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Autocorrelation Simulation Studies for Horizontal Transmission of Ethno-Medicinal-Knowledge Related with Two Corporeal Systems

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Abstract

The simulation modelling of cultural transmission (particularly horizontal) is a useful tool to identified the spread of cultural traits. In present investigation autocorrelation indices (Moran's I and Geary C), variogram and kriging simulation techniques were utilize first time to identify the present strength of horizontal transmission of cultural information (medicinal values) and for their future scope. For incorporation of these techniques data related with two corporeal systems (digestive and reproductive tracts) were collected from 12 villages of semi arid Thar Desert, India. Present simulation approaches increased the sampling efforts 17 and 7 times more from original sampling (n =360) for digestive and reproductive tracts, respectively. Autocorrelation simulation study has suggested the lack of horizontal transmission of cultural information. Further for identification of future potential for spreading the cultural information's (at horizontal level), data's regarding different pharmacological properties (30) and for different body systems (12) were treated with simulation approaches like variogram and kriging. Both these techniques simulated the sampling efforts at 5000 iteration and suggested the greater diversity of the traditional knowledge that may be spread in between and among communities with proper planning's.

Keywords: Cultural transmission, horizontal level, simulation modelling, Moran I, autocorrelation, variogram, Kriging, digestive and reproductive tracts.

Introduction

In human society the various cultural attributes like knowledge, old cultural technology, language etc. are transmitted and communicated through various approaches at various levels[1]. There are three forms of transmitting the cultural knowledge namely vertical, horizontal and oblique transmission. Vertical transmission involves the transfer of information from parents to children i.e. between individuals of different generations but within genealogy[2,3]. Horizontal transmission existing in between the members of the same generation, such as siblings, cousins, and peers[2]. While the transmission process that passed the information from one generation to another through children copying adults other than their parents or between genealogical lines termed as oblique transmission information is[1,2].

Modelling the pathway of cultural transmission may enhance our knowledge to estimate the criteria essential for understanding the maintenance, erosion, and spread of cultural traits and innovations[4,5]. For quantification of cultural transmission, there are many approaches available and they be categorized in to field based techniques[6] or by using some specific techniques[1]. However the empirical works for such type of transitions have still rare[5.] To prove these transmission processes, field techniques or other empirical studies requires large sampling size. Conclusively such studies require exhaustive field sampling. Present reviews of literature have suggested the lack of involving statistical techniques to simulate these exhaustive processes. Here author first time have tried to incorporate various simulation techniques (Autocorrelation, variogram and Kirging) to find out directions of horizontal transmission of cultural information's (typically medicinal uses) with in semi arid desert communities of the Indian Thar Desert. Present study was conducted to evaluate (a) use the autocorrelation approaches for quantifying the horizontal transmission of ethno-knowledge of medicinal plants for two different corporeal systems (Digestive and Reproductive). These two contrasting corporeal systems were selected to normalize the hindrance of people perception to talk about the various diseases related with the reproductive tract and (2) by using the simulation model (variogram and kirgning) identify the expected outcome with increasing the sample size (simulated for 5000 time)

Material and Method

Data Collection: For collecting the data regarding the medicinal uses of different plants for treatment of various diseases related with reproductive and digestive tracts, the field surveys were carried out at 12 villages during three different seasons (rain, winter and summer). Here these environmental variables are attributed with horizontal transmission process[1]. At each village 10 individuals (age >16 years) were interviewed at one specific season. For sampling semi-structured interview method[7] was utilized.

Autocorrelation Studies: Autocorrelation studies were conducted by using the three different indices of contiguity namely, rook case, bishop's and queen (figure 1). Rooks case considered the neighbourhood of 4 locations adjacent to each cell, while Bishops considers the diagonals of the relation and queens or king's case considers a neighbourhood of eight cells.

Moran's I: Moran (1950)[8] proposed the formula for autocorrelation in two or more dimensions. *Moran's I* measures the correlation among observations in a pattern[9]. The value of this index is ranges from -1 to 1. Positive signage represents positive autocorrelation, while the converse is true for negative signage. With a zero indicate no autocorrelation.

$$I = \frac{N\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}(x_i - \bar{x})(x_j - \bar{x})}{(\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij})\sum_{i=1}^{n}(x_i - \bar{x})^2}$$

Where *N* is the number of observation of the whole region, X is the mean of the variable, X_i is the variable value at a particular ailment, X_j is the variable value for a another ailment, W_{ij} is a spatial weight between locations of *i* relative to *j*

Statistical Test for *Moran's I:* *Moran's I* can be standardized to Z that can be calculated as

$$Z = \frac{I - E(I)}{\sqrt{V(I)}}$$

$$E(I) = -1/(n-1)$$

$$Var(I) = \frac{1}{w_0^2(n^2-1)}(n^2 w_1 - n w_2 + 3w_0^2) - E^2 - (I)$$

$$w_o = \sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij};\ w_1 = 0.5\sum_{i=1}^{n}\sum_{j=1}^{n}(w_{ij} + w_{ji})^2;\ w_2 = \sum_{i=1}^{n}(w_{i*} + w_{*i})^2$$

Where w_{j*} is the sum of all weights located in the row I, w_{*i} is the sum of all weights in the column i. The threshold of 1.96 can be applied to test the significance level of Z. If Z is greater than 1.96 or smaller than -1.96, it implies significant result[10].

Geary's *C* (Contiguity) Ratio: This index ranges from of 0 to +2. Zero indicate positive autocorrelation, while 2, revealed negative autocorrelation. Calculation is similar with *Moran's I*, For Moran, the cross-product is based on the deviations from the mean for the two location values while for Geary, and the cross-product uses the actual values themselves at each location. Geary's C statistic[11] is based on the departure in responses of each result with another one:

$$C = \frac{n-1}{2S_0}\frac{\sum_i\sum_j w_{ij}(x_i - x_j)^2}{\sum_i (x_i - \bar{x})^2}.$$

The variance is:

$$Var_{(c)} = \frac{1}{n(n-2)(n-3)S_0^2}\left\{\begin{matrix} S_0^2[(n^2-3) - k(n-1)^2] + S_1(n-1)[n^2 - 3n + 3 - k(n-1)] \\ + \frac{1}{4}S_2(n-1)[k(n^2 - n + 2) - (n^2 + 3n - 6)] \end{matrix}\right\}$$

where S_0, S_1, and S_2 are the same as in *Moran's I*. However, interpretation of these values is very different, essentially the opposite. *C* of approximately 1 indicates no autocorrelation/random, *C* of 0 indicates perfect positive autocorrelation/clustered, C of 2 indicates perfect negative autocorrelation/dispersed. Can convert to a -/+1 scale by: calculating C* = 1 – C

Statistical Significance Tests for Geary's C: Similar to Moran which based on the normal frequency distribution with

$$Z = \frac{C - E(C)}{S_{error}(C)}$$

E(C) = 1

Both Moran I and Geary C indices were calculated with help of RookCase software[12].

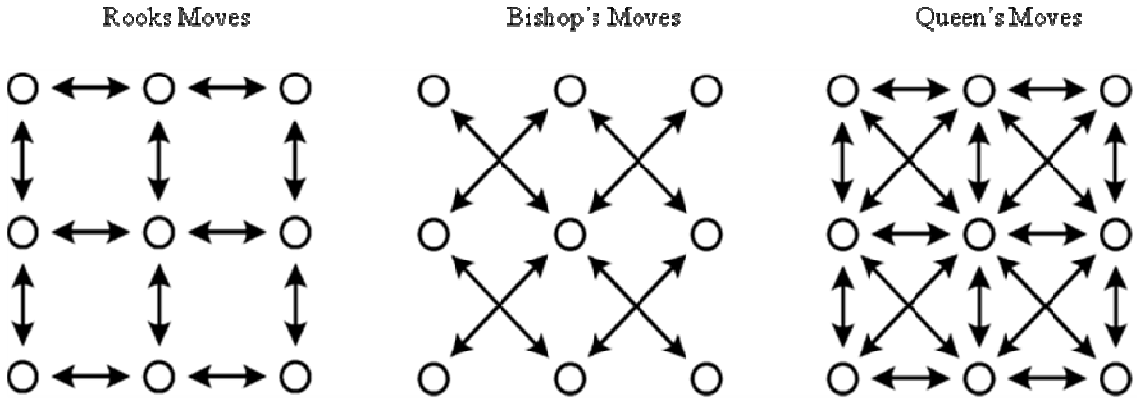

Figure-1
Different approaches of contiguity analysis in spatial autocorrelation studies

Variogram and Kriging techniques were utilized for identification of future potentials for spreading the cultural information (in between and among the communities), regarding using of plant for various pharmacological properties and for different body systems. In Kriging value at an unknown point should be the average of the known values at its neighbours; weighted by the neighbours' distance to the unknown point. In the present investigation kriging was done with two specific objectives i. Variance between point to be estimated and known points ii. Variance between known points. The kriging was calculated with point method using isotropic and regular variogram. This analysis was carried out with the help of GS^+ software[13].

Results and Discussion

During the sampling period it was noted that around 70 plants were reported for treatment of 10 various disease related with reproductive tract, while 90 plants were claimed for 18 different diseases of digestive tract. For further analysis of these matrix the data's were randomised with binary conversion in which 1 represent the use of that particular plant for a particular ailment related with two corporeal systems, while 0 represents for no claim (table 1 and 2).

Autocorrelation Simulation: Present simulation techniques increase our sampling number from 360 (in all season) to 3026-6158 for digestive system and 1242 -2562 for reproductive system. The variations in simulated number for both types of corporeal systems were attributed by number of medicinal plants uses by the respondent (90 in case of digestive system and 70 for reproductive system). Thus by using such simulation studies we were able increase our sampling afford 17 times more in case of digestive system and 7 times more for reproductive system. The main objective for increasing these sampling efforts was to measure the strength of horizontal cultural transmission for medicinal properties. Both Indices showed lack of horizontal transmission of cultural information regarding medicinal uses these plants. For both corporeal systems and for all types of cases the Moran's I values were recorded less than 1 and approaches 0 that indicates the lack of autocorrelation between information (table 3). These results were statistical significant as the Z values lies above 1.96 except for the Bishop case for reproductive system. Similarly the value of Geary's C test approaches the 1 that also represents the lack of horizontal transmission of cultural information's, however the statistical Z test were non-significant for Bishop and Queen cases in reproductive system.

Because indigenous knowledge represents a part of humanity's heritage and diversity and because it might enhance many indicators of well-being, researchers have tried to understand why indigenous knowledge might vanish so consistently across space and time[14]. Researchers have identified several overlapping reasons for the loss or devolution of indigenous knowledge among contemporary populations. Culprits include schooling[15], occupation[16,17], market exposure[18], ecological change[19], technological transformations[1], acculturation and change in value orientation[20]. The culprits reduce exposure to nature and undermine cultural support for the transmission of indigenous knowledge[21], thereby abrading its preservation. In present investigation lack of horizontal transfer of cultural information's may be associated with factors like resources depletion, inaccessibility of plants, substituted, or lack of having established market.

Kirging: The results revealed that these plants are useful for 2 to 30 different pharmacological properties and for 1 to 12 different body systems (namely, respiration, digestion, reproduction, fever, blood and hematopoietic organ, central nervous system, genito-urinary system, circulatory system, sensory system, endocrine gland, metabolism and nutrition, skin and sub-cutanious system and skeletal muscle and connective tissues. Among plants *Azadirachta indica, Achyrtanthies aspera* and *Aloe vera* were the most versatile species. Variogram construction is a very essential and intial step before kriging. It is a quantitative descriptive statistic that can be graphically represented in a manner which characterizes the continuity of a data set. The variogram diagram of both corporeal systems and their respective parameters are presented in tables 4 and figures 2 and 3. For both type of systems the Gaussian model best fitted with R^2 values 0.993** (P at 99% probability levels) and 0.994** for digestive and reproductive system, respectively.

The word *isopleth* (*plethos*, meaning 'quantity') denote the contour lines that revealed a variable which cannot be measured at a point, but which instead must be quantified from data gathered over an field. Isopleths showing the quantity of the property being studied can be drawn on the map to highlight regional trends of high or low abundance of that property. Relief "highs" (hills) are shown by concentric contour isopleths, and depressions are shown by concentric contours with hachure's pointing toward the centre of the depression.

In present study the Isopleth map were prepared by using the three different variables namely, #PH = number of pharmacological properties. # BS = number of body systems and R_{EL}.PH = relative number of pharmacological properties. The results are presented in tables 5 and 6 and figures 4 and 5. Kriging test for plants primarily reported for digestive tracts depicted with many hill and depression that means the higher level of variability for cultural information's. While kriging test for plants that were primarily reported for reproductive tracts depicted without any hill or depression. Width of each region is more or less similar with other region that shows the uniformality for cultural transmission. The various attributes related with these two corporeal system and their efficacny improvement have been discussed in details by several authors[22-26.] These results were also proves by the standard deviation between various regions that lies 0.3862 for the plants primarily respondent for digestive tract and 0.2680 for reproductive tract. Thus it can be concluded that there is ample of scope for horizontal cultural transmission still persist that need the proper effort at various levels.

Table-1
Species useful for various gastro-intestinal (Digestive) disorders

	Diseases Code (Name Given in Foot Note of Table																	
Species name	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
Abrus precatorious	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Abutilon indicum	-	-	1	1	1	-	-	1	-	1	-	-	-	-	-	-	-	-
Acacia senegal	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Achyranthies aspera	-	-	-	-	-	-	1	1	1	1	-	1	-	-	1	-	-	-
Adhatoda vasica	-	-	1	-	1	1	1	1	-	-	-	-	-	-	-	-	-	-
Aegel marmelos	-	-	-	-	1	-	1	1	-	1	1	-	-	-	-	-	-	1
Albizia lebbeck	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Aloe vera	-	1	1	-	1	-	-	-	1	-	1	-	-	1	-	-	-	-
Amaranthus spinosus	-	-	-	-	-	-	-	-	1	-	-	1	-	-	1	-	-	-
Andrographic paniculata	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	1
Aregemone mexicana	-	-	-	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
Aristolochia bracteolata	-	1	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
Asparagus racemosus	-	-	-	1	-	1	-	1	-	-	-	-	-	-	-	-	-	1
Azadirachta indica	-	1	1	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-
Balanites aegyptiaca	-	1	1	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-
Boerhavia diffusa	-	-	1	-	-	1	-	-	1	1	-	-	-	-	-	1	-	-
Boswellia serrata	-	-	-	-	1	-	1	1	-	-	-	1	1	-	-	-	-	-
Butea monosperma	-	-	1	-	-	-	1	1	-	-	-	-	-	-	-	-	-	1
Calligonum polygonoides	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Calotropis procera	1	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-
Cardiospermum halicacabum	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Cassia angustifolia	-	1	1	-	-	1	-	1	1	-	-	-	-	-	-	-	-	-
Cassia fistula	-	1	-	-	-	1	-	1	1	-	-	-	-	-	-	-	-	-
Cassia occidentalis	-	1	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-
Catharanthus roseus	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cissus quadrangularis	-	-	1	-	-	1	-	-	-	-	-	1	-	1	1	1	-	-
Citrullus colocynths	-	1	1	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-
Citrullus lanatus	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Clemoe viscosa	-	-	-	-	1	1	1	-	-	-	-	-	-	1	-	1	-	-
Clerodendrum phlomoides	-	-	-	-	1	-	-	-	-	-	-	1	-	1	1	1	-	-
Cocculus hirsutus	-	-	-	-	-	-	1	-	-	1	-	-	1	-	-	-	-	-
Commiphora wightii	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Convolvulus microphyllus	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Corchorus depressus	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Cucumis callosus	-	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Cynodon dactylon	-	-	1	1	-	-	1	-	-	-	-	1	-	1	-	-	1	-
Cyperus rotundus	-	-	1	-	-	-	1	-	1	-	-	-	-	1	-	-	-	-
Datura mental	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Echinops echinatus	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Eclipta prostrata	1	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Emblica officinalis	-	-	-	-	-	-	1	1	-	1	-	-	1	-	-	-	-	-
Euphorbia caducifolia	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-
Euphorbia hirta	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Evovulus alsinoides	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-
Fagonia indica	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-
Ficus religiosa	-	1	-	-	1	-	1	-	1	1	-	-	-	-	-	-	-	-

	Diseases Code (Name Given in Foot Note of Table																	
Species name	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
Fumaria indica	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Glycyrrhiza glabra	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Hibiscus rosa-sinensis	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Holarrhina antidysentrica	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	1	-	-
Jatropha curcas	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Majorana hortensis	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Maytenus emarginata	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Mimosa pudica	-	-	-	-	1	-	-	1	-	-	-	1	-	-	-	-	-	-
Mollugo cerviana	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Moringa oleifera	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mucuna pruriens	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Murraya koenigii	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-	-	1	-
Ocimum sanctum	-	-	1	-	1	-	-	1	-	-	1	-	-	-	-	-	1	-
Opuntia elatior	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Pedalium murex	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	1
Peganum harmala	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Pergularia daemia)	-	1	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1
Phyllanthus fraternus	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Plantago ovata	-	-	-	-	-	-	1	-	-	1	1	1	1	-	-	-	-	-
Polygela senega	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Prosopis cineraria	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Punica granatum	-	-	-	1	-	-	1	1	1	-	-	1	-	-	-	1	-	-
Ricinus communis	-	1	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1
Saccgaraum spontaneum	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Salvadora persica	-	1	-	-	-	-	-	-	1	-	1	-	-	1	-	-	-	-
Sarcostemma acidum	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sida cordifolia	-	-	-	1	-	-	1	-	-	1	-	-	-	-	-	-	-	-
Solanum nigrum	-	-	-	-	1	-	-	1	-	1	-	1	1	-	-	-	-	-
Solanum surattense	-	-	-	-	-	-	-	-	1	1	-	1	1	-	-	-	-	-
Sphaeranthus indicus	-	-	1	-	-	-	-	1	-	-	1	1	-	-	-	1	-	-
Tamarindus indica	-	1	-	-	-	-	1	1	-	1	-	1	1	1	1	-	-	-
Tephrosia purpurea	-	-	1	-	-	-	1	1	1	-	-	1	-	-	1	-	-	-
Tinospora cordifolia	1	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-
Tianthema portulacastrum	-	-	-	-	1	-	-	-	1	-	1	-	-	-	-	-	-	1
Tribulis terrestris	-	-	-	1	-	-	-	-	-	-	-	-	1	1	-	-	-	-
Trigonella foenum graecum	-	-	1	-	-	-	1	-	-	-	-	-	-	1	1	-	-	-
Tylophora indica	1	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-
Urginea indica	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Vernonia cinerea	-	-	1	-	-	-	1	-	1	-	-	1	1	-	-	-	1	-
Vitex negundo	-	-	-	-	1	-	1	-	-	-	-	-	-	-	1	-	-	-
Vetiveria zizanoides	-	1	-	-	1	-	-	-	-	-	-	1	-	1	-	1	-	-
Withania somifera	-	-	-	-	-	-	-	-	-	-	-	1	-	1	1	-	-	-
Ziziphus mauritiana	1	-	-	-	1	-	1	1	-	-	-	-	1	-	-	-	-	-
Saccgaraum spontaneum	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1. Emetic, 2 Purgative, 3 Anti-helminitc, 4 Demulcent, 5 Ulcer, 6 Refrigerant, 7Diarrhea, 8Anti-dysentric, 9 Anodyne, 10 Laxative, 11Constipation, 12 Dyspespia, 13 Appetizer,, 14 Carminative, 15, Flatulence, 16 Colitis, 17 Ant-vomiting, 18 Emollient.

Table-2
Species useful for various reproductive tract disorders

	Disease Code (Name Given in Foot Note of Table)									
Species Name	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Abrus precatorious	-	1	1	-	-	-	-	-	-	1
Abutilon indicum	-	1	1	-	-	-	-	-	-	1
Achyranthies aspera	-	-	-	-	1	-	-	1	-	-
Aloe vera	-	-	-	1	-	-	-	-	1	-
Amaranthus spinosus	-	-	-	-	-	-	-	1	-	-
Andrographic paniculata	-	-	-	1	-	-	-	1	-	-
Argyeria nervosa	-	1	-	-	-	-	-	-	-	-
Aristolochia bracteolata	-	-	1	-	-	-	-	-	-	-
Asparagus racemosus	-	1	-	-	-	1	-	-	-	1
Balanites aegyptiaca	1	-	1	-	-	-	-	-	-	-
Barleria prionitis	-	-	-	-	-	-	-	-	-	1
Blepharis sindica	-	1	-	-	-	1	-	-	-	-
Boerhavia diffusa	-	-	1	-	-	-	-	-	1	-
Butea monosperma	-	1	-	-	-	-	-	-	-	1
Cardiospermum halicacabum	-	-	-	1	-	-	-	-	-	-
Cassia occidentalis	-	1	-	-	-	-	-	-	-	-
Catharanthus roseus	-	-	-	1	-	-	-	-	-	-
Cissus quadrangularis	-	1	-	-	-	-	-	-	-	-
Citrullus lanatus	-	1	-	-	-	-	-	-	-	-
Cocculus hirsutus	-	1	1	-	-	-	1	-	-	-
Corchorus depressus	-	1	1	-	-	1	-	-	-	-
Cyperus rotundus	-	-	-	-	-	-	1	-	-	-
Echinops echinatus	-	1	-	-	-	-	-	-	-	-
Eclipta prostrata	-	-	-	-	-	-	-	1	-	-
Euphorbia caducifolia	-	-	-	-	1	-	-	-	-	-
Euphorbia hirta	-	-	1	-	-	-	-	-	-	-
Evovulus alsinoides	-	1	-	-	-	-	-	1	-	-
Ficus religiosa	-	1	-	-	-	-	-	-	-	-
Hibiscus rosa-sinensis	1	1	1	1	-	-	-	-	-	-
Holarrhina antidysentrica	-	-	-	-	-	-	-	1	-	-
Indigofera linnaei	-	-	-	-	-	-	1	-	-	-
Moringa oleifera	-	1	-	-	-	-	-	-	-	-
Mucuna pruriens	-	1	-	-	-	-	-	-	-	-
Neurada procumbens	-	1	-	-	-	-	-	-	-	-
Opuntia elatior	-	-	1	-	-	-	-	-	-	-
Pedalium murex	-	1	-	-	-	-	-	1	1	1
Peganum harmala	-	1	-	-	-	-	-	-	-	-
Pergularia daemia	-	-	-	1	-	-	-	1	-	-
Phyllanthus amarus	-	1	-	-	-	-	-	-	-	-
Plantago ovata	-	1	1	-	-	-	-	-	-	-
Prosopis cineraria	-	1	-	-	-	1	-	-	-	-
Ricinus communis	1	-	-	-	-	-	-	1	-	-
Salvadora persica	-	-	1	-	-	-	-	-	-	-
Sida cordifolia	-	1	-	-	-	-	-	-	-	-
Ssolanum nigrum	-	1	-	-	-	-	-	-	-	-
Sphaeranthus indicus	-	1	-	-	-	-	-	-	-	-

	Disease Code (Name Given in Foot Note of Table)									
Species Name	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Tribulis terrestris	-	1	-	-	-	-	-	-	-	-
Withania somifera	-	1	-	-	-	-	-	-	-	-
Ziziphus mauritiana	-	-	1	-	-	-	-	-	-	-
Ziziphus nummularia	-	-	-	-	-	1	-	-	-	-
Blepharis edulis	-	1	-	-	-	-	-	-	-	-
Celosia argentea	-	1	1	-	-	-	-	-	-	-
Chenopodium album	-	1	-	-	-	-	-	-	-	1
Cressia critica	-	1	-	-	-	-	-	-	-	-
Dalbergia sissoo	-	1	-	-	1	-	-	-	-	1
Grewia tiliaefolia	-	1	-	-	-	-	-	-	-	-
Chloris virgata	-	1	-	-	-	-	-	-	-	-
Cyprus scarisous	-	1	-	-	-	-	-	-	-	-
Corchorus trilocuris	-	1	-	-	-	-	-	-	-	-
Grewia populifolia	-	1	-	-	-	-	-	-	-	-
Lycium barbarum	-	1	-	-	-	-	-	1	-	-
Lycium chinese	-	1	-	-	-	-	-	1	-	-
Mimosa hamata	-	1	-	-	-	-	-	-	-	-
Saccgaraum spontaneum	-	1	-	-	-	-	-	-	-	-
Solanum xanthcarpum	-	1	-	-	-	-	-	-	-	-
Terminalia arjuna	-	1	-	-	-	-	-	1	-	1
Cordia mixa	-	1	-	-	-	-	-	-	-	-
Cymbopogon citratus	-	1	-	-	-	-	-	-	-	-
Desmostachya bipinnata	-	1	-	-	-	-	-	-	-	-
Heliotropium indicum	-	-	1	-	1	-	-	-	-	-

1Contraceptive, 2 Aphrodisiac, 3 Gonorrhea, 4 Menstrual complaints, 5Abroficient, 6 Galactagogce, 7 Venereal disease, 8 Uterine disorder, 9Spermatorrhoea, 10 Leucorroea

Table-3
Moran's I and Geary' C and their associated Z tests for digestive and reproductive systems with different contiguity approaches

	Digestive System			Reproductive System		
Parameters	**Rookcase**	**Bishop's case**	**Queen case**	**Rookcase**	**Bishop's case**	**Queen case**
Moran's I	0.061	0.05	0.056	0.099	-0.002	0.05
Z statistics	3.48*	2.84*	4.48*	3.67*	-0.028ns	2.62*
Geary's C	0.945	0.96	0.95	0.91	1.033	0.97
Z statistics	3.019*	2.85*	3.34*	3.05*	-1.08ns	1.27ns
Neighbours	3132	3026	6158	1320	1242	2562

*=significant at 99% probability level; ns = non-significant

Table-4
Various aspects of Variogram test and their interpretations

Event Types	**C_0 or Nugget (It is the Y intercept of the model) The C_0 variance can never be greater that sill**	**C_0+C or Sill (Is the model asymptote) The sill can never be less than nugget variance**	**A or range (The separation distance over which spatial dependence is apparent**	**Residual Sum of Square (provide an exact measure of how well the model fit the variogram data; the lower the RSS value, the better the model fit**	**R^2**	**Model Type**
Digestion	0.00	0.200	18.46	1.229E-04	0.993*	Gaussian
Reproduction	0.00	0.200	18.81	7.11E-05	0.994*	Gaussian

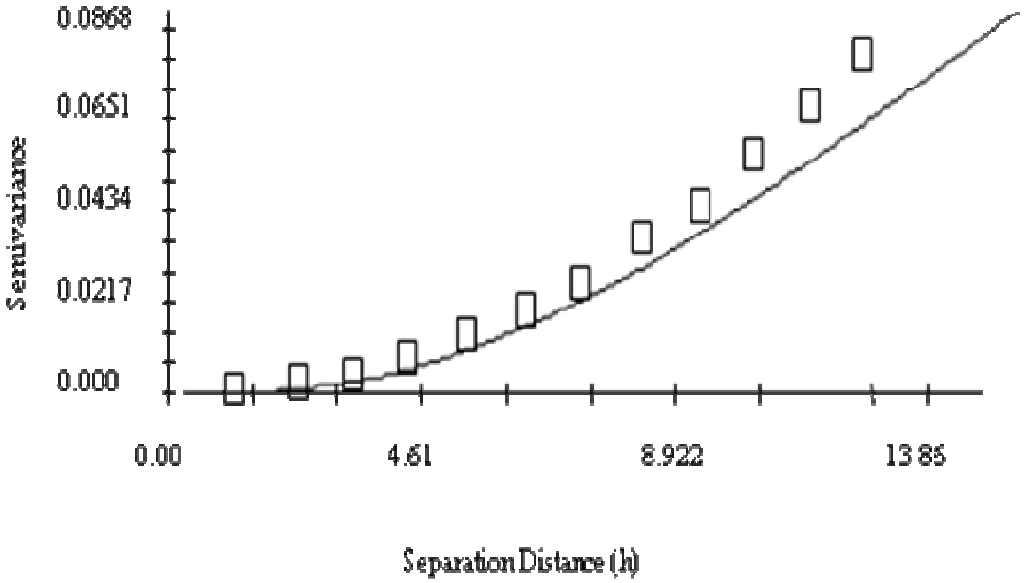

Figure-2
Variogram for Digestative Tract Disorders

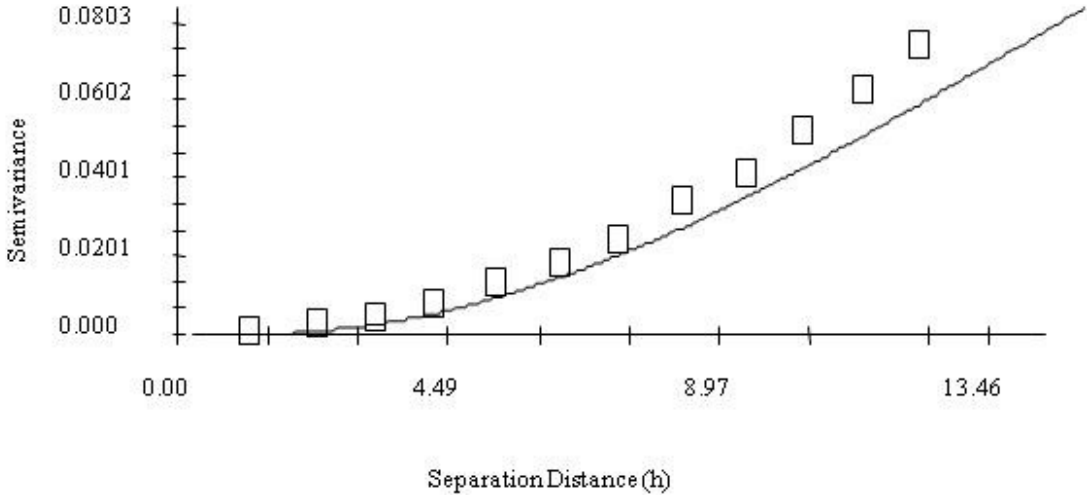

Figure-3
Variogram for Reproductive Tract Disorders

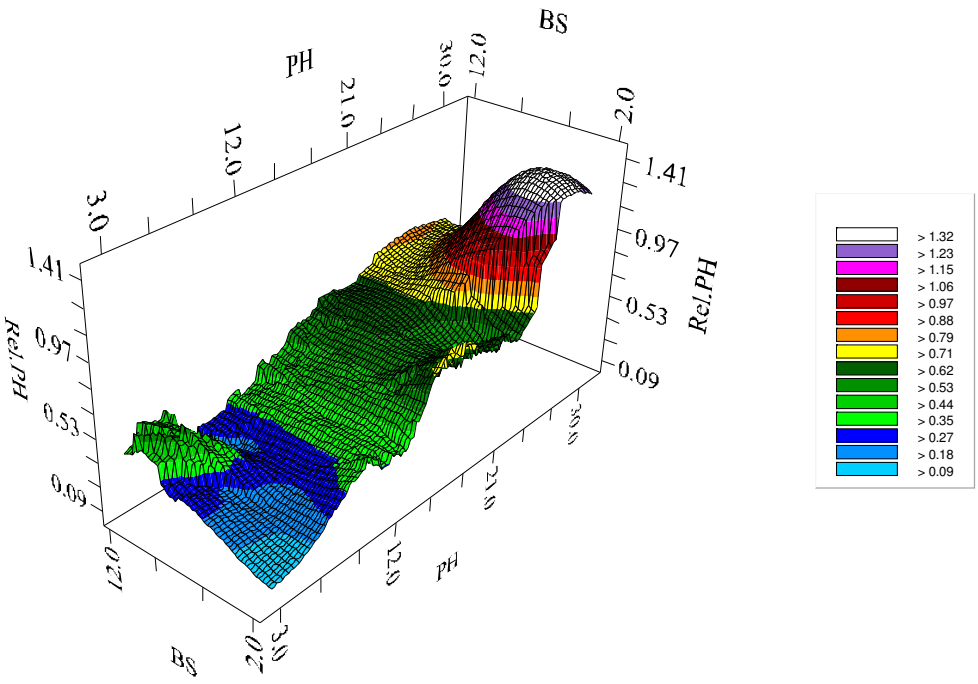

Figure-4
Iso- Pleath Map (Kriging simulation test) for plants primarilry reported for digestive tract

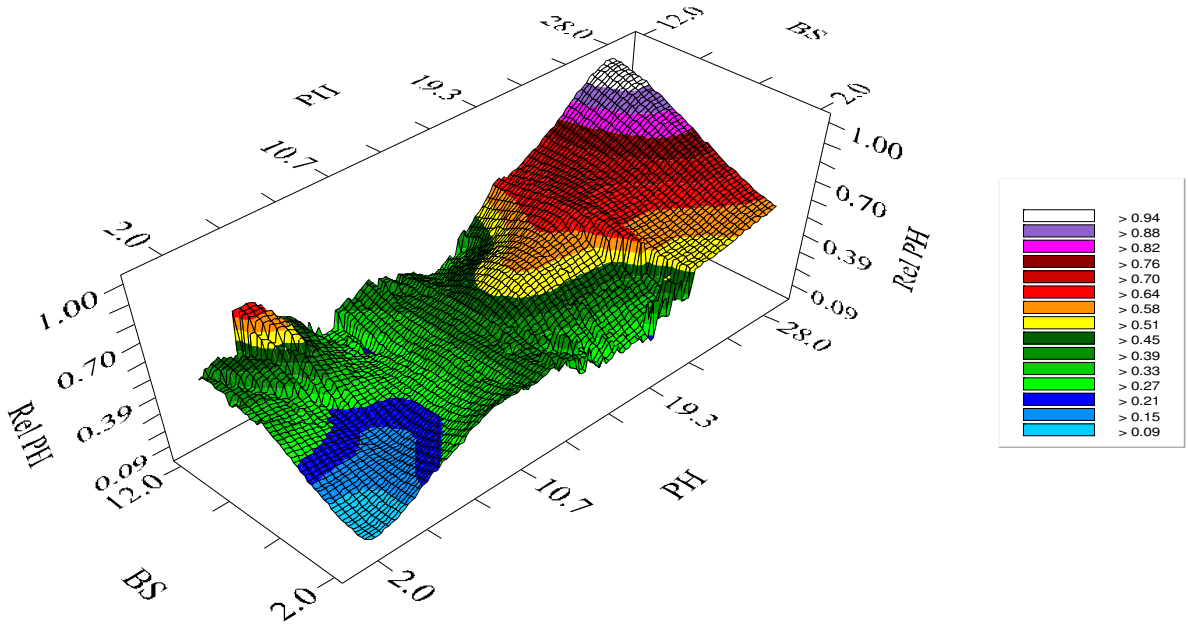

Figure-5
Iso- Pleath Map (Kriging simulation test) for plants primarilry reported for reproductive tract

Table-5
Pharmacological, Biological system and relative pharmacological properties of medicinal plants primarily reported for digestive tract. (#PH = number of pharmacological properties. # BS = number of body systems and R_{EL}.PH = relative number of pharmacological properties (normalized to maximum value of 1)

	#PH	#BS	R_{EL}.PH
Aloe vera	24	12	0.8
Achyranthies aspera	28	9	0.9
Azadirachta indica	30	8	1
Boerhavia diffusa	22	10	0.7
Ocimum sanctum	23	8	0.8
Terminalia arjuna	20	9	0.7
Asparagus racemosus	22	8	0.7
Solanum nigrum	21	8	0.7
Abutilon indicum	18	9	0.6
Emblica officinalis	17	9	0.6
Eclipta prostrata	16	9	0.5
Moringa oleifera	16	9	0.5
Sphaeranthus indicus	18	8	0.6
Vernonia cinerea	18	8	0.6
Amaranthus spinosus	15	9	0.5
Withania somifera	15	9	0.5
Abrus precatorious	17	8	0.6
Hibiscus rosa-sinensis	17	8	0.6
Vitex negundo	17	8	0.6
solanum surattense	16	8	0.5
Datura mental	18	7	0.6
Aegel marmelos	15	8	0.5
Cassia fistula	17	7	0.6
Commiphora wightii	17	7	0.6
Sida cordifolia	12	9	0.4
Vetiveria zizanoides	12	9	0.4
Agemone mexicana	19	6	0.6
Butea monosperma	14	8	0.5
Ricinus communis	14	8	0.5
Euphorbia caducifolia	13	8	0.4
Cocculus hirsutus	12	8	0.4
Tinospora cordifolia	12	8	0.4
Ficus religiosa	14	7	0.5
Calotropis procera	16	6	0.5
Tephrosia purpurea	16	6	0.5
Tianthema portulacastrum	11	8	0.4
Boswellia serrata	18	5	0.6
Holarrhina antidysentrica	13	7	0.4
Andrographic paniculata	10	8	0.3
Echinops echinatus	10	8	0.3
Mucuna pruriens	10	8	0.3
	#PH	#BS	R_{EL}.PH
Trigonella foenum graecum	15	6	0.5
Ziziphus mauritiana	15	6	0.5
Clemoe viscosa	12	7	0.4
Evovulus alsinoides	12	7	0.4
Glycyrrhiza glabra	12	7	0.4
Peganum harmala	12	7	0.4
Tamarindus indica	17	5	0.6
Cynodon dactylon	14	6	0.5
Cardiospermum halicacabum	11	7	0.4
Salvadora persica	13	6	0.4
Saccgaraum spontaneum	10	7	0.3
Cissus quadrangularis	12	6	0.4
Adhatoda vasica	14	5	0.5
Citrullus colocynths	11	6	0.4
Clerodendrum phlomoides	11	6	0.4
Cyperus rotundus	11	6	0.4
Murraya koenigii	11	6	0.4
Fumaria indica	8	7	0.3
Urginea indica	13	5	0.4
Catharanthus roseus	10	6	0.3
Albizia lebbeck	12	5	0.4
Balanites aegyptiaca	12	5	0.4
Acacia senegal	9	6	0.3
Phyllanthus fraternus	11	5	0.4
Punica granatum	13	4	0.4
Aristolochia bracteolata	10	5	0.3
Cassia occidentalis	10	5	0.3
Jatropha curcas	12	4	0.4
Tribulis terrestris	12	4	0.4
Euphorbia hirta	9	5	0.3
Majorana hortensis	9	5	0.3
Pergularia daemia	9	5	0.3
Cassia angustifolia	11	4	0.4
Maytenus emarginata	8	5	0.3
Corchorus depressus	7	5	0.2
Fagonia indica	7	5	0.2
Pedalium murex	9	4	0.3
Tylophora indica	8	4	0.3
Opuntia elatior	5	5	0.2
Mimosa pudica	7	4	0.2
Plantago ovata	8	3	0.3
Citrullus lanatus	5	4	0.2
Mollugo cerviana	5	4	0.2
Prosopis cineraria	5	4	0.2
Convolvulus microphyllus	3	3	0.1
Zygophyllum simplex	4	2	0.1
Polygela senega	4	2	0.1
Cucumis callosus	3	2	0.1
Sarcostemma acidum	3	2	0.1

Table-6
Pharmacological, Biological system and relative pharmacological properties of medicinal plants primarily reported for reproductive tract

	#PH	#BS	R_{EL}.PH
Aloe vera	24	12	0.8
Achyranthies aspera	28	9	0.9
Dalbergia sissoo	27	9	0.9
Boerhavia diffusa	22	10	0.7
Terminalia arjuna	20	9	0.7
Asparagus racemosus	22	8	0.7
Solanum nigrum	21	8	0.7
Abutilon indicum	18	9	0.6
Mimosa hamata	20	8	0.7
Eclipta prostrata	16	9	0.5
Moringa oleifera	16	9	0.5
Sphaeranthus indicus	18	8	0.6
Amaranthus spinosus	15	9	0.5
Withania somifera	15	9	0.5
Abrus precatorious	17	8	0.6
Hibiscus rosa-sinensis	17	8	0.6
Sida cordifolia	12	9	0.4
Cressia critica	17	7	0.6
Grewia tiliaefolia	17	7	0.6
Butea monosperma	14	8	0.5
Ricinus communis	14	8	0.5
Chenopodium album	14	8	0.5
Euphorbia caducifolia	13	8	0.4
Cocculus hirsutus	12	8	0.4
Ficus religiosa	14	7	0.5
Holarrhina antidysentrica	13	7	0.4
Andrographic paniculata	10	8	0.3
Blepharis sindica	10	8	0.3
Echinops echinatus	10	8	0.3
Mucuna pruriens	10	8	0.3
Ziziphus mauritiana	15	6	0.5
Evovulus alsinoides	12	7	0.4
Peganum harmala	12	7	0.4
Cardiospermum halicacabum	11	7	0.4
Saccgaraum spontaneum	10	7	0.3
Heliotropium indicum	10	7	0.3
Cissus quadrangularis	12	6	0.4
Citrullus colocynths	11	6	0.4
Cyperus rotundus	11	6	0.4
Solanum xanthcarpum	11	6	0.4
Desmostachya bipinnata	8	7	0.3
Catharanthus roseus	10	6	0.3
Corchorus trilocuris	10	6	0.3
Balanites aegyptiaca	12	5	0.4
Cordia mixa	9	6	0.3
Aristolochia bracteolata	10	5	0.3
Cassia occidentalis	10	5	0.3
Argyeria nervosa	7	6	0.2
Barleria prionitis	12	4	0.4
Tribulis terrestris	12	4	0.4
Euphorbia hirta	9	5	0.3
Pergularia daemia	9	5	0.3
Cymbopogon citratus	9	5	0.3
Cyprus scarisous	6	6	0.2
Corchorus depressus	7	5	0.2
Pedalium murex	9	4	0.3
Indigofera linnaei	5	5	0.2
Opuntia elatior	5	5	0.2
Ziziphus nummularia	7	4	0.2
Plantago ovata	8	3	0.3
Prosopis cineraria	5	4	0.2
Celosia argentea	5	4	0.2
Lycium barbarum	5	3	0.2
Lycium chinese	5	3	0.2
Phyllanthus amarus	4	3	0.1
Chloris virgata	4	3	0.1
Neurada procumbens	3	3	0.1
Salvadora oleoides	5	2	0.2
Grewia populifolia	3	2	0.1
Blepharis edulis	2	2	0.1

Conclusion

Measuring of the cultural transmission is still an exhaustive effort. In present investigation use of simulation techniques like autocorrelation, variogram and kriging (primarily useful for spatial data analysis), proves to be an useful approaches for quantification of the strength of cultural transmission. Present simulation studies suggested that within 12 selected villages of the semi arid communities of the Thar Desert, cultural information (in term of medicinal values for two corporeal systems) were non transmitted at horizontal level. However there is an ample of scope to increase the width of these cultural information that is indicated by knowledge of people about the uses of plants for different pharmacological properties and for different body systems.

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