

Research Article

How factors affecting farmers job satisfaction in the agricultural sector of Khyber Pakhtunkhwa, Pakistan

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Abstract

This study aimed to identify factors affecting farmer's satisfaction in the agriculture sector of Khyber Pakhtunkhwa, Pakistan. The factors included in this study were person-job fit, employee empowerment, person-organization fit, self-efficacy, leadership, workload, salary, promotion opportunity, employee training, teamwork, and work environment on job satisfaction of farmers in the agricultural sector of Khyber Pakhtunkhwa, Pakistan. The data was collected through a non-random sample of 502 small farm business participants funded by the Malaysian Knowledge Synthesis Grants Global Research Foundation. The questionnaires were distributed in different regions in the Malakand Division of the Khyber Pakhtunkhwa and analyzed the data through SPSS (Statistical Packages for Social Sciences) and SEM (Structure equation modeling) accordingly. The results show that employee empowerment, person-job fit, self-efficacy, person-organization fit, leadership, salary, promotion opportunity, teamwork, and employee training positively impact farmers' satisfaction levels. However, the workload and work environment adversely impact the farmer's satisfaction levels. The study concluded that by assigning meaningful tasks, assessing existing compensation, professional recognition, and creating a working environment that encourages and inspires farmers. This research helps better understand the various elements of farmers' satisfaction and provides input to improve the Malakand Division agricultural sector's productivity in Khyber Pakhtunkhwa-Pakistan.

Keywords: Confirmatory Factor Analysis, Farmers Job Satisfaction, Structural Equation Modelling

Introduction

Job satisfaction is widely considered a sector-agnostic for any firm's operations and is a crucial indicator of success and productivity [1]. Greater importance is accorded to job satisfaction issues as workers' satisfaction has a favorable relationship with the attainment of individuals and firms' long-term goals.

Any organization's ability to achieve its strategic goals depends vitally on its capacity to maintain, attract, and retain capable and satisfied workers [2]. Thus, job satisfaction is an exciting area, with many researchers studying the factors contributing to their work satisfaction in the agriculture sector [3]. The worker will be more committed and satisfied in those

occupations, which tend to be important and vice versa [4]. According to [5], Job satisfaction is a multidimensional and complex construct, meaning different things. In a highly modest business environment, work is the most important characteristic in a person's life because most people's time is spent at work, and worker's job satisfaction is more important than ever [6]. However, lack or absence of job satisfaction may lead to job dissatisfaction, absenteeism, exhaustion, indifference, and rotation, directly or indirectly affecting personal productivity. [7] believe that job satisfaction can significantly promote the productivity, profitability, and efficiency of organizations in various industries, including agriculture, service, and manufacturing industries.

This study focuses on agricultural workers in some private firms in the Khyber Pakhtunkhwa (KPK) province of Pakistan. Its main objective is to identify critical elements such as person-organization fit, person-job fit, employee empowerment, employee self-efficacy, leadership, workload, salary, promotion opportunities, teamwork, employee training, and work environment to work employee job satisfaction. This research endeavor is timely needed because it highlights important aspects of enhancing job satisfaction concerning the agriculture sector in Pakistan, which is the national economy's backbone to infuse greater productivity. The study's findings will serve as a stepping stone to hire, supervise, and develop new strategies and policies for enhancing job satisfaction within the realms of running a farming business [5]. Additionally, this study endeavors to propose strategies to mitigate workers' displeasure, creating a platform for future investigations, and providing benchmarks for upcoming researchers. In the light of the preceding discussion, the purpose of this research is to investigate the associations among employee self-efficacy, person-job fit, employee empowerment,

person-organization fit, employee training, leadership, workload, salary, job satisfaction, promotion opportunity, teamwork, and work environment in the agricultural sector of KPK province, Pakistan.

The construct of job satisfaction is gaining heightened attention because of its universality and importance to broad spectra of industries, especially agriculture, widely acclaimed as the Pakistan economy's backbone [8]. Organizational psychologists and industry researchers have published numerous research articles and reports on job behaviors and motivations in the agriculture sector's domains. By the early 20th century, job satisfaction in the literature was already remarkable and significant about job satisfaction in the Western world. [9] noted that from 1935 to 1976, more than 3,000 research studies were published, making it, on average, one study every five days. According to [10], managers now believe that it is their moral responsibility to germinate high worker satisfaction levels, mainly to enhance their control over efficiency, performance, absenteeism, and job-hopping. This is one of the many reasons why work satisfaction is a common concern for practitioners and researchers in many fields, including but not limited to industrial psychology, business, public administration, and agriculture and higher education sectors. Studying work attitudes and people's feelings about work have become an important research field in organizational behavior and productivity analysis [11]. Based on the previous discussion about the importance of job satisfaction, it is naturally interesting to study and further evaluate farmer satisfaction factors.

Moving ahead in the same vein, we are now discussing empowerment, person-job, and person-organization fit in the context of research. According to [12], the concept of empowerment stems from job enrichment, participative management, and industrial democracy. [13] define

empowerment as the greater involvement and participation of workers leading to improved decision-making, which is useful for the organization of all sizes. The person-job fit can be defined as the degree to which a person's abilities, knowledge, needs, skills, values, and preferences align with his job or job requirements [14]. Employees with a high degree of Person-Job (P-J) fit indicate that their performance and job satisfaction are high. Most researchers define it as a matching process between an organization and an individual. According to [15], P-O matching is divided into two main categories: additional matching and complementary matching. The former is achieved when a person has similar characteristics to others in the organization. On the contrary, when a person's characteristics add something new to fill the gaps in organizational knowledge and skills, thereby creating value for himself and others, the latter can be achieved.

In the same continuation, the concept of self-efficacy, leadership, workload, and promotion or advancement in farmers' lives is discussed in ensuing lines. Self-efficacy refers to 'people's judgments of their abilities to organize and perform the course of action needed to achieve a designated type of performance [16]. Many scholars believe that self-efficacy is closely related to job satisfaction in various departments [17]. At the same time, leadership is a term that can be found in all workspaces and defined in many ways. [18] believe that leadership manages teamwork under appropriate control and influence. Similarly, [19] define leadership to guide organized people to achieve their goals. [20] describe workload as the work environment requirements for workers in the same vein. The qualitative workload is related to difficulty in physical or mental tasks, while the quantitative workload is related to worker output. [21] reported that job satisfaction correlates positively with that of employee's salaries. Managers within the organization or new

entrepreneurs such as farmers strive to improve their quality of life, income prospects, and labor mobility to increase workplace productivity [22].

[23] posited that training could be divided into on-the-job and off-the-job training, with the former undertaken internally and later outside organizational boundaries. Teamwork enables workers to co-operate, enhance personal skills, and provide an adequate response without any conflict among fellows [24]. Teamwork as a strategy can improve employees and the organization's performance, but it must be developed over time to improve performance in an increasingly competitive environment [25]. It naturally makes sense that individuals who feel relaxed in their workplace are more productive and enjoy the workflow more than those who feel otherwise, which makes aspects of the employee's work environment more critical in the study. Some problems may hinder the relaxation of the environment, such as noise, ventilation, hygiene of the workspace, and pressure. Work stress can be caused by various reasons, such as the nature of work, work location, monotony, repetition, payment system, shift work, and colleague's attitude. [26] proclaims that many workers respond differently to different situations. However, it is hard to eliminate stress wholly faced by farmers beyond their control, but experts assert that some form of stress is useful as it brings out the best in certain situations.

The objective of the study

To examine how factors affecting farmers Job Satisfaction in the Agricultural sector of Khyber Pakhtunkhwa, Pakistan.

Materials and Methods

The study uses a quantitative research design to check the hypotheses of association among independent and dependent variables, such as employee empowerment, P-O fit, P-J fit, employee training, leadership, workload, salary, promotion opportunity, teamwork, employee self-efficacy, and work

environment—on employee job satisfaction in the agricultural sector of the District Malakand of KPK, Pakistan. We chose a causal study for examining the natural environment to reduce the level of interference with the researcher taking a neutral stance [27]. We used a cross-sectional survey design to analyze data for results. For the data collection, we used the questionnaire survey technique for the measurement, and the sample design was non-random purposive of sample 502 participants in line with [28] to ensure a representative sample is used. The variable employee empowerment, P-O fit, P-J fit, employee self-efficacy was measured through the construct as developed by [28-

30]. The variable Leadership style, workload, salary, and promotion opportunity were measured through the construct developed by [31-34]. Whereas the variable employee training, teamwork, and work environment were measured through the construct as developed by [35] and [36]; while, variable job satisfaction was measured through the construct as developed by [37]. In the current research, Cronbach α was used to calculate the reliability by using SPSS. In addition, CFA (confirmatory factor analysis) was used to measure the validity, structural equation modeling (SEM) was also used to test model fitness, and using AMOS 21 software. (Fig. 1).



Figure 1. The conceptual model

Results

The results have been given clearly and concisely furnished with the elaboration of figures and tables. As per the research objectives, we summarized the effects of eleven elements—employee empowerment, P-J fit, self-efficacy, P-O fit, leadership, workload, salary, promotion opportunity, teamwork, training, and work environment—on job satisfaction of employee in the agricultural sector, of the KPK-Pakistan in the ensuing discussion.

Respondent's demographic information
Descriptive analysis was employed to

identify the demographic information of the interviewees. The results of (Table 1) shows that out of 502 respondents, 16.9% were female respondents, while 83.1% were male respondents. In terms of age group, most of the respondents, 54%, were in the range of 31 to 40 years, followed by 41-50 years (19.5%). The age category of 21-30 years constitutes 14.1% of the sample size. The smallest group was those above 51 years old (12.4%). The results of (Table 1) illustrates that of the 502 respondents who participated, 73.9% of the respondents were married, while the

remaining 26.1% were unmarried. In terms of education, 2.7% of the respondents' had an MS degree, 32.5% a master's degree, 16.5% a high school certificate, 30.9% a BS/bachelor's degree, While 17.3% had a diploma or lower level qualification. Regarding the respondent's job contract information, only 4.6% of the respondents worked in the existing organization for more than nine years, 12.0% worked for six to nine years, 39.6% work for three to six years, 37.8% worked for one to three years respectively. While the remaining 6.0% of the respondents had less than one year of work experience in the current

organizational setup. 18.1% of the respondents earn between PKR 20001 to 30000 per month, while 28.7% earn between PKR 30001 to PKR 40000 per month. Similarly, 37.1% of the respondents earn between PKR 40001 to 50000 per month, while 11.8% earn between PKR 50001 and PKR 60000 per month. Only 1.8% of the respondents earn more than PKR 60000 per month. Similarly, 2.6% of the respondents had income in the range of PKR 20000 or under. See (Table 1) for more details on demographic variables.

Table 1. Demographic details of the sample

Variable	Value	Frequency	Valid(%)
Gender	Male	417	83.1
	Female	85	16.9
Age	21-30 years	71	14.1
	31-40 years	271	54
	41-50 years	98	19.5
	Above 51 years	62	12.4
Marital Status	Unmarried	131	26.1
	Married	371	73.9
Qualification	M.Phil.	14	2.7
	Master	163	32.5
	Undergraduate	155	30.9
	Intermediate	83	16.5
	Diploma	87	17.3
Experience	Less than one year	30	6.0
	One-three years	190	37.8
	Three-six years	199	39.6
	Six-nine years	60	12.0
	Above nine years	23	4.6
Monthly income (Rupees)	PKR 20000 or under	13	2.6
	PKR 20001 to 30000	91	18.1
	PKR 30001 to 40000	144	28.7
	PKR 40001 to 50000	186	37.1
	PKR 50001 to 60000	59	11.8
	Above than PKR 60000	9	1.8
Total participants		502	100

Validity and reliability analysis

The results of (Table 2) shows that the current research adopted the construct and

items from other multiple research studies which measured employee empowerment, P-J fit, self-efficacy, P-O fit, leadership,

workload, salary, promotion opportunity, teamwork, employee training, work environment, and job satisfaction. The survey questionnaire was modified for the goodness of measure for perceptual constructs the validity of variables fit. 11 factors employee empowerment, P-J fit, self-efficacy, P-O fit, leadership, workload, salary, promotion opportunity, teamwork, employee training, work environment, and job satisfaction were extracted with 49 items and AVE (average variance extracts) resulted in 0.577, 0.572, 0.539, 0.570, 0.594, 0.557, 0.587, 0.567, 0.548, 0.581, 0.541, and 0.597, respectively. [38] recommends that Cronbach's alpha is used

to test the reliability of factor analysis with an acceptable value for the internal consistency of the construct. The Cronbach's alpha value is generally considered to be 0.70. Likewise, the value of Cronbach's alpha of employee empowerment, P-J fit, self-efficacy, P-O fit, and leadership are 0.868, 0.835, 0.821, 0.839, and 0.852, while for workload, salary, promotion opportunity, teamwork, employee training, work environment, and job satisfaction, the Cronbach's alpha value are 0.790, 0.806, 0.835, 0.853, 0.869, 0.854, and 0.850 respectively, which are acceptable.

Table 2. Confirmatory factor analysis

Code	Items	Factor Loadings	EVE	Reliability
	Employee Empowerment		0.577	0.868
EE1	I got more facilities to carry out my job	0.820		
EE2	I provide plenty of important information to get the job done	0.859		
EE3	I can use my authority and have the right to decide and performed my job well	0.805		
EE4	My boss motivates me always which in turn give me the confidence to make the right decision in my job	0.732		
EE5	I am free in my job whatever how I do my job	0.801		
	Person-Job Fit		0.572	0.835
PJF1	There is a similarity between what I am looking for in a job and what my job offers me	0.746		
PJF2	The characteristics that I look for in a job are fulfilled very well in my current job.	0.799		
PJF3	The similarities are excellent between the demands of my job and my expertise.	0.849		
PJF4	The job that I currently hold gives me just about everything I want from a job.	0.789		
	Person-Organization Fit		0.539	0.821
POF1	The placement of an organization is a good match for me.	0.807		
POF2	My personality matches the reputation of the placement of the organization.	0.756		
POF3	The placement of the organization fulfills my needs	0.746		

POF4	The values of the placement of the organization, similar to my values.	0.792		
	Self-Efficacy		0.570	0.839
SE1	Whenever I face any problem, I can manage to solve that problem by using my skills.	0.780		
SE2	If someone does not agree with me, I can find the means and different ways to get what I want.	0.784		
SE3	I am inquisitive about my job; that's why easy for me to accomplish my goals.	0.747		
SE4	I am confident when I face unexpected events and deal with them.	0.828		
	Leadership		0.594	0.852
LS1	I am aware of the abilities of my immediate boss's towards the employees.	0.761		
LS2	I am satisfied with the style of my boss's directions.	0.818		
LS3	I am satisfied with the support of my manager.	0.787		
LS4	I am satisfied with the managerial skills of my boss.	0.817		
	Workload		0.557	0.790
WL1	My colleagues are not doing their jobs properly that's why my workload is often increased	0.796		
WL2	Sometimes I face pressure at work	0.803		
WL3	I am expected that I am working too much	0.810		
	Salary Package		0.587	0.806
SP1	The Company where I am working the remuneration package is competitive.	0.797		
SP2	I am much satisfied with the entirety of my salary package.	0.827		
SP3	If I found better opportunities than the current job, I will leave this organization immediately.	0.821		
	Promotion Opportunity		0.567	0.835
PO1	For expanding my knowledge, I am allowed to attend different workshops, seminars, and conferences	0.767		
PO2	Different in-service education programs leading to promotions are available.	0.790		
PO3	I work hard to express my professional developmental needs.	0.814		

PO4	The Promotion criteria of my organization are well defined.	0.822		
	Teamwork		0.548	0.853
TW1	The team members have a strong association with each other	0.749		
TW2	The team members give respect to every one	0.812		
TW3	My department team member always support me during my work	0.796		
TW4	work hard is the motive of my team member to get things done	0.799		
TW5	For the accomplishment of their job my team member encourages one another	0.673		
	Employee Training		0.581	0.869
ET1	For staff development, my department management organizes different seminars and conferences to respond to the changing needs of work	0.669		
ET2	The reward system is fundamental in my department to encourage their employees	0.793		
ET3	The training opportunities which I got well suited my job	0.787		
ET4	My expectations are fulfilled my training program	0.783		
ET5	By conducting a different training program which I got feel satisfied me	0.861		
	Work Environment		0.541	0.854
WE1	I feel that my workplace is a safe environment.	0.756		
WE2	I am satisfied with the supporting equipment I use to get help in my job.	0.819		
WE3	My occupational health care is good, and I am happy.	0.805		
WE4	I am pleased with the cleanliness and lighting of the working place.	0.688		
	Job Satisfaction		0.597	0.850
JS1	I am satisfied with my current working status.	0.794		
JS2	My earning condition feel satisfied me	0.704		
JS3	I am so happy to select this organization for my job	0.725		
JS4	I am delighted and curious about my current job	0.718		

Table 3. Model goodness of fit measures

Fit indices	Acceptable Level	Measured value	Benchmark paper	Decision
CFI	> 0.90	0.931	[40]	Acceptable
TLI	> 0.90	0.927	[41]	Acceptable
GFI	> 0.80	0.851	[42]	Acceptable
AGFI	> 0.80	0.836	[42]	Acceptable
NFI	>0.80	0.843	[41]	Acceptable
P-CLOSE	>0.50	1.000	[43]	Acceptable
RMSEA	< 0.08	0.036	[44]	Acceptable
X ²		1933.602		
DF		1164		
Chi-square (X ² /DF)	> 1< 3	1.661	[45]	Acceptable

Table 4. Hypotheses testing

Hypothesis	Independent Variable	Dependent Variable	Estimate	S.E.	C.R.	P-Value	Decision
H1	Empowerment	Self-efficacy	0.250	0.051	4.906	***	Supported
H2	Person-job fit	Self-efficacy	0.621	0.093	6.673	***	Supported
H3	Person-organization fit	Self-efficacy	0.342	0.062	5.484	***	Supported
H4	Self-efficacy	Job satisfaction	0.240	0.036	6.695	***	Supported
H5	Leadership	Job satisfaction	0.202	0.048	4.196	***	Supported
H6	Workload	Job satisfaction	-0.047	0.048	-0.98	0.327	Rejected
H7	Salary	Job satisfaction	0.282	0.045	6.337	***	Supported
H8	Promotion opportunity	Job satisfaction	0.280	0.047	6.015	***	Supported
H9	Teamwork	Job satisfaction	0.213	0.047	4.571	***	Supported
H10	Training	Job satisfaction	0.276	0.055	5.044	***	Supported
H11	Work environment	Job satisfaction	-0.035	0.049	-0.72	0.470	Rejected

Discussion

This study has been used to determine the important factors (empowerment, P-J fit, P-O fit, leadership, workload, salary, promotion opportunity, teamwork, employee training, work environment) that affect the job satisfaction of employees working in the agricultural sector of the KPK, Pakistan, mediated by self-efficacy, resulting in relationships between variables. This study found that employee empowerment positively affects employee self-efficacy and goes in agreement with

prior research [46]. Many studies show that job empowerment strategies can increase employees' self-efficacy. The study found that work-related fitness has a significant positive effect on employee performance. This study's results are consistent with previous studies undertaken in developing countries [46, 47]. According to social knowledge theory, workers with greater autonomy will pursue higher goals, perform better in the workplace, and earn more appreciation, salary, and career advancement

opportunities [48]. Person–organization fit can significantly impact employee self-efficacy and was supported by previous research [35]. According to the person-organization fit theory, when employees' values are congruent with their organizational values, they will have positive attitudes and behaviors [49]. This study suggests that workers can be advised to identify organizations with similar values in their job search in career counseling or mentoring. Workers who are farmers, in this case, with low-value fit may be challenging to identify with their organization, which may have a negative influence on their self-efficacy, commitment, and job satisfaction [50]. This study investigates that employee self-efficacy significantly influences employee job satisfaction and has been supported by previous research [51]. With the improvement of self-efficacy, the workforce can more easily adapt to changing environments. Therefore, individuals with higher self-efficacy tend to be more positive and active in their employment and working environment, contributing to their work satisfaction. In addition, individuals with higher self-efficacy tend to remain highly persistent in the face of failure and effectively overcome difficulties. Once strong self-efficacy is achieved, individuals are likely to be happy with their employment. Moreover, this study found that leadership has a significant favorable influence on employee job satisfaction and has been supported by previous research [52, 53]. These research results are consistent with the transformational leadership theory, emphasizing leaders' role in providing a supportive work environment for employees, thereby increasing satisfaction and productivity [54]. Moreover, leadership styles and organizational culture are critical organizational antecedents of job satisfaction. Leadership and job satisfaction are considered significant components that influence the organization's overall productivity [55].

This study found that the workload had a negative and insignificant impact on employee job satisfaction, and the results didn't provide support for this hypothesis. This finding was supported by many researchers earlier [56], who found that the workload is insignificantly linked with employees' job satisfaction. The rise in the workload of personnel is inversely related to the job satisfaction of workers. The decline in job satisfaction is generally considered related to anxiety, anger, tension, depression, and fatigue [57]. Excessive workload leads to increased mental and physical stress and dissatisfaction. Hence, we can argue that the more organizational tasks and the number of hours of work per week were associated with emotional exhaustion, which manifests burnout and employee job dissatisfaction. However, salary had a positive and significant influence on employee job satisfaction, and the results support this hypothesis. This financing has been supported by several researchers [58, 59], who found that pay is the essential variable for job satisfaction. If a person is paid more, the performance of the individual is likely to rise. [60] stated that Herzberg's theory of motivation-hygiene tells us that pay is one of the hygienic factors that reduce job dissatisfaction. The study also found that promotion opportunities significantly affect employee satisfaction and that the results support this assumption. The results of this study are consistent with previous studies undertaken [61, 62].

Teamwork can significantly impact employee job satisfaction, and the results also support our hypothesis for this study. Researchers such as [63] and [64] support this finding, and they believe that teamwork plays a crucial role in improving employee job satisfaction. In these environments, teamwork efforts will positively affect employee job satisfaction, as the study results show following [65]. This study found that employee training has a positive effect on job satisfaction for

work. It has a positive effect and has been supported by previous research done by [66]. Training plays a crucial role in building new and existing employees, as it helps them perform their job effectively. Training also prepares staff for upcoming positions in an organization with full capacity and helps overcome gaps in work-related areas. Many researchers have found that the right work environment was related to higher job satisfaction, lower job burnout, and less willingness to leave [53].

Conclusions and Recommendations

The results argue empirically that employee empowerment, person-job fit, self-efficacy, person-organization fit, leadership, salary, promotion opportunity, teamwork, and employee training have a positive impact on farmers satisfaction level in the context of the study. It has been concluded that the workload and work environment adversely impact the farmer's satisfaction levels. The study concluded that assignment of meaningful tasks, assessing existing compensation, professional recognition, and creating a working environment that encourages and inspires farmers improves satisfaction levels. The results indicate that Person-job fit plays a key role in farmer's productivity decreases turnover intention, and improves farmers' work satisfaction, improving their self-efficacy level. Intervention, both internal and external, is required to improve worker's person-organization fit perceptions. The study indicates that self-efficacy can also influence job-related pressure employees experience when dealing with various demands. Our findings suggest that supervisory employees should consider increasing worker's confidence when deciding how to improve job satisfaction.

Moreover, a leadership style that involves workers in the decision-making process will provide farmers with even more satisfying opportunities. Likewise, a positive work environment can motivate good organizational leadership and contribute to organizational success in the

agriculture sector of Khyber Pakhtunkhwa. The study indicates that workers in the farm business who perceive the workload as unfair are more likely than others to execute poorly and may require closer scrutiny and more support and supervision. Salary or compensation is an invaluable tool for retention and a motivational factor for employee's commitment to the organization, improving attraction and retention. Regarding advancement, workers will be more satisfied if their jobs provide personal and career advancement opportunities, which determines the degree of employee satisfaction. Likewise, teamwork and training positively impact farmer's job satisfaction, making it imperative in contemporary practices. To improve employee's efficiency, productivity, and commitment to work, organizations must meet their staff's needs by providing the right working environment. As the agriculture sector relies heavily on human resources, managers must increase job satisfaction within farming businesses to motivate farmworkers through meaningful tasks, re-assessing compensation, professional recognition, and creating a working environment that encourages and inspires workers. The researchers suggest that future research used other variables such as perceived organizational support and self-efficacy also different sectors like telecom, health, and education. The study examines the effects of an extended set of eleven elements on farmers' job satisfaction, unlike prior researchers who had paid scarce attention as evident from the scant empirical treatment of research area having more than six variables in the agriculture sector Khyber Pakhtunkhwa, Pakistan. Moreover, Structural equation modeling has been used, which amalgamates a family of related methods rather than a single technique, which further adds credence to the study.

Author's Contributions

Conceived and designed the experiments: A Ali, Performed the experiments: A Ali,

M U Din, & M Nawaz, Analyzed the data: A Ali & Q Hussain, Contributed reagents/materials/analysis tools: A Ali, M U Din, M Nawaz, & Q Hussain, Wrote the paper: A Ali & Q Hussain.

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