Factors Enhancing Rice Production in Manipur

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Abstract: Indian Easternmost State internationally bordering with Myanmar, Manipur has rice production as major livelihood and other natural resources are taking very low contribution to NSDP. Henceforth, the factors contributing in enhancement of the agriculture production have to be identified so as to gear up the sustainable development in that state. **Objectives:** It aims to identify the factors of rice crop associated with various socio-economic and agro-climatic conditions of Manipur. **Materials and Methods:** Based on a primary data, the variations in agricultural productions particularly that of rice has been examined by using principal component analysis to identify the high contributing, factors on the rice production. **Findings:** Out of fifteen principal components, only six principal components are selected to be total variance extracted from the empirical data being 1 and greater. The total variance extracted by the first principal component is 3.01(20.1%) and other components' variances are varying from 6.8% to 11.4%. Findings show that the analysis carried out in the existing data is quite satisfactory.

Keywords: principal component, primary data, extracted variance, Manipur.

1. Introduction

Manipur is far from north-eastern corner of India. Rice is the staple food of this state. So, rice production should be increased to be a sustainable food for the people of this region. In the light of this discussion, an attempt has been made to detect and identify the factors of production of rice crop. In Manipur, due to the existence of different topographic, socio-economic, agro-climatic conditions and because of its isolated position where agricultural development is a snail's face, the problem to be considered is supposed to be handled and dealt with in the light of the prevailing conditions and factors of the state. Due to lack of manpower and scientific and technological facilities, systematic and periodical reliable data cannot be found in this isolated state. Consequently, many relevant data cannot be properly utilized and identified in this region. For instance, scientific irrigation facility is almost nil in Manipur. A large number of crop studies have been developed for all major crops in conjunction with modern adequate technological tools that facilitated analyses for sustainability options for agricultural development. However, these existing studies cannot appropriately utilize due to the lack of technological tools in Manipur socio-economic and agro-climatic conditions. Accordingly, the existing works are quite initial and have to be modified, to bring about adequate analysis and to suit the prevailing conditions of this region as well as to enable us to carry out formal mathematical analysis using relevant sophisticated data for future strategy of agricultural development in this predominantly rural and agrarian state. Keeping in mind the necessity of a reasonably justifiable and workable mathematical approach that fulfils the essentialities, the new research work has been developed.

2. The Definition of Variables and Measurements

X_{i1} = Age of the i^{th} farmer in years,
X_{i2} = Year of schooling of the i^{th} farmer,
X_{i3} = Size of the family for the i^{th} farmer,
X_{i4} = Area under tenant operated by the i^{th} farmer in hectare,
X_{i5} = Area under owner operated by the i^{th} farmer in hectare,
X_{i6} = Area under double cropping of the i^{th} farmer.
X_{i7} = Irrigated area of the i^{th} farmer (if any) in hectare,
X_{i8} = Quantity of fertilizers consumed by the i^{th} farmer in kilograms,
X_{i9} = Area under modern High-Yielding Variety in the i^{th} farm in hectare,
X_{i10} = 1, if the soil of the i^{th} farmer has been tested,
= 0, otherwise,
X_{i11} = Quantity of farmyard manure applied to the i^{th} farm (per load of bull card),
X_{i12} = Distance of market from the i^{th} farmer's residence,
X_{i13} = Amount of loan availed by the i^{th} farmer from any govt. recognized agency, etc.,
X_{i14} = Cost of cultivation excluding fertilizer cost incurred by the i^{th} farmer,
X_{i15} = Monthly family income of the i^{th} farmer in rupees.

3. Method of Analysis

(I). The sampling frame

In order to carry out the analysis, we collect the cross-sectional data by preparing a pre-designated questionnaire method is used. The sampling design of this crop survey is a stratified two stage sampling scheme of equal size suggested by Cochran (1977). With the blocks of Imphal West District as strata, villages in the blocks as the primary sampling unit and farmers of experimental site of the selected villages as the ultimate second stage sampling unit. The data used in the study were from the survey of 795 farms in 43 villages.

(II). Analysis Carried Out.

Table-1
Communalities

Variables	Initial	Extraction
X_{i1}	1.000	0.752
X_{i2}	1.000	0.744
X_{i3}	1.000	0.640
X_{i4}	1.000	0.911
X_{i5}	1.000	0.852
X_{i6}	1.000	0.550
X_{i7}	1.000	0.337
X_{i8}	1.000	0.739
X_{i9}	1.000	0.688
X_{i10}	1.000	0.508
X_{i11}	1.000	0.485
X_{i12}	1.000	0.532
X_{i13}	1.000	0.656
X_{i14}	1.000	0.658
X_{i15}	1.000	0.470

Each communality (in the above Table-1) represents the proportion of variance in the corresponding variable and is accounted for by the fifteenth components (1, 2, 3, ..., 15), i.e., 75.2% of the variance in variable X_{i1} is accounted for by the fifteen(15) principal components [and the remaining 24.8% of the total variance in variable X_{i1} scores is thought of as being made up of two parts: a factor component specific to the attribute represented by variable X_{i1}, and a portion due to errors of measurement involved in the assessment of variable X_{i1} (but there is no mention of these portion in the above table because we usually concentrate on common variance in this analysis)].Similarly, others are interpreted as above.

Based on the variance extracted by the principal components in variables, the variables are listed in the Table-2 below:

Table-2

Variables	Initial	Extraction
X_{i4}	1.000	0.911
X_{i5}	1.000	0.852
X_{i1}	1.000	0.752
X_{i2}	1.000	0.744
X_{i8}	1.000	0.739
X_{i9}	1.000	0.688
X_{i14}	1.000	0.658

X_{i13}	1.000	0.656
X_{i3}	1.000	0.640
X_{i6}	1.000	0.550
X_{i12}	1.000	0.532
X_{i10}	1.000	0.508
X_{i11}	1.000	0.485
X_{i15}	1.000	0.470
X_{i7}	1.000	0.337

Table-3
Total Variance Explained

Components	Initial Eigen-values		
	Total	% of Variance	Cumulative %
1	3.014	20.093	20.093
2	1.716	11.440	31.533
3	1.391	9.274	40.807
4	1.298	8.653	49.460
5	1.081	7.209	56.669
6	1.020	6.799	63.467
7	0.988	6.587	70.054
8	0.820	5.465	75.519
9	0.807	5.379	80.897
10	0.780	5.203	86.101
11	0.675	4.498	90.599
12	0.517	3.446	94.045
13	0.417	2.782	96.828
14	0.331	2.209	99.036
15	0.145	0.964	100.00

The above Table-3 gives information about the usefulness of the fifteen components in explaining the relations among the fifteen variables. In this study the total variance, V=15 (equal to the number of variables involved on the presumption that variables are standardised or normed). The common variance (Eigen-value) gives the numerical value of that portion of the variance attributed to the components in the concerning variables accordingly. The total variance i.e., 15(fifteen) is partitioned into 3.014 as eigen-value for component-1, 1.716 as eigen-value for component-2 and similarly so on. Out of these, only six components are selected as the variance extracted being 1 and greater [by the criterion of 'root greater than one' by Kaiser (1958)].

The corresponding proportion of the total variance 15.0 are shown in the table-4 below:

Table-4

Component	Eigen-values (Variances accounted for i.e., common variances): λ_i	Proportion of total variance	Proportion of common variance
1	3.014	0.2009 (20.09%)	0.3166 (31.66%)
2	1.716	0.1144 (11.44%)	0.1803 (18.03%)
3	1.391	0.0927 (9.27%)	0.1461 (14.61%)
4	1.298	0.0865 (8.65%)	0.1363 (13.63%)
5	1.081	0.0721 (7.21%)	0.1136 (11.36%)
6	1.020	0.068 (6.8%)	0.1071 (10.71%)
Total	9.52	0.6347 (63.47%)	1 (100%)

It can be noticed that 63.47% of the total variance is related to these six components i.e., approximately 63.47% of the total variance is common variance whereas remaining 36.53% of it is made up of portions unique to individual variables (and the techniques used to measure them).

The last column (table-4) shows that the proportion of the common variance approximately 31.66% is accounted for by the component 1 and 18.03% by the component 2, and the remaining 14.61%, 13.63%, 11.36% and 10.71% by the components 3, 4, 5 and 6 respectively. Thus, it can be concluded that the six (6) components together explain the common variance.

Table-5

Component (loading) Matrix

Variable	Component					
	1	2	3	4	5	6
X_{i1}	0.169	0.061	0.383	0.754	-0.057	-0.013
X_{i2}	0.113	-0.471	-0.473	-0.443	0.299	0.097
X_{i3}	0.341	-0.133	0.109	0.274	0.632	0.141
X_{i4}	0.129	0.863	-0.361	0.001	0.135	0.006
X_{i5}	0.576	-0.652	0.239	0.012	-0.189	0.032
X_{i6}	0.151	0.056	0.603	-0.387	-0.101	-0.019
X_{i7}	0.388	0.371	0.154	-0.033	-0.011	-0.155
X_{i8}	0.818	0.178	-0.144	-0.036	-0.112	0.052
X_{i9}	0.803	0.072	-0.118	-0.008	-0.157	0.011
X_{i10}	0.097	-0.120	0.094	0.099	0.489	-0.538
X_{i11}	0.235	-0.243	-0.397	0.200	-0.399	-0.117
X_{i12}	0.155	0.189	0.474	-0.471	0.104	0.121
X_{i13}	-0.015	-0.019	-0.017	0.105	0.053	0.801
X_{i14}	0.788	0.097	-0.023	-0.125	-0.093	-0.046
X_{i15}	0.557	-0.074	-0.088	0.084	0.361	0.098

From the above table-5, the first principal component has loadings in excess of 0.33 (to be the minimum of absolute value) on seven (7) variables and is taken to represent whatever it is that seven (7) of the variables have in common. [We might consider all the seven variables to be the product of some unobserved variable (which can be named subjectively by the researcher considering the nature of his study). The factor name is chosen in such a way that it conveys what it is that seven (7) variables that correlate with it (that "load on it") have in common].

Similar arguments arise for the varying variables i.e., four (4), six (6), four (4), four (4) and two (2) for the second, the third, the fourth, the fifth and the sixth principal components respectively.

4. Conclusion

The high contributing factors (variables) on rice crop can be arranged in descending order as X_{i4}, X_{i5}, X_{i1}, X_{i2}, X_{i8}, X_{i9}, X_{i14}, X_{i13}, X_{i3}, X_{i6}, X_{i12}, X_{i10}, X_{i11}, X_{i15} and X_{i7}.

The (common) variance extracted by the first principal component is 3.019(20%) and other component's variances are varying from 1.716(11.440%), 1.391(9.274%), 1.298(8.653%), 1.081(7.209%) and 1.020(6.799%) accordingly.

Based on the component loadings, the variables are clumped as:

(i). For the first principal component - X_{i3}, X_{i5}, X_{i7}, X_{i8}, X_{i9}, X_{i14}, X_{i15}.

(ii). For the second principal component - X_{i2}, X_{i4}, X_{i5}, X_{i7}.

(iii). For the third principal component - X_{i1}, X_{i2}, X_{i4}, X_{i6}, X_{i11}, X_{i12}.

(iv). For the fourth principal component - X_{i1}, X_{i2}, X_{i6}, X_{i12}.

(v). For the fifth principal component - X_{i3}, X_{i10}, X_{i11}, X_{i5}.

(vi). For the sixth principal component - X_{i10}, X_{i13}.

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