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Teachers' Perceptions on Agricultural Science Curriculum Evolvement, Infrastructure Provision and Quality Enhancement in Limpopo Province, South Africa

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ABSTRACT This study was conducted in Limpopo Province of South Africa focusing on Agricultural Science teachers. From a population of about 243 teachers, 88 who attended the Provincial conference organized by the Association of South African Agricultural Educators participated in the study. The study aimed at responding to teachers' demographic characteristics, availability of land for agricultural purposes, Senior Certificate subject pass rates and teachers' perceptions regarding evolvement of subject content, teacher qualifications and quality of output and infrastructure support. A quantitative, multistage clustered non-probability sampling design was employed to solicit responses from teachers. Data was collected using Likert scale questionnaires and analyzed through non-parametric ordinal level statistical techniques. The study recommends the retraining of teachers who are expected to remain in the system for at least 10 years, provision of support that would assist in transmitting practical knowledge and arrangement of workshops on restructuring the Agricultural Science syllabus to relevant stakeholders.

INTRODUCTION

Background of the Study

Perhaps the importance accorded to accessing education in South Africa could best be reflected by the high proportion of 5-year-olds, and those between 14 and 18 years that attended school as of 2015 (87.2% and 90.7%, respectively) (Motshekga 2016). Central to the production of sufficient food in South Africa is the need for highly skilled agricultural scientists that should emanate from the country's education system. The apartheid system of South Africa's policy of separate development however promoted an education system that ensured inequity, especially in resource endowment and appropriate focus on the teaching of Agricultural Science as a school subject in former black schools. The above statement is attested by various literature sources (Horrell 1969; Christie and Collins 1982; Shepherd 1955; Badat 2016). The statement raises several concerns related to the teaching of Agricultural Science in South African schools generally, and former black schools in particular. Pertinent to this observation could be an assessment of the evolution of the Agricultural Science syllabus and perceptions held by teachers regarding subject offering, especially at the senior secondary phase (Grades 10 to 12).

Objectives of the Study

This paper seeks to respond to the above concerns through identification of demographic characteristics of teachers that offer the subject at the above-mentioned levels, assessing Senior Certificate pass rates as reported by teachers and their perceptions on evolvement of the subject content over time, relevant teacher qualifications and physical infrastructure support. The outcome of this paper is of global interest, especially for developing countries that are also battling with enhancing agricultural productivity through youth involvement. As noted by UNESCO (online), ensuring food security for the ever-increasing world population will require infusion of sustainable agriculture into school curricula.

Situational Analysis for the Teaching of Agricultural Science in South Africa

A study by the Limpopo Department of Education (2010) revealed that the province had 4,117 ordinary public (3,972) and private (145) schools. The same study also reflected an almost equal number of male (about 86,300) and female (about 83,700) learners serviced by about 5,300 teachers. The high proportion of female teachers is desirable especially in reducing income inequality amongst households (Guner et al. 2016). One finding of note from the same study was minimal preference for Agricultural Science by many learners as compared to other subjects. Despite the above observation, a study by Monyooe et al. (2013) revealed that Limpopo Province did not only have the highest number of schools offering Agricultural Science in the country (987) followed by KwaZulu-Natal (slightly more than 600), but also the highest number of learners of the subject (31,209 in 2010). However, in terms of Senior Certificate pass rates in the subject, the province was the second last in South Africa (56%). It is encouraging though that learner performance has improved substantially from 2011 (in excess of 70%) to 2015 (81.6%) (Department of Basic Education 2015). However, the province ranked 6th as compared to the other eight provinces. The best performing province in Agricultural Science for the academic year 2014 was North-West (90.2%) while the least was the Western Cape (76.7%). A study on factors impacting the attitude of learners towards Agricultural Science identified gender (more females), location (rural) and school type (single-sex) (Olatunji and Etuk 2010).

An analysis of the state of provisioning of education in three rural provinces of South Africa, that is, Limpopo, KwaZulu Natal and Eastern Cape revealed that the three had more learners compared to the others (Seroto 2011). The study also asserted that most citizens of Limpopo Province (90%) did not only live in rural areas, but also faced massive poverty (64%) with most rural schools dependent on pit latrines (72%), without libraries (93%), laboratories (94%) and computers (89%) (Seroto 2011). Earlier on, Masigo and Matshego (2002) arrived at similar findings in a study that focused on agricultural education and training in the North-West Province. Specific findings of that study included inequitable distribution of resources between agricultural high schools and schools that simply offered Agricultural Science as a subject (academic schools). In addition, while agricultural high schools offered the subject in conjunction with Mathematics and Physical Science, their counterparts had several combinations that were mostly outside the realm of core natural sciences.

Fiske and Ladd (2006) assessed progress made by the South African government on the basis of three criteria, that is, equal treatment by race, equal education opportunity and educational adequacy. The study revealed substantial achievements in the first objective. The latter two encountered challenges related to poor facilities and lack of human capacity especially in schools serving black children. The study by Masigo and Matshego (2002) also found similar trends for North-West province academic schools, especially inadequate supply of infrastructure such as water, electricity and farming space. The above facilities were however adequately supplied at state sponsored and well-equipped agricultural high schools. An interesting finding by Masigo and Matshego's (2002) study was that most teachers had acquired Agricultural Science bachelor's degrees. Power (2016) has correctly noted that out of the three types of schooling offered in South Africa, that is, independent privately owned, government and school governing body funded public schools, the first were not only well equipped but also offered exceptionally high standard of education to children from middle- and high income earning families.

The above scenario occurred within an environment in which educational reform was accorded priority, especially in that immediately after assuming political power in 1994, the new government initiated policies that sought to remove the fragmented and racially based education system. Policies that were put in place included the Outcomes-Based Education (OBE) in 1997 and the Revised National Curriculum Statement for Grades R to 9 and 10-12 in 2002 (Department of Education 1997; Department of Basic Education 2011). The above policies were later amalgamated into a single document called the National Curriculum Statement Grades R-12 in 2012 due to implementation bottlenecks. According to the Department of Basic Education (2011), the latter move was especially initiated to provide clearer specification related to term-by-term syllabus coverage.

While a comprehensive study on Agricultural Science teachers in Limpopo province has not been conducted, Rakumo and Laugksch (2010) studied the demographic characteristics of Mathematics teachers in the province (an important co-subject) and noted that most were aged between 20 and 40 years with 4 to 10 years' experience. The highest academic qualification achieved by most teachers was senior certificates (more than 50% of respondents) with a substantial proportion that had acquired Senior Certificate plus three-year diplomas as professional qualifications. As Mathematics is an important core for Agricultural Science the above information could be vital in understanding the demographic and other characteristics of the latter.

The following sections provide an outline of the study methodology, results, discussions, conclusions and recommendations.

METHODOLOGY

Research Design

A quantitative research design was adopted for this cross-sectional survey study that was conducted with the teachers of Agricultural Science covering five districts of Limpopo Province of South Africa, that is, Vhembe, Mopane, Capricorn, Sekhukhune and Waterbeg. Hopkins (2008) identified quantitative research design as a descriptive or experimental study that aims at determining relationships between variables. While in the former (the focus of this paper) no attempt is made to change behavior or conditions, the latter is highly dependent on such constructs. Hopkins (2008) further indicates that quantitative descriptive studies usually take the form of either case, case-series, cross sectional, cohort, longitudinal or retrospective designs. According to Onwuegbuzie and Collins (2007), random and non-random sampling schemes are important techniques for quantitative researchers.

Sampling Technique

All 88 teachers that attended the Limpopo Teachers Agricultural Science Conference organized in the Mopani District, Giyani town in July 2014 participated in the study. The expected number of attendees was about 243. A multi-stage clustered non-probability sampling technique was used in that only those teachers that attended the provincial conference were targeted and categorized on the basis of their age groups (18 to 50 and 51 to 65 years). Clustering was also achieved through differentiating Agricultural Science teachers from those that could be teaching other subjects.

Data Collection and Analyses

Data was collected through structured Likert scale designed questionnaires. A Likert Scale is a commonly used technique considered as an important rating format for quality measurement (Allen and Seaman 2007). Also referred to as a frequency scale, it is seen as an important tool for measuring attitudes, especially in studies where participants respond to statements covering particular topics (McLeod 2008). It is thus a good measure for levels of agreements or disagreements. Vanek (2012) provides a clear distinction between Likert scales and Likert items, the former being a sum of all responses to several of the latter.

As noted by Allen and Seaman (2007), data collected through Likert scales are usually grouped into a hierarchy of four levels, that is, nominal, ordinal, interval and ratio. In analyzing Likert scale type data, Allen and Seaman (2007) warn against the invalidity of using parametric techniques such as means and standard deviations for categorically collected data and suggest the use of non-parametric procedures such as tabulations, frequencies and Chi-squared tests. As attested by Jamieson (2004), in ordinal levels of measurements, response categories have rank orders but intervals between values cannot be presumed equal. Ordinal data can therefore be described using frequencies or percentage responses in each category. This point is further elucidated by Field (2013), who stated that categorical variables do not have properties that can be measured continuously, especially in that the numeric values attached to them are arbitrary. These are factors that this study took into consideration when finally adopting non-parametric techniques for data analysis (frequencies and percentages).

The above-mentioned questionnaire captured demographic characteristics of respondents (gender, age, marital status, highest levels of academic and professional qualification and grades taught). Respondents were also asked

to provide information on land availability for practical teaching of the subject. Other data that was collected from teachers included pass rates in Senior Certificate Agricultural Science ranging from less than forty percent to one hundred percent, perceptions on the evolvement of Agricultural Science syllabus over time, relevance of teacher qualification in offering the subject, output (learner) quality and support mechanisms (land access and need for Mathematics and Science as co-subjects).

Collected data was captured into the SPSS Version 22 computer program and analyzed based on a five-point Likert scale using non-parametric ordinal level statistical techniques, that is, frequency and percentage distributions.

Validity and Reliability of Results

The questionnaire was pre-tested on five teachers located close to the research institute to remove ambiguous questions and test the analytical technique. Validity and reliability of results were ascertained by allowing respondents to withdraw at will without any penalty. The questionnaire also refrained from capturing respondents' names to ensure anonymity.

RESULTS

The results of this study are presented in Tables 1 to 6. According to Table 1, many teachers that participated in the study were married (69.3%) and were males (58%) ranging between the ages of 18 to 50 years (75%). The highest academic and professional qualifications achieved by teachers of Agricultural Science in Limpopo Province were respectively other degrees (39.8%) and secondary education diplomas (70.5%). The usual practice in South African education, especially during the former racially segregated system that prevailed prior to 1994, was for teachers to undergo a three-year teacher's diploma after acquiring a senior certificate and thereafter enroll on a part-time basis for various degree programs that were usually not in line with the subjects being taught at school, but quite pivotal in enhancing their income generation ability. The above could provide an explanation for the high proportion of teachers with non-agricultural aligned degrees, secondary rather than university teachers' diplomas and in some cases primary education diplomas but teaching at senior phases. Table 1 also reflects few teachers that had acquired degrees in agriculture.

Table 1: Demographic profiles of agricultural science teachers in Limpopo Province (2014)

Variable	*Frequency*	*%*
Gender		
Male	51	58.0
Female	37	42.0
Age of Respondent		
18-50 years	66	75.0
51 to 65 years	21	23.9
Not revealed	1	1.1
Marital Status		
Single	19	21.6
Married	61	69.3
Divorced	5	5.7
Widowed	3	3.4
Highest Level of Professional Teaching		
Secondary Education Diploma	62	70.5
Primary Education Diploma	3	3.4
University Education Diploma	18	20.5
Not revealed	5	5.7
Highest Academic Qualification		
Senior Certificate	33	37.5
BAgric Degree	13	14.8
BSc Agric Degree	5	5.7
Any other (BA.)	35	39.8
Not revealed	2	2.2
Total	88	100

Source: Authors

Table 2 shows grades taught by Agricultural Science teachers for the past three years (2011 to 2013) and school infrastructure support. Accordingly, many teachers had taught at all three

Table 2: Grades taught and infrastructure access

Grade/Infrastructure	*Frequency*	*%*
Grade taught in last 3 years		
Grade 10	6	6.8
Grade 11	2	2.3
Grade 12	13	14.8
Other : Grades 8 or 9	2	2.3
All three senior level grades	39	44.3
Only two	26	29.5
Infrastructure for Agricultural		
School garden only	4	4.5
Science teaching		
Garden tools only	3	3.4
Laboratory only	1	1.1
Fenced yard only	10	11.4
All of the above	24	27.3
Two of the above	29	32.9
Three of the above	14	15.9
None	4	4.5
Total	88	100

senior level grades (44.3 %) with a substantial proportion that taught in either two of the three grades (29.5%). Out of the four identified essential infrastructure needs (school garden, gardening tools, laboratory and a fenced schoolyard) most schools had either two (32.9%) or three (27.3%) with close to a quarter (22.4%) having at least one. About five percent of schools offering Agricultural Science had no access to supportive infrastructure.

Senior Certificate pass rates as provided by teachers for the respective schools are shown in Table 3. It can be observed from the table that pass rates have consistently been high, averaging in excess of seventy to seventy-nine percent and above in 2011 and 2012 (at more than 50% of schools), and increasing to more than seventy-two percent of schools in 2013 with almost a third obtaining in excess of ninety percent passes. The above pass rates are quite critical especially in South Africa where a Senior Certificate is regarded as an important benchmark for assessing learner readiness to proceed to institutions of higher learning or for joining the job market (Spaull 2014). While acknowledging the general increasing pass rates, Monyooe et al. (2013) questioned the impact of low performance norms and standards on passing grade 12.

Table 4 shows that most (58.62%) respondents saw the subject content that was offered prior to 1994 as having been superior to the newly developed National Curriculum Statement (NCS) (that embraced Outcomes Based Education (OBE) and Curriculum and Assessment Policy Statement (CAPS)) largely emulating the old syllabus across the two major age groups.

The gap between respondents that affirmed and those that were against was also even between the two groupings (about 17.25% and 16.9% respectively). Regarding knowledge of Agricultural Science syllabi in other countries, the results of this study reflect that many teachers (45.79%) were ignorant of developments outside the country. As to whether there was a need to restructure the present content and of-

Table 3: Senior certificate pass rates as provided by teachers of secondary school agricultural science in Limpopo Province (2014)

	2011		*2012*		*2013*	
	No. of schools	*%*	*No. of schools*	*%*	*No. of schools*	*%*
Less than 40%	1	1.1	1	1.1	1	1.1
40-49%	4	4.5	2	2.3	2	2.3
50-59%	11	12.5	7	8.0	4	4.5
60-69%	11	12.5	14	15.9	8	9.1
70-79%	**23**	**26.1**	**20**	**22.7**	13	14.8
80-89%	13	14.8	**20**	**22.7**	25	28.4
90-100%	9	10.2	11	12.5	**26**	**29.5**
Total	72	81.8	75	85.2	79	89.8

Source: Authors

Table 4: Perceptions of agricultural science teachers regarding the evolvement of the syllabus content over time and knowledge of syllabi of other counties

Likert item	*Likert scale responses (%)*						
	Age years	*Strongly agree*	*Agree*	*Neutral*	*Disagree*	*Strongly disagree*	*Total*
The old Agricultural Science syllabus was much better than the NCS and CAPS (n= 87)	18-50	23.0	17.2	11.5	13.8	9.2	74.7
	51-65	8.0	10.3	5.7	1.1	0.0	25.3
	Sub-Total	31.0	27.6	17.2	14.9	9.2	100.0
Most Agricultural Science teachers are aware of agricultural science syllabi offered in other countries (n=85)	18-50	4.7	18.8	16.5	20.0	15.3	75.3
	51-65	1.2	4.7	8.2	8.2	2.4	24.7
	Sub-Total	5.9	23.5	24.7	28.2	17.6	100
The present form of Agricultural Science syllabus needs to be changed	18-50	9.2	11.5	14.9	26.4	12.6	74.7
	51-65	4.6	5.7	4.6	8.0	2.3	25.3
	Sub-Total	13.8	17.2	19.5	34.5	14.9	100.0

fering, largely theoretical, many teachers (39.08%) between the ages of 18 and 50 years were not supportive while those aged between 51 to 65 years struck a balance (10.35% each) between the two extremes (agree or disagree).

The perceptions of teachers regarding the need for appropriate qualifications in teaching Agricultural Science are shown in Table 5. Despite the finding above that many teachers had low academic or professional training in agriculture, their perception was that the subject should be taught by individuals with appropriate qualifications (60.9%). Despite the theoretical offering of the subject due to infrastructure backlogs, most teachers perceived the output (learner) that emanated from the system as being ready to practice agriculture (41.4%).

Table 6 seeks to assess the perception of teachers regarding the need for provision of suitable land for practical agriculture at schools, and whether Mathematics and Science should be integral core subjects. About one in five teachers (20%) identified the need for setting land aside for practical Agricultural Science teaching with an astonishing proportion (in excess of 60%) perceiving agricultural land as a minor requirement. However, many teachers regarded Mathematics and Science as critical subjects for understanding Agricultural Science (47.0%).

DISCUSSION

Marriage is an important determinant of the period that a particular teacher will remain in the system in addition to redressing income disequilibria amongst households (Stinebrickner 1998; Guner et al. 2016). This study confirmed the dominance of married Agricultural Science teachers (close to 60%), suggesting that many could continue providing their services until formal retirement age (usually between 60 and 65 years in South Africa). However, a relevant teacher qualification in the subject is a critical requirement for productive learner engagement and redressing socioeconomic inequalities (Boe et al. 2007; Ogunniyi and Rollnick 2015). The present study's findings, especially that the highest teacher professional qualification was a secondary diploma, could be indicative of the need to restructure subject teaching qualification requirements. As noted by Seale (2014), under-qualified teachers are usually not well grounded to effectively teach their allocated

Table 5: Perceptions of agricultural science teachers regarding teacher qualification and quality of the outcome (learner) (N=87)

Likert item	*Age Likert scale responses (%)*						
	Age years	*Strongly agree*	*Agree*	*Neutral*	*Disagree*	*Strongly disagree*	*Total*
Agricultural science can be taught	18-50	3.4	10.3	12.6	18.4	29.9	74.7
by any qualified teacher without	51-65	1.1	8.0	3.4	9.2	3.4	25.3
any prior exposure to the subject	Sub-Total	4.6	18.4	16.1	27.6	33.3	100.0
The output of the subject (learner)	18-50	11.5	19.5	21.8	13.8	8.0	74.7
after Grade 12 is well-prepared	51-65	2.3	8.0	10.3	2.3	2.3	25.3
to produce crops or rear livestock	Sub-Total	13.8	27.6	32.2	16.1	10.3	100.0

Table 6: Perceptions of agricultural science teachers on need for mathematics and physical science as core subjects and land allocation to enhance subject matter offering (N=87)

Likert item	*Age Likert scale responses (%)*						
	Age years	*Strongly agree*	*Agree*	*Neutral*	*Disagree*	*Strongly disagree*	*Total*
Schools that do not have land	18-50	8.1	7.0	15.1	22.1	22.1	74.4
allocated for Agricultural Science	51- 65	2.3	2.3	3.5	15.1	2.3	25.6
should not offer the subject	Sub-total	10.5	9.3	18.6	37.2	24.4	100.0
Mathematics and Science should	18-50	12.6	13.8	12.6	23.0	12.6	74.7
not be major requirements for	51- 65	2.3	8.0	3.4	8.0	3.4	25.3
enrolling for a degree in Agriculture	Sub-total	14.9	21.8	16.1	31.0	16.1	100.0

subject, mainly due to lack of subject content skills.

A closer scrutiny of the results also revealed most teachers that had upgraded their academic qualifications to non-agricultural aligned qualifications, although teachers perceived the need for correct alignment of qualification with actual teaching of the subject. The latter could emanate from stringent requirements to enroll for agriculture-based degrees, especially the need for a pass in both Mathematics and Science at Senior Certificate level. The observation translates into need for development of transformational strategies, including subject cluster and teacher association meetings for achievement of professional growth and development as recommended by Mukeredzi (2013).

In terms of support to the offering of Agricultural Science, most schools were found lacking with close to a quarter having only one of the required infrastructures, while some had none. While an ambitious plan for South African schools does recognize the need to address infrastructure backlogs, especially room space (providing between 100m^2 and 120 m^2) and sports grounds (4800 m^2), it runs short of a similar focus towards Agricultural Science (only 15m^2 for food gardens) (Department of Basic Education, 2012). In countries such as Zambia, it is the basic requirement of the syllabus that schools offering Agricultural Science be adequately equipped with agricultural land, facilities and laboratories (Republic of Zambia, online). Infrastructure backlogs are however not unique to Limpopo Province. A Kenyan study conducted by Waithera (2013) identified a number of related challenges, including inadequate agricultural land and classrooms (institutional), negative attitudes associated with the use of agricultural activities as punitive measures against wayward learners, unreliable rainfall and high levels of poverty (non-institutional).

Another critical finding of the study was the superiority attached by teachers to the syllabus that was offered prior to 1994 compared to NCS and CAPS. It could thus be expected of such teachers to be against initiatives meant to restructure the largely theoretically system. The finding is in line with transformational challenges experienced in a Lesotho study that sought to unearth perceptions of teachers to incorporation of democratic elements in the teaching of Geography (Raselimo and Wilmot 2013).

Teachers' perceptions that learners emanating from the system were well prepared for effective and productive farming could be associated with subsequent good performance at institutions of higher learning. However, due to the theoretical basis of the subject such learners are likely to lack the necessary background knowledge that would ensure immediate engagement in productive farming after completion of their Senior Certificate. The latter has negative consequences for Limpopo Province in particular where vast areas of land are soon expected to be transferred to black youth under the new land reform program.

As noted by UNESCO (online) above, sustainable agricultural production requires that future food producers, learners at school level, be empowered through adoption of techniques that will ensure sufficient food for the anticipated and ever increasing world population. Practical agricultural production skills will thus be quite crucial in achieving that objective.

CONCLUSION

This study was conducted with teachers of Agricultural Science who attended the Limpopo Provincial Agricultural Science teacher's conference arranged by the Association of South African Agricultural Educators (ASAAE) in July 2014. In all about 243 teachers were expected to attend the conference but only 88, mostly from Vhembe and Mopani Districts that were closest to the conference venue, Giyani in Mopani District, attended. The study had four specific objectives, that is, teachers' demographic characteristics, availability of land for agricultural purposes, Senior Certificate subject pass rates as provided by teachers and teacher's perceptions regarding, evolvement of subject content, teacher qualifications, quality of output and infrastructure support.

A quantitative, multistage clustered but non-probability sampling design was employed to solicit responses from teachers. Data was collected through Likert scale questionnaires and analyzed through non-parametric ordinal level statistical techniques, that is, frequency and percentage distributions. The general findings and recommendations of the study are as reflected above.

RECOMMENDATIONS

The potential for teachers remaining in the system until formal retirement is quite high, seeing that most are married. The implication therefore is that since the majority of teachers fell within the age group of 18 to 50 years, it can be inferred that they will continue teaching for at least 10 to 15 years, a factor that calls for decisive strategies to transform their mindsets towards accepting a changing curriculum environment and need for restructuring professional qualifications towards a biased agricultural orientation. Success could be achieved through concerted and collaborative engagement amongst education policymakers, teacher formations, affected civil structures and employer organizations.

The challenge though could revolve around the inability of teachers to enroll for higher agricultural oriented degree programs mainly due to lack of requisite scientific knowledge, especially mathematical and scientific background. The challenge could be mitigated through structured workshops that could be administered by institutions of higher learning, especially universities and colleges of agriculture, with strong emphasis on practical aspects. Paramount to the success of such an initiative could be formal accreditation of identified short programs that could be coupled with appropriate incentives.

Teachers reported minimal support to effectively transmit practical knowledge to learners, although they also did not see much value in such support, especially the provision of land for practicing agricultural activities. The latter finding could generally be expected in an environment in which teachers lack basic exposure to practical agricultural teaching skills. In line with the practical orientation accorded to the teaching of agricultural science in other counties, it becomes imperative for policy to shift towards emphasis on provision of basic infrastructure such as land as a precondition for offering the subject. However, there will be need for not only exposing teachers to the value of practical skills acquisition, but also informative workshops targeting all interested stakeholders, that is, policymakers and learner supply bases of parents, guardians and the general public.

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