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SCIENTOMETRIC DIMENSIONS OF INNOVATION COMMUNICATION PRODUCTIVITY SYSTEM

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Communication activities of Sugarcane Breeding Institute (SBI) during the past 75 years (1912-1987) are quantitatively documented for general characteristics, collaborations, core channels of communications and creativity of researchers. A communicator's productivity and the distribution of papers to a number of domains are classified and Pearson Product Moment Correlation Coefficients are calculated. Genderwise creativity, participation in joint authorships, communications, theses, etc. from SBI are classified year-wise, domain-wise and university-wise. Breeding, genetics & cytogenetics, entomology, pathology and physiology & biochemistry domains show high communication productivity. The study may be of interest to all those interested in evaluating research communication performance of departments in universities, institutions, industries and R & D laboratories.

INTRODUCTION

The organisation of science and its productivity analysis results in scientometrics. Scientometrics has emerged as a new discipline which uses bibliometric methods for evaluation and measurement of scientific progress and its social relevance.

Scientometrics of the publications in a field of specialisation for a specific period in a specific region reliably reflects its development trend. Publications are also a reliable source of information to measure the productivity trend of authors and provide reliable data for quantitative analysis.

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Review of the periodical literature reporting researches in any field is useful in gaining an insight into the general direction of research and to ascertain the future needs in the context of changing perspectives of a particular discipline.

The communications emanating from Sugarcane Breeding Institute (SBI), Coimbatore, are studied to ascertain the communication productivity pattern in sugarcane research. The discipline of sugarcane improvement involves six domains, namely - botany (A), genetic resources (B), breeding (C), genetics & cytogenetics (D), mutation (E) and tissue culture (F). The discipline of sugarcane production involves three domains, namely - physiology & biochemistry (G), agricultural chemistry (H) and agronomy & soil science (I). The discipline of sugarcane protection involves three domains, namely - pathology (J), entomology (K) and nematology (L). The staff of the domain of statistics (M) assists all scientists and technicians of Sugarcane Breeding Institute in data processing, thus enabling the generation of information through analyses of the recorded data. The staff of the domains of extension (N) and library (O) gathers relevant information generated by researchers and supplies it to the clients, namely - farmers and industries, and further collects the information on problems faced by the clients and gives feed-back to the concerned scientists. So, M, N and O domains are mainly service oriented, whereas other domains are purely research oriented.

The study pertains to information on an individual cash crop, i.e. sugarcane which is top ranking among all crops for calories production per unit area [1] and has vital significance in the context of all round regional socio-economic development.

Researchers at Sugarcane Breeding Institute generate information through experimental investigations and disseminate it through communications to their fellow sugarcane researchers elsewhere, managers of sugar industries, administrators in the Government, teachers and students in the universities, farmers and the society in general.

OBJECTIVES AND SCOPE

The objectives of the present study are:

a) To understand characteristics of communications,

b) To identify core communication dissemination channels,

c) To ascertain the prolific innovation communication stars,

d) To calculate Pearson Product Moment Correlation, and

e) To note gender-wise participation in research.

The present study encompasses only one crop - sugarcane and publications from only one institute, i.e. SBI, and confines itself to the quantitative assessment only. A microtheme of the kind dealt herein may not throw much light on all aspects of the multidimensional innovation communication system at macrolevel. The contribution to science differs from paper to paper. The differences between disciplines and institutions occur with regard to the communication behaviour. Thus,the study will serve to project the partial indicators of research performance. However, these limitations will not stand in the way of highlighting past activities and current state-of-art of research to researchers, administrators, extension personnel, planners and policy makers.

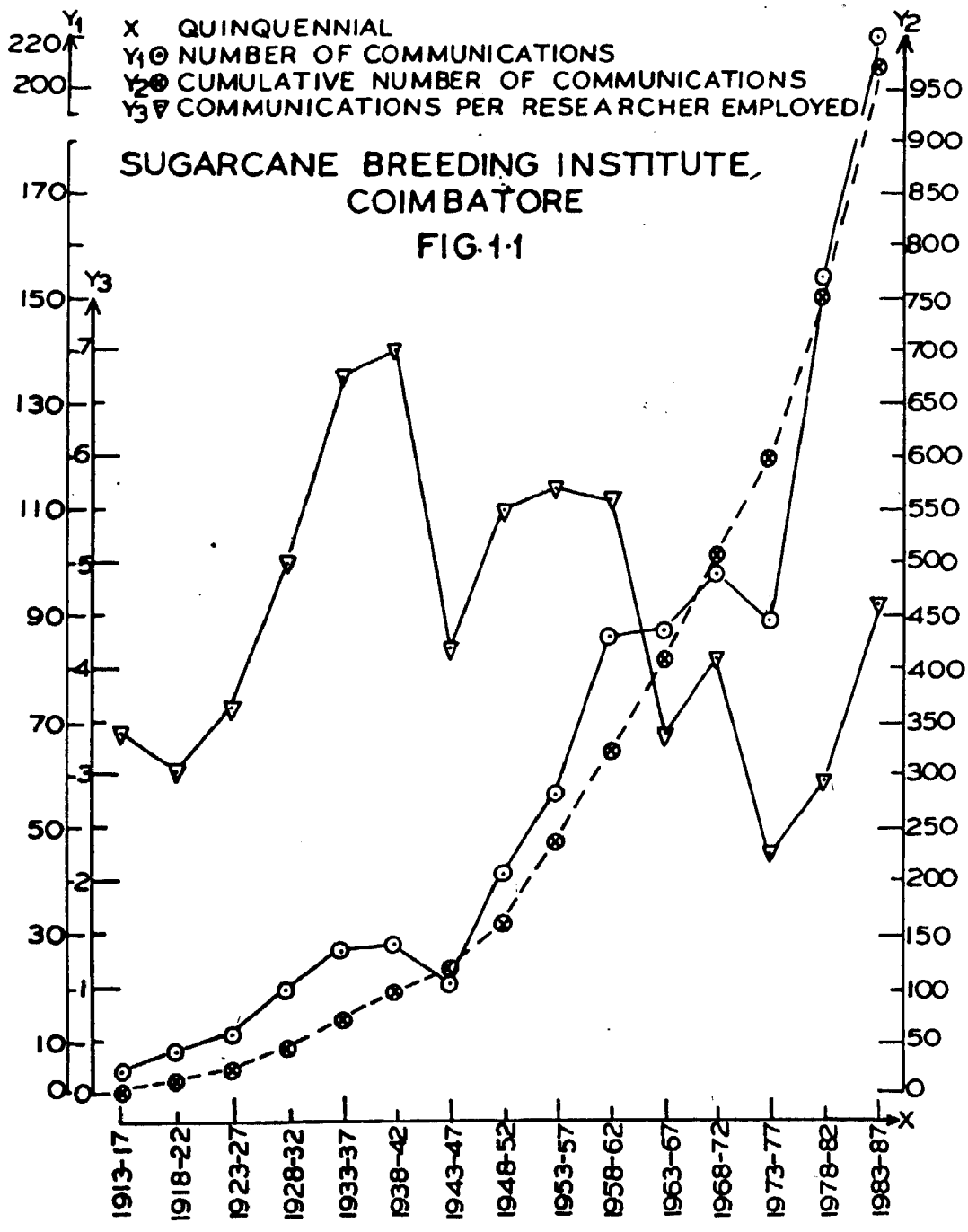
METHODOLOGY

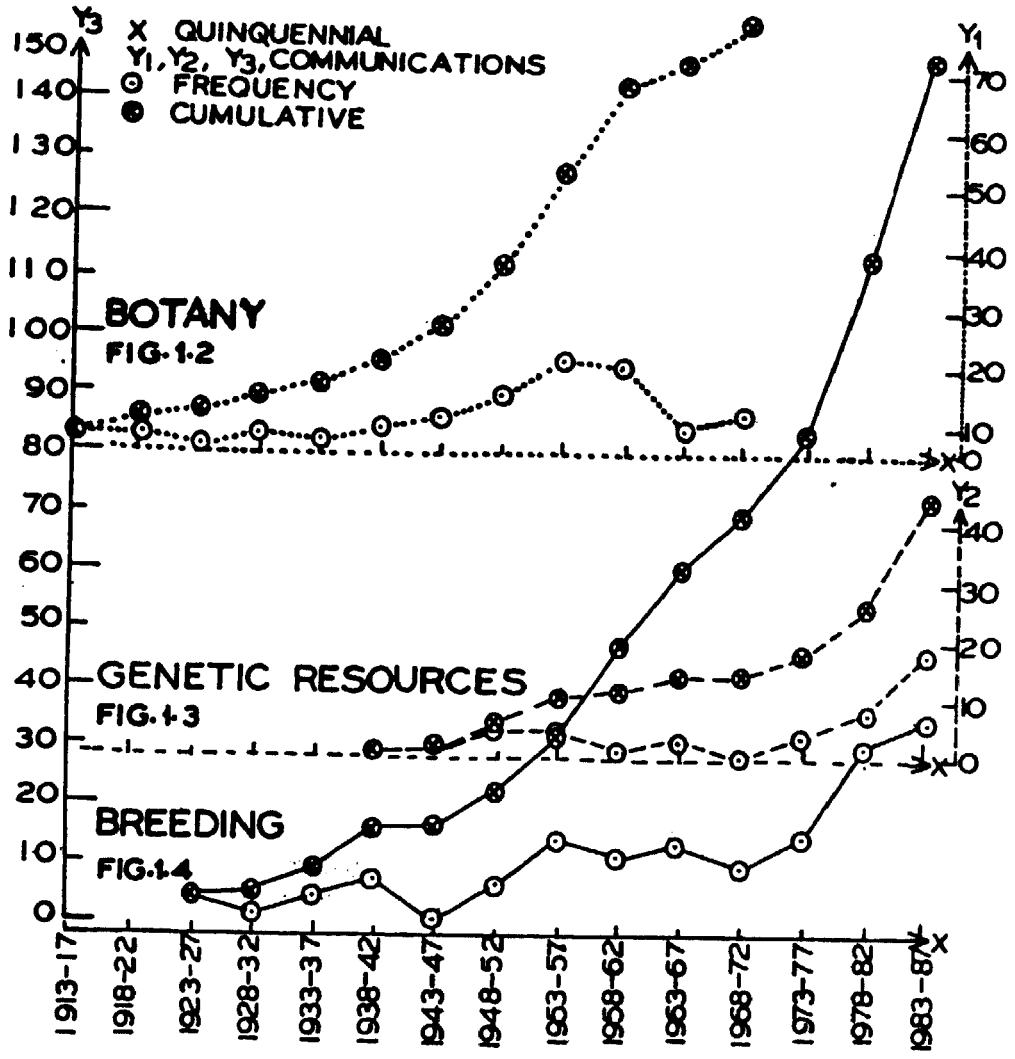
The necessary content particulars of publications were recorded on reference cards. These reference cards were arranged keeping in view the requirements of the study, each author was given full authorship credit i.e. one score for every occurrence of the name in authorship.

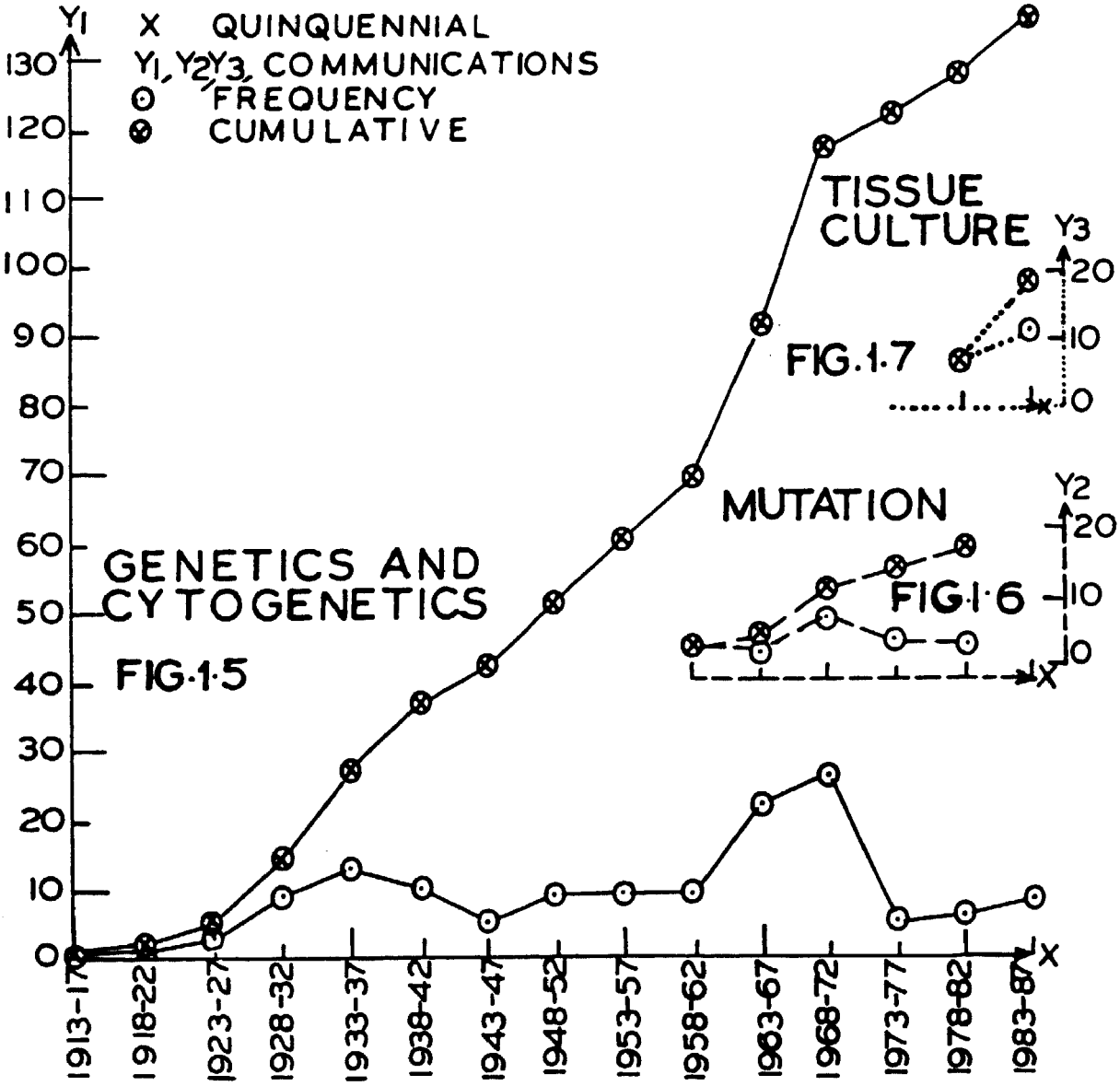
The degree of collaboration in a domain is defined as the ratio of the number of collaborative papers to the total number of papers published in a domain during a certain period of time and is called `g' ``Group Collaboration Coefficient'' [2].

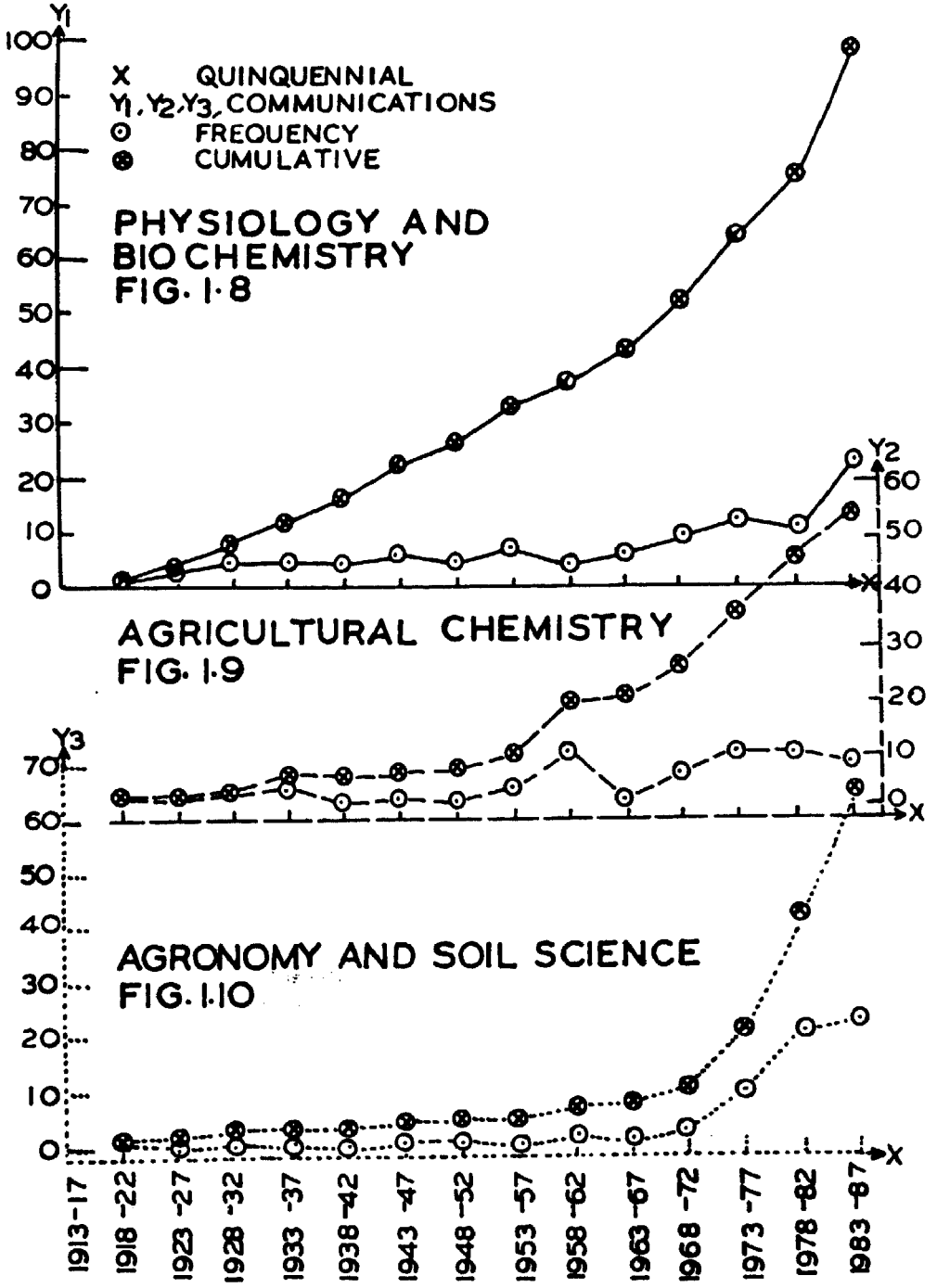
Creativity [3] was recognised as ``convergent'' for those who contribute to a single discipline and ``divergent'' for those who contribute to more than one discipline. The authors who restrict themselves to only one domain were called ``domainers'', those who contribute to two domains in the same discipline were called ``interdomainers'', those who contribute to more than two domains but restrict to only one discipline were called ``discipliners'' whereas those who interact with and contribute to other disciplines were ``interdiscipliners'', while ``spanners'' were those who interact with more than two disciplines. Spanners possessed higher divergent creativity.

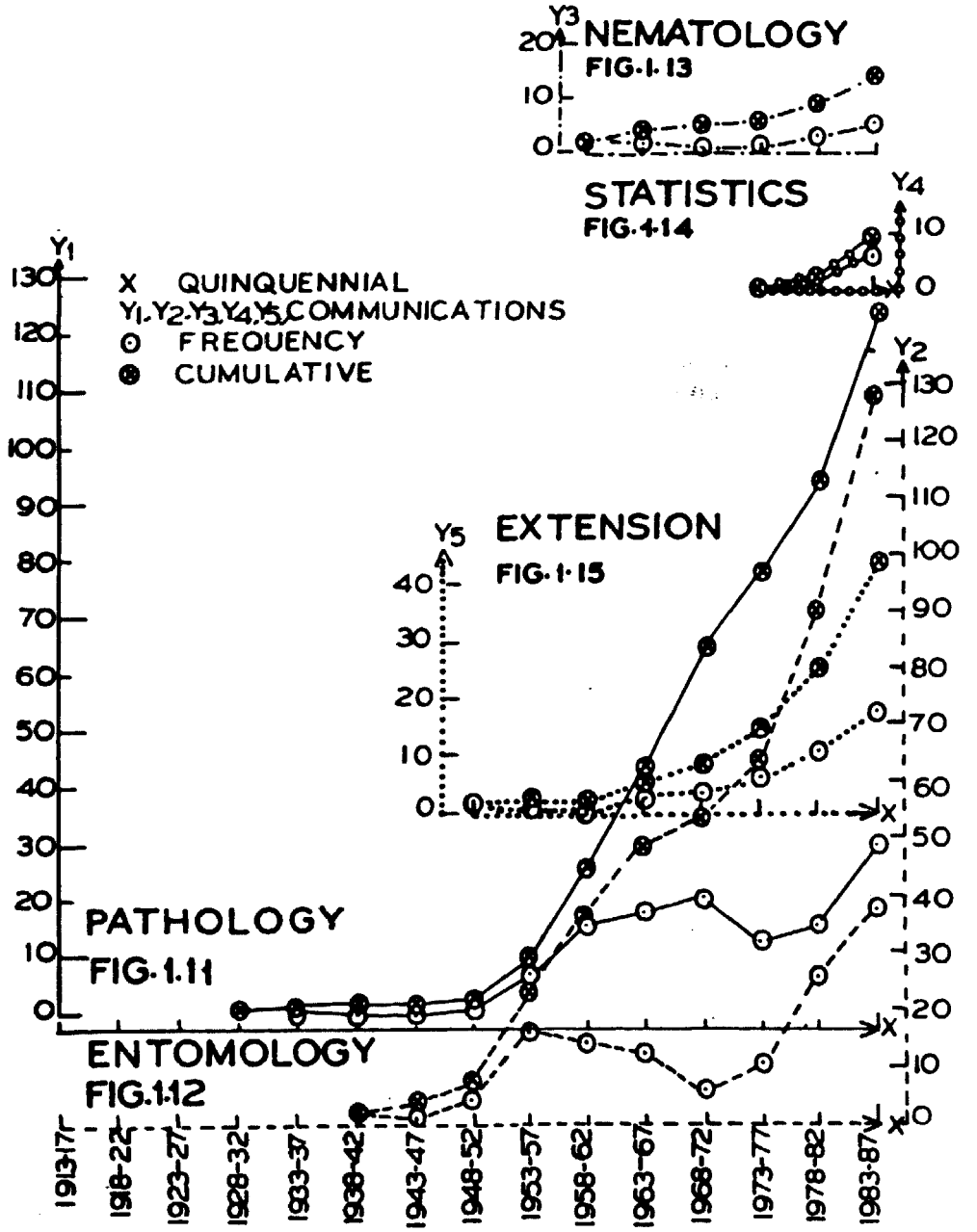
``Divergent Thinking Creativity Ratio'' (DTCR) is defined as the ratio of the number of domains to which an individual contributed to the total number of domains to which the institute contributed. Contributions to


X QUINQUENNIAL
Y1 ⊙ NUMBER OF COMMUNICATIONS
Y2 ⊗ CUMULATIVE NUMBER OF COMMUNICATIONS
Y3 ▽ COMMUNICATIONS PER RESEARCHER EMPLOYED
SUGARCANE BREEDING INSTITUTE, COIMBATORE
FIG·1·1
Y1
Y2
Y3
X
220
200
170
150
130
110
90
70
50
30
10
0
950
900
850
800
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
1913-17
1918-22
1923-27
1928-32
1933-37
1938-42
1943-47
1948-52
1953-57
1958-62
1963-67
1968-72
1973-77
1978-82
1983-87


Y3
X QUINQUENNIAL
Y1, Y2, Y3, COMMUNICATIONS
FREQUENCY
CUMULATIVE
Y1
Y2
BOTANY
FIG. 1.2
GENETIC RESOURCES
FIG. 1.3
BREEDING
FIG. 1.4
1913-17
1918-22
1923-27
1928-32
1933-37
1938-42
1943-47
1948-52
1953-57
1958-62
1963-67
1968-72
1973-77
1978-82
1983-87
X


Y1 X QUINQUENNIAL
Y1, Y2, Y3, COMMUNICATIONS
FREQUENCY
CUMULATIVE
130
120
110
100
90
80
70
60
50
40
30
20
10
0
GENETICS AND
CYTOGENETICS
FIG·1·5
TISSUE
CULTURE
Y3
20
10
0
FIG.1.7
MUTATION
Y2
20
10
0
FIG·1·6
X
1913-17
1918-22
1923-27
1928-32
1933-37
1938-42
1943-47
1948-52
1953-57
1958-62
1963-67
1968-72
1973-77
1978-82
1983-87


Y1
100
90
80
70
60
50
40
30
20
10
0
X QUINQUENNIAL
Y1, Y2, Y3, COMMUNICATIONS
FREQUENCY
CUMULATIVE
PHYSIOLOGY AND BIO CHEMISTRY FIG. 1·8
Y2
60
50
40
30
20
10
0
X
AGRICULTURAL CHEMISTRY FIG. 1·9
Y3
70
60
50
40
30
20
10
0
X
AGRONOMY AND SOIL SCIENCE FIG. 1·10
1913-17
1918-22
1923-27
1928-32
1933-37
1938-42
1943-47
1948-52
1953-57
1958-62
1963-67
1968-72
1973-77
1978-82
1983-87


Y3
NEMATOLOGY
FIG.1.13
STATISTICS
FIG.1.14
Y4
Y1
X QUINQUENNIAL
Y1.Y2.Y3.Y4.Y5 COMMUNICATIONS
FREQUENCY
CUMULATIVE
Y2
Y5 EXTENSION
FIG.1.15
PATHOLOGY
FIG.1.11
ENTOMOLOGY
FIG.1.12
1913-17
1918-22
1923-27
1928-32
1933-37
1938-42
1943-47
1948-52
1953-57
1958-62
1963-67
1968-72
1973-77
1978-82
1983-87

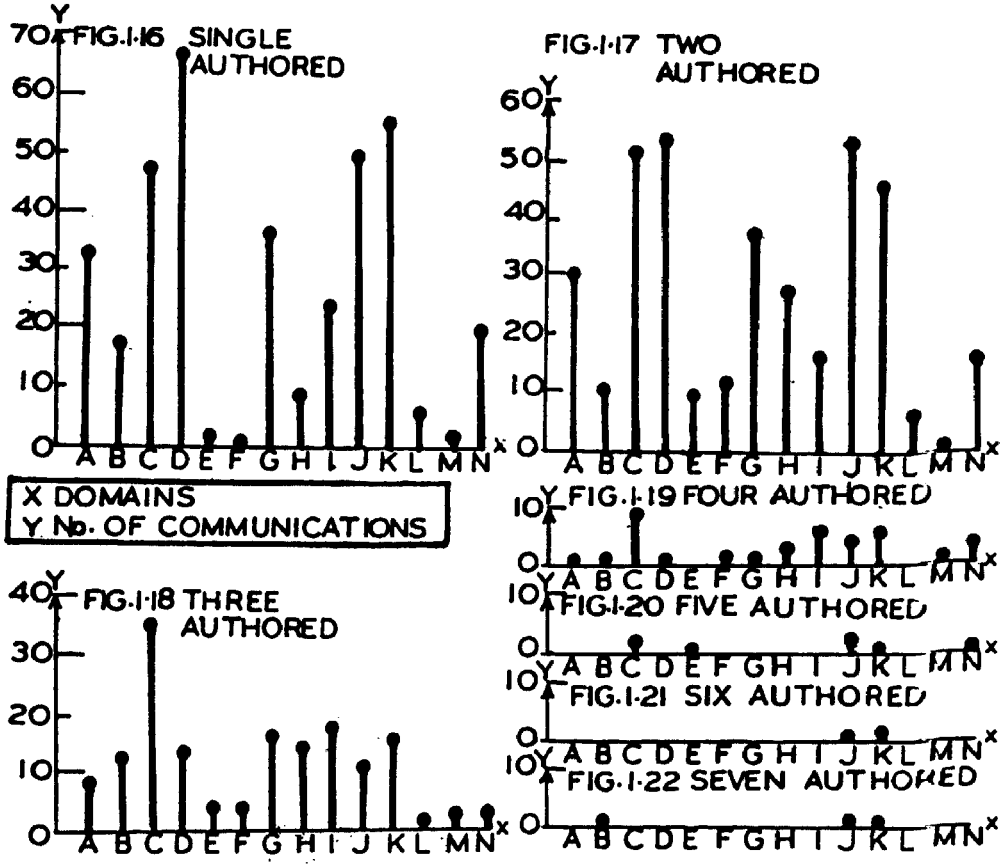


FIG.1.16 SINGLE AUTHORED
FIG.1.17 TWO AUTHORED
X DOMAINS
Y No. OF COMMUNICATIONS
FIG.1.18 THREE AUTHORED
FIG.1.19 FOUR AUTHORED
FIG.1.20 FIVE AUTHORED
FIG.1.21 SIX AUTHORED
FIG.1.22 SEVEN AUTHORED

Table 1

Absolute characteristics of the communication activities at Sugarcane Breeding Institute, Coimbatore, India : 1912-1987

Characteristics / Domain	n	c	nm	cm	ns	cs	ma	ta	w
Botany	33 (7.93)	74 (7.63)	29 (7.46)	41 (6.87)	12 (10.71)	33 (8.85)	93 (6.26)	126 (6.78)	134 (6.44)
Genetics Resources	30 (7.21)	44 (4.54)	23 (5.91)	26 (4.36)	10 (8.93)	18 (4.83)	72 (4.85)	90 (4.84)	98 (4.71)
Breeding	54 (12.98)	147 (15.15)	51 (13.11)	99 (16.58)	14 (12.50)	48 (12.87)	258 (17.37)	306 (16.47)	357 (17.15)
Genetices & Cytogenetics	49 (11.78)	136 (14.02)	47 (12.08)	69 (11.56)	18 (16.07)	67 (17.96)	154 (10.37)	221 (11.89)	223 (10.71)
Mutation	21 (5.05)	17 (1.75)	21 (5.40)	15 (2.51)	2 (1.79)	2 (0.54)	37 (2.49)	39 (2.10)	52 (2.50)
Tissue Culture	5 (1.20)	18 (1.86)	5 (1.29)	17 (2.85)	1 (0.89)	1 (0.27)	40 (2.69)	41 (2.21)	57 (2.74)
Physiology & Biochemistry	36 (8.65)	98 (10.10)	35 (9.00)	61 (10.22)	13 (11.61)	37 (9.92)	141 (9.49)	178 (9.58)	202 (9.70)
Agricultural Chemistry	20 (4.81)	54 (5.57)	19 (4.88)	45 (7.54)	3 (2.68)	9 (2.41)	110 (7.41)	119 (6.40)	155 (7.49)

Contd.

Characteristics / Domain	n	c	nm	cm	ns	cs	ma	ta	w
Agronomy & Soil Science	40 (9.62)	65 (6.70)	37 (9.51)	41 (6.87)	9 (8.04)	24 (6.43)	112 (7.54)	136 (7.32)	153 (7.35)
Pathology	47 (11.30)	124 (12.78)	47 (12.08)	74 (12.40)	8 (7.14)	50 (13.40)	185 (12.86)	235 (12.65)	259 (12.44)
Entomology	38 (9.13)	128 (13.20)	35 (9.00)	72 (12.06)	12 (10.71)	56 (15.01)	188 (12.66)	244 (13.13)	260 (12.49)
Nematology	11 (2.64)	14 (1.44)	10 (2.57)	8 (1.34)	2 (1.79)	6 (1.61)	18 (1.21)	24 (1.29)	26 (1.25)
Statistics	9 (2.16)	7 (0.72)	9 (2.31)	5 (0.84)	1 (0.89)	2 (0.54)	15 (1.01)	17 (0.91)	20 (0.96)
Extension	23 (5.53)	44 (4.54)	21 (5.40)	24 (4.00)	7 (6.25)	20 (5.36)	62 (4.18)	82 (4.41)	86 (4.12)
Sugarcane Breeding Institute, CBE.	177	970	133	597	44	373	1485	1858	2082

Percentage share in publication output in parentheses

n = Actual number of contributors or researchers or communicators or authors in the domain

c = Number of absolute communications per domain

nm = Number of contributors for multiauthored communications in the domain

cm = Number of multiauthored communications per domain

ns = Number of contributors for single authored communications in the domain

cs = Number of single authored communications

ma = Multiauthorships total

ta = Total authorships total

w = Weight for communication which is simply one over the number of collaborators.

one discipline were taken as ``Convergent Thinking Creativity'' (CTC).

The authors were treated as a `source' of publications and the following seven files were created:

i) authors with 1 to 4 papers (very low productivity),
ii) authors with 5 to 10 papers (low productivity),
iii) authors with 11 to 20 papers (medium productivity),
iv) authors with 21 to 30 papers (high productivity),
v) authors with more than 31 papers (very high productivity),
vi) authors with more than 2 papers (multiple-paper authors' productivity) and
vii) total group of authors' productivity.

To test the relationship of productivity of authors and their contributions to a number of research areas, Pearson Product Moment Correlation Coefficient (r) was computed [4] for the data in each file.

Motivation behind gender-wise analyses of credits was to focus particularly on the participation of women in agricultural research, wishing the outcome would sensitize, encourage and create consciousness among young women to confidently undertake active participation in the mainstream of agricultural research without any hesitation, enabling themselves to share responsibilities with men equally in the 21st century.

RESULTS AND DISCUSSION

Sugarcane Breeding Station was started in 1912 at a time when sugarcane production had suffered widespread failure due to diseases and pests in tropical thick cultivars. Yields were very low in sub-tropical thin cultivars and the first Sugarcane Commission had recommended closing of all sugar factories and stopping of cultivation of sugarcane as it was not economical. If it was accepted, probably India would have suffered from sugar shortage and sugarcane cultivators would have missed the varieties of sugarcane released from SBI which became very popular all over notwithstanding the geographical and political barriers.

Communication Characteristics

Research output in terms of the number of communications provides an important measure of performance of a research institution [6]. Domain-wise, quinquennial vs. frequency and cumulative number of communications in SBI are depicted in Figs 1.1 to 1.15.

In order to determine authorship pattern in communications, data were compiled as per authorships and plotted in Figs 1.16 to 1.22 which indicated that the majority of the collaboration activities were limited upto three authorships. Very few domains had five to seven collaboratorships. Researchers do cooperate, but their cooperation is narrowed down due to personal interests of deeper specialization. Researchers do not work alone but they prefer to share more with their likes than with those who differ greatly in the training acquired as well as in profession. Swaminathan [5] pointed out - `Another requisite of a successful research system is the development of a pattern of inter-disciplinary coordination within the scientific team so that it performs like a symphony orchestra'.

The general characteristics of the communication activities [7] are discussed below.

Absolute Characteristics: Table 1 indicates absolute characteristics of the communications productivity. During seventy five years, the 177 researchers have contributed 970 papers. More than forty communicators

Table 2

Ratio characteristics of the communication activities at SBI, 1912-1987

Characteristics	c/n	cm/nm	cs/ns	ma/nm	ta/n	ta/c	w/n	w/c	w/nm	g
Domain										
Botany	2.24	1.41	2.75	3.21	3.82	1.70	4.06	1.81	4.62	0.554
Genetic Resources	1.47	1.13	1.80	3.13	3.00	2.05	3.27	2.23	4.26	0.590
Breeding	2.72	1.94	3.43	5.06	5.66	2.08	6.61	2.43	7.00	0.673
Genetics & Cytogenetics	2.78	1.47	3.72	3.28	4.51	1.63	4.55	1.64	4.74	0.507
Mutation	0.81	0.71	1.00	1.76	1.86	2.29	2.48	3.06	2.48	0.882
Tissue Culture	3.60	3.40	1.00	8.00	8.20	2.28	11.40	3.17	11.40	0.944
Physiology & Biochemistry	2.72	1.74	2.85	4.03	4.94	1.82	5.61	2.06	5.77	0.622
Agricultural Chemistry	2.70	2.37	3.00	5.79	5.95	2.20	7.75	2.87	8.16	0.833
Agronomy & Soil Science	1.63	1.11	2.67	3.03	3.40	2.09	3.83	2.35	4.14	0.630
Pathology	2.64	1.57	6.25	3.94	5.00	1.90	5.51	2.09	5.51	0.596
Entomology	3.37	2.06	4.67	5.37	6.42	1.91	6.84	2.03	7.43	0.562
Nematology	1.27	0.80	3.00	1.80	2.18	1.71	2.36	1.86	2.60	0.571
Statistics	0.78	0.56	2.00	1.67	1.89	2.43	2.22	2.86	2.20	0.714
Extension	1.91	1.14	2.86	2.95	3.57	1.86	3.74	1.95	4.09	0.545
Sugarcane Breeding Institute, CBE.	5.48	4.49	8.48	11.17	10.49	1.92	11.76	2.15	15.65	0.615

c/n = number of communications per author, cm/nm = Number of multiauthored communications per author contributing towards multiauthored communications, cs/ns = Number of single authored communications per author contributing towards single authored communications, ma/nm = Multiauthorship per author contributing towards multiauthored communications, ta/n = Average authorship per author, ta/c = Average authorship per communications, w/n = Weighted communications per author, w/c = Weighted communications per absolute communication, w/nm = Weighted communications per number of contributors for multiauthored communications, g = group collaboration coefficient.

contributed to breeding, genetics & cytogenetics, agronomy & soil science and pathology. More than hundred communications were from breeding, genetics and cytogenetics, pathology and entomology.

More than forty researchers contributing to multiauthored communications were from breeding, genetics & cytogenetics and pathology while there were fifty multiauthored communications from breeding, genetics & cytogenetics, physiology & biochemistry, pathology and entomology.

More than twelve communicators with sole authorships were in botany, breeeding, genetics & cytogenetics, physiology & biochemistry and entomology domains whereas single authorship communications in the domains of botany, breeding, genetics & cytogenetics, physiology & biochemistry, pathology and entomology were above thirty.

More than one hundred multiauthored communications were in breeding, genetics, & cytogenetics, physiology & biochemistry, agricultural chemistry, agronomy & soil science, pathology and entomology. The number of total authorships in botany, breeding, genetics & cytogenetics, physiology & biochemistry, agricultural chemistry, agronomy & soil science, pathology and entomology were also above hundred.

Weighted communications in the domains of breeding, genetics & cytogenetics, physiology & biochemistry, pathology and entomology were more than two hundred.

Overall indications are that breeding, genetics & cytogenetics, entomology and pathology had higher innovation communications productivity since all of these domains had an early beginning in research activities. Tissue culture, mutation, nematology and statistics had a low productivity during the period because research activities in these domains were initiated only recently.

Ratio Characteristics: Table 2 provides information on ratio characteristics of innovation communication productivity. More communications per communicator were in breeding, genetics & cytogenetics, tissue culture, physiology & biochemistry, agricultural chemistry, pathology and entomology. A high number of multiauthored communications per author were recorded in breeding, physiology and biochemistry, tissue culture, agricultural chemistry and entomology.

The number of single-authored communications per author in breeding, genetics and cytogenetics, agricultural chemistry, pathology, entomology and nematology was also high.

High multiauthorships per author contributing to multiauthored communications were found in breeding, tissue culture, physiology & biochemistry, agricultural chemistry and entomology.

High total authorships per author were recorded in breeding, genetics & cytogenetics, tissue culture, physiology & biochemistry, agricultural chemistry, pathology and entomology.

High total authorships per communication were found in genetic resources, breeding, mutation, tissue culture, agricultural chemistry, agronomy & soil science and statistics.

High weighted communications per communicator were found in breeding, tissue culture, physiology & biochemistry, agricultural chemistry, pathology and entomology.

High weighted communicators per communication were found in mutation and tissue culture domains.

Table 3

Authorship Pattern in the Communications from Sugarcane Breeding Institute, Coimbatore during 1912-1987.

Authorship	Improve-ment	Produc-tion	Prote-ction	Stati-stics	Exten-sion	S.B.I
I	169 (45.31%)	70 (18.76%)	112 (30.03%)	2 (0.54%)	20 (5.36%)	373 (100%)
II	170 (44.62%)	88 (23.10%)	106 (27.82%)	1 (0.26%)	16 (4.20%)	381 (100%)
III	80 (48.78%)	49 (29.88%)	29 (17.68%)	3 (1.83%)	3 (1.83%)	164 (100%)
IV	13 (34.21%)	10 (26.32%)	10 (26.32%)	1 (2.63%)	4 (10.52%)	38 (100%)
V	3 (37.50%)	- -	4 (50.00%)	- -	1 (12.50%)	8 (100%)
VI	- -	- -	3 (100%)	- -	- -	3 (100%)
VII	1 (33.33%)	- -	2 (66.67%)	- -	- -	3 (100%)
Total	436 (44.95%)	217 (22.37%)	266 (27.42%)	7 (0.72%)	44 (4.54%)	970 (100%)
Multi-authored	267 (44.72%)	147 (24.62%)	154 (25.80%)	5 (0.84%)	24 (4.02%)	597 (100%)
g	0.612	0.677	0.578	0.714	0.545	0.615

I to VII - Single authored to seven authored communications
g = group collaboration coefficient

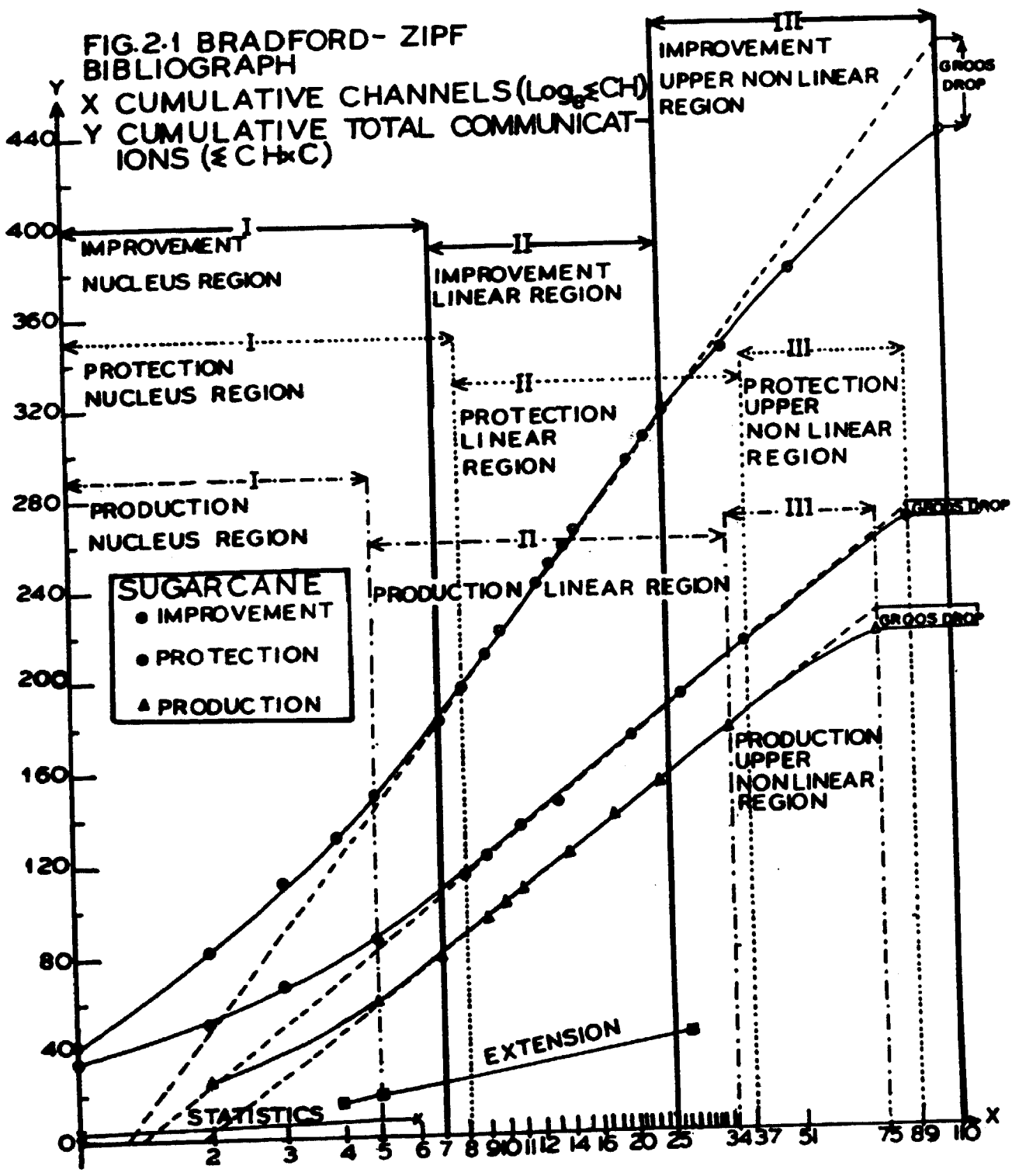


FIG.2.1 BRADFORD- ZIPF BIBLIOGRAPH
X CUMULATIVE CHANNELS (Log$_e$ ΣCH)
Y CUMULATIVE TOTAL COMMUNICATIONS (Σ CH×C)
Y
X
I
IMPROVEMENT NUCLEUS REGION
II
IMPROVEMENT LINEAR REGION
III
IMPROVEMENT UPPER NON LINEAR REGION
GROOS DROP
PROTECTION NUCLEUS REGION
PROTECTION LINEAR REGION
PROTECTION UPPER NON LINEAR REGION
PRODUCTION NUCLEUS REGION
PRODUCTION LINEAR REGION
PRODUCTION UPPER NON LINEAR REGION
SUGARCANE
IMPROVEMENT
PROTECTION
PRODUCTION
EXTENSION
STATISTICS
440
400
360
320
280
240
200
160
120
80
40
0
2 3 4 5 6 7 8 9 10 11 12 14 16 20 25 34 37 51 75 89 110

High weighted communications per number of multiauthored communicators were found in breeding, tissue culture, physiology & biochemistry, agricultural chemistry, pathology and entomology.

High group collaboration coefficients were observed in breeding, mutation, tissue culture, agricultural chemistry and statistics.

Although group collaboration coefficients were higher in tissue culture, mutation and agricultural chemistry the weighted communication values were very low since only two authorship papers were predominant in these domains. Hence the group collaboration coefficient [2] alone will not be sufficient to characterise and explain the reality.

Total multiauthored communications from SBI were 597 and single authored communications were 373. Multi-authorship total for SBI was 1485, total authorships total was 1858 and weighted authorship total was 2082.

Crop improvement had a major share of 436 papers (Table 3) with 44.95 percentage and justified the main mandate of SBI, Coimbatore.

Crop protection accounted for 266 papers with 27.42 percentage share whereas crop production had 217 papers with 22.37 percentage share justifying their supportive mandates to breeders.

Communication Inputs per Communication: References cited at the end of a research paper indicate that those communications were related to or had an impact on the research undertaken and its results. The statistical parameters of mean communication inputs per unit of communication output and range of the number of communications cited are given in Table 4. The research communication cited by an author in producing his paper represents roughly valid indicators of the influence of the cited paper on his work and the information gathering habit of the author. However, it does not fully reveal the network of influence operating, or the quality of cited and uncited research work.

Core Channels

Twenty three core channels publishing 61 percent of the communications were identified. Top six favourite channels of communications for SBI constituted 51 percent of the communications published in core channels.

Communication scattering pattern with five or more number of communications per channel or communication concentration indicated availability of highly specialised periodicals for the domain as well as high level of specialized knowledge content in the communications being channelised as an output of specialised research activity.

When plotted as cumulative total of communications (Σ CH.C) against natural logarithm of the total of productivity channels (Log_e ΣCH), the data revealed elongated S-shaped curves (Fig 2.1). Part one of the curve, the initial concave portion, represents the higher density or nuclear zone, part two - the linear portion of the curve and part three called the Groos drop [8] show the deviation from the normal which may be due to unpublished works in disciplines in the present context. Identical trend was found in sugarcane improvement, protection and production innovation communication productivity system outputs. Extension and statistics were just emerging domains and so have not yet shown any specialisation in their channels of communications.

Prolific Communicators

Out of 35 star communicators, the study iden-

Table 4.

Characteristics of Communication Inputs per unit of Communication Output in Sugarcane Communications from Sugarcane Breeding Institute, Coimbatore during 1912-1987

Domain	Number of references Min.	Max.	Variance	Standard deviation	Mean±Standard error
Botany	0	24	26.06	5.16	6.12±0.79
Genetic Resources	0	25	61.06	8.05	10.00±1.95
Breeding	0	21	29.19	5.44	6.84±0.62
Genetics & Cytogenetics	0	133	425.11	20.74	12.67±2.25
Mutation	1	24	46.97	7.16	9.17±2.07
Tissue Culture	0	24	69.84	9.34	11.6±4.18
Physiology & Biochemistry	0	49	82.76	9.19	10.47±1.34
Agricultural Chemistry	0	83	232.41	15.42	10.25±2.32
Agronomy and Soil Science	0	21	37.66	6.25	7.89±1.18
Pathology	0	54	116.90	10.89	9.27±1.29
Entomology	0	144	380.40	19.61	11.81±2.07
Nematology	3	19	45.19	7.76	9.25±3.88
Statistics	4	17	29.55	6.66	9.67±3.85
Extension	0	29	43.61	6.79	6.78±1.60

Table 5

Gender-wise number of communications and their Divergent Thinking Creativity Ratio (DTCR) during 1912-1987 at Sugarcane Breeding Institute, Coimbatore.

No. of communicators Female	Male	Total SBI	DTCR
–	1	1	0.786
1	1	2	0.643
-	3	3	0.571
1	6	7	0.500
1	6	7	0.429
2	6	8	0.357
1	6	7	0.286
1	14	15	0.214
3	29	32	0.143
11	84	95	0.071

tified 7 spanners, 2 interdisciplinerers and one discipliner in sugarcane improvement domain; 6 spanners, 3 interdisciplinerers and one interdomainer in sugarcane production; one spanner, 2 interdisciplinerers, one discipliner, 4 domainers and 2 interdomainers in sugarcane protection; only one spanner in sugarcane statistics and 3 spanners and one domainer in sugar extension domain.

Productivity-Domains Correlation

Out of 177 researchers 44 communicators (24.86%) contributed to only one domain since they had published only one paper each. 51 other domainers (28.81%) had multiple papers. Each one of the remaining 82 researchers (46.33%) produced multiple papers and also contributed to multiple domains. Communication productivity and their distribution paper-wise into number of domains to which they contributed group-wise were found out and Pearson Product Moment Correlations were recorded for each profile which indicated following stages in the evolution of innovation communication activity.

Very Low Productivity: A majority of the researchers (54.24%) are found to belong to this group. 82.29% of these researchers contributed to one, 14.58% contributed to two and two researchers contributed to three domains whereas only one researcher in this group contributed to four domains. The major group productivity is concentrated more in one domain and productivity is very low hence correlation +0.39 is observed.

Low Productivity: This group consists of 15.25% of the total researchers. Of them 33.33% contributed to only one domain, 40.74% contributed to two domains, 22.22% contributed to three domains. Only one communicator contributed to four domains. Since the majority contributed to two domains correlation +0.06 is observed.

Medium Productivity: 15.25% of the total communicators constitute this group. Out of them 22.22% contributed to only one, 22.22% contributed to two, 14.81% contributed to three, 11.11% contributed to four, 14.81% contributed to five, 7.41% contributed to six and 7.41% contributed to seven domains. In this case a diversification activity is initiated and -0.03 correlation is observed.

High Productivity: This group consists of only 8.47% of all communicators. The diversification of activities is prominent but their contributions are not proportionately distributed to all domains hence the correlation is -0.3.

Very High Productivity: Only 6.78% of the total researchers belong to this group. Further diversification of activities in proportion to their high contribution lead to +0.36 correlation.

Multiple-paper Authors' Productivity: This group consists of 75.14% of the total communicators. Analysis resulted in +0.73 correlation.

Total Group of Authors' Productivity: When the whole group of communicators is considered the correlation is strengthened due to a balanced activity of domainers and nondomainers and +0.77 correlation is observed.

Productivity-domains Significance: Correlations for communication productivity and contributions to a number of domains were highly significant for a very low productivity as well as multiple papers and total group productivity.

Unlike Subramanyam [9] and Gupta [4] who had obtained positive correlations and Hurt [10] who did not get any relationship in their respective studies, the present case study revealed both positive and negative relationships. Thus the group of productivity under consideration for analysis determines the correlation values.

Table 6

Theses output during 1912-1987 from Sugarcane Breeding Institute, Coimbatore.

Year	Ph.D.		M.Phil.		M.Sc.		IARI Assoc.		Total (SBI)		Total
	A	B	A	B	A	B	A	B	A	B	
1938	-	-	-	-	-	1	-	-	-	1	1
1941	-	-	-	-	-	1	-	-	-	1	1
1942	-	-	-	-	-	-	-	1	-	1	1
1944	-	-	-	-	-	-	-	1	-	1	1
1945	-	-	-	-	-	-	-	2	-	2	2
1947	-	-	-	-	-	1	-	-	-	1	1
1949	-	1	-	-	-	-	-	1	-	2	2
1955	-	-	-	-	-	1	-	-	-	1	1
1958	-	-	-	-	-	2	-	1	-	3	3
1959	-	-	-	-	-	1	-	-	-	1	1
1961	-	1	-	-	-	-	-	-	-	1	1
1964	-	1	-	-	-	-	-	-	-	1	1
1965	-	1	-	-	-	-	-	-	-	1	1
1967	1	-	-	-	-	-	-	-	1	-	1
1968	-	2	-	-	-	-	-	-	-	2	2
1969	-	3	-	-	-	1	-	4	-	8	8
1971	1	1	-	-	-	-	-	-	1	1	2
1972	-	1	-	-	-	-	-	-	-	1	1
1975	-	1	-	-	1	1	-	-	1	2	3
1977	-	1	-	-	-	-	-	-	-	1	1
1978	-	1	-	-	1	-	-	-	1	1	2
1979	-	1	-	-	-	1	-	1	-	3	3
1980	-	1	-	-	-	-	-	-	-	1	1
1981	-	3	1	-	4	1	-	-	5	4	9
1982	1	1	-	-	2	5	-	-	3	6	9
1983	1	1	-	-	-	7	-	-	1	8	9
1984	-	4	1	1	-	5	-	-	1	10	11
1985	-	2	6	1	-	10	-	-	6	13	19
1986	-	3	1	1	-	8	-	-	1	12	13
1987	-	3	-	-	-	14	-	-	-	17	17
Total	4	33	9	3	8	60	-	11	21	107	128

A = Female
B = Male

Table 7.
Domain-wise and genderwise distribution of theses during 1912-1987.

Domain	Ph.D		M.Phil		M.Sc.		IARI Assoc.		Total (SBI)		Total
	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	
Botany	-	1	-	-	-	3	-	5	-	9	9
Genetic Resources	1	3	1	-	-	1	-	3	2	7	9
Breeding	2	7	-	-	-	9	-	2	2	18	20
Genetics & Cytogenetics	-	6	1	-	-	3	-	-	1	9	10
Mutation	1	2	-	-	3	1	-	-	4	3	7
Tissue culture	-	-	2	-	2	-	-	-	4	-	4
Physiology & Biochemistry	-	2	1	1	1	10	-	-	2	13	15
Agricultural Chemistry	-	3	1	2	-	5	-	-	1	10	11
Agronomy & Soil Science	-	4	-	-	-	8	-	1	-	13	13
Pathology	-	2	1	-	2	6	-	-	3	8	11
Entomology	-	2	2	-	-	7	-	-	2	9	11
Extension	-	1	-	-	-	7	-	-	-	8	8
Total	4	33	9	3	8	60	-	11	21	107	128

Genderwise Participation

Genderwise number of communicators and their divergent thinking creativity ratios are tabulated in Table 5. Women communicators numbered only 21 against 156 men. All women were good followers and invariably collaborators with the prolific innovation communication stars, who happend to be their mentors. Participation in joint authorships revealed equal participation in nematology and tissue culture domains by both male and female scientists.

The productivity communications in the form of theses from SBI by males and females during the period under consideration is tabulated in Tables 6 & 7.

A comparison with world literature production on sugarcane by Lovett [12] of the present study clearly highlighted that the independent scientific tradition' had quite an early setting at SBI, Coimbatore. This may be probably due to climatic advantage as flowering and seed-set at Coimbatore (11° N latitude) is very congenial. Although all the domains have a great number of researchers and produce a greater number of communications, it is generally accepted that the latent time for the production of a unit of communication is more for sugarcane breeding than entomology, pathology and genetics & cytogenetics. Since the time taken by breeders in field experiments is always longer, the other domains have the advantage of controlled laboratory experiments requiring a shorter duration. Sugarcane breeding depends partly on luck and partly on hard work. Luck was a major factor in the finding of variety Co 205.

CONCLUSION

The objective was to give a brief insight into the communication productivity of SBI researchers. The study can be extended to quinquennial reviews of researchers and their establishments for a comparative study with other sugarcane research groups in the country or at an international level. Similar reports from all over the world wherever sugarcane research is conducted may lead to a global view of the innovation communication status. Similar work can be undertaken on sugarcane research in the country or other crops or research areas of concern. Such studies can help to strengthen the interaction of scientists at the national and international level since they highlight strong research expertise in various fields at a particular location. Scientometric tools may enable coordinating the efforts of the research institutions of the country, to converge scientific efforts and resources on a definite range of problems and avoid unnecessary duplication of projects.

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