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# Improvising Climate Smart Agricultural Practices Using Design Thinking by Undergraduate Student of Agriculture under Central Agricultural University, Imphal: A Case of Social Network Analysis

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***Authors' contributions***

*This work was carried out in collaboration between both the authors. Author EK collected the data, performed the statistical analysis, wrote the protocol and first draft the manuscript. Author RJS designed the study, assisted in analysis of the study and refined the manuscript. Both authors read and approved the final manuscript.*

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## ABSTRACT

**Aims:** This study uses Social Network Analysis (SNA) to investigate the social interaction that shape student collaborative problem solving activity when undergoing Design Thinking (DT) to improvise Climate Smart Agricultural Practices (CSAPs).
**Place and Duration of Study:** The study was conducted at the three Colleges of Agriculture (CoAs) under Central Agricultural University, Imphal at Manipur *viz.,* the (1) CoA, Imphal at Manipur, (2) CoA, Pasighat at Arunachal Pradesh; and (3) CoA, Kyrdemkulai at Meghalaya. The study was conducted between November 2019 and February 2020.
**Methodology:** A sample of 28 respondents who constituted fifty percent of population of final year B.Sc. (Agriculture) students was selected through simple random sampling without replacement from the three CoAs. SNA of respondent-students was analyzed using Gephi 0.9.2 software with

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the following attributes to understand the student community *viz.,* average degree, modularity, average clustering coefficient and average path length.
**Results:** The network for CoA, Imphal displayed the following characteristic as 'Average Degree' of 5.69, 'Modularity' of 0.149, 'Average Clustering Coefficient' of 0.468 and 'Average Path Length' of 1.57. In case of CoA, Pasighat, the attributes of social network were as 'Average Degree' of 3.63, 'Modularity' of 0.513, 'Average Clustering Coefficient' of 0.099 and 'Average Path Length' of 1.52j; while for the case of CoA, Kyrdemkulai, it had 'Average Degree' of 3.86, 'Modularity' of 0.024, 'Average Clustering Coefficient' of 0.650 and 'Average Path Length' of 1.360.
**Conclusion:** For meaningful improvising of CSAPs using DT, the efficiency of social network was more functional on smaller collaborative working groups as information flow was found to be high in small groups leading to development of more ideas on DT.

*Keywords: Climate smart agricultural practices; colleges of agriculture; design thinking; social network analysis.*

## 1. INTRODUCTION

Agricultural education remains to be a key facilitator in transfer of technologies in developing countries where these technologies are geared towards solving problems which hinders farmers from achieving their objectives of maximizing agricultural productivity, key personnel are expected to address farmers issues, agricultural experts in this case (Undergraduate Students of Agriculture) need to adequately be equipped with skills to enable them to be the design thinkers who create workable solution in solving farmers oriented farming constraints.

The agricultural education models of the industrial era are no longer passable [1] as forthcoming businesses ought to be buttressed by agricultural students who possess 21$^{st}$ century competencies to decipher and resolve complex and ill-structured agricultural problems. Design Thinking (DT) is defined as a human centered problem solving approach whereby a professional grafts new solution while taking customers views to model innovation, whereby the solution is modelled through a five step processes namely, (1) Empathizing, (2) Defining, (3) Ideating, (4) Prototyping and (5) Testing of ideas before coming up with solution [2]. Such kinds of experiential learnings engross agricultural students to conceptualize artifacts on cognitive and conative domains, which in return intercede numerous styles of active erudition progressions. These DT based experiential learning procedures encompass agricultural graduates in recognizing and outlining glitches, exploring delinquencies and design spatial skills, creating and determining on ideas to peruse, penetrating and fusing relevant knowledge repositories, prototyping and assessing ideas and/or objects, and engaging in metacognitive replication of their DT progression [3]. In general, learning through DT provides rich opportunities for agricultural graduates to foster 21$^{st}$ century DT competencies [4].

During DT problems are typically solved through team works. Largely, communication and collaborative reasoning are indispensable parts while undergoing DT progression by students in a social setup. Critical comprehension of how exchange of ideas occurs in a social set up is important while undergoing design thinking. The SNA has gained popularity because of its ability to depict visual relationship, magnitude and strength of ties between individuals in asocial setup. The SNA, according to [5,6] is a combination of social network of organizations, persons, focus groups and their linkages mapped during exchange of information. Strong ties in a social network were found to be more beneficial for the exchange of knowledge and information [7]. Social network provided an opportunity for the student to interact with each other while sharing professional and personal information [8]. The SNA was used by [9] to measure students' collaboration, it revealed that the more the collaborative learning was, the stronger was the information network. The SNA was applied to generate socio-grams that showed patterns of information flow in climate change communication while identifying opinion leaders [10]. This study uses SNA to investigate the social interaction that shape student collaborative problem solving activity when undergoing DT to improvise CSAPs.

## 2. MATERIALS AND METHODS

### 2.1 Location of Study

The study was conducted at the three CoAs under Central Agricultural University, Imphal,

**Table 1. Description of network attributes in relation to current study**

| S. no | Network attributes | Description in relation to current study. |
|---|---|---|
| 1 | Average Degree | Average number of edges per node in the graph, it measures the connectedness in graph. |
| 2 | Modularity | Measure of structure of networks, divides network into functional modules each representing logical connectivity. |
| 3 | Average Clustering Coefficient | Measure of degree to which nodes in a graph tend to cluster together, high clustering coefficient mean high interaction among members in a social set up. |
| 4 | Average Path Length | Average number of steps along the shortest paths for all possible pairs of network nodes, it measures efficiency of information transfer within a network. |

Manipur *viz.,* the (1) CoA, Imphal at State of Manipur that was established in 1993, (2) CoA, Pasighat at State of Arunachal Pradesh which was established in 2015; and (3) CoA, Kyrdemkulai at State of Meghalaya which was established in 2015, respectively.

## 2.2 Sampling

Mixed-method sampling procedure was followed in the study. The three CoAs under CAU, Imphal had been chosen purposively as these institutes follow the latest curriculum as approved by 5$^{th}$ Deans' Committee of Indian Council of Agricultural Research (ICAR) in providing B.Sc. (Agriculture) degree. Subsequently, census of the students who were in their final year B.Sc. (Ag.) of the respective colleges had been performed on the following dates 18$^{th}$ of November, 2019; 15$^{th}$ of January, 2020 and 24$^{th}$ of February, 2020 thereby enabling to record the respective population of students be 26, 16 and 14. The scientific inquiry administered simple random sampling without replacement for selecting fifty percent of population thereby allocating the sample size be 13, 8 and 7 with respect to (1) CoA, Imphal, Manipur; (2) CoA, Pasighat, Arunachal Pradesh; and (3) CoA, Kyrdemkulai, Meghalaya.

The study followed Priority Ranking Matrix (PRM) in identifying five important CSAPs from each adopted villages of the respective colleges. Hence, the most important five CSAPs at CoA, Imphal, Manipur were: (1) Integrated Agriculture and Animal Based Farming Systems (IAABFS), (2) Soil Testing & Amelioration of Problem Soil (STAPS), (3) Micro Irrigation for High Volume Horticultural Crops (MIHVHC), (4) Rain Water Harvesting (RWH), and (5) Conservative Cultivation of Kharif and Rabi Crops (CCKRC). In case of CoA, Pasighat, the most important five CSAPs were: (1) Agro-horti-animal husbandry IFS (AHAHIFS), (2) Taungya System of Cultivation (TSC), (3) Rain and Pond Based Water Conservation (RPBWC), (4) Compost Making of Local Biomass (CMLB) and (5) Minimum Tillage of Soil (MTS). The most important five CSAPs at CoA, Kyrdemkulai were: (1) Cultivation of Stress Tolerant Varieties (CSTV), (2) Raised & Sunken Bed Technology (RSBT), (3) Conservative Cultivation in Horticultural Crops (CCHC), (4) Rain-Fed Vegetable Cropping system (RFVCS) and (5) Access to Agro-Advisory Services Provided by State Department of Agriculture (AAASPSDA).

## 2.3 Data Analysis

In order to examine the structure of information and ideas exchange in the social network among the students while undergoing DT, the SNA has been performed using the software Gephi 0.9.2. The social network among students on DT in the study incorporated the social network attributes *viz.,* average degree, modularity, average clustering coefficient and average path length.

## 3. RESULTS AND DISCUSSION

### 3.1 Social Network of Student-Respondents of CoA, Imphal under CAU, Imphal

It is clearly witnessed in the Fig. 1 that the student-respondent Vaulalhriatrenga and Ningombam Niranjit had highest and lowest 'Indegree' values of 9 and 2 respectively, in other words, Vaulalhriatrenga was always consulted by nine of his colleagues, while Ningombam Niranjit was every time consulted by only two students in dealing DT on CSAPs for farmers in the college and in farmers' field. With the 'Average Degree' of 5.69 in the SN of student-respondents, as depicted in Table 2, it implied that the average

number of students per node was around five persons. The 'Modularity' of 0.149 hinted that the strength of division of network into modules was very less which was around fifteen percent only. The 'Average Clustering Coefficient' of 0.468 inferred the degree of around forty seven percent in the network to which a student-respondent tend to cluster together on application of DT on CSAPs. The 'Average Path Length' of 1.57 depicted the efficiency on transaction of information in DT on CSAPs in the social network happened to be around two students only.

**Table 2. Attributes of social network of student-respondents of CoA under CAU Imphal**

| S. no | Network attributes | CoA. Imphal values | CoA. Pasighat values | CoA. Kyrdemkulai values |
|---|---|---|---|---|
| 1 | Average Degree | 5.69<br>(1 - 12) | 3.63<br>(1 - 7) | 3.86<br>(1 - 6) |
| 2 | Modularity | 0.149<br>(0 - n) | 0.513<br>(0 - n) | 0.024<br>(0 - n) |
| 3 | Average Clustering Coefficient | 0.468<br>(0 - 1) | 0.099<br>(0 - 1) | 0.650<br>(0 - 1) |
| 4 | Average Path Length | 1.57<br>(1 - 3) | 1.52<br>(1 - 3) | 1.360<br>(1 - 2) |

*N.B. – The numerals inside the first parenthesis indicates the range*

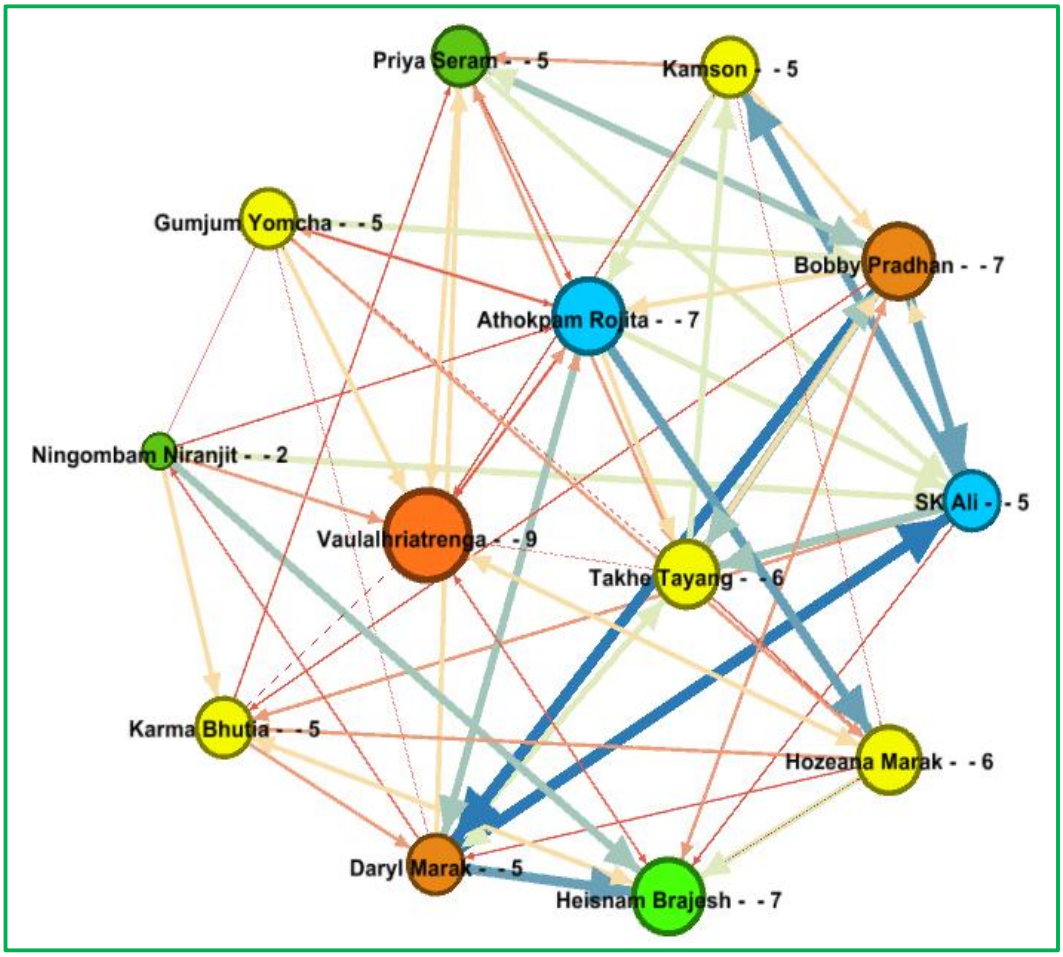


**Fig. 1. Sociogram of student-respondents of CoA, Imphal**

### 3.2 Social Network of Student-Respondents of CoA, Pasighat under CAU, Imphal

It is clearly witnessed from the Fig. 2 that the student-respondent Dignium had highest 'Indegree' value of 6 and Nancy & Nihar Jamatia had lowest 'Indegree' value of 2 equally. In other words, Dignium was always consulted by six of his colleagues, while Nancy & Nihar Jamatia were every time consulted by only two students in dealing DT on CSAPs for farmers in the college and in farmers' field. With the 'Average Degree' of 3.63 in the SN of student-respondents, as depicted in Table 2, it implied that the average number of students per node was around three persons. The 'Modularity' of 0.513 hinted that the strength of division of network into modules was moderate which was around fifty one percent. The 'Average Clustering Coefficient' of 0.099 inferred the degree of around nine percent in the network to which a student-respondent tend to cluster together on application of DT on CSAPs. The 'Average Path Length' of 1.52 depicted the efficiency on transaction of information in DT on CSAPs in the social network happened to be around two students only.

### 3.3 Social Network of Student-Respondents of CoA, Kyrdemkulai under CAU, Imphal

It is clearly witnessed from the Fig. 3 that the student-respondent Ziljia Moirangthem had highest 'Indegree' value of 6 and five student-respondents *viz.,* Ningthoujam Birjit Singh, Lalhruaitluangi Sailo, Sumita Mog, Amchi Christbya Marak and Jerrycan Dkhar had lowest 'Indegree' value of 3 equally. In other words, Ziljia Moirangthem was always consulted by six of his colleagues, while the five student-respondents were every time consulted by only three students in dealing DT on CSAPs for farmers in the college and in farmers' field. With the 'Average Degree' of 3.86 in the SN of

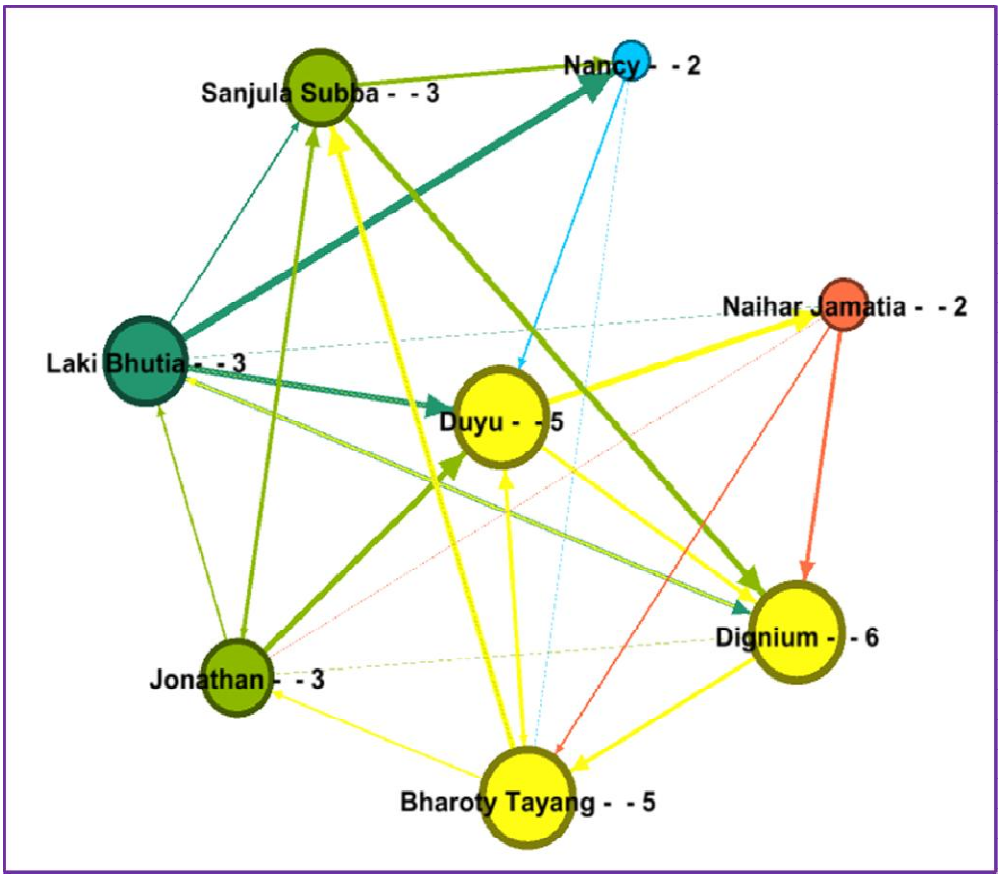


**Fig. 2. Sociogram of student-respondents of CoA, Pasighat**

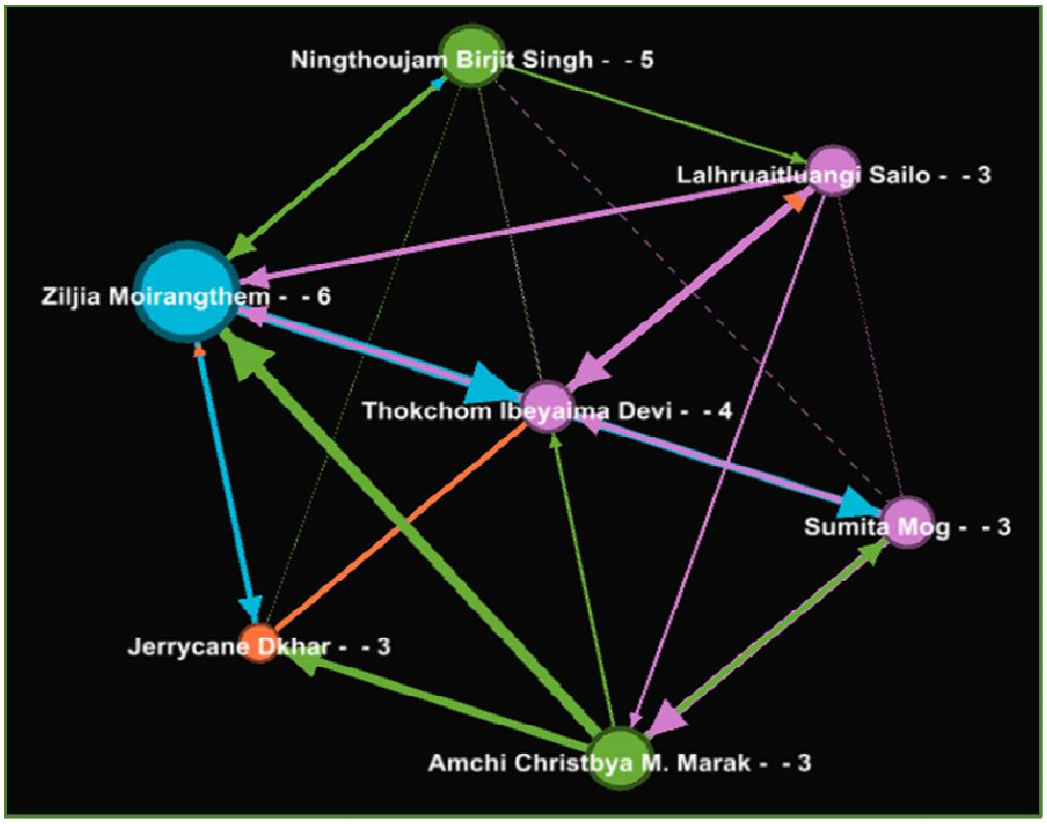


**Fig. 3. Sociogram of student-respondents of CoA, Kyrdemkulai**

student-respondents, as depicted in Table 2, it implied that the average number of students per node was around four persons. The 'Modularity' of 0.024 hinted that the strength of division of network into modules was very low which was around two percent only. The 'Average Clustering Coefficient' of 0.650 inferred the degree of around sixty five percent in the network to which a student-respondent tend to cluster together on application of DT on CSAPs. The 'Average Path Length' of 1.360 depicted the efficiency on transaction of information in DT on CSAPs in the social network happened to be around one student only.

## 4. CONCLUSION

The study concluded that the smaller the number of individuals in a social network was, the higher was the efficiency of information flow; and hence more ideation for collaboration and team work can be fully exploited in developing prototypes of CSAPs by the undergraduate B.Sc.(Agriculture) students when they are in a group of 3 students. The study recommended that members in a social setup could be subdivided into small groups having less members to fully participate in problem solving using Design Thinking technique.

Glossary; {Climate Smart Agricultural Practices (CSAPs), Colleges of Agriculture (CoAs), Design Thinking (DT), Social Network Analysis (SNA)}

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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