Participation analysis of south Asian rural women towards sustainable development in agriculture.

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ABSTRACT

In Asia most of the countries are in developing stage where a high proportion of women are employed in agriculture. The official statistics do not always reveal fully the actual status and role of women in agriculture but such data provides adequate insight for economic analysis and policy decision in agricultural planning, food security allevation of rural poverty, rural development and agrian reforms. The present paper explores the participation trend of female workforce in agriculture for five leading SAARC nations i.e. Bangladesh, India, Nepal, Pakistan and Sri Lanka. The work participation rate (WPR) of female agricultural population is analyzed. A hierarchical clustering of economically active female agricultural population (EAFAP) of the SAARC nations is considered. Also an analysis has been done to study the influence of increased female literacy rate on female agricultural population. Finally an effort has been made to project the future participation in EAFAP.

Keywords: EAFAP, mean absolute percentage Error (MAPE) and WPR.

Gender mainstreaming in agriculture is a process to triumph inequalities between men and women that are causes of concern for all of us. Agricultural developments with the infusion of science and technology has ignored women's role in it. In developing countries, agriculture continues to absorb more than $2/3^{rd}$ of the female workforce. Irrespective of the geographical area, location and time-period women have been an important contributor or labour in the agricultural sector. The female labour force in the rural sector of all developing countries face the oppressive double drudgery of being both the major provider to family maintenance. But rural development policies rarely take into account their needs and problem. In most of the South- East Asian countries, where convention prevents women from working outside the home, care of livestock, processing of harvested crop, craft and other pursuits still provide them with a status of contributing materially to the family income. An analysis of international statistics (ILO, FAO, and NPC) showed that women constituted 38% of the agricultural labour force in developing countries. It is also estimated that 45.3% of the agricultural labour force consists of women (Dixon 1982).Throughout the 1980s and 1990s many researchers have attempted to overcome this through gendered empirical research studies for using on gender analysis and gender roles. The Country profile study is in use from Economic and Social commission for Asia and Pacific (ESCAP, 1995- 1997). Women constitute about half of the world's population, their labour contributes to 60% of the hours worked, contributing up to 30% of official hours. Yet women receive only 10% of the world's income and own less than 1% of the world's property (Gupta, 1987).

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The present work is an attempt to study the participation trend of Economically Active Female Agricultural Population (EAFAP) for five major SAARC nations namely Bangladesh, India, Nepal, Pakistan and Sri Lanka. Along with that the Work Participation Rate (WPR) of the female agricultural population in all the five nations is analyzed from the period of 1992- 2001. Also an analysis has been done to study the effect of improved female literacy on female agricultural population. Further the future participation of the female population in agriculture is projected upto 2015.

MATERIALS AND METHODS

The entire study has been done over five major countries among the SAARC namely; India, Bangladesh, Nepal, Pakistan and Sri Lanka. The data for Economically Active Agricultural Female Population (EAFAP) has been recorded from the Bulletin of SAARC Agricultural Data (2003) for a period from 1992- 2001. The above data have been utilized to study the different growth models and to estimate the growth pattern. The Growth Models that are taken into considerations are given below with their respective equations:

Growth model	Equations
Linear	$Y_t = b_0 + b_1 t$
Compound	$Y_t = b_0 e^{b_1 t}$
Exponential	$Yt = Y_0 (1+ r)^t$

Work Participation Rate of Economically Active Female Agricultural Population (Chatterjee and Ghosh, 2002).is calculated for each country under study as: WPR = EAFAP / TEAFP* 100. The ratio is the ratio of respective probabilities i.e. the odd ratio is

not only linear in t but also from the estimation point of view linear in the parameter also.

Analysis of natural Hierarchical grouping cluster of the countries considering different indicators like Coefficient of Variation, WPR and Compound Growth Rate is made here for the study (Johnson R.A. and Wichern D.W., 2000). The choices of measure of similarity are based on Euclidean distances between multidimensional observations. Further Hierarchical clustering method has been displayed by Dendrogram considering average linkage between the groups.

To measure the forecast accuracy and small value of this statistics Mean Absolute Percentage Error (MAPE) have been calculated as (Pankratz A., 1983)

$$MAPE = \frac{100}{m} \sum \frac{|en + 1|.}{Y_{n+1}}$$

RESULTS AND DISCUSSIONS

The Work Participation Rate (WPR) of Female Agricultural Population in all the five SAARC nations is shown in Table 1and the Average WPR is represented graphically in Graph 1 to have an outlook on the increasing participation of female in agriculture with mounting time.

Table 1: Year wise WPR female agricultural populations for the SAARC countries

	Country				
Year	**Bangladesh**	**India**	**Nepal**	**Pakistan**	**Sri Lanka**
1992	47.00	36.43	40.56	34.52	33.43
1993	47.32	36.51	40.67	35.32	33.6
1994	47.65	36.6	40.78	36.09	33.78
1995	47.75	36.68	40.88	36.84	33.94
1996	48.32	36.76	41.00	37.53	34.09
1997	49.27	36.69	41.11	38.04	34.10
1998	49.00	36.91	41.22	38.83	34.40
1999	49.35	36.99	41.32	39.47	34.56
2000	49.71	37.06	41.43	40.00	34.71
2001	50.00	37.11	41.54	40.69	34.83

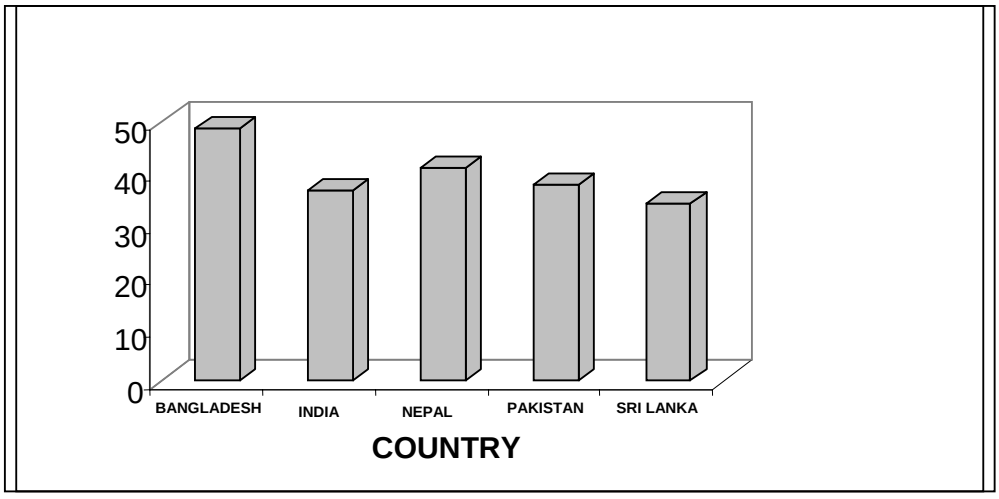
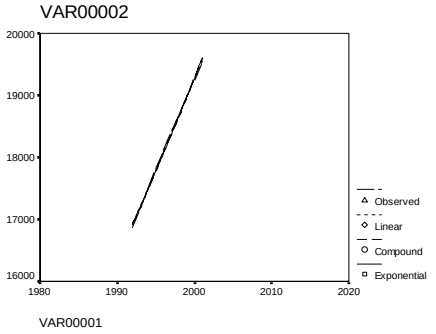


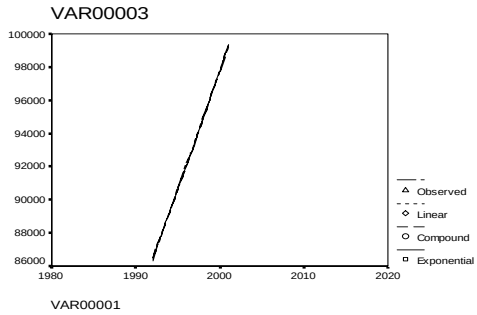
Fig 1: **Average WPR of female in SAARC nations**

The highest Work Participation Rate (WPR) of female is attained by Bangladesh followed by Nepal, Pakistan, India and Sri Lanka On the basis of best fitted coefficient values and values of R^2 for different growth models the observed and expected fitting of linear, compound and exponential trend equations are presented in graphs (Fig 2– 4) for all the five major SAARC countries. The values of regression coefficients are suggesting good fit of the equations for all the three models although the best fitted curves are viewed in case of linear trend.

Fig 2: **Growth trend of Bangladesh and India**

	Bangladesh			India		
	R^2	b_0	b_1	R^2	b_0	b_1
Linear	0.999	-570863	295.067	0.999	-3.E+06	1421.41
Compound	0.997	1.6E-10	1.0164	0.999	4.6E-09	1.0155
Exponential	0.997	1.6E-10	.0162	0.999	4.6E-09	.0153

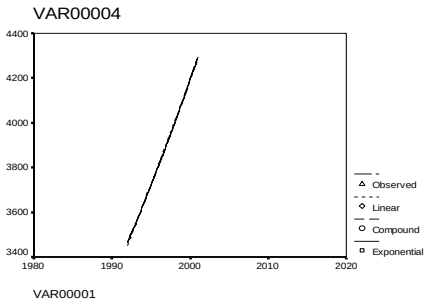


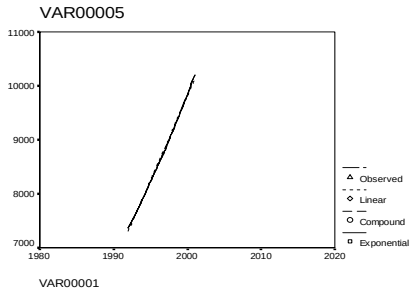


Bangladesh **India**

Fig 3: Growth Trend of Nepal and Pakistan

	R^2	**b_0**	**b_1**	R^2	b_0	b_1
Linear	0.999	-180114	92.1515	0.998	-617639	313.727
Compound	0.999	8.1E-18	1.0241	0.998	4.5E-28	1.0367
Exponential	0.999	8.1E-18	.0238	0.998	4.5E-28	.0361

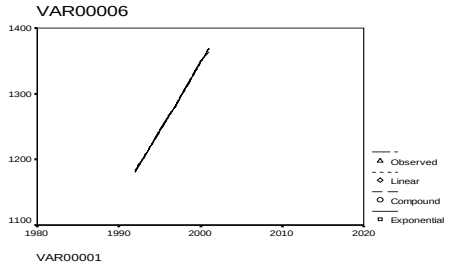




Nepal **Pakistan**

Fig 4: **Growth Trend of Srilanka**

	R^2	d.f	F	b_0	b_1
Linear	0.999	8	6067.38	-39938	20.6424
Compound	.998	8	3564.27	1.1E-11	1.0164
Exponential	.998	8	3564.27	1.1E-11	.0162



Countries	Linear Equations
Bangladesh	Yt = 570863 + 295.067
India	Yt = 3.E+06 + 1421.41
Nepal	Yt = 180114 + 92.1515
Pakistan	Yt = 617639 + 313.727
Sri Lanka	Yt = 39938 + 20. 6424

The above result clearly indicates that the growth patterns of EAFAP for the five major SAARC Countries are obeying a linear trend with the following equations.

Cluster Analysis

Cluster analysis for classifying the countries considering the indicators vide: WPR, CV and CGR of each country has been made and shown in the Dendrogram picturing the hierarchical order. We consider the hypothetical distance i.e. Euclidean distance between the pair of five countries for grouping. From the particular Dendrogram, it is being observed that Bangladesh and India form a homogeneous group at low level of distance. Proximity matrix reveals the closeness of India and Bangladesh in Table-8, which is minimum between any pair of countries. The just cluster extents its membership to Pakistan at a short level of distance. Pakistan differs from both Bangladesh and India in terms of percentage of coefficient of variation and compound growth rate while resemble no difference in term of WPR. On the other hand Sri Lanka keeps its own identity as a distinct cluster at low level of distance. Sri Lanka possesses low level of population growth among all the countries. Moreover, the country has a low level of WPR comparing to other countries. However, percentage of coefficient of variation of Sri Lanka does not differ much from Bangladesh and India. Dendrogram also represents Nepal as a lone member to a separate cluster, which differs, from others in term of WPR. Again Nepal differs from Bangladesh, India and Sri Lanka in terms of its high percentage of coefficient of variation of population growth rate. At five rescaled distance, three distinct cluster emerged -- one cluster comprising India, Bangladesh and Pakistan, another comprising Sri Lanka alone and the other having Nepal. At higher level of distance, Nepal keeps its dissimilarities from rest of the countries under study shown in Graph 7.

Table 2 : Proximity matrix

	Bangladesh	India	Nepal	Pakistan	Sri Lanka
Bangladesh	0	1.8	29.2	5.9	20.8
India	1.8	0	27.4	6.7	22.6
Nepal	29.2	27.4	0	30.5	49.9
Pakistan	5.9	6.7	30.5	0	20.3
Sri Lanka	20.8	22.6	49.9	20.3	0

Fig 7:

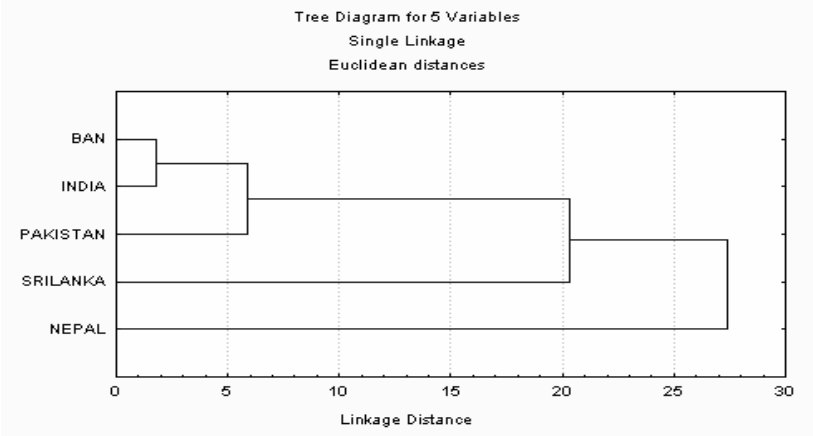


Table 3: Work participation and Literacy rates of SAARC Countries.

Country	Average WPR (%)	Literacy (%)
Bangladesh	48.54	11
India	36.77	38
Nepal	41.05	25
Pakistan	37.73	16
Sri Lanka	34.14	84

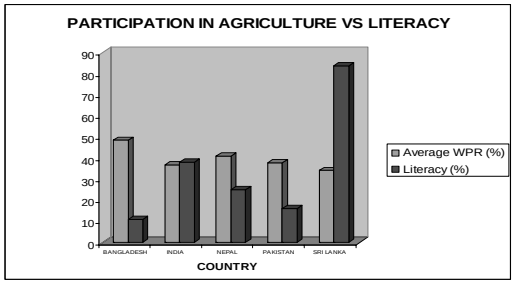


Fig 6

The above diagram (Graph 8) reveals a negative impact of growing literacy rate in the involvement of women in agriculture. As the literacy rate among the women is highest in Sri Lanka the participation in agriculture is lowest therein in comparison to that in other SAARC nations followed by India.

The projection of EAFAP upto 2015 for all the five SAARC countries are presented in Table 4.The MAPE have been calculated and it is seen that it varies from 0.27% to 0.63% which indicates that the forecast values have more than 99% accuracy by this method.

The above study examined critically the participation pattern of rural women workforce in various agricultural aspects in five major SAARC nations. From the study it can be concluded that female labours in agriculture have experienced a rapid transformation of workforce structure with growing span of time. Previously itself their role in agriculture was neglected and lack of proper documentation made that point stronger but interestingly with the present paper a clear scenario came up that, there has been an increased feminization of rural employment structure in the entire SAARC nations. The paper reveals that female participation trend in agriculture follows an increasing growth pattern. Thus they are becoming an integral part of sustainable agriculture. The Work Participation Rate (WPR) of women in agriculture is much higher in Bangladesh and Nepal as compared to India and Sri Lanka. The increasing literacy rate among them may be a constraint for it in those countries. The challenges ahead are more skilled work force and improved technology to overcome the crisis and for sustainable agricultural development with food security.

Again the concept of Gender budgeting came up as a socio- economic tool for ensuring gender equity in the development process and lays a strong emphasis on engendering public expenditure and policy of women participation in agriculture for all the countries across the world. The actual status and future prospect may influence the policy makers for proper Gender budgeting which is an integral part of sustainable social development for all the SAARC nations.

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Table 4: Projection of the population of the SAARC countries

Country	**Bangladesh**		**India**		**Nepal**		**Pakistan**		**Sri lanka**	
Year	Actual	Forecast	Actual	Forecast	Actual	Forecast	Actual	Forecast	Actual	Forecast
1992	16864	16888	86296	86316	3466	3444	7365	7285	1180	1180
1993	17191	17181	87801	87731	3549	3536	7642	7597	1202	1201
1994	17510	17474	89288	89146	3634	3628	7926	7909	1224	1221
1995	17820	17677	90756	90561	3721	3719	8221	8221	1245	1242
1996	18120	18061	92203	91976	3811	3811	8526	8533	1266	1262
1997	18120	18354	92203	93391	3811	3902	8526	8845	1266	1283
1998	18694	18647	95022	94806	3997	3994	9166	9157	1307	1303
1999	18974	18940	96391	96221	4092	4086	9499	9469	1328	1324
2000	19254	19234	97730	97636	4189	4177	9839	9781	1349	1345
2001	19531	19257	99148	99051	4301	4269	10188	10093	1364	1365
2002		19820		10046		4360		10406		1386
2003		20193		101881		4452		10718		1406
2004		20407		10326		4544		11030		1427
2005		20700		104711		4635		11342		1447
2006		20993		106126		4727		11654		1468
2007		21286		107541		4818		11966		1488
2008		21580		108956		4910		12278		1509
2009		21873		110372		5002		12590		1529
2010		22166		111787		5093		12902		1550
2011		22459		113202		5185		13214		1571
2012		22753		114617		5276		13526		1591
2013		23046		116032		5368		12838		1612
2014		23339		117447		5459		14150		1632
2015		23632		118862		5551		14462		1653
MAPE (%)		**0.29**		**0.26**		**0.48**		**0.75**		**0.31**