the average family labour income is Rs. 105317/ha. Family labour income and farm business income is higher at small farms Rs. 105317-113377/ha. Our result shows (Table 1) the minimum and maximum of 400 farmers' MI are Rs. 4000/month and Rs. 7500/month with average Rs. 5870.133/month (SD 631.8889). By the cultivation of marigolds, farmers can make a regular income and work throughout the year. So that life can be carried out.

Table 1 Descriptive Statistics

	Minimum	Maximum	Mean	Std. Deviation
MCL	0.5	5.7	2.3486	1.17896
AMP	700	9000	2469.867	1378.857
MI	4000	7500	5870.133	631.8889
TI	7500	21700	11597.81	3796.608
LUC	1	21	8.3782	5.38608
LP	0.2	4	1.4464	1.02905
FM	2	8	4.775	1.36346
E	12	97	51.505	18.04381
M	1	8	3.77	1.58378
I	1	6	2.185	1.34547
EG	2	16	8.05	3.02247
El	30	144	80.5688	23.76231
FC	2500	7000	4691.375	942.4297
CE	360	1600	959.735	252.4709
HE	100	981	533.83	172.6996
WD	304	361	338.55	12.56651
H	1	6	2.4325	1.71838
T	1	5	3.4725	1.08729
F	5	12	8.0225	1.71737
D	5	52	25.32	9.48301

3.2.2 Socioeconomic environments analysis

Each farmer cultivates (Table 1) an average of 8.3782 bighas (=1.3451 ha in West Bengal) of land (LUC). The total land area of the farmers is 1 to 21 bighas (SD 5.38608). The amount of marigold cultivated lands (MCL) of the farmer here is 0.5-5.7 bighas per year. However, on average, they cultivate 2.3486 bighas or 0.37708 ha (SD 1.17896) of land. These are different from marigold land size 0.72ha to1.51 ha and total cropping land 1.12 ha (Singh, 2013). Average marigold production (AMP) from marigold lands comes to 700-9000Kg flowers/month with average 2469.867Kgflowers/month and SD 1378.857. Marigold production per family per month has never measured before but Haque et al. 2012 report it was 4.73 or 4730Kg mt/ha and Gawle et al. 2012 reveal 4-5t/acre. Total income is marigold income and other income. The total monthly income (TI) of each family is Rs 7500-21700/month with average Rs 11597.81/month with the help of which they have purchased or leased (LP) 0.2-4 bighas and average 1.4464 of land till December 2019. Gawle et al. 2012 earlier report the total annual income of farmer including marigold income are below 20000 to above 60000. A total number of family members

(FM) of the farmers here is 4.775 on an average with lowest to highest 2-8 (SD 1.36346). It is closely related to up to 5/6 maximum family members (Gawle et al, 2012).

Sahu et al. 2011 exhibit that more than 80% of marigold farmers said that education, per capita income, consumption of food, sophisticated goods (T.V., freeze, bike), electricity (Village electrification increased from 3.7% to 15.9%), education, health etc. have dramatically increased after the cultivation of marigold. In Ranaghat-II we have got each family has 1-8 mobiles and internet points with mobile internet and broadband internet 1-6. Every family has Expensive goods (EG) is 2-16items, Furniture is 5-12 items with mean 8.0225 and Electricity (El) use 30-144 Kilowatt-Hour per month. They spend Rs 2500-7000 (mean 4691.375) for food (FC), Rs 360-1600 (mean Rs 959.735) for clothes (CE) and Rs 100-981 (mean Rs 533.83) for Health (HE) per month. Marigold cultivation happens all year round so workers have to work all year round. Gawle et al., 2012 and Haque et al., 2012 express that floriculturist some time needs other work. It is close to our result depending on the amount of total land and with proportion to marigold lands, there are 304 to 361 and average 338.551 (with SD 12.5665) days of work (WD) per year for farmers and labourers. Housing (measured on 6 points Likert scale) and toilet (5 points Likert scale) condition of them on an average are 2.4325 and 3.4725. Toilet condition is more developed than housing. However, the amount of debt is not very high at an average of Rs 25.32000 (5000-52000) per year and they repay it on time. Marigold floriculture is very positively related to all socio-economic environments. As the number of elements in each environment increases, so does the marigold income. Marigold floriculture, on the other hand, is promoting the developments of socio-economic environments. Again, while marigold income is increasing, the amount of debt is decreasing. So it can be said that the socio-economic environment is playing an important role in the development of marigold floriculture for farmers' livelihood in this block.

3.2.3 Socioeconomic environments and marigold production relationship

We did multiple linear regression to see the socioeconomic environment impact on marigold floriculture. The result of Pearson Correlation shows that the effects of MCL (0.888), AMP (0.733), TI (0.632), LUC (0.659), H (0.612), T (0.612), F (0.607), EG (0.568) and LP (.510) are greatest, but influence of other elements FM (.304), E (.368), M (.424), I (.309), E (.263), FC (.338), CE (.362), HE (.341) and WD (.432) are not less. Debt (-.511) has given the negative impact on marigold income (MI) which is in line with reality. The higher the marigold income is, the lower the amount of debt. Based on MLR equation we find this (Table 2):

Marigold floriculture or Marigold Income (MI) = 3803.649 + 516.291 MCL + -.041 AMP + -.095 TI + 58.450 LUC + -43.582 LP + 118.801 FM +.883 E + -27.073 M + -11.296 I + 8.600 EG + -4.496 El + -.048 FC + .021 CE + .027 HE+ 4.097 WD + -3.576 H + 48.583 T + 10.374 F + -.200

Here R, R^2, F Change and Significance F Change are .914, .836, 102.126 and .000 (<.05). Another result of Durbin-Watson (1.761) is also the significance level. All results suggest 19 independent variables significantly define marigold income. ANOVA has df value of regression is 19 and F is 102.126 those are also significant .000 (< .05). By looking at these values we can say socio-economic environment predicts marigold floriculture very well in Ranaghat-II.

Table 2 of coefficients exhibits that MCL (.000), AMP (.036), TI (.000), LUC (.000), FM (.006), El (.002), WD (.005) are significant level because they are bellow p-value (<.05) and T (.056) and LP (.074) have close to the p-value. Other indicators are above p-value. Socio-economic indicators are auto-correlated. They are making Collinearity while predicting the result.

Table 2 Coefficients of multiple linear regression

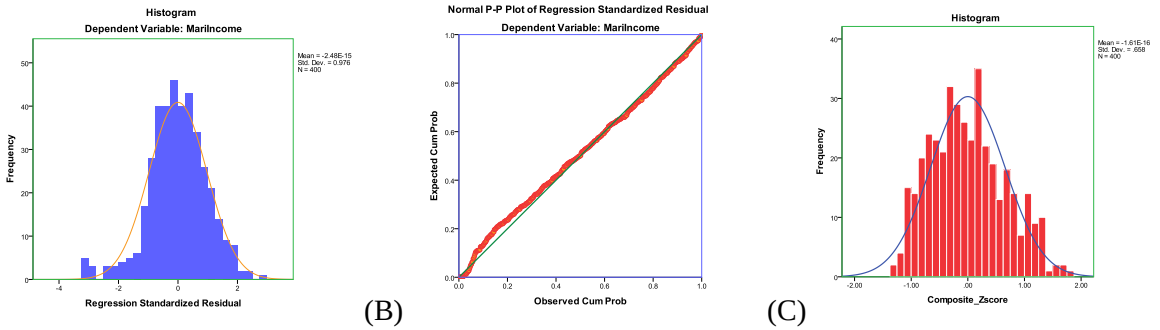
	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
	B	Std. Error	Beta			Zero-order	Partial	Part	Tole-rance	VIF
(Con-stant)	3803.649	503.528		7.554	0.000					
MCL	516.291	25.457	0.963	20.281	0.000	0.888	0.721	0.421	0.191	5.235
AMP	-0.041	0.02	-0.091	-2.109	0.036	0.733	-0.108	-0.044	0.234	4.276
TI	-0.095	0.018	-0.57	-5.22	0.000	0.632	-0.259	-0.108	0.036	27.658
LUC	58.45	14.587	0.498	4.007	0.000	0.659	0.201	0.083	0.028	35.87
LP	-43.582	24.367	-0.071	-1.789	0.074	0.51	-0.091	-0.037	0.274	3.654
FM	118.801	42.75	0.256	2.779	0.006	0.304	0.141	0.058	0.051	19.745
E	0.883	1.506	0.025	0.586	0.558	0.368	0.03	0.012	0.233	4.291
M	-27.073	18.177	-0.068	-1.489	0.137	0.424	-0.076	-0.031	0.208	4.817
I	-11.296	18.385	-0.024	-0.614	0.539	0.309	-0.032	-0.013	0.281	3.556
EG	8.6	8.256	0.041	1.042	0.298	0.568	0.053	0.022	0.276	3.618
El	-4.496	1.438	-0.169	-3.128	0.002	0.263	-0.158	-0.065	0.147	6.781
FC	-0.048	0.051	-0.071	-0.933	0.352	0.338	-0.048	-0.019	0.075	13.418
CE	0.021	0.119	0.008	0.178	0.859	0.362	0.009	0.004	0.189	5.28
HE	0.027	0.156	0.007	0.173	0.863	0.341	0.009	0.004	0.237	4.215
WD	4.097	1.447	0.081	2.831	0.005	0.432	0.144	0.059	0.52	1.922
H	-3.576	25.83	-0.01	-0.138	0.89	0.612	-0.007	-0.003	0.087	11.449
T	48.583	25.379	0.084	1.914	0.056	0.661	0.098	0.04	0.226	4.425
F	10.374	14.282	0.028	0.726	0.468	0.607	0.037	0.015	0.286	3.496
D	-0.2	2.283	-0.003	-0.088	0.93	-0.511	-0.005	-0.002	0.367	2.724

Each indicator has a different share of marigold income. In Table 2 Zero-order, Partial and Part correlation suggest that one unit of variables increase marigold income. Zero-order correlation of MCL (.888), AMP (.733), TI (.632), LUC (.659), LP (.510), FM (.304), E (.368), M (.424), I (.309), EG (.568), H (.612), T (.661) and F (.607) is more significant than rest of other variables.

MCL (5.235), AMP (4.276), LP (3.654), E (4.291), M (4.817), I (3.556), EG (3.618), El (6.781), CE (5.280), HE (4.215), WD (1.922), H (11.449), T (4.425), F (3.496) and D (2.724) have significant VIF values and the rest 4 have above 10 causing some trouble (Uyanik, 2013). Collinearity Diagnostics presents 11 out of 20 variables have significant values (<30) and 3 variables are close to significance level and the rest 5 parameters have a high value above 30 having non-significant. Eigenvalues of 10 indicators nearly close to 0, 5 parameters are above 0 and 5 parameters in between them indicating significance level. Variance proportions reveal that 13 parameters out of 20 have one single trouble having just above .5 significance value and 7 parameters are free from any problem.

Finally, the Residuals (Figure 2A) statistics proved mean values of Residual, Standard predicted and standard residual are all same 0.000. The Standard Deviations of Residual, Standard

predicted value and standard residual are 255.712, 1.000and .976. Furthermore, the minimum and maximum standard residuals are -3.238 and 2.871. Std. Predicted Value has a minimum and maximum values are -1.857 and 2.562. The P–P Plot (Figure 2B) shows the scatters fell on beautifully to the standard distribution line, indicating regular, linear, homoscedasticity and favourable distribution of residuals. All those statistics prove that the overall socio-economic environment significantly contributes to marigold floriculture (marigold income) and/or its fluctuations in Ranaghat-II in 2019. No significant result like this we have found through web search but all previous studies prove that marigold improves socioeconomic conditions (Gawle et al, 2012, Sahu et al. 2011, Singh, 2013, Haque et al. 2012) all over the world.



(A) (B) (C)

Figure 2 (A) Histogram of regression standardized residual, (B) Normal P-P Plot, (C) The standard normal distribution of composite Zscore

3.2.4 Composite Zscore

We have created the composite Zscore (Figure 2C) by combining all the variables so that we can get the correct distribution of the socioeconomic environment and marigold floriculture of each family. It reveals that the scores fall nearly within -1.96 and + 1.96 standard deviations from the mean are 95%.

3.2.5 Policies acceptance

It is very difficult to measure exactly what scale of parameters to maximize marigold income. No special research has been done in this area before in every village in such a perfect way. For more or less socio-economic indicators, the marigold income of different villages has also been different. Therefore, some policies have been adopted to maximize marigold income. 1) Natural environment and marigold plant balance: The farmers need to know the exact quality of the soil (Kumara et al., 2019), perfect climatic and/or seasonal conditions in the year for high plant growth, proper irrigation, scientific tillage (Ahmed et al., 2017), crop rotation, high yielding types of marigold plants etc. for maximum MI. 2) Florist farmers: The farmers must have minimum education and modern technology to know the whole spectrum including marketing. Farmers also need to organise to maximum benefit for their production. Government, non-government, agricultural university have to train farmers to best production. 3) Researches and models: More researches on the socio-economic environment, models need to be built to ensure that marigold floriculture maintains its sustainability in the future in every village.

4 CONCLUSION

Marigold floriculture is the main livelihood of farmers here. The relationship between socioeconomic environment and marigold floriculture at village level in 2019 from 400 florist farmers is presented in this paper. The work includes two ways; first, marigold floriculture composed identifying marigold income and second, farmers' socioeconomic environment. Using multiple linear regressions, we found that all nutrients are auto-correlated. MCL (0.888), AMP (0.733), TI (0.632), LUC (0.659), H (0.612), T (.612), F (0.607) EG (0.568) and LP (.510) have a strong positive effect on marigold income than other socioeconomic indicators. However, D (-.511) has given a negative impact on marigold income. Increasing marigold income is decreasing debt pressure on farmers' shoulders. Overall socio-economy has placed a meaningful contribution to the growth, yield and income of cultivars. Making composite Zscore, we are getting the distribution of marigold flower related to socio-economic environments is normal. The inequality of SE indicators ratio in the block is the apparent reason for this kind of unevenness of marigold income. Some initiatives like crop rotation, crop diversity, manure use conscious use of irrigation, scientific tillage, appropriate plot size, farmers training, and modern technology while preserving nature and future researches well ensure the sustainability of marigold production and society. It leads the income (Priyanka et al., 2013) and food security, farmers' livelihood over the long run.

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4.2 Conflict of interest

The authors have no conflict of interest.

5 REFERENCES

Ahmed, R., Hussain, M. J., Ahmed, S., Karim, M. R., & Siddiky, M. A., 2017. Effect of nitrogen, phosphorus and potassium fertilizers on yield and yield attributes of marigold (Tagetespatula L.). The Agriculturists, 15(1), 101–109.

Aslam, A., Zaman, F., Qasim, M., Ziaf, K., Shaheen, I., Afzal, N., et al., 2016. Impact of nitrogen and potash on growth, flower and seed yield of African marigold (Tagetes erecta L.). ScientiaAgriculturae, 14(2), 266–269.

Friedman, L., & Wall, M., 2005. Graphical views of suppression and multicollinearity in multiple linear regression. The American Statistician, https://doi.org/10.1198/000313005X41337.

Gawle, S. K., Chaturvedi, M. K., & Yadaw, K. N., 2012. Analysis of socio-economic profile of marigold grower in adoption of improved marigold production technology. Journal of Plant Development Sciences, Vol.4 (2): 225-230.

Good, P. I., & Lunneborg, C., 2006. Limitations of the analysis of variance. Journal of Modern Applied Statistical Methods, 5(1), 41–43. https://doi.org/10.22237/jmasm/1146456240.

Gravetter, & Wallnau. 2003. Introduction to analysis of variance (ANOVA), Statistics for the Behavioral Sciences (5th ed.), 1–12.

Haque, M.A., Miah, M., Hossain, S. & Alam, M., 2012. Economics of marigold cultivation in some selected areas of Bangladesh, Bangladesh J. Agril. Res. 37(4): 711-720

Isaac, O. E., & Chikweru, A. E., 2018. Test for significance of Pearson's correlation coefficient (r). International Journal of Innovative Mathematics, Statistics & Energy Policies, 6(1), 11–23.

Kumura, A., Pandey, G., Mishra, P., & Kumar, R., 2019. Effect of integrated nutrient management on growth and flowering of African marigold (Tagetes erecta) cv. Pusa Narangi Gainda. International Journal of Current Microbiology and Applied Sciences, 8(11), 1271–1278. https://doi.org/10.20546/ijcmas.2019.811.150.

Lee, M., 2013. Rebuilding critical values of Durbin–Watson Test by sufficient statistic in the multivariate Regression and first-order autoregressive Error model with intercept, DO-https://doi.org/10.2139/ssrn.2279604, JO - SSRN Electronic Journal.

Midi, H., Sarkar, S. K., & Rana, S., (2015). Collinearity diagnostics of the binary logistic regression model. Journal of Interdisciplinary Mathematics. https://doi.org/10.1080/09720502.2010.10700699.

Nimon, K. F., & Oswald, F. L., 2013. Understanding the results of multiple linear regression: Beyond standardized regression coefficients. Organizational Research Methods, 00, 1–25. https://doi.org/10.1177/1094428113493929.

Priyanka, D., Shalini, T., & Navneet, V. K., 2013. A brief study on marigold (Tagetes species). International Research Journal of Pharmacy, 4(1), 43–48.

Rahman, M., Howladar, M. F., & Faruque, M. O., 2017. Assessment of soil quality for agricultural purposes around the Barapukuria coal mining industrial area, Bangladesh: insights from chemical and multivariate statistical analysis. Environmental Systems Research, 6, 24. https://doi.org/10.1186/s40068- 017-0101-x.

Sahu, A., Chatterjee, S. & Paul, A., 2011. Growth of Floriculture and its Role in Promoting Socio-Economic Status of Floriculturists of Panskura and Kolaghat Blocks, Purba Medinipur. Indian Journal of Geography & Environment 12, 01-08.

Sai, Y. K., Banafar, KNS., Sahu, T. & Chandravanshi, V., 2018. Economic analysis of marigold in Surajpur district of Chhattisgarh. Journal of Pharmacognosy and Phytochemistry, 7(2): 2018-2020.

Singh, A. K., Singh, M. K., & Singh, R. R., 2013. The Economics of marigold flowers in Eastern Uttar Pradesh, The Journal of Rural and Agricultural Research Vol. 13 No. 2, 75-78.

Uyanik, G. K., & Guler, N., 2013. A study on multiple linear regression analysis. Procedia Social and Behavioral Sciences, 106(2013), 234–240.