

# **Supporting modernization of land administration in Colombia with joint further education programs**

**Dante SALVINI, Carmen VEGA OROZCO and Lorenz JENNI, Switzerland**

**Key words:** Land Administration; multipurpose cadaster with decentralized operation; advance education program; double certification program; knowledge transfer

## **SUMMARY**

Since 2016, Colombia has conducted important reforms for the modernization of the land administration, such as the development of a decentralised multipurpose cadastre. This challenging mission not only demanded a rethinking at all political and institutional levels, but also highlighted an urgent call for qualified professionals who can ensure its correct execution. In this framework, the Institute of Geomatics FHNW started a project funded by the Swiss Confederation to support the planning and implementation of adequate offers of advanced education programs in land administration. This article aims to present a concerted work between FHNW, two Colombian Universities and the Colombian Geographic Institute IGAC that concluded in a suitable and innovative dual certification program in land administration (FHNW and national diplomas). A close collaboration with national and international specialists from both public and private sector made it possible to meet the requirements, to transfer the know-how between the partners and to ensure the development of relevant learning material. Moreover, this project offers a great degree of flexibility and independence to these institutions to adapt and to enhance the content and teaching formats at different territorial scales in relation to the land administration capacity development needs.

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## **1. INTRODUCTION**

Despite Colombia's significant economic performance over the last decade compared to other Latin American countries, uneven territorial development remains common across the country, with poverty rates widely varying among regions, being extremely high in rural areas. In addition, the effects of decades of armed conflict are further exacerbated by natural disasters and negative impacts of climate change. Moreover, other situation that poses considerable problems particularly to fiscal sustainability and productivity is the obsolete cadastral information, as only 36% of households have formal title and nearly 60% of the country lacks cadastral surveying and mapping [1]. To combat this important condition and to contribute to a balanced territorial development, the Colombian government is leading far-reaching policies and reforms in land administration [4] since 2015, which are reinforced by the peace agreement with the FARC (The Revolutionary Armed Forces of Colombia), approved by the Congress of the Republic in December 2016 [2], the entry into force of the Law 1753 of 2015 of the National Development Plan (NDP) 2014 – 2018 [3] and the creation of the National Land Agency NLA (decree 2363 of 2015).

A central aspect is the government's decision to introduce a cadastre with a multipurpose approach that serves both for taxation purposes and as a reliable source of information to develop legal, transparent and equitable public policies. It shall be an official registry for recording the spatial location, size, use, owners and other parcel related information throughout the country, in order to ensure the legal security of land ownership, to strengthen municipal taxation and to serve as a basis for other applications such as spatial, environmental and socioeconomic planning [5].

The current NDP 2018-2022 of the government of President Ivan Duque, promoted under the slogan "Pacto por Colombia" [5], proposes to build a country of legality, entrepreneurship and equity [5]. Likewise, pacts for equal opportunities for ethnic groups and women, efficiency in public administration and decentralization to connect the territories will be implemented. A strong axis of the new NDP is spatial planning, which will be improved based on updated cadastre information, both at the municipal and regional levels and will be achieved through the updating of the municipal land management plans. Improved access to interoperable geoinformation should be a basic prerequisite for these new plans.

Among other important innovations, is the decentralization at regional and municipal level, where cadastral management changes from a public function to a public service that allows territorial entities to act as independent cadastral managers [6]. This configuration also offers to the private sector a new role of participation in the data collection and updating processes [5].

The national policy document CONPES 3958 (2019) updates and replaces the CONPES document 3859, containing a supposedly broader vision and scope [4]. The updated policy

shall guarantee the gradual and progressive updating of the cadastral information on the national territory, going from the current roughly 6% of the country's surface with updated cadastral information, to 60% in 2022 and 100% in 2025. To this end, mechanisms are foreseen to ensure its financial sustainability and permanent updating [4].

This new vision and mission have not only required a rethinking at all political levels, the adaptation of the legal and regulatory framework, the restructuring of existing institutions and the creation of new ones in the field of land administration in Colombia, but also leads to the demand for qualified personnel to ensure its proper implementation. Based on an exhaustive search, there is currently a large number of educational institutions offering training or further education in subjects related to land administration, including Surveying, Cadastre, Geomatics and Geoinformation Management. A stocktaking conducted in 2021 by this project showed that there are at least 36 public and private institutions throughout the country offering more than 65 programs/courses on these topics [14].

However, regarding the topics of the processes of modernizing land administration in Colombia, training programs are very scarce, being offered only in the three main cities of Bogota, Medellin and Cali, and presented in the form of short courses as they are not yet integrated into the curriculum of undergraduate programs. This not only highlights the urgent need for qualified and manifold training offers that can reach all the professionals in the country, but also the lack of training of university professors in this subject.

The Swiss State Secretariat for Economic Affairs (SECO) supported the Colombian government through the “Modernization of Land Administration in Colombia” (2015-2020) project by providing technical and technological assistance to the institutions involved in the modernization of the land administration. The current second phase of the project called “SwissTierrasColombia” (2021 – 2024) focuses on the institutional strengthening in public policies and processes of land administration, on supporting national, regional and local entities for the adoption of technical and technological changes within the framework of the decentralization policy and the strengthening of human capital in these field [7]. In this context, and to address the need for training professionals, SECO funded a project with the University of Applied Sciences and Arts Northwestern Switzerland (FHNW), on behalf of the Institute of Geomatics. The general objective of the project is to contribute to the continuity of the process of modernizing land administration in Colombia through the development of appropriate training opportunities to keep with the generation of the required human resources. Likewise, such further training should also seek to:

- Train professionals already active in the field to participate in the implementation of an efficient and sustainable multipurpose cadastre.
- Meet the demands of a high-quality higher education and be developed within a common reference frame / academic credit system (e.g., ECTS) and in line with requirements of formal and informal education in Colombia.
- Fulfil the requirements defined for the decentralized operation of the multipurpose cadastre, involving territorial entities (e.g., municipalities) and the private sector.

This article aims to present a concerted work between FHNW with two Colombian Universities and the Colombian Geographic Institute (IGAC) that concluded in a suitable and innovative dual certification program (FHNW and national diploma) in land administration in

Colombia for active professionals at different management and operational levels to obtain the required and updated knowledge to face the new challenges.

Close collaboration with national and international specialists from the public and private sector also made it possible to satisfy the new specifications for a multipurpose cadastre with decentralized operation in terms of technical and managerial knowledge, to transfer this know-how among the partners and to ensure the development of relevant topics. Moreover, this project also offers a great flexibility and independence to educational institutions to adapt and enhance contents and teaching formats at different territorial scales in relation to the land administration demands.

## **2. MATERIALS AND METHODS**

As presented in the previous chapter, this project consisted of developing advance training opportunities to foster and further generate the required professionals to contribute to the continuity of the modernization process of land administration in Colombia.

### **2.1 PARTNER INSTITUTIONS**

A strategic document for the creation of this project was an interinstitutional Memorandum of Understanding (MOU) between the Ministry of Agriculture, Ministry of Justice, National Department of Statistics (DANE), National Department of Planning (DNP), Geographic Institute Agustín Codazzi (IGAC), Superintendency of Notaries and Registry (SNR) and National Land Agency (ANT). In addition to the different planning requirements for implementation, the document also defines conceptual and technical objectives and principles. Two relevant topics of this institutional MOU were considered for the development of further education offers: 1) The IGAC as the regulatory and control body as well as an authorizing entity for cadastral operators; and 2) the need to generate competent human resources accredited by private and public academia, the IGAC, National Learning Service (SENA) or other entities capable of generating skills to supply the demand of human resources of the new cadastral system [12]. In this sense, given the leading role of the IGAC, the integration of this institution in the project as an executing partner was imperative. Moreover, IGAC also hosted at that time the CIAF, a geographic information research and development center, created for the technological innovation and institutional strengthening of the institute, as well as for the training of the institute's personnel and other interested professionals.

The project was also developed and implemented in close collaboration with two Colombian universities: University Distrital Francisco José de Caldas (UD) and University Sergio Arboleda (USA). One of the major reasons for choosing these institutions, besides their credibility in the country, was to favouring those that already offer curricula, a training or advanced education programs in fields related to land administration. Other aspects were also inquired, such as the experience in establishing new advanced education courses and administrative flexibility to adopt new postgraduate studies in a short term. To formalize the relationship between all participating institutions, two official documents were signed: first, a MOU, and in a second step, a collaboration agreement for the advance training program.

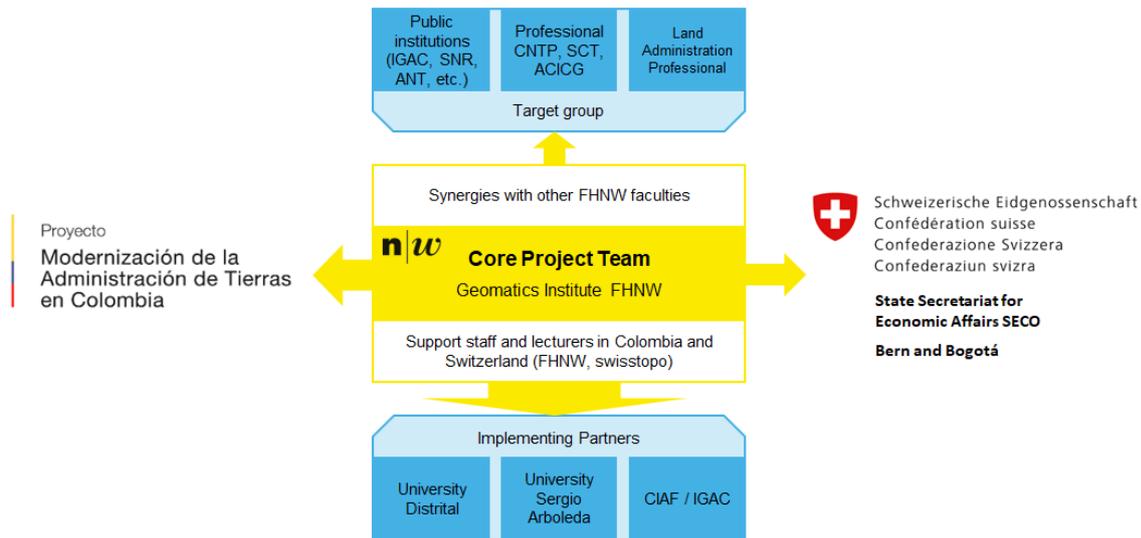


Fig. 1: Involved Stakeholders in the Project Implementation

## 2.2 SELECTION OF RELEVANT TOPICS

At the time of the conceptualization of this project, the project funded by the Swiss Government had achieved several significant results in the process of defining new standards and approaches of the new multipurpose cadastre system and in general in modernizing land administration in Colombia. This allowed to identify and to develop some of the main issues of the course. Additionally, further important topics were also defined in collaboration with different public and private experts from different national and international institutions involved in land administration. Based on the of the new challenges in land administration in the country and with the objective of training professionals at the managerial and technical levels, nine main topics were selected to be developed in the proposed course as follow:

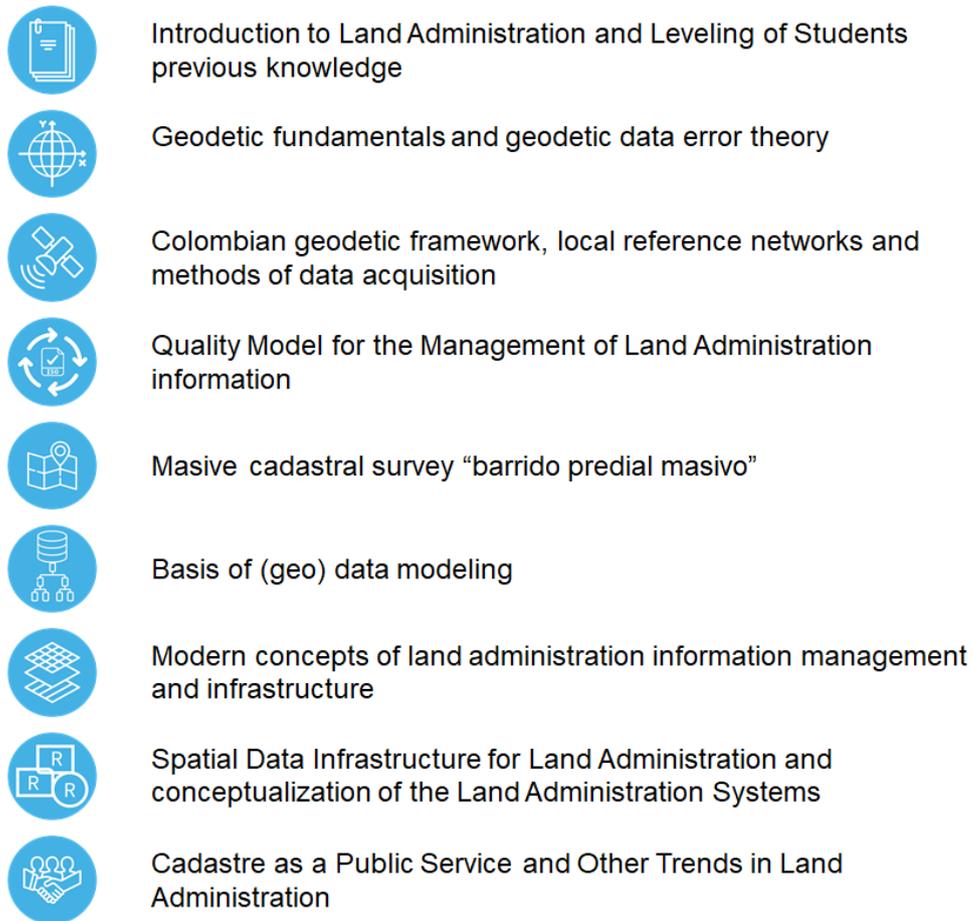


Fig. 2: overview of modules of the CAS

- Modules one, two and three aim to familiarize and leveling participants with the basis of legal and technical topics of land administration such as the political framework in Colombia with emphasis on the development of the new cadastre with a multipurpose approach; geodetic reference systems and Colombia framework; data acquisition methods to satisfy the technical specifications of the multipurpose cadastre.
- The fourth module is intended to define quality elements and processes for evaluating the fulfilment of multipurpose cadastre product with the defined standards.
- The fifth module is the central topic where participants are aware of all the phases of the production of a multipurpose cadastre product; from planning and preparation to field work including the social components, quality control and articulation of cadastral information with the land registry for property formalization and titling processes.
- The sixth, seventh and eighth modules concern a broad knowledge and concepts in data infrastructure and modelling, understanding the ISO 19152 (LADM) standard, the profile developed for Colombia using the modelling language INTERLIS [13] and the conceptualization of the land administration system for consultations on public law restrictions and responsibilities on property rights.

- The last module shows a work path for the empowerment of managers, the mechanisms of collaboration with private entities and the proposal of a modern public services delivery scheme focused on citizenship, supported by technology and innovation. Furthermore, it presents current trends in land administration such as 3D Cadastre, BIM, Augmented Reality, Smart City, Blockchain, Crowd Sourced Cadastre, Augmented Citizen, among others.

### 2.3 ACCADEMIC CERTIFICATION

Higher education in Colombia is inscribed as a permanent process of professional academic training that takes place after secondary education and allows the development of the human being's potential in an integral manner [**Error! Reference source not found.**]. At the postgraduate level, in addition to specializations, master's degrees and PhD programs, there are other certified short programs such as Diplomados, seminars and other short courses. At the postgraduate level, higher education in Colombia offers traditional programs such as specializations, master's degrees and PhD. The latter programs are offered by universities on an autonomous basis, which means that they can only be certified and are not awarded degree per se. They are intended for university graduates and are considered as a way of improving professional performance by providing practical knowledge and specific tools that allow them to keep abreast of the main advances in a profession.

From the Colombian context, based on the flexibility of these certified short programs, in terms of administrative process of implementation, the land administration training program of this project was inscribed under this form to facilitate a short/medium term deployment procedure as the incorporation of the program into an undergraduate and master's curriculum could take many months or even years.

From the Swiss context, the land administration training program was structured as a Certificate of Advance Studies (CAS), consisting of 15 ECTS, translated into a total time of 450 hours (time spent attending lectures and events, accompanied and individual self-study, practical exercises, assignments, exams, and a final thesis).

### 2.4 TARGET AUDIENCE

The training targeted professionals who are already actively involved or wish to participate in the further development and implementation of the multipurpose cadaster and other topics related to Land Administration. These professionals should be able to benefit from their further education for their personal development and in general for the economic and social environment and growth in Colombia.

To this end, it was important to differentiate between the needs of public institutions and of the private sector:

- In the case of institutions, a possible approach was the strategic-political level of Land Administration, including training in management competencies. At the technical level, professionals from public institutions will be confronted with monitoring and data validating functions, during execution of operator's contracts. Therefore, they must know the technical standards and validation processes and methods, including the acceptance criteria in detail. They must master the technology to correctly interpret the data delivered by the operators.

- For the private sector, on the other hand, the focus was rather on the operational and technical implementation of the future cadastre system. The correct and proper application of the standards and a variety of data acquisition methods is important, as well as the mastery of the tools and principles to be applied to generate reliable data used in Land Administration. This includes a thorough knowledge of official data models and data transformation. Knowledge of the application of internal quality assurance methods, but also certain ethical aspects in the exercise of a public service function in the new cadastre, must also be taught.

## **2.5 DIDACTICAL CONCEPT AND RESPONSE TO THE COVID-19 OUTBREAK**

The course modality was based on a blended learning scenario to create the greatest possible flexibility for both students and lecturers. Blended learning is an approach to education that combines online educational materials and online interaction opportunities with traditional place-based classroom (face-to-face) methods. The appropriate use of digital technology plays an important role in supporting a collaborative learning environment and thus meeting the requirements of modern teaching. Moodle hosted by FHNW was used, as a web-based collaboration platform, for the course implementation, as it fitted perfectly into a blended learning design. The entire course and its materials were offered in Spanish.

As mentioned before, the course consisted of nine modules, which covered the same number of topics, identified as relevant (see section 2.2). Each module was self-contained and yet built on each other. For each module an expert in the relative topic was awarded as module leader by the academic committee. It was his/her task to develop the detailed course content and the coordination of the contribution of the teachers involved.

Beside the e-learning part, classroom lectures and practical exercises played an important role, for which the partner university provided the necessary infrastructure and logistics in their campus in Bogotá. The theory was complemented by practical applications, which were solved partially during the lessons and completed in self-study. If software was needed for these, free and open-source software was used. A practical field exercise offered the opportunity to the course participants to apply surveying equipment and related tools for data collection and to experience a part of the workflow for the acquisition of cadastral data.

Due to the outbreak of the pandemic about halfway through the course, all lessons had to be switched to distance teaching and further field works had to be canceled. The course program was quickly readjusted to the new requirements, switching to a completely virtual classroom mode. This resulted in the duration of the course being extended over two months longer than planned, since the week-hours intensity was reduced to fit to distance teaching. The MS Teams from FHNW was used as the platform to hold the virtual lessons and for sharing other information during the course.

Corresponding to the guidelines for the implementation of CAS, a thesis work and an exam were to be carried out at the end of the course. The topics for the thesis were proposed by the teachers and elected by the course participants at the beginning of the course. This to allow the redaction of a technical paper during the course, including examination of the required literature and self-studying. The thesis was presented at the end of the course.

### **3. RESULTS**

#### **3.1 TEACHING MATERIALS**

The developed teaching material in form of script, slides, videos etc. for the course is based on the state of technology and the technical rules of the art. The topics of the modules were in-line with the institutional requirements in Colombia at the time. The high-quality standard could only be reached thanks to the involvement of national and international experts in land administration.

Once the first implementation of the course went to its end, the entire teaching material was revised, and the course structure was improved according to the feedback from course participants (see section 3.3). This in view of repetitions of the course or part of it.

All project implementing partners have the same rights of use over the documentation and can rearrange it into new course formats on their own or cooperating with other training institutions. This ensures the further development of the content and promotes its integration into existing curricula of undergraduate programs.

#### **3.2 THESIS**

The topics proposed by the teachers for the thesis work were applied to the actual context and referred to the current developments in Colombia at the time. The elected topics vary from legal aspects to the social impact of land administration, from the adaptation of agile methods to the configuration of tools and equipment for field work. The following titles are intended to give an impression of the breadth of the topics covered:

- Analysis of the legal framework of the integration process of the multipurpose cadastre, and the social management of rural property (Ordenamiento Social de la Propiedad Rural – OSPR) and identification of gaps and potential for improvements.
- Comparative analysis of direct and indirect acquisition methods for cadastral surveys.
- Configuration of the tool QField for field data capture in accordance with the LADM-COL operating model.
- Modelling of a simplified LADM-COL data model and implementation using available tools.
- Planning with an agile project management method (Scrum or Kanban) a massive property survey, with its stages, organization, communication strategy, etc.
- Proposal for the qualification of a municipality as a cadastral manager (provision of a public service).
- The role of the private sector and Public-Private Partnerships (PPP) in land administration: comparison of different models at the international level and conclusions for the case of Colombia
- Development of a collaborative approach for the permanent maintenance of cadastral information
- Proposal of tools and good practices for a transparent and participatory cadastral management.
- Cadaster with a differentiated approach: proposal for the development of an inclusive cadastral management.

The theses were presented to a panel consisting of the academic committee, course participants, teachers and representatives of various institutions and evaluated.

### **3.3 TITLE ISSUED AND CERTIFICATION**

In order to joint together the two training modalities mentioned above, and in order to validate them in the educational systems of the two countries (Colombia and Switzerland), a doubled certification was considered and applied as following:

- A Diplomado certificate issued from the partner institutions UD, USA and IGAC, after meeting the 100% attendance requirement.
- A CAS certificate issued by the FHNW, after meeting the following three requirements: 1) approved final exam; 2) a sufficient CAS thesis; and 3) at least 80% of the class hours attended.

### **3.4 COURSE EVALUATION**

An extensive evaluation of the course was carried out both by the participants who completed the course and by the teachers involved. The evaluation per module by the participants was done through an online form directly on Moodle. Teacher evaluation was done through a question form sent to them.

From the point of view of the course participants, the difficulty of the modules was evaluated ambivalently. This also due to the heterogeneity of the participant's background, with lawyers, social scientists, environmental scientists and cadastral engineers.

The practical exercises were very well received, and it has been suggested to dedicate even more time to such activities as well as linking them stronger with the theoretical parts. The presentation of good practices from other countries was very much appreciated as well.

The teachers qualified all modules as highly relevant to the subject of land administration in Colombia. Some didactical improvements were suggested, as for example mechanisms for holding (improving) the active participation during distance teaching or the introduction since course begin of some techniques for self-study.

The detailed evaluation has been documented and can be used for the implementation of further similar courses.

## **4. DISCUSSIONS**

This project developed and implemented a flexible land administratin training program for professionals active in this field in Colombia, in close collaboration with two Colombian universities and IGAC. One of the main reasons for choosing to work with these institutions was that they already offer training or advanced education programs in the field of land administration. The extended project team was made up of contracted freelance consultants, lecturers and professors from the partner universities and administrative staff. Other

government institutions also contributed to the lectures due to their expertise and involvement in relevant Land Administration topics such as ANT, DANE, SNR and swisstopo.

The further education training consisted of a modular CAS course of 450 hours (equivalent to 15 ECTS) developed and implemented and available for further editions. This course meets the requirements of a high-quality advance education and was developed within a common academic credit system (ECTS) and in line with requirements of formal and informal education in Colombia. It included a double certification consisting of a diploma issued by the FHNW and a joint certificate issued by the two partner universities and IGAC.

The participants attending the program acquired the essential basic knowledge and solid theoretical foundations on various political, legal and technical issues of land administration in Colombia. They were sensitized to the legal and social requirements in relation to the future implementation of the multipurpose cadaster as a public service, where parts of its operation may be outsourced to third parties. They were also familiarized with the fundamentals of geodesy, including the national geodetic reference framework and the establishment of geodetic networks, with a focus on the design, measurement and processing of local densification networks.

Within the scope of exercises and employing different software and hardware components, the participants completed a data modelling project, its testing and the provision of LADM-compliant data; they also learned the comprehensive standards of the new multipurpose cadaster and transferred this knowledge into practice.

They acquired knowledge on the detailed procedures of the Barrido Predial and attained the necessary skills to adequately plan and execute such projects, with special attention to quality assurance, and to the creation of reliable information, required to contribute to the legal security of land ownership. This included procuring the necessary knowledge to design, establish and apply a quality plan, experiencing new possibilities and limitations in the use of new and efficient methods and technologies for surveying and in general fit-for-purpose data acquisition in the field. Likewise, to know the conceptual basics of Spatial Data Infrastructure (SDI) and, in particular, the case of the Colombian ICDE. The potential of the SDI for Land Administration (IDE-AT) for consultations on public law restrictions and property rights responsibilities were explored in depth and enriched by a case study of the Swiss Public Law Restrictions Cadaster, which can be considered as a worldwide best practice of implementing the Cadastre 2014 principles.

Finally, participants developed appropriate skills and knowledge to apply the new standards and approaches in their current and future projects, to lead, as experts, the dialogue between the stakeholders and to support decision-making in the process of modernizing the countries' Land Administration.

The multidisciplinary background of participants contributed to an interesting ex-change. The fact that among the CAS graduates there were engineers, lawyers, architects, political scientists and other professions showed that the content corresponds to a multi-disciplinary domain such as Land Administration.

The COVID pandemic also had an impact on this project. The change to a purely virtual operation required the adaptation of the already detailed existing program as well as part of the contents. Due to the great flexibility of the participants as well as of the lecturers, the last

4 modules as well as the final exam and the final presentations were carried out with additional efforts but with no major complications.

In the organization and execution of this CAS, other complex challenges were experienced and endured, not only in terms of the topics and the different profiles of the participants, but also in terms of organizational, financial and coordination aspects. These included, for instance, the coordination of four institutions that, although they shared the same vision, mission and language, their administrative and bureaucratic realities were not the same. Moreover, another challenge was the coordination of a large number of professional staffs to ensure a high and equal quality of all classes and to maintain a continuous line of the different topics taught. Another important point was also the coordination and execution of the different hiring conditions that were handled for each lecturer according to his status as an employee of the partner institutions, or as national or international freelance consultant.

## CONCLUSION

Given the requirements and demands of the new Land Administration in Colombia, and as experienced in this education project, one of the main current issues is the need to count with adequate professional training offers that address all the mandatory knowledge, from management to technical aspects.

A diversification of the training offers could be of great importance in Colombia to cover the variety of technical and management professionals with different levels of training and experience. In this regard, IGAC could have an essential role in coordinating the topics and the different levels of training, seeking to guarantee equity in the quality of the programs and the information provided.

The “Swiss” CAS format, although very demanding for the students - is certainly transferable to Colombia. The 20 graduates with FHNW CAS diploma fulfilled all the requirements and should be able to perform future tasks as technical employees, consultants and managers.

In the case of further executions, a shorter implementation time is advisable, with only 10 ECTS instead of 15, as is also the case in most CAS in Switzerland. A somewhat more modular offer with optional leveling courses at the beginning of the modules would align the different levels of prior knowledge even better.

A more manageable format, with lower registration fees and shorter completion time, was successfully carried out by the UD and the USA individually (Diplomado with 60-100 hours).

This highlighted the necessity to maintain flexibility in training offers in accordance with Colombia's socioeconomic and labor conditions.

As a result of the above, it is also important to identify the profile of the professionals involved in the different processes of Land Administration in Colombia in order to plan their priorities and orient their needs for future trainings.

The structuring of the course into modules offered great flexibility for the execution and adaptation of new and still-evolving topics. This allowed the use of individual module contents in other short courses (facilitated by both UD and USA), mainly in the topics of Land Administration Domain Model, Certification of Cadaster Management Institutions and Spatial Data Infrastructures. The FHNW project team worked as well with the UD to organize a new Diplomado course of about 60 hours in total duration. This course was based on some of the existing CAS contents, with minor up-dates on some topics. Preference was given to UD professors and they were encouraged and supported to go deeper into these topics to ensure knowledge transfer.

Currently, several CAS topics are being considered in modernizing of the curriculum for cadastral engineers at UD. It is expected in a medium term, that universities or academic institutions include the new topics of Land Administration in their graduate programs as undergraduate and postgraduate.

In addition of the topics of Land Administration in Colombia required for professional training, it is also imperative to consider incorporating lessons in project management and technical report writing. These two subjects were offered in the CAS and were worthwhile, as many of the participants did not have the required skills.

Formal cooperation between the partner institutions involved considerable efforts to establish a legal framework for cooperation (MOUs and specific agreements). Despite this and the other organizational challenges when working from different continents, the implementation of this project was very valuable. The personal commitment of all partners undoubtedly contributed to the success of the project and strengthened synergies between these institutions. Moreover, there was a network of specialists willing to develop state of the art didactic materials, to participate as lecturers and who also showed great commitment.

In this context, it is very important that the institutions responsible for the development of Land Administration in Colombia work hand in hand with the academic institutions that train professionals to update and strengthen the human capital necessary to carry out a state-of-the-art cadaster and an integral and functional Land Administration System. Professionals must be

aware of the new processes required in the new operation of the ,multipurpose cadastre and academic institutions must be able to meet these new demands.

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## **BIOGRAPHICAL NOTES**

Dante SALVINI studied surveying and geomatics at ETH Zurich (Switzerland). He completed his Ph.D. at the Institute of Geodesy and Photogrammetry in 2008. After eight years in the private sector, in 2016 he was appointed professor at the institute of geomatics at the FHNW, where he conducts research in the fields of geodesy, land management and navigation.

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