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# FROM POPULAR KNOWLEDGE TO THE INTERNATIONAL SYSTEM: A SOFTWARE FOR CONVERTING AGRICULTURAL MEASUREMENTS BASED ON METRIC UNITS USED BY BRAZILIAN FARMERS

## DO SABER POPULAR AO SISTEMA INTERNACIONAL: UM SOFTWARE PARA CONVERSÃO DE MEDIDAS AGRÁRIAS BASEADO EM UNIDADES MÉTRICAS UTILIZADAS POR AGRICULTORES BRASILEIROS

## DEL SABER POPULAR AL SISTEMA INTERNACIONAL: UN SOFTWARE PARA LA CONVERSIÓN DE MEDIDAS AGRARIAS BASADO EN UNIDADES MÉTRICAS UTILIZADAS POR AGRICULTORES BRASILEÑOS

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**Abstract:** Ethnomathematics studies the mathematical knowledge of cultural groups—such as farmers, bricklayers, embroiderers, street vendors, Indigenous peoples, Quilombola communities, among others—who use mathematics in non-academic ways. In this context, it becomes necessary to translate the concepts used by these communities into the academic mathematical language. Based on this perspective, the general objective of this article is to convert the length and area measurements commonly used by Brazilian farmers into the

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International System of Units (SI) and for farmers from different regions, taking ethnomathematical knowledge into account. To achieve this general objective, the specific objectives are: to identify the length and area measurements adopted by Brazilian farmers and to develop a computer program to perform the conversion of these measurements. The methodology consisted of using the Dev C++ programming environment to build a program capable of converting length and area measurements used by Brazilian farmers into SI units and between the units adopted in different regions. These measurements were sourced from the article titled The Mathematical Knowledge of Brazilian Farmers: An Ethnomathematical Study on Length and Area Measurements by Teixeira (2018) and Georges (2016). As a result, we developed a software application that converts farmers' measurements into meters, centimeters, square meters, and between regionally adopted units, facilitating understanding for people unfamiliar with such measures, including IBGE census takers.
**Keywords:** Dev C++, Ethnomathematics, measurement converter.

**Resumo:** A Etnomatemática estuda o saber matemático de grupos culturais, seja agricultores, pedreiros, bordadeiras, feirantes, comunidades indígenas, quilombolas, dentre outros grupos que a utilizam de maneira não acadêmica. Diante disso, faz-se necessário que esses conceitos utilizados por essas sociedades sejam decifrados para linguagem matemática da academia. Levando em consideração a isso, o artigo tem como objetivo geral, converter as medidas de comprimentos e áreas usadas no cotidiano pelos agricultores brasileiros para o Sistema Internacional (SI) e para agricultores de diferentes regiões, considerando os saberes etnomatemáticos. Para que o objetivo geral seja alcançado, temos como objetivos específicos: filtrar medidas de comprimento e áreas adotadas pelos agricultores brasileiros e criar um programa computacional para realização da conversão dessas medidas. A metodologia partiu-se da conversão, através do programa computacional Dev C++, de medidas de comprimento e áreas usadas por agricultores brasileiros para o Sistema Internacional (SI) e entre agricultores de diferentes regiões. Para tanto, essas medidas foram obtidas do artigo intitulado: O conhecimento matemático dos agricultores brasileiros: um estudo etnomatemático sobre medidas de comprimento e área; Teixeira (2018) e Georges (2016). Obtivemos como resultado, um programa que converte as medidas dos agricultores para metro, centímetro, metro quadrado e entre medidas adotadas pelas diferentes regiões do país, que facilita o entendimento de pessoas que desconhecem essas medidas, ou até, para os recenseadores do IBGE.
**Palavras-chave:** Dev C++, Etnomatemática, conversor de medidas.

**Resumen:** La Etnomatemática estudia el conocimiento matemático de grupos culturales, como agricultores, albañiles, bordadoras, vendedores de férias, comunidades indígenas, quilombolas, entre otros que la utilizan de manera no académica. Ante esto, es necesario que estos conceptos utilizados por dichas sociedades sean traducidos al lenguaje matemático académico. Considerando lo anterior, el objetivo general de este artículo es convertir las medidas de longitud y área utilizadas cotidianamente por los agricultores brasileños al Sistema Internacional (SI) y para agricultores de diferentes regiones, teniendo en cuenta los saberes etnomatemáticos. Para alcanzar el objetivo general, se establecieron como objetivos específicos: filtrar medidas de longitud y área adoptadas por los agricultores brasileños y crear un programa computacional para realizar la conversión de dichas medidas. La metodología se basó en la conversión, a través del programa computacional Dev C++, de medidas de longitud y área utilizadas por agricultores brasileños al Sistema Internacional (SI) y entre agricultores de diferentes regiones. Estas medidas fueron obtenidas del artículo titulado: El conocimiento matemático de los agricultores brasileños: un estudio etnomatemático sobre medidas de longitud y área; Teixeira (2018) y Georges (2016). Como resultado, se obtuvo un programa que convierte las medidas de los agricultores a metro, centímetro, metro cuadrado y entre medidas adoptadas por diferentes regiones del país, facilitando así la comprensión para personas que desconocen estas medidas, e incluso para los censistas del IBGE.

**Palabras clave:** Dev C++, Etnomatemática, conversor de medidas.

## INTRODUCTION

Ethnomathematics studies the mathematical knowledge of cultural groups, such as farmers, bricklayers, embroiderers, market vendors, indigenous communities, quilombolas, and other groups that use it in a non-academic manner. Ubiratan D'Ambrósio, known as the father of Ethnomathematics, first used the term in 1985. The researcher clarifies the etymology of the word: *ethno* covers everything from codes of behavior to symbols, *mathematics* means to know, understand, explain and *tica* derives from *techne,* the root of art and techniques.

Therefore, it is necessary that these concepts used by these societies be deciphered into the mathematical language of academia, that is, researchers analyze where Mathematics is being applied, since these groups may have attended little school, but possess mathematical

knowledge.

Georges (2016) and Teixeira (2018) showed that the length and area measurements of the Brazilian farmers surveyed are related to the International System of Units (SI), as well as among farmers from different regions, although with different nomenclatures. Therefore, it is necessary to convert the measurements to the International System of Units (SI) and among farmers.

The C programming language has played a crucial role in automating complex tasks and solving problems in various fields, and its use in converting farmers' area and length measurements to the International System of Measures (SI) is no exception. Agriculture is one of humanity's oldest and most fundamental activities, and accurate measurements are crucial to ensuring the efficiency and standardization of agricultural processes globally. Adopting C in this context offers a number of significant benefits.

First, the C language is known for its efficiency and execution speed. When dealing with large data sets, such as the various area and length measurements used in agriculture, efficiency becomes crucial for performing conversions quickly and accurately. This is especially important for farmers who need to make quick, informed decisions to optimize the use of land, water resources, and agricultural inputs.

Furthermore, the C language offers a high degree of control over the hardware, allowing developers to optimize algorithms to suit the specific needs of agricultural systems. This is particularly advantageous considering that many agricultural devices, such as tractors equipped with GPS systems and monitoring drones, rely on precise software to operate correctly. By using C for measurement conversions, it is possible to ensure consistent and reliable results, contributing to the accuracy of agricultural operations.

Modularity and reusability are other key features of the C language that make it suitable for this purpose. When developing a program to convert agricultural measurements to SI, it is possible to create specific functions and modules for different types of measurements (such as hectares, acres, meters, inches, etc.), making the code more organized and easier to maintain. This modular approach also allows farmers and developers to customize the program to their specific needs, adapting it to different crops, territories, and local standards.

In short, using the C programming language to convert farmers' area and length measurements to the International System of Measures offers an efficient, accurate, and flexible approach to addressing the challenges of standardization and accuracy in agricultural practices. The ability to develop custom *software* (computer programs) combined with the efficiency and control offered by the C language, contributes to improving productivity and sustainability in

agriculture, promoting the adoption of practices aligned with global standards.

That said, our article has the general objective of converting Brazilian farmers' length and area measurements to the International System (SI) and to farmers from different regions, considering ethnomathematical knowledge. To achieve our general objective, we have the following specific objectives: filtering length and area measurements adopted by Brazilian farmers and creating a computer program to perform the measurement conversion.

Furthermore, the measurements will be converted, based on the table constructed by Teixeira and Nery (2023), which shows the area measurements adopted by farmers from different regions of Brazil; while the length measurements are those cited by Teixeira (2018) and Georges (2016).

## MATERIALS AND METHODS

Dev C++ software to convert length and area measurements used by Brazilian farmers into the International System (SI) and among farmers from different regions. These measurements were obtained from the article entitled: The mathematical knowledge of Brazilian farmers: an ethnomathematical study on length and area measurements (Teixeira and Nery, 2023). As shown in the table below:

**Table 1 -** Transformations of farmers' areas to the SI

| Brazilian municipalities / or regions | Name given by farmers | Areas per square meter |
|---|---|---|
| Saint Raymond Nonato – PI | Cube | 4.84 m $^2$ |
| | Account | 484 m $^2$ |
| | Task | 3,025 m $^2$ |
| | Frame | 12,100 m $^2$ |
| Pedro II – PI | Line | 3,025 m $^2$ |
| | 50 block | 12,100 m $^2$ |
| | 100 block | 48,400 m $^2$ |
| | Half line | 756.25 m $^2$ |
| Tacaratu – PE | Task | 3,025 m $^2$ |
| Marajo – PA | Task | 3,025 m $^2$ |
| Saint Anthony of the Patrol | Tamina | 968 m $^2$ |
| Poço Verde – SE | Task | 3,025 m $^2$ |
| Mining Region | Alqueire Mineiro | 48,400 m $^2$ |
| Paulista Region | Paulista bushel | 24,200 m $^2$ |
| Northern Region | North Alqueire | 27,225m2 |

**Source:** Teixeira and Nery (p.90, 2023)

In the table above, the authors cite the area measurements used by farmers in different regions of Brazil, as well as the International System (SI) measurements, that is, square meters ($m^2$). We also note the proportionality between the measurements adopted by farmers. It is worth noting that farmers obtain these areas from the fathom or square vara, which is equivalent to 2.2 $m^2$. For example, 2.2 m x 2.2 m = 4.84 $m^2$, which in São Raimundo Nonato, Piauí, is a measurement of area called a cube. That is, when we divide the areas by square fathom or cube, we observe that they are exact divisions. It is worth noting that the alqueire in the north is the only area that is not an exact division.

Furthermore, farmers measure the contour, and based on the number of fathoms or rods, classify the area by one of the names given in the 2nd column of table 1. In this sense, the

information in the 3rd column is only for conversions, that is, farmers do not use it.

The authors, Georges (2016) and Teixeira (2018), cite the length measurements most used by farmers, which are essential for obtaining area measurements, such as the palm (22 cm), the fathom or rod (2.2 m), key (17 cm) and league (6600 m).

Understanding this proportionality relationship, the area and length measurements mentioned will be converted using the computer program created in Dev C++ for the International System of Measurements and between farmers from different regions.

From this perspective, the methodology adopted to convert farmers' area and length measurements to the International System of Measures (SI) using the C++ programming language involved a set of steps designed to ensure the accuracy, efficiency, and usability of the conversion system. The development process was divided into distinct phases, each contributing to the creation of a robust and reliable program. Below, we describe in detail the main steps followed during development:

- Requirements Analysis: In this initial stage, we gathered the specific requirements of farmers and the agricultural context regarding area and length measurements. We identified the different types of measurements used, as well as the conversion standards needed to adapt them to the SI.
- Architectural Design: Based on the requirements gathered, the program's architectural design was developed. The modules and functions needed to perform the conversions accurately were defined. The architecture was designed to be modular and flexible, allowing for the addition of new measurement types and conversions in the future, if needed.
- Implementation in Dev C++: The C++ programming language was chosen for the program implementation due to its efficiency and ease of use. Unit conversions were coded in specific functions, each following the appropriate conversion formulas. Modularity was maintained, allowing code reuse and facilitating maintenance.
- Testing and Validation: After implementation, a comprehensive battery of tests was conducted to verify the accuracy of the conversions. Test cases with known and varied measurements were used to verify that the results produced by the program were accurate. Any discrepancies identified were corrected and retested before proceeding.
- User Interface and Usability: An intuitive user interface was developed to allow farmers to input the measurements to be converted and view the results clearly. The usability of the interface was evaluated through user testing, ensuring that the program was accessible and understandable for the target audience.

- Documentation and Support: Detailed documentation was created explaining how the program works, its features, and how to perform conversions. Additionally, a support channel was created for users, allowing them to obtain assistance with questions or issues while using the program.

By following this methodology, we aim to develop a reliable and effective solution for converting farmers' area and length measurements to the International System of Measures (SI). The modular approach, rigorous testing, and focus on usability ensure that the program meets farmers' practical needs, promoting the adoption of agricultural practices aligned with global measurement standards.

DEV C++ is an Integrated Development Environment (IDE) that provides a powerful platform for creating and running programs in the C/C++ programming language. Combining a compiler, a code editing environment, and other useful tools, DEV C++ provides developers with a complete and efficient workspace for writing, debugging, and running C/C++ code.

DEV C++'s importance lies in its ability to simplify and streamline the C/C++ software development process. By providing an intuitive and user-friendly interface, it allows programmers to focus on the logic and structure of their programs, rather than worrying about complex development environment configuration. Furthermore, DEV C++ is a popular choice for both beginners and experienced developers due to its core features:

- Simple Compilation and Execution: DEV C++ has a built-in compiler that transforms source code into executable code. With just a few clicks, developers can compile and run their programs, making error checking and testing easier.
- Efficient Debugging: DEV C++'s debugging environment allows developers to identify and fix errors in their code. Step-by-step debugging, variable visualization, and stack inspection help diagnose problems and improve code quality.
- User-Friendly Interface: DEV C++'s interface is designed to be accessible, even for those new to programming. Features like syntax highlighting, code suggestions, and auto-completion speed up the coding process.
- Project Management: DEV C++ allows developers to organize their projects into folders and files, making it easier to maintain and expand their programs over time.
- Customization and Extensions: DEV C++ is highly configurable, allowing developers to choose from a variety of layout options, themes, and plugins to suit their preferences and needs.
- Active Community: DEV C++ has an active community of developers and users

who share tips, tutorials, and solutions to common problems. This creates an environment of learning and collaboration.

While DEV C++ is a valuable tool, it's important to mention that as technology advances, other IDE options for C/C++ are also available, such as Visual Studio Code, Qt Creator and Code: Blocks. The choice of IDE depends on the personal preferences and needs of each developer.

Therefore, DEV C++ is a fundamental tool for developers who want to create efficient C/C++ programs. Its intuitive interface, debugging capabilities, and integrated development environment simplify the software development process, contributing to the productivity and effectiveness of developers of all skill levels.

## RESULTS AND DISCUSSION

In this section, we present the results obtained from the implementation of a program to convert farmers' area and length measurements to the International System of Measures (SI) using the Dev C++ programming language. We also discuss the relevance and implications of these results in the context of modern agriculture and the adoption of standardized practices.

The tests performed demonstrated that the program developed in Dev C++ is capable of accurately converting units of measurement for area and length used in agriculture to their equivalents in the International System of Measurements. The conversion test results were consistent and within acceptable margins of error, indicating that the program performs conversions reliably and accurately.

The developed user interface also proved intuitive and easy to use, allowing farmers to quickly and efficiently input the measurements to be converted. Conversion results were displayed clearly and legibly, making them easy for users to interpret.

Through Table 1, cited in the methodology, it was possible to create conversions for SI and measures used among farmers, in which the user enters the conversion option, then the quantity they wish to convert, as shown in Figure 1 below.

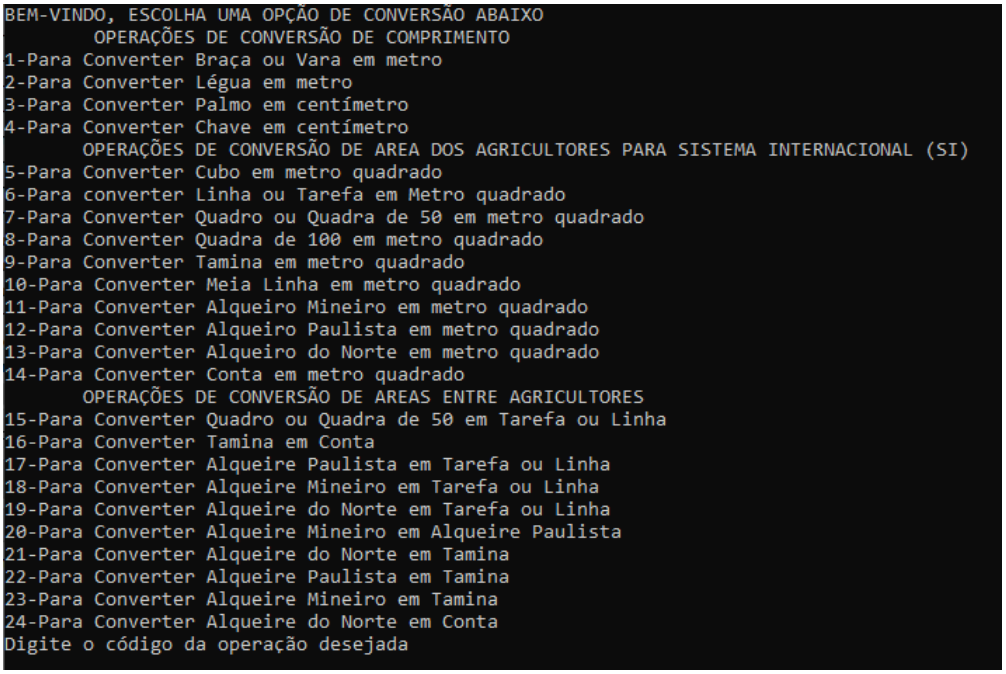


**Figure 1 -** DEV C++ program for converting farmers' measurements
**Source:** Teixeira and Fernandes (2025).

Options are initially presented: options 1 to 4 for converting length measurements to SI, 5 to 14 for converting area measurements to SI, and 15 to 24 for converting between agricultural measurements. It's worth noting that there's an informative text before the conversion blocks, making it easier for the user to find the desired conversion option. After presenting the options, the program asks the user to enter the code for the desired operation, as shown in the last line of the image. Therefore, in Figure 2 below, the program displays the code after the user enters the option.

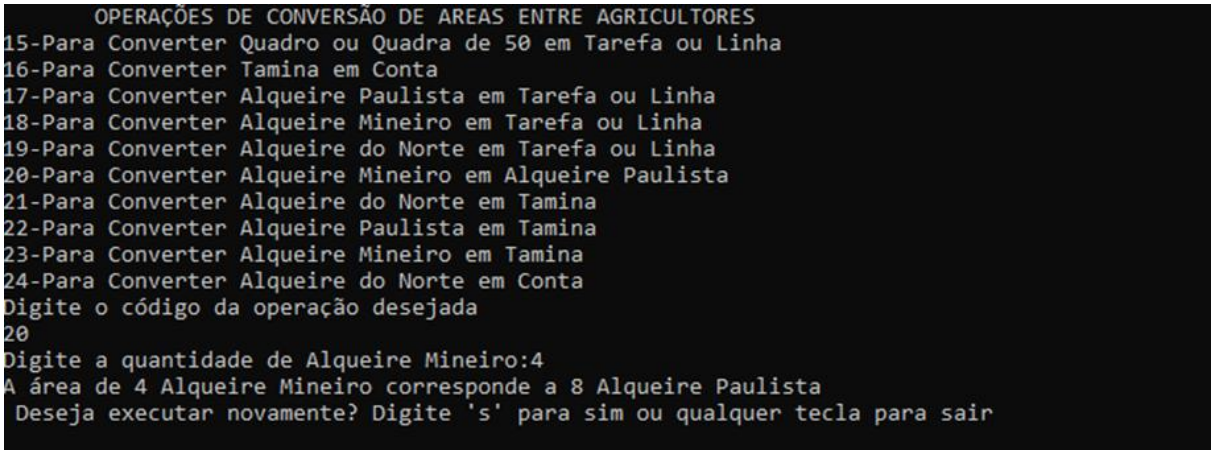


**Figure 2 - DEV** C++ program, after the user enters the option and the quantity, they want convert

**Source:** Teixeira and Fernandes (2025).

In Figure 2, the user entered option 20, which is the conversion from Alqueire Mineiro to Alqueire Paulista; then, 4 was entered , the quantity of Alqueire Mineiro; the program showed that it corresponds to 8 Alqueire Paulista; if the user doesn't know how much this is in square meters, they can type "s", choose the option that performs the conversion (option 12 - Figure 1), and enter 8; the program will then display the value in square meters. To exit the program, simply press any key. The following shows the standard conversion for all measurements.

```
1  //CONVERSOR DE UNIDADES DE AGRICULTORES - Resultado do TCC da Graduação em Matemática
2  #include <stdio.h>
3  #include <conio.h>
4  #include <stdlib.h>
5  #include <locale.h>
6
7  float braca_m(){ //1
8        float braca;
9        printf("Digite o valor em braça\n");
10       scanf("%f",&braca);
11       printf("A medida de %.0f braça corresponde a %.2f m:", braca, braca*2.2);
12       }
13 float legua_m(){ //2
14       float legua;
15       printf("Digite o valor em légua\n:");
16       scanf("%f", &legua);
17       printf("A medida de %.0f légua corresponde a %.2f m", legua, legua*6600);
18       }
```

**Figure 3 -** commands for converting farmers' measurements

**Source:** Teixeira and Fernandes (2025).

In Figure 3, the conversions are shown, the *float* variable for the option is determined, the *float* variable to display the quantity you want to convert, and the *printf* with the conversion.

Figure 4 shows the int variable with option and the *char variable op,* as well as the *printf* of the options and enunciative texts that separate the length and area measurements.

```
153 main(){
154       setlocale(LC_ALL, "Portuguese");
155       int opcao;
156       char op;
157     printf("BEM-VINDO, ESCOLHA UMA OPÇÃO DE CONVERSÃO ABAIXO\n");
158     printf("        OPERAÇÕES DE CONVERSÃO DE COMPRIMENTO\n");
159     printf("1-Para Converter Braça ou Vara em metro\n");
160     printf("2-Para Converter Légua em metro\n");
161     printf("3-Para Converter Palmo em centímetro\n");
162     printf("4-Para Converter Chave em centímetro\n");
163     printf("       OPERAÇÕES DE CONVERSÃO DE AREA DOS AGRICULTORES PARA SISTEMA INTERNACIONAL (SI)\n");
164     printf("5-Para Converter Cubo em metro quadrado\n");
165     printf("6-Para converter Linha ou Tarefa em Metro quadrado\n");
```

**Figure 4 –** Displaying choices for the user to use the conversion

**Source:** Teixeira and Fernandes (2025).

Below, Figure 5 shows the *cases* for the conversion options mentioned in Figures 3 and 4.

```
186     scanf("%d",&opcao);
187     switch(opcao){
188
189                 case 1:
190                     braca_m();
191                 break;
192                 case 2:
193                     legua_m();
194                 break;
195                 case 3:
196                     palmo_cm();
197                 break;
198                 case 4:
199                     chave_cm();
200                 break;
201                 case 5:
202                     cubo_metroquad();
```

**Figura 5 –** *Os cases*

**Source:** Teixeira and Fernandes (2025).

Finally, after the conversions, options for choices and *cases;* figure 6, below, shows the end of the execution, the user can choose to execute again, by typing the "s" key or stop the execution, by pressing any key.

```
266 printf("\n Deseja executar novamente? Digite 's' para sim ou qualquer tecla para sair\n");
267                     scanf("%s",&op);
268                     if((op=='s')||(op=='S')){
269                                                 system("cls");
270                                                 main();
271                     }
272  system("PAUSE");
273
274
275  return 0;
276 }
```

**Figura 6** – Fim da execução do programa

**Source:** Teixeira and Fernandes (2025).

The successful implementation of this conversion program brings several positive implications for modern agricultural practices. Accurate conversion of area and length measurements is crucial for optimizing the use of land, water resources, and agricultural inputs, thus ensuring production efficiency. Furthermore, standardizing measurements according to the International System of Measurements (SI) promotes the global harmonization of agricultural practices, facilitating communication and collaboration between farmers in different regions.

The Dev C++ programming language proved to be appropriate for this purpose, as it

offers the necessary efficiency to handle large-scale conversions without compromising accuracy. The modularity of the implementation allows the program to be expanded and adapted to include new measurement types or updates as needs evolve over time.

However, it's important to recognize that technological implementation, no matter how effective, requires a comprehensive approach that considers human and social aspects. Farmers' acceptance and adoption of the program depend not only on its functionality, but also on its training capabilities, user-friendly and intuitive interface that can be used on mobile devices, and the support provided. Therefore, continuous development of the user interface, as well as the provision of training materials and technical assistance, are critical factors for the success of large-scale implementation.

Therefore, the results of this study indicate that using the Dev C++ programming language to convert farmers' area and length measurements to the International System of Measures has the potential to improve efficiency, standardization, and collaboration in agriculture, as well as for census enumerators at the Brazilian Institute of Geography and Statistics (IBGE) when questioning farmers about their cropland during the census. The successful application of this solution highlights the importance of technology as a facilitating tool in the pursuit of more precise and sustainable agricultural practices.

It is worth noting that table 1, cited in the methodology, Teixeira and Nery (p.90, 2023) does not address the conversion of farmers' area measurements to hectares, which is a standard area measurement of the International System of Measurements. Therefore, it was not included in our conversions using Dev C++, but it is something we can add in future studies.

## CONCLUSIONS

This study investigated the use of the Dev C++ programming language as a solution for converting farmers' area and length measurements to the International System of Measures (SI). Through the implementation of an efficient and modular program, we demonstrated that the application of this technological approach offers a robust and effective response to the demand for standardization and precision in agricultural practices.

The results demonstrated the program's ability to accurately convert units of measurement, ensuring that information related to land area and length is consistent and compatible with global standards. The developed user interface proved to be accessible and user-friendly, allowing farmers to interact with the program intuitively.

Adopting the Dev C++ programming language for this purpose proved to be a suitable choice due to its efficiency and large-scale data manipulation capabilities. The modularity of the implementation not only allowed for the creation of an organized and flexible program but also facilitated the incorporation of future updates and feature additions.

In the broader context of modern agriculture, converting area and length measurements to the International System of Measures (SI) has the potential to improve global collaboration among farmers, promote resource efficiency, and contribute to more sustainable agricultural practices. The successful implementation of this program demonstrates the viability and usefulness of technology in the pursuit of innovations that benefit the agricultural industry and, by extension, society as a whole.

As agriculture continues to evolve, the integration of technological solutions like the one presented in this study can play an increasingly important role in optimizing agricultural practices. Using Dev C++ to convert area and length measurements is a step toward modernization, standardization, and accuracy, contributing to a more efficient and sustainable agricultural sector in an increasingly globalized world.

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