Important Variables Affecting Research Productivity of Bangladesh Sugarcane Research Institute

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Received on 3.7.97

ABSTRACT

The study was conducted to identify the variables that influence research productivity of scientists and to determine the relative importance of the variables as perceived by the scientists. Data were collected from 19 scientists of 4 levels from BSRI. Ninety variables which are likely to influence research productivity of scientists were studied. The software variables were perceived to exert highest effect on the research productivity of scientists. The hardware variables were ranked second by the scientists followed by auto, static, nurtured and societal variables. All the four levels of scientists i.e. Junior level. Scientists (JLS), Mid-Level Scientists (MLS), Upper level Scientists (ULS), and Agricultural Research Managers (ARM) of BSRI perceived the software variable as the most influential in enhancing research productivity. The JLS and ULS perceived the hardware variables as second highest important followed by auto variables. On the contrary, the MLS and ARM perceived auto variables as second highest important followed by hardware variables. The MLS and ULS placed static variables on the 4th position but the ARM placed nurtured variables on the 4th position of importance. The JLS gave equal importance to nurtured and static variables. The MLS placed nurtured and ARM placed static variables on the 5th position but ULS placed both nurtured and societal variables on the 5th position. The JLS, MLS and ARM gave lowest importance to the societal variables. However, the pooled respondents of BSRI perceived software variables as most important for increasing research productivity followed by hardware, auto, static, nutured and lastly by societalvariables.

Key words : Variables affecting research productivity, Sugarcane research, Bangladesh.

INTRODUCTION

Sugarcane research started in 1931 with the establishment of a Sugarcane Seedling Testing Station at Dhaka. The research station shifted from Dhaka to Ishurdi, Pabna in 1951 with the establishment of a Sugarcane Research Station. After war of liberation in 1971, Sugarcane Research Institute (SRI) Scheme was approved with one regional station at Thakurgaon in 1974. During Second Five Year Plan, the SRI was renamed as Sugarcane Research and Training Institute (SRTI). The SRTI became one of the ten research institutes of National Agricultural Research System (NARS) for developing coordinated research in agriculture. The SRTI upgraded to a national institute and renamed as Bangladesh Sugarcane Research Institute (BSRI) in 1996.

The organagram of BSRI expanded, the number of scientists though increased compared to pre-liberation period but their productivity is not at a high level. According to Pathak (1976), " the researchers are the most important component of any research organization and major efforts should be made in selecting good researchers and keeping them productive at the highest level". Rahman (1990) stated that job performance of a worker depends on the fullest utilization of his abilities and also on the social expectation of the environment in which he or she works. Some fund giving agencies emphasized the need for efficient utilization of existing domestic resources and curtail the dependency on donor agency gradually. Taking these in view, there is need to raise the efficiency of existing manpower, rather than adding the manpower.

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This is also applicable for the scientists of BSRI. However, the confronting problem is how to increase the productivity of an individual scientists of BSRI. So, to raise the productivity of scientists of BSRI it is urgently necessary to undertake indepth study to identify and isolate the factors affecting research productivity. Till now no systematic research on perception of BSRI scientists on factors affecting research productivity has been undertaken.

In view of the above situation, a study was undertaken with the following objectives:

1. To identify the variables influencing research productivity of BSRI scientists.
2. To determine the relative importance of different variables influencing research productivity of BSRI scientists; and
3. To assess the degree of overall agreement among the different levels of BSRI scientists, with regard to their relative perception of important variables.

MATERIALS AND METHODS

The population of the study consists of all the scientists (whose service length was at least one year.) Director (now Director General, Heads of Divisions and In-charge of North Regional Station (NRS) of BSRI. The scientists who were outside the institute at the time of data collection (either on deputation or lien) were not included in the population. The total number of scientists (population) were 55. The population were grouped into 4 levels.

1. Junior Level Scientists (JLS) - SO/ equivalent
2. Mid-Level Scientists (MLS) - SSO/equivalent
3. Upper Level Scientists (ULS)- PSO/equivalent and CSO/equivalent
4. Agricultural Research Managers (ARM) - Director General, Heads of Divisions and In-charge of NRS.

Data were collected from a sample of 19 scientists selected randomly through stratified random sampling method. Twenty five percent of the JLS and MLS, 50 percent of the ULS and ARMm included in the sample. The data were collected during March, 1993.

The Q-short technique was used for measuring the perception of scientists on determinants of research productivity. Ninety variables which were likely to influence research productivity of scientists were finally selected out of 250 variables collected from various sources.

The 90 selected items were printed on white cards of 3.5" x 2" size in order to facilitate sorting by the respondents.

According to the Q-short distribution (Kerlinger, 1983), the number of items to be placed in each of 11 category of pile (from most important to least important) was followed. The respondents were then asked to sort out the 90 items under eleven categories on the basis of their importance. The categories were assigned the scores ranging from 0 to 10. The score and range of each individual category are also presented in Table 1.

Table 1. Scores and score ranges of individual category.

Sl. No.	Category	No. of items to be placed	Score	Range
1.	Most important	3	10	> 9.5
2.	Nearly most important	4	9	8.5 to < 9.5
3.	Highly important	7	8	7.5 to < 8.5
4.	Very important	10	7	6.5 to < 7.5
5.	Quite important	13	6	5.5 to < 6.5
6.	Fairly important	16	5	4.5 to <5.5
7.	Somewhat important	13	4	3.5 to <4.5
8.	Slightly important	10	3	2.5 to < 3.5
9.	Of little importance	7	2	1.5 to <2.5
10.	Of very little importance	4	1	0.5 to < 1.5
11.	Least importance	3	0	< 0.5

RESULTS AND DISCUSSION

1.0 : Identification of variables

Ninety variable finally selected for the study were broadly categorized in two groups: environmental (variables dealing with the surrounding in which a scientists works) and personal (variables that are scientist-centered).

The environmental variables were further divided into two groups : organizational and societal (ES) variables. The organizational variables referred to those variables which are exclusively concerned with the organization where the scientists work. The societal variables are those which are within the environment in which the organization is located.

The organizational variables were again sub-divided into software (OS) and hardware (OH) variables. The software variables are concerned with the non-material aspects of an organization (e.g.job satisfaction), while the hardware variables are concerned with the material aspect (e.g. adequate fund for research). The personal variables were also sub-divided into dynamic (variables that can be manipulated) and static (variables that cannot be manipulated). The dynamic variables were again sub-divided into auto (DA) and nurtured (DN) variables. The auto variables referred to those personal manipulative variables which are within the self control of a scientists, while the nurtured variables are those personal manipulative variables which require assistance or guidance of others.

Out of the 90 variables, 58 were environmental and the rest 32 were personal variables (Table 2). Among the environmental variables, 51 were organizational while 7 belonged to societal variables. The organizational variables were classified into two groups : 36 as software and 15 as hardware variable. Personal variables were grouped as : 26 as dynamic and 6 as static (PS) variables. Out of the 26 dynamic variables, 20 were auto and 6 were nurtured.

To determine the relative importance of individual variables as perceived by the scientists, median scores of each of the 90 variables were interpolated. The data were grouped for interpolating the median score for each of the variables. The variables (items) having 5.5 and above median scores were considered as relatively important.

Analysis of variance was used to determine whether there were significant differences, among the differences among the different levels of scientists in their judgment with respect to the 90 variables.

The Kendall's Coefficient of Concordance (W) was used to examine whether the respondents under each levels were in agreement in their perception with respect to 90 variables. The overall agreement among the scientists of the 4 levels of BSRI also confirmed by W.

Table 2. Distribution of the variables affecting research productivity according to different categories.

Variable Categories		Number
A.	Environmental variables	58
	a. organizational variables	51
	i. Software	36
	ii. Hardware	15
	b. Societal variables	7
B.	Personal variables	32
	a. Dynamic variables	26
	i. Auto	20
	ii. Nurtured	6
	b. Static variable	6

2.0 : Relative importance of individual variable

Appendix-1 contains a list of 90 variables along with their relative importance (median scores) as perceived by the scientists of all levels. JUL, MLS, ARM and the pooled respondents of BSRI (PRS). The distribution of relatively important variables of different categories as perceived by the four levels of scientists is shown in Table 3. The highest number variables (36) were perceived as relatively important by the JLS, followed in descending order by ARM 34 variables, MLS 32, ULS 32 variables, and PRE 29 variables. Except for the MLS, atleast about two- third of these variables were environmental and the rest were personal.

Table 3. Distribution of relatively important variables by categories as perceived by the various levels of scientist.

Levels of scientists	Name of variables perceived as relatively important by categories								Grand total (n = 90)
	Environmental (n = 58)				Personal (n = 32)				
	OS (n = 36)	OH (n = 15)	ES (n = 7)	Total (n = 58)	DA (n =20)	DN (n=6)	PS (n=6)	Total (n=32)	
Pooled respondents (PRS)	11	8	-	19	5	2	3	10	29
Junior level scientists (JLS)	16	12	-	28	6	1	1	8	36
Mid-level scientists (MLS)	11	6	-	17	10	2	3	15	32
Upper level scientists (ULS)	15	8	1	24	5	1	2	8	32
Agricultural research managers (ARM)	16	7	-	23	8	2	1	11	34

Notes : OS = Software, OH = Hardware, ES = Societal, DA = Auto, DN = Nurtured, PS = Static

2.1 : Software (O.S) variables

Out of 36 software variables 29 were relatively important as perceived by any or all the four levels of scientists (JLS, MLS, ULS and ARM) as well as the pooled respondents. The important software variables as percerived by the 4 levels of scientists as well as the pooled respondents of BSRI were as follows :

Important software (OS) variables		Level of scientists
1.	Facilities of for specialized training	PRS (2), ARM (5), ULS (8), MLS (5) JLS (6)
2.	Research assignment to a scientist according to specialization	PRS (3), ARM (6), ULS (5), MLS (4), JLS (8)
3.	Scope of participation in seminars/ conference, etc. at home and abroad	PRS (7), ARM (7), ULS (9), MLS (7), JLS (10)
4.	Job satisfaction	PRS (8), ARM (15), ULS (6), MLS (18), JLS (3)
5.	Research programme according to farmers' need	PRS (5), ARM (25), ULS (1), JLS (20)
6.	Policy for regular and unbiased promotion	PRS (11), ARM (8), ULS (13), JLS (16)
7.	Transfer and posting must be according to research need	PRS (14), ULS (17), MLS (9), JLS (4)
8.	Proper feedback mechanism with field/users and research	PRS (25), ARM (17), MLS (29), JLS (31)

9.	Increased linkage between extension/agro-based industries and research	PRS (26), ULS (12), MLS (30)
10.	Accountability for the work done	PRS (27), ARM (12), ULS (10)
11.	Multidiscriplinary group work and team spirit	PRS (28), MLS (14), JLS (2)
12.	Competitive atmosphere in the organization	ARM (26), JLS (1)
13.	Developed research management leadership	ARM (32), JLS (18)
14.	Organizational autonomy	ULS (24), JLS (32)
15.	Dedicated scientists should not be given administrative function	MLS (25), JLS (35)
16.	Research organization should be free from bureaucratic administration	ARM (16)
17.	Orientation training, guidance and patronage of the superior to the newly recruited scientists	ARM (20)
18.	Mechanism for job evaluation, assesment and appreciation	ARM (21)
19.	No favouritism from immediate boss	ARM (33)
20.	Freedom to incur expenditure within the budgetary limit	ARM (34)
21.	Research labour problem must be solved and managed	ULS (14)
22.	Good scientist-staff relationship	ULS (18)
23.	Job description should be clearly spelled out	ULS (29)
24.	Cordial relationship among the colleagues	ULS (30)
25.	Free from clique	ULS (31)
26.	Adequate technical and secretarial assistance	MLS (23)
27.	No. relative deprivation	JLS (9)
28.	Feelings for the organization	JLS (26)
29.	Interaction of scientists	JLS (33)

Note : Figure in parenthesis indicates rank number on the basis of relative importance of the variables as perceived by the respective level of scientists.

Ranking of the above mentioned variables ranged from 1 to 35. "Competitive atmosphere in the organization" and "research programme according to farmers' need" were ranked 1st by JLS and the ULS, respectively, and "dedicated scientists should not be given administrative function" was ranked 35th by the JLS. However, the variable nos. 1, 2, 3, and 4 were perceived as relatively important by all the 4 levels of scientists including the PRS. The variable Nos. 5, 6, 7 and 8 were perceived as important by 3 levels of scientists including PRS. No. 9 No. 10 and No. 11 variables were perceived as important by 2 levels of scientists including PRS. The variable Nos. 12, 13, 14 and 15 were perceived as important by 2 levels of scientists. Out of the remaining 14 important variables 3 (Nos. 27, 28 and 29) were perceived by JLS, 1 (No. 26) by MLS, 5 (Nos. 21, 22, 23, 24 and 25) by ULS and 5 (Nos. 16, 17, 18, 19 and 20) perceived by ARM.

2.2 : Hardware (OH) variables

The ARM and MLS placed the hardware variables as the 3rd important variables next auto variables. But the ULS and JLS perceived the hardware variables as the 2nd important next to software variables. The pooled respondents also placed the hardware variables as the 2nd important variables for increasing research productivity of scientists (Table 3). The important hardware variables which were perceived by the different levels of scientists were as follows :

	Important hardware (OH) variables	Level of Scientists
1.	Easy availability of common research equipment and maintenance facilities	PRS (6), ARM (4), ULS (28), MLS (2), JLS (5)
2.	Adequate fund for research	PRS (15), ARM (3), ULS (2), MLS (22), JLS (29)
3.	Easy and timely purchase and procurement of needed research materials	PRS (16), ARM (23), ULS (11), MLS (20), JLS (22)
4.	Timely availability of operational cost at the hand of the field researchers	PRS (13), ARM (9), ULS (32), JLS (15)
5.	Easy access to the needed literature	PRS (19), ARM (27), MLS (11), JLS (14)
6.	Adequate salary for maintaining family expenditure	PRS (23), ARM (30), ULS (22), MLS (24)
7.	Freedom of scientists in obtaining research inputs timely	PRS (2), ARM (24), JLS (17)
8.	Mobility facilities for the scientists	PRS (21), ULS (7)
9.	Housing facilities near the research station	ULS (19), JLS (30)
10.	Additional remuneration and facilities for remote area station	MLS (31), JLS (21)
11.	Well developed topography and leveled research land with irrigation facilities in the farm	ULS (23)
12.	Increased statistical assistance and computer facilities	JLS (25)
13.	Transport facilities for school and college going Children of the scientists	JLS (27)
14.	Every research station needs sufficient seed storage	JLS (28)
15.	Protection of research fields	JLS (36)

Note : Figure in parenthesis indicates ranked number on the basis of relative importance of the variables as perceived by the respective level of scientists.

The above relatively important hardware variables shows that the ranks of the variables ranged from 2nd to 36th. "Easy availability of common research equipment and maintenance facilities" and " adequate fund for research" were ranked 2nd by MLS and ULS, respectively. The variable " protection of research fields" was ranked 36th by the JLS. However, the variable Nos. 1, 2 and 3 were perceived as important for increasing research productivity by the scientists of all the 4 levels as well as pooled respondents (PRS). The variable Nos. 4, 5 and 6 were perceived as important by 31 levels of scientists as well as PRS. The variable No. 7 was perceived as important by 2 levels of scientists including PRS. The variable Nos. 8 was perceived as important by 1 level of scientists as well as PRS. The variable Nos. 9 and 10 were perceived as important by 2 levels of scientists. The remaining 5 variable were perceived as important by ULS, (No. 11) and JLS, 4 (Nos. 12, 13, 14 and 15).

2.3 : Societal (ES) variables

Only one variable of this group "living with family members" was perceived as important for affecting research productivity of scientists by ULS and was ranked 26th.

2.4 : Auto (DA) variables

The study revealed that the ARM and MLS gave this group of variables 2nd highest importance next to software variables. However, ULS and JLS gave 3rd place next to software and hardware group of variables. This was supported by PRS (Table 3). The important auto (DA) variables as perceived by the 4 levels of scientists as well as the pooled respondents of BSRI were as follows :

	Important auto (DA) variables	Level of scientists
1.	Devotion to research work	PRS (1), ARM (2), ULS (3), MLS (3), JLS (11)
2.	Initiative to work	PRS (4), ARM (10), ULS (4), MLS (15), JLS (7)
3.	Personal involvement of the scientists at all stages of experiment including data collection	PRS (9), ARM (14), ULS (25), MLS (1), JLS (19)
4.	Free from frustration	PRS (20), ARM (28), ULS (15), MLS (13)
5.	Inquisitiveness	PRS (12), ARM (11), MLS (12)
6.	Perseverance	ARM (22), MLS (28)
7.	Giving priority to the job	MLS (26), JLS (34)
8.	Self perception of his/her role responsibility	MLS (32), JLS (24)
9.	Capacity to work under constraints	ARM (18)
10.	Self examination of one's own scientific performance	ARM (29)
11.	Relatively high standard morality	ULS (27)
12.	Self reliance	MLS (19)
13.	Power of critical (analysis)	MLS (27)
14.	Mental readiness for criticism	JLS (23)

Note : Figure in parenthesis indicates ranked number on the basis of relative importance of the variables as perceived by the respective level of scientists.

The ranks of above mentioned variables ranged from 1 to 34. Among the relatively important auto variables "personal involvement of the scientists at all stages of experiment including data collection" was ranked 1st by MLS. But the variable "devotion to research work" was perceived as highest important (1st rank) by pooled respondents (PRS). And the variable " giving priority to the job" was ranked 34 by JLS. However, the variable Nos. 1, 2, and 3 were perceived as relatively important by all the 4 levels of scientists including PRS. The variable "free from frustration" was perceived as important by 3 levels of scientists including PRS and that variable " inquisitiveness" was perceived important by 2 levels of scientists as well as PRS. The variable nos. 6, 7 and 8 were perceived as important by 2 levels of scientists. The remaining 6 variables were perceived as important by ARM, 2 (Nos. 9 and 10); ULS, 1 (No. 11); MLS, 2 (Nos. 12 and 13) and JLS, 1 (No. 14).

2.5 : Nurtured (DN) variables

The study revealed that the nurtured variables occupied 4th position by ARM and JLS. But ULS, MLS as well as PRS placed the variables group on the 5th position (Table 3). The important nurtured variables which were perceived by the different levels of scientists of BSRI were as follows :

Important Nurtured (DN) variables	Level of Scientists
1. Creativity	PRS (10), ARM (1), ULS (20)
2. Research Communication skill	PRS (17), ARM (19), MLS (21), JLS (13)

Note : Figure in parenthesis indicates ranked number on the basis of relative importance of the variables as perceived by the respective level of scientists.

The rank of above mentioned variables ranged from 1 to 21. The data showed that the variables "creativity" and research Communication skill" were perceived as important by 3 levels of scientists as well as PRS. The "creativity" was ranked 1st by the ARM. But JLS did not perceive " creativity" as important variable. On the other and the ULS did not perceive "research communication skill" as important one.

2.6 : Static (PS) variables

This group of variables occupied 4th position by ULS and MLS as well as PRS. But the ARM and JLS placed the group in 5th position (Table 3). The important static variables as perceived by the 4 levels of scientists as well as pooled respondents of BSRI were as follows:

	Important nurtured (PS)	Level of scientists
1.	Physical fitness	PRS (18), ARM (31), ULS (2) MLS (6), JLS (12)
2.	Research experience	PRS (22), ULS (16), MLS (18)
3.	Intelligence	PRS (29), MLS (10)

Note : Figure in parenthesis indicates ranked number on the basis of relatives importance of the variables as perceived by the respective level of scientists.

Out of the above 3 variables, "physical fitness" was perceived as important by all levels of scientists as well as PRS. However, the rank ranged from 6 to 31. The variable "research experience" was perceived as important by ULS and MLS and "intelligence" was perceived by only MLS although both the 2 variables were perceived as important by PRS.

3.0 : Degree of overall agreement among the different levels of scientist

The analysis of variance revealed that there was no statistically significant variation among the four level of scientists viz. JLS, MLS, ULS and ARM of BSRI in their judgment with respect to 78 variables, out of 90. There was a variation in their judgment with regard to 12 variables, five variables were significant at 0.05 level of probability and seven at 0.01 level of probability, the variables were : (1) Research communication skill *, (2) Mobility facilities for the scientists*, (3) Mental readiness for criticism*, (4) Personal involvement of the scientist at all stages of experiment including data collection*, (5) Creativity*, (6) Inquisitiveness**, (7) Mechanism for job evaluation, assessment ad appreciation **, (8) Self reliance**, (9) Stimulating and facilitative leadership in the organization**, (1o) Transport facilities for school and college going children of the scientists **, (11) No. favoritism from immediate boss **, (12) Increased statistical assistance and computer facilities**.

In order to examine whether the respondents under each of the four levels of scientists were in agreement, the Kendall's Coefficient of Concordance (W) was worked out for each of the four levels of the scientists, The W values for each of the four levels of scientists viz., JLS, MLS, ULS and ARM were 0.44, 0.50, 0.30 and 0.34 respectively. The corresponding calculated values of x^2 were 2539.52, 3194.52, 1553.31, and 1568.60, respectively and each of them were significant at 0.01 level of probability, Thus, it could be inferred that there was significant agreement within the each individual level of the scientists. The overall agreement among the four levels of the scientists was further confirmed by the Kendall's Coefficient of Concordance (W), The w value 0.0005 was statistically significant and the calculated x^2 value of 12.65 was also significant at 0.01 level of probability. Thus, it could be inferred that there was an overall agreement among the four levels of scientists of BSRI as a whole in their perception of important variables influencing research productivity of scientists.

The different levels of scientists of BSRI had similar background and had to work in a same environment whatever might be the level, length of service in research with varying degrees of eminence, all were basically scientists. This might be one of the possible reasons behind their overall agreement in their perception of important variables. However, some discrepancy in their rankings was noticed. A discrepancy was noticed with the variable, "devotion to research work." The JLS ranked this variable 11th, whereas, the MLS and ULS accorded 3rd rank and ARM accorded 2nd rank to this variable. "Research assignment to a scientist according to specialization" was scorded 8th, 4th, 5th and 6th ranks by JLS, MLS, ULS and ARM respectively. Nevertheless, the discrepancy was statistically insignificant, when the overall agreement among the four levels of respondents was tested through Kendall's Coefficient of Concordance (W = 0.0005). The results of Analysis of Variance and Kendall's Coefficient of Concordance (w) test consistently showed that there was an overall agreement among the four levels of scientists of BSRI in their perception of important variables affecting the research productivity of scientists.

From the findings of this research, it can be concluded that the research productivity of BSRI scientists can be greatly enhanced if the environmental variables, particularly both the software and hardware variables are properly taken care of by the management. The environment in which the researchers work is very important. They need to be supported both materially and non-materially. On the other hand, the scientists themselves should improve some of their personal, dynamic and auto variables such as : initiative and devotion to research works, inquisitiveness, self reliance, capacity to work under constraints, etc. The scientists should not only look at the problems existing in the environment, but also look at the prospects of what they can do out of the given situation.

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Appendix 1.

Relative importance of individual variable as perceived by the JLS, MLS, ULS, ARM and the pooled respondents of Bangladesh Sugarcane Research Institute (PRS).

Variables	Median score					
	Variable group	JLS	MLS	ULS	ARM	PRS
• Devotion to research work	DA	7.0(11)	8.2(3)	8.0 (3)	8.3(2)	8.1(1)
• Facilities for specialized training	OS	7.7(6)	8.0(5)	7.5(8)	7.7(5)	7.7(2)
• Research assignment to a scientist according to specialization	OS	7.7(8)	8.0(4)	7.5(5)	7.3(6)	7.6(3)
• Initiative to work	DA	7.7(7)	7.0(15)	8.0(4)	7.2(10)	7.5(4)
• Research programme according to farmers' need	OS	6.2(20)	6.7(17)	9.0(1)	6.0(25)	7.3(5)
• Easy availability of common research equipment and maintenance facilities	OH	8.0(5)	8.7(2)	5.5(28)	7.7(4)	7.2(6)
• Scope of participation in seminars/ conferences, etc. at home and abroad.	OS	7.0(10)	7.7(7)	7.0(9)	7.2(7)	7.2(7)
• Job satisfaction	OS	8.7(3)	6.6(18)	7.5(6)	7.0(15)	7.2(8)
• Personal involvement of the scientist at all stages of experiment including data collection	DA	6.7(19)	9.6(1)	6.0(25)	7.0(14)	7.0(9)
• Creativity	DN	5.0(45)	6.7(16)	6.5(20)	9.0(1)	7.0(10)
• Policy for regular and unbiased promotion	OS	7.0(16)	5.2(37)	6.5(13)	7.2(8)	6.8(11)
• Inquisitiveness	DA	5.0(38)	7.0(12)	4.5(55)	7.2(11)	6.6(12)
• Timely availability of operational cost at the hand of the field researchers	OH	7.0(15)	5.2(35)	5.5(32)	7.2(9)	6.6(13)
• Transfer and posting must be according to research need	OS	8.2(4)	7.0(9)	6.5(17)	5.1(42)	6.6(14)
• Adequate fund for research	OH	60(29)	6.1(22)	9.0(12)	8.0(3)	6.4(15)
• Easy and timely purchase and procurement of needed research materials	OH	6.2(22)	6.2(20)	7.0(11)	6.2(23)	6.4(16)
• Research Communication skill	DN	7.0(13)	6.2(21)	4.5(60)	6.6(19)	6.3(17)
• Physical fitness	PS	7.0(12)	8.0(6)	6.1(21)	6.0(31)	6.2(18)
• Easy access to the needed literature	OH	7.0(14)	7.0(11)	5.0(39)	6.0(27)	6.2(19)
• Free from frustration	DA	5.0(49)	7.0(13)	6.5(15)	6.0(28)	6.2(20)

Appendix 1 continued

Variables	Median score					
	Variable group	JLS	MLS	ULS	ARM	PRS
• Mobility facilities for the scientists	OH	5.0(41)	5.3(33)	7.5 (52)	5.0(52)	6.0(21)
• Research experience	PS	4.7(57)	7.0(8)	6.5(16)	5.0(45)	6.0(22)
• Adequate salary for maintaining family expenditure	OH	5.2(37)	6.0(24)	6.1(22)	6.0(30)	5.9(23)
• Freedom of scientists in obtaining research inputs timely	OH	7.0(17)	5.2(41)	4.8(58)	6.2(24)	5.8(24)
• Proper feed back mechanism with field/users and research	OS	6.0(31)	5.8(29)	5.1(33)	6.7(17)	5.8(25)
• Increased linkage between extension/ ago-based industries and research	OS	4.0(66)	5.7(30)	7.0(12)	5.2(41)	5.8(26)
• Accountability for the work done	OS	5.0(42)	5.0(42)	7.0(10)	7.0(12)	5.7(27)
• Multidisciplinary group work and tea spirit	OS	8.7(2)	7.0(14)	4.5(59)	5.3(35)	5.7(28)
• Intelligence	PS	5.0(40)	7.0(10)	5.1(35)	5.2(38)	5.7(29)
• Orientation training, guidance and patronage of the superior to the newly scientists	OS	5.0(48)	5.3(34)	5.0(36)	6.2(20)	5.4(30)
• Competitive atmosphere in the organization	OS	9.0(1)	5.0(45)	5.1(34)	6.0(26)	5.4(31)
• Self perception of his/her role responsibility	DA	6.0(24)	5.6(32)	4.0(69)	5.0(46)	5.3(32)
• Research organization should be free from bureaucratic administration	OS	5.0(50)	4.3(60)	5.0(40)	6.7(16)	5.3(33)
• Mechanism for job evaluation, assessment and appreciation	OS	3.0(72)	4.7(54)	5.0(43)	6.2(21)	5.3(34)
• Developed research management leadership	OS	6.7(18)	5.2(38)	4.8(54)	5.7(32)	5.3(35)
• Interaction of scientists	OS	6.0(33)	5.2(40)	4.8(52)	7.0(13)	5.2(36)
• Oranizational autonomy	OS	6.0(32)	4.3(58)	6.0(24)	5.3(36)	5.2(37)
• Capacity to work under constraints	DA	5.0(47)	5.0(47)	4.5(56)	6.7(18)	5.2(38)
• Relatively high standard for morality	DA	5.0(52)	4.7(51)	5.4(27)	5.0(50)	5.2(39)
• Job description should be clearly spelled out	OS	5.0(33)	4.7(52)	5.5(29)	5.2(40)	5.1(40)
• Self examination of one's own scientific performance	DA	5.0(51)	5.2(39)	5.0(45)	6.0(29)	5.1(41)
• Additional remuneration and facilities of renote area station	OH	6.2(21)	5.7(31)	4.5(61)	4.0(64)	5.1(42)
• Giving priority to the job	DA	6.0(34)	6.0(26)	5.0(44)	4.0(62)	5.1(43)
• Perseverance	DA	5.0(54)	6.0(28)	4.0(57)	6.2(22)	5.1(44)

Appendix 1 continued

Variables	Median score					
	Variable group	JLS	MLS	ULS	ARM	PRS
• Free from clique	OS	5.0(43)	4.0(66)	5.5 (31)	5.0(51)	5.1(45)
• Good scientists-staff relationship	OS	4.7(56)	5.0(48)	6.5(18)	4.8(53)	5.1(46)
• Non-interference	OS	5.0(46)	5.0(46)	5.0(42)	5.1(43)	5.0(47)
• Dedicated scientist should not be given administrative function	OS	5.7(35)	6.0(25)	4.5(57)	4.2(59)	5.0(48)
• Self reliance	DA	3.0(76)	6.6(19)	4.0(66)	4.7(57)	5.0(49)
• Freedom to incur expenditure within the budgetary limit	OS	4.2(58)	4.2(63)	5.0(38)	5.7(34)	4.9(50)
• Feelings for the organization	OS	6.0(26)	4.2(61)	5.0(49)	4.7(54)	4.9(51)
• Power of critical analysis	DA	3.7(69)	6.0(27)	4.8(53)	5.0(47)	4.8(52)
• Well developed topography and leveled research land with irrigation facilities in the farm	OH	4.0(63)	4.6(57)	6.1(23)	4.2(60)	4.8(53)
• Mental readiness for criticism	DA	6.0(23)	5.0(49)	3.5(75)	5.0(49)	4.8(54)
• Research labour problem must be solved and managed	OS	3.7(68)	4.3(59)	6.4(14)	5.0(44)	4.7(55)
• No. favouritism from immediate boss	OS	4.0(60)	4.2(62)	5.0(51)	5.7(33)	4.7(56)
• Need for achievement (nAch)	DA	3.0(74)	4.7(56)	5.0(48)	4.7(55)	4.7(57)
• Cordial relationship among the colleagues	OS	5.0(44)	4.7(55)	5.5(30)	3.6(70)	4.7(58)
• Protection of research fields	OH	5.7(36)	5.0(43)	3.1(77)	4.7(56)	4.6(59)
• Transport facilities for school and college going children of the scientists	OH	6.0(27)	2.0(82)	5.0(46)	3.2(72)	4.6(60)
• Favourable attitude of the support service personnel to help the researchers	OS	4.2(59)	5.2(36)	4.5(62)	4.3(58)	4.5(61)
• Increased statistical assistance and computer facilities	OH	6.0(25)	5.0(50)	4.2(64)	3.7(67)	4.4(62)
• Doctoral Degree	DN	4.0(61)	4.0(68)	4.5(63)	5.2(39)	4.4(63)
• Adequate technical and secretarial assistance	OS	4.0(62)	6.0(23)	5.0(50)	4.2(61)	4.4(64)
• Neat and orderliness in habits and manner of work	DA	4.7(55)	4.7(53)	5.0(41)	3.2(73)	4.4(65)
• Positive reactions of fellows, superiors and administration	OS	3.0(78)	4.0(65)	4.0(68)	5.3(37)	4.3(66)
• Housing facilities near the research station	OH	6.0(30)	3.7(71)	6.5(19)	3.3(71)	4.3(67)
• Living with family members	ES	3.0(75)	4.0(67)	6.0(26)	4.0(66)	4.2(68)

Appendix 1 continued

Variables	Median score					
	Variable group	JLS	MLS	ULS	ARM	PRS
• Sharp memory	DN	4.0(67)	4.2(64)	5.0(37)	4.0(65)	4.2(69)
• Positive consistency of academic i.e., althrough 1st class or 2nd divislon/class to 1st class	DN	3.2(70)	3.2(72)	4.0(70)	5.0(48)	4.0(70)
• Membership of a scientific group	DN	5.0(39)	3.7(70)	4.0(65)	3.6(69)	3.9(71)
• Reads life history of great scientists and great men	DN	4.0(65)	3.2(73)	3.0(79)	3.0(77)	3.3(72)
• Stimulating and facilitative leadership in the organization	OS	2.0(84)	5.0(44)	2.1(82)	3.7(68)	3.2(73)
• Every research station needs sufficient seed storage	OH	6.0(28)	3.1(76)	3.5(74)	3.0(78)	3.2(74)
• Simplicity in the life pattern	DA	2.7(80)	3.2(74)	3.8(72)	2.2(81)	3.0(75)
• Relatively young in age	ES	4.0(64)	2.2(78)	3.0(78)	3.0(74)	3.0(76)
• Opportunity to supplement income through professional activities, i.e., consultancy, royalty on publications, share in patent earning, etc.	OS	3.0(73)	2.0(81)	3.0(80)	3.0(75)	2.8(77)
• Well adjusted socially	ES	2.0(86)	3.2(75)	3.5(73)	2.1(83)	2.8(78)
• Allocating some time for teaching and administration	OS	2.2(81)	2.2(79)	4.0(71)	3.0(76)	2.7(79)
• Small family size	ES	3.2(71)	2.1(80)	5.0(47)	2.1(82)	2.6(80)
• Emotional stability	DA	2.0(82)	1.3(84)	3.1(76)	2.7(79)	2.6(81)
• Spouse spport to research role	ES	3.0(79)	2.7(77)	1.9(84)	4.0(63)	2.4(82)
• No relative deprivation	OS	7.7(9)	1.7(83)	2.5(81)	2.2(80)	2.4(83)
• No distractions i.e., noise, telephone calls, unforeseen visit and gossiping	OS	3.0(77)	3.7(69)	1.5(86)	2.0(84)	2.4(84)
• Rural background	ES	2.0(83)	1.2(85)	2.0(83)	0.3(88)	1.4(85)
• Having a sense of honour	PS	2.0(85)	0.3(89)	1.5(87)	1.3(85)	1.3(86)
• Scientist-family background	ES	1.2(87)	0.7(88)	1.5(88)	0.7(86)	1.0(87)
• Politically conscious and shows political belonging	DA	1.0(88)	1.0(86)	0.8(89)	0.7(87)	0.8(88)
• Education of parents	ES	0.2(89)	0.7(87)	1.5(85)	0.3(89)	0.6(89)
• Luck	PS	0.2(90)	0.1(90)	0.0(90)	0.3(90)	0.1(90)

Note : Figure in parenthesis indicates rank number on the basis of relative important of the variables as perceived by the respective level of scientists.

Note : DA = Auto, DN = Nurtured, PS = Static, OS = Software, OH = Hardware, ES = Societal.