

Kallaama: A Transcribed Speech Dataset about Agriculture in the Three Most Widely Spoken Languages in Senegal

Elodie Gauthier, Aminata Ndiaye, Abdoulaye Guissé

Orange Innovation, Jokalante SARL, École Polytechnique de Thiès
Lannion, France, Dakar, Sénégal, Thiès, Sénégal
elodie.gauthier@orange.com, amina.ndiaye@jokalante.com, aguisse@ept.sn

Abstract

This work is part of the Kallaama project, whose objective is to produce and disseminate national languages corpora for speech technologies developments, in the field of agriculture. Except for Wolof, which benefits from some language data for natural language processing, national languages of Senegal are largely ignored by language technology providers. However, such technologies are keys to the protection, promotion and teaching of these languages. Kallaama focuses on the 3 main spoken languages by Senegalese people: Wolof, Pulaar and Sereer. These languages are widely spoken by the population, with around 10 million of native Senegalese speakers, not to mention those outside the country. However, they remain under-resourced in terms of machine-readable data that can be used for automatic processing and language technologies, all the more so in the agricultural sector. We release a transcribed speech dataset containing 125 hours of recordings, about agriculture, in each of the above-mentioned languages. These resources are specifically designed for Automatic Speech Recognition purpose, including traditional approaches. To build such technologies, we provide textual corpora in Wolof and Pulaar, and a pronunciation lexicon containing 49,132 entries from the Wolof dataset.

Keywords: speech dataset, Senegalese languages, low-resource setting, agriculture

1. Introduction

While information and communication technology is essential for many to thrive, 6 billion people still lack access to broadband, 4 billion lack access to the Internet, and 2 billion lack access to a mobile phone (Zelezny-Green et al., 2018). Latest estimations from UNESCO Institute for Statistics (2023) indicates around 213 million adults (population over 15 years old) who could not read or write, in 2022, across the sub-Saharan African region, including nearly 49 million young people (15-24 years old). In Senegal, ANSD (2021) reports an overall illiteracy rate of 48,2%, reaching 62,7% in rural area.

Literacy rate relates to the official language of a country. In Senegal, the official language is French but is seldom spoken by the population in their daily lives. Senegalese people primarily use their native languages or Wolof, as a vehicular language, to communicate. World Bank (2021) reports that nearly 65% of Senegalese who do not use the Internet are hindered by a lack of digital literacy. This is partly due to the limited (if not none at all) availability of content in the language they speak. Currently, there is a severe lack of accessible content for those who do not speak the official languages in Africa. The development of technologies and tools for the most widely spoken languages would enable a larger proportion of the Senegalese people to use smartphones and applications, and to access content that is still unavailable today.

Research work as Medhi et al. (2011) and the

success of WhatsApp voice communication show that the development of conversational voice services in local languages is a credible and promising way of making services more accessible. Aker (2011) also suggested in that time that combining a voice-based approach with information that can be accessed through answers to common farmer questions would overcome literacy challenges due to the common texting modes. To make progress in this area, robust speech recognition systems need to be designed for these languages. While automatic speech recognition (ASR) technologies tend to be mature in the languages most commonly found on the Web, there is still very few solutions dedicated to African languages.

In Senegal, Wolof, Sereer, Pulaar, Joola, Malinké and Soninké languages are recognised as national languages in the Constitution, but none of these six languages seriously benefit from the major technological advances generated by AI. Efforts have been made to develop speech resources and technologies in Wolof (see section 4) but no resources are available for Large Vocabulary Continuous Speech Recognition (LVCSR) in Pulaar nor Sereer. Yet, Wolof, Pulaar and Sereer languages are spoken in more than two-thirds of Senegal country (Leclerc, 2023).

Agriculture is the primary source of income for 2 billion people around the world (Zelezny-Green et al., 2018). In Senegal, 55% of the population is involved in the agricultural value chain, including family farming, livestock breeding, and fishing.

Today, digital technologies are assisting farmers in expanding their businesses by enabling them to position themselves on marketplaces, providing them with information on commodity prices, and granting them access to suitable financial services. Nonetheless, such solutions are still not appropriate for farmers, particularly given the prevalence of written communication and the use of a language they do not speak, when interacting with these interfaces.

With the intention of speech solutions development, this dataset is intended to fill the gap in this area.

Paper contribution. This paper presents the dataset created from speech data produced and annotated during the Kallaama project, as well as textual data gathered from the web, with the aim of developing voice-based solutions in local languages.

Paper outline. After an introduction, we present the project in section 2. The targeted languages are described in section 3 and existing resources in these languages are listed in section 4. Section 5 presents the collection methodology, while section 6 gives details about the dataset. Then, we present some of the challenging times we faced during the project in section 7 and we mention some of the resulted limitations in section 8. Finally, section 9 concludes and gives some perspectives about the use of Kallaama.

2. The Kallaama project

"Kallaama" means "speech" (from Latin "verbum") in Wolof.

2.1. Description

As mentioned in section 1, no resources are available to build LVCSR systems in Pulaar nor Sereer. Only a small amount exist in Wolof, but none focus on agriculture. The Kallaama project aims to fill this gap by producing several dozen hours of transcribed and annotated localized audio data, to train speech recognition systems in three of the Senegal's main national languages: Wolof, Sereer and Pulaar.

The choice of these 3 languages was guided by the number of speakers in the country. There are around 5 million native speakers of Wolof, 3.5 million native speakers of Pulaar and 1.3 million native speakers of Sereer (Leclerc, 2023), which represent three quarter of the total population. These are the 3 most widely spoken languages in Senegal, and they are also spoken cross several borders.

The data produced are natural, spontaneous utterances, with vocabulary in context, designed to

develop large vocabulary speech recognition models, particularly relating to the agricultural domain. Speech recognition is the main technological barrier to be overcome to develop voice-based services for people with little or no literacy. Agriculture plays an important role in rural activities in Senegal. It is one of the pillars of the Senegalese economy, estimated to contribute 15% of GDP in 2022 as mentioned in the Annual Agricultural Survey of DAPSA (2023), and a large proportion of the population remains directly dependent on it.

2.2. Use case

Several and local companies and start-ups in the IT sector are increasingly embarking on the production of AI solutions that take national languages into account. These are essentially automatic text or speech translation solutions, allowing them to expand their customer base and offer their services in French or English to users who prefer Wolof, Pulaar, Sereer, or other languages. Serious initiatives also have been noted in the development of multilingual chatbots and voicebots. However, due to the scarcity of natural language data in local languages, most of them rely on synthetic data from machine translation systems. Moreover, AI models still only marginally address agriculture. Yet, digital solutions for agricultural extension work cover a range of needs, including information delivery services, small business management tools, training and skills enhancement, and financial services (Zelezny-Green et al., 2018).

The Kallaama dataset contributes to the growth of the agricultural sector in Senegal. It can strengthen food security by providing vital information directly in the farmers' native language, through the development of voice-based services such as personalised agricultural and financial advice to smallholder farmers. Besides, the produced transcriptions increase the available datasets in Senegalese languages, and will boost AI-based developments for agriculture, like setting up knowledge bases, conversational assistants, recommendation systems and decision support systems.

3. Focus on the targeted languages

Wolof, Pulaar and Sereer languages are spoken by nearly 80% of native speakers in Senegal. Cissé (2005) indicates 43,7% of Wolof native speakers, 23,2% of Pulaar native speakers and 14,8% of Sereer native speakers. These three languages belong to the Niger-Congo phylum and are part of the North-Atlantic family group. They are toneless,

unlike most Niger-Congo languages¹. By having a national status, the three languages received an official spelling system. It is based on the Latin characters.

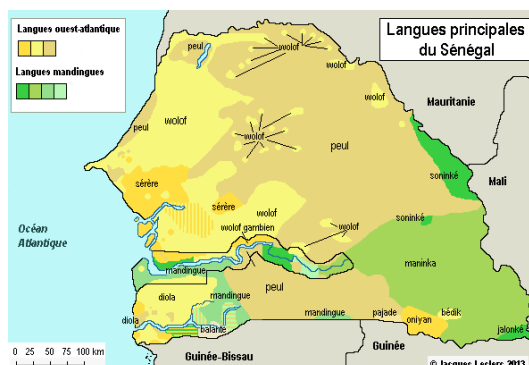


Figure 1: Map of main languages spoken in Senegal (Leclerc, 2023)

3.1. Wolof

Wolof is by far the most spoken language in Senegal. It is the native language of about 5 million speakers. The Wolof spoken in Senegal is identified by the ISO 639-3 language code name "wol"². By being spoken by almost 90% of the population, Wolof is the national language of communication, widely surpassing French in terms of usage (Cissé, 2005). On social networks, comments are mainly written in Wolof in response to articles written in French. The National Assembly provides a translation service as 20% of MPs do not speak French. Additionally, private TV and radio channels have developed programmes in Wolof (OIF, 2022).

3.2. Pulaar

Pulaar is part of the Fulfulde languages. Fulfulde is spoken in about 20 sub-Saharan African countries, by nearly 30 million people, from West to Central Africa. "Pulaar" refers to the variant spoken in Senegal. Pulaar is the native language of about 3.5 million of the Senegalese people, making it the second most widely spoken language in the country. Pulaar speakers across the country do not always understand each other. Clear differences in accents and lexicons should be noted. There may be borrowings and mutual influences between the accents. The Pulaar spoken in the north, considered as the reference in Senegal, used in the areas

¹As mentioned by Creissels (2019), non tonal languages are primarily spoken in the Atlantic languages of western Senegal and the Bantu languages of eastern Kenya and Tanzania (like Swahili).

²Another variant of Wolof is spoken in Gambia, for which the ISO code is "wof".

of Fouta Toro and Ferlo, is different from the one spoken in the south, in Fouta Djallon and Boundou areas, and from the centre (particularly in Saloum). The economic activities practiced by the Fulani in these regions are at the origin of these differences, without forgetting the mobility of populations and inter-cultural exchanges.

3.3. Sereer

Sereer language is spoken by around 1 million speakers, making it the third language spoken in Senegal. Several dialects are spoken in Senegal (Renaudier, 2012), and mutual understanding between Sereer speakers is sometimes difficult. The majority of the recordings proposed in this dataset are in Sereer-Siin (ISO 639-3 code "srr") variant, which is spoken in a region between the Petite Côte (south of Dakar) and the Gambia, and which is considered as "standard" Sereer. Nonetheless, depending on where the recording was made, it may be in another variant. The official script is based on the standard Sereer-Siin variant but is very little used for writing. The language is fundamentally spoken.

4. Existing language resources for Wolof, Pulaar and Sereer

More material (in any field of application, from linguistic description to language learning) can be found in Wolof, as a vehicular language. The situation is very different with Pulaar and Sereer: as vernacular languages, they are mainly spoken and rarely written. The presence of Wolof online is preponderant against Pulaar and Sereer, reflecting its place in the Senegalese society.

To build voice-based solutions, very few datasets were released so far in Wolof. Pulaar and Sereer speech datasets are nearly non-existent, exceptions made from the initiatives presented below. Before this work, the largest transcribed speech dataset in Wolof was the one collected by Gauthier et al. (2016). It consists in 18 hours of validated read sentences.

Wolof is also proposed in FLEURS, a multilingual dataset consisting in translation of English sentences that has been read by native speakers (Conneau et al., 2023).

Nelson (2022) conducted a project of large collection of Wolof speech consisting in 519 hours of audio recordings, for which 6.45 hours have been transcribed so far. Among the 2,018 Wolof transcriptions, we counted 608 translations in Pulaar, 571 in Sereer but only 156 audio recordings translated in both languages.

Finally, the last significant work we found involving the three Senegalese languages addressed in this

paper, is part of a data collection project of isolated words for keyword spotting, led by the Senegalese Galsen AI community (Djiba, 2021).

5. Collection methodology

5.1. Audio recordings and transcriptions

Audio recordings. The recordings are about agriculture. The recorded consist of farmers, agricultural advisers, and agri-food business managers. All the data is produced by Jokalante, a Senegalese company specialising in the dissemination of information about agriculture in local languages. Type of recordings comprise interactive radio programmes, focus groups, voice messages, push messages and interviews³. Therefore, spontaneous speech is prevailing. Quality of audio may vary depending on the type of programme. For instance, focus group are made outdoor and so noises may arise from the outside (cars, wind, birds, additional voices). In radio programmes, music and jingles sometimes also appear. A selection from these recordings were transcribed, resulting in over a hundred hours of spontaneous speech in the three targeted languages (see Section 6.1).

Transcriptions. To produce written form of the audio recordings, we asked the transcribers to follow the rules edited by the Centre of Applied Linguistics of Dakar (CLAD)⁴, which coordinates the orthographic standardization of the national languages in Senegal. Despite that caution, it was very difficult to obtain a standard form in the writing of languages concerned in the present work. As mentioned by Robert (2022) for Wolof, official rules are rarely used by the population (as example, advertisements are often written with alternative forms), even if an official orthography is established since 1971. The same situation appears for Pulaar and Sereer, and this is primarily due to the fact that the national languages are taught very little in the education system. In addition, the transcription work involved recordings of spontaneous speech, making the work all the more complex and time-consuming. Transcription task was performed by 3 students in Linguistics, in the language they natively speak. They used the dedicated Transcriber⁵ tool to achieve the task. The work took 9 months to complete. Then, 3 qualified experts, specialised in the languages of the transcripts, reviewed a sub-part of the transcriptions produced by the students. At first, we were aiming to verify half of the transcriptions produced, for each language. But it was an ambitious goal given the complexity and ardu-

³For each dataset, the number of recordings per programme type is detailed in appendix C.

⁴<http://clad.ucad.sn/>

⁵<http://trans.sourceforge.net/>

ousness of the task required. Nonetheless, nearly 13 hours of speech transcription were checked in Wolof, 11 hours in Pulaar and 11 hours in Sereer within the allotted time.

5.2. Texts collection

Senegalese languages are low-resourced. Very few data in the targeted languages were unearth. First of all, no documents on agriculture were found. Since the observations from Renaudier (2012) who mentioned that the local press is predominantly written in French, with only a few newspapers available in Wolof, and that no press were available in Sereer at the time, the situation remains unchanged.

Most of the written sources found were in Wolof. The Wolof corpus we distribute is composed of the books, Wikipedia articles (dump from summer 2023), the first book of the New Testament, two historic blogs about Hubert Fichte (a German novelist) and Cheikh Ahmadou Bamba (a theologian), publicly available online articles from newspapers. Open source data from the Programme Algorithme et Solution (PAS) challenge⁶, organised by the Institution des Algorithmes du Sénégal (IAS), have also been included. Written data in Wolof can also be retrieve from open source research projects (in particular, the ALFFA project⁷ and Masakhane⁸). We choose not to add them to our release as they are already clean and easy to get.

We found a very little amount of writings in Pulaar⁹. We extended our data research to include varieties spoken in regions bordering Senegal, and finally found more websites written in this language, particularly in Mauritania.

About Sereer, although it is the third most widely spoken language in Senegal, gathering written data poses a significant challenge. Despite extensive research, no textual content was found on the consulted websites. We even went to the two main university of linguistic and language libraries in Dakar (Cheikh Anta Diop University (UCAD) and to the Institut Fondamental d’Afrique Noire (IFAN)), and only found two books written in Sereer. We still tried to apply some Optical Characters Recognition (OCR) tools to convert it into digital texts, but the special characters existing in Sereer were not recognised.

We have deliberately excluded all social networks in order to avoid biases that could be

⁶<https://www.ias.sn/pas/>

⁷https://github.com/getalp/ALFFA_PUBLIC/

⁸<https://github.com/masakhane-io/masakhane-ner/>

⁹Without distinction of dialectal variants spoken in Senegal.

induced in future models. For example, [Dione \(2016\)](#) observed, in her study on the online usage of Wolof and Sereer languages, that most internet users use French and Wolof alternatively in a single message. Besides, Wolof and Pulaar are the only two national languages present on the websites consulted by the author, while Sereer is also his subject of study. Moreover, the author indicates that internet users use Wolof to criticise, to display political choices and conivance, and to insult. For all these reasons, we preferred not to collect textual data from the forums.

These text corpora can be used to train monolingual and multilingual language models on the theme of agriculture. Language models are involved in various NLP tasks, such as ASR rescoring or natural language understanding/generation (NLU/NLG) modelling.

5.3. Lexicon

We found no dictionary with word pronunciation for Pulaar and Sereer, so we could not train a grapheme-to-phoneme (G2P) model for these languages. For Wolof, we used the lexicon from ALFFA project to train a G2P model, in order to generate phonetic transcription of the Wolof speech set. The G2P model was trained using Phonetisaurus¹⁰. The generated phonetic symbols are in X-SAMPA alphabet. We provide the G2P model and the lexicon in a GitHub repository. It can be useful to train HMM-based ASR models.

6. Dataset details

The dataset is released under the CC-BY 4.0 license. All textual data (transcriptions, text corpus, lexicon) are available on GitHub¹¹. Audio recordings are hosted on both OpenSLR¹² and Zenodo¹³ platforms.

6.1. Audio recordings and transcriptions

Audio files have been converted into 16 kHz, 16-bit, mono channel, to fit the standard format used in ASR. Transcriptions are provided under the original Transcriber format (.trs), as well as in stm NIST format (.stm) as this one is more often used by ASR toolkits.

Details about speech datasets are given in table 1.

¹⁰<https://github.com/AdolfVonKleist/Phonetisaurus/>

¹¹<https://github.com/gauthelo/kallaama-speech-dataset/>

¹²<https://www.openslr.org/151/>

¹³<https://zenodo.org/records/10892569/>

Language set	Total Duration	#Turn-taking	Gender (%)	
			F	M
Wolof	55h12	46,907	10.2	89.8
Pulaar	31h55	16,558	13.6	86.4
Sereer	38h12	9,007	28.0	72.0
Overall	125h19	72,472	17.3	82.7

Table 1: Kallaama speech corpus overview

The high number of turn-taking that can be observed in the table 1 for the Wolof set is explained by a larger amount of interviews and focus group, involving more people in the talk.

The underrepresentation of women’s voices in this corpus is regrettable, but it reflects the interviews conducted and the women’s presence in agribusiness.

More details are given in appendix B, where we also describe the checked subpart of the dataset.

6.2. Texts collection

The set of texts collected in Wolof, before the application of post-processing methods, totalled 3,244,642 words. The set of texts collected in Pulaar, before the application of post-processing methods, totalled 5,462,823 words. As we said in subsection 5.2, no written data were found in Sereer.

During post-processing non roman characters were removed from raw texts. Punctuation has been preserved to give users greater freedom, depending on how the corpus will be used. Finally, a new line was added after each final punctuation mark (the dot, exclamation and question marks) while spaces was added between other kind of typography mark (such as comma, colon, semi-colon, dash, bracket, etc.).

After these post-processing steps, the Wolof text corpus contains 1,140,508 words, while the Pulaar text corpus contains 742,024 words. Detailed are given in table 2 and table 3, for Wolof and Pulaar respectively. This considerable reduction in content reflects the significant presence of other languages in the writings, particularly French and Arabic (we did not apply a language identification algorithm, but we did remove many characters in the Arabic alphabet). We also found a quite large number of Cyrillic characters in the collected texts from Wikipedia.

The compiled data will enhance the understanding of the usage of the languages and strengthen the ability to develop more robust linguistic tools. It will also serve as a training baseline for language models.

Sources	#Words	Distribution
Newspapers	571,122	50%
Wikipedia	346,604	30%
PAS Challenge	157,119	14%
Book	27,283	2%
New Testament	22,468	2%
Blog	15,912	1%
Overall	1,140,508	100%

Table 2: Details about the web scrapped texts in Wolof, after cleaning

Sources	#Words	Distribution
Newspapers	698,400	94%
Blog	43,624	6%
Overall	742,024	100%

Table 3: Details about the web scrapped texts in Pulaar, after cleaning

6.3. Lexicon

In the aim to build ASR systems, we also provide a pronunciation dictionary for Wolof. It contains 49,132 phonetised entries from speech transcriptions and texts. Entries can also be loanwords, such as French words, since code-switching is frequent in Senegal and therefore occurs in the speech dataset. Entries are phonetically transcribed with the X-SAMPA characters.

7. Challenges encountered

Transcribers struggled to write some of the words because of the absence of certain characters on standard keyboards, such as b (b-hook), c (c-hook), d (d-hook), p (p-hook), t (t-hook) which exist in the spelling of African languages, in particular in Pulaar and Sereer. The SenLangEdit visual keyboard application¹⁴, especially developed to write the national languages of Senegal, still eased the transcription process.

7.1. Writing rules

It was particularly hard to find qualified experts for checking the quality of the produced transcriptions. We ask each expert to make a report of their reviews. For Wolof, the expert declared that the work was quite easy. To complete the work within the allocated time, he managed to check nearly 13 hours of speech transcriptions and the conclusion was very encouraging. He noted a very good quality of work, with very few mistakes. In contrast, the two qualified experts hired to review

¹⁴<https://esp.sn/senlangedit-un-clavier-virtuel-pour-la-promotion-des-langues-nationales/>

the transcriptions in Pulaar and Sereer declared a tedious work. In spite of this, they manage to verify around 11 hours of audio recordings each. They raised numerous mistakes and warned us that their work would be more about rewriting than simple checking and correction. We detail the main mistakes found in appendix A.

In fact, this assessment of the transcriptions quality primarily indicates a lack of written skills rather than a lack of attention to transcription quality. This is the result of attempting to transcribe a language that has traditionally been unwritten. As long as these languages are not taught to be write, there will be no good written productions.

7.2. Spoken dialects

The fact that recordings are produced throughout the Senegal¹⁵ made the transcription work much more complex, because of the several dialectal variations of Pulaar and Sereer which are spoken in the country (see sections 3.2 and 3.3). We selected the audio recordings at the very beginning of the project, before the transcriber hiring. But Pulaar or Sereer transcribers sometimes listened to programmes recorded that they did not understand because of a conversation in a dialect that they do not speak. Consequently, we had to carry out a second recordings collection campaign that took into account the specific dialects spoken by the transcribers.

This process also highlights the need to take account of the semantic subtleties between dialectal varieties, especially when dealing with a particular subject (in this case agriculture, but it could be health or finance) and illustrates the challenges inherent in accurately and exhaustively preserving the meaning of words in these languages.

8. Limitations

Transcription work is a very challenging task, and to produce a transcript from spontaneous speech, when overlapping events occur, sometimes in noisy environments, is even more so. Add to this the use of specialised software that is unfamiliar to the workers, with keyboards that are not adapted to writing the language, and the start of the work becomes even more tedious.

Despite the care of all the workers involved in this project, this dataset contains some transcription mistakes, and the spelling used may not correspond exactly to the expected standards, as pointed out in Section 7. Only one transcriber was selected

¹⁵Diouroup, Fatick, Kaffrine, Kaolack, Kebemer, Kelle, Koungeul, Louga, Matam, Ndoundour, Niodior, Niore, Podor, Saint-Louis, Tambacound.

per language to carry out the transcription work. Perhaps some mistakes could have been avoided if more transcribers were doing the job (supposing this is possible, since the number of skilled people is very limited). But, due to production costs, we have chosen to provide the community with a larger set of transcribed data rather than increasing the number of transcribers. In this way, we have been able to increase the number of subjects covered on agriculture. A larger speech dataset is also more suitable for large-scale studies, such as phonetic and phonological research on Atlantic languages, a field where works lack.

9. Conclusion and Opportunities

In this paper, we present the work carried out to create a transcribed speech dataset on Wolof, Pulaar and Sereer, the 3 most widely spoken languages in Senegal. This dataset comprises 55h of audio recordings in Wolof, 32h in Pulaar and 38h in Sereer, all along with their corresponding transcriptions. We also provide more generic text corpora in Wolof and Pulaar, as well as a Wolof phonetic lexicon along with its G2P model. These resources can be used for setting up traditional ASR systems.

As pointed out by many recent studies (Joshi et al., 2020; van Esch et al., 2022; Ruder et al., 2022; Adebara and Abdul-Mageed, 2022), a lot of languages with large speaker populations still are under-represented in natural language processing (NLP) studies and applications, reinforcing inequalities such as knowledge access. We hope that this work will stimulate interest in the development of applications that incorporate the vernacular languages of Senegal, but also that it will be a source of inspiration and encouragement to develop the same kind of resources in order to progress towards the inclusion of languages in the world of AI.

Opportunities offered by this dataset are numerous. From a scientific perspective, the speech dataset released can be exploited for instance, to study phonetic phenomena occurring in a spontaneous context, to study speech interaction, or to study the impact of spontaneous and noisy speech on recognition systems. From a technical perspective, this dataset can be used to solve various AI tasks, including speech modelling (such as speech-to-text or spoken language understanding), automatic response modelling (as QA answering), and language modelling (used from scratch or used to fine-tune a pre-trained multilingual model). From a technological perspective, it can be utilised to develop speech recognition systems, generic or specific to the agricultural sector, as well as

localised conversational agents for answering questions on agricultural topics related to the Senegal context and in national languages.

10. Acknowledgements

The Kallaama project was made possible thanks to the financial support from the Lacuna Fund¹⁶, the world's first collaborative effort to fund labelled data for social impact. Lacuna Fund promotes creation, expansion, and maintenance of labelled datasets in three domain areas with key needs: agriculture, health, and languages.

The authors would also like to acknowledge and thank the linguists and data scientist interns involved in the project.

11. Bibliographical References

- Ife Adebara and Muhammad Abdul-Mageed. 2022. *Towards afrocentric NLP for African languages: Where we are and where we can go*. In *Proceedings of the 60th Annual Meeting of the Association for Computational Linguistics (Volume 1: Long Papers)*, pages 3814–3841, Dublin, Ireland. Association for Computational Linguistics.
- Jenny C Aker. 2011. Dial "A" for agriculture: a review of information and communication technologies for agricultural extension in developing countries. *Agricultural economics*, 42(6):631–647.
- ANSD. 2021. *Enquête harmonisée sur les conditions de vie des ménages (EHCVM)*. Technical report, Agence Nationale de la Statistique et de la Démographie (ANSD).
- Mamadou Cissé. 2005. *Langues, état et société au Sénégal*. *SudLangues. Revue électronique internationale de Sciences du langage*, 5(1):99–133.
- Denis Creissels. 2019. *Morphology in Niger-Congo languages*. In *Oxford Research Encyclopedia of Linguistics*.
- DAPSA. 2023. *Rapport de l'Enquête Agricole Annuelle (EAA) 2022-2023*. Technical report, Direction de l'Analyse, de la Prévision et des Statistiques Agricoles.
- Amadou Dione. 2016. *Contacts et valorisation du sérère et du wolof, langues nationales du Sénégal: Pratiques langagières et usages en ligne*. Ph.D. thesis, Université Grenoble Alpes (ComUE).

¹⁶<https://lacunafund.org/>

Pratik Joshi, Sebastin Santy, Amar Budhiraja, Kalika Bali, and Monojit Choudhury. 2020. [The state and fate of linguistic diversity and inclusion in the NLP world](#). In *Proceedings of the 58th Annual Meeting of the Association for Computational Linguistics*, pages 6282–6293.

Jacques Leclerc. 2023. [Sénégal. L'aménagement linguistique dans le monde](#).

Indrani Medhi, Somani Patnaik, Emma Brunskill, SN Nagasena Gautama, William Thies, and Kentaro Toyama. 2011. [Designing mobile interfaces for novice and low-literacy users](#). *ACM Transactions on Computer-Human Interaction (TOCHI)*, 18(1):1–28.

OIF. 2022. [La langue française dans le monde](#). Technical report, Organisation Internationale de la Francophonie.

Marie Renaudier. 2012. [Dérivation et valence en sereer. Variété de Mar Lodj \(Sénégal\)](#). Ph.D. thesis, Université Lumière Lyon 2.

Stéphane Robert. 2022. [Wolof: a grammatical sketch](#). In Friederike Lüpke, editor, *The Oxford guide to the Atlantic languages of West Africa*. Oxford University Press, Oxford.

Sebastian Ruder, Ivan Vulić, and Anders Søgaard. 2022. [Square one bias in NLP: Towards a multi-dimensional exploration of the research manifold](#). In *Findings of the Association for Computational Linguistics: ACL 2022*, pages 2340–2354, Dublin, Ireland. Association for Computational Linguistics.

UNESCO Institute for Statistics. 2023. [Education: Number of illiterates](#). Last consulted on 13 Feb 2024 07:49 UTC (GMT).

Daan van Esch, Tamar Lucassen, Sebastian Ruder, Isaac Caswell, and Clara Rivera. 2022. [Writing system and speaker metadata for 2,800+ language varieties](#). In *Proceedings of the Thirteenth Language Resources and Evaluation Conference*, pages 5035–5046.

World Bank. 2021. [World development report 2021: Data for better lives](#).

Ronda Zelezny-Green, Steven Vosloo, Gráinne Conole, et al. 2018. [Digital inclusion for low-skilled and low-literate people: a landscape review](#).

12. Language Resource References

Conneau, Alexis and Ma, Min and Khanuja, Simran and Zhang, Yu and Axelrod, Vera and Dalmia, Siddharth and Riesa, Jason and Rivera, Clara and Bapna, Ankur. 2023. [Fleurs: Few-shot learning evaluation of universal representations of speech](#). 2022 IEEE Spoken Language Technology Workshop (SLT). PID <https://huggingface.co/datasets/google/fleurs>.

Djiba, Daouda Tandieng. 2021. [Keyword Spotting with African Languages](#). Zenodo. PID <https://doi.org/10.5281/zenodo.7561858>.

Gauthier, Elodie and Besacier, Laurent and Voisin, Sylvie and Melese, Michael and Elingui, Uriel Pascal. 2016. [Collecting Resources in Sub-Saharan African Languages for Automatic Speech Recognition: a Case Study of Wolof](#). European Language Resources Association (ELRA). PID <https://hal.science/hal-01350037>.

Nelson, Perry. 2022. [Waxal Speech Data Resources](#). PID <https://github.com/Waxal-Multilingual>.

A. Details on speech transcription mistakes

A.1. Wolof transcriptions

Main mistakes mentioned are:

- failure to respect certain vowel lengthenings (e.g.: word "mbooleem" written instead of "mboolem");
- failure to respect consonant gemination internally and in the final position for a number of words (e.g.: "loppaalëb" instead of "loppaalëp");
- confusion between plosives consonants in final position of certain words (/p/ versus /b/, /k/ versus /g/).

A.2. Pulaar transcriptions

Main mistakes reported in the Pulaar transcriptions are the following:

- no distinction between the consonant *d* and the consonant *ɓ* (e.g.: "heedī" instead of "heɓi");
- use of a simple consonant instead of a prenasal consonant (e.g.: "jiiya" instead of "njiiyaa");

- concatenation of a noun and its article (e.g.: "yimbeɓe" instead of "yimbe ɓee");
- confusion in the vowel lengthening (e.g.: "deemowo" instead of "demoowo"; "reemoɓeɓe" instead of "remoowo ɓee").

A.3. Sereer transcriptions

In the Sereer transcriptions, phonetical, morphological and syntactical mistakes were found. Notably:

- pre-nasalised consonants ("/nd/", "/mb/", "/nj/", "/ng/") used instead of glotalised or nasal consonants ("ɓ", "ɗ", "ŋ");
- vowel lengthening not written ("refe" instead of "refee", "maga a mbag o njirña" instead of "maaga a mbaag o njirña");
- noun and class pronoun are detached as in "xa qol axe" written "xa qola xe".

B. Speech dataset details

Rows explanation of Table 4 and Table 5:

- "Min (sec.)" is the minimum duration of an audio file in the given dataset.
- "Max (sec.)" is the maximum duration of an audio file in the given dataset.
- "Mean (sec.)" is the average duration of all the audio files in the given dataset.
- "Total audio" is the total duration of the audio set.
- "Total speech" is the total speech duration of the audio set.
- "Female speech" is the total speech duration of female speakers within the audio set.
- "Male speech" is the total speech duration of male speakers within the audio set.
- "Female speech ratio" is the percentage of speech duration of female speakers within the audio set.
- "Male speech ratio" is the percentage of speech duration of male speakers within the audio set.
- "#Turn-taking" is the number of speaker turn-takings in the whole audio set.
- "#Files" is the total number of recordings and transcriptions in the speech dataset.

"Total speech", "Female speech", "Male speech" and "#Turn-taking" durations have been computed from the Transcriber (.trs) files. This information should be treated with caution, as it depends on the accuracy of the annotations made by the transcribers. All other information in the table is calculated from audio files (.wav).

B.1. Whole set

Table 4 gives some statistics on the whole speech dataset.

Dataset statistics	Wolof	Pulaar	Sereer
Min (sec.)	21	20	25
Max (sec.)	3014	3033	3461
Mean (sec.)	1299	1384	1306
Total audio (hh:mm:ss)	55:11:41	31:55:10	38:12:10
Total speech* (hh:mm:ss)	51:08:50	30:06:43	36:23:37
Female speech* (hh:mm:ss)	05:12:41	04:05:07	10:12:10
Male speech* (hh:mm:ss)	45:56:09	26:01:36	26:11:26
Female speech ratio (%)	10.19	13.57	28.03
Male speech ratio (%)	89.81	86.43	71.97
#Turn-taking*	46,907	16,558	9,007
#Files	306	166	210

*extracted from annotations

Table 4: Details about Kallaama speech dataset

B.2. Checked set

Table 5 gives some statistics on the checked subpart of the speech dataset.

Dataset statistics	Wolof	Pulaar	Sereer
Min (sec.)	21	117	444
Max (sec.)	2849	3033	2907
Mean (sec.)	1283	1472	1250
Total audio (hh:mm:ss)	12:49:35	11:02:28	11:06:52
Total speech* (hh:mm:ss)	11:47:34	10:56:15	10:51:33
Female speech* (hh:mm:ss)	01:27:00	01:08:09	03:12:29
Male speech* (hh:mm:ss)	10:20:33	09:48:06	07:39:03
Female speech ratio (%)	12.30	10.39	29.54
Male speech ratio (%)	87.70	89.61	70.46
#Turn-taking*	11,968	3,583	1,796
#Files	72	54	64

*extracted from annotations

Table 5: Details about checked part of Kallaama speech dataset

C. Recordings types

The recordings are from various types of programmes and are rated on a scale of 1 to 5 based on their potential complexity for speech processing. This rating is subjective and takes into account factors such as recording duration, number of talking speakers, and recording conditions.

A rating of 1 indicates relatively low complexity, while a rating of 5 indicates relatively high complexity. This ID is the first number composing the name of the files.

Table 6 shows the number of recordings per programme type, for each language set.

Type ID	Type	Wolof	Pulaar	Sereer
1	push message	9	1	0
2	voice message	0	0	14
3	interview	22	10	15
4	radio show	120	72	67
5	focus group	2	0	9

Table 6: Number of recordings per programme type, for each language dataset