International Journal of Ecology and Environmental Sciences
www.ecologyjournal.in
Online ISSN: 2664-7133; Print ISSN: 2664-7125; Impact Factor: RJIF 5.28
Received: 27-12-2020; Accepted: 11-01-2021; Published: 01-02-2021
Volume 3; Issue 1; 2021; Page No. 209-212

Validity assessment of participatory agro-ecosystem appraisaland geographical information systems for development of model fruit village at Nongpoh, Ri-bhoi, Meghalaya

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Abstract
Even though the climatic conditions of the state Meghalaya of North East India favours wealth of fruit production, the state has the lowest development indices in production and marketing of fruits. The study on participatory agro-ecosystem assessment with application of GIS for development of model fruit village was conducted during February, 2020 at Nongpoh village, Ri-bhoi district of Meghalaya by the College of P.G. Studies in Agricultural Sciences (CPGS-AS), Central Agricultural University (Imphal), Umiam, Ri-bhoi Meghalaya. The study reported that 50000 m^2, 25000 m^2, 3000 m^2, 400 m, 1000 m, 10500 m^2, 6500 m^2, 500 m and 480 m were the units of records as reported by the respondents of the study through resource mapping spatial PRA with respect to the following criteria (1) Consolidated Area under MFV, (2) Cultivable Area, (3) Area under water bodies, (4) Length of Stream available in the MFV, (5) Perimeter of MFV, (6) Area of Hillock #1, (7) Area of Hillock #2, (8) Altitude of Hillock #1, and (9) Altitude of Hillock #2. However, the 56431 m^2, 29178 m^2, 3656 m^2, 835 m, 1184 m, 12600 m^2, 6379 m^2, 550 m and 545 m were the respective units of the same criteria measured by using Google-Earth Pro in ArcGIS 10.2 platform. On testing validity of the two approaches by employing Wilcoxon Signed Ranks Test, it was found that thee remained a significantly valid Difference at $p = 0.021$ with Wilcoxon $T = 3.00$ and $n = 9$.

Keywords: PRA, google-earth pro, arcgis and wilcoxon T

Introduction
Meghalaya is an agricultural state with about 80% of its total population depending entirely on agriculture for their livelihood. The state is blessed with tropical, sub-tropical and temperate climates distributed among the eleven administrative districts. The variation of altitude, soil and climatic conditions provide ample scope for the cultivation of a wide variety of fruit crops. Fruits and plantation crops have specific agro-climatic requirement for high value production, however there is no appropriate Geographical Information System (GIS) for cultivation of the fruit crops [1]. Even though the climatic conditions favours wealth of fruit production the state has the lowest development indices in production and marketing of fruits in India as evidenced by other indigenous population [2]. Keeping into considerations the above background the study on participatory agro-ecosystem assessment with application of GIS for development of model fruit village was conducted during February, 2020 at Nongpoh village, Ri-bhoi district of Meghalaya by the College of P.G. Studies in Agricultural Sciences (CPGS-AS), Central Agricultural University (Imphal), Umiam, Ri-bhoi Meghalaya. The research objectives of the enquiry were: (1) To conduct a participatory GIS based Agro-ecosystem assessment for development of Model Fruit Village (MFV) at Nongpoh, Ri-bhoi, Meghalaya; and (2) To validate the relationship between participatory agro-ecosystem assessment and GIS database.

A wide range of participatory mapping approaches under spatial Participatory Rural Appraisal (PRA) techniques for ecosystem services assessments have been applied in different countries [3, 4, 5, 6, 7, 8, 9, 10]. These tools were applied through various techniques such as focus group discussions, workshops, semi-structured interviews, paperbased surveys, internet-based surveys, transect walks or ground-truthing, and the combination of two or more methods [3, 11, 12]. Each of these tools and data collection techniques has its strengths and limitations. So far, the corroboration of spatial PRA tools and GIS has not been used in any research work in the state of Meghalaya. Furthermore, local communities may have different interests in, and preferences for mapping activities, methods, and objects than researchers [9], yet, they are rarely taken into account in decisions regarding the choice and design of research.

Materials and Methods
The research followed exploratory research design. Keeping into concern the existence of sub-tropical agro-climatic zone and its suitability & potential of fruit production at the village Nongpoh of Ri-bhoi district, Meghalaya. In analysing the agro-ecosystem assessment of MFV the following criteria *viz.*, (1) Consolidated Area under MFV, (2) Cultivable Area, (3) Area under water bodies, (4) Length of Stream available in the MFV, (5) Perimeter of MFV, (6) Area of Hillock #1, (7) Area of Hillock #2, (8)

Altitude of Hillock #1, and (9) Altitude of Hillock #2 have been taken into consideration. The inquiry underwent into the spatial PRA technique of participatory resource mapping in acquiring the information from 19 respondents who were farmers of the village in the study. The inquiry utilize database of Google-Earth Pro in GIS platform (ArcGIS 10.2) of the identified locale of study for validation of the acquired information.

Results and Discussion

By referring Table 1, it could be reported that 50000 m^2, 25000 m^2, 3000 m^2, 400 m, 1000 m, 10500 m^2, 6500 m^2, 500 m and 480 m are the units of records as reported by the respondents of the study through resource mapping spatial PRA with respect to the following criteria (1) Consolidated Area under MFV, (2) Cultivable Area, (3) Area under water bodies, (4) Length of Stream available in the MFV, (5) Perimeter of MFV, (6) Area of Hillock #1, (7) Area of Hillock #2, (8) Altitude of Hillock #1, and (9) Altitude of Hillock #2. However, the 56431 m^2, 29178 m^2, 3656 m^2, 835 m, 1184 m, 12600 m^2, 6379 m^2, 550 m and 545 m are the units of respective criteria as mentioned in previous line which have been derived from the database of Google-Earth Pro in ArcGIS 10.2 platform. The Figures 1 and 2 depictthe thematic map and topographic of MFV.

Table 1: Criteria of agro-ecosystem assessment through participatory resource mapping alongside its GIS counterpart of MFV.

S. No.	Criteria of agro-ecosystem assessment	Database	
		Through Participatory Resource Mapping	***Through GIS***
1.	Consolidated Area under MFV	50000 m^2	56431 m^2
2.	Cultivable Area	25000 m^2	29178 m^2
3.	Area under water bodies	3000 m^2	3656 m^2
4.	Length of Stream available in the MFV	400 m	835 m
5.	Perimeter of MFV	1000 m	1184 m
6	Area of Hillock #1	10500 m^2	12600 m^2
7	Area of Hillock #2	6500 m^2	6379 m^2
8.	Altitude of Hillock #1	500 m	550 m
9.	Altitude of Hillock #2	480 m	545 m

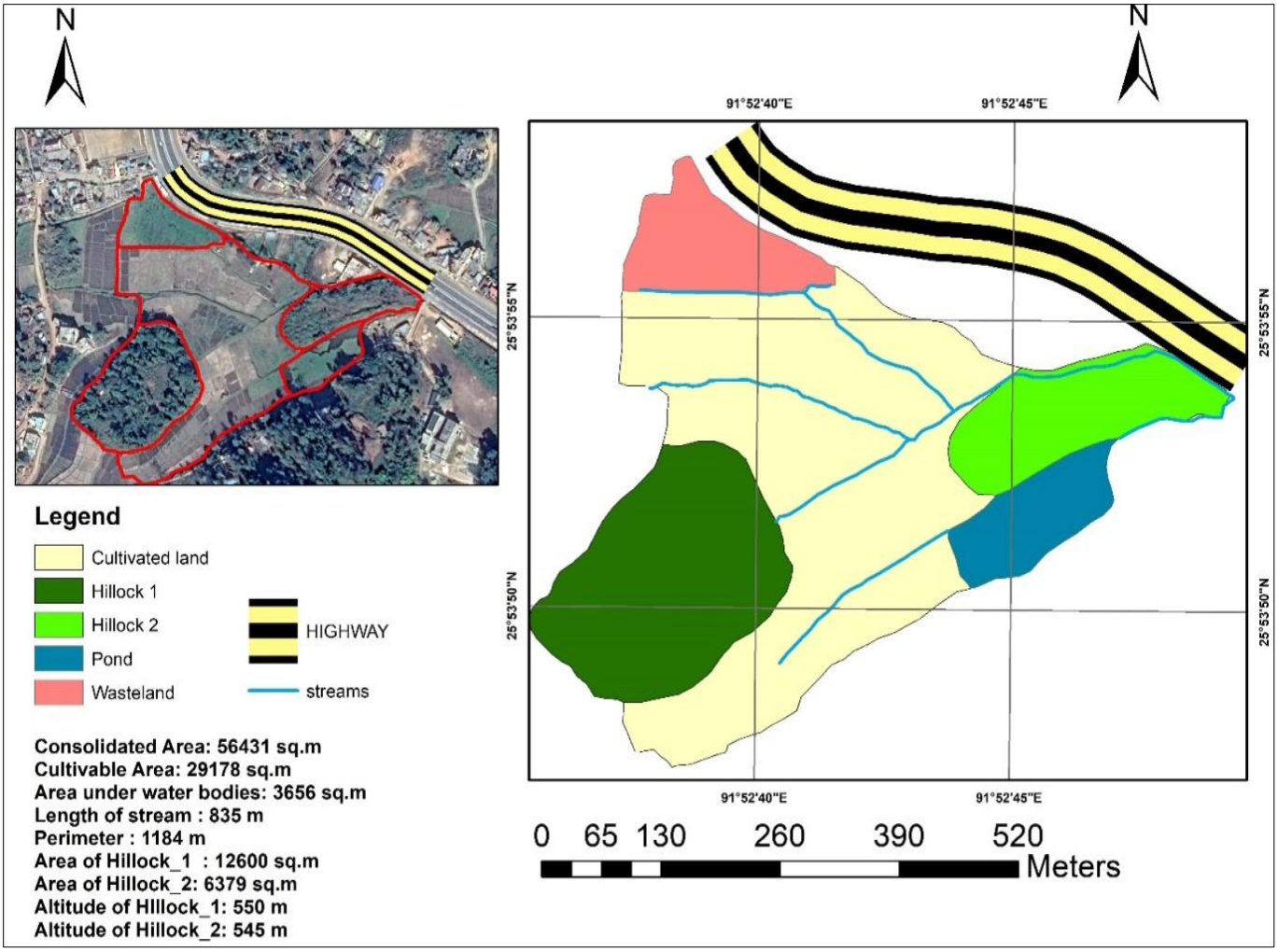

Fig 1: The thematic map of MFV

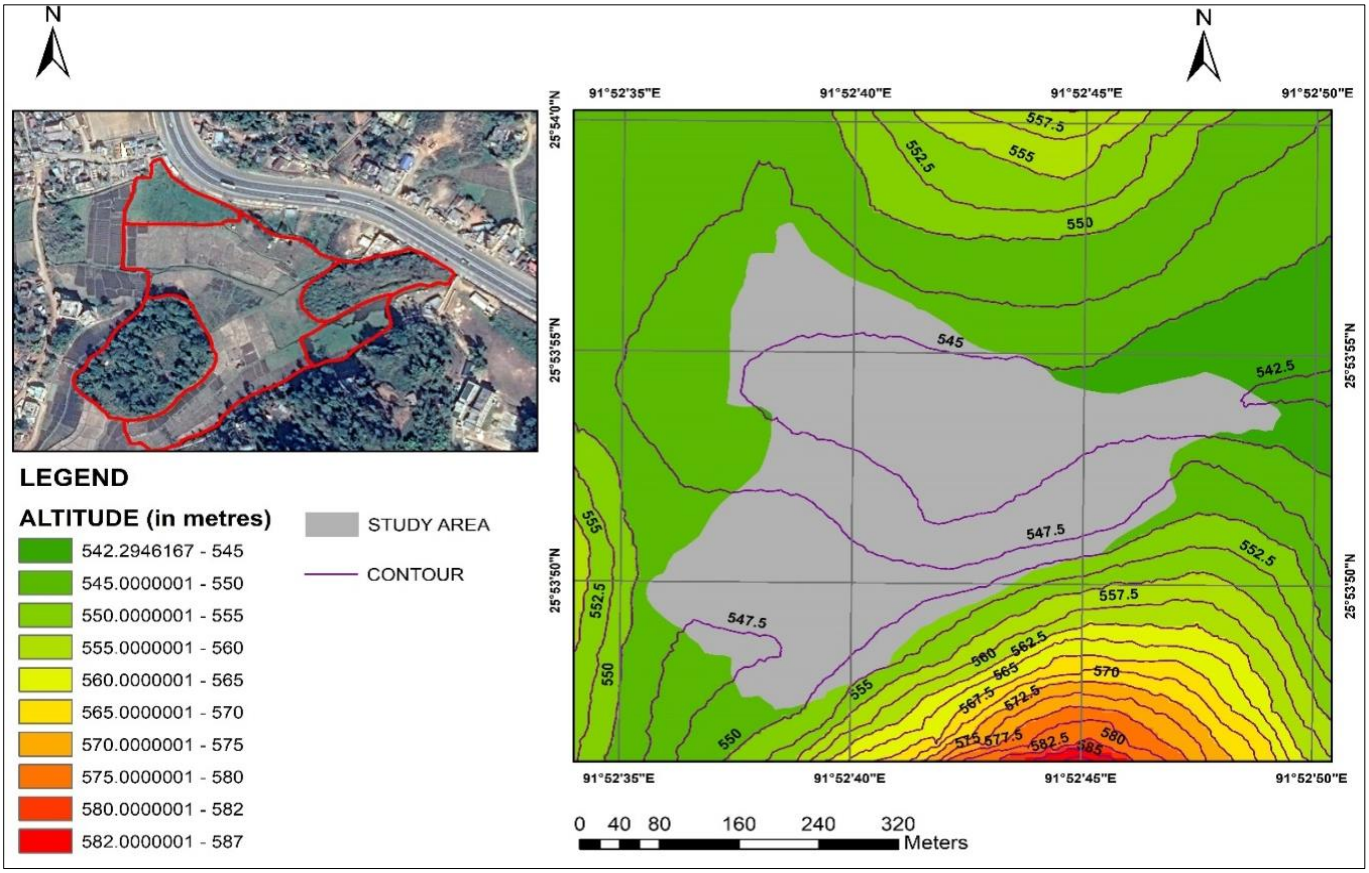

Fig 2: The topographic map of MFV

The research on validating the database apropos of participatory resource mapping and GIS two hypotheses have been formulated as follows:

H_0: There exist no valid difference in the database apropos of participatory resource mapping and GIS.

H_1: There exist a valid difference in the database apropos of participatory resource mapping and GIS.

Consequently, on employing Wilcoxon Signed Ranks Test for explicating the hypotheses, as supported by Table 2 and 3, it can be pronounced that the null hypothesis is rejected and the alternate hypothesis is accepted at the Wilcoxon T = 3.00, n = 9 and p = 0.021. It is further observed that the sum of positive difference ranks ($\sum R_+$ = 42.00) was larger than the sum of negative ranks ($\sum R_-$ = 3.00), demonstrating a positive and valid information of GIS database over the database of participatory resource mapping.

Table 2: Wicoxon Signed Ranks Test for testing validity of database apropos of GIS and participatory resource mapping database

		Ranks N	Mean Rank	Sum of Ranks
GIS - PAR	Negative Ranks	1[a]	3.00	3.00
	Positive Ranks	8[b]	5.25	42.00
	Ties	0[c]		
	Total	9		
a. GIS < PAR; b. GIS > PAR; and c. GIS = PAR				

(N.B. - Where, GIS = GIS database and PAR = participatory resource mapping database)

Table 3: Test Statistics of Wicoxon Signed Ranks Test for testing validity of database apropos of GIS and participatory resource mapping database

Test Statistics[a]	GIS - PAR
Z	-2.310[b]
Asymp. Sig. (2-tailed)	.021
a. Wilcoxon Signed Ranks Test	
b. Based on negative ranks.	

Conclusion

The study concludes that there remains a significant difference in the quantitative information derived from the Participatory Agro-Ecosystem Appraisal from farmers and GIS. Hence, any techniques of Participatory Rural Appraisal should be assessed for accuracy with the help of GIS tools and techniques. The researchers could observed that the farmers were empowered in their knowledge on their agro-ecosystems when the GIS database were shared and explicated.

Authors' Contributions

This work was carried out under the college extension programme of CPGS-AS, CAU (Imphal). Author 1 collected participatory rural appraisal, collected data, performed statistical analysis and wrote the manuscript. Author 2 designed the study, assisted in analysis of the study and refined the manuscript. All authors read and approved the final manuscript.

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