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Assessment of the use of Participatory Integrated Climate Services for Agriculture (PICSA) approach by farmers to manage climate risk in Mali and Senegal

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ABSTRACT

Recently, a new approach to extension and climate information services, namely Participatory Integrated Climate Services for Agriculture (PICSA) has been developed. PICSA makes use of historical climate records, participatory decision-making tools and forecasts to help farmers identify and better plan livelihood options that are suited to local climate features and farmers' own circumstances. This approach was implemented in 2016 in two sites in Senegal and Mali, with 57 and 47 farmers, respectively. At the end of the growing season, these farmers were surveyed to explore their perceptions on the use of the approach. In Senegal and Mali, respectively 97% and 76% of the respondents found the approach 'very useful'. The approach enabled farmers to make strategic plans long before the season, based on their improved knowledge of local climate features. Moreover, evidence demonstrates that PICSA stimulated farmers to consider and then implement a range of innovations which included: (i) changes in timing of activities such as sowing dates, (ii) implementing soil and water management practices, (iii) selection of crop varieties, (iv) fertiliser management and (v) adaptation of plans for the season (farm size, etc.) to the actual resources available to them. The study also demonstrated the potential of farmer-to-farmer extension in scaling up the approach, which is of great interest especially in the current context of limited extension services in the West African region.

Practical implications

Our study analysed the additional support brought to smallholder farmers in Mali and Senegal by the Participatory Integrated Climate Services for Agriculture (PICSA) approach (Dorward et al., 2015). This approach uses historical climate records, participatory decision-making tools and seasonal climate forecasts to help farmers identify and better plan livelihood options suited to their own circumstances and climate conditions. The historical climate records provide extension staffs and farmers with locally relevant climate information required for production and livelihood activities (start, end and length of the season, etc.) as well as related probabilities/risks of occurrence for specific events. The approach was judged as useful by farmers as it allowed them, to start taking major tactical decisions long before the season, based on their improved knowledge of local climate features. Moreover, evidence demonstrates that PICSA stimulated farmers to consider and then implement a range of innovations. The approach also led to demand from farmers for other services and information associated with the innovations and resulted in extension or advisory staffs connecting farmers with

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technical and financial institutions. The approach also has the potential to improve the understanding and use of seasonal forecast information by farmers and extension staffs by adding actual figures for locations rather than only qualitative descriptions currently used in seasonal climate forecasting (SCF) in many countries. Implementing PICSA at large scale has the potential to reduce production risks faced by smallholder farmers, as has been achieved in several countries in Africa. In countries where extension services are limited PICSA can be delivered through working with other institutions such as farmer organisations and community volunteers. The approach also requires that Meteorological service staffs are capacitated to analyse historical climate records and produce the required graphs. An issue that might hamper implementation of PICSA in some localities is the lack of historical climate records due to the poor coverage of climate and weather information recording equipment. This will require Government and development organisations to support initiatives aimed at improving recording, storing and analysing climate data.

1. Introduction

The livelihoods of rural people in sub-Saharan Africa commonly depend on rain-fed production systems that are vulnerable to climate variability and change (Dabiré et al., 2011; Zougmoré et al., 2014; Ramirez-Villegas and Thornton, 2015; Zougmoré et al., 2016). This, in combination with factors such as a lack of a conducive food system environment, low soil fertility (Omotayo and Chukwuka, 2009; Sasson, 2012; Tully et al., 2015) creates a serious threat to food security in the region. Climate services are presently considered by many actors as a means to improve decision-making and mitigate climate-related risks in the agricultural production sector (Ouédraogo et al., 2018; Vaughan et al., 2017) and are thus considered a key component for the implementation of climate-smart agriculture (FAO, 2009; Zougmoré et al., 2014; CCAFS, 2015, 2016). In recent decades significant progress has been achieved in predicting seasonal mean states of weather and, therefore, seasonal forecasting has become an operational activity in many national weather services worldwide (Nikulin et al., 2018) although there remain serious questions concerning forecast skill and the usefulness of forecasts of the mean states to farmers. In addition, effective and efficient ways of communicating forecasts to end users and facilitating useful interpretation remain challenging due, among other things, to the context-specificity of the assistance needed by users (Nikulin et al., 2018).

In general, rural smallholders in sub-Saharan Africa (SSA) are assisted by Governmental and/or Non-Governmental extension services in their agricultural production activities. These extension services are often perceived to act as a bridge between scientists, who strive to resolve problems in the practice of agriculture through research, and the farmers who need the solutions (Wesley and Faminow, 2014). In some countries, agricultural extension follows a common pattern where technical prescriptions derived from controlled conditions are disseminated using top-down approaches with little attention to local conditions, often making the content unworkable (Wesley and Faminow, 2014). The efficiency of rural sector assistance is further complicated by the high ratio of farmers to extension staff and recent trends are towards experimentation of ICT based extensions (Sanga et al., 2013). However, this also faces the challenge of high illiteracy in farming communities.

Extension systems in many countries are struggling to shift to more farmer-oriented approaches that emphasize the importance of mutual learning between different knowledge systems, and include multiple disciplines (Wesley and Faminow, 2014). For the purpose of addressing climate risks in production, Vaughan et al. (2016) found that “better connecting climate information to users” is one of the priorities for advancing climate services. With these challenges in mind, PICSA has been developed and tested by the University of Reading (Dorward et al., 2015). PICSA was piloted and then began to go to scale in southern and eastern Africa (Zimbabwe, Tanzania, Kenya and Malawi). It is now being implemented in West Africa (Ghana, Senegal, Burkina Faso, Mali, Niger) as well as in Asia and Latin America. PICSA is built around the following elements and principles: (1) supporting farmers as decision makers to make their own choices and plans (and does not seek to provide advisories/recommendations); (2) making available locally specific historical and forecast information and the tools to interpret them; (3) facilitating the consideration of a range of locally relevant ‘options’ for crops, livestock and/or other livelihood enterprises, as well as specific management practices; (4) a set of participatory decision-making and planning tools to help farmers identify the options that are most suitable for them. Furthermore, PICSA emphasises ‘options by context’ i.e. the recognition that each farmer operates within his own biophysical and socioeconomic context and that different options will be appropriate for different contexts (Dorward et al., 2015).

Unlike other existing forms of climate information services (CIS), PICSA includes analysis and use of historical climate information. The novelty of this approach is twofold: Firstly, it utilises historical climate records (available for some areas for at least the past 30 years) for joint analysis with farmers, as well as informing their decision-making. Secondly, this is done long before the season starts, with the intention of developing farming strategies for ‘any season’. In this way, PICSA differs from conventional CIS which tends to start with seasonal forecasts arriving just before the season. In PICSA, historical climate records are used to help describe and understand the climate and in particular the variability, or change in the amount of rainfall and/or in temperature, and to calculate simple probabilities/risks of occurrence of climate events (given amounts of rainfall, start and end dates of the rainy season, length of growing period, risk of dry spells or extreme rainfall) which are discussed with farmers in combination with various livelihood options (agriculture, livestock and other livelihoods) available for adapting to their local climate. Options are also jointly analysed with farmers in terms of effectiveness and applicability (required resources) while they still have time to plan and prepare for the season. Moreover, by making use of local historical climate records, PICSA also helps improve the understanding and use of SCF information by the extension agents and consequently the rural farmer; as it provides locally relevant figures rather than relying solely on qualitative words (below normal, normal, above normal, etc.) used in the seasonal climate forecast. Where more advanced forms of SCF are available, PICSA also enables interpretation of and communication about products with farmers. PICSA is a novel extension and CIS approach that seeks to enable extension staffs to work with farmers in a participatory and facilitating manner and to support decision making and planning that takes into account local climate together with other constraints and opportunities that farmers have.

Documenting how the provision of climate services for agriculture helps improve the management of climate risks (Bayala et al., 2017; Clarkson et al., 2017) can help in shaping future initiatives. This study aimed to assess the lessons from the use of the PICSA approach for risk management by farmers. It used data collected in two sites in Mali and Senegal through surveys targeting farmers who participated in the roll-out of the approach in 2016. We hypothesised that PICSA would add value to the current commonly used CIS approach (i.e. the use of seasonal forecasts) and we assessed farmers’ perceptions of the usefulness of the approach, the major decisions taken based on the approach and their contribution in the farmer-to-farmer information sharing.

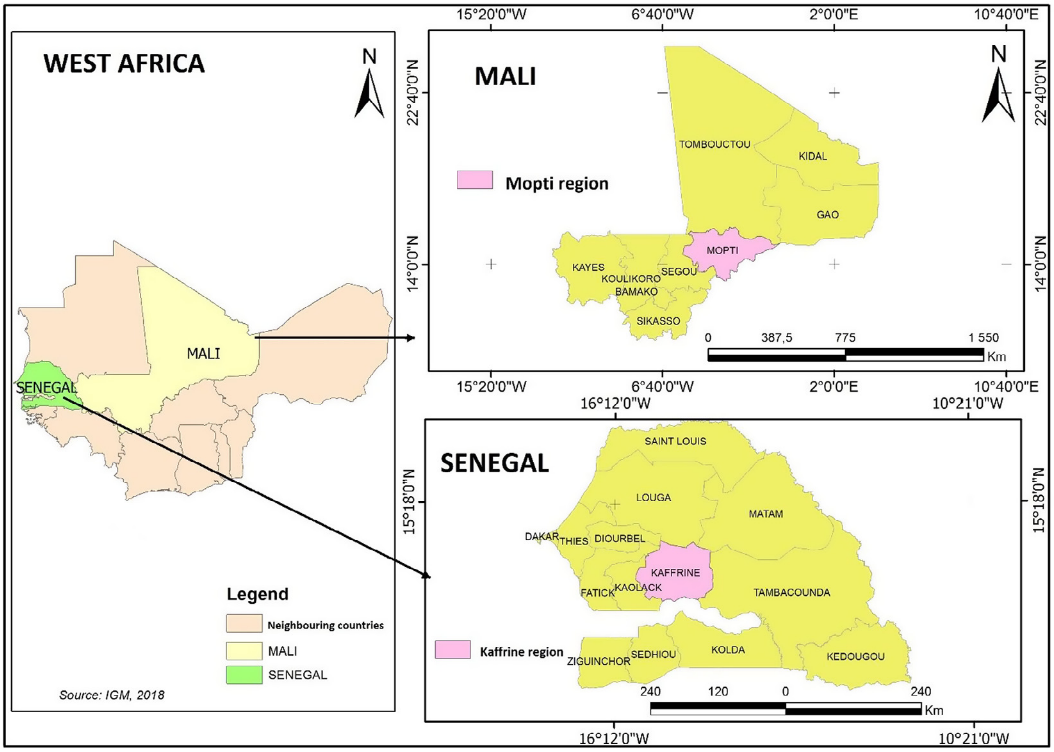

Fig. 1. Study sites location.

2. Materials and methods

2.1. Study sites

Data for this study were collected in the villages of Kouna, Allaye Daga and Youre in Mopti region (14°29′ N, 4°10′ W) in Mali, and in the villages of Ngouye and Daga-Birame in Kaffrine region (14°07′ N, 15°42′ W) in Senegal (Fig. 1).

Rainfall in the Kaffrine area varies between 600 and 700 mm. The hydrology of the region consists of the Saloum branch, temporary ponds and small valleys fed by rainwater. These are the main water supply points for livestock, but they dry up in the dry season. Vegetation is of Savannah grassland type where only few trees and shrubs are encountered, mainly in the north of the Kaffrine region, in areas with very shallow (encrusted) or very dry soil. Agriculture, livestock, forestry, handicrafts and trade are the main activities in the region. However, due to soil degradation and decreasing rainfall, crop productivity is declining (Sanogo et al., 2017).

The climate in the Mopti region is in between Sahelian (isohyets 150–550 mm) and north Sudanian (isohyets 550–750 mm). The first zone is characterised by an arid to semi-arid regime while the second, more humid (compared to first one), covers only a small part of the region. The hydrology is characterised by the Niger and Bani rivers and their tributaries, as well as lakes Walado-Debo, Korientze, Niangaye, Korarou, Aougoundo, and many small permanent or semi-permanent ponds. Agriculture, livestock and fishing are the main economic activities. Around these activities, there is an ongoing development of trading on livestock products, fish and cereals. Handicrafts and tourism had been an important contribution to the economy of the region prior to the security crises since 2012 (Haysom, 2014).

2.2. Description of the PICSA approach and implementation in Mali and Senegal

PICSA is an approach implemented at different times in the lead up to and during the season. An important aspect of PICSA is to consider, together with farmers, the climate risks related to activities they undertake as well as the risks and opportunities related to what they could do, so that they are informed and can plan and undertake those activities appropriate for their circumstances.

For the current study, trained facilitators (research assistants at ICRAF in Mali and at Senegalese Institute for Agricultural Research (ISRA) in Senegal, accompanied by local governmental extension officers), worked with 47 and 57 farmers in Mali and Senegal respectively. The first phase of PICSA, “long before the cropping season”, was implemented in Mali and Senegal at the end of April-early May 2016 through four meetings with each of the communities. During these meetings the facilitators worked with small groups of farmers and each farmer focused on his own farm and household. In the first meeting which lasted between three and four hours and focused on Step A of PICSA (see Fig. 3), the farmers considered their resources and how they allocate them to their different enterprises (using a Resource Allocation Map); their different activities throughout the season (using Seasonal Calendar) and how they might be affected by climate and weather conditions. For this first session, farmers were provided with material (paper and markers) with which they could depict their situation and the facilitators explained the idea behind each tool and showed a pre-prepared example to the farmers. The team made it clear to the farmers that, taking note from their example, each farmer should depict his/her own situation (own context/circumstances). While farmers worked on their cases, the facilitators walked around and assisted with clarifications for individual farmers. After this session, the meeting venue and time were agreed for the next one; the extension accommodated farmers’ schedules as much as possible.

In a session that followed the next day and lasted for 3–4 h, farmers focused on Steps B and C (Fig. 3), and were introduced to historical climate records, starting with an explanation that for many decades, Meteorological services have been recording climatic parameters in their locality (or from the most relevant/closest rain gauge). The time series graphs showing the history of these different climate parameters, for instance annual rainfall amount, start and end dates of the rains, length of the rainy season, dry spells, etc. (See Fig. 2 for example) were

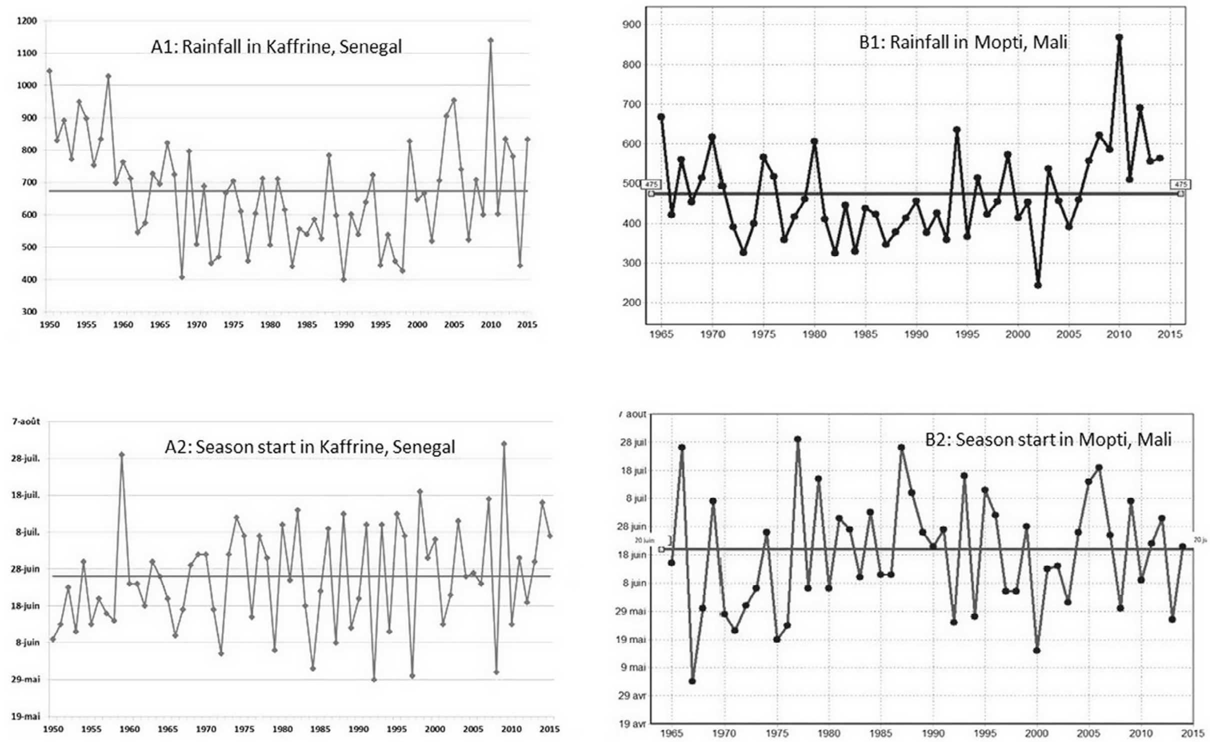

Fig. 2. Variability of rainfall and season start date from 1950 to 2015 in Kaffrine (Senegal) and from 1965 to 2015 in Mopti (Mali).

introduced and explained to the farmers. Farmers' experience and perceptions of the historical climate in their locality were also explored. The following points emerged from this participatory discussion: the vast majority of participants (irrespective of level of literacy) fully understood the graphs (although it took a long time to explain due to illiteracy); whilst there was good agreement between farmer recollection of particularly dry or wet years and the data on the graphs, farmers were surprised by a) the extent of the variability from year to year and b) that the graphs normally do not show clear long term trends in rainfall (e.g. worsening conditions such as decreasing amounts of rainfall). This was not surprising as most farmers have not had access to measurements of rainfall and rely on indicators such as crop yields, water tables and food security, each of which can be strongly influenced by factors other than rainfall, such as declining soil fertility effecting yields, economic conditions effecting food security and access to crop inputs (Osbahr et al., 2011).

Once a common understanding of historical records graphs was reached, probabilities and risks for specific climate events that are relevant for decision making (for instance, amounts of rainfall and lengths of seasons to help choice of crops and varieties, as well as season start dates to help inform sowing dates for local farmers, etc.) were calculated using a simple participatory procedure with the farmers so that they could see the chance of such events occurring in their area.

The third session, which also took 4 h, followed the discussions on historical climate trends, and sought to support farmers to explore how to address the issues that had emerged (Step D, Fig. 3). For example, given the high variability in rainfall amounts and timing from year to year, farmers identified enterprises and management practices (in agriculture, livestock and other livelihoods) that individually or together provided strategies to address variability. In the process, farmers were encouraged to come up with their own suggestions. Then, the support team members, based on their experiences, also added new options (practices/technologies) that farmers might try to better adapt to their local climate. Using a participatory tool, an 'Options Matrix' (Dorward et al., 2015), farmers analysed and then selected several options they were interested in trying. The support team members then assisted them in making participatory budgets (Dorward et al., 2003) for the options they had selected to allow them to compare the different options and see which ones were more beneficial (not only cost-effective, but other reasons, such as food self-sufficiency and timing of resource use/investment were also taken into account) (Step F Fig. 3). The process also helped farmers with different contexts select different options they considered best suited to them (e.g. farmers with different wealth levels and soils are likely to select different options). This last session of the "long before the season" phase allowed farmers to make their choices for the season to come and to start preparing for implementation on their farms.

The majority of the PICSA Steps are completed long before the season. The two following phases enable farmers to make adjustments to the plans they have established during the earlier exercises outlined above, in the context of seasonal and short-term forecasts. In Senegal and Mali these forecasts are already provided by Governmental services to farming communities just before the start of, and throughout the season using different means depending on localities (TV, rural radios, face-to-face workshops, etc.). In this study, once the seasonal forecast became available, the support team members went back to the field, explained the forecast in relation to the historical data, and discussed the forecast with farmers. In the case of Senegal, multidisciplinary working groups (GTP) established by the National Meteorological Service (ANACIM) in collaboration with other technical services (Agriculture, livestock and Environment), provide CIS to farming communities beginning with the seasonal forecast. Farmers participating in the current study also benefitted from that support.

The short-term forecasts and warnings were also disseminated to famers by the existing GTPs on a decadal basis during the cropping season and adaptation measures were discussed.

The final activity in PICSA (Step L, see Fig. 3) took place with farmers at the end of the cropping season and aimed to document successes, challenges, and lessons, and to discuss ways of improving the process for future seasons (Dorward et al., 2015). It was during this last

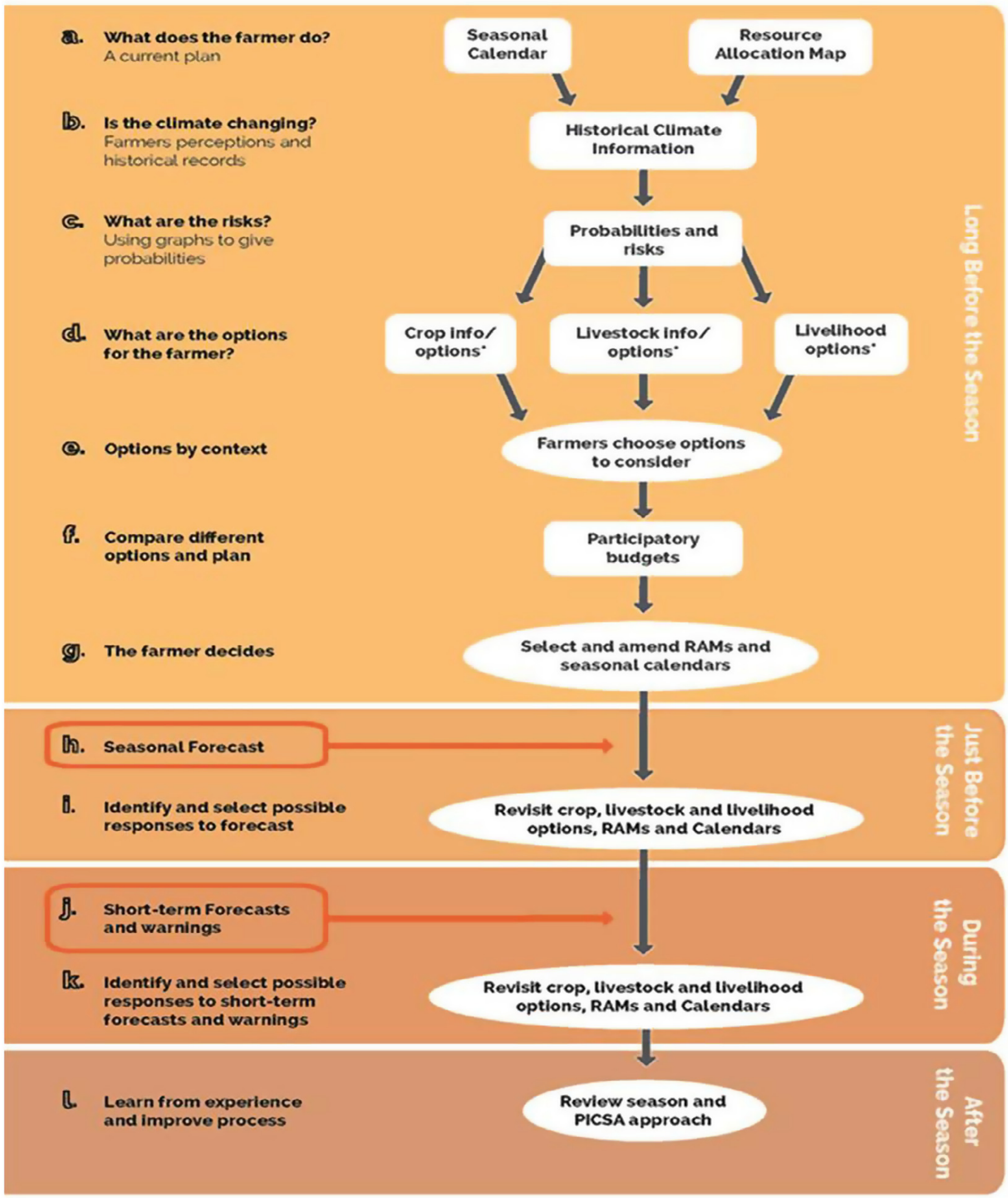

Fig. 3. Overview of the PICSA approach showing the main steps.

phase that data for the current study were collected.

A full description of the approach can be found here.[1]

2.3. Data collection and analysis

In the two countries farmers were individually surveyed, using a questionnaire to document their perceptions on the usefulness of PICSA and to identify any changes and decisions that they had made which could be attributed to the approach. Farmers were also asked to provide information on the number of fellow farmers with whom they shared ideas and information following their participation in the trainings on the approach. The survey was conducted in the local language. Before the start of each survey the respondent was assured of the anonymous nature of the survey and that the sole objective of the survey was to learn lessons from the roll out of the PICSA approach and see how potential weaknesses may be resolved. The level of usefulness was measured on a 5-point Likert scale, i.e. not useful (1), of little use (2), useful (3), very useful (4) and extremely useful (5).

Descriptive statistics were used to analyse the data regarding the usefulness of the approach after disaggregating the data by sex. We ran Mann-Whitney tests to assess the significance of the differences with regard to sex. Qualitative analysis (first, reading through all types of responses and reflecting on how they could be categorised according to the main themes that emerged) was used to explore the reasons behind the farmers' assessments and the decisions they had taken following their participation in the approach.

3. Results and discussions

The PICSA approach was implemented with 47 farmers in Mali and 57 in Senegal. However, the post season survey had captured the perceptions of 45 in Mali and 40 in Senegal. Of the farmers surveyed in

[1] https://cgspace.cgiar.org/bitstream/handle/10568/68687/PICSA%20Field%20guide.pdf?sequence=1.

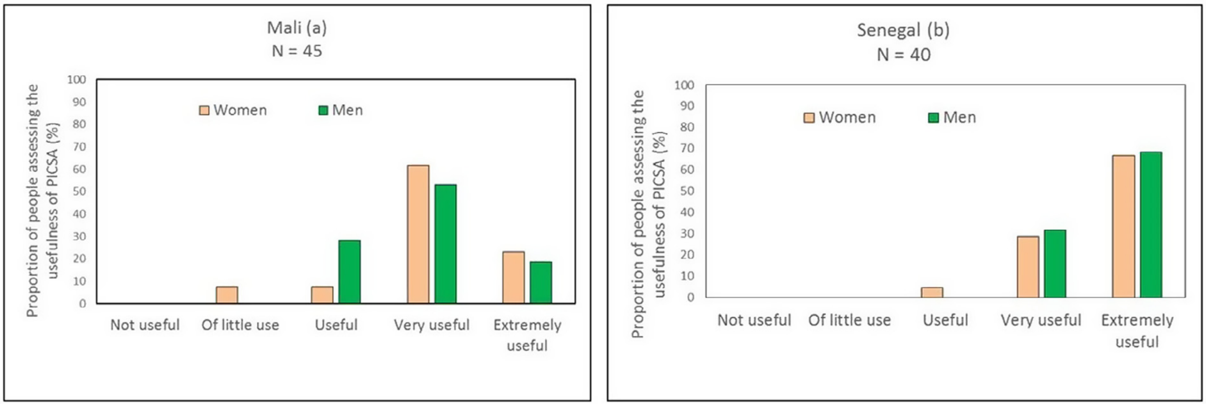

Fig. 4. Farmers' perception on the usefulness of the PICSA approach from Mopti region in Mali (a) and from Kaffrine region in Senegal (b).

Kaffrine 52.5% were women and the mean ages of men and women respondents were 46 and 38 years respectively. Land sizes were typically around 5 ha or more for each category. In Mopti, 29% of the surveyed farmers were women and their average age was 52 years while for men it was 49 years. Land size was relatively higher for men as compared to women (8 ha vs. 3 ha). "Literacy in local language" and "koranic school" were the most dominant education type and accounted for 50% and 22%, respectively, of surveyed farmers in Senegal while equivalent figures for Mali were 33% and 44%.

3.1. Usefulness of the PICSA approach

All men and about 95% of women from the site in Senegal judged the approach as very useful. The ratings "not useful" or "of little use" were not mentioned. At the site in Mali about 80% of women and 75% of men found the approach very useful. The approach was judged of little use by a few women in Mali (Fig. 4).

The questionnaire asked farmers to list which aspects of the PICSA approach they had found most useful. Results are presented as frequencies (ie numbers of times an aspect was mentioned). They revealed that in Mopti (Mali), historical climate information and related probabilities were considered most useful by both women and men (Fig. 5). For women in Kaffrine (Senegal), seasonal and short-term forecasts and discussions on options for adapting to climate variability were the most useful aspects. The same trend was observed for men in Kaffrine although the second most important aspect appeared to be historical climate information and related probabilities.

3.2. Reasons given by farmers to support their judgement of the usefulness of PICSA and types of decisions taken

In Mali, women mentioned: composting/preparing manure, choosing crop varieties, adapting sowing date, adapting production plans to available resources (reducing crop land size) and applying stones to contour lines as key changes they had made because of using the PICSA approach. Men also reported a wide range of changes that they had made because of implementing the approach including: composting, adapting production plans to available resources (farm size reduction), adapting sowing date, choosing crop varieties and adapted site, doing budgets for cropping activities, paying more attention to

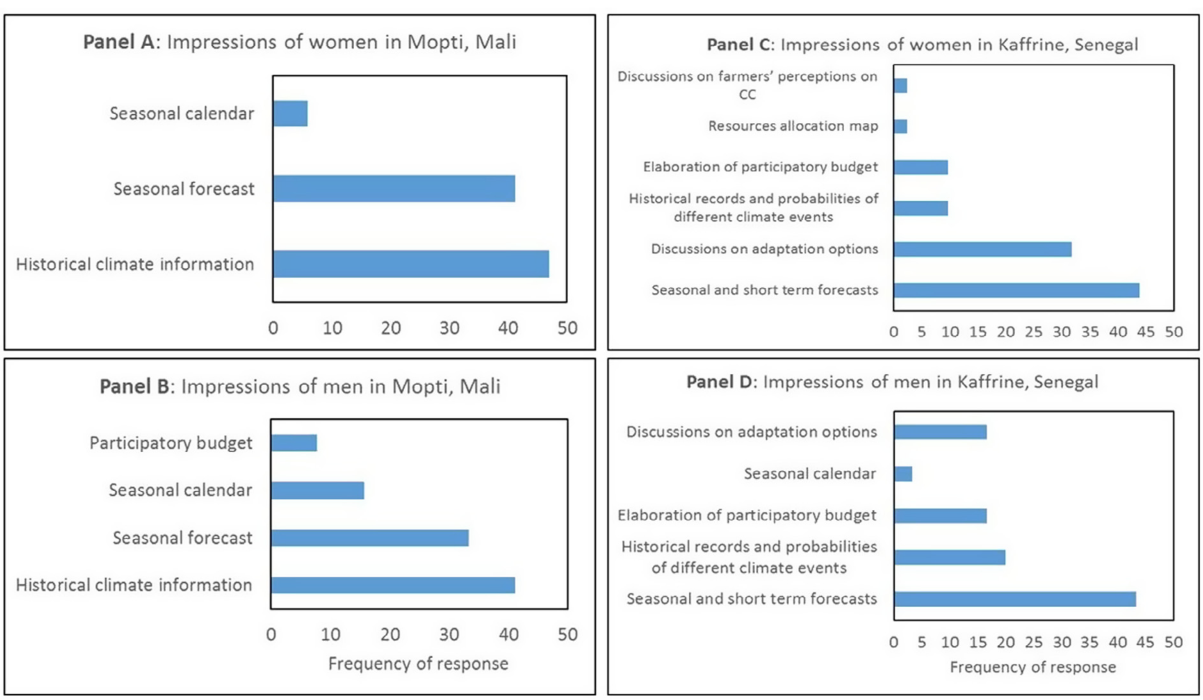

Fig. 5. Frequencies of PICSA aspects found useful by farmers in Mopti region in Mali and Kaffrine region in Senegal.

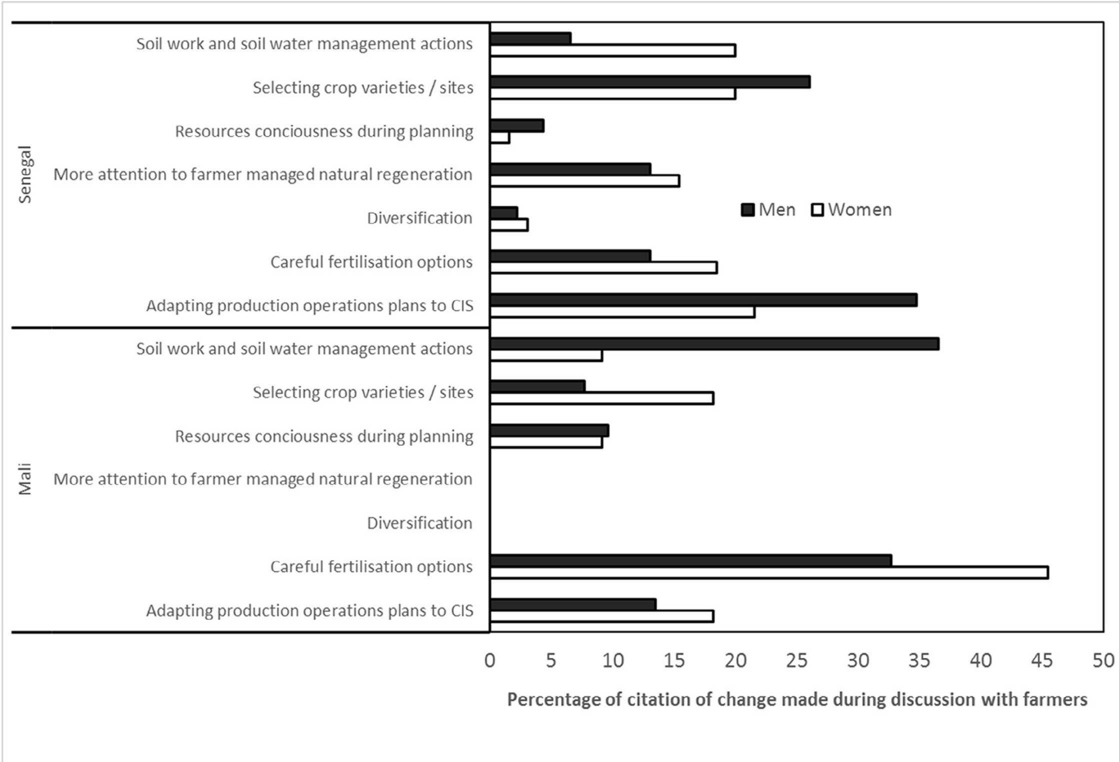

Fig. 6. Percentage of citation of the different changes operated by farmers in Mopti (Mali) and Kaffrine (Senegal) as a result of using PICSA.

climate conditions and soil and water conservation improvement practices such as earth bunds and zaï pits.

Women at the sites in Senegal reported that the approach was good for: helping to identify and select agricultural options such as adapted varieties, optimum soil management work and fertilisation options, farmer managed natural regeneration (FMNR) and considering diversification of production; careful planning and timing of activities such as weeding, fertiliser application and harvest; and matching activities to available resources (reduction of crop land area). Men from the same site reported that through the approach they improved their orientation to the features of the season, selecting options such as adapted crops/varieties, land preparation and fertiliser management, FMNR and planning operations such as sowing, weeding, and fertiliser application. It also helped them reviewing household production resources to match production plans – crop land size, paying attention to cost effectiveness and thinking of the necessity to diversify. Fig. 6 summarises the frequencies of citation of the changes.

In both Senegal and Mali the terms “very useful” and “extremely useful” on the Likert scales received the highest numbers of responses, with the second of these being dominant in Senegal and the first in Mali. Gender did not significantly influence the assessments made by farmers regarding the approach. Absence of gender differences were also reported by Etwire et al. (2017) when assessing mobile phone based CIS in northern Ghana.

Preparing for the cropping season requires resource mobilisation to purchase agricultural inputs and CCAFS (2015) observed that some farmers assessed their debt capacity for the cropping season based on the seasonal forecasts. Farmers reported that the PICSA approach helped them start planning, including budgeting, for the upcoming season long before the season start.

The usefulness of the historical climate information and its associated probabilities of specific climate events (start of season, length of season, etc.), as indicated by respondent farmers in Kaffrine and Mopti regions, was also observed in another Sahelian part of the West Africa where the PICSA approach was introduced. In Niger, during a training session that occurred in June 2017, participant farmers after having been acquainted with the historical climate records of their localities (Kobaguié and Iboye villages in the Torodi commune) decided to assess the effectiveness of a practice most of them in the village had just implemented. Indeed, there was rain on the 9th of May and the majority of farmers in the community had sown immediately afterwards. Based on the historical climate records, it was revealed that 7 times out of 8, the cropping season would not start by May 9 and crops sown on that date would fail afterward due to long dry spells following the first rains. Farmers confirmed that all seeds sown at that date failed as it did not rain for about 20 days afterwards. This was an opportunity to share and discuss the findings from the historical records which indicated that the average start of season for that locality was 3rd June (authors’ personal communication.).

3.3. Sharing information with fellow farmers in Kaffrine and in Mopti

All respondents at the site in Senegal (except one male) had shared information with fellow farmers who were not part of the group trained on the use of PICSA. The average number of people with whom farmers shared information on PICSA was 9 for women and the modal value was 5 while the values were 11 and 10 for men. Leaders of farmers’ organisations shared the information with their organisations and therefore reported numbers as high as 40 (for women) and 110 (for men).

All respondents in Mali (except 3 women) shared information with other farmers. The average number of people with whom each category shared information was 12 for women and 11 for men. Zero (0) was the value most frequent for women (appeared 3 times) while the modal value was 20 for men.

These results show that farmers, through their networks, play an active role in the dissemination of climate information services within their community (Fig. 7). Similar results were observed by CCAFS (2015).

It is worth considering whether PICSA is increasing the workload of already stretched extension agents. However, the benefits reported by

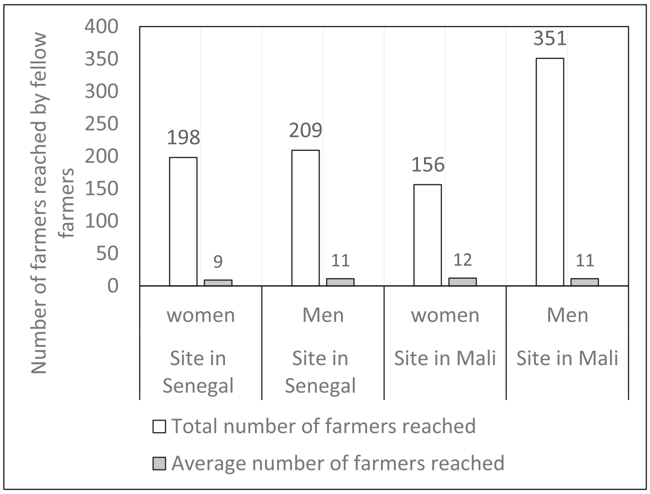

Fig. 7. Number of farmers reached through farmer-to-farmer extension on PICSA.

farmers in this study indicate that PICSA is an effective extension approach stimulating innovation and valued by farmers. The approach was designed to complement the roles that extension workers already undertake (Dorward et al., 2015). The high farmer to extension worker ratio raises the debate of the efficiency and effectiveness of face to face CIS in comparison to relying on facilities provided by ICT in a context where extension services are under strain. However, studies have also shown that contact with agricultural extension agents significantly influences farmers' decision to utilise CIS, especially mobile phone-based weather and market information (Etwire et al., 2017; Amegnaglo et al., 2017). Moreover, Dabiré et al. (2011) and CCAFS (2015) found that, for climate information to be well understood, farmers need to be assisted with interpretation especially in this context where the majority of them are illiterate. Therefore, although ICT are providing several opportunities for large scale CIS use, extension intermediaries would be essential in climate services delivery and to facilitate interpretation of information, consideration of options, interaction and dialogue, and the use of participatory decision-making tools. This calls for strategies to strengthen the extension systems, and might include seeking ways to support and facilitate use of community volunteers and farmer-to-farmer extension.

3.4. *Lessons learnt and perspectives*

During the implementation of the approach in the different sites, it was observed that of the historical graphs, farmers found rainfall amounts, the length of the season, the start and end of the season the most interesting. Extension agents, found in addition to these, graphs showing dry spells, terciles on historical records, and temperature were also very useful. Concentrating exploration of the graphs to the most important ones for the target groups helps free up more time for consideration of practical coping and adaptation options. Moreover, it was found that PICSA stimulated farmers to consider and then implement a range of changes in the way they farm. It also led to demand from farmers for other services and information associated with the changes and to extension staffs helping to connect farmers with technical and financial institutions. It was observed that this has the potential to improve the relationship between farmers and extension and create opportunities for further interactions. For instance, in Mopti, farmers identified the use of improved seeds, fertilisers and practices of water and soil conservation as the main activities to improve their adaptability to local climate and increase their production. Based on that request, some volunteer farmers were supported through a USAID funded project, Global Climate Change, for establishing contour bunds and tree planting along bunds while others were connected to an agricultural inputs loan project that helps farmers obtain seeds and fertiliser to increase production in Mali.

An issue that might hamper the implementation of PICSA in some localities is the lack of historical climate records due to the poor coverage in terms of climate information recording equipment. Initiatives that seek to improve data availability by filling spatial and temporal gaps in climate observation through combining gauge data with satellite proxies (such as Enhancing National Climate Services ENACTS) may offer means of addressing this. A further challenge is the lack of quality checked and analysed historical climate records. Working with National Meteorological Services as partners in PICSA and to develop capacity in production of products (graphs) required for PICSA rather than requesting raw data has proved one successful approach.

PICSA can go to much bigger scale in countries and for example has recently been delivered to tens of thousands in farmers in Rwanda and farmers in multiple districts and thousands of farmers in Malawi and Tanzania (Steinmuller and Cramer, 2017). To do this it requires preparation and contextualisation regarding CSA and other options, and of climate information, for different environments. Contextualisation also involves identifying and working with formal and informal organisations that currently interact with farmers and, in some countries where government extension services are weak, working more with NGOs, community volunteers and farmer organisations. The current study addressed farmers' assessment of the use of PICSA including how it has influenced behaviours and decision making. Further studies on the effectiveness of the approach could usefully investigate in more detail both the decision making processes and the effects on livelihoods and wellbeing, potentially through detailed household case studies. Quantitative economic approaches might also provide further insights and evidence. Further large scale studies such as conducted in Rwanda (Clarkson et al., 2017) are also warranted and have indicated that there is a case for mainstreaming PICSA into national-level programs and projects. It was also evident from this study in Mali and Senegal that PICSA influenced the way extension staff interact with farmers and this is a further area warranting research.

4. Conclusions

The PICSA approach was judged very useful by most farmers as it stimulated them to consider and then implement a range of innovations. The approach entails a new way of doing extension and communicating with farmers. It includes not only climate information support for farmers to make their own decisions, but also other useful tools to support them to identify, assess and plan innovations and options to suit their conditions and improve their livelihoods. The study also showed that farmer-to-farmer extension of PICSA offers the potential to support reaching larger numbers effectively and efficiently, although this could benefit from some further focus on development of materials for farmers to share.

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Competing interest

The authors declare that they have no competing interest.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.cliser.2018.07.003.

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