Individual and institutional factors influencing the research productivity of agricultural scientists

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In this study, the individual factors influencing the research productivity of agricultural scientists at the Professor Jayashankar Telangana State Agricultural University were: Psycho-social factors, including commitment, achievement motivation, self-efficacy, time-utilization pattern, level of aspiration and creativity, psycho-motor factors like discipline, and research knowledge and skills contributed to 66.53% of the variance. The institutional factors influencing research productivity were research-related factors, including the availability of the mentoring system and research assistance, infrastructural facilities, feasibility for interdisciplinary research, research collaboration and professional development opportunities, work flexibility, mission and vision of the university, participative leadership and decision-making, performance-linked promotional opportunity, job-related factors, including involvement in administrative activities and job security, contributed to 61.07% of the variance.

Keywords: Agricultural scientists, individual and institutional factors, research productivity.

IN the current scenario of ever-changing climatic conditions, agricultural productivity is being affected. In India, the majority of people depend on agriculture. Yet, the country has a vast starving population and malnourished individuals. This emphasizes the need to strengthen research systems concerned with agriculture which help increase agricultural production, productivity and the nutritional quality of agricultural produce. Conducting research in the current environment and the need for sustainability requires more potential and competency among agricultural scientists to cope with the changing conditions.

The research productivity of agricultural scientists is being influenced by several internal and external factors. Agha *et al.*[1] reported a significant relationship between integrating research into teaching courses, collaborative research and teaching practices in Nigerian universities at 5% significance. Charles *et al.*[2] reported that faculty members with high scientific rank, effective time management skills, high value on research, higher time availability to conduct research, higher institutional support, fewer courses to teach and similar priority to departmental work as that of research had higher research productivity. Ghanta[3] reported that training received by scientists followed by their designation, education, age and facilities provided directly affected their research productivity. Joe *et al.*[4] showed that the number of doctoral students advised to completion in the last five years ($R^2 = 0.37$), the research confidence of faculty members ($R^2 = 0.09$), and the number of graduate assistant hours allocated to the faculty members (additional $R^2 = 0.04$) accounted for 50% variance in research productivity ($R^2 = 0.50$). Ju[5] stated that among faculty professional characteristics, the administration support research and peer support research and faculty associated with international colleagues were the best predictors of research productivity. Madarsang[6] found that interpersonal communication and organizational climate significantly affected research productivity at 1% level of significance while education had a significant effect at 5% level. Nguyen *et al.*[7] revealed that among institutional characteristics size, time in operation and privileged location were positively correlated with research productivity, while among institutional policies management and infrastructure were positively correlated with research productivity and policies related to human resources had a positive effect on the research outcome of faculty. Ogunsola *et al.*[8] stated that the development of personal skills, contribution to society and personal research interest were the major intrinsic factors, while a desire for promotion, respect from peers and increased social standing were the major extrinsic factors influencing research productivity. Paul[9] showed that organizational research environment, creativity, perseverance and commitment, research facility, ability to work under constraint, incentive policy, proactiveness, purpose-driven orientation, achievement motivation, involvement in teaching and job satisfaction were the major factors influencing the research productivity of scientists.

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Table 1. List of individual and institutional factors given to the respondents

Individual factors	Institutional factors
Intelligence	Presence of highly reputed and accredited, outstanding scientists in the organization
Self-efficacy	Peer group influence on a scientist's research productivity
Achievement motivation	Feasibility for interdisciplinary research
Time-utilization pattern	Number of research assistants or students the scientist is working with
Perseverance	Transparent/impartial policy
Level of aspiration	Salary and fringe benefits
Networking for scientific causes and adequate contact with superior scientists	Involvement in administrative activities
Self-esteem	Job security
Self-evaluation of own scientific performance	Research autonomy
Discipline	Research collaboration and professional development opportunities
Research knowledge and skills	Availability of mentoring system and research assistance
Desire for recognition and achievement	Mission and vision of university
Mastery of research procedures and techniques	Work flexibility
Creativity	Participative leadership and decision making
Commitment	System to measure progress of scientists
Urge for excellence	Organizational stress
Publication skills	Freedom to publish
Proactive behaviour	Awards and recognition
Purpose orientation	Performance-linked promotional opportunity
Ability to get funds for research	Infrastructural facilities

Universities, General universities, Voluntary organizations, Private Organizations and other scientific societies. Agricultural research in Telangana is being conducted under the Professor Jayashankar Telangana State Agricultural University (PJTSAU), Hyderabad, India. Hence, the present study was conducted to delineate the factors influencing research productivity among agricultural scientists of PJTSAU for further improvement in the research output from the university.

Research methodology

An exhaustive list of individual and institutional factors, 20 each, was given to the respondents (Table 1). The factors were categorized according to their mean ranking obtained in Kendall's *W* test, along with the agreement among respondents. The individual and institutional factors were categorized into five classes – highly important, very important, quite important, somewhat important and less important. The first three classes were chosen and factor analysis with varimax rotation was run to finally arrive at two individual and two institutional factors influencing the research productivity of agricultural scientists.

Results

Kendall's *W* test was conducted to determine the degree of agreement among respondents and rank the factors influencing research productivity. The data collected for the individual factors were analysed.

Table 2 shows that among the individual factors influencing research productivity, commitment ranked first (I) followed by achievement motivation (II), discipline (III), research knowledge and skills (IV), perseverance (V), time-utilization pattern (VI), self-efficacy (VII), networking for scientific causes and adequate contact with superior scientists (VIII), level of aspiration (IX), creativity (X), urge for excellence (XI), self-evaluation of own scientific performance (XII), desire for recognition and achievement (XIII), mastery of research procedures and techniques (XIV), self-esteem (XV), publication skills (XVI), purpose orientation (XVII), intelligence (XVIII), ability to get funds for research (XIX) and proactive behaviour (XX). The distribution of individual factors according to mean ranking is shown in Figure 1. According to the mean ranking of factors, four each were divided into five classes: highly important, very important, quite important, somewhat important and less important.

Table 3 shows that Kendall's coefficient of concordance is 0.70, which implies that the extent of agreement among respondents was as high as 70%. A highly significant chi-square value (101.572, $P < 0.01$) indicates that there was statistically reliable agreement among the respondents regarding the perceived degree of importance of the individual factors that influence research productivity. This might be due to similar jobs, professional requirements and the overall outlook of agricultural scientists holding different positions in the research stations.

Factor analysis – individual factors

The first three classes, viz. highly important, very important and quite important, were selected for factor analysis. Principal component method with varimax rotation was followed.

Table 4 shows that the individual factors are categorized into two groups: (i) psycho-social factors, including commitment, achievement motivation, self-efficacy, time-utilization

Table 2. Distribution of individual factors according to their mean ranking

Category	Individual factors	Mean ranking	Rank
Highly important	Commitment	12.06	I
	Achievement motivation	11.98	II
	Discipline	11.23	III
	Research knowledge and skills	11.15	IV
Very important	Perseverance	10.93	V
	Time-utilization pattern	10.92	VI
	Self-efficacy	10.82	VII
	Networking for scientific causes and adequate contact with superior scientists	10.75	VIII
Quite important	Level of aspiration	10.47	IX
	Creativity	10.42	X
	Urge for excellence	10.41	XI
	Self-evaluation of own scientific performance	10.38	XII
Somewhat important	Desire for recognition and achievement	10.28	XIII
	Mastery of research procedures and techniques	10.16	XIV
	Self-esteem	10.15	XV
	Publication skills	9.93	XVI
Less important	Purpose orientation	9.78	XVII
	Intelligence	9.49	XVIII
	Ability to get funds for research	9.43	XIX
	Proactive behaviour	9.27	XX

Table 3. Kendall's coefficient of concordance for individual factors

n	120
Kendall's *W* (Kendall's coefficient of concordance)	0.70
Chi square	101.572
Asymptotic significance	$P < 0.01$

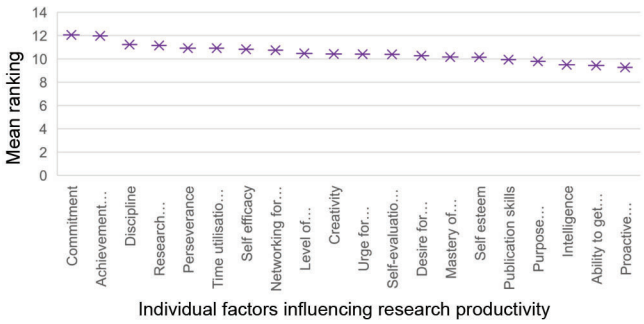

Figure 1. Distribution of individual factors according to mean ranking.

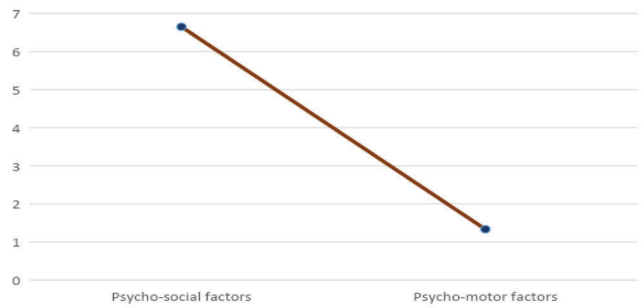

Figure 2. Eigen-values (after rotation sum of square loading) of individual factors influencing research productivity.

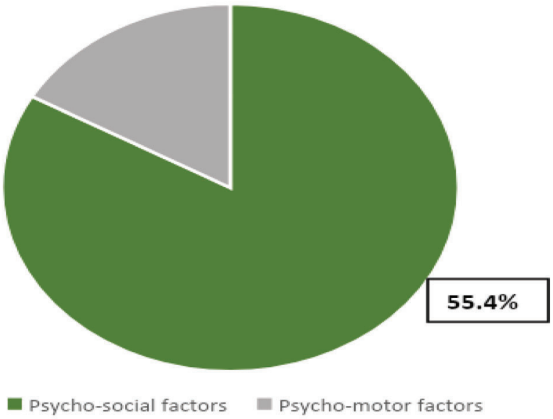

Figure 3. Percentage variance contribution by individual factors influencing research productivity.

pattern, level of aspiration and creativity, and (ii) psycho-motor factors, including discipline, and research knowledge and skills. Only those variables with factor loadings and communalities more than 0.7 were considered, and only those factors with eigen-values more than 1 were selected. The psycho-social factors contributed to 55.4% of variance, while the psycho-motor factors contributed to 11.13% of variance. On the whole, the individual factors contributed to 66.53% of variance. Eigen-values (after rotation sum of square loading) and the percentage variance contribution of individual factors are shown in Figures 2 and 3 respectively.

Factor I: Psycho-social factors

The first factor can be explained by six individual variables, namely commitment, achievement motivation, self-efficacy,

Table 4. Factor analysis – individual factors

Individual factors	Variables	Factor loading	Eigen value	Communality	Variance contribution (%)
Psycho-social	Commitment	0.715	6.648	0.777	55.40
	Achievement motivation	0.739		0.762	
	Self-efficacy	0.794		0.766	
	Time-utilization pattern	0.822		0.787	
	Level of aspiration	0.76		0.784	
	Creativity	0.789		0.73	
Psycho-motor	Discipline	0.875	1.335	0.793	11.13
	Research knowledge and skills	0.894		0.822	
Total					66.53

Table 5. Distribution of institutional factors according to their mean ranking

Category	Institutional factors	Mean ranking	Rank
Highly important	Availability of mentoring system and research assistance	11.68	I
	Infrastructural facilities	11.55	II
	Involvement in administrative activities	11.52	III
	Feasibility for interdisciplinary research	11.43	IV
Very important	Research collaboration and professional development opportunities	11.3	V
	Work flexibility	11.3	VI
	Mission and vision of the university	11.24	VII
	Participative leadership and decision-making	11.21	VIII
Quite important	Number of research assistants or students the scientist is working with	11.01	IX
	Presence of some highly reputed and accredited, outstanding scientists in the organization	10.81	X
	Performance-linked promotional opportunity	10.58	XI
	Job security	10.57	XII
Somewhat important	Transparent/impartial policy	10.44	XIII
	System to measure progress of scientists	10.36	XIV
	Research autonomy	10.16	XV
	Freedom to publish	10.08	XVI
Less important	Awards and recognition	9.53	XVII
	Salary and fringe benefits	9.21	XVIII
	Peer group influence on a scientist's research productivity	8.49	XIX
	Organizational stress	7.53	XX

time-utilization pattern, level of aspiration and creativity as indicated by communality (0.777, 0.762, 0.766, 0.787, 0.784 and 0.73 respectively) and very high loading (0.715, 0.739, 0.794, 0.822, 0.76 and 0.789 respectively) of these six variables on this factor. It contributed to highest variance (55.40%) in total variability.

Factor II: Psycho-motor factors

The second factor can be explained by two individual variables, namely discipline and research knowledge and skills, as indicated by communality (0.793 and 0.822 respectively) and factor loading (0.875 and 0.894 respectively) of these two variables on this factor. It contributed to 11.13% of variance to the total variability.

Table 4 indicates that psycho-social factors including perseverance, achievement motivation, self-efficacy, time-utilization pattern, level of aspiration and creativity as the major individual variables influencing research productivity. This emphasizes the need to concentrate on improving the personal factors of agricultural scientists by conducting specialized periodical training sessions on upscaling their motivation, aspiration, creativity and perseverance. Besides psycho-social factors, psycho-motor factors, including discipline and research knowledge and skills influenced research productivity. This emphasizes the need to upscale research skills and improvement of research knowledge by conducting workshops and periodical training sessions.

Kendall's *W* test – institutional factors

Kendall's *W* test was conducted to determine the degree of agreement among respondents and rank the factors influencing research productivity. The data collected for the institutional factors were analysed.

Table 5 shows that, among the institutional factors influencing research productivity, availability of mentoring system and research assistance ranked first (I), followed by infrastructural facilities (II), involvement in administrative activities (III), feasibility for interdisciplinary research (IV), research collaboration and professional development opportunities (V), work flexibility (VI), mission and vision of the university (VII), participative leadership and decision-making (VIII), number of research assistants or students the scientist is working with (IX), presence of some highly reputed and accredited outstanding scientists in the organization (X), performance-linked promotional opportunity (XI), job security (XII), transparent/impartial policy (XIII), system to measure progress of scientists (XIV), research autonomy (XV), freedom to publish (XVI), awards and recognition (XVII), salary and fringe benefits (XVIII), peer group influence on a scientist's research productivity (XIX) and organizational stress (XX). The distribution of institutional factors according to mean ranking is shown in Figure 4. According to the mean rankings of the factors, four each were divided into five classes: highly important, very important, quite important, somewhat important and less important.

Table 6 shows that Kendall's coefficient of concordance is 0.72, which implies that the extent of agreement among the several groups of respondents was as high as 72%. A highly significant chi-square value (182.477, $P < 0.01$) indicates that there was statistically reliable agreement among the respondents regarding the perceived degree of importance of the institutional factors that influence research productivity. This might be due to similar kind of jobs, professional requirements and the overall outlook of agricultural scientists holding different positions in the research stations.

Table 7 shows that the Institutional factors can be categorized into two major groups (i) Research-related factors, including the availability of mentoring system and research assistance, infrastructural facilities, feasibility for interdisciplinary research, research collaboration and professional development opportunities, work flexibility, mission and vision of university, participative leadership and decision-making, performance-linked promotional opportunity and job-related factors, including involvement in administrative activities and job security. Only those variables with factor loadings and communalities more than 0.7 were considered and only those factors with an eigen-value of more than 1 were selected. The research-related factors contributed to 49.72% of variance, while the job-related factors contributed to 11.35% of variance. On the whole, the institutional factors contributed to 61.07% of variance. Eigen-values (after rotation sum of square loading) and the percentage variance contribution of institutional factors are depicted in the Figures 5 and 6 respectively.

Table 6. Kendall's coefficient of concordance for institutional factors

n	120
Kendall's *W*	0.72
Chi square	182.477
Asymptotic significance	$P < 0.01$

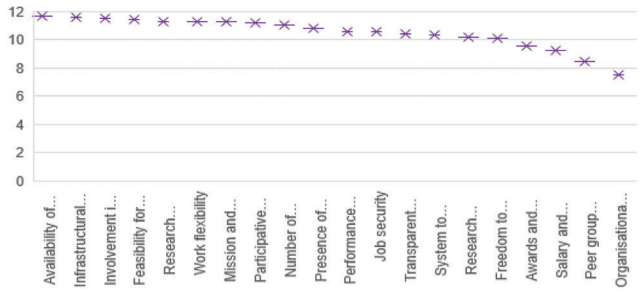

Figure 4. Distribution of institutional factors according to their mean ranking.

Factor I: Research-related factors

This first factor can be explained by eight institutional variables, namely availability of the mentoring system and research assistance, infrastructural facilities, feasibility for interdisciplinary research, research collaboration and professional development opportunities, work flexibility, mission and vision of the university, participative leadership and decision-making and performance-linked promotional opportunity, as indicated by communality (0.763, 0.703,

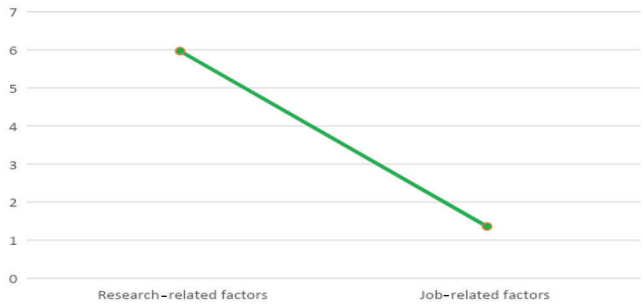

Figure 5. Eigen-values (after rotation sum of square loading) of institutional factors influencing research productivity.

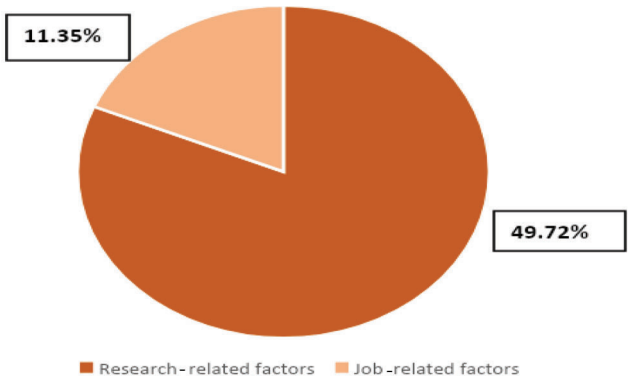

Figure 6. Percentage variance contribution by institutional factors influencing research productivity.

Table 7. Factor analysis – institutional factors

Institutional factors	Variables	Factor loading	Eigen value	Communality	Variance contribution (%)
Research-related factors	Availability of mentoring system and research assistance	0.809	5.966	0.763	49.72
	Infrastructural facilities	0.776		0.703	
	Feasibility for interdisciplinary research	0.745		0.713	
	Research collaboration and professional development opportunities	0.815		0.701	
	Work flexibility	0.863		0.76	
	Mission and vision of the university	0.786		0.749	
	Participative leadership and decision-making	0.811		0.705	
	Performance-linked promotional opportunity	0.776		0.748	
Job-related factors	Involvement in administrative activities	0.78	1.361	0.713	11.35
	Job security	0.783		0.728	
Total					61.07

0.713, 0.701, 0.76, 0.749, 0.705 and 0.748 respectively) and very high loading (0.809, 0.776, 0.745, 0.815, 0.863, 0.786, 0.811 and 0.776 respectively) of these variables on this factor. It contributed to the highest variance (49.72%) in the total variability.

Factor II: Job-related factors

This factor can be explained by two institutional variables, namely involvement in administrative activities and job security as indicated by communality (0.713 and 0.728 respectively) and factor loading (0.78 and 0.783 respectively) of these variables on this factor. It contributed to 11.35% of variance in the total variability.

Table 7 indicates that research-related factors, including the availability of mentoring system and research assistance, infrastructural facilities, feasibility for interdisciplinary research, research collaboration and professional development opportunities, work flexibility, mission and vision of university, participative leadership and decision-making, and performance-linked promotional opportunity are the major institutional variables influencing research productivity. This emphasizes the need to improve the organizational research climate in the research stations and provide research-related incentives to agricultural scientists. The job-related factors, including involvement in administrative activities and job security, were found to influence research productivity. This emphasizes the need to reduce the workload among scientists by filling up vacant posts.

Conclusion

As evident from the results, the variance contribution of individual factors was more when compared to institutional factors. This indicates that individual factors need more emphasis for improving research productivity among agricultural scientists. Besides, agricultural scientists must be motivated by providing better incentives and promotional policies. Periodical assessment and renewal of organization research climate will also help improve the research productivity. The agricultural scientists have to be trained periodically to increase their motivation, creativity and innovativeness, thus contributing to higher research productivity.

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