Impact of the Insertion of Modern Information and Communication Technologies in Brazilian Rural Communities

Marco Figueiredo, Mauro Câmara, Roberta Sabin

Abstract— **Information and communication technologies have the potential to overcome age-old barriers of space, time, class, and custom to integrate poor, isolated and disenfranchised rural populations into the mainstream of the larger society. This article describes** *Gems of the Earth***, a rural community telecenter project currently in development in a poor region of Brazil, once prosperous in the eighteenth century. The study analyzes the impact of the telecenters on the lives of these communities. Preliminary results point to the creation of new habits and customs, with initial signs of a return to sustainable development.**

Index Terms—**Information and Communication Technology, Poverty Alleviation, Sustainable Development, Telecenters.**

I. INTRODUCTION

T HE Gems of the Earth Rural Community Telecenter Network was established as a Brazilian non-government organization (NGO) in September 2003. Its mission is to empower small rural communities through the use of modern Information and Communication Technologies (ICT), to bring them social and economic development through their integration into the Information Society. The project began with two years of research and development to identify an appropriate methodology to deploy community telecenters in remote rural communities in Brazil [1]. This methodology is described in section II below.

For our purposes, a telecenter is defined as a place for public and shared access to modern ICT, with the initial requirement that it provide broadband access to the Internet. The main objective of this research project was to establish a model for self-sustainable rural community telecenters in Brazil. Besides the identification of the elements required within the community to deploy and sustain a community telecenter, we determined that a network management organization (NMO) was required to facilitate and foster the

growth of the telecenters. Isolated rural communities, in general, lack the resources to attract external support for their development projects. The establishment of an organization that represents the interest of several communities in negotiations with governments and the private sector is essential for the success of the project.

The study of telecenter projects around the world showed that a community telecenter with 20 computers typically serves up to 3,000 users [2],[3],[4],[5],[6],[7]. The Gems of the Earth project focuses on rural communities with less than 2,500 inhabitants, represented in Brazil as rural districts of nearby municipalities. These communities do not have self-governance. They are administered by the mayor and the legislative council of the municipality. The communities in more advanced states of development have formally established community associations and sometimes elect representatives to their municipal legislative council. In general, these communities are the last recipients of federal, state and municipal resources. The integration of these communities with the Internet and consequent greater access to information is intended to reduce their state of isolation and promote economic and social development.

A pilot project was established in the Northeast Brazil, in the Upper Jequitinhonha Valley, recognized as one of the poorest areas of Brazil. The project involves five rural communities, each hosting a community telecenter with at least two computers, a multi-function unit providing printer, copier, scanner and fax, and broadband Internet access via satellite. The office of the Gems of the Earth NMO is located in Belo Horizonte, the capital of the state of Minas Gerais, where the communities are located.

An analysis of the impact of the telecenters in the communities of the pilot project was carried out as part of a Master Thesis developed at the School of Informatics of the Federal University of Minas Gerais [9]. A summary of this analysis is presented here along with a description of the Gems of the Earth telecenter deployment methodology. This paper also describes the deployment and provides usage statistics of the online knowledge bank, which was created to integrate, in cyberspace, the efforts of the communities and the network management organization.

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II. TELECENTER DEPLOYMENT METHODOLOGY

The Gems of the Earth methodology, as illustrated in figure 1, is based in a non-profit, non-government model of community organization. It was designed to allow communities to first realize the potential of ICT to bring them economic and social development. Through field research, we found that community leaders, accustomed to false promises by visiting politicians, one-time donations by philanthropists, and short-term projects of external development agents, need to see, first-hand, an example of the positive effect of a community telecenter. Once community leaders are convinced of the telecenter potential, the *Gems of the Earth Network* works with them to build a telecenter and provide for its maintenance.
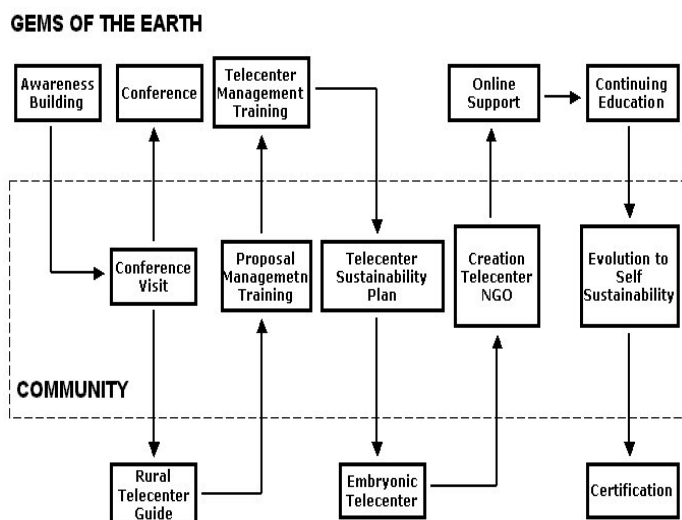
GEMS OF THE EARTH

Figure 1 – Telecenter Deployment Methodology

The first step in the chain of events, building awareness of the network organization, is achieved through advertisement, media publications, and participation in digital inclusion conferences and local civic meetings. A regional *Gems of the Earth Conference* allows community leaders to see first-hand the benefits a telecenter can bring to their community. The objective is to gather in a single place community activists and supporters of the digital inclusion movement. The conference attendees leave with a copy of the *Gems of the Earth Guide to Rural Community Telecenter* [1]. This guide describes in simple language the process needed to mobilize the community and create a telecenter integrated in a network of independent telecenters. It also provides guidance for the collection of data about the community that is needed to support the planning.

In the second step of the methodology, the community sends a group of four representatives to a telecenter management course. The focus of the Gems of the Earth methodology is the training of telecenter managers, as they are the catalyzing agents of change in the communities; they

must be prepared to deal with the changes in political structures at the local level, while facilitating the introduction of the new technologies. Telecenter management training targets people at the high-school level, as the organization hopes to facilitate the creation of the telecenter by community members, not outsiders. Brazilian rural communities generally have many unemployed high-school graduates. Frequently, they are young, energetic and eager to work and bring change to their communities. At the end of the course, using the data they collected in their communities prior to attending the course, the group of students from each community, with the help of the instructors, creates a preliminary *Telecenter Sustainability Plan* for his/her community.

In the third stage, the students return home and mobilize their communities to complete the *Telecenter Sustainability Plan* and prepare a proposal to create an embryonic telecenter. In this initial configuration, the telecenter is just a single room with one multimedia computer server, one intelligent computer terminal, one multi-function printer (copier, scanner, fax and printer) and broadband Internet connection. The Gems of the Earth Network complements the resources provided by the community in the building of the embryonic telecenter. The ability of the organization to fund the community activities is dependent on its ability to raise funds, which is directly influenced by the number of successful telecenter projects in the network. The co-dependence of the two organizational levels promotes overall progress.

Once the *embryonic telecenter* is in operation, the community integrates the *Gems of the Earth Online Knowledge Bank* (www.gemsdaterra.org.br) into the telecenter setting. In this environment, telecenter developers find technical documentation and online support, plus continuing distance-education courses. During this fourth stage, the community formally creates a non-government organization (NGO) to manage the telecenter activities.

The last stage of the telecenter development encompasses the search for self-sustainability. The *Gems of the Earth Certification Program* provides incentives for communities to move their telecenters to a self-sustainable and advanced level. The certification at each level promotes the telecenter to a new class of incentives. The program has five levels:
1. Community establishes an embryonic telecenter,
2. Community forms a non-profit organization to manage the telecenter,
3. Telecenter achieves self-sustainability,
4. Telecenter matures to an advanced stage with at the least 20 computers in two separated rooms,
5. Telecenter becomes a regional Telecenter Management Training Center.

At the highest level, the telecenter proliferates network capabilities by training new telecenter managers in the region. The Gems of the Earth *Online Technical Support Team* grows with the expansion of the network by hiring its team members from the community telecenters, once more contributing to the generation of income in the communities and supporting the self-sustainability of the telecenters and the network organization.

III. STRUCTURE OF ORGANIZATION

The choice of the non-government and non-profit models of organization meet the need to strengthen civil society in rural settings while promoting democratic values and non-discriminatory forms of organization. Figure 2 illustrates the form of organization proposed for the Gems of the Earth telecenters.
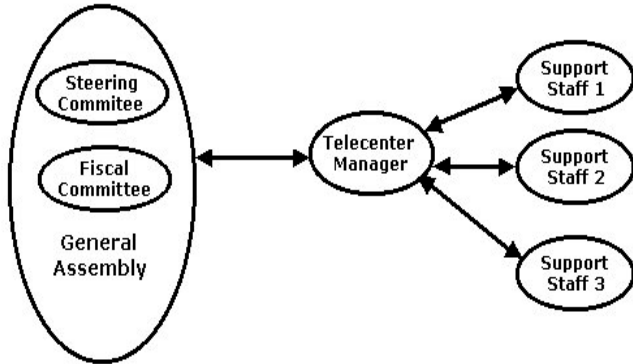

Figure 2 – Structure of Organization of a Gems of the Earth Telecenter

The telecenter organizers mobilize the community to attract a broad and inclusive participation in the General Assembly, which may be composed of as many members as possible. The General Assembly elects a Steering Committee and a Fiscal Committee for a period of two years. The President of the Steering Committee hires a telecenter manager who has been trained by the Gems of the Earth Network. As the telecenter grows, the manager hires supporting staff.

The President of the Steering Committee of each telecenter participates in the General Assembly of the Gems of the Earth Network, as illustrated in figure 3.

The General Assembly of the Gems of the Earth Network elects a Steering Committee and a Fiscal Committee. The president of the Steering Committee hires an Executive Director, who hires the staff to manage the NGO. The Executive Director and the staff of the NGO work directly with the managers and staff of the telecenters participating in the network.
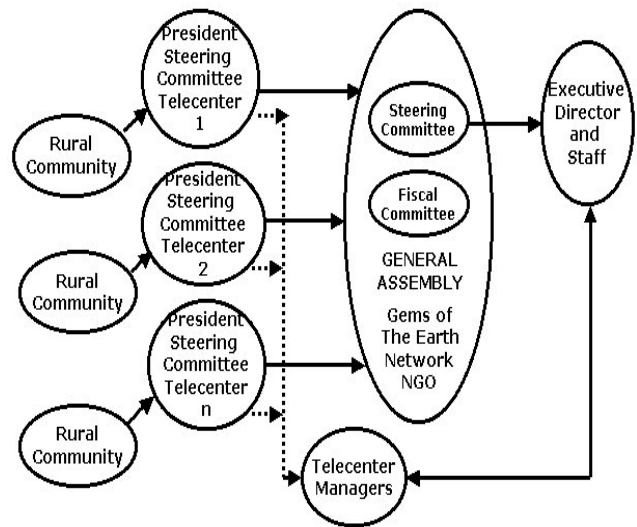

Figure 3 – Rural Communities Control the Network

It should be noted that, ultimately, it is the people of the rural communities that control not only the telecenter in their community but also the organization that runs the network of telecenters. This model of organization results in the empowerment of the communities, creating a new voice for them in a global level. As an illustration, if 100 people participate in the General Assembly of their community telecenters in a network of 10,000 telecenters, then the network organization directly represents one million people, a rather powerful voice in all political levels, and an attractive market.

IV. THE KNOWLEDGE BANK

The *Gems of the Earth Knowledge Bank* is composed of the *Rural Community Telecenter Guide*, the *Online Knowledge Bank* and the collective knowledge of all participants of the network, both individuals and organizations. All information contained in the *Online Knowledge Bank* is available as open content, for free use and distribution.

The *Rural Community Telecenter Guide* [1] is published in the *Online Knowledge Bank* both in source and printable formats. It is divided in three sections. The first section explains the advantages of a telecenter for a community. The second explains in detail the methodology summarized above. The third section provides tools to support the methodology including templates for project data logs and community surveys; proposals to the network organization; a telecenter fundraising and financial plan with sample spreadsheets; a sample of by-laws; a guide on how to create a NGO; and a volunteer management manual. It also includes the description of the architecture of the embryonic telecenter along with a CD with free-software to be used in the telecenter deployment.

The interactive *Online Knowledge Bank*, based on the MySQL database, PHP programming language, and the Apache web server [8], [14], provides a set of tools to complement the telecenter guide. Registered users can leave their contribution in the online system in several ways, such as:

- Publication of news,
- Events publication in the public calendar,
- Publication of links to other sources of information on the web,
- Publication of a personal journal (blog),
- Information organization in encyclopedia and Frequently Asked Questions (FAQ) formats,
- Creation of surveys,
- Participation in forum discussions,
- Publication of photos and videos,
- Identification and communication with other community members,
- Publication of articles, manuals, newsletters, courses, and software in the public download section, and
- Participation in an electronic mailing list.

V. PROJECT CHRONOLOGY AND STATUS

The following is a chronology of the major events of the project:

1. November 2001 – First visit to the region where the pilot project was established.
2. February 2002 – Agreement with local NGO (FUNIVALE) to incubate the project.
3. June 2002 – Established residence in São Gonçalo do Rio das Pedras and visited 12 surrounding communities.
4. June 2003 – Received support from the Brazilian Ministry of Communications (satellite Internet) and UNESCO (computing equipment) to start five embryonic telecenters.
5. September 2003 – Created the Brazilian NGO *Gems of the Earth Rural Community Telecenter Network*.
6. November 2003 – First telecenter working.
7. December 2003 – Volunteer training on basic use of the telecenter software.
8. January 2004 – All five telecenters operating.
9. March 2004 – Completed design of the rural telecenter deployment methodology.
10. July 2004 – Performed ICT impact studies in the communities of the pilot project.
11. January 2005 – Published the *Rural Community Telecenter Guide*.
12. March 2005 – Published the *Online Knowledge Bank.*
13. August 2005 – First Meeting of the Gems of the Earth Volunteers, in Conselheiro Mata.

Experience with the pilot project was essential in the formulation of the telecenter deployment methodology. The lack of financial resources, however, has impeded the full implementation of the pilot project. All telecenters and the network organization are operating with volunteers. The first *Telecenter Management Training Center* is yet to be built. The *Rural Community Telecenter Guide* describes the training curriculum but training materials have not yet been developed. Four of the five telecenters are still operating in the embryonic stage (São Gonçalo do Rio das Pedras, Milho Verde, Tombadouro and Conselheiro Mata). The telecenter in Rodeador has eight computers. The Gems of the Earth Network office also has a computer system similar to the embryonic telecenters.

The *Online Knowledge Bank* has yet to incorporate the distance learning environment and courses, the community survey tools and the telecenter impact assessment tools. The use of the *Online Knowledge Bank* by the communities has been limited due to the lack of comprehensive training of the volunteers in the use of the tools available and the limited abilities of community members facilitated by these volunteers. The *Online Knowledge Bank User's Guide* is being developed. The following table describes the usage statistics of the online system. The increase (more than double) in the number of accesses in August 2005 is due to the *First Meeting of Volunteers*, where they received introductory training on the use of the system. A technical problem with the Internet Service Provider kept the system down for two weeks in September 2005, resulting in a reduction in the number of hits in the online system.

Month	Number of Hits
March	583
April	3004
May	10435
June	10517
July	12975
August	26590
September	13636
October	27401
November	17773

Table 1 – Online Knowledge Bank – Usage Statistics in 2005

There are 85 users registered in the *Online Knowledge Bank*, the great majority are volunteers from the communities of the pilot project. There are 31 news articles published in the portal and 137 messages posted in the forum. There are two photo albums that together host 49 photos, and one video

album hosting 6 short films with interviews with participants of the pilot project.

The *First Gems of the Earth Conference* has yet to occur. The General Assembly of the Gems of the Earth Network NGO is composed of a group of founding members and the community associations are still incubating the telecenters of the pilot project. None of the communities of the pilot project have created a NGO to manage their telecenters.

VI. SOCIAL IMPACT

Data were collected regarding the impact of ICT in the communities of the pilot project through visits to the five communities between 15 and 24 of July of 2004, according to the following schedule: São Gonçalo do Rio das Pedras (15,16,17), Milho Verde (18,19), Tombadouro (20), Conselheiro Mata (21), and Rodeador (22, 23, 24). The telecenter managers and up to four users per community were interviewed, with the exception of Conselheiro Mata, where the manager was not present.

The analysis of the data depends upon the concept of information appropriation [13], a process that occurs in three stages. In the first phase, digital inclusion, the emphasis is on the use of technologies, i.e., the ability to operate and communicate through the use of computers. The understanding of the functionality of the equipment (hardware) and its application programs (software) grows, as does the ability to produce, organize, disseminate and visit the information in an automated form.

The second phase, information inclusion, emphasizes cognitive processes. Its objective is to construct knowledge including the use, interpretation and search for meanings, and the creation of mental models. The construction of knowledge occurs at the establishment of relationships between the various information items. Uncertainty decreases as learning occurs and new knowledge is incorporated in the pre-existent cognitive structure of the individual [10]. Information systems are examined according to how they are perceived by individuals, with special attention to the understanding of how a person searches the meaning of their questioning and learning processes; it is the *sense-making* in the work of Dervin and Nilan [12], [15].

The third stage comprises the process of social inclusion, understood as information literacy with emphasis on the construction of the sense of citizenship that emerges from the learning process. It must include, beyond a set of skills and knowledge, the notion of values connected to its social and situational dimensions. These values involve the development of attitudes and personal positions, including ethics, autonomy, responsibility, creativity, critical thinking and the learning of how to learn.

The preceding background, the interviews with telecenter users and volunteers, and the experience of every day life in the communities of the pilot project, helped to identify behavioral changes and the mental models of telecenter participants.

People in rural communities are used to intense face-to-face contact. Given this fact, the process of dissemination of information is occurring slowly but gradually. This process develops through daily contacts of the volunteers, who participated in the capacity building courses and disseminate their knowledge with people close to them. During the interviews, they showed clearly their interest in giving to the community the "little" knowledge acquired in the courses and the short period of familiarity they have with computers. Many participants show a certain satisfaction for having found something new, which they demonstrate when they talk about their activities.

In São Gonçalo do Rio das Pedras, the activities of most interest to the population included school research and email. Beyond this, volunteers in this community supported research about recyclable waste, development of activities geared towards children, search for information about arts and crafts, finding cooking recipes, access to bank accounts, and text editing. In the opinion of the telecenter manager, "the telecenter serves to integrate the population" and as such, she would like to "engage in works for the community." One of these works would be to "download free movies, record on CD-ROM and play for the community in the town's main square" as a way to preserve a custom of the community to meet at sunset and also to show the possibilities of the new technology.

Another initiative occurred in Milho Verde, where the telecenter manager researched, on the Internet, a technique to construct a solar stove to utilize the natural resources of the region and create new activities for its inhabitants. This use of the telecenter shows how access to global information matched with resources and skills of the region can generate benefits for all.

The state-run school in Rodeador provides training only through the eighth grade. Students must pursue further schooling at the closest city, Monjolos, about 15 miles away. In order to pursue college courses in the major cities, students must first pass a comprehensive test, which require further preparation in specialized educational programs not available in Monjolos. The telecenter manager in Rodeador has been researching the Internet for help from other NGOs to create an online college preparation course for interested students from her community and students from Monjolos, who would

take advantage of the telecenter's broadband access to the Internet. This activity should improve access to college level training and help improve education levels in the region.

These are sample initiatives that demonstrate the potential contribution of telecenters to sustainable development, utilizing local and natural resources. Even though slow in this initial stage, the project should pick up momentum in the mid to long term. It is understandable that the communities may have not yet realized the numerous possibilities of the telecenter infrastructure, given the novelty of the technology in this environment of poverty. Participants at this stage mostly realize only the basic activities of access to the Internet, photocopies, scanning and data entry, and printing. But it is these basic services that make it possible to create income for the sustainability of the telecenters, an issue of major concern to the communities, as expressed in all interviews.

Telecenters are also educational instruments, which if oriented towards broader objectives, can satisfy the demands of the community not yet imagined or considered possible. A telecenter is not just a school, it is also a workshop, a business center, an entertainment center, and a place to meet and exercise citizenship. The telecenter, as a learning environment, can initiate a chain of social transformations. These can occur because the space allows interaction and promotes education while creating possibilities for personal growth and initializing social mobilization. Studies by Delors support this view [11]. Capacity building is one of the principal income generation activities for the telecenter, and it is not limited to the use of technologies of digital inclusion. It extends to capacity building in citizenship to promote human and social development, and in entrepreneurship to foster the growth of the local economy.

The advent of the telecenter infrastructure in the communities of the pilot project has caused transformations in a progressive manner. The project is being discretely consolidated in a rhythm determined by the local community. Even though use is still light, everyone in the community knows of the existence of the telecenter. The community looks at them as beneficial to its development. The pilot project has shown important progress in the actions of volunteers who believe in their work and see the possibility for change.

The appropriation of information and knowledge is perceived in all three stages referenced above: understanding of the technology (computer, Internet, satellite antenna, etc); understanding of how to search for information in the large web, and finally the understanding of how to put this information into use for the benefit of the community.

The study demonstrates that the use of ICT can promote important changes even in communities physically and culturally distant from the location where the technologies were developed. The coordinated and directed use of telecenter infrastructures can enable local development through localized solutions, while exploring the knowledge acquired from social networks that move via social mobilization and insertion, and digital inclusion. However, for the instrument it represents, the digital inclusion must accompany other programs such as education, health and better conditions of life, the pillars of a development that is broader, sustainable and harmonious with the natural environment.

VII. CONCLUSION

The adoption of a non-government, non-profit model of organization for both the telecenters and the network organization implies that a long period of time will be needed to reach financial sustainability. The lack of continued capital investment slows the process of the creation of the infrastructure required by the network organization to support the deployment of telecenters. Nevertheless, the work performed to date has proven to be essential for the establishment of the methodology required to build self-sustainability both at the telecenter and the network levels, while allowing time for the communities to appropriate the solutions. The degree of success of the Gems of the Earth project should be measured not only on the direct impact of the telecenters in the communities but more importantly on the ability of the communities to understand the potential for empowerment that the telecenters and the network of telecenters bring to them and take full control of the building process.

The research and development stage of the project was in great part the effort of an external agent building a methodology based in scientific research of telecenter experiences around the world, and fact finding while living in the target communities over a lengthy period of time. Besides the three-year full-time commitment of the principal investigator and the many hours of dedication of tens of volunteers, the total capital investment in the project to date is less than one hundred thousand dollars. As more financial resources become available to build the infrastructure of the network organization, it will be easier for the communities to appropriate and develop the model into a self-sustainable system. The elements for success are built into the model and positive impacts in communities have already been identified.

The low cost of maintenance of the non-profit model, which is largely based in volunteer work, associated with the low cost of persistence of an Internet based organization makes the Gems of the Earth a candidate for successful self-

sustainability. The reliance on open source software also contributes to the reduction of cost and the natural evolution of the system. Today, the only dependence on external agents of the project is the funding of the satellite Internet access of the five pilot telecenters. This is provided by the Brazilian government. However, if this support were to be eliminated, it is expected that the communities, having experienced the benefits of the telecenters, would react by contributing to the maintenance of the telecenters. Recently, the donor of the space that hosts the telecenter in Conselheiro Mata withdrew his support, as he saw no direct benefits of the telecenter to the overall community. The community reacted immediately and the donor reiterated his support, but this time with more commitment from the community in supporting the telecenter financially.

The Gems of the Earth project has built a considerable knowledge base and an extensive social network of contributors at the local and global levels, a requirement for survival in the Information Society. It still needs to overcome a natural temerity of the construction of such a large project with such a profound vision. This vision foresees the inclusion of an estimated 16,000 Brazilian rural communities in the Age of Knowledge, which would provide the basis for the cultural changes needed in Brazilian society to resolve the enormous gap in economic level. Such changes could provide an example for rural communities around the globe.

VIII. FURTHER DEVELOPMENT

To raise the funds to allow the completion of the pilot project and sustain the growth of the telecenter network towards self-sustainability, the *Gems of the Earth Network* NGO was registered as a non-profit organization in the Unites States. Its mission is to build awareness among Brazilian immigrants in that country to support social development back in their home country. It has been determined by the Inter-American Development Bank [16] that the more than 2 million Brazilians living abroad send more than 5 billion dollars yearly to Brazil. This transnational community, however, lacks voice and representation in Brazil. Investing in rural development through a philanthropic cause allows the Brazilian Diaspora to establish a political agenda in Brazil. The challenge lies in organizing this community. For this purpose, an *Online Knowledge Bank* (www.gotenet.org), similar to the one used in the Brazilian project, was created to integrate the immigrant community and build awareness towards participation in this social development goal.

The experience with the Gems of the Earth project has also led to the creation of the Center for Community Informatics (CCI) at Loyola College in Maryland. The CCI has as mission the research and development of technologies that will facilitate the deployment of ICT in low-income communities. Many of the ICT tools needed in the Gems of the Earth project will be implemented by the CCI, facilitating the evolution of the project.

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