

AGRICULTURAL REGIONALISATION IN INDIA

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Abstract. The present paper deals with a scheme of delineating the agricultural planning regions of India where diversified patterns of agricultural characteristics prevail. Considering 20 agricultural variables of agro - ecological, production, growth - potentials, technological and organizational characteristics for each and every district (i.e., called Operational Taxonomy Unit) of the country, 5 macro, 23 meso, 52 micro and 92 lowest order homogeneous agricultural planning regions have been delineated by applying discriminant procedure of classification. It is found that the application of modern technology influences the assimilation processes of agricultural region - formation. Therefore, there is an emergence of unstable agricultural planning regions in India.

Keywords. Discriminant - Processes, Region - Formation, Assimilation, Unique Regions.

REGIONALISATION AGRAIRE EN INDE

Surendra Singh

Cet article est une tentative de schéma des régions de planification agricole en Inde, où prévalent plusieurs combinaisons de caractéristiques agricoles. En considérant 20 variables de caractéristiques agro-écologiques, de production, de pouvoir de croissance, technologiques et organisationnelles pour tous les districts (appelés unités opérationnelles taxonomiques) du pays, une procédure discriminante de classification identifie 5 macro-régions, 23 méso-régions, 52 micro-régions et 92 régions d'ordre minimal homogènes de planification agricole. Il en résulte que l'application de technologies modernes influence le processus d'assimilation de formation de régions agricoles. En Inde émergent donc des régions instables de planification agricole.

Mots clé :

Procédure discriminante, formation de régions, assimilation, régions uniques

LANDWIRTSCHAFTLICHE REGIONALISIERUNG IN INDIEN

Surendra Singh

Im vorliegenden Paper wird ein Versuch unternommen, ein Schema der landwirtschaftlichen Planungsregionen von Indien zu skizzieren, in denen verschiedene Muster landwirtschaftlicher Charakteristika vorherrschend sind. Wir betrachten 20 landwirtschaftliche Variablen, die das Produktions- Wachstumspotential, agroökologische, technologische und organisatorische Charakteristika für die einzelnen Distrikte (genannt Operational Taxonomic Unit) des Landes beschreiben. 5 Makro-, 23 Mittlere-, 52 Mikro- und 92 Kleinstplanungszone werden skizziert, indem man Diskriminanz-Verfahren der Klassifikationen anwendet. Es stellt sich heraus, daß die Anwendung moderner Technologien den Assimilierungsprozeß von landwirtschaftlicher Regionalbildung beeinflusst. Aus diesem Grunde ergibt sich eine Entwicklung von instabilen landwirtschaftlichen Planungsregionen in Indien.

Schlüsselwörter: Diskriminanz, Prozesse, Regionalbildung, Assimilation, einzigartige Regionen

Introduction

There have been numerous studies on the methodological as well as on the empirical aspects of region formation processes (Berry 1961, 1964, 1965, Berry and Rao 1968, Casetti 1964, 1966, Grigg 1965, 1967, Amedeo 1969, Amedeo and Golledge 1975, Pal 1975). These studies highlight three major aspects of delineating the regional boundaries, namely, the choice of attributes, the procedure for identifying the system of regions and the assimilation processes of areal units with spatial contiguity. In fact, Baker (1926 to 1932) introduced a classical scheme for interpreting regional dimensions of the U.S.A. agriculture, which was the first milestone to generate neo-classical models for agricultural regionalization. Later on, Whittlesay (1936) introduced a neo-classical scheme and Kostrowicki (1972) put forward a modern scheme for agricultural typology of the world. He prepared 33 model typograms by selecting 20 variables of social, ownership, organizational, technological and production characteristics of world agriculture. But in the Indian context, the agro-ecological attributes have only been considered for macro agricultural zonation because Indian agriculture might have been controlled by physical and ecological factors before green revolution period (Sen Gupta 1968, Bhat and Learmonth 1968). Following the impact of green revolution technology on agricultural systems, significant changes in their structure and growth components are taking place. These changes are now breaking the limits of physical attributes of agricultural systems in India. Thus, the present paper focuses on the accelerated processes and evolved forms of the regional structure of Indian agriculture, especially in its present perspective.

System of Region Formation

The selection of agricultural attributes for understanding the system is mainly based on the characteristics of agriculture. Indian agriculture is characterized as foodgrain dominated in a labour intensive environment. It has enough potential for the improvement of its conditions in the near future. Therefore, the

chosen attributes for the present scheme of agricultural regionalization, that are 20 in number, are broadly grouped into four categories of agricultural characteristics including agricultural productivity, growth and production potential variables (table 1).

Identification of the system of region formation is fundamentally based on the procedure of ordering the variance of multi-dimensional functional set which is interpreted in various ways by adopting:

(i) A division criterion of space partitioning by many classical theorists (Koppen 1900, Whittlesay 1936, Thornthwaite 1948).

(ii) The systematic approach of classification applying various distance functions like hierarchical group functions (Ward 1963, Park 1970).

(iii) The non-parametric criteria for a simulation of classification. This approach is based on natural measures of spatial proximities. In this context, space partitioning problems are solved by applying uniform density functions of transformation of functional dimensions rather than classical type normal density functions (Rasson, et.al. 1988, Urban-Ferauge, et.al. 1992).

Procedure

On the whole, there are three major steps in the procedure of region formation:

(i) generation of discriminant space from the multi-dimensional original problem space (that is transformation of variables);

(ii) system arrangement of areal units (i.e., points of distribution on the discriminant space); and the

(iii) evaluation of the degree of stability of region formation (based on spatial contiguity and the optimal solution).

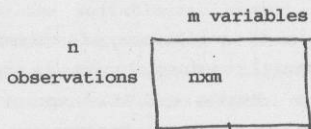
Transferring multi-dimensional data of 20 variables on "Z" score (which is mean and variance free), the discriminant process of regionalisation, that requires the calculation of the degree of

taxonomic distance D_{ij} , between i th and j th Operational Taxonomic Units, OTUs, of the k th variable (being in the present case districts), has been operated by applying the euclidan distance formula for m -dimensional space:

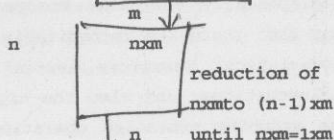
$$D_{ij} = [\sum_{k=1}^m (X_{ik} - X_{jk})^2]^{1/2}$$

The main steps of the discriminant procedure employed here are the following:

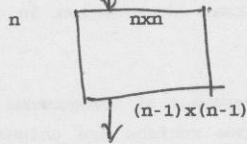
I. Raw Data Matrix (R-Mat)



II. Transformation of Data (Z-Mat)



III. Evaluation of Functional D-Mat (D_{ij})



IV. Evaluation of Reduced D-Mat

$(n-1) \times (n-1)$

V. Stop



By applying this method of ordering of spatial variance, a total of 348 Indian OTUs have been considered. They were grouped into 5 macro, 23 meso and 92 lowest order homogeneous agricultural planning regions.

Interpretation of Results

The region formation processes of Indian agriculture involve the following inherent characteristics and salient features of its spatial variations:

(1) In the assimilation process of the 5 macro agricultural regional units, the Coastal Region of the country is assimilated with the Deccan Plateau at the lowest assimilated level of 3.20 (table 2). Likewise, the Western Himalayan Regions and the Ganga Plains Region, characterized by the most dissimilar physiographic conditions, seem to be the least dissimilar in agricultural characteristics. On the contrary, the Ganga Plains and the Rajasthan Plains, although they are physiographically the most homogeneous, they are significantly dissimilar to each other in their agricultural characteristics (for more details see Singh 1994).

(2) The range of variations of assimilation levels within the macro-agricultural regional units is recorded very high in the Great Plains Region (0.857 to 17.750) although it is physiographically the most homogeneous part of the country. It appears that there are recognizable diversities in its agricultural characteristics. Therefore, assimilating tendencies exhibit very high fluctuations, and also the highest degree of information loss in the grouping processes operating in this Region (95.12%). The above means that this region is not much stable in its region formation.

(3) In the emergence of homogeneous groups of OTUs (see Dendrogram, figure 1), some regions are unique in their nature but they are grouped together with other groups of higher level of assimilation because of spatial contiguity constraints. For example, Shevoroy and Javadi Hills Region of micro level (Xb), which is spatially contiguous to the Madras Plains of the East Coastal Plains (Ic), has been grouped together with the Rayalseema Region of meso level (X) at a very high level (14.26) because of its areal proximity (figure 2). The regions that have higher level of spatial variance in the assimilation of OTUs are called unique regions. They are emerging in isolation because of the direct impact of urbanization in agricultural characteristics or due to hindrances of physical factors like relief conditions and climatic variations. For example, the districts of Sundergarh and Ahemdabad of Gujrat, which

are central parts of the Gujrat plains of the same physiographic unit, are quite unique in their agricultural characteristics.

At the end, it can be safely concluded that there is a direct effect of the green revolution technology on the evolving regional patterns of Indian agriculture. It is creating inter- and intra-regional diversities in the agricultural characteristics. Consequently, the regional boundaries of agricultural phenomena at all their levels are deviating from the regional setup of agro-ecological conditions in the diversified regional patterns. Thus, assimilation processes in the agricultural region formation of India have been influenced by the application of modern technology, especially in the plain areas where intensive cultivation is being practiced. Therefore, the emergence of agricultural regions is not stable even at the macro regional levels in the Great Plains of India, while instability of region formation in the Plateau and Mountain areas is mainly due to physical barriers.

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Table- 1: Selected Attributes for Agricultural Regionalisation, Their Definitions and Coefficient of Variations.

Name of the Attribute	Definitions	Mean	C.V. (in %)
<u>(a) Agro Ecological Characteristics</u>			
1. Moisture index	$[(P-PE)/PE]$	- 0.151	-
2. Soil fertility index	(unit)	61.908	15.26
<u>(b) Production Characteristics</u>			
3. Per capita agricultural output 1991	(Rs./person)	280.601	130.04
4. Average annual growth rate of Ag. output 1979-82 to 1988-90	(%)	8.439	149.23
5. Land productivity (Y) 1988-90	(Rs./ha)	1576.620	80.92
6. Labour productivity 1991	(Rs./person)	1189.411	98.37
7. Crop intensity 1988-90	(%)	134.219	19.60
<u>(c) Growth Potential Characteristics</u>			
8. Potential productivity index (A) 1988-90	(Rs./ha)	3228.081	73.58
9. Magnitude of production potential (A-Y) 1988-90	(Rs./ha)	1681.635	106.80
10. Production potential intensity (A/Y) 1988-90	(Ratio)	2.578	58.30
11. Marginal product to labour input	(unit)	3.688	240.48
12. Marginal product to technological input	(unit)	22.515	417.88
13. Absorption rate of potential intensity w.r.t. labour	(unit)	0.025	356.00
14. Absorption rate of potential intensity w.r.t. technology	(unit)	0.292	506.51
<u>(d) Organisational and Technological Characteristics</u>			
15. Input of labour	(Rs./ha)	512.782	85.15
16. Input of non-land capital 1988-90	(Rs./ha)	96.819	104.76
17. Extent of irrigation 1990-91	(in %)	35.584	75.76
18. Mechanisation 1988-90	(Rs./ha)	55.310	145.98
19. Use of chemical fertilizer 1988-90	(Rs./ha)	43.991	104.27
20. Size of operational land holding 1991	(NSA/Cult.)	1.466	61.05

N.B.: C.V. = Coefficient of Variation.

Table- 2: Assimilation Process and Groupings of the Macro-Agricultural Regional Units.

Groups	Assimilation of macro-units	Within group D values	% of variance	
			cumulative	Absolute
Prior to grouping	-	0	0	0
After I grouping	A/B	3.204	40.78	40.78
II grouping	AB/C	6.144	78.20	37.42
III grouping	ABC/D	6.551	82.82	4.62
Final grouping	ABCDE	7.857	100.00	17.18

N.B. : 1. Final grouping is the stage of complete generality where total informations of the spatial system are lost. For assimilation of the agricultural regional units, see inset of Fig.- 2.

Abbreviations:

- A= the Coastal Region,
- B= the Deccan Plateau,
- C= the Western Himalayas,
- D= the Great Plains, and
- E= the Rajasthan Plains.

DENDROGRAMS

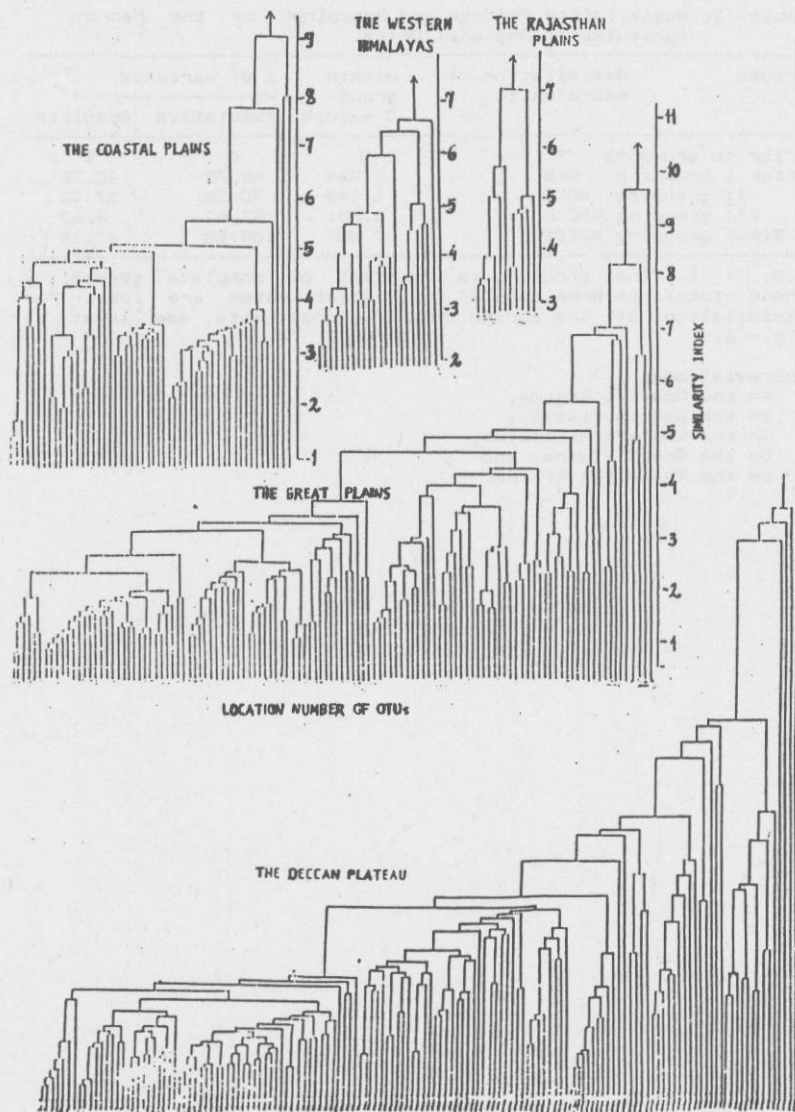


Figure 1. Dendrograms

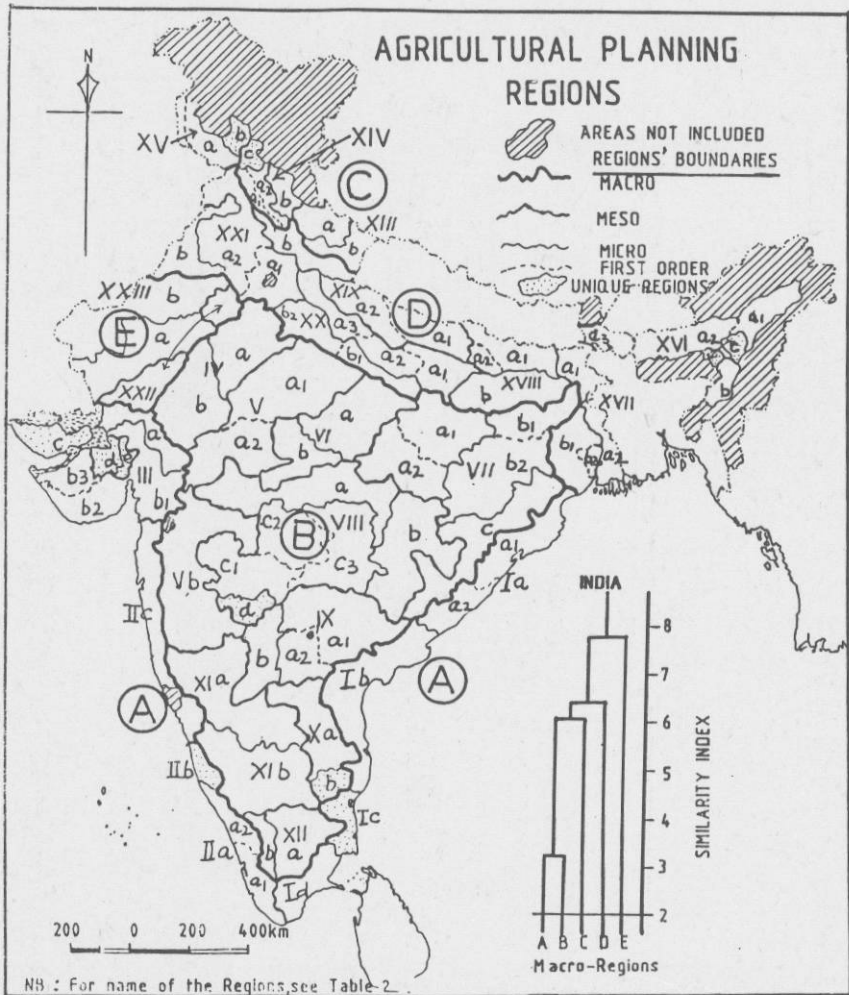


Figure 2. Agricultural planning regions of India