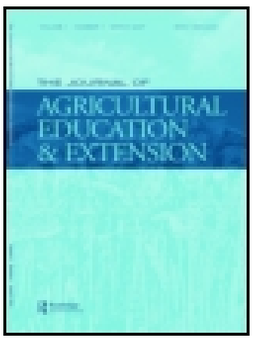
Using improved understanding of research and extension professionals' attitudes and beliefs to inform design of AIS approaches



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Using improved understanding of research and extension professionals' attitudes and beliefs to inform design of AIS approaches

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ABSTRACT

Purpose: This paper seeks to understand what influences research and extension professionals' intentions to use AIS approaches and to explore how this can inform implementation and design of more effective AIS.

Methodology: We applied the Reasoned Action Approach through focus groups and structured questionnaires with research and extension professionals from government and non-government organisations in Sierra Leone, where AIS approaches are not widely used although increasingly institutionalised in policy.

Findings: Research and extension professionals have surprisingly positive attitudes towards using AIS approaches and associate it with a range of positive outcomes related to food security and inclusive processes. The perceived ability to successfully implement AIS approaches is strongly influenced by funding, organisational culture and dynamics between senior and junior staff. We also found that alongside use of AIS approaches there is a continued adherence to top-down approaches.

Practical Implications: This work highlights the enthusiasm and interest among extension and research professionals as a promising start for improving the innovation systems. Practical requirements include training of senior and involvement of junior staff respectively in AIS design, and addressing extension education and organisational culture.

Theoretical Implications: This study highlights the importance of socio-psychological theory for understanding attitudes towards AIS approaches. We show how considering both institutional and personal constraints is vital for conceptualising how AIS are evolving.

Originality: There has been very little research conducted on research and extension professionals' intentions to use AIS approaches in developing countries that links with personal and systemic preconditions for supporting more effective AIS.

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1. Introduction and background

Improving the innovation capacity of the agriculture sector and supporting sustainable livelihoods for smallholder farmers are key functions of research and extension services (Longley et al. 2007). The research and extension literature is characterised by a shift from the use of top-down, transfer of technology (TOT) models to more participatory and farming systems models, and most recently to agricultural innovation systems (AIS) models of agricultural innovation (e.g. Roling 2009b). This shift has implications for roles and required capabilities for research, extension and development staff to support innovation in smallholder agriculture (Tarekegne et al. 2017). In this paper, we explore these changing roles by looking at what attitudes and beliefs influence the intentions of research and extension professionals to use AIS approaches, and how this can inform the design of more effective AIS.

1.1. From TOT to AIS approaches

In transfer of technology approaches, extension is seen as transferring and disseminating, or indeed 'extending' the ready-made knowledge from research to farmers (Rogers 1962), and it remains a very common narrative of innovation. This linear thinking about technology transfer has been criticised for excluding farmer innovation in the knowledge system (Agwu, Ekwueme, and Anyanwu 2008), lacking focus on resource poor farmers, and limiting the scope for meaningful dialogue between researchers and farmers (Chambers and Jiggins 1987; Roling 2009a). Subsequent approaches have similarly been criticised e.g. the AKIS (Agricultural Knowledge and Information Systems) models for their focus on the knowledge system in the public sector and lack of an understanding of the heterogeneity of actors, including the private sector (Hall et al. 2007). AIS approaches emerged as a way of challenging this *pars-pro-toto* thinking by drawing on a conceptualisation of innovation that looks at processes of interactions between a multiplicity of actors (e.g. input providers, farmers), taking place at multiple levels (e.g. local, national) and across multiple dimension (e.g. economic, institutional) and how these influence innovation in food systems (Schut et al. 2014; World Bank 2012).

There is considerable consensus about the importance of AIS approaches as a basis for national systems, resulting in a growing body of innovation systems diagnostic research and methodologies (e.g. Schut et al. 2015; Hermans, Klerkx, and Roep 2015; Amankwah et al. 2012). However, important questions remain, including around operationalising and embedding AIS approaches in various contexts. Also, the substantial institutional change required at multiple levels, as is implied with this new paradigm, inevitably takes a long time even in a supportive environment (Slangen, Loucks, and Slangen 2008, 75–119). There is a concern about the limited use of AIS approaches in the developing world where the majority of actors are perceived to still adhere to top-down linear models, despite the advancement of AIS approaches (Klerkx, Van Mierlo, and Leeuwis 2012; Roling 2009b).

1.2. Changing roles in research and extension

The roles of research and extension have gradually changed in parallel to the developing ideas about innovation (see Table 1) from primarily being seen as experts to increasingly being facilitators of complex interactions. In these interactions, planning is characterised

Table 1. Overview of models of research and extension interventions (adapted from: Roling, Kuiper, and Janmaat 1996, 55).

	Paradigm of innovation				
Paradigm of innovation	Transfer of technology (TOT)	various partly overlapping paradigms[a] →			Agricultural innovation system (AIS)
Type of intervention	Behavioural change	Knowledge transfer	Advising	Facilitating	Institutional change
Subjects of intervention	unsuspecting target group	passive adopter	active client	people who experience a problem	participants with a common problem/ goal
Role of research/ extension	expert/ strategist	expert	consultant	trainer/ facilitator	organiser/ facilitator
Point of action	determinants of behaviour	acceptance process	problem solving process	organisation, awareness	group processes
Goals of	intervening party	intervening party	both (overlap)	client	collective
Nature of planning	blueprint	linearly phased	strategic anticipation	planning of learning process	planning of group process
Objective	increase the frequency of wanted behaviour	adoption of technology	remove obstacles	improve decision capacity	platform at higher aggregation level
Degree of participation[b]	client is manipulated	client is informed	client is informed/ consulted	client is consulted/ in partnership	client in partnership

[a]These include: Farming Systems approach, Participatory Technology Development, Participatory Learning and Action, Agricultural Knowledge and Information Systems (*information* was later replaced with *innovation*) (see e.g. Biggs and Smith 1998; Roling 2009b).
[b]Adapted from DFID (1995).

by learning and group processes rather than supplying information. Researchers and extension professionals are expected to be knowledge brokers and systemic facilitators (Leeuwis and Aarts 2011) to ensure innovation system performance.

For researchers or extension officers to become successful in their role in AIS approaches, they may need to engage in the facilitation of complex and dynamic interactions among diverse actors (Tropical Agriculture Platform 2016) and deliberately negotiate rules and norms e.g. in action research (Minh et al. 2014). They may further be required to engage in linking and strategic networking, providing technical backstopping, mediation, advocacy, capacity building, management, documenting learning and acting as champions of innovations (Mur and Nederlof 2011). As such, researchers or extension professionals increasingly require complex capacities at the individual level, such as having first-hand knowledge of the topic, showing leadership, facilitating multi-stakeholder processes, building trust, resolving conflict and having good communication skills. Although we stress that the functioning of innovation systems is largely contingent on the effectiveness of individual actors to be able to perform various complex functions, it is equally important to consider capacities at higher social aggregation levels such as the functioning of systems, processes and structures in organisations, as well as capacities in the enabling environment which can involve incentive structures and political commitment (Tropical Agriculture Platform 2016).

1.3. Understanding intentions with the reasoned action approach

Various methodological approaches exist to explore dilemmas and contradictions in the transformations of research and extension systems associated with AIS thinking.

Through institutional analysis, Mahon, Farrell, and McDonagh (2010) show how a participatory extension programme changes power relations and is adapted in ways that can undermine the very goals of participation. Minh et al. (2014) applied action research to understand actor networks in institutional change processes related to developing more demand-driven approaches in Vietnam. Another strand of research has focussed more on individual perceptions and attitudes. For example, Davis et al. (2019) explored different conceptualisations of the role of the extension worker, of the goals of extension and of efficient avenues of achieving these, and found a range of sometimes conflicting attitudes that help understand why TOT remains a common feature in the innovation system.

To understand the attitudes of research and extension professionals towards the use of AIS approaches, we used the Reasoned Action Approach (RAA). The RAA, previously known as the Theory of Planned Behaviour (TPB, Ajzen 1991), is a socio-psychological model that allows exploration of both internal and extrinsic factors, including personal, social as well as institutional aspects that play a role in behavioural change. It aims at understanding how intentions to perform an action or behaviour follow from attitudes (A, the perception of how good or favourable an action is), subjective norms (SN, the perception of social pressure to engage in an action) and perceived behavioural control (PBC, the perception of ability and control over performing the action). These are in turn explained by underlying outcome beliefs about likely outcomes of adopting the action; underlying normative beliefs about opinions of important others; and underlying control beliefs showing how confident someone feels to implement the action, respectively.[1]

The RAA (and TPB) has been applied in various disciplines, ranging from health (e.g. smoking, drug and alcohol abuse), environmental conservation management (e.g. Greiner 2015); soil and water conservation (e.g. Lynne and Rola 1998); knowledge and technology transfer (e.g. Rehman et al. 2007). In an agricultural context, the RAA has been used to understand farmers' adoption of technologies (e.g. Van Hulst and Posthumus 2016). However, in this study, we apply the RAA model in a novel way by looking at researchers' and extension officers' intention to use an AIS approach, including the underlying beliefs. The study, therefore, includes investigating to what extent researchers and extension officers have the intention to use AIS approaches, what their attitudes are and what perceived social pressure exists regarding the use of AIS approaches, and to what extent they feel able to implement AIS approaches. How we conceptualise the relationship between beliefs, attitudes and adoption of a behaviour is detailed further in the methodology section.

1.4. Research objectives

An increasing institutionalisation of agricultural innovation systems approaches in national research and extension institutions comes with changing requirements and expectations attached to the roles of research and extension professionals. This research seeks to understand the attitudes and underlying beliefs that influence intentions to use AIS approaches in the rice sector in Sierra Leone. Our specific research questions are as follows:

(a) What is the relative contribution of attitudes, subjective norms and perceived behavioural control in explaining intentions of research and extension professionals to use AIS approaches?

(b) What are the implications of understanding attitudes and beliefs for the implementation and design of more effective AIS approaches?

While the importance of AIS approaches is well recognised in research and policy discourses, the perceptions of extension and research professionals, who are central to AIS, have hardly been explored. Our literature search showed one similar study by Mose (2013), who looked at the willingness of research and extension staff in Kenya to support participation and empowerment of farmers. This paper complements other work we have conducted (Kamara et al. 2019) by focussing more on systemic aspects of AIS functioning. This research thus fills an important research gap and in addition provides insights for policy-makers working to strengthen AIS to further support effective research and extension for sustainable smallholder agriculture.

2. Methodology

2.1. Study area

In Sierra Leone, the importance of using an AIS approach in the provision of research and extension services for the rice sector is increasingly recognised and institutionalised. Policy documents of the key regulatory institutions such as the Ministry of Agriculture, Forestry and Food Security (MAFFS) and the Sierra Leone Agriculture Research Institute (SLARI) explicitly aspire to the adoption of an AIS approach in the provision of their services to smallholder farmers (SLARI 2011; MAFFS 2012). However, little is known about the extent to which research and extension professionals in the country feel positive about putting an AIS approach into practice, which is typical for many developing countries.

Rice is the major crop in Sierra Leone and the key focus of policy and of the AIS approach. This study was therefore conducted in the districts of Kambia, Port Loko, Tonkolili and Koinadugu in the North of Sierra Leone where ironically both rice cultivation and food insecurity are highest (World Bank 2013). As a result, the area is host to many agriculture sector actors including national and international NGOs. Available studies (e.g. MAFFS 2012) suggest the existence of a weak agriculture innovation system in the country with several weak linkages between various actors.

In the study area, the engagement of diverse actors in the planning, implementation and evaluation of agricultural innovation programmes has often been operationalised either through value chain approaches or innovation platforms. Several key rice innovations have been promoted in these areas by research and extension actors within the period 2005–2015. These include institutional innovations such as the Agricultural Business Centers (ABCs), and technological innovations such as the System of Rice Intensification (SRI), Technical Package on Rice (TP-R) and Improved Rice Varieties (IRVs) – most notably NERICA. ABCs aimed at bringing actors together to improve processing and marketing of rice, but their implementation was unsuccessful and highly politicised by local leaders without involving farming communities. SRI, TP-R and

IRVs were a specific, defined package of technologies promoted primarily to improve production by smallholder rice farmers, were mainly championed by NGO's and are being increasingly used in the country.

2.2. Research design and sample

We used a sequential mixed-method research design. In the qualitative phase, we held eleven Focus Group Discussions (FGDs) with research and extension professionals from SLARI ($n = 3$), MAFFS ($n = 4$) and NGOs ($n = 4$). Separate FGDs were conducted for each seniority cadre of staff (junior, middle and senior) to encourage genuine discussion. Participants were informed about the purposes of the research, encouraged to speak freely as their responses would remain anonymous, and an introduction to AIS ensured similar understanding among participants of what was meant by AIS approaches in their specific context. Participants were asked, both individually and in group discussions, to list and discuss the advantages and disadvantages of using an AIS approach; to list and discuss people and organisations that would approve or disapprove of its use; and to list and discuss conditions that would make it easy or difficult if they were to use an AIS approach in their work as research and extension professionals. This then formed the basis for the RAA questionnaire design in the quantitative phase of the research, by providing lists of outcome beliefs, salient referents and control beliefs.

RAA questionnaires were completed with 122 research and extension professionals, selected with purposive and stratified sampling techniques. We targeted research and extension professionals that have been implementing innovations on rice in the past ten years (2005–2015) in both the public and private sectors, including research scientists from the SLARI – the umbrella agricultural research institute in the country, extension professionals from the MAFFS and a range of professionals from NGOs active in the agricultural sector. Respondents were purposively selected based on the criteria that they must have been involved in the design and implementation of agriculture programmes in the past ten years and must have developed or promoted an innovation on rice. We ensured that staff from a mix of senior, middle and frontline staff were included.

2.3. Definition of AIS approach

Before the FGDs, a preparatory workshop was held to reduce disparities in understanding of what constitutes an AIS approach in research and extension. Different ideas and perceptions of definitions of an AIS approach were discussed after which we could agree on and further explain the working definition of AIS for the purposes of the research. Building on the AIS literature and the specific context of rice research and extension in Sierra Leone, we used the following definition of an AIS approach as a basis for the data collection. An agricultural innovation systems approach in research and extension:

- Involves the engagement and facilitated interaction of **diverse actors** beyond research and extension, such as private input suppliers, farmers, transporters, processors etc.
- Provides products and services working towards increasing smallholder **farmers' capacity** to solve their complex farming problems.

- Involves **putting mechanisms in place** by the various actors to help farmers to actively innovate, adopt external innovations and co-innovate with other farmers.

2.4. Variables and measurement

The 'action' or behaviour of interest in this study is 'the use of an AIS approach in research and/or extension', and in line with the Reasoned Action Approach, the key constructs in the model are Intention, Attitude, Subjective Norm, and Perceived Behavioural Control. In Table 2, we summarise which items were used to assess each construct and give Cronbach's Alpha coefficients as a measure of the internal consistency of each construct. Although mathematically not an exact indicator (see Van Hulst and Posthumus 2016, 306), it is generally accepted that Cronbach's alpha greater than 0.6 indicates that the items reliably measure an underlying construct (Field 2005). We, therefore, considered all constructs to have a satisfactory internal consistency, in which the items cover slightly different aspects of the construct.

All questions were scored using a 5-point bipolar Likert-type scale which considered likelihood, agreement, importance or helpfulness. Scales ranged from −2 to +2 in which 0 was a neutral category. The Mann–Whitney U test was used to test whether there is a significant difference between the institutions studied (SLARI, MAFFS and NGOs) for each of the RAA constructs.

2.5. Linear regression model

The relationship between Intentions and other RAA constructs was explored with a linear regression analysis in addition to non-parametric correlation analysis (using Spearman's rho). Quantitative analysis was carried out using SPSS version 24.0. Following Fishbein and Ajzen (2010) the regression model considered A, SN and PBC as follows:

$$B \cong I = \mathrm{A}\beta_1 + \mathrm{SN}\beta_2 + \mathrm{PBC}\beta_3$$

Table 2. Measurement of RAA construct.

	RAA constructs			
	Intention	Attitude	Subjective Norm	Perceived Behavioural Control
Items	(1) I expect to … (2) I intend to … (3) I want to … … use an AIS approach.	(1) How pleasant … (2) How useful … (3) How good … (4) How sustainable … … is the use of an AIS approach?	(1) Important others want me to … (2) It is expected of me that … (3) I feel social pressure to … (4) Important others think I should … … use an AIS approach.	(1) If I wanted to, I am confident that I could … (2) The decision is beyond my control[a] to … … use an AIS approach.
Cronbach's alpha coefficient	$\alpha = 0.921$	$\alpha = 0.875$	$\alpha = 0.782$	$\alpha = 0.647$

[a]This statement was reverse coded during the data analysis since it was negatively worded.

in which β indicates the relative contribution of A, SN and PBC in predicting Intentions to use an AIS approach. The link with actual behaviour (B) is hypothetical and is not considered in this study (Fishbein and Ajzen 2010).

2.6. Expectancy-value model for beliefs

At the belief level, we used the expectancy-value model (Fishbein 1963). We considered various outcome beliefs *(i)* regarding using an AIS approach, such as 'Using an AIS approach can increase productivity and profitability of innovations for farmers'.[2] We then considered both the likelihood (e_i) and the importance (b_i) of this outcome for the respondent, so that a correlation between intentions and $e_i{}^*b_i$ becomes an indicator of how much that belief contributes to the formation of intentions. For SN we similarly considered for a number of social referents (j), such as 'employers' or 'farmers', both the subjective belief (sb_j), i.e. the extent to which this referent is supportive or dismissive of the respondent using an AIS approach, and the motivation to comply (m_j) with each referent. The PBC was explored by listing control belief (b), such as 'I have the knowledge and skills to use an AIS approach'. For each control belief, we considered the strength of the control belief (C_b) and the power (P_b), or importance of this control belief to be able to use an AIS approach.

The expectancy-value model (Fishbein and Ajzen 1975) constitutes a relatively rigid conceptualisation of how attitudes are linked with beliefs, which can rightfully be criticised for seemingly assuming that people rationally calculate advantages and disadvantages in such a manner. However, we concur with Fishbein and Ajzen (2010) that, as a methodological approach for eliciting belief evaluation, it can give valuable insight into reasons behind intentions, even when intentions in real life are not always formed by rational or conscious decision-making and evaluation processes.

3. Results

3.1. Mean RAA values by organisation

The general pattern emerging from the results is that respondents had positive intentions to use an AIS approach (0.83 on a possible range of −2–2), very positive attitudes towards it (1.53), but only slightly positive perceived subjective norms and behavioural control (0.35 and 0.36 respectively, see Figure 1). We disaggregated these average results by organisation to explore difference between respondents from the MAFFS (primarily agricultural extension), NGOs (primarily agricultural extension) and SLARI (primarily agricultural research). This analysis shows that the MAFFS has the highest mean score for intentions (1.18) followed by NGO staff (0.76) and then the significantly lower ($p < 0.01$) average for SLARI (0.46), suggesting that extension officers are more likely to use AIS approaches than researchers. Attitudes were very positive among the MAFFS and NGOs (1.64 and 1.69 respectively), and significantly lower ($p < 0.001$) but still positive for SLARI (1.20).

Regarding subjective norms, there appears to be more variation between the organisations, with the MAFFS and NGOs showing the highest mean perceived subjective norms to use an AIS approach (0.60 and 0.57 respectively) which were statistically significantly

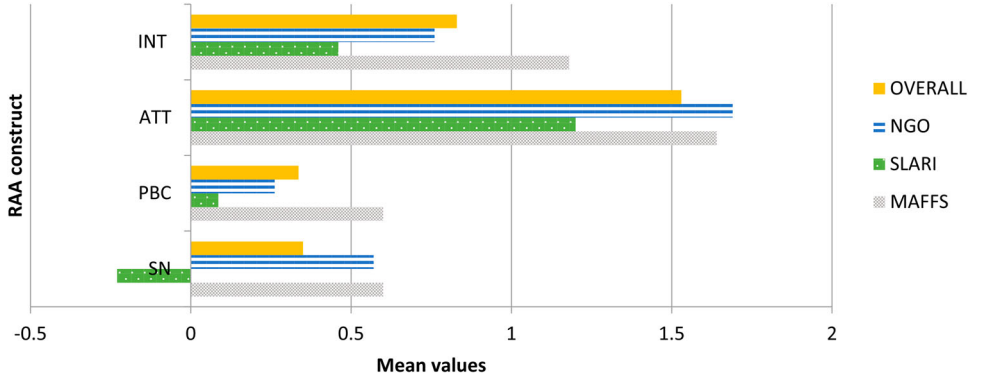

Figure 1. Mean values for intention, attitude, subjective norms and perceived behavioural control by organisation.

higher than for SLARI (−0.23). The negative mean SN for SLARI shows that the salient referents (i.e. important others) for respondents from SLARI are less likely to approve their use of an AIS approach in research programmes. Finally, respondents from MAFFS showed the highest perceived behavioural control (0.60) followed by NGOs and SLARI (0.26 and 0.09 respectively), although this difference was not statistically significant. Nowhere were differences between MAFFS and NGOs statistically significant.

From engaging with the respondents during interviews and focus groups, several features emerged that partly explain why extension professionals from the MAFFS have significantly higher intentions, attitudes and subjective norms regarding the use of an AIS approach than the researchers at SLARI. For example, as the MAFFS are the primary regulatory and implementing body when it comes to extension, they were characterised in FGDs as 'pace-setters' in the field. As such they may feel more obliged to first adopt new guidelines or paradigms in agricultural innovation to be followed by other actors in the sector, thereby influencing attitudes, subjective norms and intentions. SLARI is different in that they are more dependent on international donors than the MAFFS, and were seen to be focussed more on conducting traditional research on breeding and improved technologies to be adopted by farmers. Also, FGD participants mentioned how the lack of incentives to change in research institutions could also be responsible for the low perceived behavioural control, subjective norms and intentions to use AIS approach among SLARI respondents. The RAA model offers a more structured way to further explore in the subsequent sections of the paper, the relative contribution of each of these factors and the underlying beliefs that may help explain some of these differences.

3.2. Factors influencing respondents' intention to use AIS approach

To examine the relative contribution of each of the three key constructs of the reasoned action approach – attitudes, subjective norms and perceived behavioural control – we conducted regression analysis in addition to simple correlation analysis (see Figure 2).

Correlations between respondents' attitude ($r = 0.424$, $p < 0.01$), subjective norm ($r = 0.438$, $p < 0.01$) and perceived behavioural control ($r = 0.482$, $p < 0.01$) and their intention

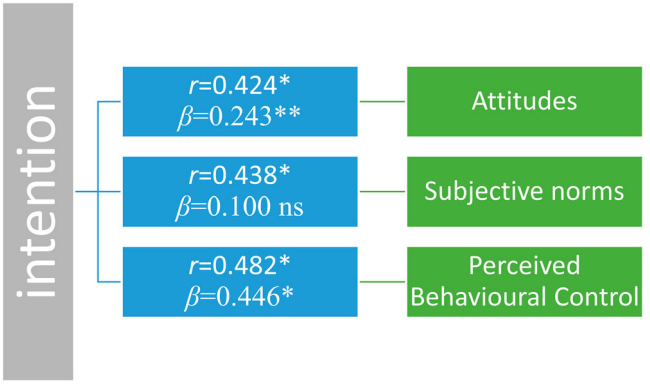

Figure 2. Regression (β) and correlation (r) coefficients of the RAA constructs with intention. Note: *significant ($p < 0.01$), *ns* = not significant.

to use an AIS approach were high, positive and significant. The regression analysis shows that perceived behavioural control and attitudes were significant variables in the regression model, while subjective norms were not significant. PBC ($\beta = 0.446$**) has the highest influence on intention to use an AIS approach, followed by attitudes ($\beta =$ 0.243**), which suggests that extension officers and researchers' intentions to use an AIS approach are primarily determined by their perceived behavioural control, secondly by their attitudes, and intentions are not directly determined by subjective norms ($\beta =$ 0.100 ns). However, given the positive correlation between SN and intentions, the influence of SN is likely mediated by attitudes in the regression analysis. The next section will look in more detail at the underlying beliefs of each construct.

3.3. Underlying beliefs influencing intentions to use an AIS approach

3.3.1. Attitudes and outcome beliefs

A total of 13 outcome belief statements were established during FGDs for all cadre of staff (junior, middle and senior levels) which are analysed to better understand respondents' attitude to use an AIS approach (see Table 3). Research and extension professionals from all FGDs most strongly agreed (*bi*) with the belief that using an AIS approach can foster capacity development of stakeholders including farmers (belief 4). They also strongly believe that using an AIS approach can increase productivity of rice innovations (1), increase food security for smallholder farmers (2), enhance the effectiveness of rice innovations (3), improve smallholder farmers' access to input and output markets (5) and enhance sharing of experiences between actors (6). Respondents were relatively neutral about whether using an AIS approach would be very time-consuming (11) or expensive (12), or that it would be difficult to manage diverse stakeholder groups (9, 10).

Regarding the weight of the outcome beliefs (*ei*), respondents attributed most importance to the statement that using an AIS approach can increase productivity and profitability of innovations for farmers (1) and can enhance experience sharing and best practices among different actors (6). The outcome attitudes for 10 out of 13 outcome belief statements have a significant association with respondents' intention to use an AIS approach. A negative association was found for belief 10, showing that the more

Table 3. Underlying beliefs contributing to the formation of attitudes.

Outcome belief statements	Belief strength (*bi*)	Evaluation of outcome (*ei*)	*bi***ei*	Correlation with intention
1. It can increase productivity and profitability of innovations for farmers	1.32	1.60	2.26	0.326**
2. It can increase the attainment of food security among smallholder farmers	1.34	1.49	2.16	0.463**
3. It can enhance the effectiveness and sustainability of innovations on rice	1.29	1.46	1.98	0.294**
4. It can foster capacity development of stakeholders including farmers	1.42	1.43	2.25	0.267**
5. It can improve smallholder farmers' access to input and output markets.	1.27	1.38	1.98	0.292**
6. It can enhance experience sharing and best practices among different actors	1.29	1.54	2.11	0.357**
7. It helps reduce burden on any one actor.	1.00	1.20	1.36	0.285**
8. It increases agricultural innovation actors (including farmers) ability to innovate	1.11	1.31	1.70	0.350**
9. Coordination of activities of the various stakeholders difficult	0.27	−0.37	−0.52	0.256**
10. It is difficult to use due to the diversity of interests of various actors	−0.25	0.55	−0.06	−0.279**
11. It is time consuming	−0.30	−0.17	−0.40	0.141
12. It is expensive	−0.16	−0.09	−0.30	−0.143
13. It is difficult to use outside the organisation's policies	0.80	−0.88	−0.78	0.022
Calculated attitude ($\sum bi^*ei$): Possible range −52 to +52			13.75	0.382**

**Correlation is significant at the 0.01 level (2-tailed).

people think it is difficult to use an AIS approach due to the diversity of interests of various actors, the less likely they are to have the intention to use an AIS approach.

The FGDs with all cadre of staff showed differences in attitudes towards AIS approaches were associated with seniority of staff, with junior staff being more positive than senior staff. Indicative of a hierarchical organisational culture, junior staff expressed feeling obliged to follow directives from their seniors who were more sceptical of AIS approaches. Junior staff thought that the curriculum of their agricultural education was much more attuned to recent trends in agriculture development than the training their older senior counterparts had received, which may indeed partly explain this difference. The discussions during FGDs with senior staff were sceptical in tone about AIS, sometimes arguing these were not always feasible and pointing towards wider institutional constraints such as funding limitations.

3.3.2. Subjective norms and normative beliefs

Researchers and extension professionals believed that especially employers and professional colleagues wanted them to use an AIS approach, followed by donors and farmers. They had a relatively high motivation to comply with the opinions of their employers, donors, colleagues and supervisors regarding the use of an AIS approach. Researchers and extension officers attributed more importance to the opinion of these referents than to the opinion of farmers (0.61), community leaders (0.56) and family members (0.30).

Overall, a positive and significant association ($r = 0.453$, $p < 0.01$) was found to exist between the calculated subjective norm and respondents' intention to use an AIS

approach in research and extension programmes. This largely suggests that the salient referents identified can enhance respondents' intention and subsequently their use of an AIS approach in research and extension programmes. The calculated (indirect) subjective norm (see Table 4) for all respondents is moderately positive (8.844, out of a range of −28 to +28).

3.3.3. Perceived behavioural control and control beliefs

The underlying control beliefs regarding using an AIS approach in research and extension shows that two control beliefs are particularly important. Having knowledge and skills to use an AIS approach was seen as important, however, respondents seem to lack adequate knowledge and skills regarding the use of AIS approaches (0.05, see Table 5). Not having the adequate financial resources in place to be able to use an AIS approach was the second control belief clearly linked with intentions. Although not clearly correlated with intentions, most respondents also experience a lack of incentives from within their organisations to use AIS approaches. This was ranked as very important but seen as missing by the respondents. On the other hand, most respondents believe that the institutional policies of their organisations, the poor cooperation and behaviour of other actors and cultural norms of farmers are not constraining factors to their intention to use an AIS approach. Overall, the calculated perceived behavioural control is mildly negative (−0.156 out of a range of −24 to +24).

4. Discussion

4.1. How perceived behavioural control influences use of AIS approaches

Given the positive attitudes towards AIS approaches demonstrated by respondents, we focus our attention ondiscussing how perceived behavioural control is limiting the intentions to use AIS approaches. The results point to a lack of capacity at personal level (need for knowledge and skills for implementing AIS approaches) and institutional level (the lack of financial resources, and the hierarchical and bureaucratic nature of national research and extension organisations). These are all identified in the literature as preconditions for successful AIS approaches (e.g. Mur and Nederlof 2011).

Knowledge and skills for implementing AIS approaches in the rice sector in Sierra Leone were defined by respondents during the FGDs as 'the capacity to facilitate complex and dynamic interactions in innovation platforms and value chain approaches'.

Table 4. Underlying beliefs contributing to subjective norms.

	Subjective belief strength (sb_j)	Motivation to comply (m_j)	sb_j * mj	Correlation (r_s) with intention
Employer	0.99	1.11	1.615	0.493**
Supervisor	0.55	0.90	0.951	0.427**
Professional colleagues	0.87	0.93	1.320	0.369**
Donors	0.74	1.07	1.246	0.269**
Farmers	0.70	0.61	0.967	0.349**
Community leaders	0.48	0.56	1.049	0.313**
Family members	0.48	0.30	0.869	0.261**
Calculated subjective norm ($\sum sb_j{*}m_j$): Range −28 to +28			8.844	0.453**

**Correlation is significant at the 0.01 level (2-tailed).

Table 5. Underlying beliefs contributing to perceived behavioural control.

Control beliefs statements ($n = 122$)	Mean control belief (C_b)	Mean power of control beliefs (P_b)	Mean behavioural control ($\sum C_b{*}P_b$)	Correlation (r) with intention
Have the knowledge and skills on AIS approach	0.05	1.32	0.23	0.323**
Have adequate financial resources (e.g. from donors) to use an AIS approach	−1.09	0.95	−0.65	0.232*
Institutional policies of my organisation discourage me from the use of an AIS approach	−0.46	0.53	−0.56	0.013
The poor cooperation and behaviour of other actors will discourage me from adopting an AIS approach	−0.20	1.08	−0.47	−0.066
Cultural norms of smallholder farmers will discourage me from using an AIS approach	−0.08	−0.14	−0.02	0.164
The lack of incentives from my organisation will discourage me from adopting an AIS approach in research and extension.	0.61	1.52	1.30	−0.003
$\sum C_b{*}P_b$, range: −24 to +24			−0.156	0.141

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

Results show that while both researchers and extension professionals had some experience with innovation platforms at national or local level, they did not feel very confident about it. Those expected to facilitate innovation platforms are often the more senior staff, who due to their higher age have also had more traditional agricultural education. While the younger researchers and extension professionals have been more exposed to innovation systems thinking in their curriculum, they have less influence over how innovation platforms are implemented. This suggests the need for retraining senior staff.

At the policy level, the agricultural institutions studied in Sierra Leone had incorporated AIS approaches in existing policies, in line with international (donor) countries. However, our respondents highlight that this is not matched with institutional and financial infrastructure to actualise these policies. This may be the result of contrasting institutional logics between policy-makers, international donors, and field staff, with similar patterns being reported in the context of Ghanaian soybean and casava value chains (Osei-Amponsah, Van Paassen, and Klerkx 2018).

The most important social referents emerging from our results are of professional nature and include the employer, colleagues and work supervisors. This draws attention to organisational culture and how attitudes of influential individuals in the organisational hierarchy influence research and extension approaches. The operationalisation of an AIS approach by frontline staff in hierarchically structured organisations, depends on the approval of senior staff of these organisations or employers. The positive attitudes towards AIS approaches suggest there is scope for involving junior staff in the design of the extension delivery systems.

4.2. Top-down and AIS narratives operating in parallel

Finally, while participants have very favourable attitudes towards AIS approaches, it appears they hold equally favourable attitudes towards more top-down ideas regarding

research and extension. These seemingly opposing ideas being held in parallel appears to be a key feature of the agricultural innovation landscape in Sierra Leone, and similar observations have been made in other countries (e.g. Davis et al. 2019). Improved rice varieties such as NERICA have been promoted in Sierra Leone and other developing countries in Africa primarily to increase productivity per unit area and smallholder farmers' income. While the objectives of NERICA overlap with perceived advantages of using AIS approaches, and while there are well established participatory approaches for varietal selection (e.g. Witcombe et al. 1996), the dissemination of NERICA in Sierra Leone is following a primarily top-down model. From many discussions in the field during the field work and the wider experience of the lead author it is evident that despite high-level policy championing of AIS approaches, the funding and design of programmes are such that the objectives (improved rice productivity) and the means (specific improved variety and technology packages) are already largely fixed, leaving little scope for AIS approaches.

The observed failure of Agricultural Business Centres, the main institutional innovation in our case study, further indicates that unless the culture and capacity in institutional and organisational environments are considered, individual innovations are unlikely to achieve AIS objectives. This resonates with other case studies e.g. Chowdhury, Odame, and Leeuwis (2014) and Minh et al. (2014) and seems to apply more strongly to functioning of public institutions in Sierra Leone compared to internationally funded NGO's, despite positive attitudes towards AIS of especially field level staff. More research is needed to understand perceptions of extension and research staff at all levels regarding preferred extension and research methods linked to specific innovation interventions and approaches 'on the ground' and the associated perceived need for capacity development and institutional change.

5. Conclusions

Our results show that research and extension professionals involved with rice production in Sierra Leone are willing to use agricultural innovation systems approaches. Their favourable attitudes stem from the beliefs that AIS approaches can increase productivity of rice innovations, food security, incomes and farmers' access to markets, and facilitate sharing of experiences between actors. The low apparent use of AIS approaches in Sierra Leone, however, could be linked to low perceived behavioural control, especially related to the knowledge and skills to implement AIS approaches, and the lack of appropriate financial resources from both government and international donors.

We demonstrate that as research and extension professionals are increasingly expected to facilitate complex interactions among diverse actors, capacity development at individual and institutional level are needed. Skills and knowledge needs of research and extension professionals are currently limiting the use of AIS approaches in the facilitation of effective innovation platforms and or value chain approaches. We further conclude that institutional capacity for innovation need to be addressed if researchers and extension workers are to feel more capable to use AIS approaches and better understanding of responsibilities and dynamics of staff of different levels of seniority is required. There is also need for increased harnessing of financial resources at the institutional level to ensure the smooth and long-term functioning of AIS approaches.

We highlight the need for more research in establishing the level of resources needed for various AIS approaches. Research is also needed to understand how organisational culture and institutional hierarchies are hindering or encouraging the shift towards wider use of AIS approaches in research and extension. Similar studies in other developing countries will be useful to inform management, policy-makers and donors alike on the factors influencing the intentions to use AIS approaches in agricultural research and extension programmes.

Notes

1. A detailed discussion of the RAA methodology is beyond the scope of this paper, please refer to Fishbein and Ajzen (2010) for general theoretical discussion, or e.g. Van Hulst and Posthumus (2016) or Wauters et al. (2010) for applications in an agricultural context.
2. The full list of outcome-, subjective- and control beliefs are given in the results section, in Tables 3–5, respectively.

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