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Is There a Case for Supporting Animal Traction Research, Policy, and Practice in Rural South Africa? - A Review

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ABSTRACT

Appropriate and efficient technology contributes a great deal to smallholder farmer development. This study uses a systematic literature review to debate whether animal traction research and practice should receive support. Firstly, the smallholder farming system is reviewed to contextualise the discussion and present a state-of-the-art review of animal traction in South Africa. After finding the diminishing use of animal traction among smallholder farming systems, the inquiry probes the causes of the rural development policies, basic education curriculum, and higher learning institutions. The results reveal that the technological needs of smallholder farmers can be met with animal traction. However, a lack of support from policies and learning institutions has contributed to the negative attitude toward animal traction. We further note that new animal traction technology is unlikely to be known to smallholders because of poor information dissemination caused by a weak agricultural extension. After realising the benefits of animal traction, it seems worthwhile to revamp animal traction research and practice for subsistence farmers.

Keywords: Small-scale; Bottom-up approach; Extension; Government; Rural development

1. INTRODUCTION

Animal traction uses animals (cattle, donkeys, horses, mules, buffaloes, camels) to carry out soil tillage and transport goods and humans. For years, animal traction has been a significant component of agricultural production, especially on smallholder farms. However, its utility and

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value have diminished over the years, and attention is given to other forms of mechanical power, such as tractors. Some localised studies provide evidence of this assertion. For example, Stroebel, Swanepoel and Pell (2011) reported that smallholder farmers ranked animal traction in Limpopo as the least important benefit of farming with cattle. Zamchiya (2019) found that in one village in the Eastern Cape, animal traction was only used by 20% of the smallholder households. In the Wild Coast, Hajdu, Neves and Granlund (2020) reported that a few households only used animal traction with larger gardens. This trend is similar in developed countries (Wilson, 2003). However, there is scepticism about why South Africa, a developing country, is following this trend from the developed countries. Evidencing this is the country's approach to rural development projects. A case in point is the government support programme, focusing on commercialising subsistence farmers through massive food production and mechanisation in the Eastern Cape (Jacobson, 2013). However, evidence shows that the limited success of the programme above has been caused by inappropriate approaches and unsuitable technology suggested to farmers, among other factors (Fischer & Hajdu, 2015).

Animal traction values and benefits to the subsistence smallholder farming systems have been documented in numerous studies (Starkey Jaiyesimi-Njobe & Hanekom, 1995; O'Neill Sneyd, Mzileni, Mapeyi, Njekwa & Israel, 1999; Simalenga, Belete, Mzeleni & Jongisa, 2000; Hart, 2011; Sheckleton & Hebinck, 2018; Zantsi & Bester, 2019). Subsistence and semi-subsistence agriculture are the dominant forms of agriculture in South Africa, and many smallholder farmers are poor, with obsolete to non-existing infrastructure (StatsSA, 2016). This makes animal traction more appropriate for such households and conditions (Makaota & Motiang, 2000). There is also evidence that even commercially-oriented irrigating smallholders with small plots make more profits from using affordable technology, such as donkey-pulled ploughs, than those who do not use animal traction (Tapela & Alcock, 2011). Furthermore, there have been new developments in animal traction with more suitable drawn machinery, such as no-till planters, mowers, and animal-drawn discs, to mention just a few.

However, these developments remain unknown to the South African smallholders partly due to poor dissemination of such information and little support from educational institutions and rural development policies (Starkey, 2000). For example, a recent systematic review of literature on smallholder technology adoption has shown that useful technologies remain unknown to smallholders in sub-Saharan Africa because of poor diffusion caused by a weak agricultural extension (Takahashi *et al.*, 2020). Joubert (2016) attributed the death of animal

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traction research in South Africa to a lack of priority from educational institutions and government policies.

In light of this background, this study seeks to first present state-of-the-art animal traction research in South Africa. Secondly, it discusses the policy and practice of animal traction concerning low adoption. Lastly, it argues whether there is a case for greater support of animal traction research and education in South Africa. We follow a systematic review approach to address the first and second research objectives.

In the next section, we contextualise our discussion by presenting the nature of South African smallholder farming, after which we describe the study methodology in section 3. In section 4, a synthesis of the reviewed literature will be presented thematically and extensively discussed. Lastly, we conclude with the scope for future research in section 5.

2. SOUTH AFRICAN SMALLHOLDER FARMING SYSTEMS IN BRIEF

According to Statistics South Africa's Agricultural Household Survey, there are 2.3 million households practising farming on a smallholding base (StatsSA, 2016). Most of these smallholder households are in Eastern Cape (27,9%), followed by Limpopo 24,1% and KwaZulu-Natal (18,6%). Mpumalanga, Free State and the Northern Cape follow with 18,2%, 16,6% and 13,8%, respectively. Western Cape and Gauteng recorded the lowest participation rates, with 3,6% and 4,9%, respectively. These smallholder households have farms with either animal or crop only, and some with a mix of the two. The provincial distribution of smallholders by type of farming is shown in Figure 1. Of the total agricultural households in South Africa, a vast majority (42%) of agricultural households in South Africa farms mostly with animals (see Figure 1 below). This somehow resembles the land distribution of South Africa, where over 60% of the land is extensive grazing land (DAFF, 2017). The herd size is smaller in large stock (cattle), with 70%owning only between one and ten animals and 27% owning between eleven and a hundred animals, and the remaining owning more than a hundred animals (StatsSA, 2016). Regarding sheep, 47% of households own between eleven and a hundred animals, and those who own more than a hundred animals are 9,2% (StatsSA, 2016).

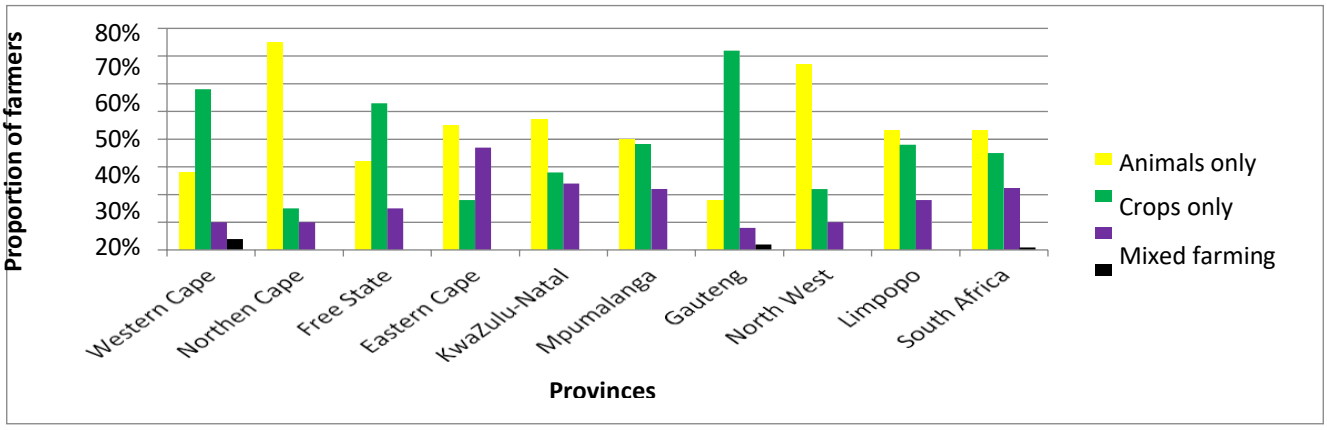

FIGURE 1: Types of Farming Activities Practiced by Agricultural Households (Source: StatsSA, 2016)

Smallholder households who practice crop farming cultivate in their backyards relatively small plots ranging between 0-20 hectares (StatsSA, 2016). Although smallholders generally share similar features, they are not homogeneous, as sub-groups that share similar features that are more specific can be found. A general typology of subsistence, semi-subsistence, and commercially-oriented smallholders are used to distinguish smallholders (Olofsson, 2020). This implies that animal traction might be suitable for specific groups, such as subsistence and semi-subsistence, who cultivate very small plots and own fewer animals than commercially-oriented smallholders (Zantsi & Bester, 2019).

3. METHODOLOGY

3.1. Approach

Review studies have gained popularity in scientific literature as one way of collecting facts from published scientific literature about a specific research inquiry. Review studies have emerged as one method of addressing research questions accepted in many disciplines, including rural development studies (Okoli, 2015). While there is more than one type of review study (e.g. traditional, snowball, systematic), systematic literature reviews (SLR) are the most preferred type for their rigorousness and replicability over other forms (Okoli, 2015). SLR has emerged as one scholarly work valuable for informing policy and practice (Petticrew & Roberts, 2006). For the reasons above, review studies have been widely adopted and used in numerous scientific and quality literature (Santeramo & Lamonaca, 2019; Fielke, Taylor & Jakku, 2020).

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In this study, as in the studies above, we also follow an SLR ensuing the guideline outlined in Okoli (2015). In the previous study, the following steps are recommended: formulating a purpose or research question, conducting a literature search, determining criteria for inclusion, screening studies for inclusion, synthesis of information from the literature, and writing. We supplement the SLR with a snowball literature review to ensure we capture a broader literature, as some journals are not indexed in large databases for scientific literature. We adapt this from Fielke *et al.* (2020).

3.2. Literature Search and Inclusion

There are numerous ways of conducting a literature search. In this study, we wanted to capture as much literature as possible by looking at various databases for scientific literature and other platforms. We first explored the three largest scientific literature databases, Scopus, Web of Science, and Science Direct, as used in similar studies (Zhang, Xu, Zhang, Wang, He & Zhou, 2020). These were accessed from the University of Stellenbosch's library databases. As was used in the study by Blakeman (2013), the largest and often free-access search engines, Google and Google Scholar, were used. Sabinet-African journals, the most extensive database for African journals, were utilised as some African journals are not indexed in Scopus, Web of Science, and Science Direct. In reading some of the first studies obtained and from our background, we delved into the ATNESA and SANAT as they have a compilation of literature on animal traction in Africa and South Africa. Most of these were directly accessible from google. The following keyword search combinations"animal+traction+research+and+practice+in+south+africa& animal+draft+power" was used for studies published between 1995-2020.

Sabinet yielded 59 studies from different sources, presented in Figure 2. However, only seven studies were relevant and retained for depth review. In Scopus, only one article appeared by O'Neill *et al.* (1999), while in Web of Science, we found no studies in South Africa. While several studies were in our various search outputs, not all were relevant to our study question. As such, a decision had to be made about which studies to read in depth and which ones to be left out. This screening criterion was based on reading the title and abstract and where we found information related to animal traction, policy and practice, particularly in South Africa and Southern Africa. Such studies were downloaded and retained for full-text in-depth review.

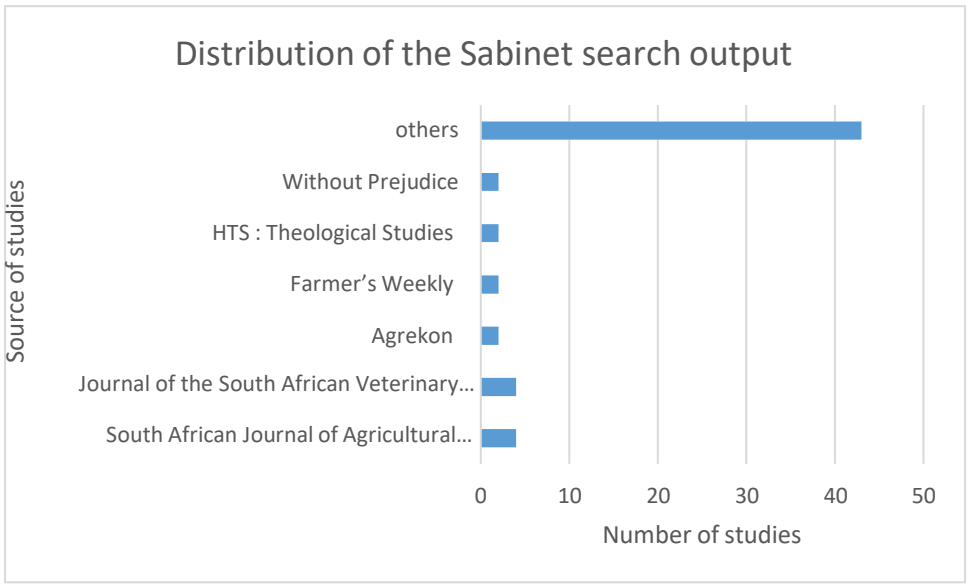

FIGURE 2: **Results of Search Output From Sabinet Indexed Journals**

3.3. Synthesis of Literature

This study followed a qualitative synthesis of the literature to assimilate the retained studies for full-text review. Following similar review studies (Machete & Shale, 2015), we employed a thematic analysis where we developed themes from the literature reviewed to quantify and qualify facts relating to our study question.

4. RESULTS: SYNTHESIS OF THE REVIEWED LITERATURE ON ANIMAL TRACTION RESEARCH IN SOUTH AFRICA

We identified five themes from reviewed literature to present a state-of-the-art review of animal traction in South Africa. The first theme speaks to the significant research outlets publishing animal traction research in South Africa. This is important, especially since animal traction research has seen a decline in journal outlets because of low-interest novelty and readership (based on authors' observations and literature search). By virtue, much of the research work on animal traction has been done by the South African Network for Animal Traction and Animal Traction Network for East and Southern Africa. These are well-established organisations for animal traction research in East Africa and South Africa. In terms of open publishing outlets, the *South African Journal of Agricultural Extension* and *Agricultural Systems* and *Development Southern Africa* is one of the few publishers of animal traction work.

The second theme that we have identified relates to how prevalent animal traction is among

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smallholders, which animals are used, and the ups and downs of using animal traction. Since Starkey *et al.* (1995) book, there has not been national work on animal traction in South Africa. Starkey *et al.* (1995) found that animal traction was used by 40-60% -of about 400 000 smallholders across South Africa. Within the smallholder farming system, cattle were mainly used for traction. The cattle are primarily used for ploughing, planting, seeding, weeding, and transporting goods (Makaota & Motiang, 2000). Six-spans are preferred in these animals (O'Neill *et al.*, 1999). There are also some cases of donkey use within the smallholder farming systems in Limpopo and KwaZulu Natal (van Averbeke & Khosa, 2011; Hart, 2011; Tapela & Alcock, 2011).

The following are the most pronounced benefits of animal traction: reduction of drudgery from humans (Wellsa & Kreceka, 2001), facilitating rural development (Wellsa & Kreceka, 2001), and encouraging sustainability and convenience for farmers with small plots such as avoiding waiting in queues for tractors, which may result in missing good rainfall (Makaota & Motiang, 2000). Evidence suggests that fewer smallholders own tractors, and many cannot afford to use expensive technologies (Hart, 2011; van Averbeke & Khosa, 2011; Zamchiya, 2019). Prevailing arguments supporting animal traction among smallholder farming systems are usually based on their advantages and appropriateness compared to tractors. Table 1 summarises the strengths and weaknesses of using animal power instead of tractors. It was compiled by the then National Department of Agriculture, now known as the Department of Agriculture, Forestry and Fisheries.

TABLE 1: **Different Draught Animals Commonly Used in South Africa Compared With Tractors**

Consideration	**Donkeys**	**Oxen**	**Horses**	**Mules**	**Tractors**
Purchase price (R)	R2 000 - 3 500	R9 000 – 15 000	R2 500 - 15 000	R10 000 - 25 000	Starts from R165 000
Working life (years)	12 - 25	6 - 9	15 - 20	20 - 30	7 - 15
Feed/fuel	Poor grass and working supplement	Good grass and working supplement	Good grass and quality working supplement	Poor grass and working supplement	Diesel or petrol and oil for lubrication

Management	Hardy, disease resistant, low management	Hardy, disease-prone, low management	Disease-prone, high management	Hardy, disease-resistant, low management	Service maintenance, high management
Operator's skill	All animals respond well to patient, friendly handling, and good management. Become confused and difficult when handled roughly. Horses and mules need one operator; donkeys and oxen 2 to 3 operators.				One highly trained operator withservice backup team
Advantage	Easy to manage, willing, produce manure, reproduce, very low operating cost	Easy to manage, strong, produce manure, low operating cost	Willing, fast, reproduce, produce manure, below average operating cost	Willing, easy to manage, hardy, long life, low operating cost	Powerful, last, effective, much work in a short time
Disadvantage	Can only work for short periods, small	Slow, cannot reproduce	Need high management	Difficult to acquire, cannot reproduce	Very high operating cost, difficult to repair
Daily workoutput: ploughing	4 hours	6 hours	5 hours	6 hours	Up to 22 h (change operator)
Type of activities	Animals can be used to plough, harrow, plant, cultivate, transport, carry loads, pump water, thrash grain, and for riding slowly				Can power all farm activities quickly

(Source: Adapted from NDA, undated)

In the preceding paragraphs, one sees the impression that cattle and donkeys seem to be the most preferred work animals. However, the facts presented in Table 1 point in a different direction. In terms of power and costs, donkeys and horses seem to be the best option for

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subsistence farmers (Zantsi & Bester, 2019). Reasons supporting the previous statement include subsistence smallholders who own small herds of cattle and small plots of arable land. Further, labour for subsistence farming is problematic to mobilise (Hull, 2014; de La Hey & Beinart, 2016); therefore, it is important to choose animals that require few labourers and can be handled by women, which account for the majority of smallholder households (StatsSA, 2016).

4.1. Animal Traction Education in Schools and Institutions of Higher Learning

Any successful technology adoption and understanding rely on research and development (R&D). The foundation of such R&D is an early curriculum on such technology. Swiegers (2000:104) argued how primary schools can be a nursery for the incubation of love for farming and improve technology appreciation:

"As more complex and productive new technologies and institutions that require a high level of verbal and numerical literacy become available to an agricultural area, primary schooling will become a worthwhile private and social investment for farm operations. Results will show that as technology increases, education of agricultural participants will become more profitable". Starkey, Njaiyesimi-Njobe, and Hanekom (1995) extensively discussed animal traction's history and crucial aspects in South Africa. In their analysis, it was clear that the rise and fall of animal traction in the 1960s and the 1970s led to numerous negative attitudes and neglect of animal traction research. They reckon that officials, including agricultural extensionists, probably knew little about animal traction. This has bred a generation with little knowledge of animal traction because even in schools, agricultural colleges, and universities, there was very little inclusion of animal traction (Starkey *et al.* 1995). A report from Food and Agriculture Organization (2010) echoed the same sentiments about the neglect of animal traction in education curricula and the vicious cycle of agricultural officials with no background in animal traction. To date, it is likely only the University of Fort Hare, where the South African Network of Animal Traction office is, that still has animal traction research practical in their curricula.

4.2. Animal Traction Policy and Practice

The imperative of rural development and agricultural development has been heavily debated, and its contribution to rural economic growth and employment has been emphasised. It is from such lines of thinking that even the National Development Plan in chapter six has focused on

building vibrant and inclusive rural communities (NPC, 2011).

However, what seems to be of conflict between research and policy practice is the mechanism of achieving rural and agricultural development to achieve vibrant and inclusive rural development (for a nuanced discussion, see Stoop & Hart, 2005). One example is suitable and appropriate technology for rural agricultural households. This is partly caused by a poor knowledge triangle – the linkages between research, teaching, and extension (ASSAF, 2017). Hazell (2005) emphasised the need for developing appropriate technologies for smallholders to improve the viability of small farms in today's highly competitive agricultural industry. Such technology includes high-yielding varieties, both seeds and animal breeds, and mechanisation.

Numerous researchers have blamed the use of inappropriate technologies for the failure of rural and agricultural development projects to promote the use of tractors instead of animal traction, which is a well-known mechanisation in rural areas (Fowler, 1999; Fischer & Hajdu, 2015). This is embedded in the ignorance of animal traction in rural and agricultural development policies. For example, two decades ago, Shetto *et al.* (2000:197) argued that "there is a lack of effective policies and support in promoting animal traction". Their context was focused on sub-Saharan Africa. This is certainly evident in South Africa, where there are very little or non-existence of animal traction policies. Swiegers (2000:103) expressed the same sentiments: "*it is with regret that I today have to report that, on the question of; "Are supporting policies for information to develop animal traction in South Africa in place?" My answer will be no… None of the Provincial or National Departments of Agriculture has an active programme on promoting animal traction.* This occurs despite the prominent role of publicly funded research and extension in meeting the technology needs of small farms (Hazell, 2005).

Although more than two and half decades ago, Starkey *et al.* (1995) expressed some positive attitude towards considering animal traction from the Reconstruction and Development policies to date, policies are silent on this issue, even in cases where there is a clear need for them. For example, the one household-one hectare policy intended for subsistence households (DRDLR, 2016) could be accompanied by one household and one horse for carrying the subsistence tillage. Fowler (1999:269) conveyed this as the "use of developed world approach in a developing world". The other common narrative defining the negligence of following a top-down policy approach in rural development is what is referred to by its proponents as "continuities catch rural development policies" (Hebinck, Fay & Kondlo, 2011).

This reality occurs despite the changing focus in rural development policies towards sustainable development (see Ellis & Biggs, 2001 for a detailed discussion). In this line of thinking which takes a bottom-up approach, development is seen to arise from the best use of household assets in a manner that promotes sustainability. In light of climate change and global warming, animal traction has been viewed as one contribution in cases where this is applicable, such as working small plots. Again, animal traction contributes by promoting crop-livestock farming systems that encourage organic fertilisation.

Lastly, this theme reveals the low adoption of animal traction technology is more pronounced in literature. Many studies attribute this to psychological and economic factors (Mbata, 2001; Starkey 2011; Kepe & Tessaro, 2014). These results stem from the stigma and low social status associated with animal traction users (Starkey, 2011). In one village in the Eastern Cape, Kepe and Tessaro (2014) reported how elderly community members reasoned for fallow arable land. They criticised young people for buying cars instead of cattle that can be used in arable production. The negative attitude around animal traction, diminishing use, and lack of policy support also affects the demand for animal-drawn implements. For example, disc-drawn implements and boom sprays are available in other countries. Still, in the ordinary former homeland, animal traction implements retailers, where most smallholder farmers could not be found. One of the author's visits in 2018 and 2019 to Agrotechnorama – Swiss Federal Agricultural Museum and German Agricultural Museum saw many different animal tractions implements than those found in the former Transkei's Umtiza™ farmers' coop. The latter is one of the growing retails for agricultural inputs, both plant and animal, and farm implements in most rural parts of the Eastern Cape province.

5. CONCLUDING REMARKS AND AREAS FOR FUTURE RESEARCH

This research note had three objectives. The first one was presenting the state-of-the-art review of animal traction research and practice in South Africa; the second objective was to discuss policy and practice of animal traction concerning low adoption. The third objective was to build an argument or debate on whether a case for greater support of animal traction research and education in South Africa exists. Through a systematic literature review approach, we noted that the small-scale farming system in South Africa is broad and can be categorised into subsistence, semi-subsistence, and commercial smallholding. The diminishing adoption and use of animal traction while subsistence and semi-subsistence smallholder households raise

questions. The first question is why the use and adoption of animal traction declined while evidence shows that subsistence and semi-subsistence can benefit from using animal traction.

It seems animal traction receives little support from rural development policies, and there are thriving negative attitudes regarding the use of animal power among rural communities. The institutions of basic and higher education offer few courses on animal power, which might be one factor behind the diminishing use of animal traction. It seems highly unlikely that new developments in animal traction technology will reach poor farmers, highlighting the ineffective role of agricultural extension. If animal traction offers benefits that can meet the power needs of subsistence and semi-subsistence smallholders, why should it not be supported? This question warrants further research that is grounded on empirical data.

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APPENDIX: LITERATURE SEARCH LINK

Sabinet search link://
search?value1=animal+traction+research+and+practice+in+south+africa&option1=fulltext&operator2=AND&value2=animal+draft+power&option2=fulltext&operator3=AND&value3=&option3=fulltext&operator4=AND&value4=&option4=fulltext&operator5=AND&value5=&option5=fulltext&operator6=AND&value6=&option6=fulltext&operator7=AND&value7=&option7=fulltext&operator8=AND&value8=&option8=fulltext&operator11=AND&option11=date_from&value11=1994-05-01&operator10=AND&option10=date_to&value10=2020-05-01&sortField=default&sortDescending=true&operator12=AND&option12=pub_collection&operator13=AND&option13=accessTypeId&operator14=AND&option14=sabinet_accreditation&option912=resultCategory&value912=ResearchPublicationContent&pageSize=59