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Construction of a composite index to assess the agricultural development of tribal farmers under Tribal Sub-Plan in Meghalaya

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ABSTRACT

Tribal Sub-Plan (TSP) project was implemented by Central Agricultural University (CAU), Imphal during the crop year 2016-17 in two agriculturally important districts of Meghalaya namely Ri-Bhoi district and West Garo Hills district to improve the livelihood status of the tribals. The general objective of the project was to enhance the socio-economic status and livelihood security of the tribal farmers of the state. The beneficiary farmers were provided with different kinds of inputs and trainings. The aim of the study was to study construct a composite index called Tribal Agricultural Development Index (TADI) to assess the performance of TSP. A total of 390 respondents were selected for the study through complete enumeration of beneficiary farmers under TSP from five villages each from Umsning, Ri-Bhoi district and Rongram, West Garo Hills district Community and Rural Development Blocks (CRDBs). The result indicated that there was moderate (70.77 %) achievement in all the domains of TSP.

1. Introduction

The North Eastern part of India comprises of different ethnic group of people. The region faces different kinds of challenging endeavours compared to mainland India. The growth potential of hill agriculture has remained under-exploited due to lack of technologies, poor infrastructure, and underdeveloped institutions, difficult terrains, inaccessible habitations, diverse sociocultural and agricultural typologies, and small, scattered and fragmented land holdings (Brithal 2010). A multitude of developmental programs such as Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), National Rural Livelihood Mission (NRLM), Training of Rural Youth for Self-Employment (TRYSEM) etc have been introduced to improve the livelihood status of the people of the state. The impact of such programs in the region were documented in some earlier studies *viz.,* Tabrez *et al.* (2019) in his study conducted in Meghalaya found that there was 20.79 per cent increase in income, after getting wage employment from MGNREGA. In the same line the impact of other programs also need to be assessed. Therefore, Tribal Sub-Plan (TSP) is one of the important projects of the tribals implemented in Meghalaya. According to Chambers and Conway (1992), "a livelihood comprises of capabilities, assets (resources, claims, and access) and activities required for a means of living". The main focus of TSP project is to bring a stable economic condition among the tribals population so as to bring them at par with the rest of the society. It provides income-generating inputs to enhance the income of the people by considering their ability and skill.

The present paper discusses the TSP project which was executed by Central Agricultural University (CAU), Imphal during the crop year 2016-17 in two agriculturally important districts of Meghalaya namely Ri-Bhoi District and West Garo Hills District. The general objective of executing the project was to enhance the socio-economic status and livelihood security of the tribal farmers of the state through need-based agricultural technological interventions. Under this project, the beneficiary farmers were provided with different kinds of inputs such as seeds, planting material, agricultural equipment, livestock, fingerlings, poly-house unit, mushroom unit, vermicomposting unit, *etc.* free of cost. Training were conducted by the experts from Central Agricultural University (CAU) and Indian Council of Agricultural Research (ICAR) to the beneficiary farmers on scientific utilization of the inputs before the distribution of

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the inputs. This enabled the farmers to be aware of new methods of farming. They also gained knowledge regarding the use of the inputs and management of crops and livestock to get optimum output and remunerative income. Regular meetings were also conducted so that the beneficiary farmers could share their problems. Frequent visit by the experts was also made to the respective fields of the farmers as a follow up of the project.

Therefore, the present paper aims to study the performance of TSP project implemented by CAU, Imphal in Meghalaya through construction of a composite index called the Tribal Agricultural Development Index (TADI).

2. Materials and methods

The study was conducted in Meghalaya, which is one of the seven sister states of North East India. Geographically, it is a hilly state with some valley areas which stretches between a latitude of 25° 07'N to 25° 41'N, and longitude of 91°21'E to 92°09'E. The state covers an area of 22429 sq.km. which constitute about 0.68 per cent of the total land surface of India with a population of 29,66,889 (Government of Meghalaya 2017). A large part of the economy of Meghalaya is occupied by the agricultural sector. It is the main source of livelihood of the people in the state, and also a traditional way of life. During the year 2014-15, the total cropped area was 343431 ha. Forest occupies about 946201 ha of the total geographical area of the state (Government of Meghalaya 2017). The income of the farmers is also supported by various livestock rearing activities and fisheries.

From Meghalaya, Umsning and Rongram Community and Rural Development Blocks (CRDBs) were selected from Ri-bhoi district and West Garo Hills district. Five villages from Umsning CRDB were selected *viz.,* (i) Palwi, (ii) Mawlein Mawkhan, (iii) Liarkhla, (iv) Sumer No. 4, (v) Khweng. Similarly, five villages from Rongram CRDB were selected *viz.,* (i) Rangwalkamgre, (ii) Dumitdikgre, (iii) Galwang Chidekgre, (iv) Edenbari (v) Sanchonggre respectively. All the study areas for the research were purposively selected owing to the existence of College of Post Graduate Studies in Agricultural Sciences (CPGSAS) and College of Home Science (CoHSc) under CAU, Imphal where the TSP was being deployed. A complete enumeration of beneficiaries of TSP project of CAU (I) in the entire ten villages under different commodities were selected as respondents. Thus, a total of 270 and 120 beneficiary farmers were selected from Ri-bhoi district and West Garo Hills district, making a total of 390 respondents.

The data was collected during 2018-2019 using survey method. Pretesting of the questionnaire was also conducted to ensure relevancy of the questions to be asked to the respondents. The data collection was done by the researcher with the help of two translators as the language in the study area was foreign to her. The translator were properly trained to help collect data from the study area to minimise bias result. The survey was conducted at the household level and structured questionnaire was used. All the questions were based on the specific inputs received through TSP project.

Based on the inputs received, the categories of domains include Crop, Birds, Fishery, Livestock, Farm Equipment, and Multiple. There are several methodologies for the construction of a composite index. One such methodology described by Nardo *et al.* (2008) is one of the most significant. Steps such as weighting and aggregation were the most significant steps among its several steps. Therefore, based on the various methodologies used to construct composite indices (Brahmachary 2014; Wiréhn *et al.* 2015; Steinert *et al*. 2016; Greyling and Tregnna 2016; Monteiro *et al*. 2018), a composite index was constructed consisting of five steps *viz.,* identification and selection of indicators, identification of sub-indicators, normalization, weighting, and summarization. Based on the content of TSP, five sub-indices were identified viz. (A) Economic, (B) Technological, (C) Farming, (D) Capacity Building, and (E) Climate Smart Agricultural Practice.

Table 1. List of indicators and sub-indicators with their empirical measurement

S. No.	Indicators	Component of Indicators	Measurement
1	Economic	Operational farm area	In hectors
		B:C ratio	Ratio scale
		Ownership of equipment	One point each for the possession of farm equipment
2	Technological	Availability of inputs	Rating
		Knowledge level	Rating
3	Farming	Farming system	Dichotomous score
		Cropping system	Dichotomous score
		Type of crop enterprise	One point each for the major crop grown
		Farm animal (birds/livestock) composition	Total number of farm animals (birds/livestock)

		Fishery composition	Dichotomous score
4	Capacity building	Training program attended	In numbers
		Problem solving capacity	Rating
		Skill development	Rating
5	Climate smart agricultural practices	Awareness	Dichotomous score
		Usage of adaptation strategies	Rating

For normalisation, Max-Min feature scaling was used. The method brings all the values to the range of [0,1]. It is also called unity-based normalisation. The present study used equal weights assignment method, and statistical procedures *viz.,* Principal Component Analysis (PCA) to assign weights. Nardo *et al*. (2008) described the detailed procedure for the use of PCA as weights. One of the most famous rules called the Kaiser's criteria was used to determine the number of PCs to be retained. In the last step, the composite Tribal Agricultural Development Index (TADI) was developed by aggregating all the indicators. The overall index for the respective dimension was formed by simply taking their weighted averages. This method was applied because it is transparent, easy to use, and understand, and also the most common form of aggregating. The formula representing the overall index is given by:

$$TADI_j = \frac{\sum_{i=1}^{n} |W_i| X_{ij}}{\sum_{i=1}^{n} |W_i|}$$

Where

$TADI$ is a composite index

W_i is the weight of the indicator

X_{ij} is the indicator value for the i^{th} indicator and j^{th} domain

The intermediate composite index *viz*. Economic Index (EI), Technological Index (TI), Farming Index (FI), Capacity Building Index (CBI), and Climate Smart Agricultural Practices Index (CSAPI), were calculated by giving equal weights and summarized by using the weighted averages technique. The index was then worked out for the six domains mentioned above.

The respective TADI domains and overall TADI were finally categorized into three categories based on equal intervals of class between the minimum, and maximum obtainable range of index score which is 0 to 1.

S. No.	Category	Class intervals
1	Low	[0.1 – 0.4)
2	Medium	[0.4 – 0.7)
3	High	[0.7 – 1.0)

3. Result and discussion

The list of beneficiary farmers along with the inputs received through TSP was listed out by analysing the written records and confirming from the individual farmers through data collection. These beneficiary farmers were the respondents for the present study. The names of all the different kinds of inputs were Paddy, Pea, Ladies Finger, Chili, Coriander, Ginger, Potato, Arecanut, Assam Lemon, Litchi, Poultry chicks, Ducklings, Piglets, Dairy animals, Goats, Rabbits, Fingerlings, Polyhouse unit, Mushroom unit, Vermicompost unit, Knapsack Sprayer, Storage bins, Water pump, Gravity fit drip irrigation set, *etc.* Specifically mentioning all the name of the inputs, and analyzing the study based on the individual input was quite perplexing, and disorienting as there were too many types of input. Therefore, similar kinds of inputs were put under one domain to represent the respective domain. This gave rise to six main domains *viz.,* Crop, Birds, Livestock, Fishery, Farm equipment and Multiple Inputs. Again, during the time of input distribution, each farmer was given only one input but during the time of the survey, it was found that some of the farmers have used multiple inputs. On investigating the matter, it was found that through farmer-farmer extension the farmer has access to multiple inputs. Such farmers were again placed in another domain called Multiple inputs domain.

Figure 1 shows the intersection of different kinds of the domain which appropriately indicates the domain Multiple inputs. It was found that highest percent of beneficiaries were from crop domain (27.69%), followed by multiple inputs (24.11%), livestock (19.74%) and so on (Table 1).

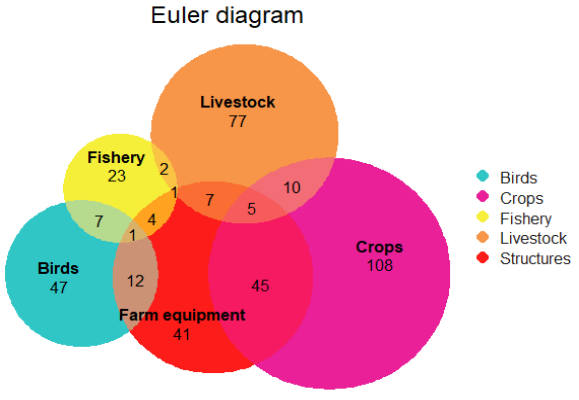

Figure 1. Number of beneficiary farmers with respect to inputs received

Table 2. Distribution of beneficiary farmers with respect to the inputs received

Sl. No.	Domains	Number of farmers	Percentage
1	Crop	108	27.69
2	Birds	47	12.05
3	Fishery	23	5.90
4	Livestock	77	19.74
5	Farm equipment	41	10.51
6	Multiple inputs		
	Crop + Livestock	10	2.56
	Livestock + Fishery	2	0.51
	Crop + Farm equipment	45	11.54
	Livestock + Farm equipment	7	1.80
	Fishery + Farm equipment	4	1.03
	Fishery + Birds	7	1.80
	Birds + Farm equipment	12	3.07
	Crops + Farm equipment + Livestock	5	1.28
	Fishery + Birds + Farm equipment	1	0.26
	Fishery + Farm equipment + Livestock	1	0.26
	Total	94	24.11
7	Total	390	100

Performance of TADI through Tribal Agricultural Development Index (TADI)

The performance of TSP was evaluated with the help of TADI, a composite index and the reliability of the constructed composite index was tested using Chronbach's alpha whose value was 0.701.

The distribution of data across different domains could be understood from Table 2. The higher the index value the better the performance of TSP. According to the index, the domain fishery has outperformed other domains. But seeing the frequency in crop domain and multiple inputs, both have outperformed other domains with majority of them being in the [0.4, 0.7) index category. The domain birds also showed fairly high index values. The rest of the other domain gained moderate scores.

Table 3. Distribution of respondents on TADI scores with respect to different domains

Sl.No	Domain	Index category	Frequency	Percentage
1	Crop	Low	25	23.15
		Medium	83	76.85
		High	0	0
2	Birds	Low	7	14.89
		Medium	40	89.11
		High	0	0
3	Farm equipment	Low	15	36.59
		Medium	26	63.41
		High	0	0
4	Livestock	Low	37	48.05
		Medium	40	51.95
		High	0	0
5	Fishery	Low	1	4.35
		Medium	20	86.96
		High	2	8.7
6	Multiple Inputs	Low	26	27.66
		Medium	67	71.28
		High	1	1.06

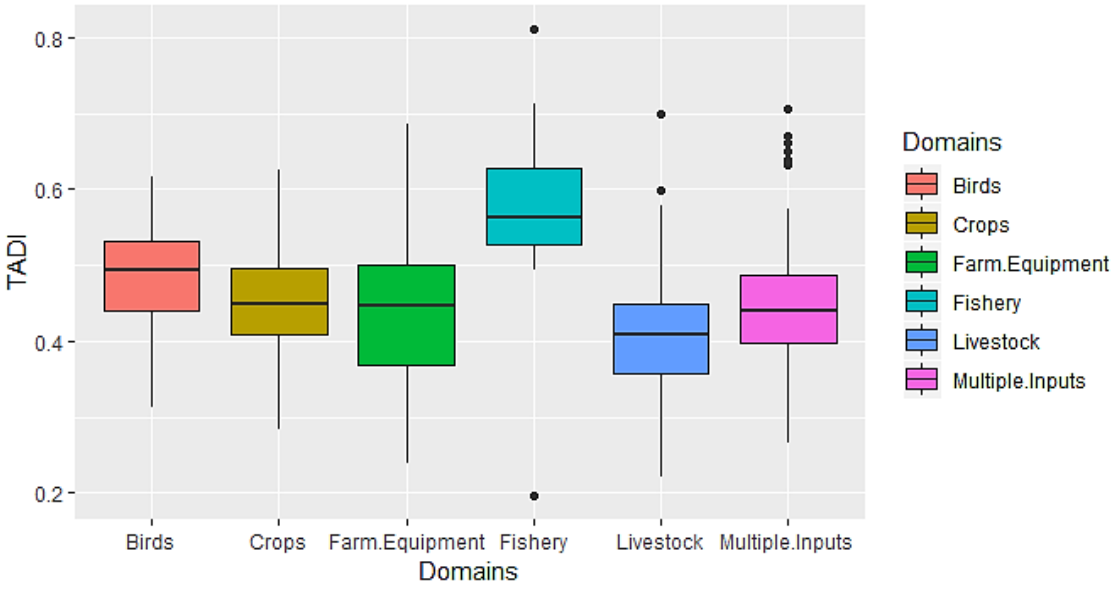

Figure 2. Box and whisker plot on TADI scores for different domains of TSP

The box and whisker plot (Fig. 2) also revealed that there were some outliers present in the domain fishery, livestock and multiple inputs. This might be the reason for some respondents falling in the low or high category in the fishery and multiple inputs. Also, majority of the farmers in all the domain showed medium level, [0.4, 0.7) of TADI scores. Because of the unequal number of beneficiary farmers in each category, it is quite hard to establish which domain was performing well above the others. Therefore, it could be concluded that there was moderate achievement in all the domains. Overall, 70.77 per cent of respondents have scored between [0.4, 0.7) and very few respondents have scored above 0.7(figure 3).

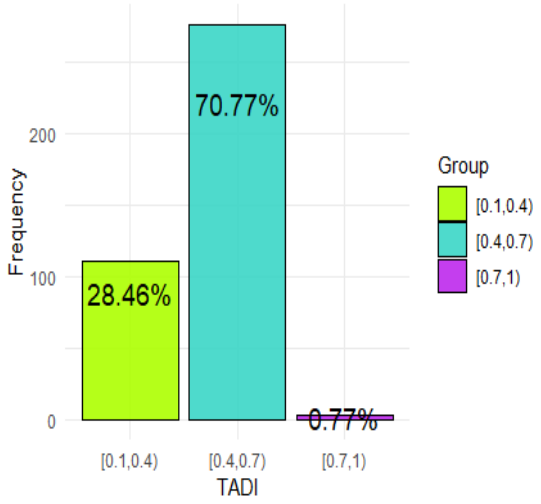

Figure 3. Distribution of respondents on TADI scores for overall domains of TSP

4. Conclusion

Under TSP, the beneficiary farmers received numerous inputs like seeds, seedlings, livestock, birds, equipment, *etc.* Since the inputs *viz*., Paddy, Pea, Ladies Finger, Chili, Coriander, Ginger, Potato, Arecanut, Assam Lemon, Litchi, Poultry chicks, Ducklings, Piglets, Dairy animals, Goats, Rabbits, Fingerlings, Polyhouse unit, Mushroom unit, Vermicompost unit, Knapsack Sprayer, Storage bins, Water pump, Gravity fit drip irrigation set, *etc.* For ease of study these were classified into six domains *i.e.,* Crop, Birds, Livestock, Fishery, Farm equipment, and Multiple Inputs. Highest per cent of farmers belongs to the domain crop, followed by multiple inputs, livestock, birds, farm equipment and fishery. The domain fishery has outperformed other domains. From, the point of view of frequency in crop domain and multiple inputs, they both have outperformed other domains. Further, the domain birds also showed fairly high index values while the other domain gained moderate index value. Overall, majority of the respondents (70.77%) scored medium TADI values when observed about the performance of TSP project.

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