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Scientometrics analysis of Genetics Literature

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Scientometric studies are conducted in order to assess the quantitative and qualitative development of subjects especially in sciences. The present paper is an attempt to assess the qualitative and quantitative research output of genetics research based on the distribution of publications in different sub-specialities of genetics. The study compares the research priorities of 16 sub-specialities of genetics in 13 countries for two time-spans; 2002-2006 and 2007-2011. Comparative analysis is carried out based on the distribution of publications in different sub-specialities of genetics. Since the raw publication counts are confounded by the size of the countries and the size of the subject specialities, cross-national comparison is made using a relative indicator-Research Priority Index.

Keywords: *Scientometrics, Research Priority Index, Growth of Literature*

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1. Introduction

Genetics a discipline of biology is the science of genes, heredity, and variation in living organisms. It is one of the youngest and the fastest growing disciplines of science. Now-a-days, it is a multidisciplinary subject related not only to life science but also many physical sciences. Research plays a vital role for the development or growth of subject(s) both qualitatively and quantitatively. This change

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in the trend can be traced by generating numerical data on the basis of the empirical evidence available in the process of identifying the trends in research priorities in a field. Knowledge of genetics being basic to progress in biology, agriculture, medicine, biotechnology, forensic sciences and many other fields, results of such studies are found highly useful. Some of the notable studies in the field are: Garag [1], Sangam [2], and Katharine [3].

2. Methodology

The data has been collected from PubMed database. To download records from PubMed, sub-specialities along with field tag were used in advanced search. The field tags used were AD for country and PPDAT for year of publication. In this way all records pertaining to 13 cross nations for a particular year were downloaded. The results were analysed on the basis of their subject areas or sub-fields. The study compares the research priorities of 16 sub-specialities of genetics in 13 countries for two time-spans; 2002-2006 and 2007-2011. Comparative analysis is carried out based on the distribution of publications in different sub-specialities of genetics. Since the raw publication counts are confounded by the size of the countries and the size of the subject specialities, cross-national comparison is made using a relative indicator-Research Priority Index.

2.1. *Publication output of World in 16 sub-specialities of Genetics*

Publication output of World in 16 sub-specialities of Genetics is indicated in Table 1 and also represented in the form of graph in Figure 1. From the Table 1, it is evident that, Human Genetics and Molecular Genetics accounts for 61.17% of the total

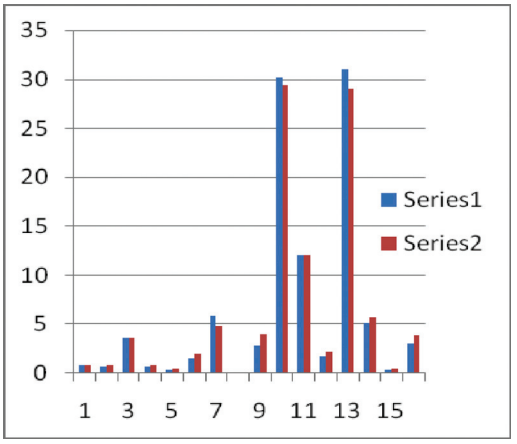

Figure 1

Growth comparison between sub-specialities of Genetics

Table 1

Publication output and World share of Publications

Branches	Number of Publications			
	2002-2006		2007-2011	
	World	%	World	%
Beh Gen	6697	0.86	7650	0.8
Cla Gen	5874	0.75	7382	0.77
Dev Gen	28377	3.62	34916	3.64
Con Gen	5392	0.69	7528	0.78
Eco Gen	2322	0.3	4531	0.47
Evo Gen	12336	1.58	18838	1.96
Gen Eng	45517	5.81	46489	4.84
Gen Int	1022	0.13	1463	0.15
Genomics	21955	2.8	38332	3.99
Hum Gen	236146	30.16	282105	29.38
Med Gen	93907	12	115770	12.06
Mic Gen	13362	1.71	20855	2.17
Mol Gen	242784	31.01	278570	29.01
Pop Gen	40263	5.14	54745	5.7
Psy Gen	2918	0.37	4310	0.45
Qua Gen	23996	3.07	36857	3.84
Total	**782868**	**100**	**960341**	**100**

Note: Beh Gen-Behavioural Genetics, Cla Gen-Classical Genetics, Dev Gen-Developmental Genetics, Con Gen-Conservation Genetics, Eco Gen-Ecological Genetics, Evo Gen-Evolutionary Genetics, Gen Eng-Genetic Engineering, Gen Int-Genetics of Intelligence, Genomics-Genomics, Hum Gen-Human Genetics, Med Gen-Medical Genetics, Mic Gen-Microbial Genetics, Mol Gen-Molecular Genetics, Pop Gen-Population Genetics, Psy Gen-Psychiatric Genetics, Qua Gen- Quantitative Genetics.

output in 2002-2006 and 58.38% in 2007-2011. Molecular Genetics accounts for the largest output of 31.01% in 2002-2006 and Human Genetics 29.38% in 2007-2011 block periods. Genetics of Intelligence accounts for the smallest output of 0.13% in 2002-2006 and 0.15% in 2007-2011. It clearly indicates the importance of trends in all the 16 branches which has increased over a period of ten years.

2.2. *Publication output and World share of publications of major countries*

The publication output and world share of publications of major cross-nations is shown in Table 2 and also is represented in form of graph in Figure 2.

The top five countries Viz., USA, Japan, Germany, China and France account for about 56.77% of the world output in 2002-2006 and 53.17% of the world output in 2007-2011.

Table 2

Publication output and World share of major countries

Country	Number of Publications			
	2002-2006		2007-2011	
Argentina	1691	0.3	2388	0.35
Australia	10532	1.87	13123	1.93
Brazil	4758	0.84	7869	1.16
Canada	17570	3.12	21388	3.15
China	29329	5.21	60796	8.94
France	22934	4.07	24519	3.61
Germany	33820	6.01	37188	5.47
India	5478	0.97	10177	1.5
Italy	16930	3.01	21278	3.13
Japan	48629	8.64	47249	6.95
Mexico	2463	0.44	3270	0.48
S.Africa	1030	0.18	1585	0.23
USA	184945	32.84	191642	28.2
Total	**380109**	**67.5**	**442472**	**65.1**

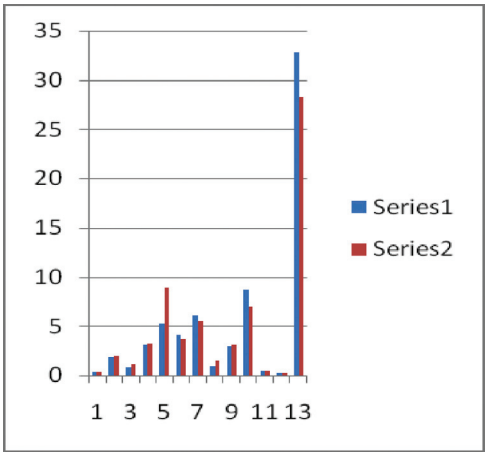

Figure 2

Growth comparison between different countries

The decline during 2007-2011may be due to decline in world share of top four countries Viz., USA, France, Germany and Japan. Whereas, china's share has increased from 5.21% in 2002-2006 to 8.94% in 2007-2011. South Africa accounts for the smallest output of 0.18% in 2002-2006 and 0.23% in 2007-2011.

Among 13 countries selected for the present study, USA leads with 376587 articles accounting for 61.04%; followed by Japan with 95878 forming 15.59%; China with 90125 forming 14.15%; Germany with 71008 forming 11.48%; France with 47453 forming 7.68%; Canada with 38958 forming 6.27%; Italy with 38208 forming 6.14%; Australia with 23655 forming 3.8%; India with 15655 forming 2.47%; Brazil with 12627 forming 2%; Mexico with 5733 forming 0.92%; Argentina with 4079 forming 0.65%; and followed by South Africa with 2615 forming 0.41%.

2.3. *Publication performance of Major countries*

The distribution of publications of major countries in different sub-specialities of genetics for 2002-2006 and 2007-2011 is presented in Table 3 and 4 respectively. The publications in different countries are arranged in the form of a matrix where the rows represent the countries and columns the sub-specialities.

The data in table 3 covers articles published in different branches of genetics during the block period 2002-2006. Columns represent 16 branches and the rows 13 different countries. The data reveals that major contribution is from USA (555342) followed by Japan (66875); China (46921);Germany (44847); Italy (42674); France (25611); Canada (23041); Australia (16226); India (8867); Brazil (5189); Mexico (2989); Argentina (1663) and South Africa (1620).

Maximum number of articles published during the block period among the branches of genetics is from Human Genetics (370763) followed by Molecular Genetics (173255); Medical Genetics (151009); Genetic Engineering (33217); Population Genetics (24960); Developmental Genetics (21464); Quantitative Genetics (17253); Genomics (15769); Microbial Genetics (8820); Evolutionary Genetics (8377); Behavioural Genetics (5168); Conservation Genetics (3794); Classical Genetics (3726); Psychiatric Genetics (2011); Ecological Genetics (1496) and Genetic Intelligence (813).Which indicates the importance of the branch Human Genetics. Human body encompass a complicated structural and functional organization which needs to be properly understood. Study of human genetics can be useful as it can answer questions about human nature, understand the diseases and development of effective disease treatment, and understand genetics of human life.

The data in Table 4 reveals articles published in 16 branches, represented in different columns and 13 countries in rows during 2007-2011. In the present block period also, it is USA which has maximum number of articles published (300091)however,it is followed by China (96578); Japan (62708); Germany (51459); France (28925); Italy (28768); Canada (28742); Australia (20169); India (17114); Brazil (9166); Mexico (4120); Argentina (2756) and South Africa (2552).

Branch wise contribution indicates maximum growth in the field of Human Genetics with the major contribution of 192692 articles during this block period, followed by Molecular Genetics (190981); Medical Genetics (76975); Population Genetics (33645); Genetic Engineering (32846); Genomics (26092); Developmental Genetics (25499); Quantitative Genetics (25490); Microbial Genetics (13646); Evolutionary Genetics (12474);

Tabal 3

Publication output of major countries in branches of Genetics of (2002-2006)

Country	Beh Gen	Cla Gen	Dev Gen	Con Gen	Eco Gen	Evo Gen	Gen Eng	Gen Int	Genomics	Hum Gen	Med Gen	Mic Gen	mol Gen	Pop Gen	Psy Gen	Qua Gen	Total
Argentina	9	26	46	18	12	35	110	2	9	359	21	54	755	160	0	47	1663
Australia	88	102	536	171	71	267	710	35	635	4623	2242	405	4771	1017	44	509	16226
Brazil	31	75	109	60	34	107	170	9	80	1339	295	162	1969	566	27	156	5189
Canada	256	174	1040	205	82	485	1450	47	739	6800	1845	382	7522	1210	87	717	23041
China	50	154	1044	267	118	300	3101	30	929	15343	9293	559	11552	2404	31	1746	46921
France	159	438	1219	271	129	592	1551	29	678	7811	476	598	8860	1642	50	1108	25611
Germany	231	624	1730	320	142	891	2565	60	1246	13670	3108	727	15945	1681	173	1734	44847
India	24	67	142	98	21	108	590	10	425	2082	1075	271	3108	704	17	125	8867
Italy	129	214	576	158	63	297	1226	33	443	25879	4370	395	6798	1337	123	633	42674
Japan	307	241	2563	222	123	552	4073	63	971	21706	9493	1173	21075	2154	104	2055	66875
Mexico	21	28	111	43	14	70	177	7	66	650	73	56	1352	234	12	75	2989
S. Africa	9	9	14	14	9	63	50	4	44	386	195	60	563	165	13	22	1620
USA	3854	1574	12334	1947	678	4610	17444	484	9504	270115	118523	3978	88955	11686	1330	8326	555342
Total	**5168**	**3726**	**21464**	**3794**	**1496**	**8377**	**33217**	**813**	**15769**	**370763**	**151009**	**8820**	**173225**	**24960**	**2011**	**17253**	**841865**

Tabal 4

Publication output of major countries in branches of Genetics of (2007-2011)

Country	Beh Gen	Cla Gen	Dev Gen	Con Gen	Eco Gen	Evo Gen	Gen Eng	Gen Int	Genomics	Hum Gen	Med Gen	Mic Gen	mol Gen	Pop Gen	Psy Gen	Qua Gen	Total
Argentina	14	29	94	38	36	69	117	3	45	567	117	112	1145	278	7	85	2756
Australia	94	143	742	260	127	485	742	44	1056	5334	2523	501	5739	1403	99	877	20169
Brazil	59	134	197	111	54	249	269	13	205	2444	598	261	3190	952	62	368	9166
Canada	301	231	1305	321	205	769	1427	75	1612	8022	2065	655	8681	1669	138	1266	28742
China	202	422	2485	785	303	1095	5703	116	3187	28913	16643	2125	24666	5144	98	4691	96578
France	219	528	1349	338	263	934	1352	55	1342	8396	745	845	9002	1988	93	1476	28925
Germany	332	632	2151	412	271	1252	2414	96	2181	14942	4049	984	16935	2086	262	2460	51459
India	41	125	314	191	69	230	1083	32	934	3957	1965	591	5825	1310	39	408	17114
Italy	187	314	801	213	86	497	1284	49	1012	9730	1846	558	9031	1830	190	1140	28768
Japan	434	270	2576	268	164	729	3583	51	1472	196880	8017	1310	19163	2412	181	2398	62708
Mexico	19	29	112	47	32	149	194	13	112	952	141	125	1669	419	11	96	4120
S. Africa	8	12	25	48	23	87	107	0	94	603	208	116	898	247	17	59	2552
USA	4095	1822	13348	2201	1287	5929	14571	647	12840	89152	38058	5463	85037	13907	1568	10166	300091
Total	**6005**	**4691**	**25499**	**5233**	**2920**	**12474**	**32846**	**1194**	**26092**	**192692**	**76975**	**13646**	**190981**	**33645**	**2765**	**25490**	**653148**

Behavioural Genetics (6005); Conservation Genetics (5233); Classical Genetics (4691); Ecological Genetics (2920); Psychiatric Genetics (2765) and Genetic Intelligence (1194).

The decline in the number of articles from Human Genetics in the later block period may be due to the complexity of the human genome. The project began in October 1990 and was initially headed by Ari Patrinos, head of the Office of Biological and Environmental Research in the U.S. Department of Energy's Office of Science. Francis Collins directed the National Institutes of Health National Human Genome Research Institute efforts. A working draft of the genome was announced in 2000 and a complete one in 2003, with further, more detailed analysis still being published.

2.4. *Priority profiles of Major countries:*

The raw count alone does not convey much information. So these figures are confounded by the size of the countries and the size of the subject specialities. Hence, an index called Relative Priority Index (PI) is computed for cross national comparison using formula

$$(PI) - \frac{n_{ij} l_{ni}}{n_{.j} l_{n.}} \times 100$$

The value $PI = 100$ indicates that the research priority of a country for a given sub-speciality corresponds precisely to the average of all countries i.e. average priority; $PI > 100$ reflects higher-than-average priority, and $PI < 100$ lower-than-average priority. It has to be kept in view that (by virtue of the definition of *PI*) no country can have high priority in all sub-specialities.

The profile of research priorities of major countries are presented in Table 5 and 6 for two time-spans; 2002-2006 and 2007-2011. These tables indicate the differences in the priority accorded to different sub-specialities by different countries.

From the values of *PI*, we can compare:

(i) The research priorities of a country for different sub-specialities of genetics in a given time span;

(ii) The research priorities of different countries for a given sub-speciality in a given time span; and

(iii) The research priorities of a country for a given sub-speciality at different time span.

In Table 5 and 6, the PI value for each variable in the table 3 and 4 is computed using PI formula i.e. for both the block period 2002-2006 and 2007-2011. The priority index of different countries is arranged again in the form of a matrix where the rows represent the countries and columns the sub-specialities. So, the row vector represents the priority profiles of countries, whereas the column vectors geographical profiles of sub-specialities.

Tabal 5

Profile of Research Priorities of major countries (2002-2006)

Country	Beh Gen	Cla Gen	Dev Gen	Con Gen	Eco Gen	Evo Gen	Gen Eng	Gen Int	Genomics	Hum Gen	Med Gen	Mic Gen	mol Gen	Pop Gen	Psy Gen	Qua Gen	Total
Argentina	88	353	108	240	406	212	168	125	29	49	7	310	221	325	0	138	2779
Australia	88	142	130	234	246	165	111	223	209	65	77	238	143	211	114	153	2549
Brazil	97	327	82	257	369	207	83	180	82	59	32	298	184	368	218	147	2990
Canada	181	171	177	197	200	212	159	211	171	67	45	158	159	177	158	152	2595
China	17	74	87	126	142	64	168	66	106	74	110	114	120	173	28	182	1651
France	101	386	187	235	283	232	153	117	141	69	10	223	168	216	82	211	2814
Germany	84	314	151	158	178	200	145	139	148	69	39	155	173	126	161	189	2429
India	44	171	63	245	133	122	169	117	256	53	68	292	170	268	80	69	2320
Italy	49	113	53	82	83	70	73	80	55	138	57	88	77	106	121	72	1317
Japan	75	81	150	74	104	83	154	98	78	74	79	167	153	109	65	150	1694

Tabal 6

Publication output of major countries in branches of Genetics of (2007-2011)

Country	Beh Gen	Cla Gen	Dev Gen	Con Gen	Eco Gen	Evo Gen	Gen Eng	Gen Int	Genomics	Hum Gen	Med Gen	Mic Gen	mol Gen	Pop Gen	Psy Gen	Qua Gen	Total
Argentina	55	147	87	172	292	131	84	60	41	70	36	195	142	196	60	79	1847
Australia	51	99	94	161	141	126	73	119	131	90	106	119	97	135	116	111	1769
Brazil	70	204	55	151	132	142	58	78	56	90	55	136	119	202	160	103	1811
Canada	114	112	116	139	160	140	99	143	140	95	61	109	103	113	113	113	1870
China	23	61	66	101	70	59	117	66	83	101	146	105	87	103	24	124	1336
France	82	254	119	146	203	169	93	104	116	98	22	140	106	133	76	131	1992
Germany	70	171	107	100	118	127	93	102	106	98	67	92	113	79	120	122	1685
India	26	102	47	139	90	70	126	102	137	78	97	165	116	149	54	61	1559
Italy	71	152	71	92	67	90	89	93	88	115	54	93	107	123	156	102	1563
Japan	75	60	105	53	58	61	114	44	59	106	108	100	105	75	68	98	1289
Mexico	50	98	70	142	174	189	94	173	68	78	29	145	139	197	63	60	1769
S. Africa	34	65	25	235	202	179	83	0	92	80	69	218	120	188	157	59	1806
USA	148	85	114	92	96	103	97	118	107	101	108	87	97	90	123	87	1653
Total	**869**	**1610**	**1076**	**1723**	**1803**	**1586**	**1220**	**1202**	**1224**	**1200**	**958**	**1704**	**1451**	**1783**	**1290**	**1250**	**21949**

For example, France has given maximum priority to Classical Genetics in 2002-2006 as well as in 2007-2011. But gives minimum priority to Medical Genetics in both 2002-2006 and 2007-2011. Japan has given more priority (*PI* = 98) to Genetics of Intelligence in 2002-2006, but has given less priority (*PI* = 44) in 2007-2011.

3. Relative Priority

Using the values of PI, we can identify the priorities and potential holes in the research agenda of 13 countries. For this purpose, we use a 7-point scale for qualitative description of research priorities, suggested by Nagpaul and Sharma[7].

7 Point Scale for qualitative description of research priorities,

Scale	Values	Description
PI<25	1	Field of neglect
25<PI<55	2	Field of very low priority
55<PI<85	3	Field of low priority
85<PI<115	4	Field around the mean position of the country
115<PI<145	5	Field of marginal priority
145<PI<175	6	Field of high priority
PI>175	7	Field of thrust

In Table 7, based on the 7-point scale, the sub-specialities of relative priority of table 5 and 6 are listed. Again rows represent countries and columns qualitative description of research priorities. One can detect from this table the change in the priorities of different sub-specialities. For example, Population Genetics and Microbial Genetics with an area of thrust priority for India in 2002-2006, becomes an area of high priority in 2007-2011; Behavioural Genetics with an area of average priority for USA in 2002-2006, becomes an area of high priority in 2007-2011.Microbial, Conservation, Population, Molecular, Classical, Ecological and Evolutionary genetics have been given either trust or high priority by most of the countries.

All countries except Italy, have given priority to Human Genetics during recent years. Few sub-specialities are in the area of neglect. For example, Behavioural Genetics is an area of neglect for China and Medical Genetics is an area of neglect for France during both block periods.

3.1. *Principal Component Analysis*

The data for the study consists of 16 sub-specialities of genetics and 13 countries for two time spans 2002-2006 and 2007-2011. The principal component analysis seeks the linear combination of the original variable, which has maximal variance. The examination of this

Table 7

Areas of Relative Priority 2002-2006

Country	Year	Trust Priority	High Priority	Marginal Priority	Average Priority	Low Priority	Very low	Neglect
Argentina	2002-06	CIG,CG,EG, EVG,MiG, MoG,PG	GE	GI	QI,QG	BG,DG	G,HG	MG,PsG
	2007-11	PG,MiG EG	CG,CIG	EvG,MoG	DG	GE,GI,HG, PsG,QG	BG,G,MG	
Australia	2002-06	CG,EG,GI, G,MIG,PG	EvG,QG	CIG,DG,MoG	BG,GE,PsG	MG,HG		
	2007-11	CG	EG,EvG,G GI,MiG,PsGPG	CIG,DG,HG, MG, MoG,QG	GE	BG		
Brazil	2002-06	CIG,CG,EG, EvG,GI,PG, MiG,MoG,PsG	QG		BG	DG,GE,G,HG	MG	
	2007-11	CIG,PG CG, PsG	EG,EvG,MiG, MoG	HG,QG	BG,GE,GI,G	DG,MG		
Canada	2006	BG,DG,CG,EG, EvG,GI,PG	CIG,GE,G,MiG, MoG,PsG,QG		HG	MG		
	2007-11		EG	DG,CG,G, EvG,GI	BG,CIG,GE, HG,MiG,MoG, PG,PsG,QG	MG		
China	2002-06	QG	GE,PG	CG,EG,MoG	DG,G,MG, MiG	CIG,EvG, GI,HG	PsG	BG
	2007-11		MG	GE,QG	CG,HG,PG, MiG,MoG	CIG,DG,EG, EvG,GI,G	BG,PsG	
France	2006-06	CIG,DG,CG, EG, EvG,PG, MiG,QG	GE,MoG	GI,G	BG	HG,PsG	MG	
	2007-11	CIG,EG	CG,EvG	DG,G,MiG, PG,QG	GE,GI,HG, MoG	BG,PsG		MG

Areas of Relative Priority 2007-2011

Country	Year	Trust Priority	High Priority	Marginal Priority	Average Priority	Low Priority	Very low	Neglect
Germany	2002-06	CIG,EG,EvG	DG,CG,G,MiG, MoG,PsG	GE,GI,PG	BG,HG	MG		
	2007-11	CIG	EG,EvG,PsG, QG	DG,CG,GE,GI, MiG,HG,G, MoG,PG	BG,MG			
India	2002-06	CG,MiG,PG	CIG,GE,MoG	EG,EvG,GI	DG,MG,QG,PsG	BG,HG		
	2007-11		MiG,PG	CG,GE,G,MoG	CIG,EG,GI,MG	EvG,HG,	BG,DG,PsG	
Italy	2002-06			HG,PsG	CIG,MiG,PG	CG, EG,EvG,GE,GI, MG, MOG,QG	BG,DG,G	
	2007-11		CIG	PG	CG,EvGE,GI,G, MiG, QG,HG, MoG	BG,DG,EG	MG	
Japan	2002-06	GG,GE,MiG, MoG,QG			EG,GI,PG	BG,CIG,CG, EvG,G,GH,MG,PsG		
	2007-11				DG,GE,HG,MG, MiG,MoG,QG	BG,CIG,EG, EvG,G,PG,PsG	CG,GI	
Mexico	2002-06	CIG,CG,EG, EvG,GI,MiG, MoG,PG	DG,GE,PsG	G,QG	BG	HG	MG	
	2007-11	EvG,PG	EG,GI	CG,MiG,MoG	CIG,GE	DG,G,HG,	PsG,QG	BG,MG
South Africa	2002-06	CG,EG,EvG, GI,MiG,PG,PsG	MoG	CIG,G	BG	GE,MG,QG	DG,HG	
	2007-11	CG,EG,EvG,MiG,PG	PvG	MoG	G	CIG,GE,HG,MG,QG	BG	DG,GI
USA	2006-06			MG	BG,DG,GI,G, HG,PsG	CIG,CG,EG,EvG, GE,MiG	MoG,PG,QG	
	2007-11		BG	GI,PsG	CIG,DG,CG,EG, EvG, GE,G,HG, MG, MiG,MoG, PG,QG			

might seek sensible a large variance "separates out" the countries. The countries can then be ranked with respect to this Standard Linear Combination (SLC).

More generally, principal component analysis looks for a few linear combinations which can be used to summarize the data losing in process as little information as possible. The attempt reduces the dimensionality of the field.

In the cited profiles of different sub-specialities of genetics for two spans 2002-06 and 2007-11, all the 16 sub-specialities are extracted. Except Molecular genetics, remaining shows hardly 1.65% for 2002-06 and 2.33% for 2007-11 (Table 8). Therefore it is necessary to consider only one sub-speciality, which explains more than 98% of the total variance.

The values are calculated by using SPSS package indicating 98% of variation in the data. During both spans, data reveals that out of 16 sub-specialities of genetics only one sub-speciality is important which occupies the percentage of variation equal to 98%. The value and percentage is presented in table 8. So the only factor being molecular genetics contributing about 98% is seen to be very important.

Table 8 indicates Molecular genetics as first factor contributing about 98.4%,the remaining 2% contribution is shared by 15 sub-specialities for block period 2002-06. For the block

Table 8

Values of the factors for two block periods 2002-06 and 2007-11

Factor	values for 2002-06			values for 2007-11		
	Values	%	Cum %	Values	%	Cum %
1	16.6040	97.6680	97.6680	15.7410	98.3830	98.3830
2	0.2530	1.4900	99.1580	0.1320	0.8250	99.2080
3	0.0852	0.5010	99.6590	0.0816	0.5100	99.7180
4	0.0342	0.2010	99.8610	0.0227	0.1420	99.8600
5	0.0113	0.0664	99.9270	0.0099	0.0620	99.9220
6	0.0065	0.0381	99.9650	0.0055	0.0347	99.9560
7	0.0030	0.0176	99.9830	0.0032	0.0199	99.9760
8	0.0016	0.0094	99.9920	0.0024	0.0151	99.9910
9	0.0010	0.0057	99.9980	0.0011	0.0067	99.9980
10	0.0002	0.0013	99.9990	0.0002	0.0015	99.9990
11	0.0001	0.0006	100.0000	0.0001	0.0005	100.0000
12	0.0001	0.0004	100.0000	0.0000	0.0001	100.0000
13	0.0000	0.0000	100.0000	0.0000	0.0000	100.0000
14	0.0000	0.0000	100.0000	0.0000	0.0000	100.0000
15	0.0000	0.0000	100.0000	0.0000	0.0000	100.0000
16	0.0000	0.0000	100.0000	0.0000	0.0000	100.0000

Note: Extraction Method: Principal Component Analysis.

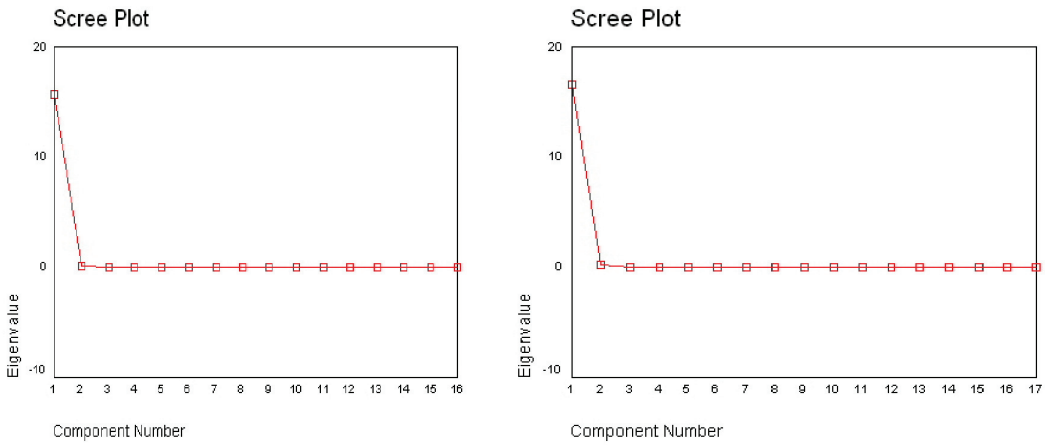

Figure 3

Percentage variation for block period 2002-06 & 2007-11

period 2007-11, 98% of share is represented by Human genetics and remaining by 15 sub-specialities.

The data indicates 100% of the total variation in the data and the eigen values for each factor, their percentage is given in Table 8 and Figure 3 explains about the percentage of variations and importance of sub-specialities in genetics for the time span 2002-2011.

During the last decade, considerable attention has been given to Genetics research. Most of the papers deal with molecular genetics relating to human, plants and animals. The reason for such output in molecular genetics is with the availability of sophisticated equipments and technologies which has enabled the researchers to analyse the science of inheritance at the molecular level.

3.2. *Comparison between two major sub-specialities during two block periods:*

In the first block period (2002-2006), both Molecular genetics and Human Genetics have exhibited the parallel growth with minor difference. This parallel growth might be because of the developments in the Human Genome Project which was started in 1990 and aimed to sequence the whole genome and fix the position of all the genes within the human genome by 2000. Scientist all over the world concentrated on analysing the human genome and many countries have financed the HGP. To start with, HGP was planned to be completed in 10 years i.e. 1990-2000.

In the second block period (2007-2011), there is considerable decline in the growth of both sub-specialities Molecular and Human Genetics. This might be because 80% of the human genome was analysed till 2010 and 20% of genome remained unanalysed due to the complexity of human genome and multigenic factors (single character governed by multiple genes).

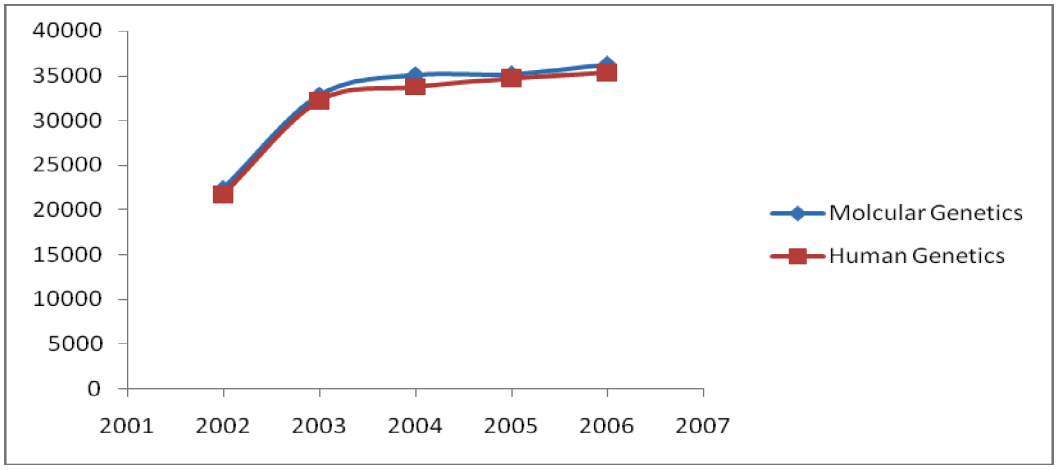

Figure 4 (a)

Growth of two major fields during first block period (2002-06)

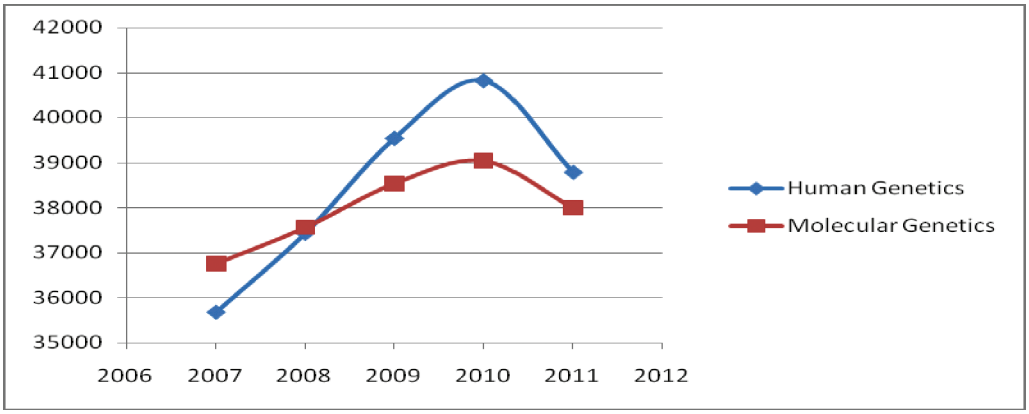

Figure 4 (b)

Growth of two major fields duirng second block period (2007-11)

The total number of articles in Molecular genetics during the first period is 161586 and Human Genetics is 157883 (Figure 4a). In the second block period Molecular genetics has 189919 articles to its credit and Human genetics has 192263 articles. So, when both block periods are considered there is a substantial growth seen in both disciplines. But, after 2010 there is a considerable decline (Figure 4b) in both the fields which might be because of the mere completion of HGP.

Table 9

Growth of two major fields during first block period (2002-06) and (2007-11)

Year	Molecular Genetics	Growth	Human Genetics	Growth
2002	22325		21743	
2003	32803	46.93	32233	48.25
2004	35064	6.89	33787	4.82
2005	35158	0.27	34727	2.78
2006	36236	3.07	35393	1.92
Year	**Human Genetics**	**Growth**	**Molecular Genetics**	**Growth**
2007	35678		36762	
2008	37431	4.91	37566	2.19
2009	39542	5.64	38544	2.60
2010	40825	3.24	39047	1.31
2011	38787	-4.99	38000	-2.68

4. Conclusion

Science indicators are used both for descriptive as well as analytical purposes. On one hand these indicators identify trends, make comparisons or give explicit information on specific science policy issue; while on the other hand, these are used as an aid to theoretical understanding of casual structure related to science and technology systems.

On the basis of above analysis the following conclusions may be drawn:

(1) Publication output of the world in 16 sub-specialties of Genetics shows that, "Human Genetics" and "Molecular Genetics" account for 61.17 % of the total output in 2002-2006 and 58.38% in 2007-2011.

(2) The major contributors to Genetics literature are USA, Japan, Germany, China and France together accounting 56.77% of the world output in 2002-2006 and 53.17% in 2007-2011.

(3) The Indian contribution is meager in both the block periods i.e. 2.47%

(4) South Africa accounts for the lowest output in genetics literature i. e 0.18% in 2002-2006 and 0.23 in 2007-2011.

(5) Among the sub-specialties, Molecular genetics accounts for the largest output of 31% in 2002- 2006, whereas "Human Genetics" 29% in 2007-2011. The sub-speciality Genetic Intelligence accounts for the lowest output of 0.1% in 2002-2006 and 0.2% in 2007-2011.

(6) We can observe the change in the priorities of different sub-specialties. Population Genetics and Microbial Genetics with an area of thrust priority for India in2002-2006, becomes an area of high priority in 2007-2011. "Behavioural Genetics" with an area of average priority for USA in 2002-2006, becomes an area of higher priority in 2007-2011.

(7) Few sub- specialities are in the area of neglect. For example, Behavioural Genetics is an area of neglect for China and Medical Genetics is an area of neglect for France during both block periods.

(8) PCA analysis highlights "Molecular Biology" with the maximum growth of 98% which indicates the priority of the field throughout the world.

(9) All the major countries have a mixed profile.

References

[1] Garag, K. C. *et al.* Scientometric profile of genetics and heredity research in India. *Annals of Library and Information Studies*. Vol. 57, 2010, pp. 196–206.

[2] Sangam, S. L. Liang, Liming and Gireesh A. Ganjihal. Modeling the Growth of Indian and Chainese Liquid Crystals Literature as reflected in Science Citation index (1997-2006). Scientometrics, (DOI 10.1007/s11192-009-0079-x), Vol. 84(1), 2010, pp. 49–52.

[3] Katherine W. McCain and Kathleen Turner. Citation context analysis and aging patterns of journal articles in molecular genetics. *Scientometrics*, Vol. 17(1-2), 1989, pp. 127–163.

[4] Nagpaul, P. S. and Sharma, L. Science in the eighties: A typology of countries based on inter-field priorities. *Scientometrics*, Vol. 34(2), 1995, pp. 263–283.