Dossier

water and landscape
AGUA y TERRITORIO

The dams of others: hydropower interventionism in the Italian and Spanish journals of civil engineers (mid-twentieth century)

Las presas de los otros: intervencionismo hidroeléctrico en las revistas italianas y españolas de los ingenieros de caminos, canales y puertos (mediados del siglo XX)

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ABSTRACT

Large dams emerged as one of the most crucial political instruments between the 1930s and the 1960s. They supported both the nation's growth, through irrigation and hydropower, as well as the legitimacy of governmental authority, thanks to techno-scientific interventions. After reading the most prestigious publications for civil engineering in Spain and Italy, such as *Revista de Obras Públicas* and *L'Acqua* or *L'Energia Elettrica*, this paper aims to highlight the impressive, if uneven and asymmetrical, mutual attention between engineers. The differing political positions during postwar era had an impact on it. Additionally, they were placed in a larger transnational framework of technical and scientific knowledge exchange with other leading countries. This research serves to explore the hierarchical nature of the technoscientific community during the Cold War by first describing the influences of Italy on Spanish hydraulic interventionism and then the near total absence of Spain in Italian engineering journals.

KEYWORDS: Dams, Engineering journals, Postwar Italy, Franco's Spain, Techno-scientific community.

RESUMEN

Las grandes presas surgieron como uno de los instrumentos políticos más cruciales entre las décadas de 1930 y 1960. Respaldaron tanto el crecimiento de la nación, mediante el regadío y la energía hidroeléctrica, como la legitimidad de la autoridad gubernamental, gracias a las intervenciones tecno-científicas. Tras la lectura de las publicaciones más prestigiosas de ingeniería civil en España e Italia, como la Revista de Obras Públicas y L'Acqua o L'Energia Elettrica, este trabajo pretende poner de relieve la notable —aunque desigual y asimétrica— atención mutua entre los ingenieros. Las diferentes posiciones políticas en la época de posguerra influyeron en ello. Además, se insertaban en un marco transnacional más amplio de intercambio de conocimientos técnicos y científicos con otros países de referencia. Esta investigación sirve para explorar la naturaleza jerárquica de la comunidad tecno-científica durante la Guerra Fría, describiendo en primer lugar las influencias de Italia en el intervencionismo hidráulico español y, posteriormente, la casi total ausencia de España en las revistas de ingeniería italianas.

PALABRAS CLAVE: Presas, Revistas de ingeniería, Italia de posguerra, España franquista, Comunidad tecno-científica.

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As barragens dos outros: o intervencionismo hidroelétrico nas revistas italianas e espanholas de engenheiros civis (meados do século XX)

RESUMO

As grandes barragens tornaram-se um instrumento político crucial entre as décadas de 1930 e 1960. Destinavam-se a contribuir para o crescimento da nação, através da irrigação e da hidroeletricidade, e a legitimar a autoridade governamental, por meio de intervenções tecnocientíficas. Partindo da leitura das mais prestigiadas publicações de engenharia civil em Espanha e Itália, como a *Revista de Obras Públicas* y *L'Acqua* ou a *L'Energia Elettrica*, este artigo pretende destacar a impressionante, embora irregular e assimétrica, atenção mútua entre os engenheiros dos dois países. As diferentes posições políticas durante o pós-guerra desempenharam um papel importante neste contexto. Para além do mais, situavam-se num quadro transnacional mais vasto de intercâmbio de conhecimentos técnicos e científicos com outros países líderes. Esta investigação permite explorar a natureza hierárquica da comunidade tecnocientífica durante a Guerra Fria, descrevendo, primeiro, as influências italianas no intervencionismo hidráulico espanhol e, depois, a ausência quase total de Espanha nas revistas italianas de engenharia.

PALAVRAS-CHAVE: Barragens, Revistas de engenharia, Itália do pós-guerra, Espanha Franquista, Comunidade tecnocientífica.

Les barrages des autres : l'interventionnisme hydroélectrique dans les revues d'ingénieurs civils italiens et espagnols (milieu du 20e siècle)

RÉSUMÉ

Les grands barrages sont devenus un outil politique crucial entre les années trente et soixante. Ils soutenaient à la fois la croissance nationale, par le biais de l'irrigation et de l'hydroélectricité, et la légitimité gouvernementale, à travers des interventions techno-scientifiques. L'examen des revues les plus prestigieuses du génie civil en Espagne et en Italie, telles que la *Revista de Obras Públicas* et *L'Acqua* ou *L'Energia Elettrica*, permet de mettre en évidence l'attention réciproque notable, bien que parfois irrégulière et asymétrique, entre les ingénieurs. Les différentes positions politiques de l'après-guerre ont joué un rôle à cet égard. De plus, ces ingénieurs étaient intégrés dans un cadre transnational plus large d'échange de connaissances techniques et scientifiques, dominé par d'autres pays plus influents. Cet article permet d'explorer la nature hiérarchique de la communauté technoscientifique pendant la guerre froide, en décrivant d'abord les influences italiennes sur l'interventionnisme hydraulique espagnol, puis en soulignant l'absence presque totale de l'Espagne dans les revues d'ingénierie italiennes.

MOTS-CLÉS : Barrages, Revues d'ingénierie, Italie d'après-guerre, Espagne franquiste, Communauté technoscientifique.

Le dighe degli altri: interventismo idroelettrico nelle riviste italiane y spagnole degli ingegneri civili (metà del Novecento)

SOMMARIO

Le grandi dighe si ersero come uno strumento politico fondamentale tra gli anni Trenta e Sessanta. Sostenevano sia la crescita della nazione, attraverso l'irrigazione e l'energia idroelettrica, sia la legittimità governativa, grazie agli interventi tecno-scientifici. Lo spoglio delle più prestigiose riviste di ingegneria civile in Spagna e in Italia, come la *Revista de Obras Públicas* e *L'Acqua* o *L'Energia Elettrica*, permette di evidenziare l'impressionante, anche se irregolare e asimmetrica, attenzione reciproca tra gli ingegneri. Le diverse posizioni politiche del dopoguerra hanno avuto un impatto su questa relazione. Inoltre, gli ingegneri erano inseriti in un più ampio quadro transnazionale di scambio di conoscenze tecniche e scientifiche, dominato da altri e più influenti paesi. Questo articolo serve a esplorare la natura gerarchica della comunità tecnoscientifica durante la Guerra Fredda, descrivendo prima l'influenza dell'Italia sull'interventismo idraulico spagnolo e poi la quasi totale assenza della Spagna nelle riviste di ingegneria italiane.

PAROLE CHIAVE: Dighe, Riviste di ingegneria, Italia del dopoguerra, Spagna franchista, Comunità tecno-scientifica.

The hydraulic mission in Italy and Spain

Eduardo Torroja, one of the most important Spanish civil engineers in mid-twentieth century, claimed that "the scientist and the technician, who until then had gone their separate ways, eventually came to look at each other"[1]. There was nothing new about this rhetoric of engineers claiming for themselves the synthesis of science and practical problem-solving, neither in Spain nor elsewhere in continental Europe[2]. Nevertheless, it is interesting to observe how different practices and technologies were presented as material embodiments of this techno-scientific fusion. The concrete, used for the dams, was one of those items that symbolised the work of the engineers as technical agents of the power. The dams were one of the star outputs of the civil engineers who moved both in national and international environments. While they presented themselves as working to improve the economy and the society of each country, shaping and implementing hydraulic policies, they felt part of a broader, global scientific community. "The bigger the community, the more powerful became the image of the ideal construction of a hydropower plant and the more the image of the success of dams was accepted", stated Benjamin Brendel[3]. As the Italian engineer Gaetano Ciocca affirmed "scientists have quietly established an international republic". Ciocca, who dedicated most of his career to the construction and the agriculture, experiencing both the fascism interventionism and the republican policies of Postwar, was referring also to the possibility of including experts from developing countries as well, because, as the world conferences showcased, everyone could be part of this republic[4]. The engineers sought and found their legitimacy in this transnational community, and the Spanish engineers —who came from a country under a dictatorship which struggled for international recognition— were no exception.

The large dams and mega-dams became an important part of development policies. Since the eighteenth century, Spanish civil engineers played a pivotal role in the water regulation, either in the Iberian Peninsula or in colonies[5]. In Italy, the modernization through hydraulic intervention was at the core of the action of the State both during fascism and the first decades of the Italian republic[6]. Rather than analysing the implementation of agricultural policies or the results of hydraulic interventions, which have already been extensively studied[7], this paper analyses the reciprocal observation between the two engineering communities. There were some common ideas, and participation in the international scientific debates. However, the two communities differ in their international presence and prestige. A glance at the book of the leading exponents of hydraulic engineering and fluid mechanics is enough to verify it mentions 104 Italian engineers, but just 27 Spanish ones, although both countries have a smaller presence compared to other ones, such as France and Germany[8]. So, this paper assesses the attention paid by the civil engineers of one mediterranean country to the other.

The study of the "hydraulic bureaucracy" and the action of state technicians in inducing technological change in the rural world has traditionally been a task shouldered by geographers, economists, and engineers. Often, as they were themselves protagonists of the period, they have tended to analyse it with a certain bias[9]. Likewise, the topic of infrastructures is not an economical or technical domain. Studies from many disciplines reflect on the value, impact, and meaning of the infrastructures. In the humanities, the environmental history and the history of science and technology are especially interested in the production and exploitation of energy, with its social and ecological issues[10], and in the control of the river and other water resources relating to the social activities and state intervention[11]. The social and cultural studies have also been concerned to the profession and the social status of the engineers. Martykánová and Pan-Montojo talked about the *engineerism*, i.e. the idea the State intervention converged with public works and the political leadership of the engineers since the nineteenth century. Brendel examined how the Spanish engineers defined their *habitus*, their masculinity and their practices along the twentieth century through the international conferences and participating in the worldwide competition for the large dams[12].

[1] Torroja, 1944, 13.
[2] Lusa Monforte, 1994. Harwood, 2006. Martykánová, 2023.
[3] Brendel, 2022, 100.
[4] Ciocca,1955.
[5] Garrido Herrero, 2014. Fernández-Armesto; Lucena Giraldo, 2022.
[6] Rossi-Doria, 1958. Stampacchia, 2000.
[7] Barone, 1986. Lanero Táboas, 2019.
[8] Hager, 2009.
[9] García Tapia et al., 1987. Sáenz Ridruejo, 1993. Spancold, 2006. Associazione Idrotecnica Italiana; Gruppo Italiano di Idraulica, 2010.
[10] Miller et al., 2019. Bonan; Occhi, 2023.
[11] Jørgensen; Arne Jørgensen; Pritchard, 2013. Parrinello; Neri Serneri, 2022.
[12] Martykánová; Pan-Montojo, 2020. Brendel, 2022.

Considering the cultural and technical relationship between Italy and Spain, the civil engineers' journals are a great source to study their voices with a historical approach. Journals and conferences were fundamental not only for the diffusion of the techno-scientific discourse, but also for the definition of the professional identity and the construction of national communities of engineering[13]. The readings, analyses, speeches, and visits to the works of Spanish and Italian technicians were numerous and left traces in various publications, such as the report of 1888 by Giacomo Torricelli and Giuseppe Zoppi about the reservoirs and irrigation in Spain[14]. They are examples of how the visit and mobility abroad contributed to the transmission of knowledge. This is crucial to understand the curiosity and, especially, the admiration of Spanish technicians for the work of their Italian counterparts. On the other side, the Italian engineering journals or the conferences of civil engineers praised mostly the progress of hydraulic works in Italy. Nonetheless, they also show attention to the engineering discipline in other countries during the decades between the 1920s and the 1970s, that civil engineers themselves considered critical for the development of their discipline[15]. This paper focuses on this period, with special emphasis on the 1950s. This time-span allows to follow the work of engineers throughout the different regimes of the two countries: from the Mussolini's dictatorship (1922-43) to the Italian democratic republic since the 1946; and both the dictatorships of Primo de Rivera (1923-1930) and Franco (1936-1975) with the Spanish Second Republic in between (1931-1939).

A comparison of agricultural policies and hydropower infrastructures

In Italy, one of the keys concepts of the modernization policies of the first half of the twentieth century was the integral *bonifica*. This notion implied not only drainage and sanitation works, but since the legislation of 1900 also the public intervention to regulate water, build road, and care of forests and soils. The policies of *bonifica*, as the battle for grain, expressed the need to "ruralise" Italy while aiming to accelerate industrialisation[16]. The geographer Teresa Isenburg interpreted this public works as an ideological tool to convincing the rural masses and to get the capitalist groups closer[17]. But the water regulation was linked also to the politicians' obsession regarding energy production. In the absence of other resources, such as coal, hydropower was considered key to the industrial take-off[18].

USA and URSS starred in this hydraulic race of the twentieth century; but other European countries, such as France and Switzerland, or recently decolonised countries, as India or Egypt, participated in it vigorously[19]. Many historians link Mussolini's regime policies with those of the other nations during the Interwar years and beyond. But fascism trend is also considered a key element of the policies of Iberian dictatorships, including Franco's regime[20]. The influences of fascism in Spain extended beyond labour legislation, i.e. the Spanish Labour Organization during Franco that was almost a translation of the corporatism of the *Carta del Lavoro*[21]. For instance, the fascist Institute for Industrial Reconstruction inspired the National Institute of Industry founded in 1941 and committed to electricity generation.

Especially since the second half of the 1940s, Franco's regime had to respond to the fall of fascism in Europe. It adapted to the new international context and was influenced by democratic-capitalist and even Communist countries[22]. Some studies have pointed out that Italian post-fascist hydraulic works continued to exert a significant influence[23]. Scholars agree that both fascist and republican interventions inspired Francoist policies of internal colonisation and constructions of the 1950s[24]. They also point out the fact that the great Spanish provincial plans of those years were framed in agricultural policies inspired by the actions of other countries. But these authoritarian and paternalistic plans of the fifties did not achieve the results of the governments of France or Italy[25]. According to Misiani and Gómez Benito, also the Italian Republic's agrarian reform, as well as Franco's internal colonisation, was an anachronistic intervention

[13] Martykánová, 2010, 185. Pretel; Camprubí, 2018.
[14] Zoppi; Torricelli, 1888.
[15] Benfratello, 2010.
[16] Stampacchia, 1983. Cavallo, 2011. Armiero; Biasillo; Graf von Hardenberg, 2022.
[17] Isenburg, 1981, 11-12.
[18] Petri, 2002. Bernardi, 2014, 85-87.
[19] Sneddon, 2015.
[20] Lanero Táboas, 2019, 270. See also Alares López, 2011. Cabana Iglesia; Díaz Geada, 2014.
[21] Muñoz Soro; Treglia, 2017.
[22] Saz, 2002. Del Arco Blanco; Hernández Burgos, 2020.
[23] Tordesillas, 2010. Rabasco Pozuelo, 2011.
[24] Flores Soto, 2013b. Bazán de Huerta; Lozano Bartolozzi, 2015. D'Amaro, 2022b.
[25] Barciela López; López Ortiz, 2013.

of a patrimonial nature, based on the redistribution of land[26]. The studies about the narrative and activities of Italian engineers have emphasized the technical continuities of the *bonifica*, between the beginning of the twentieth century and the sixties[27]. However, in the postwar period, these reforms functioned as catalysts for national propaganda to legitimise the effectiveness of the respective regime in modernising the rural world and electrify the country. Both republican Italy and Franco's Spain, as well as the Soviet Union, propaganda activated all media, including cinema and literature, to glorify the regime's hydraulics work thanks to the interventions of the engineers[28].

Agricultural transformation and the energy production were technocratic types of geographic intervention, based on civil engineering. In fact, some intellectuals, as the Spanish writer and engineer Juan Benet, put the hydropower at the centre of the State-building and considered the "correction" of the nature as a task of the engineers[29]. In Spain, Primo de Rivera's dictatorship was the representative of the "regenerationist" aspirations of the beginning of the century. The regenerationists had identified great hydraulic works as the salvation of the nation, after the loss of the empire, and the electrification as a validation of Spain as modern country trough technology and international science[30].

The organization of the civil engineers in national associations took different paths according to the local traditions and the political contingencies. The Italian engineers did not find create a national association until the first decades of the twentieth century. From Milan to Palermo, there were local engineering associations, heirs of the urban identities and the municipal engineers. Under the fascist regime, this fragmentation clashed with the radicalization of the nationalist narrative and the effort of the *Genio Civile*. So, "engineering became part of the regime's propaganda" and the infrastructures and planification, such as the large dams and the plans of land reclamation, symbolised the centralization of the intervention[31]. In Spain, the creation of a State corps of civil engineers came earlier, already in the first half of the nineteenth century, and it was based on a formal higher education in a state school; an association of engineers uniting state engineers with those working in the private sector came in the early twentieth century. By that time, both in public and private sectors, the engineers enjoyed a high social status and were considered not merely as a technical elite but wielded power in the Administration and became cultural symbols of a transforming Spain[32]. The lost-lasting idea about the centralization of water management materialized in the hydraulic planification and in the constitution in 1923 of the *confederaciones hidrográficas* (river basin authorities). At the beginning, it brought together not only the State engineers, but also all those groups interested in water who could collaborate in the design and implementation of hydraulic works. Then, with the imposition of Franco's dictatorship, they became ordinary technical authorities: a kingdom of experts that did not please everyone[33]. This was not the only important change.

The technological decline and academic stagnation characterised, above all, the first decades of the regime. It came after the political purges that hit also scientists and technicians of the republican side, who were very active until the 1936[34]. From 1945 onwards, the loss of contacts with colleagues of the Axis powers exacerbated the exclusion from international societies of the Spanish scientific community[35]. Manuel Díaz-Marta, an engineer in exile during Franco's regime, pointed out the difficulty of disseminating technological innovations in the field of water because of the cultural and professional isolation that Spain suffered since the beginning of the Civil War. The grandiose nature of the dictatorship, he said, was intended to reflect the government's capacity and to respond quickly to the public's demand for water[36]. Both in Spain and Italy, the dams met the ever-growing demand for water and energy, with a discourse based on the idea that natural resources were not scarce but mismanaged. As a prosaic sentence by hydraulic engineer Carlo Semenza said "when there is an abundance of water, there is enough for everyone; when there is none, there is none for anyone"[37]. Still in the eighties, the Spanish engineer José María

[26] Misiani; Gómez Benito, 2017, 31-32.
[27] Bevilacqua, 1980. De Bernardi, 2001. Lupo, 2005.
[28] For the URSS case see Westerman, 2010.
[29] Broncano, 2019, 281-282.
[30] Fernández Clemente, 2000. Pérez-Zapico, 2023.
[31] Bocquet, 2007, 236.
[32] Martykánová; Pan-Montojo, 2022. Martykánová, 2023.
[33] Fanlo Loras, 2008. Cf. D'Amaro, 2022a.
[34] López-Ocón Cabrera, 2022.
[35] Gómez Benito, 1995. Fernández Prieto, 2007, 320-323.
[36] Díaz Marta, 1999.
[37] Semenza, 1962, 245.

Martín Mendiluce talked about the waste of Spanish hydroelectric potential[38].

In the Interwar period and, especially, in the postwar era, the journals of civil engineers and their conferences paid attention to the action of the technical experts to the development of the agricultural sector and energy production. There were elements of mutual influences between the various governments of interwar and postwar eras either authoritarian or democratic regimes. What changed from country to country was the perception in public opinion and possibility to accept or refuse these interventionist policies in agriculture or electrification[39]. Civil engineering was an important part of this race for the modernization of rural world and led the hydraulic paradigm of the State. This kingdom of experts specifically fitted in with the conferences of engineers, both national and international. There was also a side purpose inherent in each of this kind of meeting, was said during the eighth National Conference of Italian Engineers (Milan, 1955): to encourage the development of the "associative spirit" of engineers and to facilitate their participation "in the economic life of the Nation"[40]. The conferences for engineers were moments of showcase for their work; but also, an occasion to meet between each other and get closer to politicians, farmers, and industrial producers. Nevertheless, Konstantinos Chatzis reminds us that "the identities of nations and of engineers were both forged against a backdrop of transnational circulation of people and ideas"[41]. Indeed, the exploitation of waterpower was a worldwide fascination that lasted throughout the century.

Ever-larger dams became the dream solution for flood control, energy production and irrigation expansion. "Any hydraulic engineer knew these three purposes would interfere with each other" stated J. Donald Hughes[42]. The construction of the dam could lead to conflicts between local resource, landscape, and production stakeholders[43]. Even during dictatorships, it could imply struggles and negotiations[44]. If everybody reckoned the importance of storing water, gradually has changed the size of reservoirs, the priorities among users, and the need to coordinate the water releases or to manage the allocation of flow rates. During the second World Power Conference (Berlin, 1930), the engineers saw in the electricity a tool to ensure the peace. A group of them founded the International Commission on Large Dams (ICOLD) to discuss every issue around the construction of dams, from concrete to the electrical generators. The hydroelectric plant became pivotal in the State intervention and in the engineering debate around dams, industrial economy, or rural society. The ICOLD conferences, celebrated since the Interwar years, and later the World Water for Peace conferences since 1967, promoted the practices of hydro-diplomacy and created a community of experts around the public works, the new materials, construction technics, and technologies. In the Cold War era, the engineers contributed to the spread of technocratic languages across the Iron Curtain. Also, they begun to share the concern for the resources[45]. It seemed that the international engineering community was interested in technical advancements in their field, regardless of the political or ideological context in which they occurred. For example, during the Second Republic the Spanish engineers looked to fascist Italy policies; Western nations looked to the USSR's works, and the non-aligned nations of the so-called "Third World" looked to the Cold War's superpowers. This highlights how technocratic discourses frequently present themselves as neutral and apolitical. However, it also helped to understand the creation of a global conversation about technological advancement.

The Italian influence in the Spanish journal of public works

In an article from the 1920s, an engineer talked about the Italian technological intervention, such as "land use, hydroelectric installations, tunnels and so many others", as a model "studied and imitated by engineers in other countries"[46]. The Spanish civil engineers were interested in the "successes" of Italy, seen as the "sister" country to learn from. They studied and analysed the traditional quality of technical education, but also the public works, as the articulated network of highways[47]. But this interest was even clearer in water

[38] Martín Mendiluce, 1984, 58–59.
[39] Fernández Prieto; Pan-Montojo; Cabo Villaverde, 2014, 20–28. Riesco Roche, 2020.
[40] Collegio degli ingegneri di Milano, 1955.
[41] Chatzis, 2007, 194.
[42] Hughes, 2001, 162.
[43] Boelens; Shah; Bruins, 2019. Schapper; Unrau; Killoh, 2020.
[44] D'Amaro, 2012. Corral Broto, 2016. Calatayud Giner; D'Amaro, 2019.
[45] Kirchhof; McNeill, 2019.
[46] Colás Arias, 1925.
[47] Escario Núñez del Pino, 1964.

regulation and hydropower production, that was one of the main activities of the Spanish civil engineering during the twentieth century. It is not surprising that more than 800 articles on dams were published in the *Revista de Obras Públicas* in the twentieth century[48]. The *Revista de Obras Públicas* was the most important journal of the Spanish civil engineering. Founded in mid-nineteenth century, the journal followed the life of the Corps of Engineers of Roads, Canals, and Ports. In fact, it expressed the engineers' desire to carry out major hydraulic projects dominating the natural resources[49].

During Interwar period, Spanish civil engineers claimed in their journal to follow the publications and the hydrological achievements of their Italian colleagues. They were especially interested in large dams boosted by the dictatorship, to propose new ideas and projects in Spain. Someone said that the Italian model could help to convince public opinion of the effectiveness of the realisations and the safety of even the most daring dams. Alongside the technical descriptions and despite the political differences between the Italian fascist and Spanish Second Republic, the Spanish engineers praised the architectural appearance and harmony in the landscape. José García Augustín, a prolific author of the *Revista de Obras Públicas* during the 1930s, described Italian engineering goals and infrastructures, but also the importance of the relationship among State institution, local associations, and big companies[50]. Spanish engineers that visited Italian public works knew the narrative, reinforced under fascism, about the lack of coal and other metals to support industry and the need to compensate it through hydropower solutions and different kinds of dams[51].

The attention to the fascist policies increased since the end of the 1930s, as the rebel forces claimed the integral *bonifica* as a model for the internal colonization. But the fascist policies had great influence later too, in a country devastated by the war and with a starving population[52]. At the beginning of the 1940s, the attention to the agrarian reform and public works in Italy was at its peak and inspired both rural intervention and technical publications[53]. The Instituto Nacional de Colonización (INC, the Spanish National Institute of Rural Development and Colonization) wrote that Italy was the most suitable country to serve has a guide and model of rural colonisation policies, as its political and cultural vision and its social and economic "similarity" to Spain invited attention to specific laws on integral *bonifica*[54]. In the *Revista de Obras Públicas*, the engineer José Luis Escario greeted the Italian engineers as brothers of the Spanish ones, and the *Agro Pontino* land improvement as a successful colonization model of urbanism and hydraulic woks[55].

Franco's engineers were still looking at the Italian agrarian policies even after the fall of the fascism, since the technicians of the fascism were still the protagonist of the Italian agrarian reform, such as Bandini or Serpieri[56]. Example of this was the visit to some INC works in 1951 and the lectures given by Mario Bandini —director of the republican agrarian reform— and Nallo Mazzocchi –a member of the Board of Directors of Cassa per il Mezzogiorno (Fund for the Development of Southern Italy). They stressed that new republican legislation incorporated some of the lessons of the fascist experience, but lightened the procedures and took into account of the economic and technical limitations. Even so, the lectures of Bandini and Mazzocchi were published[57], while in the report of the visit to INC works did not circulate in Italy.

In the 1950s, the interventionism in agriculture of the democratic governments entered the technical and agronomy debate on land reform in Spain. In the *Revista de Estudios Agrosociales* (*Journal of Agro-Social Studies*), while Ballarín Marcial was more cautious about the results of the reform, since he preferred to wait a few years before judging it, Emilio Gómez Ayau showed his admiration for the agrarian reform in Italy through large hydraulic interventions[58]. In several long articles about Italy, the agronomists stated that «the Italian experience seems to be one of the greatest», for example in the legal notion of agrarian enterprise or for the decentralisation of the internal colonization authorities[59]. Later, the agronomist Gómez Ayau emphasized once again that Franco's policies looked at the work of the great political powers of that time, i.e., the intervention in western USA and even in Soviet plans, but also Italy was a great example[60]. So, in the

[48] Berga Casafont, 2008, 23.
[49] Ferri Ramírez, 2015. Martykánová, 2016.
[50] García Augustín; Pérez Moreno, 1931; 1932. García Augustín, 1933.
[51] García Augustín, 1932.
[52] Del Arco Blanco, 2020.
[53] Bazán de Huerta; Lozano Bartolozzi, 2015, 227. Caballero, 2012.
[54] INC, 1941.
[55] Escario Núñez del Pino, 1940a; 1940b.
[56] See also Riesco Roche, 2020.
[57] Bandini, 1952, 13-19.
[58] Ballarín Marcial, 1951, 323. Gómez Ayau, 1953, 60.
[59] Longo, 1955, 115.
[60] Gómez Ayau, 1961, 7-10; 1973.

Revista de Estudios Agrosociales, agronomists, economists, and jurists talked about the Italian agrarian policies as model despite political differences[61]. Nevertheless, the journal of the Spanish civil engineering reflected even more the obsession of the Francoism with the dams and for the technoscientific transformation of the country[62].

In his articles in the *Revista de Obras Públicas*, the engineer Enrique Sánchez Conde wrote that, from the point of view of energy production, it made sense to look to Italy because they had a similar situation. Comparing the experiences of Italy and France in the management of dams could help to design a hydroelectric plan that would consider the water exchange among regions. The Spanish engineer suggested that it was preferable to follow the Italian model, based on large private companies coordinated by the State, rather than the more centralized French model, which implied nationalization[63]. In 1964, the engineer Escario stated that, among the countries he visited, he found Italy the most interesting. In his words, Italy had "more complete and, in some cases, spectacular solutions"[64]. Truly, the water infrastructures, as well as colonisation policies, of the Franco regime were the result of different foreign and political influences, among which it could say that the Italian and American influences were prominent in the forties and in the fifties[65]. Notwithstanding, less articles were dedicated to the Italian hydraulic engineering from the mid-1960s on, reduced to some occasional trips or analysis of disasters[66]. Probably, after the Vajont dam landslide of 1963, the Italian hydraulic engineering was no longer a fundamental reference for Spain.

Spain in the Italian engineers' journals on water and electricity

The above mentioned *Revista de Obras Públicas* was the most important journal of the Spanish civil engineers interested in hydraulic works, both for agriculture and energetical purposes. In Italy, there were several journals, but none of them standing out among the others. Italian engineers shared their projects, ideas, and knowledge through various national journals, such as *Giornale dell'Ingegnere* (*Journal of Engineers*) since the 1950s, or *Ingegneria Civile* (Civil Engineering) since the 1960s. The first one was about engineering in general, but with great attention to hydrotechnical and electrical studies and works. It expressed the concerns of Italian technicians regarding the fight between nature and humanity, and the importance of multi-functional dams, as ambitious as those being carried out in France or the USA[67]. However, the most important journals dedicated to hydraulic works were other, more specialised ones.

Italian civil engineers showed their interests and concerns mostly through, *L'Energia Elettrica* (*The Electrical Energy*), *L'Acqua nell'agricoltura, nell'igiene e nell'industria* (*The water in agriculture, sanitation, and industry*), and the oldest one, *Giornale del Genio Civile* (*Journal of Civil Engineering*) which was perhaps the one that resembled the Spanish *Revista de Obras Públicas* the most. As the official journal of the civil engineering department of the Ministry of the Public Works, *Giornale del Genio Civile* showed the development of science and technology in Italy and abroad[68]. A broad variety of subjects were addressed, but there was always space to talk about something that "deserved the admiring attention even from abroad"[69]: water works, land reclamation works and improvement of the agriculture production. The review of the technical press paid a lot of attention to what was happening abroad, not only in France or USA, but also in countries, such as Portugal, Cameroon, Canada, Switzerland, Sahara, Liberia, India, Rhodesia, South Africa etc. The journal was one of the most important sources of technical culture and knowledge, concerning construction, concrete, electricity, geophysics, hydrology, hygiene, mathematics, meteorology, etc. Agriculture did not have much space in the journal, nor did Spain.

More interested in the agrarian topics, *L'Acqua nell'agricoltura, nell'igiene e nell'industria* was founded in 1931 as the official journal of the Associazione Idrotecnica Italiana (Italian Hydrotechnical Association), while *L'Energia Elettrica* (*The Electric energy*), was the official journal of the Associazione Elettrotecnica ed Elettronica Italiana (Italian Electrotechnical and Electronic Association). As their names suggest, they were mainly devoted to water regulation or electricity, but large part of both journals was focused on *bonifica* irrigation, electrification of the agriculture, and dams.

[61] Misiani; Gómez Benito, 2017, 65.
[62] Camprubí, 2011. Swyngedouw, 2014.
[63] Sánchez Conde, 1953a; 1953b; 1953c; 1953d.
[64] Escario Núñez del Pino, 1964, 1.
[65] Rodríguez Jiménez, 2022.
[66] Torán Peláez, 1963.
[67] Parigi, 1955.
[68] Visentini, 1962 , 48.
[69] Pozzesi; Pelà, 1950, 6.

L'Acqua and *L'Energia Elettrica* dwelt almost exclusively on Italian projects, policies and works. Only the sections called Echoes and Comments addressed big works from other countries, mostly USA, URSS and western European states. Again, Spanish activities appeared only with marginally, due to occasional reports, sometimes as a specific case with different history, as the neutralities during world wars[70]. One of the few articles devotes entirely to Spain described four Iberian large dams, their construction difficulties, and technical data. The engineer Lodovico De Vito stated that these large dams, three in Spain, the other one in Portugal, were a response to hydrological deficiencies and aimed at increasing hydropower consumption[71]. He did not delve into public works policies or the characteristics of the national engineering schools. Like the other journals, *L'Acqua* and *L'Energia Elettrica* did not pay great attention to the international project. The journals were featuring only the biggest or most peculiar hydraulic works of abroad, that would not fit with Italian geomorphology[72].

The book reviews section addressed infrastructures built abroad. When Spanish works appeared, these were often reviews of French, German or English books about the Iberian case, or through articles in foreign civil engineering journals, such as the German *Bautechnik* or the French *Génie Civil*. They were not the result of a direct study, unlike the reports from the visits of Spanish engineers to Italian works. They consisted of information filtered by other engineering community. Still, they were chances to know about the technical issues of Iberian geography, to point out the ever-larger Spanish dams, or to highlight the presence of peculiar and little-known construction techniques abroad, such as the *presa de anillos* (ring dam) designed as early as 1929 by engineer Peña Boeuf, later Ministry of Public Works during Franco's regime[73].

During the 1950s Italian engineers seemed to focus almost only in hydroelectric and colonisation works carried out in Italy. Little attention was devoted to the foreigner activities. During the ninth National Conference of Italian Engineers (Milan, 1956), focused on the agriculture, also agricultural hydraulics, irrigation, and the water supplies had great space in the discussions. Holland and France were mentioned, along with Poland, Israel, and the USSR, where "a new geography" was created by Soviet rural planning. Once more, even in a speech devoted entirely to foreign countries, Spain was not considered[74].

Despite the scarce presence of Spain in the Italian engineering discourse, many scholars claimed there were similarities between the public works of the two countries. For example, in the realization of the newly founded settlements supplied with water and energy by the hydroelectric dams, the engineers of Spain and Italy claimed to take care of the aesthetic aspects. Buildings or urban layout, but also the ideological iconography, had a similar design, seeking a balance between tradition and modernity to recreate an organic conception of the rural villages. In the fifties, Spain was even closer to the Italian experience or vice versa: but the common aspects, such as the kind of expropriation, was rather an inspiration that both countries derived from US policies or other European countries[75]. During the 1960s the attention to the international hydropower increased. The journals mentioned the boost of the electricity production of Spain and pointed to the potential for growth through the construction of new hydroelectric dams and, in part, new thermal power plants[76]. But this kind of information was still relegated to short news inserted in wider international sections.

Eventually, in 1964, the journal *L'Acqua* decided to summarize a publication by the Spanish group distributed during the eight international conference of the ICOLD (Edinburgh, 1964). The publication was the special issue of the *Revista de Obras Públicas* of the same year dedicated to the Spanish hydraulic works. Among all the publication prepared for that congress by the national committees, the Italian engineers decided to talk only about the Spanish large dams because, until then, they were giving few news about them, and their construction had developed rapidly. Engineers recognised the influence of foreign dams in Spanish one. The Kariba dam, build between Zambia and Zimbabwe by an Italian construction group during the British

[70] Pagliaro, 1940, 732.
[71] De Vito, 1957, 85.
[72] Benfratello, 2010, 10.
[73] 'Sistemazione del Guadalquivir. G. Viè: Le plan d'aménagement hydraulique du bassin du Guadalquivir (Espagne). «Le Génie Civil», vol. 139, n. 8, 15 aprile 1962, 5, 4.', *L'Acqua nell'agricoltura, nell'igiene e nell'industria* XL, 3 (1962), 77. Na. Fa. 'La costruzione delle dighe in Spagna. Joachim Thon: Bauingenieuraufgaben im modernen Spanien. III Teil: Talsperrenbau. - «Die Bautechnick», settembre 1955', *L'Energia Elettrica* XXXIII, 7 (1956), 760-762.
[74] Colombo, 1957.
[75] Tordesillas, 2010, 193-198. Bazán de Huerta; Lozano Bartolozzi, 2015, 222-228.
[76] For example, 'Produzione elettrica mondiale e italiana e bilancio energetico italiano nel 1961', *L'Acqua nell'agricoltura, nell'igiene e nell'industria* XL, 6 (1962), 160-169.

empire, the Lac des Toules, a reservoir between Switzerland and Italy, or the Pieve di Cadore, another arch dam in north-eastern Italy, were acknowledged as foreign examples that pushed the Spanish engineers to build taller and larger arch dams, as those of the Valdecañas or Belesar. Also, the Italian article described the exponential increase of the number of dams: at the beginning of the century there were 14 dams, all below 50 m and only two of them on the Atlantic slopes. The pace of construction accelerated in the thirties and, after the Civil War, in the fifties. In 1964, there were already 344 dams in service or under construction: 140 on the Mediterranean side and 204 on the Atlantic side. The journals could therefore speak of an "intense construction programme" for which Spain was in third place among countries in terms of the number of dams.[77]. Some Spanish engineers defined the period 1917-1939 as the "heroic era" and Franco's regime as the "stage of intensive development"[78].

Compared to the Italian dams, the Spanish dams used for hydroelectricity were higher and had a bigger average volume. Spain had a total reservoir capacity of 22 billion m^3, which was three times greater than Italy's, despite Italy having "a slightly higher number of dams". The increase in arch dams was also due to the geology of the north and west, where more dams were built, with granite, gneiss, and archaic rocks. Until the 1940s, dams were more numerous in southern Spain, where the climate was favourable to increased irrigated cultivation. Later, however, numerous dams were built in the wetter areas of the north-west. The Italian journal emphasized that the goal of increasing hydroelectric production meant, not only higher arch dams than previously, but also shifting the axis towards the northwest of the Iberian Peninsula where irrigation was less important[79]. Hydropower became the main purpose of the new dams in the Cold War period and one of the main technological and economic goals of Franco's regime. It was not only an increase in the production of energy, but also a new kind of regulation, with the centralisation of electricity network and the creation of a national enterprise[80].

The article of 1964, as the original special issue of the *Revista de Obras Públicas*, was just a photography of the hydropower infrastructures, that reflected the narrative and practices of Francoism[81]. The hydraulic paradigm based on big infrastructures to develop the irrigation system and increase the electricity production was challenged in Spanish democracy: hydropower lost importance in overall electricity production and the environmentalists contested the construction of large dams[82]. As Swyngedouw and Camprubí pointed out, the political and technological strategies of Spanish water policies and the engineering intervention in Spain were linked to the political frame of the dictatorship. The need to dominate the "hostile" nature to modernise the rural society and order the national landscape was a part of the discourse of the fascistised regime[83]. However, the article in *L'Acqua* did not talk about the Civil War, nor it stressed that in Spain there was a dictatorship. The journal mentioned only a "political-economic crisis" caused by "notorious political events"[84]. Even if engineers were political actors and its dams were tools of socio-technical intervention, they perceived themselves and represented their activities, as did their foreign colleagues, in "technical and apolitical terms"[85].

Final remarks

Engineers strove to learn and benefit from foreign models even though the political settings they operated in deterred them from making it explicit. The influence of the integral *bonifica* of Italian fascism was evident during the dictatorship of Primo de Rivera in the 1920s, but, although not always explicit, also in the articles and in the republican public works plans of the 1930s. Spanish engineers frequently travelled to Italy, demonstrating their knowledge of and admiration for fascist interventionism. This approach left traces in the hydraulic policies, agrarian transformation, and colonization of the most depopulated areas of the Spanish countryside. During the first years of the Franco's regime, the interest of hydraulic experts in Italian organization and construction techniques was more intense. The years between the end of the 1930s and the defeat of fascism after World War II were probably the most fertile in terms of political relations and colonizing inspirations. Engineers, as well as architects

[77] 'Lo sviluppo recente della costruzione di dighe in Spagna', *L'Acqua nell'agricoltura, nell'igiene e nell'industria*, 3 (1964), 77-84.
[78] Buil Sanz; Gil García, 2008.
[79] 'Lo sviluppo recente della costruzione di dighe in Spagna', *L'Acqua*..., 78-79.
[80] Sudrià, 2007.
[81] Torán Peláez, 1964.
[82] Frolova, 2010. Castán Broto, 2016.
[83] Swyngedouw, 2015. Camprubí, 2014.
[84] Lo sviluppo recente della costruzione di dighe in Spagna, *L'Acqua*..., 77.
[85] Brendel, 2020, 14.

and economists, studied and disseminated the fascist experiences[86].

The attention continued even after 1945 and up to the 1960s. The engineers still considered the plans of a new democratic country as a model to follow. Both Italian and Spanish engineers became part of the new obsession with the development of hydroelectric production. Politicians and technicians often pointed to the need to make better use of water resources and recalled the need of post-war European countries to reduce dependence on coal as a source of energy, which also translates into the search for independence from imports of coal and other fossil fuels. The energy use of water resources revealed economic and ideological approaches of an autarkic nature. Nevertheless, the two countries differed in the way interventionist policies were designed and implemented, influenced by the Cold War strategies and policies, and US economic and technological aid. This is even more relevant if we consider that the period of maximum expansion of irrigation and rural repopulation began in the fifties, especially in Spain[87]. For this reason, the influence of Italian fascism in the Spanish water works must be resized. It was diluted in a complex of adaptations not only derived from the Spanish policies of the previous decades, but also from the experiences of many other European countries, including the USSR, and, above all, of the United States. The authors of *Revista de Obras Públicas* were the first to emphasise, perhaps exaggerating, the technical and, for few years, political closeness between these two countries. The catalogues of the ministerial libraries (public works and agriculture) or the articles in the specialised journals of the time show the attention Spanish technicians paid to internal colonisation and the Italian *bonifica*. It is hard to claim the same in the other direction. The first article dedicated to the Spanish waterworks during Franco's regime in an Italian engineering journal appeared only in the 1964s. And in that case too, it was not an original study or a report of a visit, but a summary of a Spanish publication that circulated at an international conference.

Despite the national narrative around the hydraulic successes of the Franco's regime, and the unquestionable development of water engineering and hydropower generation, Spain was not a point of reference for Italian engineers in the second post-war period. The Italian journals almost completely ignored their counterparts in Spain, which was slowly emerging from the political and scientific isolation resulting from the dictatorship. In the context of the transnational knowledge network, the central nodes were others. Probably, the diplomatic and oral history will help us to understand the experiences of engineers in terms of the international circulation of know-how, integration in international networks or the evolution of national reference models in each period. Despite the creation of professional *habitus* through national and international meetings, water engineers were still anchored in national institution, policies, and traditions of their discipline. Engineers looked more closely at leader countries, such as the USA and France, even though they recognised the importance of observing territories that were closer to them in terms of geography and economic systems, and of using them as models. This calls for further reflection on the circulation of knowledge and models, and on the dynamics of techno-scientific networks that nuances the ideas of centre and periphery.

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[86] Flores Soto, 2013a.
[87] See Monclús; Oyón, 1988, 375.

Authorships

Francesco D'Amaro: conceptualization, formal analysis, investigation, methodology, writing – original draft, writing – review & editing.

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