14 Transformative Innovation Policy, SDGs, and the Colombian University

Eliana Villa, Daniel Cardona Valencia, Alejandro Valencia-Arias, Karen Hormechea, and Jhonjali García

14.1 Introduction

The university has among its main functions the social impact and the need to be generating and transmitting new knowledge in the community where it is. In addition, the university as a center of knowledge should seek to influence the local context. It must further seek to contribute to the national, regional, and international economic, social, and cultural development bringing up solutions of specific problems on the environment. In the same way, universities have been a fundamental part of the National Innovation System (NIS). This is so because they are the spaces in which science is generated and new knowledge developed including technology and innovation.

Because of the foregoing, universities have played a leading role in the achievement of innovation processes, which, although in some countries has succeeded in impacting economic indicators, unfortunately, have not generated welfare to humanity that was intended. In other words, permanent product innovation has caused problems, such as the excessive and disproportionate use of natural resources as well as inequity in the sharing of wealth in and among countries, resulting in extreme poverty and violence, among other problems associated with these processes. It is for this reason that, these research intended to give a different look to the processes of Science, Technology, and Innovation (STI). For this reason, the TIP is presented as a paradigm shift, to which it must be migrated as a contribution to solving the problems of climate change, inequality, extreme poverty, among others. These problems are defined in the Sustainable Development Goals (SDGs), as a series of goals to be achieved by humanity and that must be addressed by researchers and knowledge in all its spheres. In this sense, in Colombia, a commitment is made

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from the national policy of science, technology, and innovation to the incorporation of this transformative approach, as part of the country's commitment to achieving the objectives of sustainable development.

In the following sections, the concept of transformative innovation policy is introduced, and the three innovation frameworks from Colombia explained, showing the objectives of each one, as well as the actors and roles of each framework. In addition, the SDGs are highlighted as part of the goals of humanity and the commitment of the country to the achievement of Agenda 2030. Finally, the chapter introduces the incorporation of the policy of transformative innovation in the National Science and Innovation framework for Colombia (Green Paper 2030), which shelters the university as a fundamental actor in the process.

14.2 Science, Technology, and Innovation in Response to the Problems of Humanity

In the twentieth century, Schumpeter proposed a distinction between innovation, seen as the commercial introduction of a new product or a "new combination," and an invention restricted to the domain of science and technology (Pérez 2010). That division gave birth to the notion of innovation linked to the economic paradigm, which has prevailed in policies and innovation studies since the 1980s. That paradigm is based on two principles: (a) value generation is a term aimed exclusively at the creation of economic value and (b) the agents that perform that function are companies and not people. That dominant paradigm, of Schumpeterian origin, conceived society as a field where innovations were disseminated, but in no case as a potentially innovative agent (Ezponda and Malillos 2011; Villa, Ruiz, Valencia and Picón 2018).

Subsequently, Porter (1996) proposed a new paradigm of competitiveness based on the dynamic innovation processes of companies and industries. According to it, the interrelationships between companies, institutions, and markets support the competitive development of the regions (Platero 2015). Afterward, Freeman and Pérez (2010) suggested the notion of techno-economic paradigms to define, in a synthetic way, the systems of production, innovation, and governance on a macro scale. A techno-economic paradigm is, therefore, the result of a complex collective learning process integrated into a dynamic mental model of optimal economic, technological, and organizational practices for the period during which a specific technological revolution is adopted and assimilated by the socio-economic system (Pérez 2010).

Furthermore, there are important differences in the way the scientific-technical society of the old paradigm of "massive production" and the knowledge society of the current flexible production paradigm conceive the innovative activity (Pérez 2004). Companies already see innovation with a holistic approach; that is, it does not only depend on Research and Development (R&D) departments but it is the result of efforts by all the departments in the organization as well as the interaction with external agents, such as suppliers, partners, and allies. However, the innovation paradigm was not significantly changed: greater competitiveness was required, and innovation was a means to that end.

Adopting an approach different from that of other Organization for Economic Cooperation and Development (OECD) member countries, at the beginning of the new millennium, Quebec (Canada) saw the development of a movement that aims to contribute, from the humanities and social sciences, to an agenda for innovation. These works were based on the study carried out by Taylor (1970), and they aimed to be the first response to the emergence of a paradigm shift in terms of innovation as a means and not as an end, a means for development and social welfare, which could take place not only at companies and companies but in any field, including the community as the first movements of "social innovation" (Echeverría 2008; Echeverría and Merino 2011). These first changes were supported at a prudent pace by European countries and the United States. More specifically, during President Obama's administration in 2009, the US government created the Office of Social Innovation and Civic Participation, which had a budget of

approximately 50 million dollars per year until 2015. Additionally, there is evidence of similar initiatives in Australia and New Zealand (Christensen et al. 2009; House 2014).

Fressoli et al. (2014a, b) emphasize that since innovation models for inclusion and development are designed by academic, governmental, and business actors, there are multiple ways to formalize, abstract, and define variables or principles. According to this thought, the social innovation implies it is better to move away collective spaces for grassroots meetings and, based on that, make commitments in terms of innovation, which will not transcend if marginalized individuals are not included (Thomas and Fressoli 2011). This also includes the acknowledgement of basic innovation, which is produced by and for "the bottom of the pyramid" (Prahalad 2005; Fressoli et al. 2014a, b) and "frugal" innovation models (Bound and Thornton 2012; Fressoli et al. 2014a, b).

14.3 The University as Part of National Innovation Systems

The great demand for education in the twenty-first century resulted in the creation of postsecondary education centers, which, in conjunction with universities, are called Higher Education Institutions (HEIs) (Sebastián and Scharager 2018). HEIs maintain their initial mission (instruction), but they also have two other objectives, conducting research and engaging with the industry and society, which has become a latent evolution (Cesaroni and Piccaluga 2016). Therefore, preserving knowledge and transmitting it, researching and promoting economic development and the welfare of society are the main pillars of HEIs, where science, technology, innovation, entrepreneurship, and social commitment are areas to work on (Beraza Garmendia and Rodríguez Castellanos 2007). HEIs are important knowledge generation centers and the industry depends on them to be competitive (González 2011).

A National Innovation System (NIS) is a network of institutions whose activities favor, import, modify, and disseminate new technologies that provide the framework within which governments develop and implement policies to influence the innovation process (Freeman 1987; Metcalfe 1995; Carayannis et al. 2017). Nevertheless, the type of innovation that has been promoted by the NIS had a competitive component, thus generating inequality, exclusion, unemployment and environmental imbalances, favoring the affluent classes, increasingly segregating low-income communities, and causing greater social, economic, and environmental problems in many impoverished countries (Fressoli et al. 2014b). Drawing from these negative consequences, a paradigm change was necessary, not only about innovating but also about creating adequate conditions so that the economic growth generated by such innovations—instead of impacting the environment or creating inequality—increases the levels of well-being and quality of life and reinforces learning, coordination, and collaboration inside organizations (Hernández 2013; Londoño-Patiño and Acevedo-Álvarez 2018); that is, innovations that contribute to the creation of "an alternative model of growth and development" (Hernández 2013, p. 2). The United Nations set a precedent when it ratified the 17 SDGs as a collective development agenda country must follow to achieve by 2030. To this end, science, technology, and innovation (STI) are widely invoked to face these challenges (Soete 2013; Chataway et al. 2017).

14.4 The Transformative Innovation Policy (TIP): Emergence of a New Paradigm

In the current world scenario, a change of direction and intention in STI processes is necessary. The term innovation for sustainability or "sustainable innovation" is increasingly mentioned, which is in agreement with the change of mentality of the post-modern era in which scientific, economic, and political efforts should be directed at solving structural problems, not only of economic growth but humanity as well (Boons and Lüdeke-Freund 2013). This new current of thought

emerged in developing countries, in which, despite immense efforts to generate economic growth, evident gaps remain in the distribution of wealth and the achievement of human well-being (Gupta 1995; Prahalad 2005; Prahalad and Hamel 1994; Prahalad and Ramaswamy 2004).

One difficulty that arises, nevertheless, is that public policy organizations make proposals only in order to create prototypes and/or innovations that can be marketed. Gupta and Prahalad suggest that, instead of contributing to the generation of "apparently innovative objects," policies should be focused on the *generation of different processes* (Smith et al. 2016). For some decades now, in different places of the world, movements and organizations have been producing this type of developments, called grassroots innovation (Smith et al. 2016). Grassroots innovation is developed through different processes in public institutions, universities, and Research and Development centers, as well as innovation departments at companies that have traditionally networked with formally organized research institutions (Smith et al. 2016). For that reason, new "frameworks" of STI policy are proposed to encourage, support, and leverage those processes, taking into account that the current model must be transformed to achieve humanity's objectives. In the following section, two existing STI policy frameworks are presented along with their actors and relationships; subsequently, this new Transformative Innovation Policy Frame is described.

14.4.1 Framing 1: Research and Development (1960–1980)

Three key actors interact in this model namely: the Government, the University, and the private sector. Additionally, their work and responsibilities are clearly defined. The government regulates and funds R&D expenditures, universities focus on generating knowledge, and the private sector seeks to transform scientific discoveries into innovations to support sustained economic growth (Schot and Steinmueller 2016a, b; Chataway et al. 2017) as shown in Fig. 14.1.

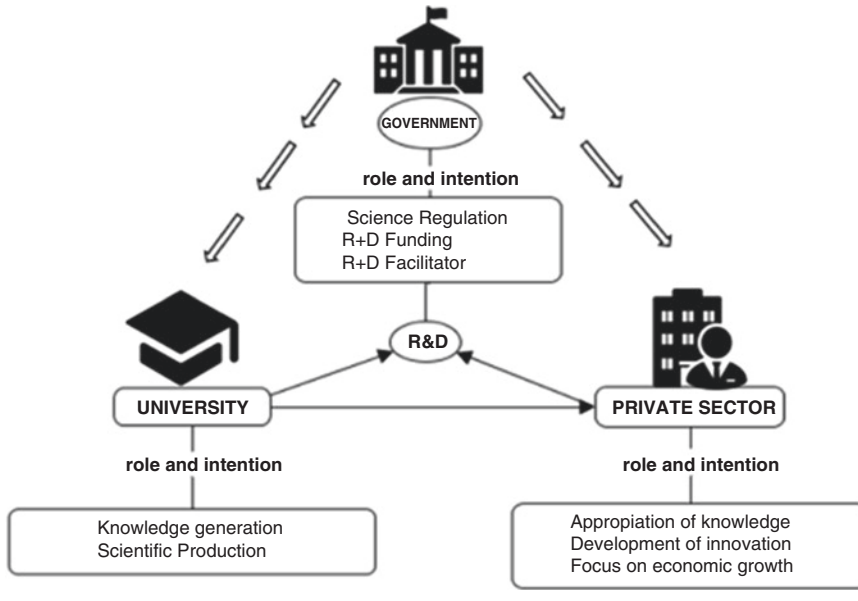

Fig. 14.1 Roles and intentions of the actors in Framing 1: RESEARCH AND DEVELOPMENT. Source: Own elaboration based on Schot and Steinmueller (2016a, b) and Chataway et al. (2017)

14.4.2 Framing 2: National Innovation System (1990 to Date)

Traditionally, Innovation Systems (IS) have been focused on actors, institutions, and their relationships (Dutrénit 2013). One of the central characteristics of this innovation approach is that it has paid less attention to development problems, social inclusion in particular, thus generating greater inequality and strongly influencing the social imbalance (Dutrénit 2013; Kaplinsky 2013; Fressoli 2015). This second frame is focused on describing the structure of actors and their relationships for competitiveness and economic development (Dutrénit 2013; Schot and Steinmueller 2016a, b; Chataway et al. 2017), leaving aside society as a nonessential part of the innovation processes (Dutrénit 2013; Schot and Steinmueller 2016a, b; Chataway et al. 2017). It is important to highlight that, in this frame, universities act as entrepreneurs, the private sector conducts basic research, and the government maintains its traditional role (Schot and Steinmueller 2016a, b; Chataway et al. 2017). The roles and intentions of key actors are reflected in Fig. 14.2.

14.4.3 Framing 3: Transformative Innovation Policy (TIP)

In order to respond to the prevailing need for transformative innovation, some authors propose what has been called the third frame for Innovation Policy. Such frame will allow a world in transition to contribute to the achievement of the SDGs as well as the generation of worldwide public policies that enable the articulation of STI initiatives, actors, and infrastructure to consolidate those processes of innovation. The third frame was studied by the Scientific Policy Research Unit (SPRU) of the University of Sussex in England, based on discussions held at

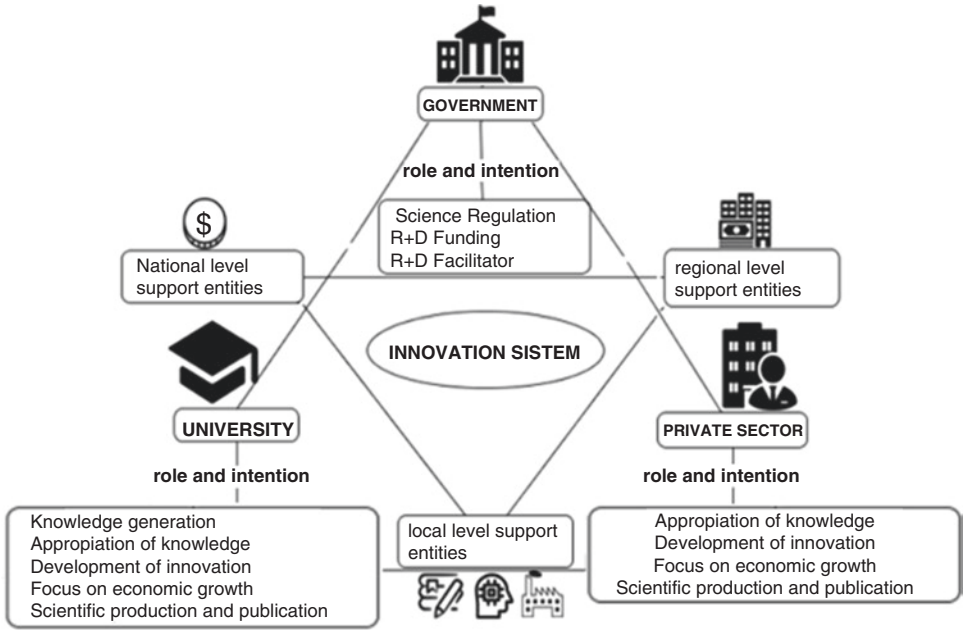

Fig. 14.2 Roles and intentions of key actors in Framing 2: National Innovation System. Source: Own elaboration based on, Dutrénit (2013), Schot and Steinmueller (2016a, b), and Chataway et al. (2017)

the OECD between June and July 2016 in Paris and Seoul; it draws on academic work on transformative innovation policies. Besides, it highlights the need to design policies for innovation that allows transformative change (Schot and Steinmueller 2016a, b).

From the third STI framing, the conception of innovation in the terms mentioned above should change because, under Framing 2, innovation is part of the cause and not the solution to the problems humanity faces. In general, this happens because innovation policy stimulates industrial activities, economic growth, and consumption, which have been the root of environmental problems, social tensions, inequality, and the widening social gap, among others. For that reason, the evolution of public STI policy could contribute to the construction of transformative change (SPRU 2016). In that regard, Thomas et al. (2015) emphasize that systems focused on transformative innovation are those that address problems linked to poverty. Therefore, their articulation with social policies (as elements that demand innovations and define innovation policies) should be more fluid in order to generate virtuous circles of knowledge, innovation, and lower inequality.

This framework recognizes that most innovations have "mixed effects", and it focuses on developing socio-technical changes, interactively linking system actors to find specific solutions. Likewise, policies become more inclusive; they find pathways for alternative development and acknowledge the fundamental role of civil society (Schot and Steinmueller 2016a, b; Chataway et al. 2017). Further details regarding the roles and intentions of the actors are presented in Fig. 14.3.

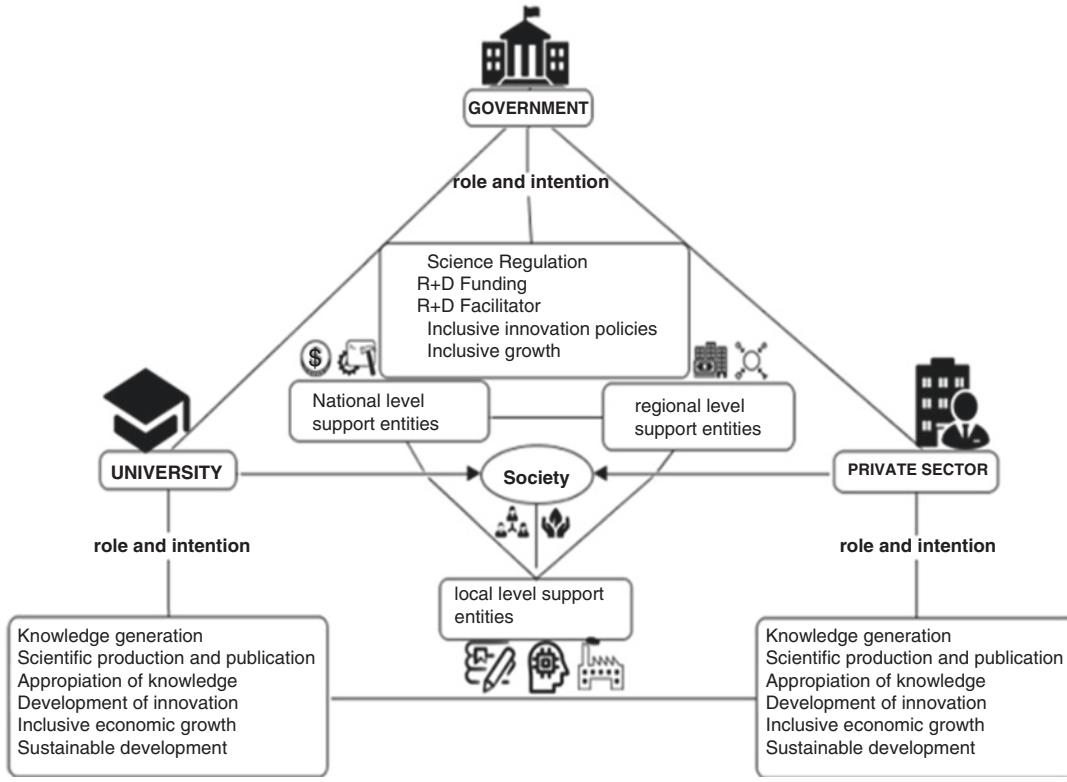

Fig. 14.3 Roles and intentions of the actors in Framing 3: Transformative Innovation Policy. Source: Own elaboration based on, Dutrénit (2013), Schot and Steinmueller (2016a, b), and Chataway et al. (2017)

From Fig. 14.3, it follows that Transformative Innovation (TI) stems from a different conception of the direction and intention of innovation processes. Such paradigm shift is a response to a need for a new structure to meet the real and urgent problems of humanity. In that regard, Schot and Steinmueller (2016a, b) point out the need to adopt the paradigm since the world is changing fast and profoundly. Fressoli et al. (2014a) also claim that the current economic development model is not oriented toward sustainability and, as a result, many scientific policies do not focus on this problem either. Every human should get involved and contribute in a synergic manner to the achievement of the SDGs (ONU 2015a).

14.5 Sustainable Development Goals (SDGs)

The SDGs are an agenda comprising 17 goals focused on eradicating poverty, protecting the planet, and ensuring prosperity for all. They were established for the period between 2015 and 2030. Among the objectives, some are a continuation of the Millennium Development Goals (MDGs) agenda and others mark a global concern for environmental issues. The discourse of sustainable development is used to justify the idea that economic growth helps to reduce social and environmental problems but, in fact, it increases the levels of inequality and environmental problems are evident. Therefore, the goal of this discourse is to maintain the approval of agendas that benefit the capitalist system without effecting a change in the concept of development. According to Fukuda-parr (2016), if the 2030 Agenda is not oriented toward inclusive development, the mistakes of the Millennium Agenda will be made again because the MDGs did not recognize human rights as a priority. They simply focused on the reduction of poverty without looking beyond the causes of the problem; that is, inequality and the economic model were not analyzed. The MDGs stressed economic growth, which prioritizes the profits of companies.

A more optimistic view of the 2030 Agenda is that of Gupta and Vegelin (2016), according to whom the SDGs can mobilize civil society, scholarly communities and communities of practice to demand change. In addition, the academic community and NGOs should monitor the commitment of countries and companies to the objectives of the agenda. The SDGs, compared to the Millennium Goals, are very closely related to each other, as demonstrated by Le Blanc (2015) using network analysis, a characteristic that will facilitate the implementation of policies derived from SDGs. Nevertheless, research, innovation, and sustainable education should be an instrument to achieve the success of the agenda and enable all actors in the quadruple helix model to put research results into practice (Lange et al. 2019).

In addition to the above, a key factor for the success of the SDGs are local conditions and aspirations since they determine how individual countries or other entities wish to respond to the agenda; this is a bottom-up element that generates the local appropriation of the solutions as local expressions of those general objectives (Griggs et al. 2014). In that line of work, Lange et al. (2019) highlight that countries are deciding to study local priorities in order to find their relationship to the SDGs. The goal of climate action and climate change issues constitute a global line of research (Lange et al. 2019). Finally, Sachs (2012) stresses that the success of sustainable development depends on economic development, environmental sustainability, and social inclusion; the three of them should exist in addition to governability. Below is a summary of the main characteristics of development agendas established by the UN until 2030. The evolution of the SDGs agenda is shown in Table 14.1.

In Latin America, interesting initiatives have been developed toward the global pact. Drawing from the second annual report on the progress and regional challenges of the 2030 Agenda by the ECLAC (Economic Commission for Latin America and the Caribbean), more and more companies, institutions, and directed initiatives in Latin America and the Caribbean are voluntarily embracing the vision of sustainable development. The report also mentions stagnation in the reduction of inequality and an uncertain

Table 14.1 Evolution of UN's sustainable development agendas

Characteristics	MGDs	SDGs
Time frame	2000–2015	2015–2030
Focus area	Applied in developing countries	All countries
Goals		
Concept of development	Focused on how economic growth could help increase human development	The evolution of sustainable development, which requires economic, social, and environmental dimensions
Funding	Donation from developed countries	All countries, and even civil society, are expected to bear a cost

Source: Own elaboration based on several works (Le Blanc 2015; Fukuda-parr 2016; Griggs 2013; Griggs et al. 2014; J. Gupta and Vegelin 2016; Kopnina 2016; Lange et al. 2019; ONU 2015b; Sachs 2012)

political landscape that are addressed toward protectionism and less international cooperation. However, the forecast of economic growth and improvements in education in coming years are expected to boost employment and academic training, drivers of equality and development (CEPAL 2018).

The Latin American university has contributed to the SDGs with significant advances in terms of infrastructure and digital skills to use and access telecommunications (widely recognized drivers of human progress, productivity, and the solution to social and educational problems). According to Cisco Systems (2016), in said region, the flow of data over the Internet will reach 11.6 exabytes/month in 2020, compared to 4.5 exabytes/month in 2015, approximately a 50% increase. This growth in digital infrastructure is aimed at promoting new industries, processes, and products, and it is directly connected to the scope of STI in educational projects in rural and urban areas as an effort to reduce educational barriers imposed by physical infrastructure and the administrative-political scope. This immersion in the digital era is decisively influencing higher education in this geographically and culturally vast region, where learning opportunities are required to transform and have an impact on Latin American realities (Cardona Valencia et al. 2018).

ICTs and internet connectivity have been the channels through which universities have launched activities about the global compact and the scope of its objectives. This is the case of Triada, an alliance created to share knowledge, generate social mobility, and create synergies in education by Universidad de los Andes (Colombia), Tecnológico de Monterrey (Mexico), and Pontificia Universidad Católica (Chile). This alliance has developed projects related to common challenges such as corruption, migration, heritage, ethnic groups, the creative industry, and online education. Regarding the latter, the alliance already offers 100 free courses on the platform Coursera, which could potentially reach more than 150,000 users.

Universities are thinking about equality, personal and family growth, and developing initiatives in that sense. For instance, the UNAM Foundation of the Autonomous University of Mexico has included financial education in vulnerable communities as part of its sustainability program—a policy for social outreach. They work in partnership with Mexican companies adhering to the strategy Making Global Goals Local Business (United Nations 2018). Other universities have had similar intentions, such as the University of Sao Paulo and Unicamp in Brazil with the project "Pé de meia" a program that is dedicated to the strengthening of financial

knowledge as a strategy to overcome poverty, aimed at young people, schools, NGOs, and private institutions. Another point that the 2030 Agenda and universities in Latin American have both addressed is migrations, as well as understanding their complexities from economic, social, and cultural standpoints. For that reason, the International Organization for Migration and the UN Agency for Refugees, hand in hand with institutions such as Universidad Nacional, Universidad de los Andes, Javeriana University, Sergio Arboleda University (Colombia), and the Latin American Faculty of Social Sciences (Guatemala, Ecuador, Mexico, and Dominican Republic) are working on reports on migration trends and migration challenges.

Finally, universities are playing an important role as promoters of alliances and validators of a country's commitment to the SDGs and the 2030 Agenda. For example, the University of Panama (Panama) created an observatory for monitoring the implementation of the SDGs that seeks to support the national government, civil society, the private sector, and the academic community to fulfill the commitments acquired in Panama. Brazilian HEIs such as the State University of Goiás, the State University of Piauí, the University of Paraiba, the Methodist University, the Tabosa de Almeida University Center, and the International Institute for Citizen Development jointly created an SDGs network. The latter aims at introducing the SDGs into instruction and extension and supporting their implementation in the country.

14.6 Methodology

The methodology that was carried out for the incorporation of the policy of transformative innovation in the public policy of science, technology, and innovation in Colombia was executed from the policy unit of the Administrative Department of Science, Technology and Innovation (Colciencias). This process was carried out in the framework of an agreement of accession by Colombia to the PIT consortium, which was created with the creation of a group of public policy managers in CTI from different countries of the world. Subsequently, a methodological approach was developed, made up of several processes that allowed the identification of strategies to achieve the OSD from the CTI processes. The processes included:

- Conversations and trainings for stakeholders
- Mentoring network
- Conversations
- Citizen consultation regarding ODS
- Interviews
- Identification of scientific and technological capacities

Based on this methodological design, a consensus was reached, which allowed the theoretical incorporation of these concepts for the incorporation of strategies, addressing and proposals for the incorporation of the policy of transformative innovation, as one way to respond to sustainable development goals in the country, with the support of science, technology, and innovation.

14.7 Results: The 2030 Agenda in Colombia

Colombia, as a member of the United Nations Organization, adopted the Millennium Agenda (2000–2015). Nevertheless, taking into account the achievements and obstacles that arose during its implementation that country expressed (in the United Nations Conference for Sustainable Development Rio + 20 in 2012) the need to expand the definition of development and the MDGs by structuring a new global development agenda (CONPES 2018b). Based on that initiative and the support of several countries, governmental and non-governmental entities, the 2030 Agenda was created, and the SDGs were set. It was adopted worldwide in 2015 and, as expected, Colombia committed itself to implement it (Gobierno de Colombia 2016).

One of the strategies that the country adopted to facilitate the implementation of the 2030 Agenda was the creation of the High Level Inter-Institutional Commission for the

Enlistment and Effective Implementation of the SDGs through Decree 280 of 2015. This commission was established to facilitate intersectoral work for the implementation of the 2030 Agenda, that is, to create a space for several ministries and departments that compose the national government to discuss public policies, programs, actions, and the monitoring of said goals in Colombia (DNP 2018). Additionally, the National Council of Economic and Social Policy (CONPES in Spanish), which advises the government on issues of public policy, published two CONPES documents regarding the 2030 Agenda. First, CONPES 3918 outlines a strategy for the implementation of the SDGs in the country, and it details a route that includes a list of indicators and goals to follow up on said implementation (CONPES 2018b). Second, CONPES 3934, the Green Growth Policy, defines strategic actions to achieve sustained and sustainable economic growth (CONPES 2018c). Although the implementation of the SDGs depends on the national, departmental, and municipal governments, CONPES documents are a point of reference in terms of policies for the adoption of the SDGs in Colombia. Figure 14.4 presents the most relevant events regarding the SDGs in Colombia.

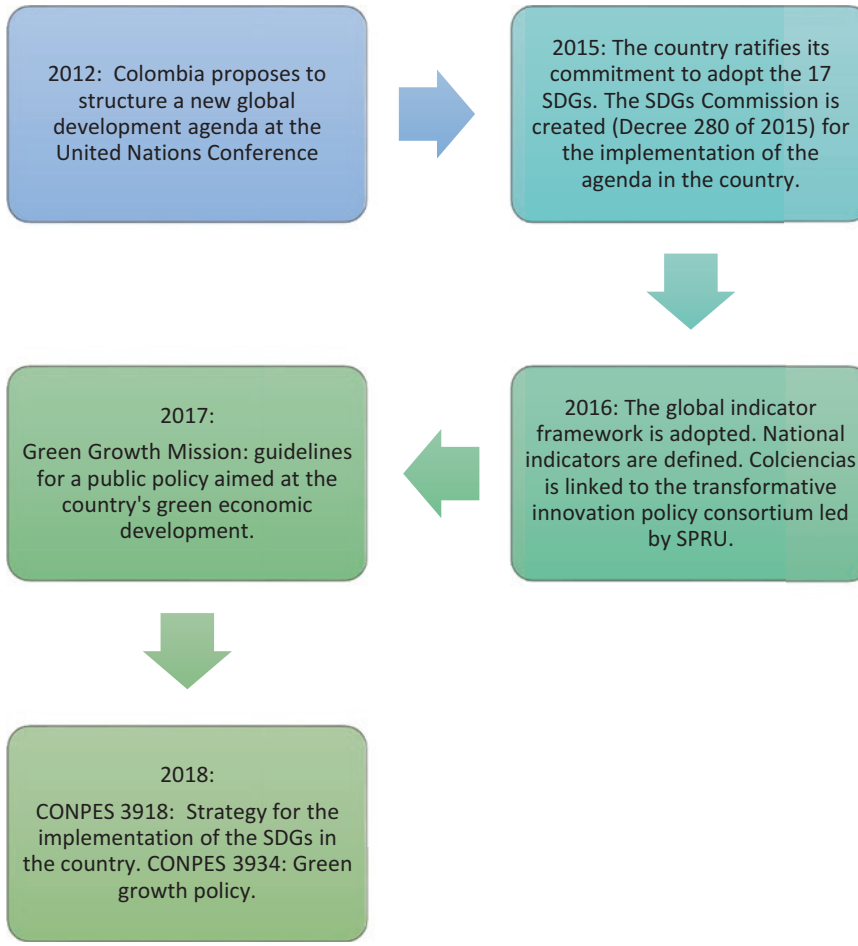

Fig. 14.4 Timeline of the 2030 Agenda in Colombia. Source: Own elaboration based on, (Colciencias 2018b; CONPES 2018b, c; Departamento Nacional de Planeación DNP 2018)

14.7.1 Main Strategies of the STI Policy in Colombia to Adopt the 2030 Agenda

The 2030 Agenda was implemented as a strategy for the sustainable and equitable progress of developing countries (United Nations 2016) and, as a result, Colombia faces major challenges that involve the reformulation of current STI policies to positively impact the social, environmental, and economic context (Colciencias 2018a, b, c, d). One of the challenges STI policies pose is the creation of an educated, prosperous, fair and equitable, society with high quality of life. In that context, development is not only driven by economic growth but also by the most local problems, the environment is taken into account, and all the actors that are part of the National Innovation System actively participate to effect a transformative and inclusive change (Colciencias 2018a, b, c, d; CONPES 2018).

Currently, Colombia has a variety of STI programs and public policies for social and environmental benefits at the national, regional, and local level promoted by different government agencies that have found support in HEIs, private companies, and the social sector. In fact, Colombia is one of the few countries in the world that has a Center for Social Innovation within a public institution and an advanced project of national public policy on innovation that addresses social and environmental problems (Thiele et al. 2010; Villa and Melo 2015). This demonstrates that the need to connect economic and social purposes has been explicit in the Colombian STI policy, and it is no wonder, given the great complexity and diversity of the country, as well as the dimension of the challenges it faces to have a more equitable and prosperous society (Colciencias 2018a, b, c, d).

14.7.2 Colombian University, Incorporation and Achievement of the SDGs

In recent years, Colombian HEIs have developed different studies and conducted research that have contributed to the reconfiguration of public STI policies for the most vulnerable sectors. They have sought to improve their living conditions and support sustainable development. Therefore, the main guidelines of the National Development Plan 2014–2018 "All for a new country" propose to train human capital in STI, research and development, innovation and entrepreneurship, transfer of knowledge and technology for economic development, and the generation of regional social and environmental welfare.

In order to generate a different STI policy and respond to the country's commitment to achieving the SDGs, Colciencias joined the Transformative Innovation Policy Consortium (TIPC), coordinated by the Science Policy Research Unit (SPRU) of the University of Sussex in the United Kingdom and ministries of and participation of funding agencies in countries such as Finland (National Research Council), Mexico (National Council of Science and Technology of Mexico, CONACYT), Norway (Research Council of Norway), South Africa (The South African National Research Foundation, NRF), and Sweden (Swedish Governmental Agency for Innovation Systems—VINNOVA). More recently, other countries have participated with similar initiatives, such as China, Panama, and Brazil. The TIPC has provided guidelines for a new STI policy framework whose objective is to contribute to the solution of the global challenges summarized in the SDGs proposed by the UN (Colciencias 2018a, b, c, d).

Since 2016, a different methodological approach has been developed by Colciencias' STI Policy Unit, which created the National Policy on Science and Innovation for Sustainable Development, known as the Green Book 2030 (Colciencias 2018a, b, c, d). Such book is the result of Colombia's participation in the TIPC and the need to align its STI policy with this global trend. Adopted through resolution 0674 of July 9, 2018, said public policy on science and innovation was developed and proposed adopting a transformative approach in order to contribute to the solution of the most important social, environmental, and economic challenges expressed in the SDGs (Colciencias a, b, c, d). The Green Book promotes changes at the socio-technical

level, considering the complexity and existing interrelation between the problems to be solved. Additionally, it promotes actions in five fronts defined by the STI policy with a transformative approach (Colciencias 2018a, b, c, d):

1. Learning and experimentation: creation of spaces and practical actions that generate processes of reflection, transmission, and acquisition of knowledge and experiences that allow to adjust the public policy and support the necessary changes.
2. Steering: collective process in which different alternatives are considered and actions are oriented toward necessary and desirable changes for sustainable development.
3. Engagement: active involvement and discussion of different actors to generate, use, and access knowledge and innovation that contribute to sustainable development.
4. Interdisciplinarity: collaboration between different disciplines to solve complex problems such as those in the 2030 Agenda.
5. Forecasting of results and effects: open and critical assessment of the purposes, motivations, and intentions in the processes of research and innovation that enable to establish the impacts and ethical limits that compromise sustainable development.

14.8 Conclusions

The current innovation system worldwide has worked on the basis of a clear division of roles and interactions of several actors to respond specifically to macroeconomic demands and market failures; nevertheless, it does not aim at generating social welfare and reducing social and environmental. This trend has only allowed the emergence of innovation approaches focused on solving economic problems and obtaining wealth. Moreover, it has deepened an exclusionary model and is unable to address the new challenges society is handling. For that reason, some nations have expressed the need for different innovation dynamics that can respond to the plurality of current social and environmental requirements (Coenen et al. 2015; Hernández and Pérez 2016; Andoni et al. 2017). As a result of that urgent need to incorporate new intervention dynamics based on innovation processes, Colombia has designed strategies that imply changes in the design of STI policies to face those challenges and achieve the SDGs in the 2030 Agenda.

In particular, the production of the Green Book 2030 revealed six challenges that STI initiatives meet to achieve the SDGs. First, low government investment in this field is a persisting situation in developing countries. Second, STI is a marginal field in people's perception; that is, society in general does not know about or value its processes. Third, STI policies and other national, departmental, and regional policies exhibit limited articulation. Fourth, research agendas are, in general, mono-disciplinary and they do not include inter- or transdisciplinary or ancestral or empirical knowledge, which can contribute to effectively create innovative solutions that are appropriate for the communities. Fifth, technology transfer is usually based on knowing how to do something rather than why, which produces unsustainable, inappropriate, and ineffective innovations. Sixth, although technology absorption capacities are necessary for peer collaboration, low levels were identified.

By contributing as an actor of the National Innovation System to the construction of the new Science and Innovation Policy for Transformation, the university in Colombia becomes as a validator of the achievement of three Sustainable Development Goals. (a) SDG 4: "Ensure inclusive and equitable high-quality education and the promotion of lifelong learning opportunities for all." (b) SDG 16: "Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, responsible and inclusive institutions at all levels." (c) SDG 17: "Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development" at the local and global level.

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