

Pereira, Karen Codazzi; Hoffmann, Mariana; Hermeto, Ana Maria; Oliveira, Marina

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Socioeconomic impact evaluation of unemployment insurance for small-scale fishers in Brazil (Seguro-Defeso)

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Socioeconomic impact evaluation of unemployment insurance for small-scale fishers in Brazil (*Seguro-Defeso*)

Food and Agricultural Organization of the United Nations (FAO)
and International Policy Centre for Inclusive Growth (IPC-IG)



Food and Agriculture
Organization of the
United Nations

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By Food and Agricultural Organization of the United Nations (FAO) and International Policy Centre for Inclusive Growth (IPC-IG)

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Research coordinators

Daniela C. Kalikoski (FAO)
Diana Sawyer (IPC-IG)
Fábio Veras Soares (Ipea/IPC-IG)

Research team

Fábio Veras Soares (Ipea/IPC-IG)
Karen Codazzi Pereira (IPC-IG)
Mariana Hoffmann (IPC-IG)
Luca Lazzarini (IPC-IG)
Carolina Bloch (IPC-IG)
Marília Rocha (IPC-IG)
Jose Silva (IPC-IG)
Tamara Santos (IPC-IG)
Laura Botega (IPC-IG)
Victor Tarifa Lopes (IPC-IG)
Ana Hermeto (IPC-IG Consultant)
Marina Oliveira (IPC-IG Consultant)

Designed by the IPC-IG Publications team

Roberto Astorino, Flávia Amaral, Priscilla Minari
and Manoel Salles

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Food and Agriculture
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ipea Institute for Applied
Economic Research

**SOCIOECONOMIC IMPACT
EVALUATION OF UNEMPLOYMENT
INSURANCE FOR SMALL-SCALE FISHERS
IN BRAZIL (*SEGURO-DEFESO*)**

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ACRONYMS AND ABBREVIATIONS

ATT	Average treatment effects on the treated
BGSD	Unemployment Insurance Management Database from the Ministry of Economy
CGU	Federal Comptroller General
CODEFAT	Deliberative Council of the Workers' Support Fund
CPF	Individual Taxpayer Registry
FAO	Food and Agriculture Organization of the United Nations
FAT	<i>Fundo de Amparo ao Trabalhador (Workers' Support Fund)</i>
GPS	Generalized propensity score
IBAMA	Brazilian Institute of the Environment and Renewable Natural Resources
IBGE	Brazilian Institute of Geography and Statistics
ICMBIO	Chico Mendes Institute for the Conservation of Biodiversity
INSS	National Social Security Institute
IPC-IG	International Policy Centre for Inclusive Growth
Ipea	Institute for Applied Economic Research
MAPA	Ministry of Agriculture Livestock and Supply
MMA	Ministry of the Environment
MPA	Ministry of Fisheries and Aquaculture
POM	Potential outcome means
RGP	General Registry of Fishing Activities

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EXECUTIVE SUMMARY

The closed fishing season, known in Brazil as *Defeso*, constitutes one of the measures of the National Policy for Sustainable Development of Aquaculture and Fishing (Brazil, 2009, Art. 3, IV). It seeks to contribute to the sustainable use of fisheries resources. The normative instruments that establish the *Defeso* need to be regularly evaluated to ensure its effectiveness in supporting the preservation of certain species. However, most normative acts of *Defeso* are out of date, largely due to a lack of data on fishing, which has become an obstacle to implement the revision of the closed periods, as foreseen in the legislation.

The Unemployment Insurance for Artisanal Fishers, popularly known as *Seguro-Defeso*, aims to address the negative impact of *Defeso* on fishers' livelihoods. It is a cash benefit to compensate for income lost during the closed fishing season by professional small-scale (artisanal) fishers. For each month of the *Defeso* (up to five months per year), registered fishers are entitled to receive an amount equivalent to the minimum wage.

The *Seguro-Defeso* is a programme that combines environmental and social goals. By ensuring compliance with the environmental measure, the programme aims to help preserve various species of fish, crustaceans, etc., contributing to the sustainability of the fishing sector. By compensating the fishers for lost income due to the *Defeso*, the programme helps fishers comply with *Defeso*.

The background papers prepared by the IPC-IG research team¹ identified key aspects of the *Seguro-Defeso* institutional setting that pose some challenges to the task of evaluating the impact of the programme. The legal framework analysis highlighted the institutional complexity of *Seguro-Defeso* due to frequent shifts in the government branches responsible for fishery management policies, and the lack of coordination of the six institutions involved in the *Defeso* and *Seguro-Defeso* management and implementation. The lack of coherence across the two intertwined policies—*Defeso* and *Seguro-Defeso*—is another problem, partially caused by the adoption of definitions and interpretations of the legislation that are not aligned across institutions. In addition, the large volume of laws regulating the *Seguro-Defeso* have been subject to modifications over time. More specifically, since *Seguro-Defeso*'s first legislation in 1991, there have been normative changes in the definition of the eligibility criteria, leading to important changes over time of the profile of beneficiaries (e.g. sex composition). Thus, the impact evaluation methodology put forward in this report factors in the main developments that occurred within the institutional context of *Seguro-Defeso*, as well as the heterogeneity of the beneficiary population over time.

Both the literature review of *Seguro-Defeso* and the legal framework analysis pointed to severe limitations of fishery data and statistics, which are essential to inform decision-making on fishery management measures (including the regulation of *Defeso* periods),² and of the General Registry of Fishing Activities (RGP), in which artisanal fishers

1. Five background studies were undertaken as part of IPC-IG's products in the context of a UN to UN agreement with FAO: 1) Legal framework analysis of *Seguro-Defeso*; 2) Literature review of *Seguro-Defeso*; 3) Study design for an impact evaluation of *Seguro-Defeso*; 4) Administrative data consistency analysis; and 5) Narrative report of activities and preliminary report on the impact evaluation of *Seguro-Defeso*.

2. Despite the urgency in assessing the effectiveness of fisheries policies, particularly *Defeso*, in the preservation of species and fishing activity in order to revise the real need for existing closed periods and for the introduction of new ones, the lack of data on fishing activity and fish stocks has prevented this type of assessment, as shown by studies carried out by FAO in partnership with the Apolônio Salles Foundation for Educational Development on *Defeso* and *Seguro-Defeso* in the Northeast region of Brazil:

Hazin, F., Silvino, A., et al. 2021. *Relatório Técnico com diagnóstico e proposições acerca de mecanismos de gestão e de ordenamento da pesca continental na região Nordeste*. [Technical report on the management and ordering mechanisms for inland fisheries in the Northeast region].

Hazin, F., Silvino, A., et al. 2021. *Relatório Técnico com o diagnóstico da eficácia e eficiência dos programas de Defeso e Seguro-Defeso em pescarias no Nordeste do Brasil, incluindo avaliação socioeconômica e proposições de alternativas econômicas à atividade pesqueira*. [Technical report on the effectiveness and efficiency of the closed season programmes in northeast Brazil, including socioeconomic assessment and proposals for economic alternatives to fishing activity].

Hazin, F., Silvino, A., et al. 2021. *Relatório Técnico Final—Proposta de Plano de Ação Nacional para a reestruturação da política de Defeso e Seguro-Defeso nas pescarias brasileiras, com foco na região Nordeste*. [Final technical report—Proposal for a national action plan for the restructuring of the closed season in Brazilian fisheries focusing on the Northeast region].

must be registered to exercise their activities and access the *Seguro-Defeso*. The Brazilian Office of the Comptroller General (CGU) evaluated the RGP in 2016 and highlighted its ineffectiveness due to the unreliability of the information self-reported by fishers registered in the RGP, the lack of inspection by competent authorities and the lack of penalties for presenting false information. According to the GCU, these deficiencies result in significant inclusion errors. However, as new registrations in the RGP have been suspended since 2015, many artisanal fishers who are eligible, but are not registered in the RGP, cannot gain access to the benefit and this increases exclusion errors.

Although the improvement of the well-being of *Seguro-Defeso* beneficiaries is not the main objective of the programme, it is expected that the income loss compensation provided by the programme not only ensures compliance with *defeso*, but also avoids the adoption by fishers and their families of coping strategies (e.g. child labour) to deal with the negative impact on livelihoods during the closed fishing season. As negative coping strategies can have long-term negative effects on the human capital of the next generation and feed an intergenerational cycle of poverty, assessing the impacts of *Seguro-Defeso* offers some clues to the effectiveness of this social protection instrument in protecting fishers and their families.

The literature review on the socioeconomic conditions of the beneficiaries of *Seguro-Defeso* found many papers describing the programme's features, and perceptions of its impacts on the living standards of fishers' communities, but none carried out a rigorous impact analysis with a clear counterfactual. Thus, after 30 years of implementation, there is no robust quantitative impact evaluation that assesses the socioeconomic impacts of the *Seguro-Defeso* on the living conditions of beneficiaries and their families. This gap in the literature reflects the challenge of identifying a counterfactual and building samples with controlled pre-treatment characteristics to define comparable treatment and control groups from existing data. This impact evaluation aims to fill this gap by focusing on outcomes related to the living conditions of beneficiaries and their families, using a robust econometric methodology for which time of exposure (dose–response) to the programme is the key treatment variable, given the impossibility of finding an appropriate control group that would not have been exposed to the programme and allow for a binary assessment: treated versus control group.

Initially, this project anticipated some primary data collection to assess not only the impact of the programme on the living conditions of beneficiaries and their families, but also other dimensions related to the implementation of *Seguro-Defeso*, including concerns about inclusion of non-fishers or non-eligible fishers into the programme. However, due to the COVID-19 pandemic the impact evaluation assessment was redesigned, and the evaluation strategy had to rely on administrative data only. Thus, issues related to the inclusion of non-fishers or non-eligible fishers on the programme database, and the exclusion of potentially eligible fishers due to inconsistencies between the legislation of both *Defeso* and *Seguro-Defeso*, could not be assessed in this study.

This impact assessment uses a dataset constructed by linking two administrative databases, namely the Unemployment Insurance Management Database from the Ministry of Economy (BGSD) and the Single Registry for Beneficiaries of Social Programmes (*Cadastro Único*). The BGSD provides information on *Seguro-Defeso* benefits (such as requests and payment dates, values, location, and type of *Defeso*) for each beneficiary since the beginning of the policy implementation in 1992. The Single Registry contains information on socioeconomic variables from 2018 that are used as outcomes and control variables in our estimations. After linking the BGSD and the Single Registry databases, we end up with a sample of 51 per cent *Seguro-Defeso* applicants (beneficiaries and non-beneficiaries, the latter corresponds to less than 3 per cent of the total number of applicants). However, if we look at most recent periods (2016 to 2018) then 95.5 per cent of those registered in the BGSD database can be found in the Single Registry.

In fact, this study highlights the potential of administrative records for programme evaluation through the successful linking of databases—BGSD and the Single Registry. It can be seen as a starting point for the establishment of routines linking the BGSD databases with other socioeconomic datasets. Another alternative is to improve the existing administrative database, specially the RGP and particularly the quality of socioeconomic variables.

Unfortunately, the socioeconomic variables currently in the RGP's database are only completed for a small number of individuals, which makes it impossible to use them to evaluate *Seguro-Defeso*. Making it mandatory to report on these variables in the RGP's registry could help overcome some of the data insufficiency of the BGSD database.

A baseline data consistency analysis showed that most individual and family socioeconomic characteristic variables were of good quality, although income variables needed treatment for outliers, and information on other federal government programmes had high percentages of missing data, probably due to underreporting of beneficiaries. This may be explained by the fact that the Single Registry database is used to assess beneficiaries' eligibility for *Bolsa Família*, Brazil's conditional cash transfer programme. This would lead potential beneficiaries to underreport access to other programmes. The comparison between beneficiaries that were linked in the Single Registry with the ones that were not, especially when restricting for recent years, suggests that there are no important differences in the characteristics available in the BGSD between the two groups, except for sex composition, as discussed below.

In terms of the features of the merged database, women are over-represented in the linked database—women represent 47 per cent of the total pool of *Seguro-Defeso* beneficiaries, about 60 per cent in the linked dataset—due to two factors: first, the greater share of women registered in the Single Registry, and second, because of the increase in the number of female beneficiaries in the most recent years of the *Seguro-Defeso*. Most families with data in the Single Registry benefit from the *Bolsa Família* programme, which prioritizes women as beneficiaries, so it is expected that the share of women in the Single Registry is higher compared to other programmes. Besides, changes in the *Seguro-Defeso*'s legal framework have generated a change in the profile of beneficiaries and since 2009 there are more women than men among new beneficiaries in each year, according to data from the BGSD. It is worth noting that for the most recent period, the difference of the linkage rate by sex is not significant; the proportion of women in both the BGSD and the Single Registry is quite similar. In addition, sex can be controlled for in the evaluation model and this difference will not affect the impact evaluation results. Finally, differences between the linked and unlinked households by age and education are not important in magnitude, suggesting that there is no bias in the linked database used to evaluate the programme on these two important dimensions.

The final dataset contains information on socioeconomic characteristics for those in the BGSD database that were linked in the Single Registry. Statistical analysis of their main characteristics showed:

- About 90 per cent are non-white, and more than 70 per cent are household heads.
- About 60 per cent are women.
- Only 4 per cent are indigenous or *quilombola*.
- About 90 per cent live in the Northeast and North regions, mostly in the states of Pará and Maranhão (50 per cent), followed by Bahia and Amazonas (20 per cent) and other states in the northeast (20 per cent).
- One third are in the group between 30 and 39 years old and 50 per cent are over 40 years old.
- About 65 per cent have less than elementary school education (<9 years of schooling).
- Of those who declare employment status in the single registry, 90 per cent are self-employed or temporary workers in rural areas.
- 86 per cent have a household per capita income below one quarter of the minimum wage and only 6 per cent above the half minimum wage.

As mentioned before, the analysis does not cover compliance with the programme's eligibility criteria. Thus, it does not provide information on the size of *Seguro-Defeso*'s inclusion or exclusion errors, which would require primary data collection. However, the descriptive analyses of beneficiaries and applicants reveals that the *Seguro-Defeso* reaches individuals with low-income (per capita income of less than a quarter of the minimum wage) and with a low level of education, as would be expected for the artisanal fishers targeted by *Seguro-Defeso*.

A challenge for the *Seguro-Defeso* impact evaluation design is the definition of a proper counterfactual. The non-beneficiary applicant group could be a good control group because it consists of a group of individuals who have applied for *Seguro-Defeso* but did not receive the benefit. However, besides the fact that no information is given for the reason they did not qualify, they are a small group compared to the number of beneficiaries on the database (less than 3 per cent of the total number of applicants). An additional challenge is the fact that beneficiaries and non-beneficiary applicants cannot be treated as a homogenous group because of normative changes over time in the definition of beneficiaries and the criteria to access the benefit.

The methodology put forward in this report addresses the issue of the heterogeneity of the treated group due to changes in normative rules, grouping beneficiaries according to the year in which laws and decrees that introduced major changes in the definition of eligibility criteria were adopted and/or by the time of exposure to the programme. The first strategy defines the multiple treatments through five groups that aggregate the beneficiaries by year of the inclusion in the payment roll of the *Seguro-Defeso*: 1997³ to 2002, 2003 to 2008, 2009, 2010 to 2014, and 2015 or later. The second strategy uses the duration of the exposure of each beneficiary to the programme as the treatment, considering the first and last year of payment to calculate the total number of years that the individual received the benefits. In both cases, observable variables are used to control for differences in the characteristics of the treatment group by entry cohort or different levels of exposure.

In more detail, the methodology adopted consisted of estimating the average treatment effect for the five different entry cohorts (as defined by changes in legislation that affected eligibility criteria) and dose–response functions using the Generalized Propensity Score (GPS) method. Propensity score methods have the ability to summarize all measured confounders into one score, which is valuable for ensuring that we are assessing the impact of the programme by “matching” similar units of observations (households of beneficiary individuals) at different levels of exposure to the *Seguro-Defeso* and/or by multiple treated groups.

Using this methodology, it was possible to assess the impact of the programme on socioeconomic conditions of beneficiaries and their families registered in the two databases—BGDS and Single Registry—based on variables of the Single Registry database. All outcome variables are annual and at the household level and can be divided into three dimensions: (1) child education and labour; (2) employment situation of working-age population; and (3) housing characteristics.

The results suggest that the programme has positive and statistically significant impacts in all three dimensions of outcomes. Specifically, the longer the exposure to the benefit of the programme, the higher the percentage of children enrolled in school and the lower the percentage of young adults that are simultaneously out of school and out of work. The results also show that the programme allows beneficiaries to improve the quality of their housing and decrease labour force participation in the medium to long term.

In the event that the design of the *Seguro-Defeso* changes, it is necessary to consider the potential negative impact of discontinuing the programme on the income of a vulnerable population. Although it is not possible to assess whether the beneficiaries do meet all the *Seguro-Defeso* eligibility criteria, especially if they are artisanal

3. Although the programme started in 1992, the information on beneficiaries and benefits paid which were used to build the treatment variables for the impact assessment were only available in the database from 1997 onwards. We do not expect this will affect the results, since the total of beneficiaries that required the benefit before 1997 represents only 1 per cent of the total number of beneficiaries.

fishers that are prevented from fishing during the *Defeso* period, the results suggest the importance of the programme as a social protection programme and therefore phasing out of benefits should be coupled with other complementary programmes.

Enforcement of eligibility criteria and assessment and revision of the *Defeso* effectiveness are the policies that would need to be adjusted to ensure better alignment of *Seguro-Defeso* with the environmental objectives of the *Defeso*. Available administrative data still do not allow for the answering of questions about governance, such as oversight over demand and access to *Seguro-Defeso*. Nor can the data either assess adverse incentives or undesired effects, i.e. re-crafting of fishing activity with the precariousness of labour conditions; entry of persons into fishing activity due to the existence of the benefit or use for electoral purposes. An effort to collect qualitative data and the continuous monitoring and evaluation of the programme, in addition to improving the administrative databases, such as the RGP (that could be used for programme evaluation if the quality of socioeconomic data is enhanced) are some essential measures to enable a broader analysis of the *Seguro-Defeso*.

In addition, it is important to improve data on fishing activity so that the environmental aspects of *Seguro-Defeso* can also be assessed. Previous studies argued that, due to the lack of data on fishing activity, it would be difficult to verify whether the periods of *Defeso* are justified from an ecological point of view and whether they are in fact contributing to the preservation of species and to the socioeconomic sustainability of fishing activity.

1. INTRODUCTION

The objective of this report is to present the results of the impact evaluation of Brazil's Unemployment Insurance for Artisanal Fishers (*Seguro-Defeso*) on the well-being of beneficiaries and their families. The evaluation design implemented here builds on five previous reports⁴ that laid the foundation for the assessment of the socioeconomic impact of *Seguro-Defeso*. The report is divided into three main sections. In the first section, we summarize key takeaways from the previous reports, including the review of the legal framework on *Seguro-Defeso* with a focus on eligibility criteria, the literature review and the initial analysis of the databases used in the impact evaluation. Then, in the second section we detail the methodology and describe the data used in the impact evaluation econometric models. Finally, in the third section we show the results of the causal inference analysis of the impact of *Seguro-Defeso* on the well-being of the beneficiaries and their families using a dose–response methodology.

Defeso is the name given to the temporary suspension of fishing for the preservation of some species with a view to ensuring their sustainable reproduction, or as a result of accidents or natural disasters. The Unemployment Insurance for Artisanal Fishers, or the *Seguro-Defeso*, is a monthly monetary benefit equivalent to the minimum wage which is paid to eligible artisanal fishers during the months of the closed fishing season. The benefit aims to protect the income of commercial artisanal fishers during the *Defeso* and incentivize them to comply with the *Defeso* restriction. Therefore, the *Seguro-Defeso* is logically and legally closely related to the closed fishing season, *Defeso*, since the benefit is granted only during the application of the latter.

This study assesses the impact of the *Seguro-Defeso* benefit on the socioeconomic conditions of the beneficiaries. The report shows that changes in eligibility criteria have led to heterogeneous groups gaining access to the benefit and that the administrative data does not have much information on non-beneficiaries, which calls for the use of a GPS to address both issues. Matters related to compliance with eligibility criteria could not be investigated, thus no evidence on errors of inclusion/exclusion are provided here. Nor is the combined impact of the *Seguro-Defeso* and *Defeso* on the preservation of the species that are meant to be protected by both policies addressed. As will be discussed later in this report, the lack of data on fish stocks is a major hurdle, not only for the definition and review of *Defeso*, but also for a proper evaluation of both policies as a combined strategy to ensure the economic and environmental sustainability of fishing stocks.

2. *SEGURO-DEFESO* LEGAL FRAMEWORK, LITERATURE REVIEW AND EVALUATION DESIGN

The background papers identified key aspects of *Seguro-Defeso* implementation that pose some challenges to the task of evaluating the impact of the programme. This section presents the main points discussed in these studies, focusing on their implications for the socioeconomic impact evaluation design.

2.1 Interdependency and coherence challenges within and between *Seguro-Defeso* and *Defeso* norms and resolutions⁵

The *Seguro-Defeso* refers to the payment of a minimum wage per month to commercial artisanal fishers during the period of fishing closures (*Defeso*). It was established by Law No. 8.287 of 20 December 1991. This law was

4. Five background studies were conducted as part of IPC-IG's products in the context of a UN-UN agency agreement with FAO: 1) legal framework analysis of *Seguro-Defeso*; 2) literature review of *Seguro-Defeso*; 3) study design for an impact evaluation of *Seguro-Defeso*; 4) administrative data consistency analysis; and 5) narrative report of activities and preliminary report on the impact evaluation of *Seguro-Defeso*.

5. This section presents the main results of the legal framework analysis conducted by Luca Lazzarini, IPC-IG researcher, presented in Appendix 1. The analysis is part of the background paper "The legal framework of the unemployment insurance for artisanal fishers" delivered in August 2020. A shorter version "Insights from an analysis of *Seguro-Defeso* legal framework" is available at: <<https://urlshort.in/eXlKU>>.

repealed by Law No. 10.779, of 25 November 2003, which was then successively amended by Laws No. 11,959, of 29 July 2009; and No. 13,134, of 16 June 2015, as well as Decree 8,967/2017, particularly in relation to the documents required to be provided by applicants to prove their eligibility for the benefit.

The Law No. 11.959/2009 details the National Policy on Sustainable Aquaculture and Fishing and regulates fishing activities, presenting a set of definitions related to fishing activities—including professional fishers—as well as a standard classification of fishing activities into two large groups with different types within them, namely (i) commercial: a) artisanal and b) industrial; and (ii) non-commercial: a) scientific; b) amateur; and c) subsistence. This law also enumerates the instruments that the government can use to reconcile the sustainable management of fishery resources and their exploitation for social and economic purposes through the regulation of fishing activities. It includes instruments such as the adoption of fishing conservation areas, species-specific closed seasons (*Defeso*), minimum catch size and restrictions on fishing equipment, among others. Finally, the law defines *Defeso* as the (i) temporary fishing closure to ensure the preservation of species, by protecting them during breeding and/or recruitment periods, and (ii) fishing closure due to natural disasters or accidents.

Defeso aims to ensure the species' reproductive capacity and the overall balance of the ecosystem, which in turn guarantees the social, economic and environmental sustainability of fisheries. However, it has a negative impact on the livelihoods of artisanal fishers because fishing of some species is not allowed for a certain period of time. Thus, *Seguro-Defeso* aims to ensure the effectiveness of the *Defeso* by addressing the economic vulnerability of artisanal fishers who could be tempted to not comply with the fishing restrictions in the absence of alternative sources of income.

Eligibility for *Seguro-Defeso* depends first and foremost on the process leading to the adoption of *Defeso* for some species in a certain area. Brazil has more than 50 normative instruments to regulate fishing closures for different species (*Defeso*) in different hydrographic basins. The interdependency between *Defeso* and *Seguro-Defeso* is operationalized by a complex interaction of different fishing and social security institutions involved in the management and implementation of the two programmes, which results in a large volume of directives and rules which are not fully clear and coherent. For example, there have been doubts whether *Defeso* periods linked to natural disasters and accidents (also known as exceptional *Defeso*) need to be adopted when the preservation of certain species is at risk, or whether exceptional *Defeso* can be adopted to prevent risks to the livelihoods of artisanal fishers, as well as their health and the health of potential consumers, in the context of an accident or natural disaster.

Artisanal fishers are defined by Laws No. 8.212/91 (Art. 12, para. VII, let. b) and 8.213/91 (Art. 11, para. VII, let. b) as those persons who, individually or in a family system and with the possible help of non-remunerated third parties, rely on fishing as their main livelihood. According to Law No. 11.959/09, the legal definition of artisanal fishing is framed as part of commercial fishing (not subsistence fishing), practiced directly by professional fishers, autonomously or in a family economy regime, with its own means of production or under a partnership contract, landed, and may use small, artisanal vessels (Art.8 , I, a), characterized as those with gross tonnage equal to or less than 20 (Art.10, § 1, I). Fishing, in turn, is defined as any act with the aim of extracting, harvesting, catching or capturing fishery resources (Art. 2, III).

While *Seguro-Defeso* initial legislation (Law No. 8.283/91) implied some level of means testing (Art. 2, II c), it only required that the professional artisanal fisher paid social security contributions, without specifying the category of contribution. However, a 2015 amendment to Law No. 10.779/03 explicitly defined the artisanal fisher eligible for *Seguro-Defeso* as a particular type of contributor, the “*segurado especial*” (specially insured). It is important to bear in mind that the *segurado especial* contribution to social security (and before any artisanal fishers' contribution to social security) does not finance the *Seguro-Defeso* benefit, it is only an additional eligibility requirement. In the Brazilian legislation, *Seguro-Defeso* is considered a special modality of the

Unemployment Insurance Programme for commercial artisanal fishers affected by the adoption of *Defeso* in a particular area. The closed fishing season is considered to produce a situation similar to temporary involuntary unemployment since commercial artisanal fishers are not allowed to work for a certain period. However, the Unemployment Insurance Programme is financed with resources from the Worker Support Fund *Fundo de Amparo ao Trabalhador*, FAT) that is mostly financed by a social contribution (PIS/PASEP) paid by firms and similar legal entities. In fact, the *segurado especial* contribution should partially finance the social security budget and ensure eligibility for standard social security benefits such as a retirement pension, survivor pension, accident and illness benefits, and maternity benefit.

Thus, legal changes in the way that artisanal fishers⁶ have been defined within *Seguro-Defeso* and Brazil's social security system is a good example of the institutional complexity of the programme and how a particular definition that pertains to the *Seguro-Defeso* legislation can also have a potential impact on the effectiveness of *Defeso*. For example, some commercial artisanal fishers affected by a particular *Defeso* are not eligible for *Seguro-Defeso* if they are not registered in the social security agency as *segurado especial*, even if they contribute to social security under a different contribution scheme.

According to the National Policy for Sustainable Development of Aquaculture and Fishing detailed in Law No. 13.844, of 18 June 2019, the Ministry of Agriculture, Livestock and Supply (MAPA) is responsible for regulating the fisheries policy and aquaculture, including the management of closed areas. Fisheries inspection, especially during the closed season, is the responsibility of the Ministry of the Environment (MMA), through the Brazilian Institute of the Environment and Renewable Natural Resources (IBAMA) and other environmental inspection bodies that comprise the National Environment System (Sisnama). As for the institutions involved in the *Seguro-Defeso* implementation, MAPA is responsible for managing the RGP in which artisanal fishers must be registered to both legally engage in fishery activities and receive the *Seguro-Defeso*. The responsibility for receiving applications and determining eligibility for the *Seguro-Defeso* lies with the National Social Security Institute (INSS).

As mentioned above, the FAT finances the *Seguro-Defeso* programme. FAT is managed by the Deliberative Council of the Workers' Support Fund (CODEFAT). The Special Secretariat for Social Security and Labour of the Ministry of Economy is responsible for the supervision and coordination of the social security sector (including unemployment insurance), whereas the *Caixa Econômica Federal*, a state-owned bank, is responsible for carrying out payments.

The main changes in terms of benefit accessibility and beneficiary definition can be summarized as follows.

- In 2003, Law No. 10.779, the current legal framework for *Seguro-Defeso*, repealed the previous law (Law No. 8.287/91) and decreased the minimum RGP registration period from three years to one year. Also introduced by the 2003 law was the characterization of the artisanal fisher as a *segurado especial* in social security.
- A second relevant change resulted from Law No. 11.959/09 which, despite not directly modifying the *Seguro-Defeso* legal framework, broadened the concept of artisanal fisheries. Art. 4 specifies that artisanal fishery activities also include producing and repairing fishing gear, repairs carried out on small vessels and processing artisanal fishery products.

6. Note that the Law No. 8.283/91 does not refer to commercial artisanal fishers, but just to artisanal fishers. Commercial fishers are defined in Law No. 11.959/09 and exclude subsistence fishers.

- CODEFAT Resolution no. 657/2010 brought about further changes. First, it determined that for the purposes of granting the benefit, (artisanal) fishery is understood as the capture, for commercial purposes of the species protected by the *Defeso* (Art. 1, § 2). This specification restricts the number of beneficiaries because ancillary activities such as the repair of fishing gear or post-capture processing would fall outside the scope of fishery and therefore those involved in these activities would not be eligible for the *Seguro-Defeso*, although they can be part of the RGP, as per the fishery definition provided by Art. 4 of Law No. 11.959/09. Once those involved in the fishery production chain are allowed to be registered with the RGP, it is difficult to see how INSS could verify their eligibility for the *Seguro-Defeso* along the lines suggested by the abovementioned CODEFAT resolution. Interestingly, this resolution has also softened eligibility conditions by requiring the proof of payment of only one contribution to social security as *segurado especial* in the year prior to the beginning of the *Defeso* period, instead of two instalments, as stipulated in previous normative instruments.
- In 2014, Provisional Measure no. 665, later converted into Law No. 13.134/15 changed Art. 1 of Law No. 10.779/03 by introducing the directive that artisanal fishers should “exclusively” and “uninterruptedly” work as fishers, and scrapped the possibility for them to have occasional help from partners who are not family members. Finally, the Provisional Measure determined that the benefit will not be extended to fishery support activities or to family members of professional fishers who do not meet the requirements and conditions established by the law. It is worth highlighting that this law introduced a disposition which allows only those artisanal fishers who do not have any source of income, other than that resulting from fishery activities, to access the benefit (Art. 2, § 4).
- Decree No. 8.424/15 defines “family economy system” as family collective work that does not engage employees or workers other than family members that work in collaboration with each other (Art. 1, § 2). It also states that fisher’s *segurado especial* category is the only one eligible for *Seguro-Defeso* (Art. 2, II). In addition, the fisher that applies for the benefit must have paid his/her social security contribution under the terms of Law No. 8.212/91 in the 12 months preceding the request for benefit or from the last *Defeso* period until the request for the benefit, whichever is the shortest period (Art. 2, III); and not having an employment contract, or any other employment relation with third parties, as well as no additional sources of income other than the one resulting from fishery activities (Art. 2, V).
- Decree No. 8.967/2017 explicitly excludes from eligibility to *Seguro-Defeso* (i) subsistence fishers, (ii) fishers who use basic fishing techniques such fishing line or fishing rod; and (iii) indigenous populations engaged in subsistence fishing. In addition, these three groups are not required to register with the RGP.

These changes to the legal framework for *Defeso* and *Seguro-Defeso* impacted the eligibility of beneficiaries, and consequently the total number of beneficiaries covered by the programme and the composition of these beneficiaries. According to data from BGSD, from 1992 to 2019, there were an average of 45,000 new beneficiaries of *Seguro-Defeso* per year (Table 1). However, this value varies significantly between the years analysed. Note that there are some years that the change in the trend of total new beneficiaries per year occurs in the same year as the changes in legislation presented above. For example, in 2003, the year in which the regulatory framework was enacted (Law No. 10.779/03), the total number of new beneficiaries doubled compared to the previous year. The General Fisheries Law (Law No. 11.959/09) was introduced in 2009, a year in which the number of new beneficiaries increased by over 50 per cent, in addition to a change in the composition of new beneficiaries, who since 2009 are mostly women (Table 1).

Table 1. Total number of new beneficiaries by the year of the first benefit and sex—BGSD (1992–2019)

Year first benefit	Male	Female	Total	% of total beneficiaries by year
1992	45	0	45	
1993	2,177	28	2,205	0.2
1994	3,907	64	3,971	0.3
1995	2,921	76	2,997	0.2
1996	4,205	340	4,545	0.4
1997	4,773	331	5,104	0.4
1998	5,361	383	5,744	0.4
1999	8,444	614	9,058	0.7
2000	8,960	625	9,585	0.7
2001	12,935	1,430	14,365	
2002	14,488	2,593	17,081	
2003	30,213	10,801	41,014	3.2
2004	35,359	14,475	49,834	3.9
2005	38,615	22,701	61,316	4.8
2006	38,405	25,553	63,958	5.0
2007	56,289	42,915	99,204	7.8
2008	54,525	46,037	100,562	7.9
2009	72,769	75,109	147,878	11.6
2010	60,466	67,035	127,501	10.0
2011	39,887	49,945	89,832	7.0
2012	38,097	49,091	87,188	6.8
2013	38,451	48,346	86,797	6.8
2014	70,067	93,291	163,358	12.8
2015	18,797	23,459	42,256	3.3
2016	9,853	10,639	20,492	1.6
2017	3,851	3,769	7,620	0.6
2018	6,186	6,896	13,082	
2019	1,466	1,473	2,939	0.2
Total	681,511	598,019	1,279,531	100.0

Source: Authors' elaboration based on BGSD (1992 to 2019).

According to the 2019 legislation, the requirements to be identified as a professional commercial artisanal fisher eligible for the *Seguro-Defeso* include:⁷

- The beneficiary should have been working as a professional fisher for least one year prior to the application for the benefit, which implies a professional and commercial fishery activity. The fisher needs to be registered in the RGP for at least one year.
- The fishing activity should be carried out on land or with small vessels.
- The labour regime should be own account/self-employed or familial economy system, with own means of production or partnership contract. No employment ties are allowed.

7. More details about the documents needed to become a *Seguro-Defeso* beneficiary are presented in Appendix 2.

Other requirements include:

- The fisher should be a Brazilian national or a resident foreigner.
- The fisher should have paid the social security contribution as a fisher *segurado especial*.
- The fisher should not be a beneficiary of another social security or social assistance benefit, except for accident and sickness aid, reclusion aid or pension by death. Another exception is the *Bolsa Família* benefit—Brazil's conditional cash transfer programme—that is suspended in the months in which the *Seguro-Defeso* is paid.

2.2 Literature review of the *Seguro-Defeso*⁸

This section presents a brief review of the literature related to the *Seguro-Defeso* programme with a focus on the socioeconomic conditions of beneficiaries. As seen before, *Seguro-Defeso*'s legislation was enacted in late 1991, and the programme has been implemented since 1992, with the objective of providing income support to artisanal fishers during the *Defeso* period.

The literature highlights the challenge around the identification of artisanal fishers, especially in assessments made by government institutions [Sunye *et al.* (2014); Dou *et al.* (2017); Campos and Chaves (2016); SECAP (2019)]. In fact, the process of identifying artisanal fishers has proved to be extremely flawed and susceptible to fraud, which has triggered several audits. It is important to highlight that the literature also assumes different definitions of artisanal fishers, reflecting changes in the legislation. In practice, at least part of the difficulty of assessing compliance with eligibility criteria and/or the impact of the programme in socioeconomic dimensions has to do with these changes.

In contrast, case studies with a focus on local communities tend to emphasize the positive effects of the programme on the well-being of beneficiaries, particularly in qualitative research based on fishers' perceptions. For example, Vale and Costa (2018) argue that *Seguro-Defeso* is the only guaranteed income that many families receive within a specific year and that it contributes not only to the preservation of fishing activities in the long term, but also protects fishing as a historical heritage, i.e. it is a means of social reproduction of fishers' communities. Capellesso and Cazella (2011) assessed the effect of the programme in some cities of Santa Catarina, finding that it led to an increase in the average monthly income by approximately one-third in a sample of 20 families, accounting for an average of 11.9 per cent of the total income of these families. For families without other sources of income (e.g. social security transfers), the *Seguro-Defeso* benefit corresponds to 48 per cent of the annual income.

The most comprehensive analysis of the *Seguro-Defeso* programme was prepared by the Ministry of Economy—“*Avaliação Executiva do Seguro-Defeso*” (2019). This report assesses the design, implementation, governance, efficiency and impact of the programme. It provides recommendations for the improvement of the programme, as well as proposals for further evaluations. According to the report, the programme was structured to deal with two interconnected challenges: (i) loss of social, economic and environmental sustainability of fishing activity, and (ii) non-compliance with *Defeso* by fishers due to their material difficulties during the fishing closures. Regarding the latter, they argue that an additional cause for non-compliance was a lack of inspections. The main points of this report are the following:

8. This section presents the main results of the “Literature Review of *Seguro-Defeso*”, conducted by Victor Tarifa Lopes, IPC-IG researcher.

- The programme is implemented by a complex governance arrangement that involves seven entities: i) Secretariat of Aquaculture and Fisheries (SAP) of the MAPA; ii) Special Secretariat for Social Security and Labour (SEPRET) of the Ministry of Economy, iii) INSS; iv) CODEFAT; v) *Caixa Econômica Federal*; vi) MMA; and vii) IBAMA.
- Between 1998 and 2018, nominal expenditure increased from R\$ 13 million to R\$ 2.54 billion (29 per cent per year, average). This change can be explained by three components: inflation (6.4 per cent per year), real increase in the minimum wage (4 per cent per year) and increases in the number of beneficiaries (16 per cent per year). Regulatory changes related to the reduction of eligibility requirements were responsible for the huge increase in the number of beneficiaries. For instance, Law No. 10.779/03 reduced the minimum requirement of being registered on the RGP as a professional artisanal fisher from three years to one year, leading to a 63 per cent increase in the number of beneficiaries between 2003 and 2004. The peak in the number of beneficiaries was observed in 2012 (around 970,000 beneficiaries).
- From 2012 onwards there has been a downward trend in the number of beneficiaries, with the lowest value observed in 2016, when the number of artisanal fishers was down to 558,000. This drop occurred after the suspension of ten *Defeso* periods (through inter-ministerial ordinance).
- As for *Defeso*, by 2017, there were 38 norms related to the programme. The report observes that although artisanal fishing is spread over the entire national territory, there is a concentration of beneficiaries around certain basins and coastlines. The analysis highlighted that the majority of beneficiaries (87 per cent) are located in the northeast (49 per cent) and northern (38 per cent) regions of the country.
- Since 2008 there has been no production of data on fishing activity, a situation that precluded the review of the periods of *Defeso*, as well as the assessment of the effectiveness of this instrument in different basins and coastlines. Thus, it is difficult to verify whether the periods of *Defeso* are justified from an ecological point of view and whether they are in fact contributing to the preservation of species and to the socioeconomic sustainability of fishing activity.
- Citing Dias Neto (2017) the report discusses the concomitant increase in *Seguro-Defeso* expenditures and on the number of artisanal fishers and the potentially negative effect of the latter on fishing stocks. The author analyses 16 inland *Defeso* and 17 marine and coastal *Defeso*, and concludes that the *Defeso*, especially the inland *Defeso* and those for lagoons and bays must be reassessed because the closed seasons seem to have contributed to an increase in fishing effort. This would have led to overfishing (fishing above the capacity of the population of a particular species to renew itself), putting environmental sustainability at risk.
- The lack of revision of the periods of *Defeso* since 2008, because of the interruption of fisheries statistics, affected fishers' perception of the legitimacy of the measure, largely because of poorly informed and defined *Defeso* in terms of protected species and/or with longer periods of time than necessary. This situation, in addition to generating more overall expenditure on *Seguro-Defeso* payments, also caused problems in the commercial value chain. Without such information, it is not possible to build indicators for policy monitoring, such as the productivity of the fishing sector and the size of the fishing stock.
- The report states that the *Seguro-Defeso* has the objective to guarantee an income to artisanal fishers during the closed fishing period to encourage compliance with the *Defeso*. Thus, *Seguro-Defeso* is adopted as an ancillary social programme that should guarantee the effectiveness of the *Defeso* policy, an environmental policy. However, some features of the design of the programme ended up driving *Seguro-Defeso* away from

its original objective, i.e. to complement the environmental policy. *Seguro-Defeso* began to be seen more as a social policy aimed at protecting the insured from the contingency of “involuntary unemployment”:

- Other problems refer to potential unintended effects, including (a) “re-crafting” of fishing with precarious labour conditions; (b) entry of persons into fishing activity due to the existence of the benefit, contributing to overfishing; and (c) electoral use of the programme.
- Eligibility requirements for access to *Seguro-Defeso* are not well defined and are difficult to verify. Registration with the INSS social security registry, which recognises the condition of an artisanal fisher is based on self-reported information. The report stresses the need to improve the verification process that applicants are in fact commercial artisanal fishers who have this occupation as their only source of income. Geographical dispersal, informality, failures in the registration process and in cross-checking information provided by fishers, and the role of fishing as a traditional cultural practice in certain regions, make it very difficult to verify the professional and commercial nature of the fishing activity. Thus, routine cross-checking of administrative databases and social registries needs to be conducted more regularly. Moreover, other databases that contain information about public servants and information predicting income, such as owned or rented residences, rural property, rural activity, ownership of automobiles, electoral donations, among other things should be incorporated as part of routine cross-checking. There are reports that a large proportion of the beneficiaries do not obtain their income exclusively from fishing, or are people who do not fish or who work in other paid activities and for whom fishing is a complementary or subsidiary income activity.
- Frequent changes in policy and programme governance, including changes in the institutional locus of the body responsible for fisheries policy, as well as poorly defined routine database cross-checks and verification protocols followed by different institutions involved in the verification of eligibility (or in the provision of information regarding eligibility) has jeopardized the implementation of *Seguro-Defeso* as an auxiliary programme to *Defeso*.
- Considering the difficulties in evaluating the results and impacts of the programme, the report says it is necessary to urgently to assess the need for the current *Defeso* periods to verify their effectiveness/efficiency based on objective data or environmental and technical studies. The studies carried out by FAO in partnership with the Universidade de Pernambuco to evaluate the *Defeso* in the Northeast region of Brazil have highlighted the need to evaluate the periods of the *Defeso*.
- Finally, the report concludes that the programme is useful for maintaining the environmental, social and economic sustainability of fishing activity but it suffers from severe limitations in its implementation and these compromise its effectiveness.

Despite the extensive literature on *Seguro-Defeso*, there has been no robust evaluation of the programme’s socioeconomic and environmental impacts. This gap in the literature reflects the challenge of developing a model with a clear counterfactual: “what would have happened in the absence of *Defeso* and *Seguro-Defeso*?” The design of this study tries to overcome some of the data challenges and puts forward a methodology to implement a robust impact evaluation of the *Seguro-Defeso* on the socioeconomic conditions of beneficiaries. It does not cover other aspects of the programme such as fraud or negative incentives that may lead to overfishing, or the impact of the adoption of *Defeso* on environmental outcomes. However, it provides evidence on the long-term impacts of the financial compensation provided by the programme and a detailed analysis of the main characteristics of the beneficiaries of the programme using various administrative data, as detailed in the next sections.

2.3 Seguro-Defeso impact evaluation design: identifying the appropriate evaluation design⁹

The main question an impact evaluation seeks to respond to is: “what would have happened to the beneficiaries if they had not participated in the programme?”¹⁰ in other words, how to estimate a counterfactual or a potential outcome we do not observe. Estimating causal effects is similar to a missing data problem: we need to find a way to learn about something we cannot observe: the non-treatment status of those treated. Thus, the main problem is to construct or identify a reliable counterfactual which represents the outcomes for the treated population in the absence of the programme (Gertler *et al.* 2016) and to evaluate average causal effect as the difference between the observed outcome and the counterfactual. The correct definition of counterfactuals enables the estimation of unbiased causal effects from the observed outcomes and counterfactual outcomes of the treated population (Rubin 1973). The basic rationale for constructing a counterfactual lies in identifying a comparison/control (non-treated) group that is as similar as possible to the beneficiaries (treated group).

In the context of randomized controlled trials (RCTs) where subjects are randomly assigned to the treated and control groups, there are no differences between the two groups in pre-treatment characteristics (Rubin, 1973). As individuals in the study have on average the same pre-treatment characteristics, they also have the same potential outcomes. In this sense, the group that did not receive the treatment (control group) is comparable to the treatment group. Thus, post-treatment differences in outcomes between the two groups can be attributed to the programme.

Because RCTs are not feasible in many evaluation settings, observational studies have tried to emulate the conditions of randomization by building comparison groups as similar as possible to the treated group. Propensity score matching methods, in which treated and non-treated groups are probabilistically matched to simulate a counterfactual for the treated population, have been widely used. The matching is made through scores derived from observable variables in the pre-treatment period (Rosenbaum and Rubin, 1983). The central concern in the matching procedure is to have two groups that are as similar as possible so that observed and unobserved differences in their composition would not cause the results to be biased.

For observational studies (i.e. non-randomized research designs), treated and non-treated groups might have non-random differences because of selection bias (Rubin 1974; Rosenbaum and Rubin 1983). The simple comparison of treated and non-treated average outcomes would lead to biased estimates of treatment effects: variations in outcomes could be due to these systematic differences between groups. Therefore, the use of matching procedures using some variables that determine selection/participation in the programme and influence the outcomes of interest is key to obtain credible counterfactuals.

The validity of the estimation yielded by propensity score matching methods strongly depends on capturing the factors that affect the treatment assignment and outcomes, or in other words, controlling for confounders, which are variables that are systematically different between the treatment and control groups and that affect treatment assignment as well as the outcome(s) of interest. This means that in the absence of relevant information in the available datasets it will be impossible to eliminate the selection bias. It is also necessary to make sure that the observables included in the analysis are correctly measured as measurement errors have a negative effect on bias reduction.

The choice of the evaluation design for the impact of the *Seguro-Defeso* on the socioeconomic conditions of the beneficiaries was mainly determined by the fact that the implementation of the programme was non-randomized and that the sample of non-beneficiary applicants is too small and unevenly distributed over time to allow for a

9. This section presents the main results of the “Study design for the impact evaluation of *Seguro-Defeso*”, conducted by IPC-IG researchers Diana Sawyer, José Silva, Tamara Santos, Marília Rocha, Luca Lazzarini, Carolina Bloch, Mariana Hoffmann and Laura Botega, as part of a series of background papers delivered in August 2020.

10. This metaphysical question has been considered for over three centuries since David Hume published *An inquiry concerning human understanding* around 1740. It concerns a discussion of inductive reasoning and its role in science and knowledge about causality.

binary treatment–control evaluation design. However, *Seguro-Defeso* beneficiaries received different doses of treatment, i.e. stayed in the programme for longer or shorter periods and entered into it during different periods under different eligibility criteria. Hence, the propensity score methodology needs to be adapted to a context of different treatment levels (duration and multi-treatment groups) using the generalized propensity score (GPS) matching methodology.

The concept of GPS generalizes the propensity score approach to situations where treatment has more than two comparison settings, either as a continuous dose or with multiple ordinal/categorical levels (Imbens, 2000; Imai and van Dyk, 2004). With a treatment that is not binary or categorical, we are interested in estimating either the impact of multiple treatments or the dose–response function where the treatment takes on a continuum of values (Guardabascio and Ventura, 2014; Flores *et al.*, 2012; Bia and Mattei, 2008; Hirano and Imbens, 2004). The dose–response function describes the relationship between the magnitude of the outcome response as a function of exposure (or dose) of the treatment. More details about the GPS methodology can be found in the methodological section and in Appendix 4.

3. DATA CONSISTENCY ANALYSIS

The dataset used in the impact evaluation has been built by linking two administrative databases. The Unemployment Insurance Management Database (1992 to 2018) from the BGSD was linked to the 2018 Single Registry for Brazilian Federal Social Programmes (CadUnico) used for programmes targeting low-income families. The former has information on the *Seguro-Defeso* benefit payment (including payment dates) and limited information on beneficiary characteristics. It provides other relevant information on the type of *Defeso* for which the fisher was registered as a beneficiary (i.e. the areas in which the fishers work and the species they catch). Using the individual taxpayer identification number (CPF, *Cadastro de Pessoa Física*), it is possible to identify the same individuals in the Single Registry and gain access to their household information. It is important to note that *Seguro-Defeso* beneficiaries are not required to enrol in the Single Registry, nor is this database used in the eligibility verification process of the programme. The Single Registry in the context of this evaluation provides the variables that will help to control for confounding factors (hence to build the GPS) as well as to select the outcomes of interest of this evaluation (socioeconomic indicators). The data from the two databases used in the analysis, and the procedures for checking their consistency and constructing the final impact evaluation dataset, are detailed below.

3.1 Unemployment Insurance Management Database from 1992 to 2020¹¹

- status of BGSD application and BGSD payments: variable used to form a group of registered but non-beneficiary individuals;
- year of payment of the benefit;
- total amount received per year, per beneficiary of *Seguro-Defeso*; the payment variables were adjusted to values of annual net earnings in minimum wages;
- year: annual registration base for each registered and/or beneficiary of *Seguro-Defeso*;
- CPF number—individual taxpayer registration number: individual identification number to link the two databases.

11. The list of the BGSD's variables is shown in Appendix 3.

3.2 Brazilian Federal Government Single Registry, 2018

- CPF number;
- household identification number;
- socioeconomic condition of beneficiaries and other household members;
- selection of outcome variables in 2018 and covariates for 2018.

It is important to highlight that the household definition used in the Single Registry is a group of people living together in the same house, sharing incomes and expenses, regardless of their family ties.

3.3 Linking the two databases using CPF number as individual identifier

The CPF number that uniquely identifies each individual in the two datasets used in the evaluation is the key to match individuals registered in both the BGSD database—which contains individuals who requested the *Seguro-Defeso* from 1992 to 2018—and the 2018 Single Registry database that contains socioeconomic data, not only for the individual that required the *Seguro-Defeso* benefit, but for all household members.

The linkage procedure succeeded in linking 50 per cent of the whole BGSD database from 1992 to 2020. Restricting to the most recent period from 2016 to 2018,¹² 95.5 per cent of the *Seguro-Defeso* beneficiaries were linked to the Single Registry. Given that the Single Registry is the registry for low-income families in Brazil, one can conclude that at least for active beneficiaries for the 2016 to 2018 period, *Seguro-Defeso* was targeted at individuals from low-income families. This higher percentage of success in joining the two databases for the most recent years could be explained by the fact that the Single Registry was created in 2001 and since then it has improved its quality and more than doubled the number of registered individuals.

Most of the households registered in the Single Registry are eligible and benefit from the *Bolsa Família* programme, which prioritizes women as the direct beneficiary of the cash transfer. Thus, the Single Registry tends to have an over-representation of women (and under-representation of men). This feature of the database has an impact on the linkage results, as shown in Table 2. While women account for 47 per cent of the total pool of *Seguro-Defeso* beneficiaries for the whole period from 1992 to 2018, in the linked database they are 60 per cent. Moreover, whereas 66 per cent of women found in the BGSD database were linked to the Single Registry, only 38 per cent of men were linked. However, for active *Seguro-Defeso* beneficiaries between 2016 and 2018, differences in the linkage rate by sex was not very large—97.5 per cent for women and 92.5 per cent for men, a fall from 22 percentage points using the entire sample to just 5 percentage points with the restricted sample (2016 to 2018).

Differences between the linked and unlinked individuals by age do not seem very important. In fact, the complete BGSD database is slightly older because it covers a longer period that comprises a wider range of birth cohorts (Table 3). Linkage success rate also decreases with age since the Single Registry data covers only the year 2018 so that older beneficiaries in the early days of the *Seguro-Defeso* (early 1990s) are less likely to appear in the Single Registry (from 2018). The comparison of the educational distribution of the linked and unlinked groups is hampered

12. The respective tables for this restricted recent period are presented in Appendix 5.

by the excess of missing and data entry errors¹³ (Table 4). Still, it appears that those who were matched are to a greater extent in the intermediate educational categories. The higher proportion of more educated beneficiaries who were not matched makes sense because they are less likely to be registered in the Single Registry, which, as presented above, contains information about the population most vulnerable to poverty in Brazil, and in general, less educated. Regarding the restricted database for the most recent period, there are no differences between the groups, in terms of age and education distributions as shown in Appendix 5.

Table 2. Database linkage and composition by sex—BGSD (1992–2019) and Single Registry (2018)

Sex group	In Single Registry	Out Single Registry	Total	% in Single Registry	Sex composition (%)			
					In Single Registry (A)	Out Single Registry (B)	Dif C= [A–B]	BGSD total
Women	393,776	204,243	598,019	65.8	60.4	32.5	27.9***	46.7
Men	257,824	423,688	681,512	37.8	39.6	67.5	-27.9***	53.3
Total	651,600	627,931	1,279,531	50.9	100	100	-	100

Note: The difference in the proportion by sex of beneficiaries in each database, merged with Single Registry and not merged, was statistically tested using a chi-square test (***p < 0.01; **p < 0.05; *p < 0.1).

Source: Authors' elaboration based on BGSD (1992 to 2019) and Single Registry (2018).

Table 3. Database linkage and composition by age—BGSD (1992–2019) and Single Registry (2018)

Age group	In Single Registry	Out Single Registry	Total	% in Single Registry	Age composition (%)			
					In Single Registry (A)	Out Single Registry (B)	Dif C= [A–B]	BGSD Total
18–24	15,031	9,803	24,834	60.5	2.3	1.6	0.7***	1.9
25–29	64,134	41,658	105,792	60.6	9.8	6.6	3.2***	8.3
30–39	214,373	150,596	364,969	58.7	32.9	24.0	8.9***	28.5
40–49	181,707	158,269	339,976	53.4	27.9	25.2	2.7***	26.6
50–64	153,231	211,316	364,547	42.0	23.5	33.7	-10.2***	28.5
65+	23,118	56,283	79,401	29.1	3.5	9.0	-5.5***	6.2
Total	651,600	627,931	1,279,531	50.9	100	100	-	100

Note: The difference in the proportion by age group of beneficiaries in each database, merged with Single Registry and not merged, was statistically tested using a chi-square test (***p < 0.01; **p < 0.05; *p < 0.1).

Source: Authors' elaboration based on BGSD (1992 to 2019) and Single Registry (2018).

The comparison of these two groups from the BGSD database (matched and not matched with the Single Registry) seeks to assess the potential bias in the selection and attrition in the matched database that will be used for the impact analysis. Although the differences are generally statistically significant, there are no relevant differences in the distributions by age and education. The observed differences by sex were expected because of the incentive put in place by the *Bolsa Família* Programme design (i.e. women as the main beneficiary) on under-representation of adult men in the Single Registry database. Thus, sex will be one of the key variables to be controlled for in the statistical models used for the estimation of impacts, attenuating any possible selection bias.

13. It is important to note that these tables are based on the responses in the BGSD database and for the purposes of estimating the impacts of the programme, in the following sections of the report, the highest quality responses from the Single Registry are used.

Table 4. Database linkage and composition by educational level age—BGSD (1992–2019) and Single Registry (2018)

Educational group	In Single Registry	Out Single Registry	Total	% in Single Registry	Education composition (%)			BGSD Total
					In Single Registry (A)	Out Single Registry (B)	Dif C= (A–B)	
Illiterate	89,788	130,649	220,437	40.7	13.8	20.8	–7.0***	15.7
Incomplete elementary	240,743	283,973	524,715	45.8	36.9	45.2	–8.3***	36
Elementary	18,785	22,195	40,980	45.8	2.9	3.5	–0.6***	2.8
Secondary	10,179	12,013	22,192	45.9	1.6	1.9	–0.3***	1.5
College graduates	56	123	179	31.3	0.0	0.0	0.0***	12.3
Missing	155,988	86,387	242,375	64.3	23.9	13.8	10.2***	16.6
Response error	136,061	92,591	228,652	59.5	20.9	14.7	6.1***	15.7
Total	651,600	627,931	1,279,531	50.9	100	100	–	100

Note: Categories and values based on BGSD responses. Educational variables used at estimation are based on Single Registry responses, which have a minimum percentage of missing and response errors (0.6 per cent). The difference in the proportion by educational group of beneficiaries in each database, merged with Single Registry and not merged, was statistically tested using a chi-square test (**p < 0.05; *p < 0.1).

Source: Authors' elaboration based on BGSD (1992 to 2019) and Single Registry (2018).

3.4 Identification of individuals from the same household to measure socioeconomic indicators at the household level

As the socioeconomic impacts of the programme are measured at the household level, it is also important to link the matched database of individuals in the BGSD and in the Single Registry with the other members of the household of these individuals. Each beneficiary has a household identification number in the Single Registry that was used to link them with their family members in the Single Registry.

3.5 Detailing the steps to get to the final evaluation dataset

The original 1992–2020 BSGD database used in the evaluation contains 1,279,531 beneficiaries and 35,478 applicants. The linkage with the 2018 Single Registry restricted the database to 651,600 beneficiaries and 15,529 non-beneficiary applicants, shown in the previous tables, that have requested or received the benefit until 2018 (those beneficiaries whose first benefit was paid in 2019 or 2020 were excluded from the analyses, a total of 1,884 beneficiaries and 1,752 non-beneficiaries). The database was reduced to 649,716 beneficiaries (out of the original 651,600 beneficiaries shown in tables 2 to 4) and 13,777 individuals that applied for the benefit but who are not beneficiaries.

There are cases of more than one beneficiary living in the same household who have received the benefit in different periods of time. As the analysis will be undertaken at the household level, only one individual was chosen to be the “main” beneficiary.¹⁴

Since the outcomes variables used in the model are at the household level, information about the other members of the beneficiary's household from the Single Registry were added to the dataset to build the household-level outcome variables.

14. Exclusion criteria [1] leave as main beneficiary the person who received it last, using the variable date of the payment of the instalment (data_pagamento_parcela). If the last date of payment coincides for beneficiaries in the same household, then [2] leave the person who received the largest number of instalments of the benefit (using the variable total number of instalments [n_parcelas]). If more than one person in the household received the same maximum number of payment instalments, then; [3] duplicate codes were removed by using the “distinct” function in R software.

3.6 Comparative analysis of impact evaluation dataset: BGSD beneficiaries versus BGSD applicants

In this section, the beneficiaries in the final database (the ones that are in the BGSD and the Single Registry database and received the first benefit before 2019) are compared to those who could have constituted an ideal control group, i.e. those who applied but did not obtain the *Seguro-Defeso* benefit. However, this potential control group of non-beneficiary applicants is not only a very small group—only 13,777 households over the entire period—but it is also concentrated in recent years (96 per cent in the last 10 years), comprising 42 per cent from 2015 to 2018, 44 per cent from 2010 to 2014, 8 per cent in 2009 and a further 6 per cent between 2003 and 2008 of the BGSD database. The fact that the ideal control group is so small precludes impact estimation with a binary treatment. Thus, the identification strategy adopted in this report put forward a multiple treatment level methodology and a dose–response framework. Despite the limitations of this potential control group for impact evaluation purposes, it can still be used to assess the targeting of the programme. This section seeks to explore evidence of differences between the beneficiaries (treatment groups) and the non-beneficiaries who applied for the benefit (potential control group).

Beneficiaries versus applicants: individual level characteristics¹⁵

There are no relevant differences between beneficiaries and non-beneficiary applicants in relation to sex (about 60 per cent are women in both groups), race (almost 90 per cent non-white) and position in the household (more than 70 per cent are heads of household) as shown in tables 5, 6 and 7, respectively. The age distribution between beneficiaries and non-beneficiaries is also similar; non-beneficiaries tend to be a bit younger (Table 8) which is expected given the abovementioned over-representation of applicants in more recent data.

The state–level distribution shown in Table 9 reveals for both groups an important concentration in states from the North and Northeast regions. In particular, both beneficiaries and non-beneficiaries are highly concentrated in the states of Pará and Maranhão (around 47 per cent), followed by Bahia and Amazonas (around 12 per cent for beneficiaries and 10 per cent for non-beneficiaries). It is noteworthy that some states have relatively more applicants than beneficiaries: Pará and Amapá, while others have relatively more beneficiaries than applicants: Maranhão, Bahia and Piauí.

As for education levels, there is an important difference in the percentage of individuals with high school education in the two groups. While 32 per cent of the applicants have high school education, just 23 per cent of beneficiaries are in this category, suggesting that applicants have higher levels of education attainment (Table 11 and 12).

As for the labour market status of individuals in the final database, it is important to note that 50 per cent of individuals in both groups—beneficiaries and non-beneficiary applicants—have no information about their occupation and average income. Among those beneficiaries who report their occupation, more than 60 per cent are self-employed, 20 per cent are temporary rural workers, in both cases with average income below one quarter of the minimum wage. Non-beneficiaries have higher income and are relatively more prevalent among employees with a formal contract.

The comparison between the two groups shows that there are relevant differences that may suggest that some non-beneficiaries have a profile that does not correspond to that of a typical commercial artisanal fisher, particularly with regard to educational attainment.¹⁶ These differences between beneficiaries and non-beneficiaries also suggest that beneficiaries are in fact among the most vulnerable population, since the beneficiaries group seems to be less educated, have a lower income and lower level of formalization (proportion of formal workers), suggesting the pro-poor approach of the programme.

15. Note that all individual characteristics analysed in this subsection and the household characteristic analysed in the next subsection come from the 2018 Single Registry database.

16. Although this can be at least partially explained by the fact that applicants are over-represented in more recent cohorts that more likely have a higher level of education compared to the older ones.

Table 5. Number of matched individuals in the Single Registry, by status in the BGSD (beneficiary/applicant) and sex, 2018

Sex	Total number		Composition (%)	
	Beneficiary	Non-beneficiary	Beneficiary	Non-beneficiary
Male	252,409	5,346	38.8	38.8
Female	397,307	8,431	61.2	61.2
Total	649,716	13,777	100	100

Source: BGSD (1992 to 2018) and Single Registry (2018).

Table 6. Number of matched individuals in the Single Registry, by status in the BGSD (beneficiary/non-beneficiary) and race/skin colour, 2018

Race/skin colour	Total		Composition (%)	
	Beneficiary	Non-beneficiary	Beneficiary	Non-beneficiary
White	81,937	1,446	12.6	10.5
Black	50,533	955	7.8	6.9
Brown	504,589	11,135	77.7	80.8
Yellow	3,027	55	0.5	0.4
Indigenous	9,345	178	1.4	1.3
NA (missing cases)	285	8	0.0	0.1
Total	649,716	13,777	100	100

Source: Authors' elaboration based on BGSD (1992 to 2018) and Single Registry (2018).

Table 7. Number of matched individuals in the Single Registry, by status in the BGSD (beneficiary/non-beneficiary) and relationship with the household head, 2018

Relationship	Total		Distribution (%)	
	Beneficiary	Non-beneficiary	Beneficiary	Non-beneficiary
Household head	463,503	10293	71.3	74.7
Spouse or partner	165,890	3012	25.5	21.9
Son or daughter	12,916	278	2.0	2.0
Stepchild	68	0	0.0	0.0
Grandchild or great-grandchild	160	4	0.0	0.0
Father or mother	2,978	69	0.5	0.5
Father- or mother-in-law	129	6	0.0	0.0
Sibling	1,498	41	0.2	0.3
Son- or daughter-in-law	139	3	0.0	0.0
Other relative	967	32	0.1	0.2
Not related	221	11	0.0	0.1
NA (missing cases)	1,247	28	0.2	0.2
Total	649,716	13,777	100.0	100

Source: Authors' elaboration based on BGSD (1992 to 2018) and Single Registry (2018).

Table 8. Number of matched individuals in the Single Registry, by status in the BGSD (beneficiary/non-beneficiary) and age, 2018

Age group	Total		Composition (%)	
	Beneficiary	Non-beneficiary	Beneficiary	Non-beneficiary
<17	47	3	0.0	0.0
18–24	23,331	922	3.6	6.7
25–29	73,118	1,940	11.3	14.1
30–39	216,317	4,744	33.3	34.4
40–49	176,218	3,317	27.1	24.1
50–64	141,961	2,415	21.8	17.5
65+	18,724	436	2.9	3.2
Total	649,716	13,777	100	100

Source: Authors' elaboration based on BGSD (1992 to 2018) and Single Registry (2018).

Table 9. Number of matched individuals in the Single Registry, by status in the BGSD (beneficiary/non-beneficiary) and Brazilian State, 2018

State	Total		Distribution (%)	
	Beneficiary	Non-beneficiary	Beneficiary	Non-beneficiary
Pará	161,088	4,262	24.8	30.9
Maranhão	144,415	2,322	22.2	16.9
Bahia	80,887	978	12.4	7.1
Amazonas	58,448	1,431	9.0	10.4
Piauí	24,864	200	3.8	1.5
Sergipe	22,796	369	3.5	2.7
Paraíba	18,886	476	2.9	3.5
Rio Grande do Norte	14,996	275	2.3	2.0
Alagoas	14,785	320	2.3	2.3
Ceará	14,208	193	2.2	1.4
Amapá	11,626	1,630	1.8	11.8
Minas Gerais	11,376	133	1.8	1.0
Acre	8,069	99	1.2	0.7
São Paulo	7,407	188	1.1	1.4
Rio Grande do Sul	6,165	44	0.9	0.3
Espírito Santo	6,244	80	1.0	0.6
Santa Catarina	5,519	60	0.8	0.4
Rio de Janeiro	5,186	89	0.8	0.6
Pernambuco	5,105	197	0.8	1.4
Mato Grosso	4,960	65	0.8	0.5
Roraima	4,450	74	0.7	0.5
Tocantins	4,380	59	0.7	0.4
Paraná	4,123	59	0.6	0.4
Rondônia	3,648	65	0.6	0.5
Mato Grosso do Sul	3,390	38	0.5	0.3
Goiás	2,367	61	0.4	0.4
Distrito Federal	328	10	0.1	0.1
Brazil	649,716	13,777	100	100

Source: Authors' elaboration based on BGSD (1992 to 2018) and Single Registry (2018).

Table 10. Number of matched individuals in the Single Registry, by status in the BGSD (beneficiary/non-beneficiary) and literacy indicator, 2018

Does the individual know how to read/write?	Total		Distribution (%)	
	Beneficiary	Non-beneficiary	Beneficiary	Non-beneficiary
Yes	558,497	12,150	86.0	88.2
No	91,219	1,627	14.0	11.8
Total	649,716	13,777	100	100

Source: Authors' elaboration based on BGSD (1992 to 2018) and Single Registry (2018).

Table 11. Number of matched individuals in the Single Registry, by status in the BGSD (beneficiary/non-beneficiary) and level of education, 2018

Level of education	Total		Distribution (%)	
	Beneficiary	Non-beneficiary	Beneficiary	Non-beneficiary
Kindergarten	347	5	0.1	0.0
Literacy class	4,768	74	0.7	0.5
Elementary (1st to 4th grade)	210,784	3,208	32.4	23.3
Elementary (5th to 8th grade)	151,931	3,132	23.4	22.7
Concluded Elementary (9-year)	28,389	612	4.4	4.4
Special elementary	3,894	62	0.6	0.5
High school	150,680	4,580	23.2	33.2
Special high school	4,011	105	0.6	0.8
Elementary education for adults (1st to 4th grade)	5,488	114	0.8	0.8
Elementary education for adults (5th to 8th grade)	7,009	233	1.1	1.7
High school for adults	2,353	61	0.4	0.4
Higher education, Master's, PhD	1,756	110	0.3	0.8
Adult literacy	948	12	0.1	0.1
None	677	14	0.1	0.1
NA (missing cases)	76,681	1,455	11.8	10.6
Total	649,716	13,777	100	100

Source: Authors' elaboration based on BGSD (1992 to 2018) and Single Registry (2018).

Table 12. Number of matched individuals in the Single Registry, by status in the BGSD (beneficiary/non-beneficiary), main occupation and average monthly remuneration, 2018

Main function	Total		Distribution (%)		Average remuneration (2018)	
	Beneficiary	Non-beneficiary	Beneficiary	Non-beneficiary	Beneficiary	Non-beneficiary
Self-employed	203,504	4,738	31.3	34.4	233.6	264.5
Temporary worker in rural area	79,324	1,335	12.2	9.7	172.8	175.6
Employee without a formal contract	6,657	247	1.0	1.8	626.5	759.5
Employee with a formal contract	5,943	390	0.9	2.8	1,006.60	1,025.20
Domestic worker without a formal contract	4,094	105	0.6	0.8	293.1	339.5
Domestic worker with a formal contract	412	24	0.1	0.2	896.6	844.4
Unpaid worker	13,671	136	2.1	1.0	30.7	28
Military or civil servant	3,227	251	0.5	1.8	1,044.30	1,021.40
Employer	87	0	0.0	0.0	1,280.20	0
Intern	55	10	0.0	0.1	384.8	638.7
Apprentice	13	1	0.0	0.0	106.9	30
	332,729	6,540	51.2	47.5	10.4	11.2
Total	649,716	13,777	100	100	241.89	324.11

Source: Authors' elaboration based on BGSD (1992 to 2018) and Single Registry (2018).

Beneficiaries versus non-beneficiaries: household level characteristics

The percentage of urban households among the non-beneficiaries is much higher than among the beneficiaries (Table 13). In contrast, there are no important differences with regard to household type, permanent or improvised (Table 14), and to the special classification as indigenous or *quilombola* (traditional communities descended from slaves) (Table 15). However, whereas for 86 per cent of beneficiary households the head of the household earns less than one quarter of the minimum wage, only 80 per cent of the non-beneficiaries are in this category (Table 16), which again suggests that beneficiaries are poorer than non-beneficiaries.

Table 13. Number of matched households in the single registry, by status in the BGSD (beneficiary/non-beneficiary) and location, 2018

Household location	Total		Distribution (%)	
	Beneficiary	Non-beneficiary	Beneficiary	Non-beneficiary
Urban	386,793	9,344	59.5	67.8
Rural	262,818	4,426	40.5	32.1
NA	105	7	0.0	0.1
Total	649,716	13,777	100	100

Source: Authors' elaboration based on BGSD (1992 to 2018) and Single Registry (2018).

Table 14. Number of matched households in the Single Registry, by status in the BGSD (beneficiary/applicant) and household type, 2018

Household type	Total		Distribution (%)	
	Beneficiary	Non-beneficiary	Beneficiary	Non-beneficiary
Permanent, private	616,146	12,621	95	92
Improvised, private	27,708	872	4	6
Collective	5,725	277	1	2
NA	137	7	0	0
Total	649,716	13,777	100	100

Source: Authors' elaboration based on BGSD (1992 to 2018) and Single Registry (2018).

Table 15. Number of matched households in the Single Registry, by status in the BGSD (beneficiary/non-beneficiary) and *quilombola*/indigenous identification, 2018

Classification	Total		Distribution (%)	
	Beneficiary	Non-beneficiary	Beneficiary	Non-beneficiary
Quilombola	17,434	275	2.7	2.0
Indigenous	9,499	182	1.5	1.3
None	622,783	13,320	95.9	96.7
Total	649,716	13,777	100	100

Source Authors' elaboration based on BGSD (1992 to 2018) and Single Registry (2018).

Table 16. Number of matched households in the Single Registry, by status in the BGSD (beneficiary/non-beneficiary) and income from the head of the household's main occupation (in terms of minimum wage), 2018

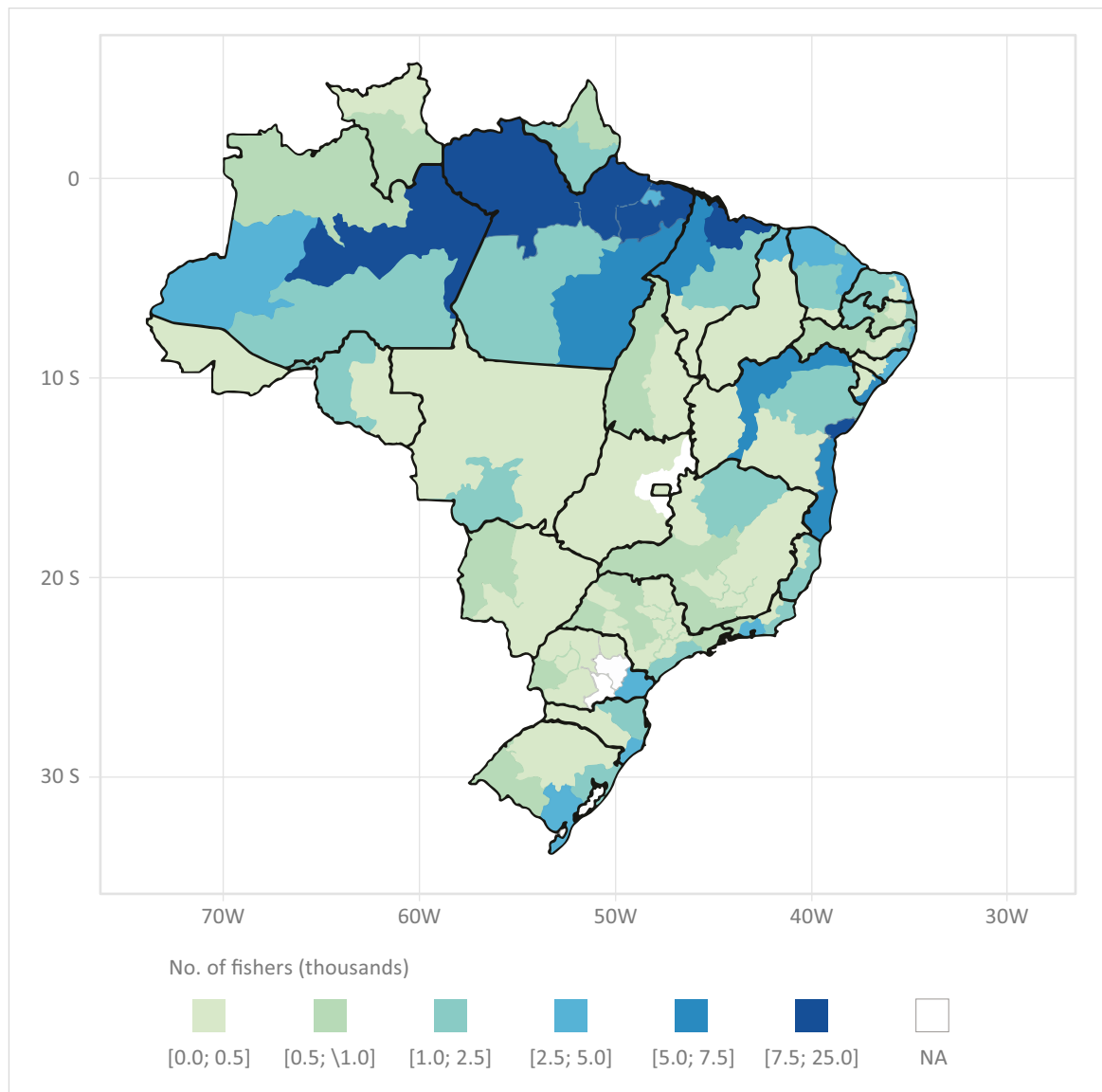
Income in terms of minimum wages	Total		Distribution (%)	
	Beneficiary	Non-beneficiary	Beneficiary	Non-beneficiary
Up to ¼ minimum wage (MW)	556,403	10,960	85.6	79.6
¼ to ½ MW	53,544	1,375	8.2	10.0
½ to 1 MW	31,375	1,076	4.8	7.8
1 to 3 MW	6,748	306	1.0	2.2
3+ MW	211	2	0.0	0.0
NA	1,435	58	0.2	0.4
Total	649,716	13,777	100	100

Source: Authors' elaboration based on BGSD (1992 to 2018) and Single Registry (2018).

Box 1. Distribution of fishers in Brazil according to the 2010 Census

It is possible to compare the distribution between the states of the beneficiaries of the *Seguro-Defeso* (artisanal fishers) with the distribution of individuals whose main occupation was declared as “fisher” using data from the 2010 Census. In doing so, we can assess whether the distribution of beneficiaries is in accordance with the distribution of fishers in the country. A very large difference in these distributions may suggest the existence of fraud in the programme. Based on the Demographic Census of 2010, Figure 1 shows the regional distribution of individuals whose main occupation was self-reported as “fisher”. As with the distribution of *Seguro-Defeso* beneficiaries depicted in Table 10, the areas with the highest concentration of fishers according to the Census are located in the North and Northeast regions. It is important to add a caveat note here: the Census data does not allow for differentiation between commercial professional artisanal fishers and subsistence fishers.

Figure 1. Total number of individuals whose main occupation was declared to be “fisher” by region, (thousands) 2010



Source: 2010 Census from the Brazilian Institute of Geography and Statistics (IBGE).

Source: Authors' elaboration.

4. METHODOLOGY

4.1 Building treatment dose indicators in the BGSD

The evaluation design needs to factor in changes in legislation, particularly with regard to *Seguro-Defeso* eligibility criteria which are largely responsible for the heterogeneity of treatment group (beneficiaries). We do so by controlling for the period in which the beneficiary entered the programme, i.e. the year in which the beneficiary started to receive the benefit. We aggregated beneficiaries by the year of their inclusion in the payment roll using five groups that were defined according to changes in eligibility criteria as per changes in legislation: (1) 1992/7 to 2002, (2) 2003 to 2008, (3) 2009, (4) 2010 to 2014, and (5) 2015 or later.

Table 17. Total beneficiaries by payments duration in years

Duration (years)	Total of beneficiaries	Distribution [%]	Cumulative distribution [%]
1	92,565	14.2	14.2
2	37,621	5.8	20.0
3	55,091	8.5	28.5
4	85,944	13.2	41.7
5	53,152	8.2	49.9
6	47,867	7.4	57.2
7	47,792	7.4	64.6
8	58,780	9.0	73.6
9	51,258	7.9	81.5
10	33,382	5.1	86.7
11	27,574	4.2	90.9
12	17,303	2.7	93.6
13	14,270	2.2	95.8
14	10,459	1.6	97.4
15	6,319	1.0	98.4
16	2,934	0.5	98.8
17	2,165	0.3	99.1
18+	5,240	0.8	100.0
Total	649,716	100	

Source: Authors' elaboration based on BGSD (1997 to 2018) and Single Registry (2018).

A second approach to capture the impact of the *Seguro-Defeso* relies on the duration of exposure, which is also associated with the period the beneficiaries entered the programme. The duration of the exposure is measured by the difference between the first and last payments. Although not all beneficiaries received the benefit in consecutive years, delays in the payment of the benefit are, in many cases, the reason for not observing consecutive years and we believe that the difference between the first and last year is a better measure to proxy the duration of the programme. Although it would be informative to have episodes-based variables, we ended up verifying that it would not be possible, given that payments do not conform exactly to the year of application and are often accumulated in the following years.¹⁷

17. It was also not possible to use variables for the duration specific to each year, i.e. the number of months during which the *Seguro-Defeso* is active [the benefit is limited to five months per year]. In all, 96 per cent of beneficiaries received up to five payments during a single year and 62 per cent received four payments. However, some payments are made in the year subsequent to the application.

Here, it is important to highlight that since we are using the variable of the value of the benefit received by year in the BGSD database, the first payment registered in the database was in 1997, even if a beneficiary had applied and entered the database between 1992 and 1996 (see Table 19). Nevertheless, we do not expect this to significantly affect the results since less than 1 per cent of the total number of beneficiaries (considering the 1,279,531 beneficiaries) entered the programme before 1997 and an even smaller proportion of the beneficiaries is included in the Single Registry.

Table 18. Total beneficiaries by year of first payment

Years	Beneficiaries	Distribution (%)
1992/7–2002	20,232	3.1
2003–2008	171,627	26.4
2009	75,401	11.6
2010–2014	330,084	50.8
2015–2018	52,372	8.1
Total	649,716	100.0

Source: Authors' elaboration based on BGSD (1997 to 2018) and Single Registry (2018).

Table 19. Number of benefits by first and last year of payments

Year	First	%	Last	%
1992/7	4,075	0.63	3	0.00
1998	1,903	0.29	9	0.00
1999	2,530	0.39	9	0.00
2000	2,631	0.40	4	0.00
2001	3,900	0.60	15	0.00
2002	5,193	0.80	13	0.00
2003	13,548	2.09	105	0.02
2004	17,463	2.69	159	0.02
2005	22,875	3.52	339	0.05
2006	25,497	3.92	3,109	0.48
2007	44,333	6.82	6,116	0.94
2008	47,911	7.37	9,133	1.41
2009	75,401	11.61	12,801	1.97
2010	69,291	10.66	10,879	1.67
2011	50,777	7.82	10,547	1.62
2012	50,665	7.80	16,476	2.54
2013	54,097	8.33	25,348	3.90
2014	105,254	16.20	53,291	8.20
2015	25,535	3.93	25,673	3.95
2016	12,926	1.99	37,435	5.76
2017	4,969	0.76	111,162	17.11
2018	8,942	1.38	327,090	50.34
Total	649,716	100.00	649,716	100.00

Source: Authors' elaboration based on BGSD (1997 to 2018) and Single Registry (2018).

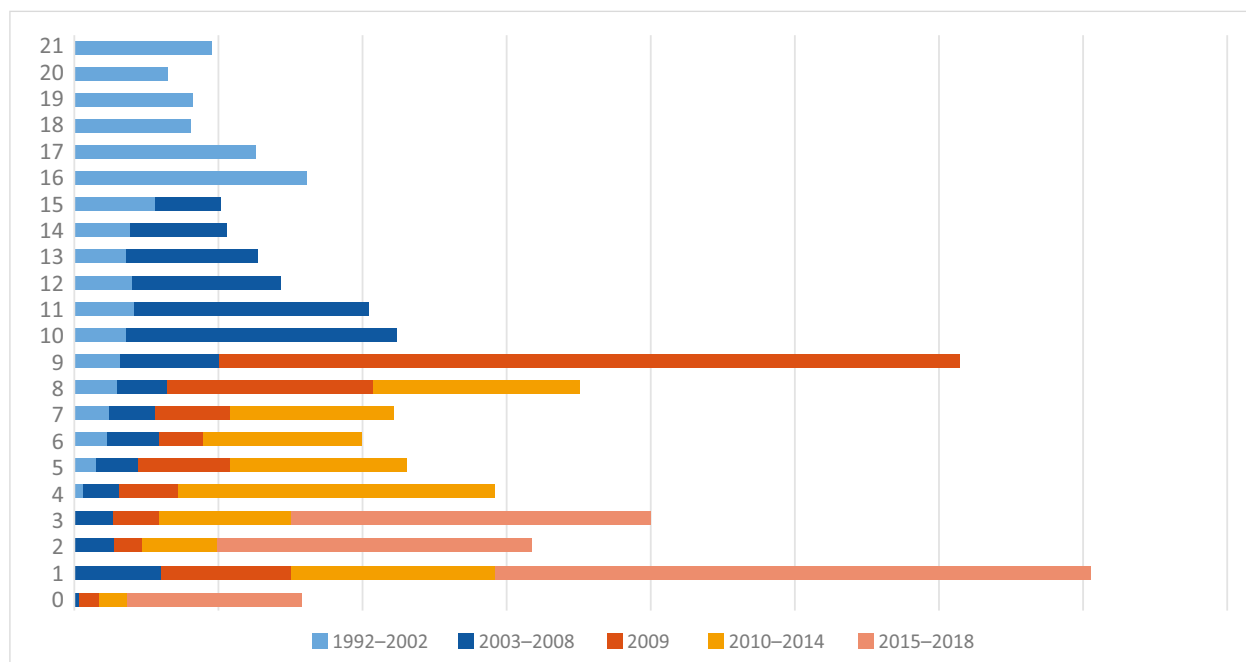
The duration of exposure indicator allows for an interpretation of impacts based on the period between 2018 and the last payment received by the beneficiary. For instance, when analysing the dose–response functions, the short term can be defined as a one-year interval, whereas the medium term is defined as the previous five years, and the long term as the 10 previous years.

The dose treatment indicator refers to the duration in years of treatment, namely the differences between the year of the first payment and the year of the last payment. Table 17 shows that 50 per cent received payments for five years and almost 87 per cent up to 10 years, which would mostly correspond to the period beginning in 2009 and ending in 2018.

Table 18 shows the result of the five-group aggregation of beneficiaries by year of their inclusion in the payment roll of the *Seguro-Defeso*. About 50 per cent of beneficiaries in the final dataset (i.e. those linked to the 2018 Single Registry) received their first payment within the 2010 to 2014 period, 12 per cent in a single year—2009, and 26 per cent from 2003 to 2008. About 8 per cent of beneficiaries were incorporated between 2015 and 2018 and 3.1 per cent in the first years of the programme. Table 19 further details the timing of payments and reveals 50 per cent of the sample was paid in 2018 (last observed payment).

In order to analyse the number of years in which the *Seguro-Defeso* was paid (duration) for each entry date into the programme (proxied by the year of first payment), we combine information from the two previous tables and get a more detailed view of the duration of benefit payments by entry cohort. Figure 2 shows that most beneficiaries received only one year of payments (without considering the number of monthly payments in that year) which is largely driven by the 2014–2018 entry cohort; followed by a second concentration in 9 years of exposure which is largely driven by the 2009 cohort. It is worth mentioning that many of those enrolled between 2009 and 2014 did not remain in the programme until 2018 (duration under 9 years for the 2009 cohort).

Figure 2. Duration (in years vertical axis) by group of first payment (entry cohort—bar colours)



Source: Authors' elaboration based on BGSD (1997 to 2018) and Single Registry (2018).

The information summarized above shows how time of entry into the programme (five entry cohorts) had different patterns of exposure to/duration in the programme, implying a large difference when estimating impacts on outcome

of interest. Moreover, the strategy of combining alternative specifications with the interaction between duration and year of entry, controlling for distance of last payment (lag) in relation to 2018, seems particularly appropriate, since for each set of outcomes of interest different periods would be expected for changes in the outcomes of interest to occur. For instance, impacts on the quality of housing would be expected to be of medium to long term, while impacts on schooling and work status would occur in the short term.

4.2 Definition of outcomes and covariates

4.2.1 Outcome variables (response/impact): socioeconomic conditions of the beneficiaries

The socioeconomic conditions of the beneficiaries were assessed using variables of the Single Registry database.¹⁸ All outcome variables are annual and at the household level from the Single Registry, and can be divided into three dimensions (tables 20 to 22): (1) child education and labour; (2) working age population occupation; and (3) housing characteristics. All indicators have a positive interpretation, i.e. the higher the values, the higher the specific quality of life indicator. In the interpretation of the results, we distinguish between lagged impacts, that is, separate analysis for short, medium and long-term impacts (as defined above).

Table 20. Child education and labour outcomes

Indicators	Definition	Categories of response
School enrolment of household children and teenagers		
All children and teenagers (6–17)	Are all children and teenagers of the household enrolled in school?	1=yes; 0=at least one is not; NA= no child or teenager in the household
Children aged 6–9	If there are any children aged 6 to 9 in the household, are they enrolled in school?	1=yes; 0=at least one is not; NA= no child aged 6 to 9 in the household
Children aged 10–14	If there are any children aged 10 to 14 in the household, are they enrolled in school?	1=yes; 0=at least one is not; NA= no child aged 10 to 14 in the household
Children aged 15–17	If there are any children aged 15 to 17 in the household, are they enrolled in school?	1=yes; 0=at least one is not; NA= no child aged 15 to 17 in the household
Children or teenagers work outside the household	Does any child or teenager work outside the household?	1=no; 0=yes, at least one; NA= no child or teenager in the household

Source: Authors' elaboration based on Single Registry (2018).

Table 21. Working-age population status outcomes

Indicators	Definition	Categories of response
Proportion of adults working in the household	Share of household members working in the year	Aged 18 or more
Young adults of the household (18–26) working and/or studying (non-“NEET”)	Are household young adults (18 to 26) working and/or studying?	1=yes; 0=at least one is not studying nor working; NA= no young adults in the household
Any adult currently employed in the formal labour market	Is there any adult currently employed in the formal labour market in the household?	1=yes; 0=no
Any adult who works more than six months in the year	Presence of at least one adult who works more than six months in the year	1=yes; 0=no
Any adult working in a non-agricultural activity	Presence of at least one adult working in a non-agricultural activity	1=yes; 0=no

Source: Authors' elaboration based on Single Registry (2018).

18. The dimensions used to proxy socioeconomic conditions were: (a) housing quality, including access to utilities; (b) schooling of the children and adolescents of the households; (c) composition of the workforce in the households; (d) main source of income of the adults of the households (see Appendix 6 for more details).

Table 22. Housing characteristics outcomes

Indicators	Definition	Categories of response
Quality of floor material	Medium/low: 1=dirt floor; 2= cement; 3=reclaimed wood High: 4=processed wood; 5=ceramics, stone or flagstone; 6=carpet; 7=other	1=high (4-7); 0=medium/low (1-3)
Quality of walls material	High/medium: 1= coated brick; 2= uncoated brick; 3=equipped wood Low: 4=coated mud; 5=uncoated mud; 6= reclaimed wood; 7=straw; 8=other	1=high/medium (1-3); 0=low (4-8)
Piped water		1=Yes, 0=No
General water supply		1=Yes, 0=No
Existence of bathroom		1=Yes, 0=No
Sewage disposal		1= Public sewage system network or septic tank; 0 = other
Index of housing quality	Sum of items: permanent private + adequacy of density of residents per bedroom + floor material + walls material + piped water + general water supply + existence of bathroom + sewage disposal + trash destination + electric lighting + pavement	Standardised to 1=maximum of 15
Housing adequacy	Adequate density of residents per bedroom up to 2; garbage directly or indirectly collected; connected to the general water supply network; septic tank or connected to public sewage system network	1=adequate density of residents per bedroom, waste destination, general water supply and quality of sewage disposal; 0 = others

Source: Authors' elaboration based on Single Registry (2018).

4.2.2 Covariates (explanatory variables):

Covariates that are supposed to have a direct effect on both the treatment assignment and the outcome of interest from the BGSD and Single Registry databases in 2018¹⁹ are presented in Table 23. From a previous extended list (Appendix 6), the following variables were chosen, based on model specification combined tests.

Table 23. Covariates

Variables	Description
General characteristics	
Region	1=North, 2=Northeast, 0=others
Place of residence	1=urban; 0=rural
Household composition	
Living arrangement	0=single mother; 1=couple with children, 2=childless couple, 3=lone person, 4=other
Cohabiting families	1=Yes, 0=No
Children dependency ratio	Ratio: number of children/working age household members
Household income characteristics	
Extreme poor (per capita income below R\$ 85 line)	1=Yes, 0=No
<i>Bolsa Família</i> beneficiary	1=Yes, 0=No
Presence of social security (retirement) income	1=Yes, 0=No
Beneficiary household head attributes	
Sex	1=male, 0=female
Age	0 = up to 29, 1 = 30–49, 2 = 50 above
Skin colour/racial groups	1=white; 0 = non-white
Educational levels	0=illiterate + functional illiterates + incomplete elementary; 1=incomplete secondary; 2=complete secondary; 3=college graduates

Source: Authors' elaboration based on BGSD and Single Registry (2018).

19. Optimal propensity scores include confounding variables and variables that predict outcome, while variables that are purely predictors of treatment should not be included in the model.

4.3 Impact evaluation models: estimating a dose–response function to evaluate the Seguro-Defeso benefits

4.3.1 Introduction

The identification strategy to estimate the impacts of *Seguro-Defeso* relies on the entry cohort as multiple treatments (given differences in eligibility criteria) and on the duration of exposure to the programme. Thus, we need to use GPS methods to estimate both the dose–response model and the multiple treatments model as detailed below.

4.3.2 Implementation

A) Dose–response:

In this study, the treatment is a continuous value, equal to the total of years that the beneficiary received the *Seguro-Defeso* benefit. Therefore, individuals that received at least one instalment of the benefit are assigned to a treated group with different levels of benefit—according to the duration of exposure (years) for which the individual received the benefit.

We assume that the duration of the *Seguro-Defeso* benefit depends on observed factors, such as region, type of household (urban or rural), sex, race, age, level of education, type of family and household and social economic conditions. After controlling for these observed confounding factors, we assume that the outcomes analysed are independent of the level of benefit. We estimate the effects of the *Seguro-Defeso* on different socio-economic outcomes (listed below) by estimating the GPS and the dose–response function following Hirano and Imbens (2004) and Bia and Mattei (2008). The correctly estimated GPS is essential to assure insignificant differences among pre-treatment covariates at each level of benefit. That is to say, the beneficiaries at each level of benefit should not be significantly different from each other if the GPS is estimated correctly. As for the dose–response function, the continuous dose is defined as the specific level of benefit, and the response is defined as the corresponding outcome.²⁰ The variables used in the model are:

Outcomes of interest (Y): (a) child education and child work (six indicators); (b) employment status of working age population within the household (five indicators); and (c) housing characteristics (eight indicators)—see tables 20 to 22.

Treatment t = duration (number of years with payments)

Covariates (X): north, northeast (reference: others); urban (reference: rural); men (reference: women); white (reference: non-white); aged 30–49, aged 50+ (reference: aged < 29); elementary, high school, college graduates (reference: incomplete elementary); *Bolsa Família* beneficiaries (reference: no); social security income (reference: no); cohabiting families (reference: no); couple with children, childless couple, lone person (reference: lone mother); children dependency ratio; extremely poor (reference: no)

The steps were:

- I. Step 1: treatment assignment model—estimation of the GPS, $\Pr(t, x)$: conditional distribution of the treatment given the covariates and test of the balancing property.

The score $r(t, x)$ is estimated through GLM. Thus, the distribution of the treatment variable is specified from the exponential family and thus may be explicitly non-normal; we assumed and tested Gaussian probability functions with a log link function $g\{E(T)\} = \beta'X \rightarrow r(T, X) = f(\hat{\beta})$ to estimate the predicted probability (GPS).

20. More details on the methodology used are presented in Appendix 4.

The balancing property of the covariates was tested dividing the set of potential treatment values (0–21) into six intervals, within each the GPS is computed at its mean (representative point) and evaluating the GPS for each household by setting $t = \text{mean of the group}$, which generated a distribution of the GPS with N elements for each group.

The values of the GPS evaluated at the representative point of each treatment interval are divided into four blocks.²¹ Within each block, the mean difference of each covariate between units belonging to treatment interval, i.e. group k and units that are in the same GPS interval but belong to another treatment interval, i.e. units not belonging to group k . Then the m differences in means are combined by using a weighted average, with weights given by the number of observations in each GPS interval.

The test statistics to evaluate the balancing property are functions of this weighted average. The highest absolute value of the *student's* t statistics is compared with reference values, and the extent of the balancing property supported by the data is obtained. If adjustment for the GPS properly balances the covariates, all differences are statistically insignificant.

- II. Step 2: estimation of the conditional expectation of the outcome Y as a function of two scalar variables, the treatment level, T , and the GPS, R : $\beta(t, r) = E(Y | T = t, R = r)$.

Polynomial functions were applied, defining the treatment levels and the quadratic power of the treatment variables and of the estimated GPS, where $\phi(\cdot)$ is a function that relates the predictor, $\lambda(T_i, R_i; \alpha)$, to the conditional expectation:

$$E(Y_i | T_i, R_i): \phi\{E(Y_i | T_i, R_i)\} = \lambda(T_i, R_i; \alpha) = \alpha_0 + \alpha_1 T_i + \alpha_2 T_i^2 + \alpha_4 R_i + \alpha_5 R_i^2$$

Based on the fitted outcomes regression models, we estimated the probability of the occurrence of the outcome for a household if their exposure was set equal to $T = t$.

- III. Step 3: estimation of the dose–response function, $\mu(t) = E[\beta\{t, r(t, X)\}]$, $t \in T$, by averaging the estimated conditional expectation, $\hat{\beta}\{t, r(t, X)\}$, over the GPS at each level of the treatment.

By taking the mean of this quantity over our database, the dose–response function: $\mu(t) = E[Y_i(t)]$ was estimated, i.e. the dose–response functions were estimated by calculating the mean probability of the occurrence of the outcome across all levels of treatment.

In order to obtain an estimate of the entire dose–response function, we estimated the average potential outcome for each level of the treatment belonging to a set of evenly spaced values, t_0, t_1, \dots, t , that cover the range of the observed treatment.

The treatment effect function is estimated considering a treatment gap, which is defined as $\mu(t+\#) - \mu(t)$, here $\#=1$. It reflects the marginal effect of receiving one more period of the benefit.

The role of the GPS in estimating the average potential outcome is in line with the estimation of the dose–response effect within strata defined by the linear predictor of the treatment density function, and then combining these estimates to form a single weighted average. Then the standard errors and confidence intervals of the dose–response function were estimated via bootstrapping. In each bootstrap iteration, the GPS is re-estimated without testing either the normality assumption or the balancing property. In practice, we are interested in the relative dose–response function, which compares the average outcome under each treatment level with

21. Various other specifications with alternative numbers of blocks, GPS intervals and break points were tested.

that under the control. Finally, the estimated dose–response function and its confidence intervals are plotted, describing the relationship between average treatment and the probability of the outcome, i.e. the treatment effects. Plots show both the estimated dose–response function and the estimated treatment effect function.

B) Average multiple treatment effect on treated using inverse probability weighting

We also conducted an alternative estimation of the treatment effects using inverse probability weighting (IPW), considering the intervals of years of entrance into the *Seguro-Defeso* programme to take account of legislation changes. We split the data series over five categories of years of first payment (entry cohorts): 1997–2002, 2003–2008, 2009, 2010–2014, 2015–2018 and used the group of applicants but non-beneficiaries as the reference group. In addition, we can interpret these breaks in periods as dose grades. IPW estimators use estimated probability weights to correct for the missing data problem, arising from the fact that each subject is observed in only one of the potential outcomes. Applying a flexible functional form of the model, i.e. multinomial, to predict treatment, we allowed multivalued treatment. Also, the outcome models are flexible: our outcome variables are continuous or binary.

Outcomes Y: same as in A)

Treatment t = categories of intervals (t) of years of entrance into the *Seguro-Defeso* programme: 1997–2002, 2003–2008, 2009, 2010–2014 and 2015–2018, reference: applicants but non-beneficiaries

Covariates x: same as in A)

IPW estimators use a two-step approach to estimate consistent treatment effects:

- I. Step 1: for the estimation of the parameters of the treatment model and of the inverse probability weights, we applied a flexible functional form of the model, i.e. multinomial, to predict treatment, allowing a multivalued treatment (six categories).
- II. Step 2: use of the estimated inverse probability weights to compute weighted averages of the outcomes for each treatment level, the potential outcome means. The outcome models are flexible: our outcome variables are continuous or binary. The contrasts of the weighted averages provide the estimates of the ATTs.

These steps produce consistent estimates of the effect parameters, the potential outcome means (POM) and the average treatment effects on the treated (ATT), because the treatment is assumed to be independent of the potential outcomes after conditioning on the covariates. The overlap assumption ensures that predicted inverse probability weights do not get too large. Both steps are implemented at once so that we do not need to correct the standard errors in the second step to reflect the uncertainty associated with the predicted treatment probabilities.

The treatment effects are interpreted as the change in an outcome caused by a household getting one treatment instead of another (different entry cohorts). The counterfactual model, i.e. potential outcome approach, provides a solution to the missing data problem of observing each household getting only one treatment and allow us to estimate the distribution of household level treatment effects. A potential outcome model specifies the potential outcomes that each household would obtain under each treatment level, the treatment assignment process, and the dependence of the potential outcomes on the treatment assignment process. When potential outcomes do not depend on the treatment levels, after conditioning on covariates, inverse probability weighted estimators can be used.²²

22. More details about the methodology are provided in Appendix 4.

5. DESCRIPTIVE DATA ANALYSIS OF THE VARIABLES IN THE MODEL OF IMPACT EVALUATION

Tables 24 and 25 present a description of the average values of the outcomes according to the constructed treatment variables. The objective is to highlight the differences between the multiple treatment values that justify the choice of the outcome to be analysed. Table 24 refers to the treatment variable of multiple periods of entry in the programme (first payment), compared to the pure control group (non-beneficiary applicants). Table 25 refers to time as beneficiary (duration in years). It is not intended to analyse the variables one by one in terms of their specific values, but the general patterns for the dimensions of outcomes.

Table 24. Means of the outcome variables, by categories of treatment variables

Outcome variables	Applicant non-beneficiary	Year of registration [first payment] with the BGSD				
		1991–2002	2003–2008	2009	2010–2014	2015+
All children enrolled in school (aged 6 to 17)	0.91	0.92	0.92	0.93	0.93	0.93
All children aged 6 to 9 enrolled at school	0.97	0.95	0.95	0.96	0.96	0.95
All children aged 10 to 14 enrolled at school	0.97	0.99	0.98	0.98	0.98	0.98
All children aged 15 to 17 enrolled at school	0.86	0.88	0.89	0.89	0.89	0.89
No children or teenagers working (6–17)	0.99	1	1	1	1	1
All young adults (18–26) working and/or studying	0.48	0.48	0.49	0.51	0.52	0.55
Any adult working more than six months in the year	0.43	0.41	0.42	0.41	0.42	0.49
Any adult working in a non-agricultural activity	0.38	0.22	0.25	0.25	0.27	0.28
Any adult working in a formal job	0.07	0.07	0.05	0.04	0.04	0.03
Household labour force participation rate	0.46	0.28	0.36	0.38	0.41	0.44
Piped water	0.68	0.78	0.68	0.65	0.64	0.59
General water supply	0.55	0.64	0.57	0.55	0.55	0.47
Sewage disposal	0.35	0.36	0.32	0.32	0.31	0.28
Existence of bathroom	0.82	0.91	0.85	0.82	0.79	0.8
Quality of wall material	0.57	0.76	0.62	0.59	0.59	0.49
Quality of floor material	0.83	0.93	0.88	0.85	0.83	0.83
Housing adequacy	0.23	0.24	0.19	0.18	0.18	0.16
Index of housing quality 0–15	0.55	0.65	0.57	0.55	0.54	0.5

Source: Authors' elaboration based on data from the BGSD and Single Registry (2018).

As for child education outcomes, there is little difference among those who have a longer duration of exposure, or who entered the programme earlier, to show higher rates of school enrolment, but, for almost all age groups there is a small difference with the control group, which has a tendency to show a lower enrolment rate. The variable of child and teenage labour suggests no difference between the groups. As for either work or study for young adults, the more recent the entry cohort and/or the shorter duration of exposure to the programme, the lower the proportion of the household's youths who neither study nor work. It is noteworthy that the applicant non-beneficiaries have the worst indicators in this dimension.

With regard to labour participation rate, indicators for the working age population at the household level, working more than six months in the year and working in a non-agricultural activity, show a tendency to increase with the duration or for more recent entry. It is noteworthy applicant non-beneficiaries have the highest percentage of individuals working in a non-agricultural activity. The formality rate indicator does present a slight tendency towards a decrease according to the exposure to the benefit.

As for housing variables, the longer the duration and the earlier the entry into the programme, the better all the housing quality indicators are.

Table 25. Means of the outcome variables, by duration

Outcome variables	Duration											
	1	2	3	4	5	6	7	8	9	10	15	20
All children enrolled at school (aged 6 to 17)	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.92	0.94
All children aged 6 to 9 enrolled at school	0.95	0.95	0.95	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.97	0.95
All children aged 10 to 14 enrolled at school	0.98	0.99	0.98	0.98	0.98	0.98	0.99	0.98	0.98	0.98	0.99	1
All children aged 15 to 17 enrolled at school	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.9	0.9	0.89	0.91
All young adults (18–26) working and/or studying	0.53	0.53	0.52	0.51	0.51	0.52	0.51	0.51	0.51	0.5	0.48	0.47
Any adult working more than six months in the year	0.45	0.44	0.43	0.41	0.41	0.41	0.41	0.41	0.42	0.42	0.52	0.57
Any adult working in a non-agricultural activity	0.35	0.31	0.28	0.26	0.25	0.25	0.23	0.21	0.21	0.22	0.21	0.24
Any adult working in a formal job	0.07	0.06	0.05	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.05	0.07
Household labour force participation	0.41	0.4	0.4	0.4	0.39	0.39	0.38	0.38	0.38	0.38	0.36	0.39
Piped water	0.69	0.66	0.64	0.64	0.66	0.64	0.66	0.62	0.62	0.63	0.67	0.79
General water supply	0.57	0.55	0.53	0.55	0.56	0.55	0.56	0.53	0.53	0.53	0.53	0.62
Sewage disposal	0.35	0.33	0.32	0.32	0.32	0.32	0.31	0.29	0.28	0.28	0.29	0.29
Existence of bathroom	0.82	0.82	0.8	0.78	0.8	0.81	0.8	0.79	0.81	0.82	0.89	0.91
Quality of wall material	0.6	0.58	0.57	0.59	0.61	0.6	0.61	0.57	0.57	0.59	0.59	0.75
Quality of floor material	0.84	0.85	0.84	0.83	0.84	0.84	0.84	0.83	0.85	0.86	0.92	0.93
Housing adequacy	0.2	0.19	0.19	0.18	0.19	0.19	0.18	0.16	0.16	0.16	0.17	0.19
Index of housing quality	0.56	0.55	0.54	0.54	0.55	0.55	0.55	0.53	0.53	0.54	0.57	0.64

Source: Authors' elaboration based on data from the BGSD and Single Registry (2018).

Table 26 presents the distribution of the covariates by the treatment groups. Differences observed in these variables justify their use for estimating the probability of multiple treatments and dose–response (GPS) in the models used to estimate the effects on outcomes:

- Region: a high prevalence of beneficiaries in the North and Northeast regions across treatment groups, but with important variations over time.
- Urban: relative stability in the prevalence of urban residence, around 60 per cent, with a slight decrease for the most recent entries.
- Male: proportion of male beneficiaries decreases greatly over time, possibly related to both changes in eligibility criteria and the use of 2018 Single Registry in the analysis.
- White: higher prevalence of non-whites, but sharp decrease in the proportion of whites in 2003 with relative stability afterwards.
- Age distribution: varying pattern following entry cohorts.
- Education: the distribution is also connected with time periods, as the younger cohorts are more educated. Noteworthy is the large proportion, throughout the period, of individuals with a lower education (incomplete elementary).
- *Bolsa Família* beneficiary: as expected, the more recent the entry into the *Seguro-Defeso* programme, the greater the proportion of *Bolsa Família* beneficiaries. This point is also connected to the fact that we are using the Single Registry matched database, and most observations in the Single Registry are from the *Bolsa Família* Programme that tends to generate a bias towards families with children (and women).
- Social security income: follows the age distribution; the older the entry cohort, the more households have some income from a social security source.
- Cohabiting families: follows age distribution, as multigenerational households are more common for the older entry cohort.
- Family arrangements (single mother, couple with children, childless couple, lone person): as expected, the more recent the entry cohorts, the greater the proportion of single mother families. It is also worth noting the express decrease in the proportion of couples with children, to a greater extent than childless couples.
- Children dependency ratio: associated age distribution; the more recent the entry cohorts, the greater the proportion of dependent children.
- Extremely poor: also connected to the fact that we are using the Single Registry matched database, that contains data from the most vulnerable population of the country, and as expected, the more recent the entry into the *Seguro-Defeso* programme, the poorer are the households. Older cohorts have more access to social security benefits and therefore are less likely to be among the poorest households.

Table 26. Distribution of covariates, by year of register with the BGSD (%)

	1997–2002	2003–2008	2009	2010–2014	2015–2018	Total
North	25.8	40.5	45.5	34.6	54.2	39.1
Northeast	50.5	47.6	47.6	58.7	37.3	52.2
Others	23.7	11.9	6.9	6.7	8.5	8.7
Urban	65.4	60.3	60.6	59.6	53.3	59.7
Male	87.3	48.1	35.5	32.4	35.1	38.8
White	21.3	15.3	11.5	11.7	13.9	13
Aged <29	0	2.1	9.3	19.8	38.7	15
Aged 30–49	27	61.7	66.5	62.1	50	60.4
Aged 50<	73	36.2	24.2	18.1	11.3	24.6
Incomplete elementary	89.9	74.8	66.3	62.6	58.8	66.6
Elementary	6.3	11.9	14.9	16.6	19.2	15.1
High school	3.7	13	18.5	20.5	21.7	18
College	0.1	0.3	0.3	0.3	0.3	0.3
<i>Bolsa Família</i> beneficiaries	14	45.3	58.6	62.6	58.6	55.7
Presence of social security income	42.7	20.9	13.5	9.5	6.5	13.7
Cohabiting families	14.4	12.6	11.7	10.7	8.4	11.1
Single mother	4.5	21.7	30.5	31.7	31.2	27.8
Couple with children	40.8	40.4	38.3	39.8	42.6	39.5
Childless couple	28	14.9	10.9	10.5	10.1	12.5
Lone person	22.4	19.1	17	15.3	13.6	17.1
Other	4.3	3.9	3.3	2.7	2.5	3.1
Children dependency ratio	19.9	44.9	59.5	65.9	69.4	57.8
Extremely poor	37.2	61.4	70.2	75.4	78.5	70.1

Authors' elaboration based on data from the BGSD and Single Registry (2018).

6. INFERENCE ANALYSIS OF THE IMPACT OF *SEGURO-DEFESO* ON AVAILABLE SELECTED VARIABLES

The results of the econometric models for the impact evaluation of *Seguro-Defeso* are presented in this section. The reported estimates cover the largest available number of linked observations between the *Seguro-Defeso* and Single Registry databases, and thus a longer time period of treatment, as well as comprehensive enough to accommodate changes in the legislation.

The dimensions of the outcomes are then analysed based on the results of the duration apartments and IPW model parameters presented in Table 27, followed by figures with plots of dose–response and treatment effect functions (based on the duration parameters). All IPW results refer to the pure control group (non-beneficiaries), usually with higher values as seen in the descriptive analysis. The comparison between the results according to the groups of beneficiaries by year of first payment is straightforward, because the multinomial model applied assumes independence between the alternatives, that is, the value in the table cells refers to the difference in relation to the value 0 of the control group (non-beneficiaries), but the differences between the values for each group are equally interpretable.

Illustrating with a numerical example for the outcome of “all children aged 6 to 17 enrolled at school,” the duration variable shows that an additional year of payment increases the school attendance of adolescents in households by 0.1 pp. Decreasing returns indicated by the negative value of the quadratic form are reflected in the longer term when variations of the benefit become insignificant to increase the proportion of children enrolled. Figure 3 illustrates exactly this point, the first figure being the dose–response function, which shows the predicted proportion of children aged 6 to 17 years, conditional on the covariates, at each level of *Seguro-Defeso* treatment (duration). It shows a positive variation over time, indicating that the greater the treatment level (duration), the higher the proportion of children enrolled. The second graphic in Figure 3 shows the marginal treatment effect function, which depicts the marginal effect on the proportion of enrolled children. It indicates that until a certain level of benefit, the marginal effect is decreasing but after that, the marginal effect is increasing. The dose–response function (figures 4, 5 and 6) for the other outcomes related to children’s enrolment, considering different age groups, are similar to the one presented in Figure 3.

The main results for each set of outcomes analysed are presented below.

- **Child education:** The duration of the treatment has a positive and significant impact on the level of enrolment of children. This effect is observed for all age groups, but it is interesting to note that it is also the case in the long term for teenagers (15 to 17 years old—see Figure 6), a group that is at risk of drop out and has a lower enrolment rate. As for the impacts by entry cohort, there is no significant difference. Unlike the descriptive analysis of the previous section, the multivariate model controlling for selection bias show positive school enrolment effects for 6 to 17 year old children and adolescents, but they are not statistically significant.
- **Child labour:** the duration model reveals a positive impact on the ratio of children and adolescents (6 to 17 years old) that are not working outside the house, which means that an additional year of benefit increases the rate of children in the household that are not working. But this effect has a decreasing marginal effect. This can be seen in Table 27 and Figure 7. As in the case of child education, the multivariate model (entry cohort) shows positive results in terms of reducing child labour, but they are not statistically significant.
- **Education and labour for young adults:** the multivariate model (entry cohort) shows positive impacts, in general, in relation to the control group, but they are only statistically significant for cohorts 2009 and 2010–2014, as shown in Table 27. This means that for these cohorts, fewer young adults are simultaneously out of school and out of work compared to the control group. For the duration model, positive results in decreasing inactivity or school drop out for young adults are observed, but with diminishing returns over time, as shown in the graphs of Figure 8.
- **Working age household members’ labour market indicators:** the duration treatment variable (Table 27) shows that an additional year of payment increases the share of adults working at a decreasing marginal rate, a result that is also seen for the multivariate model (entry cohort) with a slightly higher effect for the most recent cohorts. However, the duration variable also shows a reduction in the probability of having any adult in the household working (i) more than 6 months in the year, (ii) in a non-agricultural activity and (iii) in a formal job. On the other hand, increasing returns indicated by the positive value of the quadratic form indicates that this has a decreasing marginal effect. The first graph of figures 10 to 12 illustrates these dose–response functions with a negative variation over time, up to a point when the curve reverses; the second graph of these figures illustrates the pace of these changes, i.e. the marginal treatment effect of each additional year of the duration effect itself decreasing in magnitude (getting closer to zero). Thus, despite the lack of impact of the overall occupation of the household, the results suggest that the quality of work for household members as a whole does not seem to improve over time.
- **Housing characteristics:** Comparing the groups according to duration (time of exposure to benefits) it can be seen that positive effects are only observed in the medium and long term for most variables, most short-term impacts are actually negative. This result is observed for most entry cohorts. The availability of a toilet and improved floor indicators stand out as the most significant impacts for early entry cohorts.

Table 27. Outcomes and covariates in 2018

Outcomes	Dose–response parameters		Year of registry (first payment) in BGSD [average treatment effect—applicant non-beneficiary as group of reference] outcome					Potential
	Duration	Duration2	2015+	2010–14	2009	2003–2008	1992/7–2002	Control group
All children enrolled at school (aged 6 to 17) ²³	0.10***	-0.005***	0.025	0.027	0.027	0.031	0.031	0.891***
No children or teenagers working (6–17)	0.22***	-0.010***	0.005	0.003	0.004	0.004	0.006	0.991***
All young adults (18–26) working and/or studying	0.003	-0.0001	0.052	0.069**	0.061*	0.041	0.047	0.433***
Any adult working more than 6 months in the year	-0.08***	0.005***	0.05**	-0.007	-0.03	-0.007	0.018	0.432***
Any adult working in a non-agricultural activity	-0.105***	0.004***	-0.022	-0.072***	-0.11***	-0.089***	-0.095***	0.334***
Any adult working in a formal job	-0.260***	0.013***	-0.053***	-0.057***	-0.053***	-0.048***	-0.042***	0.119***
Working adults' share	0.010***	-0.0003***	0.079***	0.045***	0.031**	0.033***	0.026**	0.280***
Piped water	-0.016**	0.002***	-0.031*	-0.083***	-0.079***	-0.048***	-0.024	0.795***
General water supply	0.048***	-0.002***	-0.015	-0.065***	-0.054***	-0.031	-0.032	0.66***
Sewage disposal	0.004	-0.0005*	-0.022	-0.049**	-0.061**	-0.055**	-0.091***	0.44***
Bathroom	-0.018***	0.003***	-0.01	-0.043***	-0.034***	-0.004	0.035***	0.875***
Walls material quality	-0.045***	0.003***	-0.112***	-0.234***	-0.189***	-0.094***	-0.036	1.4***
Floor material quality	-0.032***	0.004***	-0.044	-0.062**	-0.07**	-0.016	0.053*	1.35***
Housing adequacy	0.015**	-0.0006*	-0.014	-0.043*	-0.052**	-0.048*	-0.078***	0.301***
Index of housing quality	-0.004***	0.0003***	-0.032**	-0.063***	-0.060***	-0.034***	-0.020*	0.669***

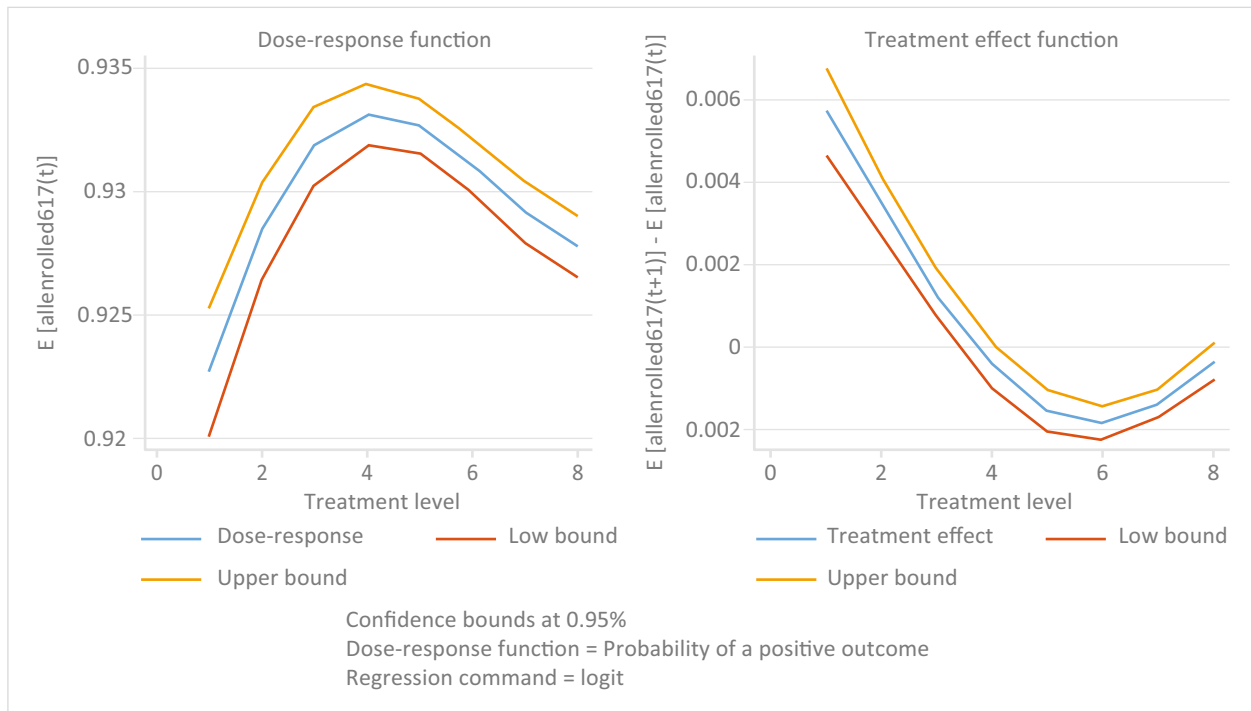
Note: ***p < 0.01; **p < 0.05; *p < 0.1.

Source: Authors' elaboration based on data from the BGSD and Single Registry (2018).

23. The equations with the output "all children aged 15 to 17 enrolled at school" did not converge, so the results by age group were not considered in this analysis.

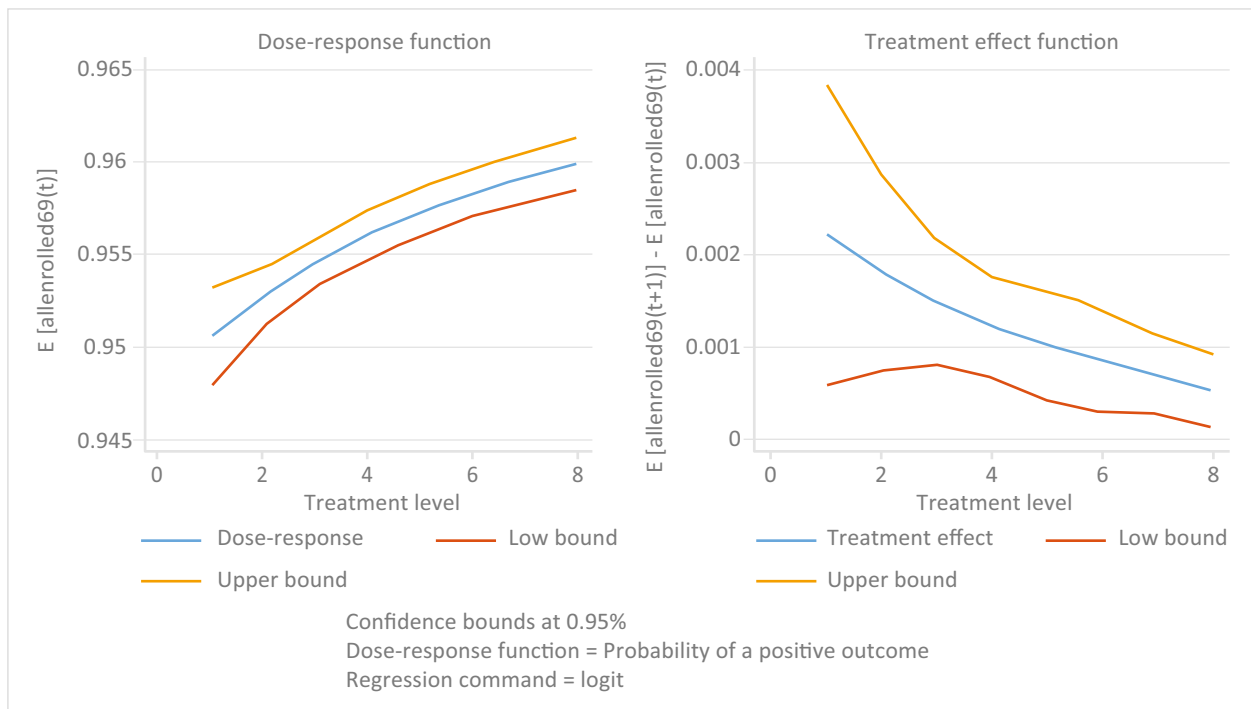
Dose-response and treatment effect functions

Figure 3. Outcome: all children (6–17) enrolled at school



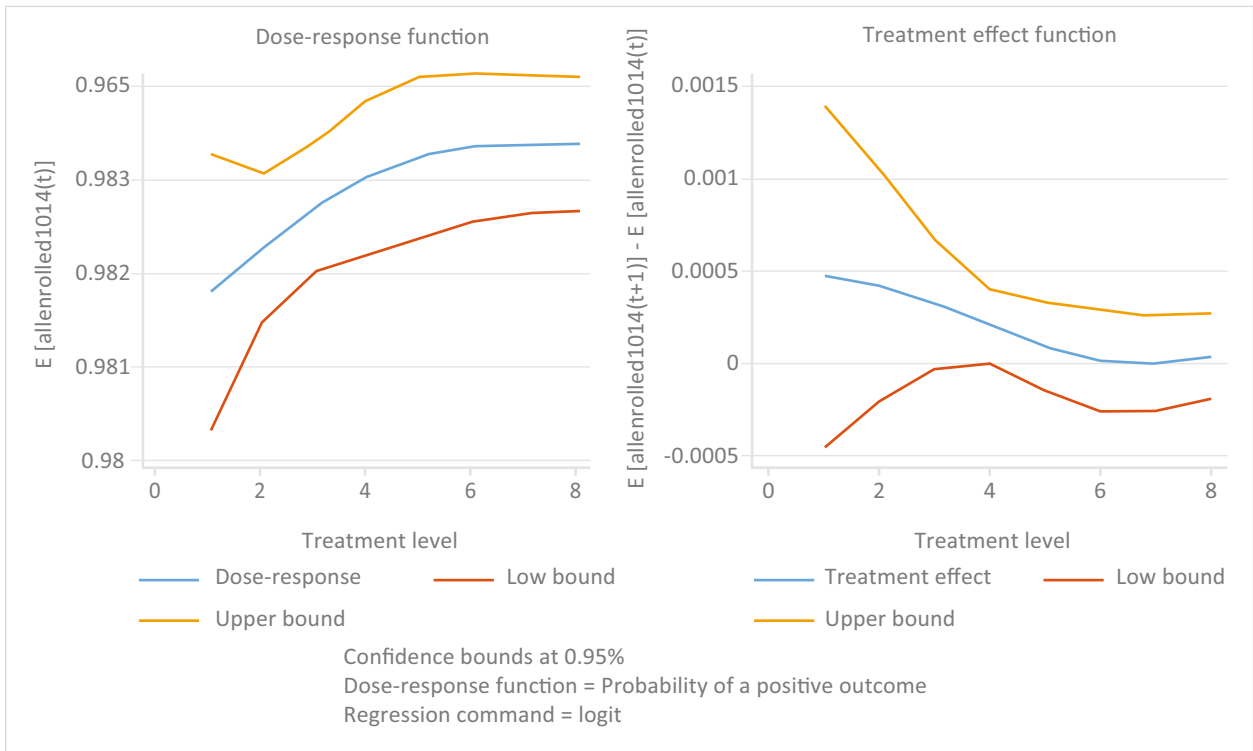
Source: Authors' elaboration based on data from the BGSD and the Single Registry.

Figure 4. Outcome: all children (6–9) enrolled at school



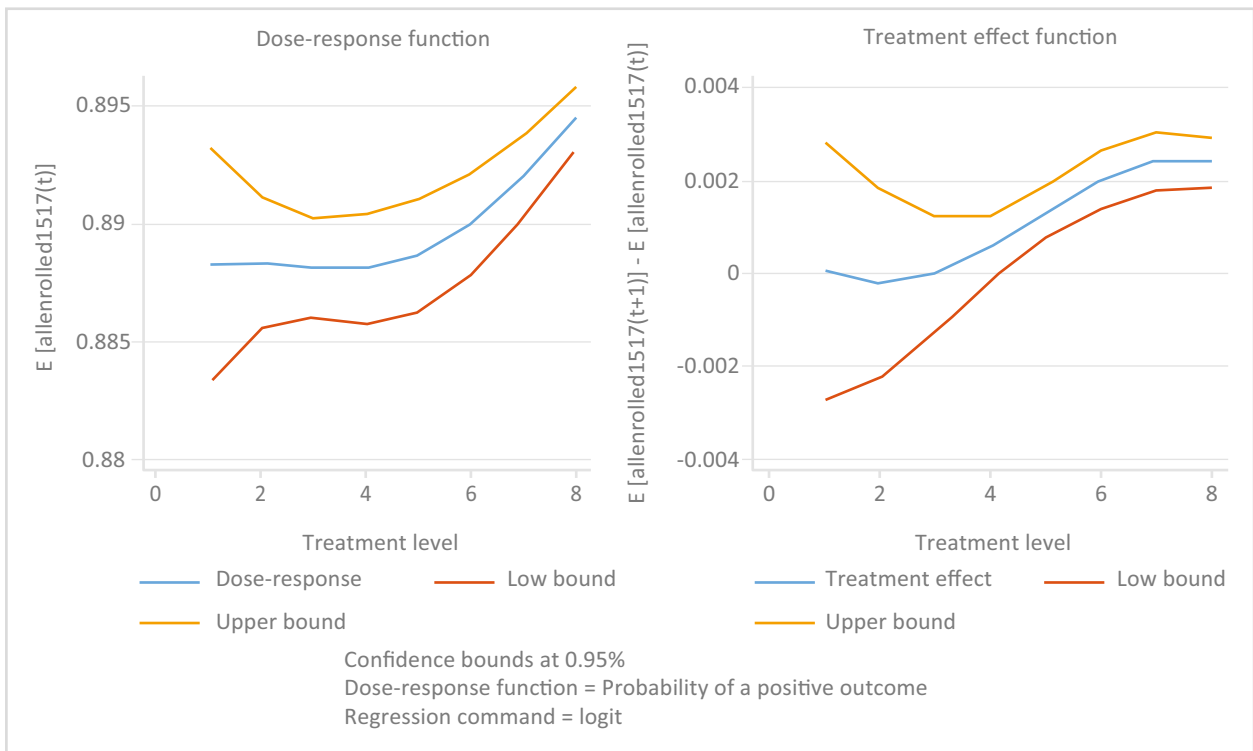
Source: Authors' elaboration based on data from the BGSD and the Single Registry.

Figure 5. Outcome: all children (10–14) enrolled at school



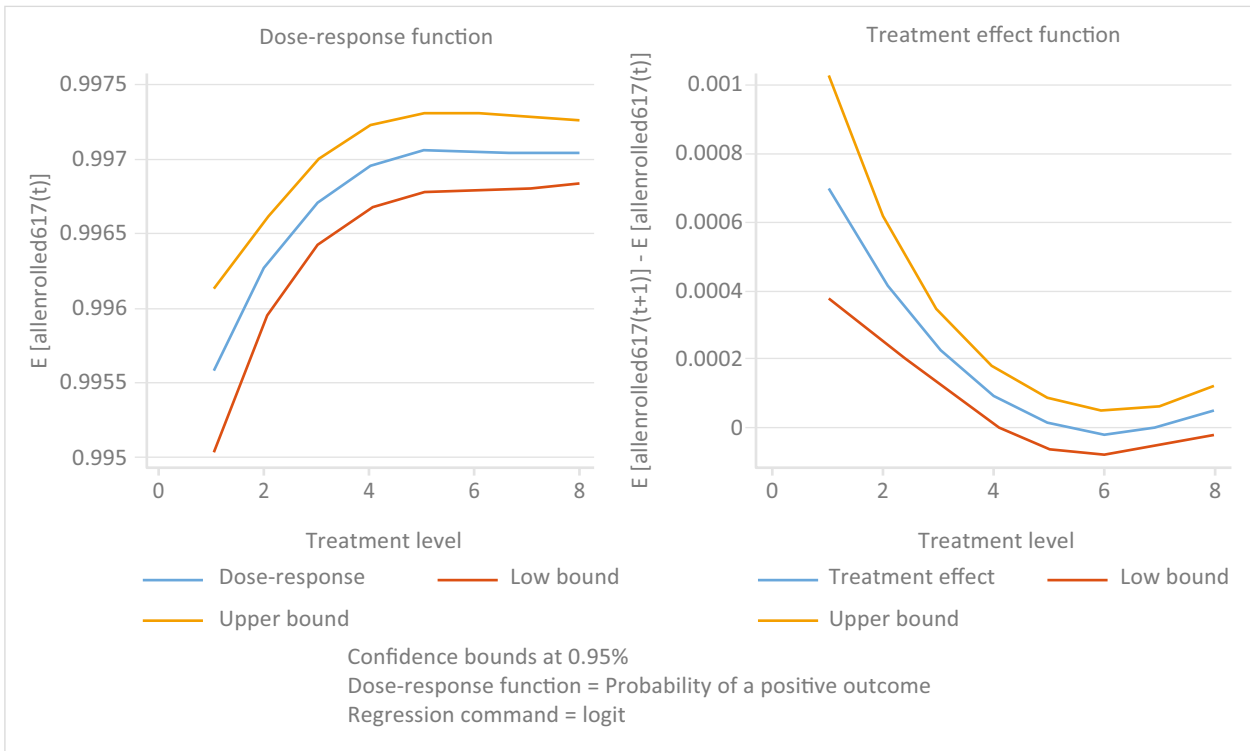
Source: Authors' elaboration based on data from the BGSD and the Single Registry.

Figure 6. Outcome: all children (15–17) enrolled at school



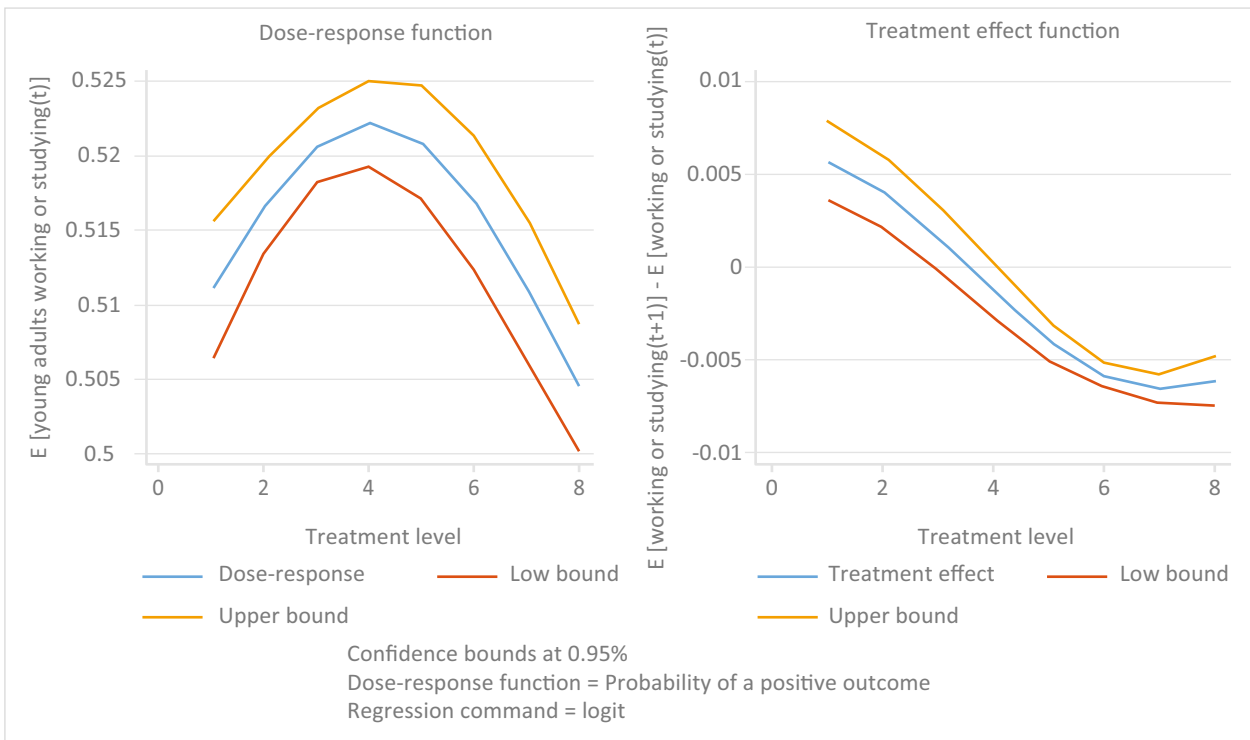
Source: Authors' elaboration based on data from the BGSD and the Single Registry.

Figure 7. Outcome: no household children or teenagers work outside the household



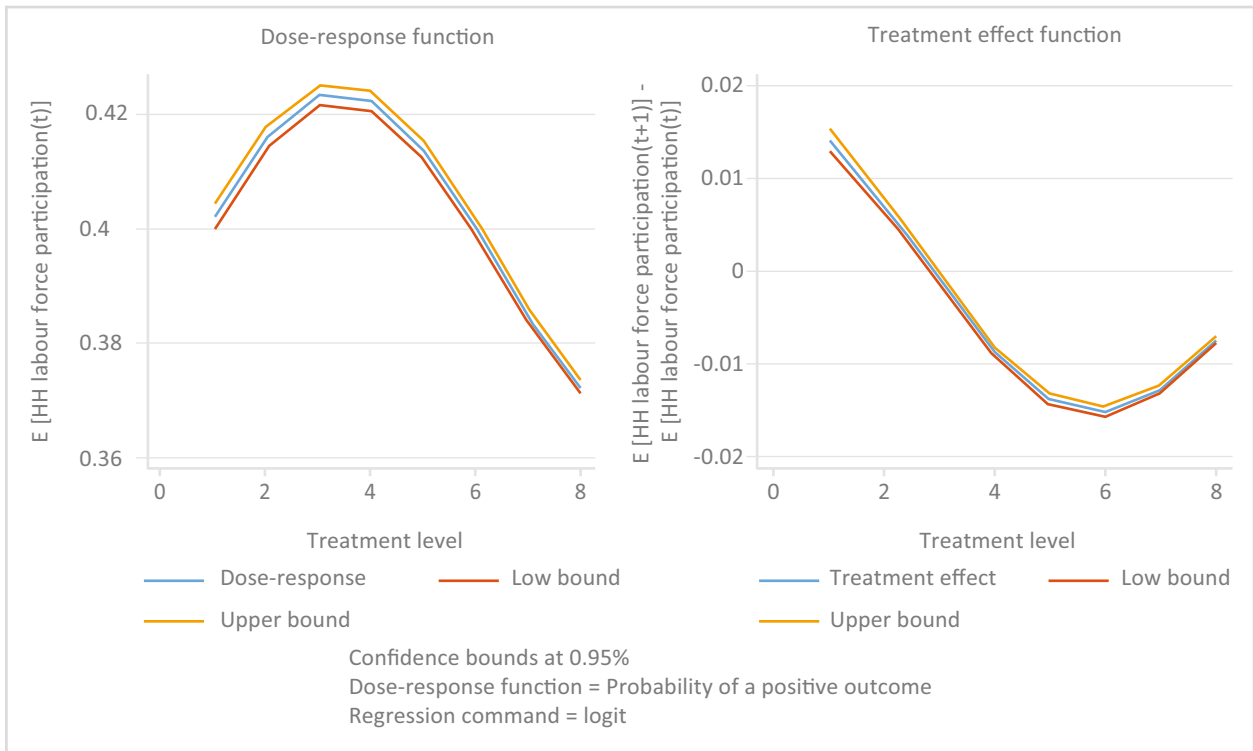
Source: Authors' elaboration based on data from the BGSD and the Single Registry.

Figure 8. Outcome: young adults of the household (18–26) working and/or studying



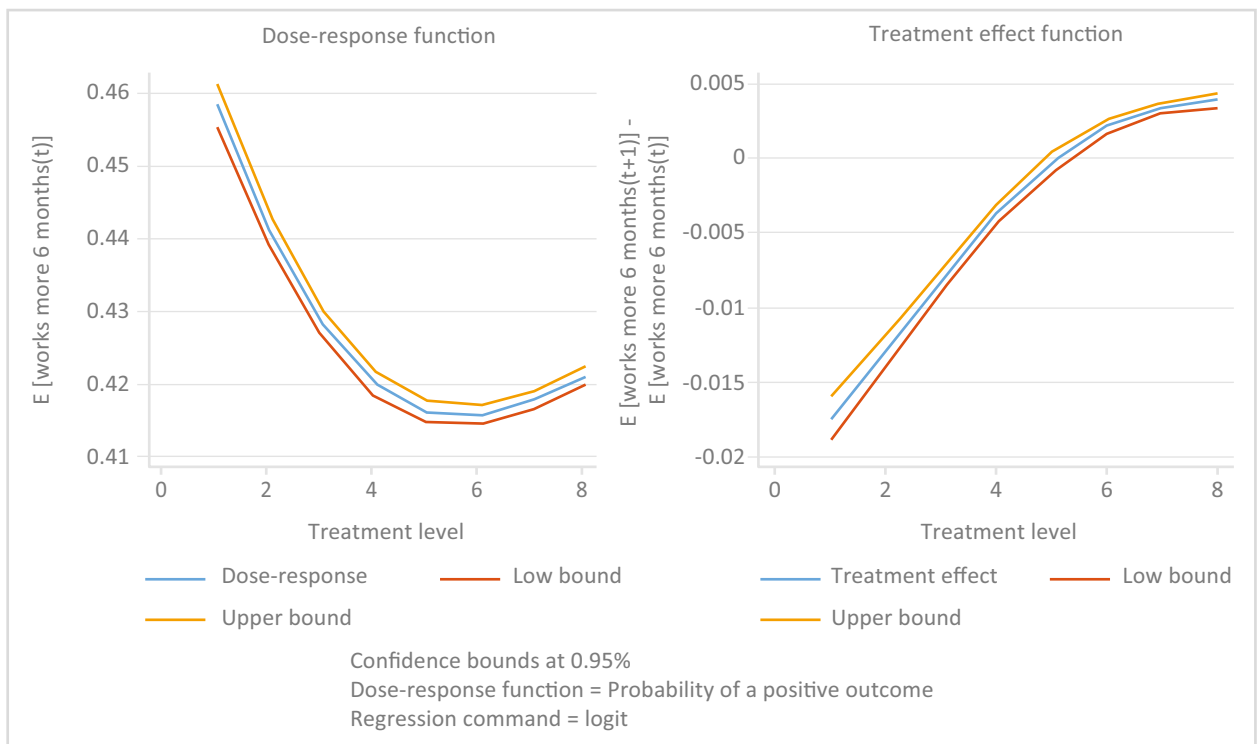
Source: Authors' elaboration based on data from the BGSD and the Single Registry.

Figure 9. Outcome: household labour force participation



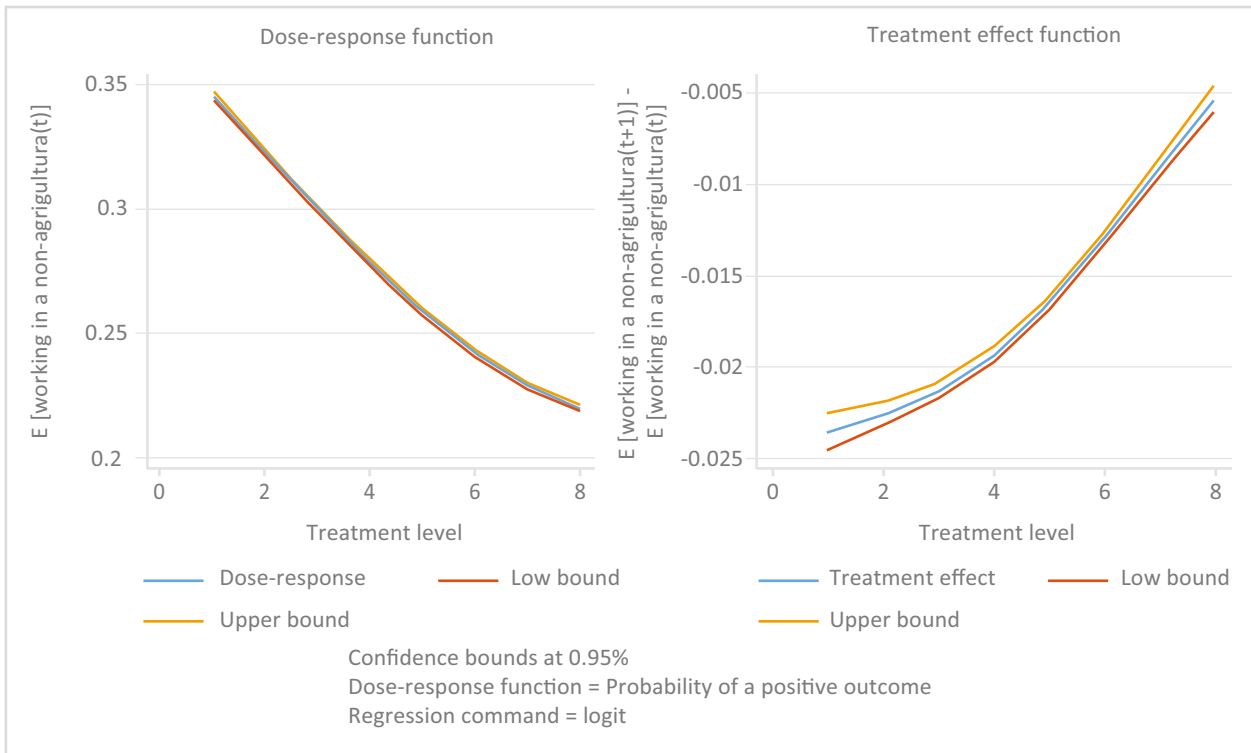
Source: Authors' elaboration based on data from the BGSD and the Single Registry.

Figure 10. Outcome: presence of at least one adult who works more than six months in the year



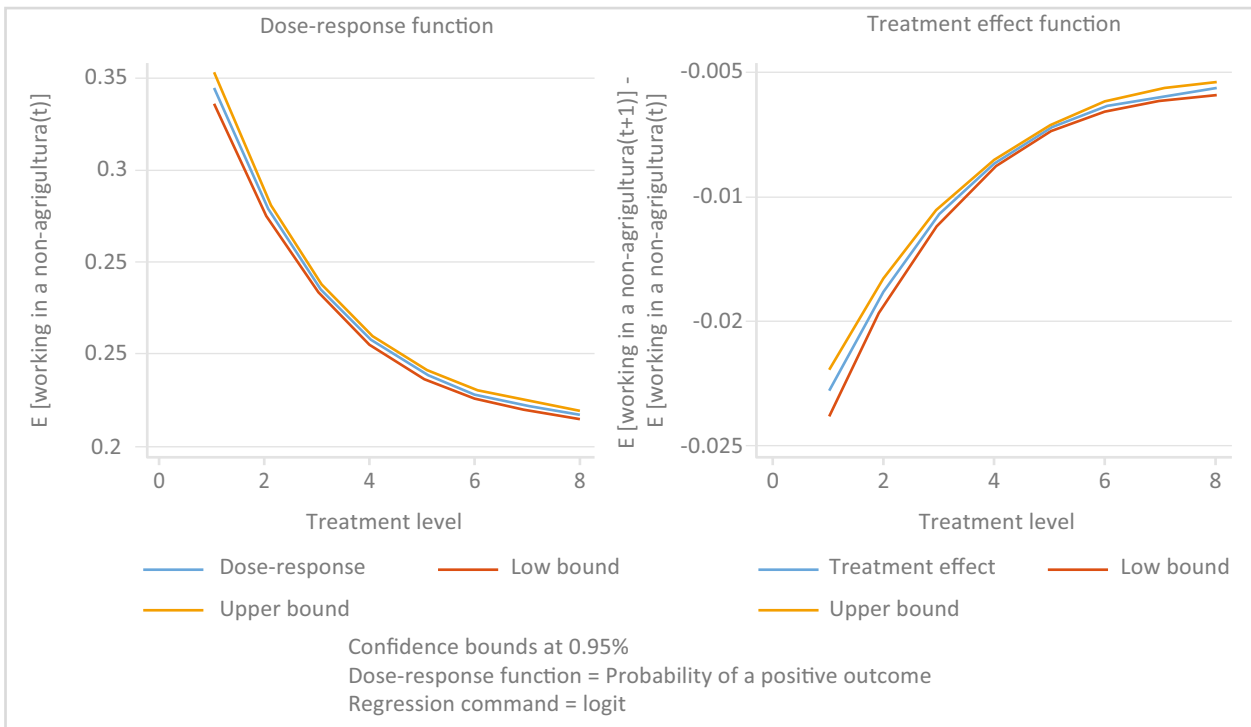
Source Authors' elaboration based on data from the BGSD and the Single Registry..

Figure 11. Outcome: presence of at least one adult working in a non-agricultural activity



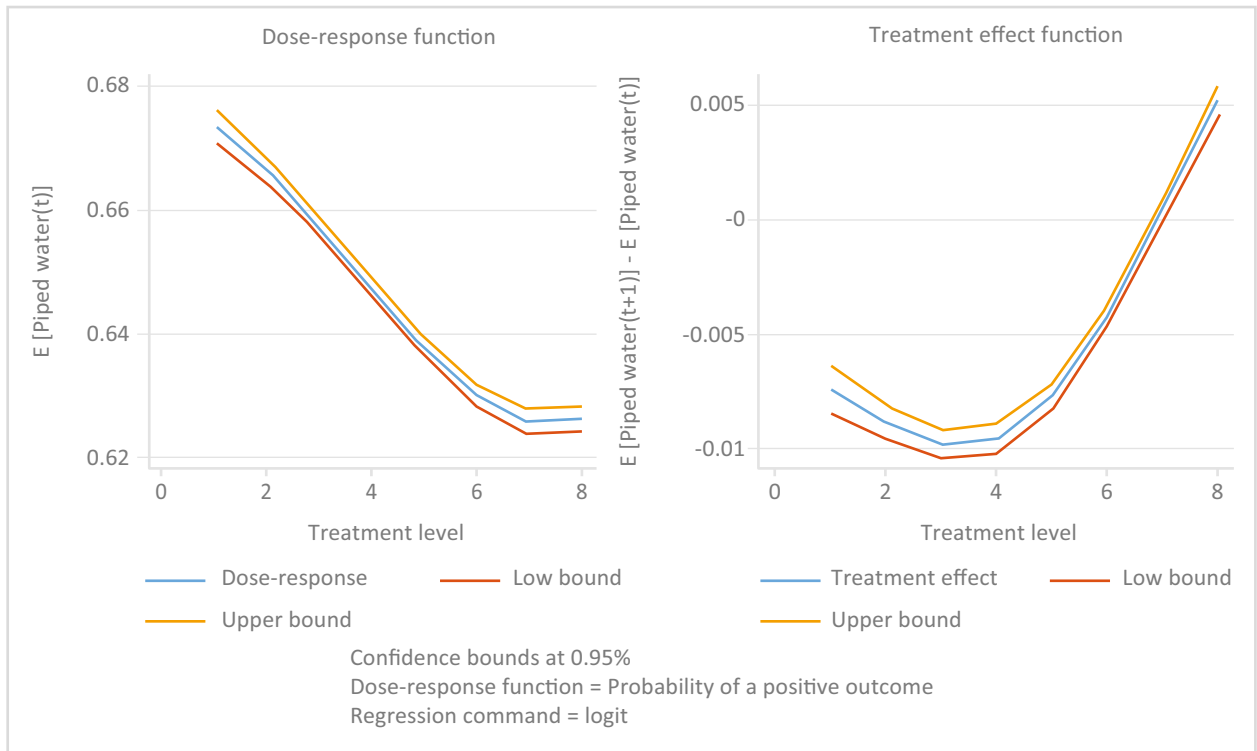
Source: Authors' elaboration based on data from the BGSD and the Single Registry.

Figure 12. Outcome: any adult of the household currently employed in the formal labour market



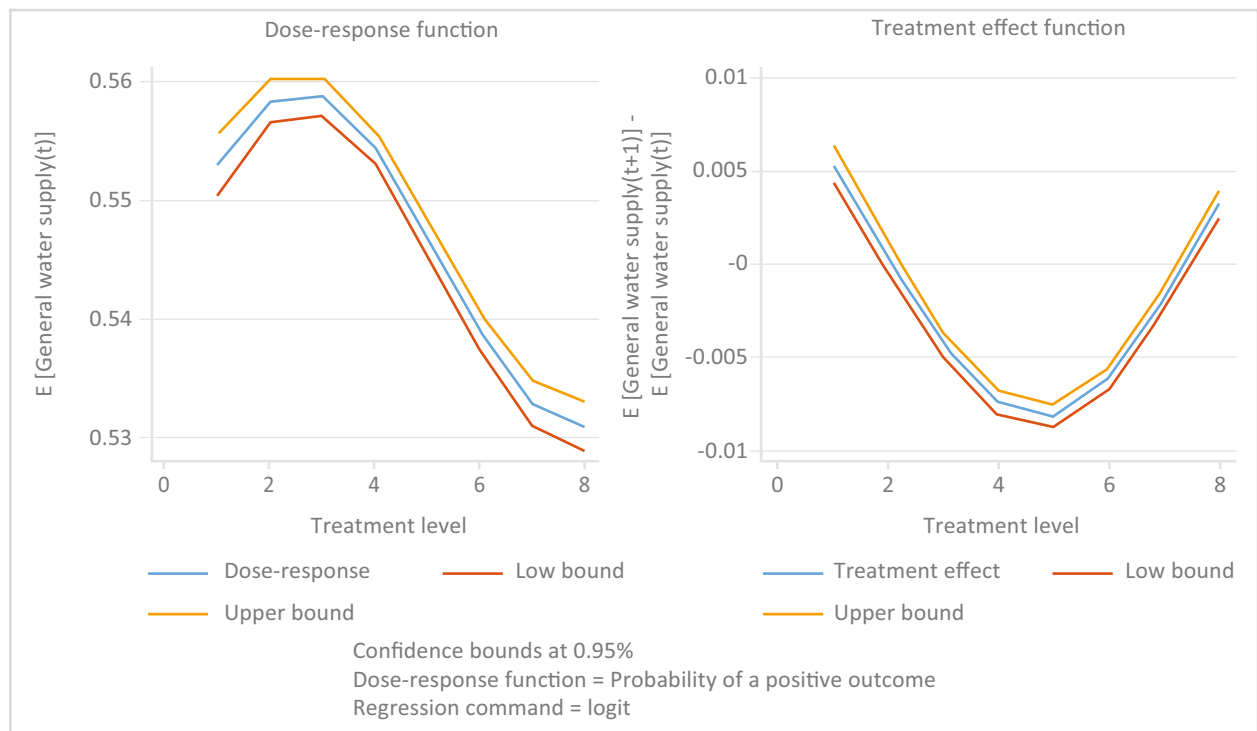
Source: Authors' elaboration based on data from the BGSD and the Single Registry.

Figure 13. Outcome: piped water



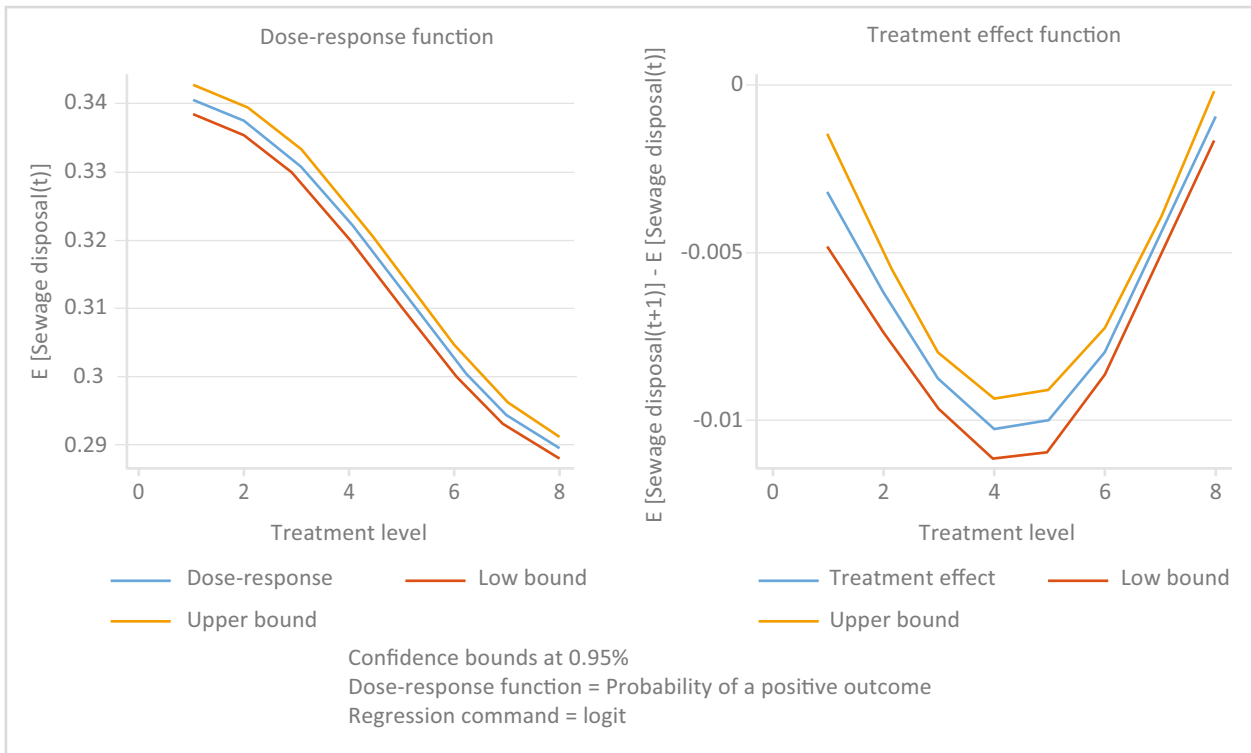
Source: Authors' elaboration based on data from the BGSD and the Single Registry.

Figure 14. General water supply



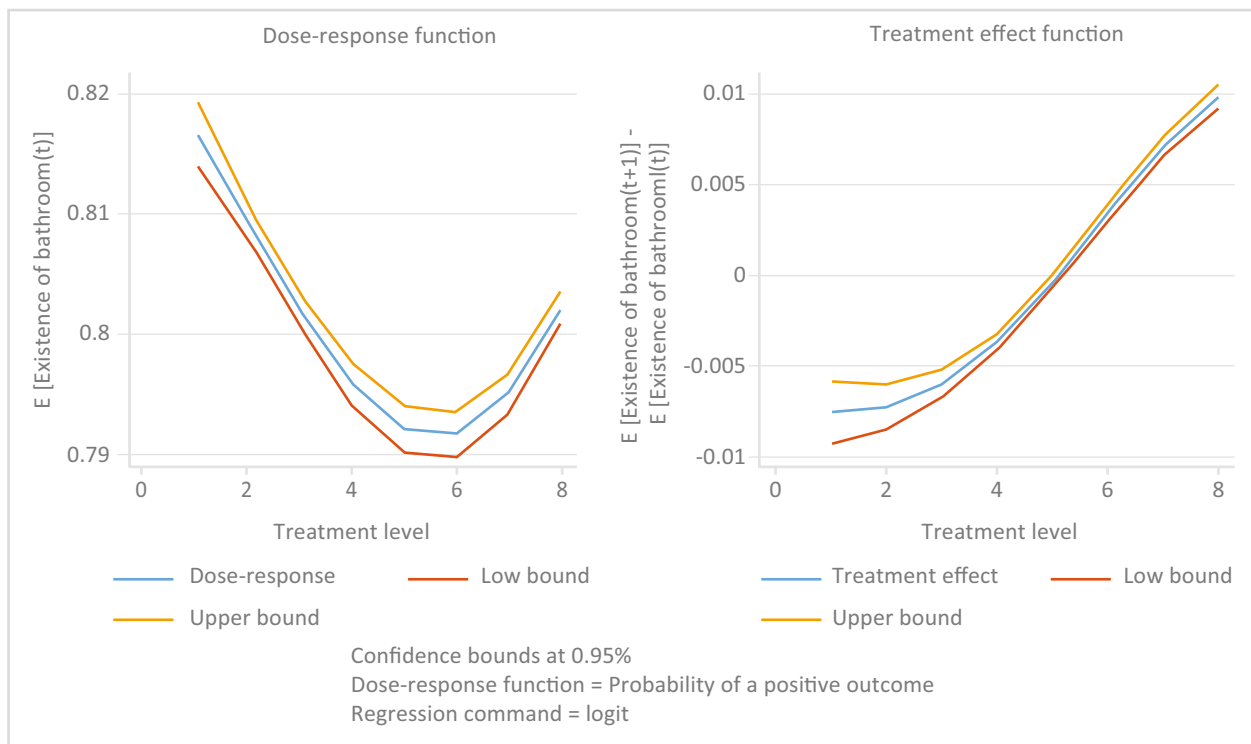
Source: Authors' elaboration based on data from the BGSD and the Single Registry.

Figure 15. Quality of sewage disposal



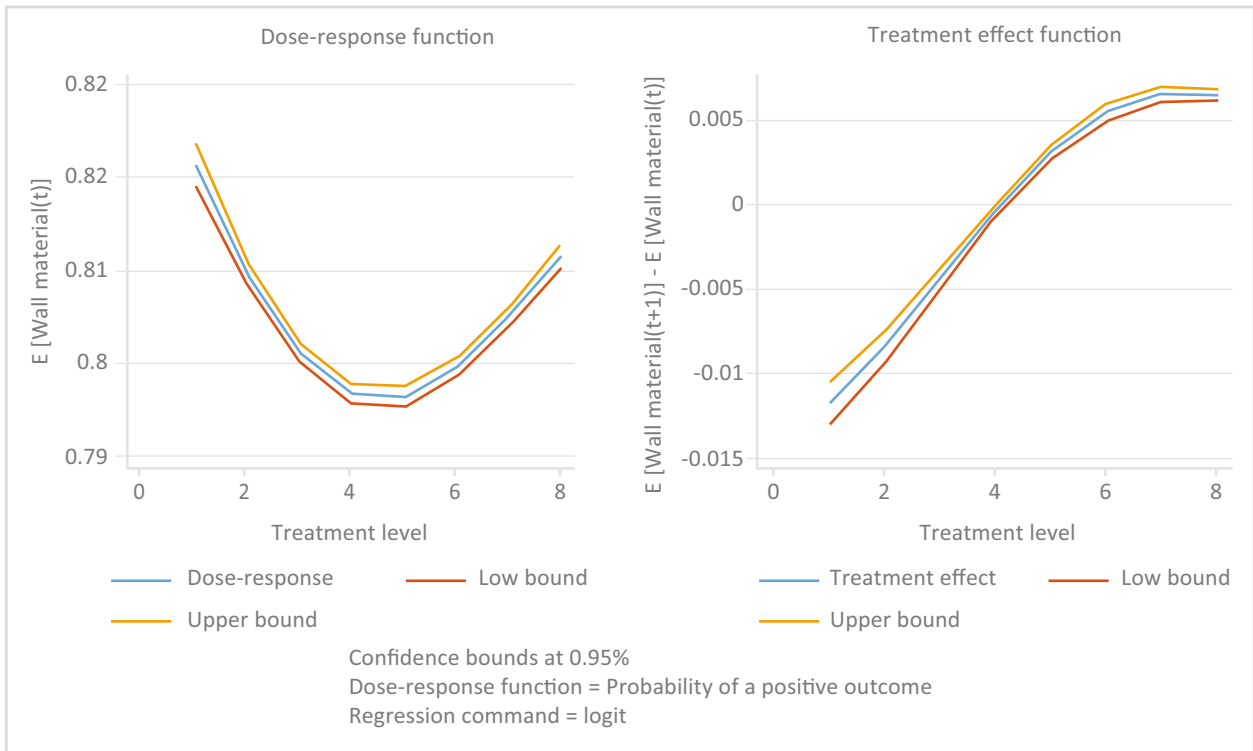
Source: Authors' elaboration based on data from the BGSD and the Single Registry.

Figure 16. Existence of bathroom



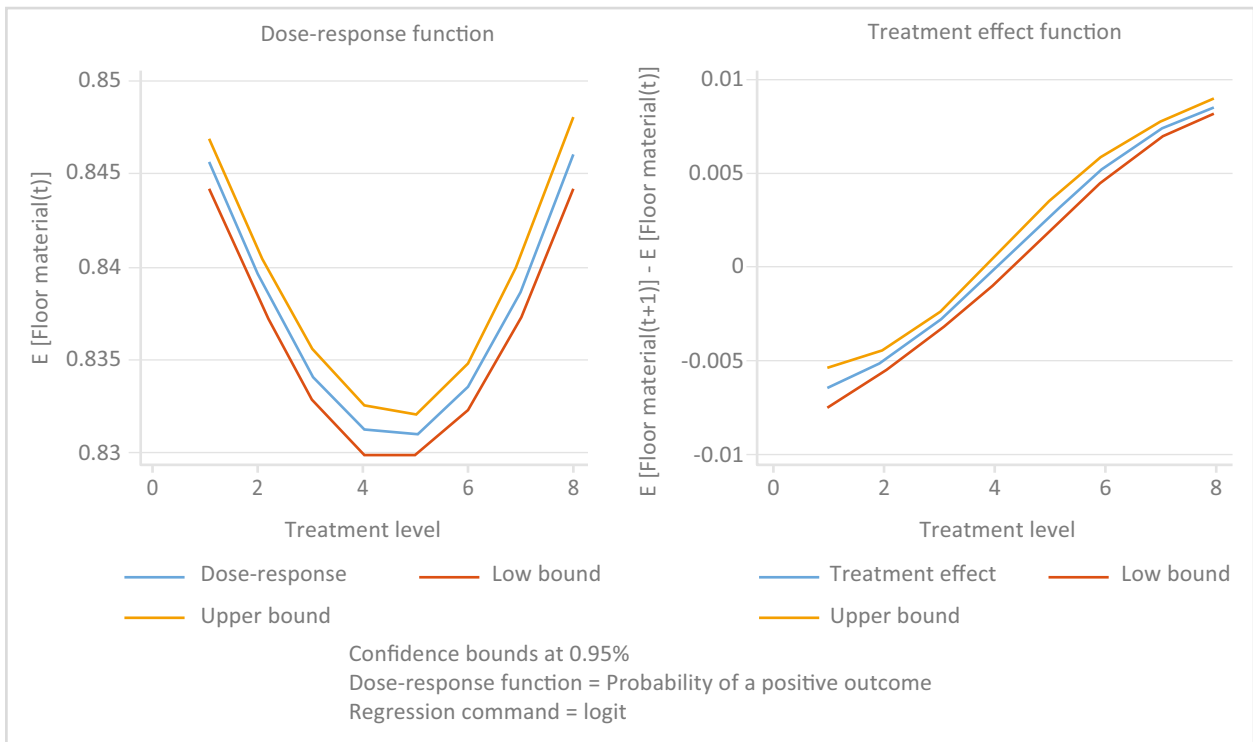
Source: Authors' elaboration based on data from the BGSD and the Single Registry.

Figure 17. Quality of walls material



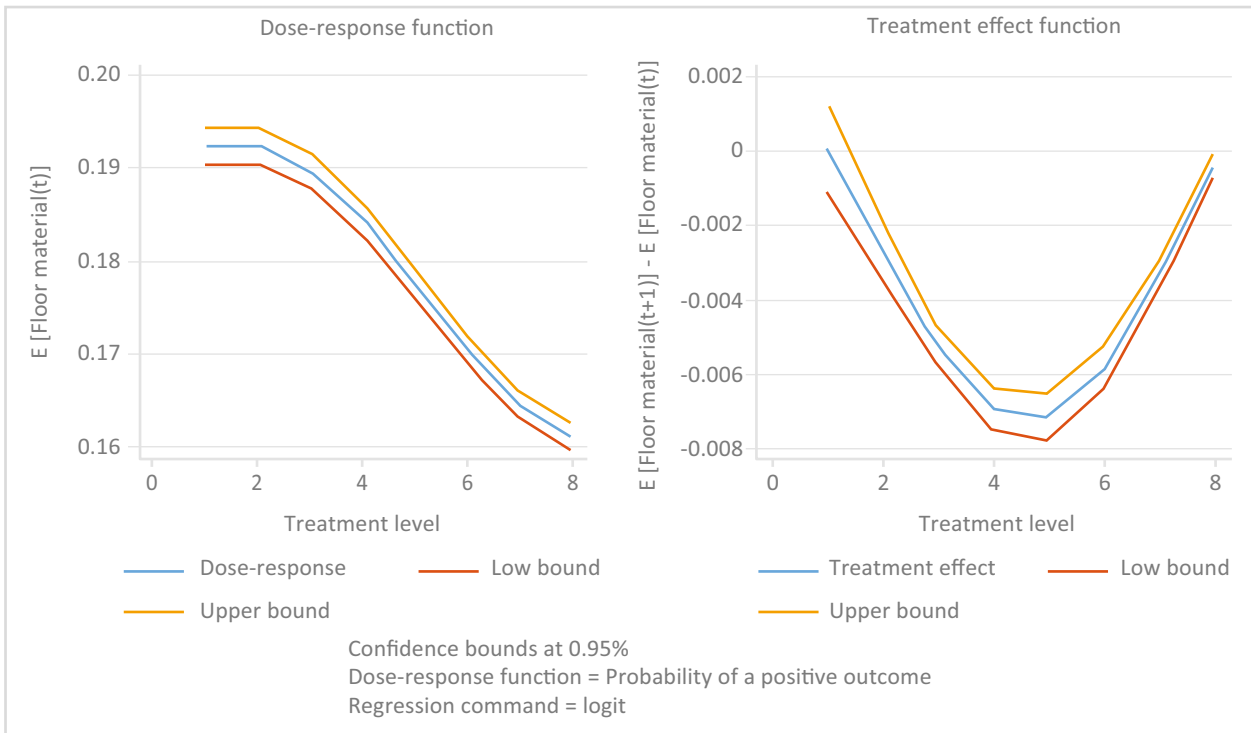
Source: Authors' elaboration based on data from the BGSD and the Single Registry.

Figure 18. Quality of floor material



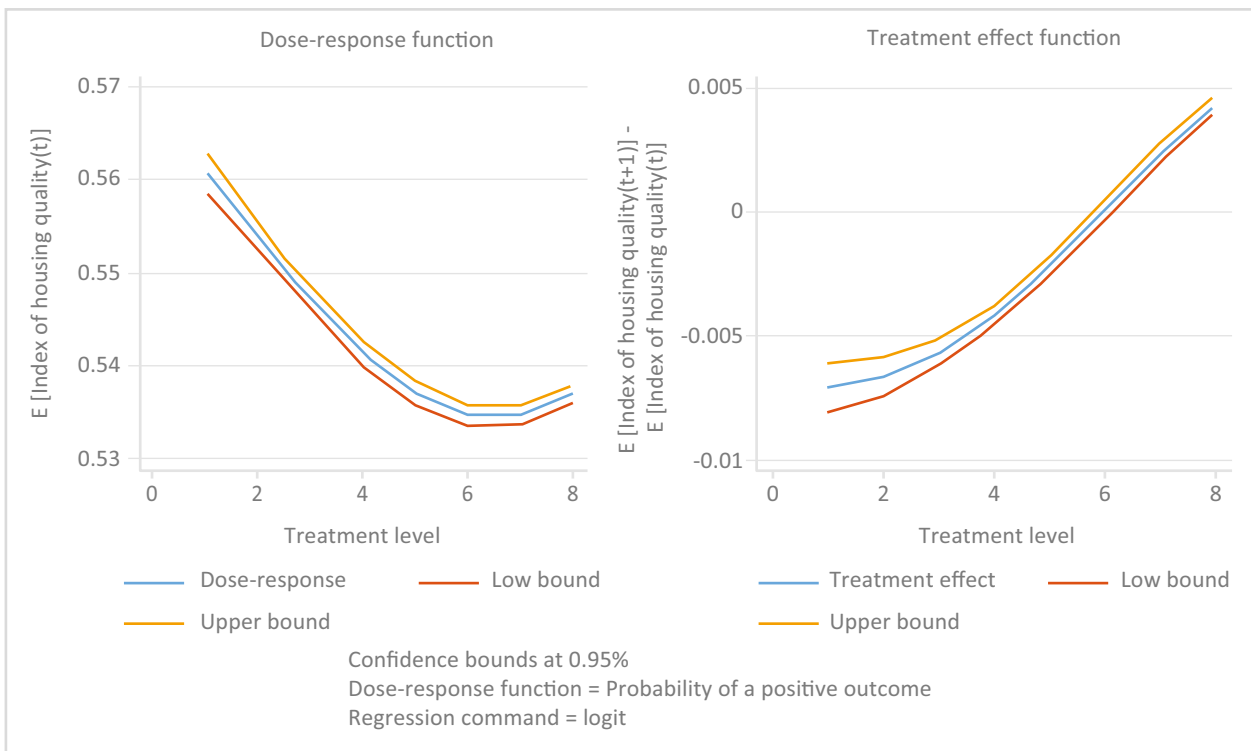
Source: Authors' elaboration based on data from the BGSD and the Single Registry.

Figure 19. Housing adequacy



Source: Authors' elaboration based on data from the BGSD and the Single Registry.

Figure 20. Index of housing quality



Source: Authors' elaboration based on data from the BGSD and the Single Registry.

7. CONCLUSION AND RECOMMENDATIONS

This impact evaluation of *Seguro-Defeso* focused on the socioeconomic indicators of beneficiary families, taking into account changes in the programme's implementation since its inception. *Seguro-Defeso* consists of paying one minimum wage per month during the period of *Defeso*, when fishing activity is prohibited. The benefit is paid to those who carry out fishing activity as a professional artisanal fisher, without interruption and individually or within a family economy. The programme was originally and explicitly structured to deal with: (i) economic and environmental sustainability of fishing activity; and (ii) potential non-compliance by fishers due to their livelihood losses during fishing closures.

Results

This impact evaluation was made possible by the successful linking of the unemployment insurance payment database—the BGSD—and Brazil's Single Registry and demonstrated the potential for administrative databases to be utilized for evaluating public policies and programmes.

The results suggest that the *Seguro-Defeso* targets fishers from low-income families who most likely need some income support during periods when fishing is prohibited. However, the database does not allow for an analysis of the eligibility criteria of the programme, especially those related to fishing activities.

Evaluation findings show the importance of the programme for the livelihoods of beneficiaries and their families, particularly for child-related outcomes. It is possible to infer the importance of the *Seguro-Defeso* programme for maintaining the fisher family's human capital:

- ensuring the schooling of younger generations in the short and medium terms, benefiting the school attendance of children and young people, reducing child labour, and positively affecting the likelihood of working or studying;
- no negative impact on household adult labour supply, but with some evidence that for adult members of the household, the quality of work does not improve as a consequence of participation in the programme; and
- for housing quality indicators, it was only possible to find some evidence of improvement in the long term.

Recommendations

The findings of this report intend to provide recommendations for improving the *Seguro-Defeso* programme and point out knowledge gaps that require further evaluation. First, in the context of the review of the eligibility criteria for the *Seguro-Defeso* benefits, it is recommended to consider the potential negative impact on the income of the vulnerable fisher population in the absence of the programme. Fishers that were found ineligible for the benefit following the recertification of the RGP implemented in 2021, could be identified via the Single Registry and become the target group of tailor-made social assistance and productive inclusion interventions, including economic alternatives to fishing or related activities during the closed season. Therefore, monitoring and evaluation of the socioeconomic situation of families with members who lose their unemployment insurance beneficiary status is recommended, particularly in the case of subsistence fishers who are not eligible for the programme.

There are not many employment alternatives for fishers in their communities, and when they are available, they may require workers with higher levels of education. In addition to their level of formal education, fishers have informal learning and experience that do not equip them with skills that are of use in other sectors, calling for complementary

training/skills building programmes to address these shortcomings. Finally, it is important to consider that labour-stickiness is high due to solid roots in community or family tradition.

Another recommendation is to strengthen the monitoring and evaluation component of the *Seguro-Defeso* programme. The creation of monitoring and evaluation protocols allows for the cross-checking of different data sources and enables the further analysis of the beneficiaries. Furthermore, this type of routine allows for an assessment of the complementarity of the programme with other policies and programmes, e.g. *Bolsa Família* and social security, the interaction with sex, labour and social assistance policies and further information on the socioeconomic conditions of beneficiaries. When feasible, qualitative research can uncover the specificities of programme effectiveness in local contexts.

In addition, it is essential to improve data on fishing activity so that the environmental aspects of *Seguro-Defeso* can be evaluated. Previous studies have argued that, due to a lack of data on fishing activity, it would be difficult to verify whether the closed seasons are ecologically justified and if they are, in fact, contributing to the preservation of species and the sustainability of fishing activities.

Moreover, a national multidimensional framework for fishery sustainability should be developed. The framework should provide both quantitative and qualitative indicators, assuming explicitly that economic, social and environmental indicators jointly provide a comprehensive view of the system's sustainability. To fully understand the system's sustainability, it is essential to develop a national integrated sustainability measure (e.g. human well-being, ecosystem well-being, sustainable economic welfare), bringing together biological, ecological and socioeconomic dimensions. Indicators that can measure the system's stability across dimensions are important to complement the statistical analysis.

Within the socioeconomic dimension, multidimensional measures of well-being, like economic viability and livelihood strategies (within the household), have important ecological implications, reaffirming the importance of sources of income support in providing flexibility for fishers' families in coping with income variability over time and the implications of this for the environment. The challenge is to move from an abstract concept of sustainability to a measurable state of dynamic human–ecological systems, embedded in a robust planning and monitoring tool.

Furthermore, an explicit link to achieving sustainable development requires multiple scale and interdisciplinary efforts and perspectives. Specifically, it is opportune, albeit challenging, to apply Sustainable Development Goal indicators to regionally-developed dimensions of well-being, drawing on locally relevant definitions to develop indicators on the connections between both people and the environment.

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APPENDIX 1: THE LEGAL FRAMEWORK OF THE UNEMPLOYMENT INSURANCE FOR ARTISANAL FISHERS

Author: Luca Lazzarini, IPC-IG

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Acronyms and abbreviations

ACT	Agreements of Technical Cooperation	MMA	Ministry of Environment
ANA	National Water Agency	MPA	Ministry of Fisheries and Aquaculture
APS	Security Agency	MPS	Ministry of Social Security
CGU	Federal Comptroller General	MTE	Ministry of Labour and Employment
CODEFAT	Deliberative Council of the Worker Support Fund	NIS	Social identification number
CONAPE	National Council for Aquaculture and Fishery	NIT	Worker registration number
CPF	Individual Taxpayer Registry	PASEP	Public Employees' Heritage Training Programme
CPG	Permanent Management Committee for the Sustainable Use of Fishery Resources	PIS	Social Integration Programme
CRCPA/MAPA	Reviewing Committee for the Registration of Professional Artisanal Fishers	PMAP	Fishing Activity Monitoring Project
CTF/APP	Federal Technical Registry of Potentially Polluting Activities or Using Environmental Resources	PNPCT	National Policy for the Sustainable Development of Traditional Peoples and Communities
CTPG	Technical Commission for the Shared Management of Fishery Resources	PPP	<i>Permissão Prévia de Pesca</i> (Prior Fishing Permit)
DPC	Directorate of Ports and Coasts of the Brazilian Navy	RGP	General Registry of Fishing Activities
FAO	Food and Agriculture Organization of the United Nations	RGPS	General Social Security System
FAT	Workers' Support Fund	SAP	Secretariat for Fisheries and Aquaculture
IBAMA	National Institute for the Environment and Renewable Natural Resources	SDPA	Unemployment Insurance for Artisanal Fishers
IBGE	Brazilian Institute of Geography and Statistics	SEPRET	Special Secretariat for Social Security and Labour
ICMBio	Chico Mendes Institute for the Conservation of Biodiversity	SINPESQ	National Fisheries and Aquaculture Information System
ILO	International Labour Organization	SisRGP	General Fishing Activity Registry System
INSS	National Social Security Institute	STN	National Treasury Secretariat
MAPA	Ministry of Agriculture, Livestock and Supply	TCU	Federal Court of Accounts
ME	Ministry of the Economy	TIEM	Tiny Vessel Registration Certificate

Structure of the report

The introduction outlines the *Seguro-Defeso* and the Unemployment Insurance for Artisanal Fishers (*Seguro-Desemprego do Pescador Artesanal*, SDPA), highlighting the relationship between these two concepts which are key to the study. It also contextualizes the *Defeso* and the SDPA within their respective fields of law, i.e. fisheries and social security.

The second section is divided into two subsections dedicated to the analysis of relevant constitutional provisions, keeping in mind that the Constitution is the fundamental source of law at the national level. The first subsection, related to the Federal Republic of Brazil, describes the constitutional allocation of competences for law making regarding certain matters relevant to the study, among autonomous federative entities—the Union, states, the Federal District and municipalities. The next subsection focuses on specific constitutional norms dedicated to fisheries and social security.

The third section is composed of two subsections, introducing sectoral concepts and mechanisms set by statutory legislation, which are instrumental to understand and analyse the legal framework of the SDPA. The first subsection introduces the main legal framework for the fishery sector and defines key concepts. The next subsection details fisheries as categorized by the legislation, focusing on artisanal fisheries. In a third and fourth subsection, the sustainability of fisheries resources as well as the activities and associated regulations are analysed. Finally, participatory mechanisms and information systems on fisheries are investigated.

The subsection dedicated to social security first recalls the main sets of law governing social security and outlines the purposes and principles of the General Social Security System (RGPS). We then present an analysis of beneficiaries and contextualize artisanal fishers within this group. Furthermore, the specific contributory regime dedicated to the category for “specially insured people” (*segurado especial*) is considered. Subsequently, the benefits granted by the RGPS are briefly recalled. The end of the third section focuses on the Unemployment Insurance Programme and its funding mechanism.

The fourth and last section is composed of two parts: first we present an analysis of the *Defeso*, which represents the logical (and legal) premise for artisanal fishers to request the unemployment insurance. The text focuses on the institutions responsible for the implementation, the regulatory framework and monitoring of this measure.

Then, in a second step, focusing on the SDPA, the analysis turns to the legal prerequisites for artisanal fishers to lawfully undertake fishery activities. We recall the institutions involved in the SDPA, presenting the various elements which comprise its regulation, including: the beneficiary, the benefit, the procedure for requesting the benefit and evaluation, the payment stage, hypotheses regarding benefit termination, complaint mechanisms, monitoring duties and, finally, sanctions.

Finally, the last section offers conclusions on several points with the purpose to inform the impact evaluation analysis, which is the wider framework within which this report was produced.

1. INTRODUCTION

The objective of this report is to provide an overview of the legal framework of *Seguro-Defeso* to serve as inputs for the design and implementation of the impact evaluation of the programme.

The SDPA, popularly known as *Seguro-Defeso*, is logically and legally interwoven with the closed fishing season (*Defeso*), considering that it is granted during the application of the latter.

Law No. 11.959/09 regulating fishery activities in Brazil, can be identified as the main set of legislation for the sector. The *Defeso*, figuring among the measures predisposed by the law to manage fishery resources (Art. 3, IV), consists of the temporary stoppage of fishery activities directed towards the capture of one or more species in a given territory, implemented in correspondence with reproductive and recruitment periods, as well as other natural phenomena or accidents. The application of this temporary fishing ban aims to ensure the reproductive capacity of the species and the overall balance of the ecosystem, which in turn guarantees the social, economic and environmental sustainability of fisheries.

Yet, while pursuing these objectives, the *Defeso* also entails the temporary restriction of the exercise of a professional activity, which translates into drastically reduced revenues generated by the sector, including those in the most fragile category of commercial fisheries—artisanal fishers.

The SDPA corresponds to the payment to professional artisanal fishers of a monthly minimum wage during the Defeso period. Hence, it aims to ensure the efficacy (results) and effectiveness (impact) of the Defeso by addressing the economic vulnerability of artisanal fishers.

The situation experienced by this group during the closed season is equated with involuntary unemployment, whereby, for reasons foreign to their will, artisanal fishers are unable to sustain themselves through work (Campos 2014). As will be analysed in detail later, the Constitution includes involuntary unemployment in the social risks to be addressed by social security and details the corresponding right of the worker to unemployment insurance (*seguro desemprego*). Thus, the SDPA can be characterized as a social security measure, conceived as an integral part of the Unemployment Insurance Programme.

2. RELEVANT CONSTITUTIONAL PROVISIONS

2.1 Distribution of competences among federal entities

The Constitution regulates the subject by categorizing law-making competences and distributing them among federal entities (the Union, states, the Federal District and municipalities), as follows:

1. Exclusive law-making: competence attributed to a certain entity that exercises it in all its fullness, without interference from other entities (Gonçalves Carvalho 2008). Art. 22 of the federal Constitution lists the subjects in which the Union has privative competences, whereas Art. 30, I assigns to Municipalities the privative competence to legislate on matters of local interest.

However, the Union's exclusive competence may be delegated, on specific matters, to states through complementary law (sole paragraph, Art. 22). Likewise, municipalities can supplement Union and state legislation (Art. 30, II). However, this prerogative can only be exercised within the scope of Art. 30, I— i.e. matters of local interest (Almeida 2005).

2. Concurrent, non-exclusive legislative law-making: competence exercised concurrently between two or various entities (Gonçalves Carvalho 2008). Concurrent competences can be subdivided into cumulative and non-cumulative. The former occurs when there are no prior limits for the exercise of competence for the federative entities involved,²⁴ while the latter implies a vertical distribution, in which there is a correspondence between the federative level and the scope of legislation, so that it is the Union's prerogative to regulate the subject through general norms (Art. 24, § 1), whereas it is incumbent on states to adopt supplementary rules (known as "supplementary competence," Art. 24, § 2) (Mohn 2010). It is also important to note that, in the absence of federal law, states can fill in the gap by legislating on the subject (Art. 24, § 3). However, in case federal law is enacted at a later date, it will suspend the dispositions of the state law that conflict with it (Art. 24, § 4). Art. 24 of the Constitution lists the subjects in which the Union, states and Federal District can legislate concurrently.
3. Residual (non-reserved) competences in law-making: Art 25, § 1 states that "are reserved to the states the competences which are not excluded/vetoed by this Constitution." Thus, states and the Federal District (see Art. 32, § 1 regarding the latter) can legislate on subjects that do not figure among the competences conferred by the Constitution to the Union or to municipalities, explicitly or implicitly (Mohn 2010).

The Union has exclusive competence in several subjects that are particularly relevant to the context of this study. Regarding fisheries, these include, in accordance with Art. 22: water (Art. 22, IV); ports and navigation

24. In case of conflict between federal and state legislation, the former prevails.

in lakes, rivers and the sea (Art. 22, X); **organization** of the national employment system and the conditions for the exercise of professions (Art. 22, XVI); and cartographic and geological systems (Art. 22, XVIII). A relevant exclusive law-making competence of the Union is social welfare (Art. 22, XXIII), which conceptually includes social security. Finally, relevant to both sectors are the national statistical system (Art. 22, XVIII) and public records (Art. 22, XXV).

Focusing instead on concurrent law making, Art. 24 attributes to the Union, states and Federal District the competence to legislate concurrently on fisheries, fauna, nature conservation, defence of the soil and natural resources, protection of the environment and pollution control (Art. 24, VI). In addition, the same article includes social security (Art. 24, XII). It is important to highlight that both competences belong to the non-cumulative category (Mohn 2010); therefore, it is incumbent on the Union to produce general norms in the respective fields of Law, whereas the states can only exercise supplementary competence, adapting this framework to their particular needs and specificities through state legislation.

2.2 Constitutional provisions inherent to fisheries and social security

The federal Constitution dedicates few provisions to fisheries. The first is located in Title VII's ("Economic and Financial System") Chapter III, "Agricultural and Land Policy and Reform": § 1 of Art. 187 clarifies that fisheries (together with agro-industrial, farming and forestry activities) is included in agricultural planning. The same article specifies that agricultural policy will be planned and enacted through legislation, with the effective participation of the production, marketing, storage and transportation sectors. Thus, considering that fisheries are a part of agricultural planning, the norm would guarantee the participation of fishers (the "productive sector"), along with other subjects, in both the design and implementation of agricultural policy.

In addition, Art. 8 sanctions the freedom to form professional or union associations and in doing so clarifies the applicability of such disposition to rural syndicates and fisher colonies (Art. 8, sole paragraph). Law 11.699/08, in connection with the sole paragraph of Art. 8, regulates at statutory level fisher colonies, federations and a national confederation.

Finally, considering that the natural environment includes—among other elements—water, flora and fauna (including fishery resources) and that it cuts across any productive activity, including fisheries, it is necessary to recall Art. 225. This norm recognises everyone's right—including future generations—to an ecologically balanced environment, characterized as a good for the common use of the people (hence detached from property)²⁵ and indispensable for a healthy quality of life. The same norm attributes the duty to protect and defend the environment to the State and society. To effectively guarantee this right, § 1 of Art. 225 ascribes to the public authority: the preservation/restoration of essential ecological processes and the provision of ecological management of species and ecosystems (Art. 225, § 1, I); the definition of protected areas (Art. 225, § 1, III); and the protection of fauna and flora, including the corresponding prohibition of practices that jeopardize their ecological functions (Art. 225, § 1, VII).

The federal Constitution also contains several provisions regarding social security. However, before we proceed to their analysis, social security should be contextualized within wider social welfare. Social welfare comprises an integrated set of measures implemented by public authorities and society, aimed at ensuring rights related to health, social security and social assistance (Art. 194). In terms of financing the social welfare system, the Constitution establishes that the associated costs will be borne by all of society, directly and indirectly, in accordance with the terms established by law, through resources from the budgets of the Union, the states, the Federal District and

25. See § 1 of Art. 1228, Civil Code.

the municipalities, as well as social contributions from employers, companies, employees, and other individuals and legal entities (Art. 195). The same article also specifies in its eighth paragraph that artisanal fishers (among other rural populations) who exercise their activities within a household system (regime de economia familiar) and without permanent employees, contribute to social welfare with a share of the proceeds from the sale of their production.

With specific reference to social security, it should first be noted that it is one of the fundamental social rights recognised by the Constitution (Art. 6). Furthermore, Art. 7 acknowledges unemployment insurance as a fundamental right for urban and rural workers in the case of involuntary unemployment. This situation is equated to that of the artisanal fishers during the application of the *Defeso*.

The Constitution provides that social security will be organized under the RGPS which is contributory in nature and requiring mandatory participation (Art. 201). Among the social contingencies to be addressed by social security and the RGPS, the same article includes the protection of workers in involuntary unemployment (Art. 201, III). Further, § 2 of Art. 201 stipulates that the amount of any benefit replacing labour earnings cannot be lower than the minimum monthly wage, whereas § 4 ensures the possibility of readjusting the benefits to preserve their value.

3. KEY CONCEPTS AND INSTRUMENTS OF THE FISHERY SECTOR

3.1 Fisheries

As previously mentioned, Law No. 11.959/09 (popularly known as the “Fishing Law”—*Lei da Pesca*) serves as the general legal framework for fisheries in Brazil. It is worth noting that the law focuses on the sustainable development of fisheries and aquaculture. As such, it seeks a balance between environmental conservation and social, economic and cultural outcomes associated with fisheries. The first Article determines that the National Policy for the Sustainable Development of Aquaculture and Fisheries shall be formulated, coordinated and implemented with a view to promote:

- I. the sustainable development of fisheries and aquaculture as a source of food, employment, income and leisure, guaranteeing the sustainable use of fishery resources, as well as the optimization of the resulting economic benefits, in harmony with the preservation and conservation of the environment and biodiversity;
- II. the organization, promotion and inspection of fishery activities;
- III. the preservation, conservation and recovery of fishery resources and aquatic ecosystems; and
- IV. the socioeconomic, cultural and professional development of those who exercise fishery activities, as well as of their communities.

The law defines several fundamental key concepts, described below along with their relevant legal provisions, which are interlinked with the SDPA.

1. Fishery system (Art. 2, XII): the set of rules and measures that allow the administration of fishery activities. The same norm also states that the fishery administration must rely on up to date information on biological, ecosystem, economic and social components.
2. Fishery activities (Art. 4): the exploitation and cultivation of fishery resources, as well as their conservation, processing, transportation, commercialization and research.

3. Fishery resources (Art. 2, I): hydrophilic (i.e. living in an aquatic environment) animals and plants subject to exploitation, study or research by amateur, subsistence, scientific and commercial fisheries and aquaculture.
4. Fisheries: included in the aforementioned wider concept of fishery activities (Art. 2, III): any operation, action or act that tends to extract, reap, catch, seize or capture fishery resources (Art. 2, III).

Fishery categorization. Referring to concept No. 4, Art. 8 makes a distinction between fishing activities for commercial purposes, which are subdivided into industrial and artisanal fisheries, and activities for non-commercial purposes, which are subdivided into scientific, amateur and subsistence fisheries. The definition of each category is depicted in Table A1.

Table A1.1 Categorization of fisheries for commercial and non-commercial purposes, as determined by Law No. 11.959/09

Fisheries for commercial purposes	
Artisanal fisheries (Art. 8, I, let. a)	When practiced directly by professional fishers, autonomously or in a household system, with their own means of production or by means of a partnership contract, on land or on small vessels
Industrial fisheries (Art. 8, I, let. b)	When practiced by an individual or legal entity and involving professional fishers, employees or in partnership with quota-parties, using small, medium or large vessels, for commercial purposes
Fisheries for non-commercial purposes	
Scientific fisheries (Art. 8, II, let. a)	When practiced by an individual or legal entity, for the purpose of scientific research
Amateur fisheries (Art. 8, II, let. b)	When practiced by a Brazilian or foreigner, with equipment and items provided for in specific legislation, with the purpose of leisure or sport
Subsistence fisheries (Art. 8, II, let. c)	When practiced for purposes of domestic consumption or barter for non-profit and using items provided for in specific legislation

Source: Authors' elaboration based on Law No. 11.959/09.

For a better understanding of the SDPA, it is necessary to expand on some of these concepts and analyse connected matters.

The concept of artisanal fisheries. In the jargon of the Food and Agriculture Organization of the United Nations (FAO), artisanal fisheries are defined as “traditional fisheries involving fishery households (as opposed to commercial companies), using relatively small amounts of capital and energy, relatively small fishing vessels (if any), making short fishing trips, close to shore, mainly for local consumption” (Garcia 2009). The same source also adds that the term tends to imply a simple, individual (self-employed) or family type of enterprise, most often operated by the owner with the support of the household and relatively low levels of technology.

In practice, the specific features of artisanal fisheries vary considerably across regions and countries: therefore, the legal definition of the concept also varies according to these particular characteristics. For example, according to Silva (2014), Brazilian artisanal fisheries are characterized by numerous and complex characteristics related to social, economic and environmental factors intrinsic to each region. What is important to highlight is the guiding thread that binds artisanal fisheries throughout the world—their significant contribution to food security and to the prevention and reduction of poverty (FAO 2009).

From a non-legal perspective, it is important to understand that the concept of artisanal fisheries might comprise several significantly diverse activities. For example, the Report on the Workshop on Management and Allocation of Fisheries Resources (FAO 2000) conceptually subdivides artisanal fisheries in Latin America and the Caribbean into:

- **Advanced artisanal fisheries:** carried out with medium-sized vessels, well-equipped for the navigation and on-board conservation of the capture, using medium productivity fishing gear. In some cases, this type of fishery successfully competes with industrial fisheries in capturing seafood and fish for the export market and benefits from subsidies geared towards artisanal fisheries in general. Recently, advanced artisanal fisheries have developed considerably in the region, supported by legislation that promotes artisanal fisheries without differentiating their modalities, and the increasing demand for high-value seafood and fish in the Asian, European and North American markets. This type of fishery has a significantly higher capture capacity and economic solvency than the other kinds of artisanal fisheries described below.
- **Traditional artisanal fisheries:** practiced with traditional boats. Fishers preserve their rooted habits and customs, the mobility of traditional fishers is usually limited and, in many cases, as owners of the means of production they work full-time, even in the face of low returns generated by the activity. Additionally, this kind of fishery has recently evolved as a result of the combination of traditional knowledge with technological improvements (for example, outboard engines), and increased demand for fisheries products at the national/local levels.
- **Subsistence artisanal fisheries:** includes subsistence artisanal fishers characterized by lacking the means of production, technical capacity and experience necessary to remain in the fishery sector in a stable manner, as well as traditional communities and Indigenous People who engage in fishery activities for non-commercial purposes.

The same report concludes that the existence of various forms of artisanal fisheries, without an appropriate legal framework that regulates them, represent a significant obstacle for guaranteeing the sustainable development of fisheries in the region.

With this in mind, we can proceed to the analysis of each of the elements comprising the legal definition of commercial artisanal fisheries, as determined by Art. 8, I, let. a):

- Directly practiced.** From a commercial perspective, artisanal fishers can request their registration in the Public Registry of Commercial Companies (*Registro Público de Empresas Mercantis*), in accordance with the Civil Code (Art. 971). As reported by Moraes de Araújo Pinheiro (2014) if someone chooses to register, they lose the status of “autonomous worker” as a result of organizing the factors of production, therefore falling into the category of “industrial fishery”. For the same reason, artisanal fishers cannot organize themselves under any form of business-oriented partnership, considering that this also entails the organization of the factors of production.
- By professional fishers.** The Brazilian or foreign resident in the country who, licensed by the competent public authority, carries out fishery activities for commercial purposes, complying with the criteria established in specific legislation (Art. 2, XX).
- From land or on small vessels.** Artisanal fishers can practice commercial artisanal fishing either from land or on a small vessel. Small vessels are defined in the same law as those with gross tonnage equal or under 20 tonnes (Art. 10, § 1, I).
- Autonomously or in a household system.** The law requires artisanal fishers to be self-employed or acting within a household system. The fact that artisanal fishers are autonomous workers directly exercising their professional activity means that they cannot contract employees.
- With their own means of production or by means of a partnership contract.** The law establishes that fishers can own the means of production (for example, the gear and vessel, when the fishing is not based on land). Alternatively, the means of production can be organized by means of a partnership contract, observing the limits stated in a) and d).

Furthermore, Law No. 11.959/09 in defining fisheries activities (Art. 4) specifies that artisanal fishery activities also comprise producing and repairing fishing gear, repairs performed on small vessels and processing of artisanal fishery products. In addition, the legislator stipulates that the fishery system must consider the peculiarities and needs of artisanal, subsistence fishers, to guarantee their preservation and continuity (Art. 3, § 1). Likewise, the National Policy for the Sustainable Development of Aquaculture and Fisheries (*Política Nacional de Desenvolvimento Sustentável da Aquicultura e da Pesca*) should promote the socio-economic and cultural development of fishing communities (Art. 1, IV).

Therefore, it is clear that Law No. 11.959/09 recognises artisanal fisheries exclusively within the context of commercial fisheries, distinguishing them from subsistence fisheries. Moreover, the definition does not make any distinction between the previously analysed concepts of “advanced artisanal fisheries” and “traditional artisanal fisheries” and might well include both. Outside of the sectoral fishery legislation, it is important to highlight that the Brazilian legal system fundamentally allows, based on the principle of self-determination, the characterization of artisanal fishers as traditional peoples and communities, as briefly explained in Box A1.

Box A1.1 Characterization of artisanal fishers as traditional peoples and communities in the Brazilian legal system

It is crucial to observe that artisanal fishers are classified, outside the scope of fishery legislation, as traditional peoples and communities.

In 2004, the 1989 International Labour Organization’s (ILO) Convention No. 169 on Indigenous and Tribal Peoples was incorporated into the Brazilian domestic system as a result of Decree No. 5.051/04 (substituted in 2019 by Decree No. 10.088/19, consolidating normative acts issued by the federal executive branch that provide for the promulgation of ILO conventions and recommendations ratified by the Federative Republic of Brazil). The convention fundamentally implies the right of indigenous and tribal peoples to self-determination, as well as the right to be consulted and participate in any measure that affects them directly or indirectly.

At the national level, the National Policy for the Sustainable Development of Traditional Peoples and Communities (*Política Nacional de Desenvolvimento Sustentável dos Povos e Comunidades Tradicionais*, PNPCT) was adopted in 2007 as a result of Decree No. 6.040/07. The Decree defines traditional peoples and communities as “culturally differentiated groups that recognise themselves as such, that have their own forms of social organisation, that occupy and use territories and natural resources as a condition for their cultural, social, religious, ancestral and economic reproduction, using knowledge, innovations and practices generated and transmitted by tradition” (Art. 3, I).

The general objective set by the policy is the sustainable development of traditional peoples and communities, with an emphasis on the recognition, strengthening and guarantee of their territorial, social, environmental, economic and cultural rights, with respect and appreciation for their identity, their forms of organization and their institutions.

The National Council of Traditional Peoples and Communities, a collegiate body with advisory functions, was created in 2016 by Decree No. 8.750/16 (as amended). The Council, in accordance with Law No. 13.844/19, is part of the structure of the Ministry of Women, Family and Human Rights. Among the competences attributed to the body are the coordination and monitoring of the implementation and regulation of the PNPCT (Art. 2, V). Artisanal fishers are among the 28 groups of traditional peoples and communities whose seat is reserved in the Council (Art. 4, § 2).

Source: Authors’ elaboration based on ILO Convention no. 169/1989, Decree No. 5.051/04, no. 10088/2019, no. 6040/2007 and no. 8750/2016, and Law No. 13.844/19.

Sustainability of fishery resources and activities. Art. 3 attributes to public authorities the duty of reconciling the balance between the principle of sustainability of fishery resources and the achievement of better economic and social outcomes, calculating, authorizing or establishing the following:

- I – access regimes
- II – total allowable catch
- III – efforts of sustainable fisheries
- IV – *Defeso* periods
- V – fishing seasons
- VI – sizes of the catch
- VII – protected or restricted areas
- VIII – fishery gear, devices, methods and systems
- IX – carrying capacity of ecosystems
- X – necessary actions for monitoring, controlling and enforcing the activity
- XI – Protection of individuals during the reproductive processes of fish stocks.

Thus, the provision spells out several management measures (including the *Defeso*) aimed at guaranteeing the sustainable use of fishery resources, with a view to realizing what is foreseen in Art. 1, I.

The law also contains a norm (Art. 7) which aims to guarantee the sustainability of fishery activities, establishing the following measures:

- I – management of access and use of fisheries resources
- II – determination of protected areas
- III – social participation
- IV – workforce training
- V – environmental education
- VI – construction and modernization of port infrastructure, as well as improvement of port services
- VII – research on resources, techniques and methods inherent to fishery activities
- VIII – fishery activities information system
- IX – fishery activities control and inspection
- X – credit to promote the sector.

Regulation of the exercise of fishery activities. In accordance with Art. 5, the exercise of fishery activities can only be carried out by means of a previous authorization issued by the competent authority, ensuring:

- I. the protection of ecosystems and the maintenance of ecological balance, observing the principles of preservation of biodiversity and the sustainable use of natural resources;
- II. mechanisms to guarantee the protection and safety of workers and populations with traditional knowledge; and
- III. food security and safety.

In addition, Art. 24 requires any person (or legal entity) or vessel carrying out fishery activities to be previously registered in the National Fishing Registry (*Registro Geral da Atividade Pesqueira* – RGP), as well as in the Federal Technical Registry of Potentially Polluting Activities or Using Environmental Resources (*Cadastro Técnico Federal de Atividades Potencialmente Poluidoras e/ou Utilizadoras de Recursos Ambientais*, CTF/APP). Both instruments, along with their respective normative acts, will be analysed in further detail in Section 4.

In addition, Art. 25 specifically foresees the following administrative acts, granted by the competent authority, for the exercise of fishery activities.

- I. **Concession:** for the private exploitation of infrastructure and public land destined for the exploitation of fishery resources.
- II. **Permission:** to transfer permission; for importing aquatic species for ornamental and aquaculture purposes, at any stage of the life cycle; for the construction, transformation and import of fishing vessels; for leasing a foreign fishing vessel; for research; for the exercise of aquaculture in public waters; and for the installation of fixed traps in Union waters.
- III. **Authorization:** for the operation of fishing vessels, and sports and recreational vessels when used in sports fishing; and for organizing amateur fishing tournaments or competitions.
- IV. **License:** for professional and amateur or sports fishers; for aquaculture farmers; for shipowners; for the creation and operation of fishing companies.
- V. **Assignment:** for the use of physical spaces in water bodies under the jurisdiction of the Union, the states and the Federal District, for aquaculture purposes.

Art. 26 demands that any vessel engaged in commercial fishery activities, in addition to complying with the requirements of the maritime authority, must be registered and authorized by the competent federal public agency. If such requirements are not met, the interdiction of vessel operations is determined until they are (Art. 26, sole paragraph).

Finally, Art. 6 regulates the possibility of temporarily, periodically or permanently banning fishery activities. The instances in which fishery activities can be prohibited include the protection of species' reproductive processes and other processes vital to the maintenance and recovery of fish stocks (Art. 6, II). This hypothesis is clearly interlinked with the *Defeso*. In addition, § 1 of Art. 6 lists a number of instances in which fishery activities are prohibited definitively, which again include the "prohibition in times and places defined by the competent authority" (Art. 6, § 1, I). Further, in accordance with the requirement posed by Art. 5, fishery activities are prohibited without a license, permit, concession,

authorization or registration issued by the competent authority (Art. 6, § 1, III). Finally, § 2 of Art. 6 forbids the transportation, commercialization, processing and industrialization of species resulting from prohibited fishery activities.

Participation in fisheries. As mentioned, Art. 187 of the Constitution establishes that agricultural planning, which includes fisheries, is carried out with the participation of the productive sector (among others), whereas Art. 7, III of Law No. 11.959/09 includes “social participation” as one of the items through which the sustainable development of fishery activities should be carried out. A further element which demands the participation of artisanal fishers in participatory governance is the previously analysed incorporation in the Brazilian domestic system of the ILO’s 1989 Convention (No. 169) on Indigenous and Tribal Peoples and the subsequent enactment of national legislation in the domestic system.

Against this background, some observations on the state of participatory channels are in order. The Shared Management System, regulated by Decree No. 6.981/09 and the implementing Inter-ministerial Ordinance MPA/MMA No. 5/15, is a system in which the responsibilities and designations of representatives of the State and civil society organizations are formed by committees, technical chambers and working groups with advisory functions (Art. 2, II IO MPA/MMA No. 5/15). This system, built on the best available scientific knowledge and data, had the objective of supporting the elaboration and implementation of norms, criteria, standards and measures for the organization of the sustainable use of fishery resources. The Shared Management System consisted of Permanent Management Committees (*Comitês Permanentes de Gestão*, CPGs) for the Sustainable Use of Fishery Resources, technical chambers and working groups, with the Technical Commission for the Shared Management of Fisheries Resources (*Comissão Técnica de Gestão Compartilhada dos Recursos Pesqueiros*—CTPG) acting as the advisory body and coordinator of activities of the system. CPGs, characterized by an equal representation of State representatives and civil society, encompassed up to ten organizations in the fisheries sector, including up to five organizations, entities or associations working with artisanal fishers.

One of the CPGs’ main outputs was management plans for the sustainable use of fishery resources, establishing general guidelines.

Several problems must be pointed out in relation to the CPGs. First, between 2011 and 2015, multiple consecutive replacements of ministers in the public body responsible for fisheries resulted in a significant discontinuity in the programmes and measures implemented over time. This discontinuity culminated in the non-implementation of the CPGs approved in 2010 (Ruffino 2016). Moreover, as reported by Souza (2008), Mendonça and Lucena (2013) and Ministério da Economia *et al.* (2019), the lack of an effective participative management structure translated into low trust by fishing communities in relation to public authorities and the de-legitimization of legal instruments for the protection and preservation of fishery activities. This observation is bolstered by Brazil’s Federal Court of Accounts’ (*Tribunal de Contas da União*, TCU) Audit Survey Report on the Commitments made by Brazil at the Rio-92 Conference (TCU 2012) which also confirmed that the decisions were mainly taken by government managers without the participation of the productive sectors, academia and non-governmental organizations (NGOs), highlighting the risk of adopting misguided, biased and technically unfounded proposals.

It is crucial to highlight that Decree No. 10.087/19 revoked Decree No. 6.981/09 whereas CPGs were temporarily suspended by Decree No. 9.759/19. In this respect, the competent authority, when queried by Brazil’s state news agency, stated that a new decree is being drafted to revamp the system (Agência Brasil 2019) and also reaffirmed its commitment to strengthening the participation of segments of extractive fisheries (artisanal, industrial and amateur fishers, when applicable), the post-capture sector (processing and marketing) and NGOs, necessary to ensure the environmental and socioeconomic sustainability of the fishery activities (MAPA - SAP 2020).

Finally, it is also important to note that 2003 saw the creation of a participatory collective body: the National Council for Aquaculture and Fishery²⁶ (*Conselho Nacional de Aquicultura e Pesca*, CONAPE), regulated by Decree No. 5.096/04, as amended. In accordance with Art 1, in addition to being responsible for providing inputs for the

26. As a result of Law No. 10.683/03.

formulation and implementation of public policies related to fishery activities, CONAPE should propose participatory strategies associated with the deliberative processes of policy guidelines, and procedures related to the development and promotion of aquaculture and fishing activities (Art. 1, II). In addition, it should encourage the expansion and improvement of mechanisms of participation and social control, through a national network of state, regional and municipal collegiate bodies, aimed at strengthening the development and promotion of aquaculture and fishing activities (Art. 1, V). Yet, as reported by Costa Silvino (2018), CONAPE effectively existed until its fourth term, which ended on 26 June 2016.

Fishery information and statistics. Information and statistics are crucial to instruct the adoption by the competent public authority of management measures which seek a balance between the maintenance of fish stocks and the socioeconomic outcomes generated by fisheries. Moreover, fishery information and statistics are key for monitoring and evaluation.

From an international perspective, it is worth noting that the FAO Code of Conduct for Responsible Fisheries (FAO, 1995) states that:

“conservation and management decisions for fisheries should be based on the best scientific evidence available, also taking into account traditional knowledge of the resources and their habitat, as well as relevant environmental, economic and social factors [...]” (paragraph 6.4).

At the national level, as already mentioned, Art. 7 of Law No. 11.959/09 mentions fishery information systems as a tool to foster the sustainable development of fishery activities. In addition, Art 27 § 2 authorizes the Executive branch to create a national information system on fisheries and aquaculture, with the aim of collecting, aggregating, exchanging and disseminating information on the national fishery and aquaculture sector.

The Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística*, IBGE), regulated by Law No. 5.878/73, is responsible for the production of fishery statistics, in accordance with Art. 2 and Art 3, V. The same institution is responsible for coordinating the implementation, development and maintenance of the National Fishery and Aquaculture Information System (*Sistema Nacional de Informação da Pesca e Aquicultura*, SINPESQ) (Art. 2 Decree No. 1.964/95). The overall purpose of the system is to collect, aggregate, process, analyse, exchange and disseminate information about the national fishery sector (Art. 1).

Ruffino (2016) lists the interruption of the SINPESQ as well as of the National Programme for Fishery Statistics as consequences of the change in ministries and the subsequent discontinuity in measures. In addition, Ministério da Economia *et al.* (2019) identifies 2011 as the year when the last Fishery Activities Bulletin was published, including production data. Costa Silvino (2018) reports that data have not been collected since 2011, and therefore, despite the availability of state-level information, fishery statistics are not systematically gathered at the national level.

3.2 Social security

This subsection analyses key social security legislation and concepts related to the fishery sector.

Social security statutory legislation and the RGPS. Within the context of social security, two sets of laws at the statutory level serve as the overall legal framework: Law No. 8.212/91 (as amended)—regulating the organization of social welfare and its funding; and, in accordance with Art. 9 of the former, Law No. 8.213/91 (as amended)—regulating social security plans and benefits. Whereas other social security regimes (for example, the special regime and complementary private social security) complement the RGPS, this report focuses exclusively on the RGPS.

Art. 1 of Law No. 8.213/91 provides that social security aims to provide its beneficiaries with crucial means for their maintenance, due to incapacity, involuntary unemployment, old age, time of service,²⁷ family changes and imprisonment or death of those on whom they depended economically.

In addition, observing the constitutional dispositions, Art. 2 lays down the following principles and objectives for social security:

- I – universality of participation in plans and benefits;
- II – uniformity and equivalence of benefits and services to urban and rural populations;
- III – selectivity and distributivity in the provision of benefits;
- IV – calculation of the benefits based on the *salários-de-contribuição* monetarily adjusted;
- V – irreducibility of the value of the benefits in order to preserve their purchasing power;
- VI – value of the monthly income of the benefits substituting the *salários-de-contribuição* or the insured's work income not lower than the minimum wage;
- VII – optional supplementary pension, funded by additional contribution; and
- VIII – democratic and decentralized character of administrative management, with the participation of the government and the community, especially workers, employers and retirees.

RGPS beneficiaries. Art. 10 of Law No. 8.213/91 identifies as beneficiaries of the RGPS the direct beneficiaries—*segurados*—as well as those who are dependent on the *segurados*. As stipulated by Art. 16, this category includes:

- I. the spouse, partner and non-emancipated children, in any condition, under 21 years old or disabled;
- II. the parents; and
- III. non-emancipated sibling, of any condition, under 21 years of age or disabled with an intellectual or mental disability that renders them totally or partially incapable, as declared in court.

Both Law No. 8.212/91 and Law No. 8.213/91 distinguish between compulsory beneficiaries (*segurados obrigatórios*) and voluntary beneficiaries (*segurados facultativos*). The latter category includes those who, despite not exercising a remunerated economic activity, wish to contribute voluntarily to the social security system (students, for example). Art. 13 of Law No. 8.213/91 and art. 14 of Law No. 8.212/91 allow for this choice only if the person is at least 14 years old.

27. *Tempo de serviço*. It is important to note that since 1998, as a result of Constitutional amendment No. 20/1998, this term has been substituted with “*tempo de contribuição*” [period of contribution]. These two concepts have the same definition (see art. 57 of the revoked Decree No. 2.172/97 and Art. 59 of Decree No. 3.048/99). This is because, in accordance with Art. 4 of the same constitutional amendment, until the law regulates the matter (which has not yet happened), time of service is counted as period of contribution.

Conversely, any person who exercises a remunerated activity in the country automatically joins the RGPS and has the corresponding obligation to contribute to the social security system, except for those who fall under the scope of other social security regimes (e.g. magistrates, military personnel, federal, state and municipal civil servants, etc.) (Zambitte Ibrahim 2005). Table A2 illustrates the compulsory beneficiaries (*segurados obrigatórios*) as defined by law:

Table A1.2 Segurados obrigatórios as determined by Law No. 8.213/91

Employees (Art. 11, I): in accordance with Art. 3 of Decree No. 5.452/43 (providing for the consolidation of labour law), an employee is an individual who provides regular (non-occasional) services to an employer, in a condition of dependence from the latter and in correspondence of a salary.
Domestic workers (Art. 11, II): individuals who provide a continuous service to a person or family, in their residence, in a non-profit activity (housekeeping, chauffeurs, etc.)
Temporary workers (<i>trabalhadores avulsos</i>) (Art. 11, VI): individuals who provide services to several companies, without an employment relationship with these. Usually there is the intermediation of a body managing the workforce or a trade union of the category to which the worker belongs.
Individual contributors (Art. 11, V): this category is very heterogeneous, as it includes all those who cannot be categorized as employees, domestic workers, <i>trabalhadores avulsos</i> or <i>segurados especiais</i> (entrepreneurs, autonomous workers, etc.)
Specially insured (<i>segurados especiais</i>) (Art. 11, VII): individuals who reside in a rural property (or in an urban or rural settlement close to it) and, individually or in a household system—even with the occasional help of third parties—carry out activities as a: <ul style="list-style-type: none"> a) producer: owner, possessor, settler, partner, lender or rural tenant, who exploits an agricultural activity (agricultural, pastoral or horticulture) in an area of up to four fiscal modules; and rubber tappers or plant extractivists, whose main livelihood is made up of these activities; b) artisanal fishers or similar, whose main profession or main livelihood is fishing; and c) spouses or partners, as well as children over the age of 16 or similar, of the <i>segurado</i> referred to in subparagraphs a and b of this category, who are proven to work together with their respective family group.

Source: Authors' elaboration based on Law No. 8.213/91.

Hence, Law No. 8.212/91 (Art. 12, para. VII, let. b) and Law No. 8.213/91 (Art. 11, para. VII, let. b) identify as *segurado especial* the artisanal fisher who, individually or in a household system (“*regime de economia familiar*”), although with the possible help of third parties, relies on fishing as a main profession or livelihood. The first paragraph of Art. 11 defines the household system as the activity in which the work of family members is indispensable for their own subsistence and for the socioeconomic development of the family unit, which is carried out under conditions of mutual dependence and collaboration, without the use of permanent employees.

The contributory regime of the *segurado especial*. A specific contributory regime for the *segurado especial* category is predisposed by the Constitution and Law No. 8.212/91. Art. 195 § 8 of the Constitution determines that artisanal fishers, along with other categories, contribute to social welfare (and not exclusively to social security) by applying a tax rate on the outcomes of the commercialization of the production. They are therefore entitled to the benefits foreseen by the law.²⁸

Art. 25 of Law No. 8.212/91 defines as obligatory contribution for this category:

- I. 1.2 per cent of the gross revenue deriving from the commercialization of its production; and,
- II. 0.1 per cent of the gross revenue from the sale of its production to finance benefits for work-related injuries.

28. Except for special pensions and pensions due to period of contribution.

In addition, the law also explicitly foresees the possibility for the *segurado especial* to further contribute, on a voluntary basis, to the RGPS in the terms described in Art. 21 (Art. 25, § 1).

It is important to note that, in accordance with Art. 30 IV, if the *segurado especial* sells their production to acquiring, consumer or consignee companies or cooperatives (i.e. legal entities), these are obliged to make the respective payment to social security. The legal entity is also required to provide the *segurado* with a copy of the goods receipt (fiscal document), for purposes of proving the operation and the respective social security contribution (Art. 30, XIII § 8). Conversely, the *segurado especial* is obliged to contribute directly to social security, in accordance with Art. 30, X when the production is sold/consigned:

- a) abroad;
- b) directly, at retail, to the individual consumer;
- c) to the individual referred to in let. a of item V of art. 12 (the natural person, owner or not, who exploits an agricultural activity, in any capacity, on a permanent or temporary basis, in an area greater than four fiscal modules; or, when in an area equal to or less than four fiscal modules or in fishing activities, with the assistance of employees or through agents); and
- d) to another *segurado especial*.

In both cases, in accordance with Art. 30, X and III, the term foreseen for the contribution is until the twentieth day of the month following the sale of the production or the consignment operation.

A relevant legal feature that deserves attention is that in terms of the law and in accordance with the aforementioned constitutional provision (Art. 25 and 30 XII), the obligation to contribute exists only when the production is commercialized. As clearly stated by Zambitte Ibrahim (2007, 190):

“the concept of contributory salary loses its meaning when referring to the *segurado especial* [considering that they are self-employed or working within a household system]. Here, the basis of calculation is simply the value of the sale of rural production (including fisheries for artisanal fishers) [in accordance with Art. 195 § 8 of the Constitution]. In contrast to other *segurados*, the contribution of the *segurado especial* is not necessarily monthly, as it exists only when there is a sale of rural products. If the *segurado* is in the inter-harvest period, there is no sale and, therefore, no contribution, although the subject remains a *segurado obrigatório* of the RGPS, with full social security coverage.”²⁹

Correspondingly, when the family group to which the *segurado especial* belongs has not obtained any revenue from the commercialization of production during the year, for any reason, the *segurado especial* is required to communicate this fact to the institution responsible for social security (Art. 30, XIII § 8).

Benefits and services afforded by the RGPS. Art. 18 attributes RGPS benefits and services to *segurados*, dependents or both, as depicted in Table A3.

29. Note: sentences between brackets were added by the author of this report.

Table A1.3 Benefits and services afforded by the General Social Security System

RGPS benefits and services destined for <i>segurados</i> (Art. 18, I)	
Disability pension	e) Sickness/illness assistance
Old age pension	f) Family allowance
Pension due to period of contribution	g) Maternity allowance
Special pension ³⁰	h) Accident assistance
RGPS benefits and services destined for the dependents of <i>segurados</i> (Art. 18, II)	
Death pension	b) Imprisonment aid
RGPS benefits and services destined for both <i>segurados</i> and their dependents (Art. 18, III)	
Social services	b) Professional rehabilitation

Source: Authors' elaboration based on Law No. 8.213/91.

As can be observed, the article does not mention unemployment insurance, which is the benefit linked with the SDPA. This feature is linked to § 1 of Art. 9, which stipulates that the RGPS guarantees the coverage of the situation listed in Art. 1, except for involuntary unemployment, regulated by a specific law. Yet, it is important to note that the sole paragraph of Art. 124 of Law No. 8.213/91 explicitly forbids the simultaneous receipt of unemployment insurance and any social security benefit of continued provision, except for death pensions and accident assistance.

Finally, it is also noteworthy that the *segurado especial* is entitled to all social security benefits to which individual taxpayers are entitled, except for special pensions and pensions due to time of contribution (Souza Pina 2017).

The Unemployment Insurance Programme and the Workers' Support Fund. In accordance with the aforementioned Art. 9, Law No. 7.998/90 regulates the Unemployment Insurance Programme (and *Abono Salarial*), in addition to establishing the Workers' Support Fund (*Fundo de Amparo ao Trabalhador*, FAT).

The purpose of the Unemployment Insurance Programme includes, in accordance with Art. 2, the provision of temporary financial assistance to unemployed workers due to unfair dismissal (including indirect dismissal). An important distinction compared to the SDPA is that the latter does not involve any kind of employment relationship. On the contrary, the definitions of both commercial artisanal fisheries and *segurado especial* refer to artisanal fishers as being self-employed or working within a household system. However, further analysis will reveal that the law regulating the SDPA, in addition to sharing a number of common points with Law No. 7.998/90, also explicitly recalls some of its provisions. Particularly relevant, for example, is the regulation of the FAT.

The FAT is, among other elements, destined to finance the Unemployment Insurance Programme (Art. 10) and the SDPA. In accordance with Art. 11, FAT resources are:

- I. the proceeds from the collection of contributions due to the Social Integration Programme (PIS) and the Public Employees' Heritage Training Programme (PASEP);
- II. the product of charges owed by taxpayers, as a result of non-compliance with their obligations;
- III. the monetary correction and the interest due by the agent applying the fund's resources, as well as by the paying agents, on the balance of the transfers received;

30. For cases in which the employee's health or physical integrity is impaired for 15, 20 or 25 years as a result of working conditions.

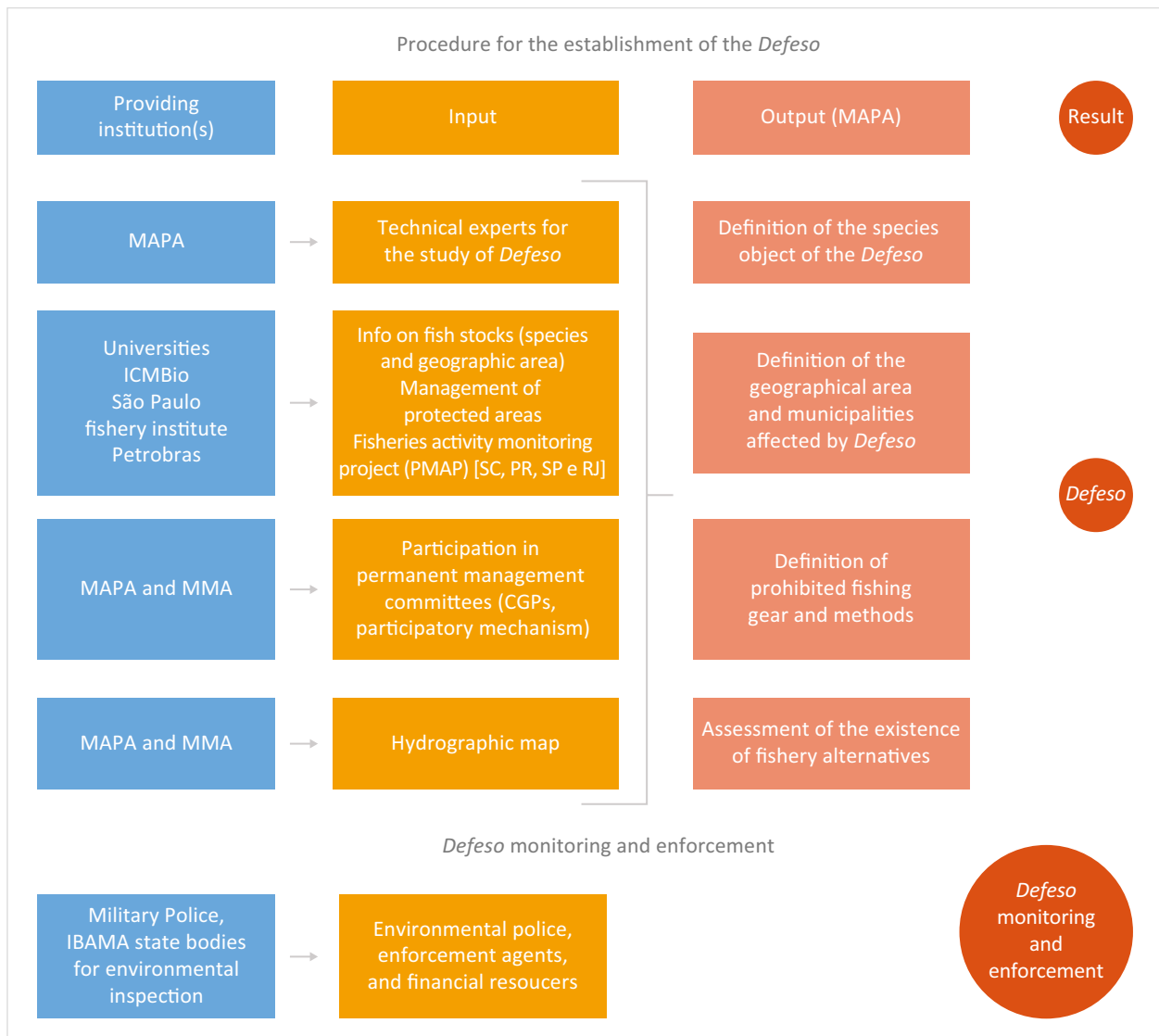
- IV. the proceeds from the collection of the additional contributions by the turnover rate, referred to in § 4 of art. 239 of the federal Constitution; and,
- V. other resources allocated to it.

Finally, the Deliberative Council of the Workers' Support Fund (*Conselho Deliberativo do Fundo de Amparo ao Trabalhador, CODEFAT*), composed of representatives of workers, employers and government agencies and entities (Art. 18), is responsible for the management of the FAT (Art. 19).

4. DEFESO AND THE SDPA

4.1 The Defeso

Figure A1.1 Procedure for the definition of the *Defeso*: inputs, outputs and institutions



Source: Authors' elaboration based on Ministério da Economia *et al.* (2019).

Responsible institutions. Law No. 13.844/19, which establishes the basic organization of the bodies of the Presidency of the Republic and the Ministries, identifies as areas of competence of the Ministry of Agriculture, Livestock and Supply (*Ministério da Agricultura, Pecuária e Abastecimento*, MAPA) both the national fishery policies and the management of fishery resources (Art. 21, III). As already mentioned, the *Defeso* is one of the measures predisposed by Law No. 11.959/09 for the sustainable management of fishery resources, thus falling under MAPA's competence.

Within MAPA's organisational structure, as determined by Decree No. 10.253/20, particularly relevant to this analysis is the Secretariat for Fisheries and Aquaculture (SAP) (Art. 2, II, let. d). It is responsible for, among other responsibilities, setting criteria, standards and measures for the sustainable use of fishery and aquaculture resources (Art. 29, IV). The SAP is also responsible for proposing and evaluating policies and initiatives and defining strategies for the sustainable development of fishery resources (Art. 29, II).

Whereas the SAP is responsible for managing fishery resources and, consequently, for formulating the *Defeso*, several other entities provide inputs to this process. In this light, the Ministry of the Environment's (*Ministério do Meio Ambiente*, MMA) residual competence is the participation in the CPGs, together with MAPA. However, as mentioned previously, the CPGs were temporarily suspended in 2019.

Academia contributes with information on fish stocks, species and geographic areas. Other entities contribute with relevant information about fisheries. For example, the Fisheries Institute of the State of São Paulo, as contracted by Petrobras, is implementing the Fishing Activity Monitoring Project (*Projeto de Monitoramento da Atividade Pesqueira*, PMAP). The project monitors fishery production and socioeconomic variables in the State of São Paulo and in the southern region of the state of Rio de Janeiro (Paraty and Angra dos Reis). Technicians responsible for monitoring and collect data where fish is discharged—these data are then included in a database and used to produce fishing statistics at the municipal, state and federal levels (Petrobras 2020). Likewise, the Chico Mendes Institute for the Conservation of Biodiversity (ICMBio), regulated by Law No. 11.516/07 and Decree No. 10.234/20, which is responsible for carrying out measures inherent to the management, protection, inspection and monitoring of conservation units established by the Union (Art. 1, I Law No. 11.516/07), manages and provides relevant information regarding protected areas.

Additionally, the National Water Agency (*Agência Nacional de Águas*, ANA) and IBGE contribute through the elaboration of the “hydrographic map” (*Mapa Hidrográfico*) which contains hydrographic basins with fishing locations. In accordance with Law No. 9.433/97, hydrographic basins are the territorial units in which both the National Water Resources Policy and the National Water Resources Management System are implemented (Art. 1, V).

Finally, once the *Defeso* has been formulated by MAPA based on these inputs, the main institution responsible for its monitoring during the active period is the Brazilian Institute for the Environment and Renewable Natural Resources (*Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis*, IBAMA), a federal authority with legal personality under public law, linked to the MMA, whose purview includes, in accordance with Law No. 7.735/89 (as amended), exercising the power of environmental police (Art. 2, I). The Military Police and State bodies competent in environmental inspection also contribute to monitoring efforts.

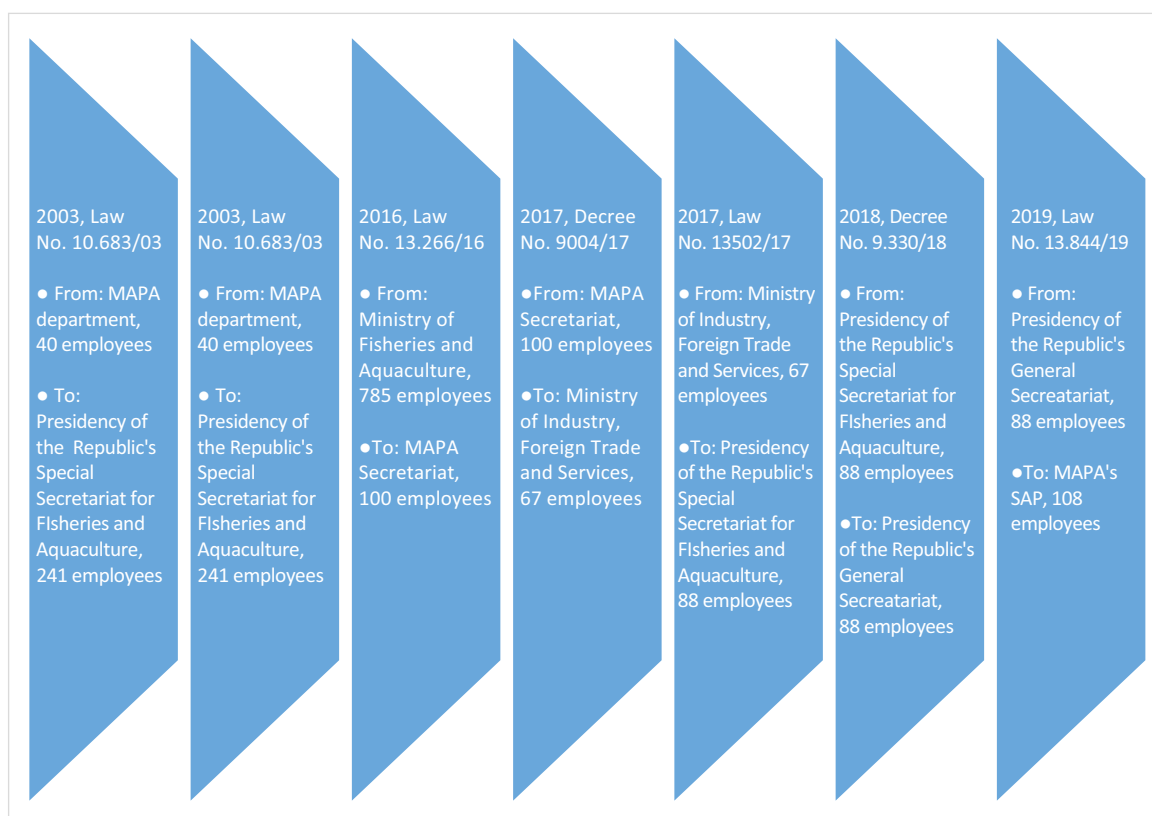
In conclusion, the scenario introduced by Law No. 13.844/19 represents an important paradigm shift for the Brazilian fishery sector, considering that previously both the formulation of the *Defeso* and the overall management of fishery resources included the participation of the MMA. Both Law No. 10.683/03 and its repealing Law No. 13.502/17³¹ (which was in turn revoked by Provisional Measure No. 870/19, subsequently converted into Law No. 13.844/19) envisioned the establishment of norms, criteria, standards and measures for planning the sustainable use of fishery resources as a joint responsibility of the public body responsible for fisheries and the MMA.

31. Art. 27, §6, I, of Law No. 10.683/03 and Art. 12, §2, I of Law No. 13.502/17.

Box A1.2 Institutional change in fisheries

It is crucial to observe that the competence for the sustainable management of fishery resources has been assigned to several public institutions in the recent past. Figure A2 represents these changes, together with the underlying normative act and the overall number of serving personnel.

Figure A1.2 Institutional change in fisheries between 2003 and 2019



Source: Authors' elaboration based on Costa Silvino (2018) and Seif Júnior (2019).

Therefore, the duty of managing fishery resources frequently shifted from one institution to another between 2003 and 2019. This fact, coupled with the necessary time for the receiving institution to adapt to the designation, as well as the significant differences in terms of personnel and infrastructure, undoubtedly hindered the continuity of actions and programmes of the body responsible for the sustainable management of fishery resources to some extent, hence limiting the implementation of this crucial competence.

Defeso regulation. As mentioned, the *Defeso* is one of the instruments foreseen in Law No. 11.959/09 to sustainably manage fishery resources. The measure is defined by the same law as the temporary stoppage of fishing activities for the preservation of species, motivated by reproduction and/or recruitment, as well as stoppages caused by natural phenomena or accidents (Art. 2, XIX).

The only relevant provision found in Law No. 10.779/03, regulating the SDPA, is para. 2 of Art. 1, which clarifies that the *Defeso* is established by IBAMA, in relation to the marine, fluvial or lake species to which the fishers' activity is dedicated. However, it is important to note that this responsibility now lies exclusively with MAPA—as a result of the enactment of Law No. 13.844/19 (Art. 21, para. III).

More norms inherent to the *Defeso* can be found in Decree No. 8.424/15, which implements and regulates Law No. 10.779/03. From a temporal perspective, it is important to note that each of these rules was introduced as a result of Decree No. 8.967/17 which amends, among other normative acts, Decree No. 8.424/15. The purpose of the amendment, in this context, is the introduction of minimum criteria and standards for the normative acts instituting *Defesos*, which lacked uniformity and consistency (Faria Carvalho 2018).

First, the legislation requires, prior to establishing *Defeso* periods, the evaluation of other measures for the sustainable management of fishery resources, through a joint act by MAPA and the MMA (Art. 1 § 9). Again, it should be considered that, as a result of Law No. 13.844/19, the competence for managing fishery resources is exclusively designated to MAPA, which is therefore responsible for the evaluation required by the provision of Decree No. 8.424/15. In this context, the evaluation of *Ministério da Economia* (2019) highlights that the *Defeso* is used in place of other instruments that would be more suitable, but entail more complex logistics or non-consensual political consequences; or because there is a lack of data on fisheries, which hinders the application of alternative solutions.

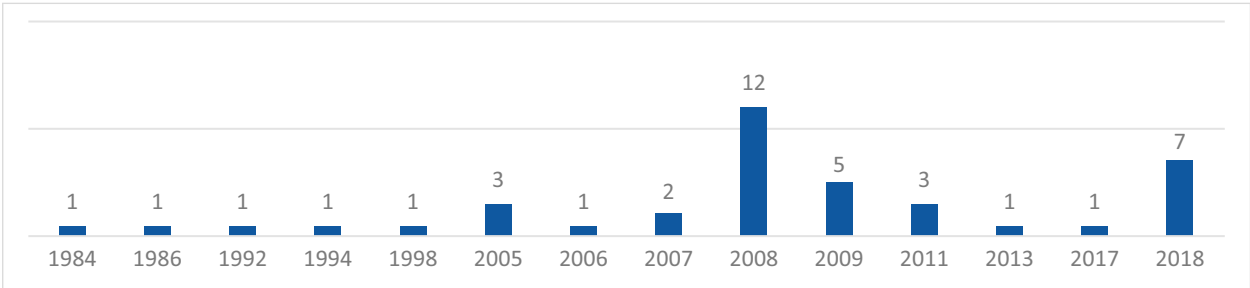
In addition to the evaluation of other management measures, Decree No. 8.424/15 requires the competent authority to periodically assess the effectiveness of the *Defesos*: if the effort for the preservation of fishery resources is proven ineffective, the associated normative acts should be revoked or suspended, including in the case of droughts, and contamination by chemical, physical and biological agents (Art. 1 § 11). This provision clearly aims to enhance the efficacy of the measure through the periodic evaluation of its outcomes.

The norms, criteria, standards and measures related to the *Defeso* periods shall (Art.1 § 10):

- I. define the species that are the object of conservation, the protection measures for the reproduction and the recruitment of species, the prohibited fishing gear and methods;
- II. establish the geographic scope of the *Defeso* to indicate the hydrographic basins, regions or coastal-marine areas and identify the municipalities concerned;
- III. define whether there are available fishery alternatives and whether they cover all fishers, or only those who operate on board vessels; and
- IV. establish mechanisms to monitor biodiversity and fisheries and to evaluate the effectiveness of the *Defeso* as a management measure.

Figure A1.3 represents the year in which the *Defeso* measures currently in place were enacted, according to the information provided by MAPA's dedicated webpage.

Figure A1.3 Year of enactment of the *Defeso* measures currently in place



Source: Authors' elaboration based on MAPA (2022).

Of the 40 *Defeso* measures currently in place, only eight were enacted in 2017 or later. Hence, the remaining 32 normative acts often fail to clearly indicate all the municipalities affected, as they could not logically take into account the requirement described above in item No. II, which was introduced in 2017. This fact significantly complicates the control of SDPA beneficiaries for the public authority.

Decree No. 10.080/2019 introduced a further relevant amendment to Decree No. 8.424/15. Exceptionally, in the event of serious contamination by chemical, physical and biological agents, it is possible for MAPA to extend the validity of the *Defeso* for the specific areas and groups affected (Art. 1, § 14). It is incumbent on MAPA to recognise the seriousness of the contamination through suitable acts (Art. 1, § 15).

These dispositions are connected to the oil spill that occurred in the Northeast region of Brazil in 2019. In this context, it is worth noting that MAPA effectively extended several *Defeso* periods, through Ordinance No. 52/19. In addition, the Emergency Financial Aid for professional artisanal fishers (registered in the RGP) who lived in the municipalities affected by the oil spill was introduced as a result of Provisional Measure no. 908/2019. The same act clarifies that the payment of this aid is also due, even if the beneficiary is entitled to another monetary amount paid by the Union in the same period, and its receipt will not prevent the cumulative receipt of financial benefits originating from other public policies (Art. 1, § 3).

To conclude the analysis of the regulatory framework of the *Defeso*, it is useful to recall that during its application, the capture, transport, marketing, processing and industrialization of the species contemplated by the measure are prohibited (Art. 6, § 2 of Law No. 11.959/09). Moreover, the non-observance of the *Defeso* falls within the scope of the application of Art. 33, which provides that practices and activities harmful to fishery resources and the environment will be punished in accordance with Law No. 9.605/98, and its regulation.

Finally, from an operational perspective, Inter-ministerial Ordinance No. 192/15 (hence, prior to the introduction of the requirement in 2017) suspended ten *Defesos*, with a view to reviewing them and allowing the re-registration of artisanal fishers in the RGP (Art. 2). However, Decree No. 293/15 re-established the validity of these suspended *Defesos*. Likewise, Inter-ministerial Ordinance No. 78/17 revoked four *Defesos*³² in 2017, concerning the States of Ceará, Paraíba, Rio Grande do Norte and Bahia. In parallel, a new *Defeso* exclusively related to native species allowed commercial fisheries to target exotic species. This has been interpreted as a fishery alternative (Art. 1 § 10, III Decree No. 8.424/15), whose existence, in accordance with Art. 1, § 12, precludes the SDPA. Yet, Decree No. 170/18 halted Ordinance No. 78/17 and re-established the validity of the four *Defesos* that had been revoked.

4.2 The SDPA

Prerequisites to lawfully exercise artisanal fishery activities. To lawfully exercise their professional activity, artisanal fishers must meet several requirements. As mentioned previously, Art. 24 of Law No. 11.959/09 requires any person, legal entity or vessel exercising fishery activities to be registered in the RGP and the CTF/APP. In addition, the law also demands a licence for professional fishers (Art. 25, IV) and permits and registration issued by the Maritime Authority and RGP for vessels engaged in commercial fishing, (Art. 26).

I – The CTF/APP in accordance with Law No. 6.938/81, is one of the instruments foreseen in Art. 9 to implement the National Environmental Policy. Art. 17, II institutes, under IBAMA's purview, the CTF/APP for mandatory registration of individuals or legal entities engaged in potentially polluting activities and/or the extraction, production, transport and sale

32. IBAMA Normative Instruction No. 03, of 21 February 2005; Ordinance No. 4, of 28 January 2008, IBAMA Normative Instruction No. 209 of 25 November 2008; and IBAMA Normative Instruction No. 210 of 25 November 2008.

of products potentially dangerous to the environment, as well as products and by-products of fauna and flora.³³ IBAMA Ordinance No. 6/13 (as amended) lists the potentially polluting activities and use of environmental resources in Appendix I. This list includes in the category “use of natural resources” the exploitation of living aquatic resources (Code 20-6) and explicitly requires the registration in the CTF/APP both for individuals (including artisanal fishers) and legal entities.

Registration is carried out by the individual or legal entity through the form available on IBAMA's website (Art. 13). Registration will necessarily contain: data on the enrolled person and the declarant (person responsible for filling in the CTF/APP forms), the potentially polluting activities developed, the date on which the activities began, the geographical coordinates and declaration of size (in the case of a legal entity), the environmental licenses of the activities carried out (when required), the reason for the individual's enrolment in the CTF/APP and finally the acceptance of a declaration of awareness and responsibility. The Proof of CTF Registration certifies the status of the person enrolled in the CTF/APP, while the Compliance Certificate, valid for three months, certifies the person's compliance with the obligations linked to the registration.

Finally, if the obligation to register in the CTF/APP is not fulfilled, Law No. 6.938/81 provides for the application of a fine, ranging between BRL 50 and BRL 9,000, depending on the size of the enterprise (Art. 17-I).

II – The RGP, established by Decree No. 221/67 and ratified by Law No. 11.959/09, currently managed by MAPA's SAP, contributes to the sustainable management of fisheries through the accreditation and subsequent legalization of individuals, legal entities and vessels, allowing them to lawfully carry out fishery activities.

Law No. 11.959/09 establishes that the registration in the RGP is a precondition for obtaining a concession, permission, authorization and licence in matters related to the exercise of fishery activities (§ 2, Art. 26) and remits to a further regulation the establishment of criteria for RGP operationalization (Art. 24, sole paragraph).

Decree No. 8.425/15 (as amended) serves as the implementing regulation for Art. 24 and 25 of Law No. 11.959/09. Art. 1, § 2 reinforces the provisions of the law by stipulating that fishery activities can only be undertaken by individuals, legal entities and fishing vessels registered in the RGP, holding an authorization, permission or licence for the exercise of these activities.

The Decree establishes a specific “artisanal fisher” category for registration in the RGP (Art. 2, I) and a specific licence (Art. 5, III, let a). In addition, if the artisanal fisher operates on a (small) vessel, the corresponding authorization is required (Art. 5, II, let. a).

Art. 3 entails the general obligation for individuals, legal entities and vessel owners (and those responsible for the vessel) to apply for registration in the RGP in one of the categories provided for in Art. 2 and the granting of authorization, permission or licence to exercise fishing activities.³⁴

33. The same law institutes the Environmental Control and Inspection Fee (*Taxa de Controle e Fiscalização Ambiental*, TCFA) [Art. 17-B], to be paid by those who undertake activities listed in Appendix [Art. 17-C], including the exploitation of living aquatic resources [category: “use of natural resources”, code 20]. However, as can be inferred from Appendix IX, which defines the *quantum* of the contribution, the fee is only due by legal entities, hence excluding artisanal fishers.

34. Correspondingly, Art. 4 sets an exception to the above-mentioned rule for:

I – subsistence fishers practicing fisheries for domestic consumption or barter for non-profit purposes and who use items provided for in specific legislation;

II – amateur fishers using a hand line or simple rod;

III – Indigenous Peoples (*índias* and *índios*) practicing subsistence fishing.

The application for enrolment in the RGP and the licence for artisanal fishers will be sent to the Federal Superintendence of Agriculture, Livestock and Supply of the federation unit closest to the place of residence of the individual (Art.4). To obtain the licence, the interested party must include in the application for registration in the RGP (Art. 6):

- I. a completed form;
- II. documents defined in an act of the Ministry of Fishing and Aquaculture (MPA); and
- III. proof of payment of the fee provided for in Decree-Law No. 221/67.

MPA Normative Instruction No. 6/12 establishes administrative procedures for the registration of individuals in the RGP in the category of “professional fisher”. The act includes the following documentation for artisanal fishers, to be filed, along with the application to register in the RGP and obtain the licence (Art. 4, I):

- a) application form duly completed and signed by the interested party;
- b) copy of official photo identification document;
- c) copy of proof of registration in the Individual Taxpayer Registry (CPF);
- d) copy of proof of residence or equivalent;
- e) standard photo (3x4cm); and
- f) copy of proof of enrolment in the PIS or PASEP, or worker registration number (NIT), or Social Identification Number (NIS).

After the delivery of the documentation by the interested party, the evaluation and eventual approval of the request will be the responsibility of the Federal Superintendence of Agriculture based on the control, analysis and evaluation of the documentation (Art. 6). The registration of the interested party in the RGP, for the purposes of issuing the Professional Fishers’ License, is carried out through the insertion of the interested party’s data in the General Fishing Activity Registry System (SisRGP) which generates a unique number (Art. 7). In accordance with Art. 7 of Decree No. 8.425/15, if the application for enrolment in the RGP and the authorization, permission or licence are granted, the interested party will receive a registration certificate referring to the authorization, license or permit for fishing activities (*carteira de pescador profissional*). The supporting documents for enrolment in the RGP and for obtaining an authorization, permission or licence to exercise fishing activities will be valid (Art. 8):

- I. for up to two years for permission, counted from the issuance date;
- II. five years for authorization, counted from the issuance date; and
- III. according to each licence category, provided that compliance with obligations and the exercise of fishery activities is proven within the period defined in an act of the MPA.

In this respect, MPA Normative Instruction No. 6/12 provides that for the maintenance of the license for professional fishers, the interested party must present within the period of up to 60 days, counting from the date of their birthday, the following documents, in the case of a Professional Artisanal Fisher (Art. 9, I):

- a) report of exercise of fishery activities in the category of professional artisanal fisher;
- b) copy of the NIT (registered as *segurado especial*), and;
- c) a recent photo (3x4cm) in sharp and clear focus.

The report must be homologated by the fisher's affiliation class entity, or, in the case of non-affiliation, by two duly registered fishers (Art. 9, § 1). One of the cases of suspension of the RGP is the non-observance of the dispositions contained in Art. 9 I and II (Art. 16), including the non-delivery of the report. Likewise, the RGP registry and license must be cancelled when the fisher is proved not to be engaged in commercial fishing (Art. 17, II).

Additional RGP features were introduced to improve SDPA targeting as a result of Decree No. 8.967/17, which amended, among other acts, Decree No. 8.425/15. In accordance with Art. 4 § 1 to § 4, the RGP must:

- I. identify whether the professional artisanal fisher has another source of income, different from the one resulting from fishery activities, regardless of its origin and value;
- II. inform the artisanal fisher category for small vessels and the industrial fisher category for vessels classified as small, medium or large;
- III. contain information that individually identifies, for each of the small vessels, the artisanal professional fisher exercising fishing activities; and
- IV. verify the fulfilment of the eligibility criteria and the permanence of artisanal professional fishers in the Unemployment Insurance Programme. This verification may be carried out at any time, by cross-referencing information contained in the RGP with official administrative records.

Finally, various events inherent to RGP operation are highlighted in Box A3, reported in a chronological order. The information in the box focuses exclusively on the national level and is non-exhaustive.

III – There are further requirements to be fulfilled if the artisanal fisher operates on a vessel. The first is MPA/MMA Normative Instruction No. 10/11 (as amended), which regulates, among other elements, the permit system requiring the Prior Fishing Permit (*Permissão Prévia de Pesca*, PPP) for vessel construction and acquisition and for any vessel without a record. The request for PPP must be filed before the Federal Superintendence where the fisher resides. The necessary documentation to be filed is listed in SEAP Normative Instruction No. 3/04 (as amended). Interlinked with the PPP is the Fishing Permit (*Autorização de Pesca*), defined as a discretionary administrative act, conditioned to the public interest, by which the owner or lessee, PPP holder is allowed to operate with a duly identified vessel for fishery activities directed at certain target species as defined in a specific type of permission (MPA/MMA Normative Instruction No. 10/11, Art. 2, VII).

In accordance with Art. 17 of SEAP Normative Instruction No. 3/04, the fishing vessel registration is the administrative act that contains the elements inherent to the fishing permit granted to the vessel, as well as the data related to their ownership and property, in addition to their physical characteristics. If the fisheries vessel registration is granted, then the certificate of registration and authorization of fishing vessel can be issued (Art. 24).

Box A1.3 General Registry of Fishing Activities functionality

- Normative Instruction SEAP/PR No. 6/05 (as amended) determined the compulsory re-registration of professional fishers in the RGP (Art. 1). Failure to apply entailed the automatic cancellation of the fisher's registration (Art. 7).
- Normative Instruction MPA No. 13/12 (as amended) determined that data should be updated and licences should be substituted for all registered professional fishers in the RGP, to allow users to access the SisRGP. The act provided for the automatic cancellation of suspended records resulting from the non-regularization of the registration (Art. 3).
- Ordinance MPA/SEMOC No. 57/14, suspended, as a result of MPA Normative Instruction no. 13/12, all licences for professional fishers registered in the RGP, with a January anniversary date, who did not carry out the procedure for updating and replacing licenses, according to established deadlines. Likewise, MPA/SEMOC Ordinance No. 58/14 cancelled all licenses for professional fishers registered in the RGP, who did not file an administrative appeal in the months of June, July, August and September 2013, in accordance with deadlines.
- MAPA/MMA Ordinance No. 192/15 determined the suspension of 10 *Defesos* and contextually provided for the re-registration of artisanal fishers during the suspension (Art. 2). In addition, MPA/SEMOC Ordinance No. 15/15, in connection with MPA Normative Instruction no. 13/12 and MPA/SEMOC Ordinance No. 57/14, cancelled the licenses of professional fishers registered in the RGP who did not file an administrative appeal under the procedure for updating and replacing licenses in January 2014 in accordance with the deadlines set.
- SAP/MAPA Ordinance No. 11/16 determined the suspension of 186,000 registries for artisanal fishers as a result of the non-delivery of the Report of Exercise of Fishery Activities. In addition, the TCU, through Decision No. 1.999/16, determined that MAPA should present to the Court, within 180 days of the acknowledgment of the decision, an action plan containing the measures to be adopted to meet the following recommendations within the RGP's management:
 - a) establish a procedure to verify and certify the updated status of *segurado especial* of artisanal professional fishers (item no. 9.1.1); a procedure that seeks to verify and attest the updated condition of professional fishers regarding the criteria for the exercise of the professional artisanal fisher activities (item no. 9.1.3); a procedure to verify the type of activity intended and carried out by artisanal fishers (item no. 9.1.5); internal controls for the registration and maintenance of the artisanal fishers' license (item no. 9.1.6); internal controls for the registration and maintenance of the artisanal fishers' license, allowing MAPA access to reliable information regarding the history of fish species, to demonstrate the locations where the activity of professional artisanal fishers was exercised, as well as which fish species were caught (item no. 9.1.7);
 - b) to verify the adherence to and sufficiency of the Professional Fishers' License application form, as a means of recording the situation of applicants (item no. 9.1.2); and
 - c) to update: the composition of the Artisanal Fishers' License application form (item no. 9.1.4.1), the RGP management systems (item no. 9.1.4.2) the RGP forms and management systems, as well as MPA Normative Instruction No. 6/12 (item no. 9.1.4.3); the management systems and systems related to the maintenance of the professional artisanal fishers' license (item no. 9.1.8).



- As a result of TCU's Decision No 1.999/16, SAP Ordinance No. 346/17 instituted the “pescador legal” (legal fisher) action plan and instituted the Reviewing Committee for the Registration of Professional Artisanal Fishers (CRCPA/MAPA), to coordinate the implementation of the new system for a general re-registration of fishers. Due to institutional change in the aftermath of the publication of the ordinance, there was a stoppage in the activities of the CRCPA/MAPA. In addition, the Federal Comptroller General (*Controladoria-Geral da União*, CGU) published the “Evaluation Report on the Execution of Government Programme no. 09/2016— General Registry of Fishery Activities.” In its conclusions, this report explicitly highlights the ineffectiveness of the registration of fishers due to the unreliability of registered information, the lack of inspection by the competent authority and the lack of penalties for presenting false information in the documentation for RGP registration (Ministério da Transparência, Fiscalização e Controladoria Geral da União 2017).

As reported by the CGU (2019), the SAP is not issuing registrations (*carteiras*) for professional artisanal fishers throughout the country and is only updating and regularizing registrations that were already in place, so as not to fill the SisRGP with records that cannot currently be audited by the Secretary. However, to allow fishers to lawfully undertake fishing activities during this period of transition and the elaboration of a new system for the management of RGP, SAP ordinances No. 2.546-SEI/17 (referring to year 2018) and No. 24/19 (referring to year 2019) were published. Both validate the initial registration request protocols for professional artisanal fisher licenses delivered as of 2014. Finally, SAP contracted the Social Security Technology and Information Company (Empresa de Tecnologia e Informações da Previdência, DATAPREV) in December 2018 for the necessary technical support to review, improve and update the current SisRGP, and develop a new system that will be used in the management of the RGP.

Source: Authors' elaboration.

Finally, the fishing vessel must also be registered and authorized by the Maritime Authority. In accordance with the Maritime Authority norms for vessels, all Brazilian vessels are subject to registration with the Port Authority (*Capitania dos Portos*, CP), police stations (DL) or agencies (AG), except those belonging to Brazil's Navy (NORMAM-01/DPC, Section I, Item 201). Brazil's Navy does not use the term “small vessel”, but rather “tiny vessel” (*embarcação miúda*), defined as any kind of vessel or floating device with: 1) a length of 5 m or less; or 2) a total length of less than 8 m and having the following characteristics: open deck, closed deck but lacking a habitable cabin and without fixed mechanical propulsion, and which, if using an outboard engine, it does not exceed 30 hp (NORMAM-01/DPC, Section I, Item 202, let. d). The vessels will be enrolled and/or registered by requisitioning the CP, DL or AG (registration bodies), in whose jurisdiction the owner/shipowner is domiciled or where they will operate. Tiny vessels are subject to a simplified registration procedure: after the requirements are fulfilled, the enrolment agency will issue the Tiny Vessel Registration Certificate (*Título de Inscrição de Embarcação Miúda*, TIEM), which is valid for five years.

Responsible institutions. The first institution involved in the implementation of the SDPA is once again the MAPA, and more specifically the SAP. In accordance with Decree No. 10.253/20, it is also competent for the organization and maintenance of the RGP (Art. 29, III).

As a result, Provisional Measure no. 665/2014, converted into Law No. 13.134/15, which amended, among others, Law No. 10.779/03 regulating the SDPA, the responsibility to receive and process applications and qualify beneficiaries is assigned to the National Social Security Institute (INSS) (Art. 2). Prior to the amendment, the law delegated this competence to the Ministry of Labour and Employment.

Figure A1.4 Procedure for obtaining the SDPA



Source: Authors' elaboration based on Ministério da Economia *et al.* (2019).

Decree No. 9.746/19 confirms the organizational structure of the INSS. It provides that the Minister of the Economy will issue internal regulations to detail the administrative units that are part of the INSS regulatory structure, their powers and the duties of their officers, within 60 days, counting from the date of entry into force of the Decree. However, this regulation is still lacking,³⁵ hence the Ministry of Social Development's Ordinance No. 414/17.

35. See for example Art. 7 of ME Ordinance No. 3.189/19 and the INSS institutional website (<https://www.inss.gov.br/>).

The act assigns several responsibilities³⁶ inherent to SDPA management (Art. 161) to the “Unemployment Insurance Management Service of Artisanal Fishers”; whereas the management of the initial recognition, recourse and review of rights to receive the SDPA is the purview of the Benefits Directorate (Art. 142).

Box A1.4 Institutional changes in social security

There has been institutional change within the realm of social security. In 2016, Law No. 13.266 terminated the Ministry of Social Security (MPS) and transformed the Ministry of Labour and Employment (MTE) into the Ministry of Labour and Social Security. Yet, in the same year, Law No. 13.341/16 reshaped the Ministry of Labour and Social Security as the Ministry of Labour: Art. 27, item V, included social security in the area of competence of the Ministry of Finance. Likewise, the law transferred the INSS to the Ministry of Social and Agricultural Development.

Further, in 2019 Provisional Measure No. 870, subsequently converted into Law No. 13.844/19, brought significant modifications to the institutional structure of social security. The first paragraph of Art. 57 transforms the Ministry of Finance, the Ministry of Planning, Development and Management, the Ministry of Industry, Foreign Trade and Services and the Ministry of Labour into the Ministry of Economy (ME), which absorbed all respective competences. In accordance with Decree No. 9.745/2019, which validates the ME’s organizational structure, a number of public bodies which have key roles in SDPA are included: the Special Secretariat for Social Security and Labour (SEPRET), CODEFAT and the INSS.

In this vein, Decree No. 9.745/19 assigns to the ME the competence for social security (Art. 1, X), whereas SEPRET is assigned the supervision of social security (Art. 71, II, let. a) and unemployment insurance (Art. 71, II, let. h). Art. 80, VII specifically assigns to the Secretariat for Public Labour Policies the responsibility to supervise and coordinate the actions related to the qualification, concession and payment of benefits of the Unemployment Insurance Programme, observing the competence of INSS regarding the qualification and concession of the SDPA.

In accordance with Art. 5 of Law No. 10.779/03, the SDPA is to be financed through the FAT. This provision is mirrored by Art. 8 of Decree No. 8.424/15, which also assigns to CODEFAT the management of SDPA payments, leaving operationalization to the (then) MTE (today SEPRET). As a result, SEPRET is now in charge of the Unemployment Insurance System, whereas the *Caixa Econômica Federal* (CAIXA) is responsible for carrying out the payment, as a result of a service contract between the two entities (Ministério da Economia et al. 2019).

SDPA regulation, beneficiaries. The “artisanal fisher” figure can be considered from various perspectives. First, artisanal fishers can be understood as belonging to traditional peoples and communities.

36. 1) Promote the integration with the National Registry of Social Information (CNIS), of the bases related to the verification of legal requirements for receiving the SDPA; 2) propose guidelines, guide, monitor and supervise the operational procedures for proving the activity of artisanal fishers and other requirements necessary to recognise the right to the SDPA; 3) act, in partnership with the Benefits Agreement Division, towards the standardization of procedures and formalization of technical cooperation agreements related to the SDPA requirements protocol; 4) promote the automation of SDPA processing, when there is sufficient information for the necessary characterization, according to the current legislation; 5) provide guidance regarding the procedures for receiving and analysing resources from the SDPA, in conjunction with the Resources Division; 6) propose mechanisms for remote application for the SDPA; 7) provide the SEPRET with information for the payment of the benefit; 8) define and guide the provision of information to beneficiaries regarding the payment of the benefit, through the available service channels; 9) provide guidance for employees on the procedures for compensation or collection of undue amounts received under the SDPA; 10) manage, together with the General Coordination for the Recognition of Rights, budgetary and financial resources for the operationalization of activities related to the SDPA; and 11) promote articulation with other external bodies to clear doubts or divergences in the analysis of the requirements, as well as share information necessary to prove the activity of artisanal fishers and recognise their right to the SDPA.

From a labour point of view, the artisanal fisher can be characterized as a rural, self-employed worker, exercising his/her professional activity autonomously with the eventual support of non-remunerated workers. Importantly, the status of “autonomous worker” makes it impossible for artisanal fishers to hire employees.

From a commercial perspective, the artisanal fisher owns the means of production or operates by means of a partnership contract: the organization of the means of production and the subsequent registration in the Public Registry of Mercantile Companies as an individual rural entrepreneur, or the establishment of any form of business-oriented society entails the loss of the status of autonomous worker and characterizes the exercise of industrial fishing activity.

From a social security point of view, the artisanal fisher can be contextualized as a *segurado obrigatório* of the RGPS within the *segurado especial* category. Artisanal fishers are defined by Law No. 8.212/91 (Art. 12, para. VII, let. b) and Law No. 8.213/91 (Art. 11, para. VII, let. b) as those who, individually or in a household system, although with the possible help of non-remunerated third parties, rely on fishing as a main profession or principal means of livelihood.

Within the context of fishery legislation, Law No. 11.959/09 does not provide a definition for artisanal fisher, but its implementing Decree No. 8.425/15 includes a definition among the categories for RGP registration. There, the artisanal fisher is defined as a:

“Brazilian or foreign individual, resident in the country, who carries out fishing activities for commercial purposes independently or in a household system, with their own means of production or by means of a partnership contract, operating on land or using a fishing vessel with gross tonnage of less than or equal to twenty” (Art. 2, I).

Law no. 10779/03, the SDPA regulatory framework, makes an explicit reference to the aforementioned articles of social security legislation (Law No. 8.212/91 and Law No. 8.213/91), which respectively frame the artisanal fisher—*segurado especial*—as a beneficiary of the RGPS and as an individual contributor to the RGPS.

Finally, both Law No. 10.779/03 and Decree No. 8.424/15 explicitly exclude the applicability of the SDPA to certain categories. First, the benefit will not be extended to fishing support activities or to family members of the professional fisher who fail to meet the requirements and conditions established by the legislation (Art. 1, § 6, Law No. 10.779/03). In addition, Decree No. 8.424/15 explicitly precludes the SDPA from the following categories of people who, in accordance with § 1 of Art. 3 of Decree No. 8.425/15 are also excluded from the obligation to register in the RGP (Art. 1, § 6):

- I. subsistence fishers who practice fishing for domestic consumption or barter for non-profit purposes, and who use items provided for in specific legislation;³⁷
- II. amateur fishers using a hand line or simple pole; and
- III. Indigenous People (*índias* and *índios*) who practice fishing for their subsistence.

Criteria to access the benefit. The analysis starts with the criteria established by Law No. 10.779/03 and the first norm to be considered is Art. 1. It provides that the “*artisanal fisher referred to in item “b” of item VII of art. 12 of Law No. 8.212/91, and item “b” of item VII of art. 11 of Law No. 8.213/91, as long as carrying out the professional activity uninterruptedly, in an artisanal way, individually or in a household system, will be entitled to the unemployment insurance benefit [...]”* The contents of the single elements that compose the provision are analysed in Table A4.

37. The law referred to in the norm has not yet been enacted.

Table A1.4 Criteria to access the benefit contained in Article 1, Law No. 10.779/03

Element	Content	Normative provision defining the concept
Artisanal fisher referred to in item “b” of item VII of art. 12 of Law No. 8.212/91, and item “b” of item VII of art. 11 of Law No. 8.213/91	The natural person, <i>segurado especial</i> , residing in a rural area or in urban or rural municipalities close to rural areas, in the condition of artisanal fisher, who relies on fishing as the regular profession or principal means of livelihood ³⁸	Art. 12, VII, let. b) Law No. 8.212/91 and Art. 11, VII, let. b) Law No. 8.213/91
Professional activity	The activity must be professional (i.e. for commercial purposes)	Art. 2, XXII and Art. 8, Law No. 11.959/09
Uninterruptedly	The activity performed during the period in between the previous and the current <i>Defeso</i> period, or in the 12 months immediately preceding the current <i>Defeso</i> , whichever is less.	Art. 1, § 3, Law No. 10.779/03
In an artisanal way	Fishing is considered artisanal when directly practiced by professional fishers autonomously or in a household system, with their own means of production or by means of a partnership contract, on land or on small vessels. For an analysis of the individual elements, please refer to Section 3.1	Art. 8, I, let. a) Law No. 11.959/09
Household system	The work of members of the same family, indispensable to their own subsistence and performed under conditions of mutual dependence and collaboration, without the use of employees	Art. 1, § 2 Decree No. 8.424/15

Source: Authors' elaboration based on Law No. 10.779/03.

Two further criteria for accessing the benefit can be found in Art. 1, § 4 and Art. 2, § 1 of Law No. 10.779/03.

The former provides that the artisanal fisher (*segurado especial*) who does not have another source of income other than the one resulting from fishery activities is exclusively entitled to the unemployment insurance. The latter entails that, in order to qualify for the benefit, the fisher may not enjoy any benefits resulting from a social security or assistance benefit of a continuous nature, except for death pensions and accident assistance.

Decree No. 8.424/15, which implements the SDPA legal framework, further integrates and specifies the criteria to access the SDPA of Law No. 10.779/03. In accordance with Art. 1, § 8, artisanal fishers are entitled to the SDPA who, during the acquisition period (as determined in Art. 1, § 3 Law No. 10.779/03 and mirrored by Art. 1, § 1 of Decree No. 8.424/15)³⁹ have received sickness/illness assistance, accident sickness assistance or maternity pay, exclusively under the category of *segurado especial*, or who contributed to social security under the exclusive exercise of that activity.

In addition, Art. 2 of Decree No. 8.424/15 sets the following criteria:

- Registration in the RGP, with an active registration status resulting from a license, issued by the MAPA, as a professional artisanal fisher, with due regard for the minimum registration period set in Article 2 of Law No. 10.779/03 (1 year) (Art. 2, I). Since the amendment by Decree No. 8.967/17, the RGP must identify whether the professional artisanal fisher has another source of income different from the one resulting from fishery activities, whatever its origin and value (Art. 4, § 1 Decree No. 8.425/15).
- Having the status of *segurado especial* only in the category of artisanal professional fisher (Art. 2, II). In accordance with social security legislation, anyone who simultaneously carries out more than one

38. Habitual profession or principal means of livelihood: the activity performed during the period in between the previous and the *Defeso* period currently in force, or in the 12 months immediately preceding the current *Defeso*, whichever is less (Art. 1, § 1, Law No. 10.779/03).

39. The activity performed during the period between the previous and the current *Defeso* period, or in the 12 months immediately preceding the current *Defeso*, whichever is smaller.

remunerated activity subject to the RGPS is necessarily registered under each one (Art. 12, VII, § 2 Law No. 8.212/91 and Art. 11, VII, § 2 Law No. 8.213/91).

- Having paid their social security contribution, under the terms of Law No. 8.212/91, in the 12 months immediately prior to the application for the benefit, or from the last *Defeso* until the application for the benefit, whichever is less (Art. 2, III).
- Not enjoying any benefits resulting from a federal income transfer programme with conditionalities or from a benefit of continued provision of social assistance or social security, except for accident assistance or death pensions (Art. 2, IV). This provision mirrors Art. 2, § 1 of Law No. 10.779/03. It should be noted that CODEFAT Resolution no. 657/2010 also includes imprisonment aid (Art. 2, V).
- Not having an employment relationship, or any other employment relationships, or any other source of income other than the one resulting from fishing activities prohibited by the *Defeso* (Art. 2 of Decree No. 8.424/15). This provision integrates Art. 1, § 4 of Law No. 10.779/03.

Further, if the criteria set in Art. 2 are met, the unemployment insurance benefit will be granted to artisanal professional fishers whose families are beneficiaries of an income transfer programme with conditionalities, and the federal public administration body or entity responsible for maintaining the programme will be responsible for suspending payment for the same period of perception of the SDPA (Art. 2, § 2). To fulfil this provision, the INSS will make information available to the federal public administration bodies or entities responsible for maintaining income transfer programmes with conditionalities to identify the beneficiaries and unemployment insurance benefits granted, including those related to the duration, suspension or termination of the benefit (Art. 2, § 3). In this context, the amendment of Decree No. 5.209/04—regulating the law which institutes the *Bolsa Família* programme—produced by Decree No. 8.424/15 should be highlighted: Art. 25, IX determines that the receipt of the SDPA results in the suspension of *Bolsa Família* financial benefits.

Finally, both the definition of the beneficiary and the criteria to access the benefit have been subject to several changes, which reduced or increased the number of SDPA beneficiaries. Box A5 lists the most relevant changes in the SDPA legal framework.

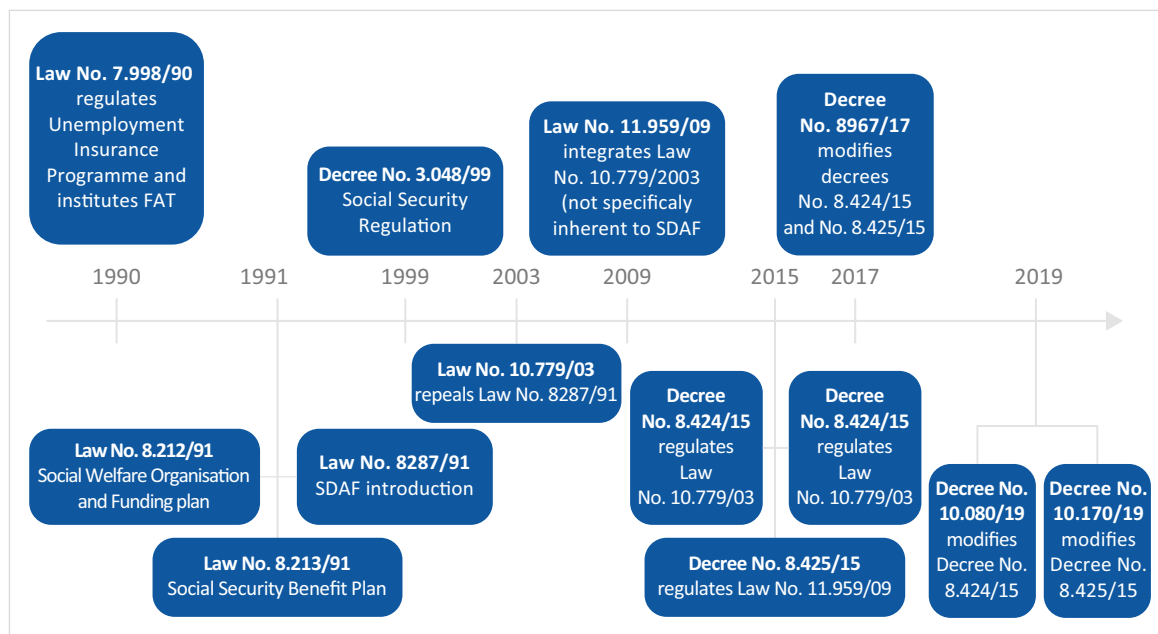
The benefit. In accordance with Art. 1 of Law No. 10.779/03, the unemployment insurance corresponds to the value of one minimum monthly wage during the *Defeso* period. The federal Constitution enshrines the national minimum monthly wage as a social right and provides for its periodic adjustment to maintain its purchasing power (Art. 7, IV). Likewise, the fundamental law sets as an objective of social welfare the irreducibility of the value of the benefits (Art. 194, sole paragraph, IV) and referring to social security, paragraph 4 of Art. 201 ensures the readjustment of the benefits to maintain their real value, in accordance with criteria defined by law. Against this background, it is important to note that with Provisional Measure No. 919/20, subsequently converted into Law No. 14.013/20, the value of the minimum monthly wage corresponds to BRL 1,039 for the month of January 2020 and, since 1 February 2020, to BRL 1,045.

As established by Art. 1, § 7 of Law No. 10.779/03 the SDPA benefit is personal and non-transferable. This fact implies that, in case the artisanal fisher operates within the context of a household system, the documentation of a member of the family group cannot be extended to the others. CODEFAT Resolution 657/2010, while confirming this principle, foresees several hypotheses (if certain conditions are met) in which the benefit will be paid to certain people, other than the beneficiary, in the event of the death of the insured, absence, contagious disease and incarceration of the beneficiary (Art. 8, as amended by CODEFAT Resolution No. 665/2011).

Box A1.5 Changes in the definition of beneficiary and criteria to access the benefit

Figure A1.5, focusing exclusively on acts at the statutory level, represents key amendments and changes to SDPA's legal framework.

Figure A1.5 Timeline representing the changes to SDPA's legal framework and related legislation



Source: Authors' elaboration.

The most relevant changes, which had the effect of increasing or reducing the number of beneficiaries, include:

In 2003, Law No. 10.779/03, the actual legal framework of the SDPA, repealed the previous one (Law No. 8.287/91) and contextually decreased the minimum RGP registration period from three years to just one. A further adjustment introduced by the 2003 law is the characterization of the artisanal fisher as a *segurado especial* in social security. Ministério da Economia *et al.* (2019) reports an increase in the number of SDPA beneficiaries, which grew from 114,000 to 186,000 between 2003 and 2004.

A second relevant change resulted from the introduction, in 2009, of Law No. 11.959/09 which, despite not directly modifying the SDPA's legal framework, broadened the concept of artisanal fisheries. Art. 4 specifies that artisanal fishery activities also include producing and repairing fishing gear, repairs carried out on small vessels and processing artisanal fishery products. As a result, the number of beneficiaries increased from 437,400 in 2009 to 637,100 in 2010 (Ministério da Economia *et al.* 2019).

CODEFAT Resolution No. 657/10 brought further changes. First, it determines that for purposes of granting the benefit, the (artisanal) fishery is intended as the capture, for commercial purposes, of the species protected by the *Defeso* (Art. 1, § 2). This specification restricts the number of beneficiaries, as ancillary activities such as the repair of fishing gear or post-capture processing, fall outside of the scope of the SDPA. On the other hand, the resolution increased the number of beneficiaries by requiring the proof of payment of only one instalment of social security as *segurado especial* in the year prior to the beginning of the *Defeso* period (instead of two instalments).



In 2014, Provisional Measure no. 665, which was subsequently converted into Law No. 13.134 the following year, substituted Art. 1 of Law No. 10.779/03. On the one hand, the new wording of the provision added the terms “exclusively” and “uninterruptedly”, referring to the activity undertaken by artisanal fishers, and on the other hand, it eliminated the phrasing “even with the occasional help of partners”. Moreover, the amendment of Art. 2 resulted in the requirement of registration as a professional artisanal fisher for at least three years in advance, counting from the date of application to the benefit. Finally, the measure determined that the benefit will not be extended to fishery support activities or to family members of professional fishers who do not meet the requirements and conditions established by the law. The number of beneficiaries decreased from 868,000 in 2014 to 736,000 in 2015 (Ministério da Economia et al. 2019).

In 2015, Law No. 13.134 also modified the beneficiary definition as well as the criteria to access the benefit. First, it brought the actual wording of Art. 1 of Law No. 10.779/03: in particular, it is worth highlighting that this law introduced a disposition which allows access to the benefit exclusively to those artisanal fishers who do not have another source of income other than the one resulting from fishery activities (Art. 1, § 4). Second, it reduced the minimum period for RGP registration to one year (Art. 2, § 2, II), therefore increasing the number of potential beneficiaries.

However, Decree No. 8.424 was enacted in 2015, which specified in relation to the beneficiary definition the notion of “household system” (Art. 1, § 2). Referring instead to the criteria for accessing the benefit, the Decree introduced the following requirements: to have the condition of *segurado especial* exclusively in the category of artisanal professional fisher (Art. 2, II); to have made the payment of the social security contribution, under the terms of Law No. 8.212/91, in the last 12 months preceding the application for the benefit or from the *Defeso* period until the application for the benefit, whichever is less (Art. 2, III); and not having an employment relationship, or any other employment relationships (in addition to no sources of income other than that resulting from fishery activities (Art. 2, V).

The number of SDPA beneficiaries decreased from 736,000 in 2015 to 558,000 in 2016. Also contributing to this significant decrease is the previously mentioned suspension of 10 *Defesos* as a result of MAPA–MMA’s Inter-ministerial Ordinance No. 192/15.

The last modification in the eligibility criteria was the result of Decree No. 8.967/17, which amended Decree No. 8.424/15. According to the Decree, the Executive Branch may condition the receipt of the SDPA to the proof of the *segurado’s* enrolment and attendance in initial and continuing training or professional qualification courses, with a minimum workload of 160 hours (Art. 6-A).

Source: Authors’ elaboration.

Further, Art. 1, § 5 of Law No. 10.779/03 explicitly prohibits the accumulation of the benefit resulting from *Defesos* related to different species. The law, by referring to Art. 4 of Law No. 7.998/90—regulating the Unemployment Insurance Programme and instituting the FAT—determines that the benefit will be granted for a maximum period ranging from three to five months for each acquisition period (Art. 1, § 8).⁴⁰ As a result of the amendment produced by Decree No. 8.967/17, Decree No. 8.424 precludes the granting of the benefit when, in the municipalities affected by the *Defeso*, fishing alternatives exist (Art. 1, § 12).

Benefit request and evaluation. Since 2014, as a result of Provisional Measure No. 665/14—subsequently converted into Law No. 13.134/15—the responsibility to receive, process and eventually validate benefit requests is assigned to the INSS (Art. 2 of Law No. 10.779/03). This competence was previously assigned to the Ministry of Labour and Employment. The new version of Art. 2 demands an implementing regulation, which is represented by Decree No. 8.424/15. From a temporal perspective, it is important to note that Decree No. 8.424/15 provides that the Act (and the rules established therein) is applied to *Defesos* beginning on or after 1 April 2015. For the *Defeso* periods

40. In the specific case of the SDPA, the maximum period is five months.

up to 31 March 2015, the provisions of the previous legislation apply, including the deadlines, procedures and resources, as well as the competence of the MTE for the activities of receiving and processing applications, enabling beneficiaries and investigating irregularities (Art. 12).

In the same year, Normative Instruction No. 79/PRES/INSS was published, establishing the internal administrative procedures to be adopted by the INSS. Eight months later (December 2015), Normative Instruction No. 83/PRES/INSS was published, which revoked Normative Instruction No. 79/15, but validated the acts carried out while it was active.

Art. 3 of Normative Instruction No. 83/PRES/INSS regulates the request of the benefit as follows. First, the application is preferably filed through remote channels, which may schedule the delivery of documents to a Social Security Service Unit (*Unidade de Atendimento da Previdência Social*). As already mentioned, the application for the SDPA must be made individually and the documentation submitted must refer to the applicants themselves; documents from other members of the family group cannot be used. The SDPA application may be processed at any Social Security Agency (*Agência da Previdência Social, APS*), regardless of the applicant's place of residence. The application period will start 30 days before the date of the start of the *Defeso* and will end on the last day of the *Defeso*. The sole paragraph of Art. 4 of Decree No. 8.424/15, based on the assumption that the benefit is indeed requested within this period, specifies that payment will be due from the beginning of the *Defeso* period, regardless of the date of the request.

It is also important to highlight that Art. 117 of Law No. 8.213/91 fundamentally allows, through an agreement with social security institutions, for trade unions to process benefit requests for their employees or associates and their dependents, preparing and instructing with a view to dispatching them to APS. The agreement referred to in the provision includes the Agreements for Technical Cooperation (*Acordos de Cooperação Técnica, ACT*). Therefore, if the artisanal fisher belongs to a representative entity which has an ACT with INSS, this entity can act on behalf of the fisher as an intermediary in the SDPA request. Conversely, if the artisanal fisher is not affiliated to any representative entity, or if this entity did not establish an ACT with the INSS, the person will have to physically present themselves to the APS to provide the requested documentation. This occurs in the event that the artisanal fisher is requesting the SDPA for the first time. Since 2019, the INSS concluded the automatic processing of SDPA requests. As reported by INSS (2019), all requests by fishers who had received the benefit in the last two years and whose registrations were regular in 2018 were completed without the person having to physically present themselves to an APS.

If the benefit is requested for the first time, Art. 6 of Normative Instruction No. 83/PRES/INSS foresees the presentation of the following documents:

- I. official identification document;
- II. CPF number;
- III. number of the active RGP, with a fishing license in the category of artisanal professional fisher;
- IV. a copy of the tax document for the sale of fish to the company acquiring, consuming or consigning the production, which contains, in addition to the registration of the operation carried out, the amount of

- V. the respective social security contribution referred to in § 7 of Art. 30 of Law No. 8.212/91, or proof of payment of the social security contribution, if its production has been sold to individuals, as per Art. 25 of the same law;⁴¹
- I. proof of residence in municipalities covered by the ordinance that declared the *Defeso* (or in the vicinity); and
- II. the following documents, for *Defesos* restricted to fishing on vessels:
 - a) vessel registration certificate, issued by MAPA, which contains the authorization to capture the species subject to the *Defeso*;
 - b) for engine-propelled vessels, copy of the vessel registration title registered with the Brazilian Navy;
 - c) registration booklet—CIR, issued by the Directorate of Ports and Coasts of the Brazilian Navy (DPC), which contains the holder's category as a professional fisher; and
 - d) the vessel's equipment list, issued by the DPC, containing the crew manifest.

Against this background, some observations are required. First, it should be recalled that Art. 2, § 4 of Law No. 10.779/03 provides that MAPA—the institution responsible for the management of the RGP—will develop activities that ensure access by the INSS to the registration information available in the RGP, which is necessary for granting the SDPA. This provision is further integrated by Art. 5, § 2 of Decree No. 8.424/15, which requires MAPA to relay to the INSS information which demonstrates the uninterrupted exercise of fishing activities, indicating the locations where they took place and the species captured, as well as the municipalities covered by the *Defeso* to which the fisher is linked. As reported by Ministério da Economia *et al.* (2019, 54) according to MAPA, this update is sent weekly and the following data are shared: personal data (name, date of birth, CPF, PIS/PASEP and RGP number), fishing activity (landed or on a vessel), location (lake, river, sea), the product (fish species) and employment/social security benefits, if any.

41. Further, § 4 of Art. 6 of Normative Instruction No. 83/PRES/INSS lays down a number of rules within the context of item IV referring to the presentation of the Social Security Slip [*Guia da Previdência Social*, GPS, a document used to collect social contributions] to prove the commercialization of fishing production to individuals. It should be noted that:

I – the payment is made on the registration of the INSS—CEI Specific Register;

II – the penultimate digit of the CEI registration in the GPS must be the number 8, relative to the CEI for rural contribution;

III – the payment must have been made with code 2704, corresponding to the payment regarding the sale of rural production;

IV – the payment collected must be contained in the period between the end of the previous *Defeso* and the application, or in the 12 months immediately preceding the application for the benefit, whichever is less;

V – in case the GPS presented refers to a *competência* [period] during the *Defeso*, while dealing with the commercialization of species collected before this period, a document from IBAMA or another environmental inspection body must be presented, attesting the authorized commercialization of the fish stock;

VI – in case the GPS presented refers to a *competência* during the *Defeso* period, but which does not correspond to the commercialization of authorized stock, the benefit will be paid only in case of error in the competence informed in the GPS, in which case the fisher must be guided, by a letter of exigency (*carta de exigências*), to request its correction before the Federal Revenue of Brazil [*Receita Federal do Brasil*, RFB];

VII – the aggregate payment of more than one *competência* is possible when they do not reach the minimum value established in the RFB Act. It is sufficient to present only one paid GPS to prove the period described in item IV of § 4 of the caput, without the need to discriminate between the different periods gathered in the GPS;

VIII – the presentation of the GPS is waived if payment is verified through information made available on a government database; and

IX – GPS will be accepted even if paid after the due date.

Finally, § 5 of the same Art. provides that when the sale is made to a legal entity, at least one tax document must be presented as proof.

From a different perspective it is also worth noting that the documents listed in items II to VI need not be produced if the information is included in government databases made available to the INSS by other bodies, under the terms of art. 2 of Decree No. 6.932/09 (Art. 6, § 2 of Normative Instruction No. 83/PRES/INSS). Likewise, in accordance with § 6 of Art. 5 Decree No. 8.424/15, in cases where the fisher has already received the SDPA benefit, the INSS may waive the need for them to resubmit the application for the next periods of the *Defeso* that elicited the benefit, provided that it has information demonstrating the upkeep of the requirements of Art. 2 and the characteristics of the fishing activities that were carried out.

In addition to all this documentation, the artisanal fisher, in accordance with Art. 5, § 1 of Decree No. 8.424/15 must sign a declaration stating that:

- they have no other source of income;
- they had continuously engaged in fishing of the species and in the locations affected by the *Defeso* during the period between the end of the previous *Defeso* and the beginning of the current one, or in the 12 months immediately preceding the beginning of the *Defeso*, whichever is less; and
- they assume civil and criminal liability for the information provided in order to grant the benefit.

Considering that the form through which the norm must be fulfilled is a mere declaration signed by the beneficiary, there is significant difficulty in verifying the accuracy and veracity of the information. In this respect, the National Treasury Secretariat points out (STN 2015) that there are few obstacles to proving requirements, mainly because eligibility is proven only through self-declaration, which can in turn cause serious distortions in the distribution of resources and in the policy's focus.

In accordance with § 6, Art. 6 of Normative Instruction No. 83/PRES/INSS, pending qualifications will be notified by the Task Manager System (*Gerenciador de Tarefas*, GET),⁴² and divided into three categories:

- I. Notification of correct information divergence: indicates the need to confirm ownership of the informed PIS number;
- II. Notification of adjustment of registration data: indicates pending issues that can be rectified by updating the registration by the INSS or other bodies; or
- III. Notice of appeal: indicates the rejection of the request. It is possible to verify the reason for rejection provided by the system.

Art. 7 provides that if documents essential to the analysis of the law are missing or if there is a need to rectify any information, the civil servant must issue a requirements letter, according to Appendix II of the same Normative Instruction, observing the term provided for in art. 678 of Normative Instruction No. 077/PRES/INSS, of 21 January 2015. If the right to the benefit is not recognised and there are no more possible requirements, the information regarding the rejection must be made available to the applicant (Art. 8).

42. This system allows for secure, efficient and quantifiable management of authenticated digital information, traceable across different actors. The system was effectively instituted as an INSS corporate system after the publication of Ordinance No. 91/PRES/INSS of 19 January 2017.

The payment stage. If no anomalies are found during verification⁴³ before the APS, the applicant is considered suitable and the process is sent to SEPRET for payment authorisation.⁴⁴ SEPRET is responsible for the operationalization of the payment, whereas CODEFAT is responsible for payment management (§ 1 Art. 8, Decree No. 8.424/15). In accordance with the subsequent paragraph of the same Art., INSS will provide SEPRET with the necessary information to make the payment effective.

CODEFAT Resolution No. 759/2016 (as amended), establishes several criteria for the payment of the benefit. Art. 1, § 1 integrates Art. 8 of Decree No. 8.424/15 by disposing that the benefit will be paid for with funds from the FAT, with payment carried out by SEPRET through CAIXA. According to the second paragraph, the payment of the first instalment will correspond to the first 30 days from the beginning of the *Defeso* and subsequent instalments after a 30-day interval. In addition, fishers will be entitled to full payment of subsequent instalments for each month, for a fraction equal to or greater than 15 days of the *Defeso* (Art.1, § 3).

Art. 2 of the resolution establishes that the payment of the benefit will be made through a transfer to the beneficiary's bank account. It is the responsibility of the worker to provide all data necessary for the payment. Payments made by CAIXA will be confirmed by means of authentication in the document itself or through electronic verification, filed at CAIXA, which shall be made available for a period of five years. Finally, instalments unduly credited by the paying agent will revert automatically to the Unemployment Insurance Programme.

Benefit termination. Art. 6 of Decree No. 8.424/2015 provides for the termination of the benefit in the following cases:

- start of paid activity or receipt of other income that is incompatible with the receipt of the benefit;
- non-observance of the *Defeso* or any prohibitions established therein;
- obtaining income from fishing of alternative species not contemplated in the act that establishes the *Defeso*;
- suspension of the *Defeso*;
- death of the beneficiary, except for instalments that are overdue;
- beginning of the receipt of income originating from social security or social assistance benefits of a continuous nature, except for accident assistance or death pensions;
- provision of a false declaration; or
- evidence of fraud.

Complaint mechanism. Art. 7 of Decree No. 8.424/15 establishes that in case of rejection of application for the benefit or termination of the benefit, professional artisanal fishers may appeal to the Social Security Appeals Council (*Conselho de Recursos da Previdência Social*, CRPS). The period for proposing the appeal and offering

43. From a practical perspective, as reported by Ministério da Economia *et al.* (2019), this process involves a case-by-case documental analysis and data cross-checking in the INSS database, which is cross-checked against the databases of the RGP, General Registry of Employed and Unemployed Persons (*Cadastro Geral de Empregados e Desempregados*, CAGED), Social Security Guide, National Civil Registry Information System (SIRC), National Registry of Social Information (CNIS) and Integrated Personnel Administration System (SIAPE).

44. As reported by Ministério da Economia *et al.* (2019), upon receipt of beneficiary files authorized by the INSS, a second round of data cross-checking is carried out in the SERPRET SD system to issue the payment (against the CNIS, RGP, CAGED, and SDPA databases) before each instalment. After this phase is complete, the payroll is generated and sent weekly to CAIXA.

counterarguments is 30 days, decurrent from the acknowledgment of the decision and the filing of the appeal, respectively (Art 7, § 1). The processing and judgment of appeals will follow the provisions of the Social Security Regulation (Decree No. 3.048/99) and of the CRPS internal regulations (Art 7, § 2). Finally, Art. 12 of Normative Instruction No. 83/PRES/INSS/15 specifies that, in cases of review requests, the provisions of the Social Security Regulation and Normative Instruction No. 83/PRES/INSS/15 shall apply.

Monitoring. The INSS also has monitoring responsibilities. In accordance with Art. 16 of Normative Instruction No. 83/PRES/INSS/15, the Operational Monitoring of Benefits (*Monitoramento Operacional de Benefícios*, MOB) will verify any signs of irregularities provided for in art. 10 (hypotheses of benefit termination, which mirrors the previously analysed Art. 6 of Decree No. 8424/15), and the benefit should be terminated, when applicable, after implementing the procedures provided for in the Manual for the Operational Monitoring of Benefits—Determination of Indications of Irregularities.

Sanctions. Law No. 10.779/03 foresees as sanctions, in case of false documentation, the resignation of the civil servant from their position and, for the fisher, a two-year suspension of fishing activities (Art 3), adding to the civil, administrative and criminal sanctions foreseen in other sets of law. Particularly relevant within this context are Law No. 9.605/98—providing for criminal and administrative sanctions resulting from conduct and activities harmful to the environment—and Decree No. 6.514/08, regulating administrative infractions and sanctions to the environment and establishing the federal administrative process for investigating them.

CONCLUSIONS

It is worth recalling several points which must be considered during the development of the impact evaluation analysis:

- The cross-cutting nature of the SDPA translates, from a legal and institutional perspective, into a complex intersection of different branches of law and public bodies involved in programme management and implementation. This complexity is compounded by the fact that the legal framework of the SDPA and associated legislation have been subject to numerous changes over time.
- Institutional changes in fisheries, coupled with the time needed for the receiving institution to adapt to newly designated competences, has hindered the continuity of actions and programmes by the body responsible for the sustainable management of fishery resources.
- The lack of effective participatory management has translated into low trust by fishing communities in public authorities and into the de-legitimization of legal instruments for the protection and preservation of fishery resources. A participatory approach is required by the Constitution and Law No. 11.959/09, as well as the characterization of artisanal fishers as traditional peoples and communities, resulting from the incorporation of ILO Convention No. 169/89 into the Brazilian domestic legal system.
- The normative acts establishing the various *Defeso* periods should be revised to implement the amendments introduced by Decree No. 8.967/2017.
- The non-collection of fishery data at the national level hinders the review of *Defeso*'s normative acts, as well as the adoption of other measures for the sustainable management of fishery resources. Fishery statistics serve, among other purposes, to instruct the adoption by the competent public authority of management measures that seek a balance between the maintenance of fish stocks and the socioeconomic outcomes of fishery activities.

- The RGP represents a crucial tool for fisheries, considering that it allows individuals, legal entities and vessels to lawfully exercise fishing activities. Therefore, the effective incorporation in the new RGP system of the points raised in the TCU Decision No. 1.999/16 is necessary to ensure the lawful exercise of fishery activities and to ensure the accuracy of the information provided, which would contribute to the SDPA's improved targeting.
- The considerable number of institutions involved in the SDPA, as well as the constantly shifting responsibilities regarding the implementation of the measure among public bodies has resulted in the enactment of a large volume of normative acts at the substatutory level, which regulate single aspects of the programme. Their interrelation, particularly regarding their temporal application, results in a substantial degree of legal complexity from the beneficiary's point of view. Furthermore, there are no coordination mechanisms through which the various responsible institutions could better harmonize their actions.
- The granting of the benefit hinges on (among other elements) a declaration by the artisanal fisher, stating the absence of other sources of income and the continuous engagement in fishing activities for the species and in the locations affected by the *Defeso*. The significant difficulty in verifying the accuracy and veracity of this self-declaration must be pointed out.

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APPENDIX 2: DOCUMENTS REQUIRED FOR THE *SEGURO-DEFESO*

- To acquire a license, the professional artisanal fisher will provide the SAP/MAPA:
 1. Identification documents and a completed application form stating the category of the professional fisher, type and size of the fishing vessel, type of fishery products, place of fishing, declaration of employment or other source of income, schooling and membership of the fisher's representative entity (colony, union, association, other), identification and localization of the representative entity.
 2. After the license has been granted, the fisher's data will be part of the RGP and the registration should be updated annually. At the time of the application for renewal, the fisher should present—along with the application form and identification documents—a report of the fishery activity in the period, with information on the gear used for fishing, the type of fishery, the volume of the catch, value of sales, etc., as well as receipts of sales and proof of contribution to social security if the fisher held a temporary license.
 3. The report should be validated by the fisher's representative entity or by two licensed fishers.
- To be qualified/eligible for the benefit, the fisher will have to provide the INSS with the following documents:
 1. Registration as a professional fisher, under the artisanal category, duly updated in the RGP, issued by the Secretariat of Fisheries and Aquaculture at least one year in advance, from the date of application of the benefit.
 2. Copy of the tax document of sale of the fish to the acquiring company, consumer or consignee of the production, which includes, in addition to the registration of the operation performed, the amount of the respective social security contribution referred to in § 7 of art. 30 of Law No. 8.212, of 24 July 1991, or proof of payment of the social security contribution, if it has marketed its production to individuals.
 3. Others established by act of the Ministry of Social Security proving: the exercise of the profession in the terms exposed above; that the fisher effectively undertook fishing activities during the period between the previous and the current Defeso, or in the 12 months immediately preceding the current Defeso; that the fisher does not have another source of income, other than the fishery.

Applications can be carried out through the fisher's representative entity that has an Agreement of Technical Cooperation (ACT) with the INSS, or by the fisher using the online platform.

APPENDIX 3: TABLE OF VARIABLES OF THE UNEMPLOYMENT INSURANCE MANAGEMENT DATABASE OF THE MINISTRY OF ECONOMY

Table A3.1 Variables of the BGSD database

Variables	Base	Description
cpf_requerente	BGSD/CADUNICO	CPF
CO_FAMILIAR_FAM	CADUNICO	<i>Código do domicílio</i> [Domicile code]
quantidade_segurados	BGSD	<i>Variável criada com base na quantidade de pessoas que receberam o seguro defeso por domicílio</i> [variable created based on the number of people who received insurance per household]
data_pagamento_parcela	BGSD	<i>Data de pagamento da parcela</i> [installment payment date]
n_parcela	BGSD	<i>Variável criada com base no número de parcelas recebidas em um ano</i> [variable created based on the number of installments received in a year]
inicio_1992	BGSD	<i>Variável criada para verificar quantos seguros foram iniciados em cada ano</i> [variable created to check how many insurances were started each year]
inicio_1993	BGSD	
inicio_1994	BGSD	
inicio_1995	BGSD	
inicio_1996	BGSD	
inicio_1997	BGSD	
inicio_1998	BGSD	
inicio_1999	BGSD	
inicio_2000	BGSD	
inicio_2001	BGSD	
inicio_2002	BGSD	
inicio_2003	BGSD	
inicio_2004	BGSD	
inicio_2005	BGSD	
inicio_2006	BGSD	
inicio_2007	BGSD	
inicio_2008	BGSD	
inicio_2009	BGSD	
inicio_2010	BGSD	
inicio_2011	BGSD	
inicio_2012	BGSD	
inicio_2013	BGSD	
inicio_2014	BGSD	
inicio_2015	BGSD	
inicio_2016	BGSD	
inicio_2017	BGSD	
inicio_2018	BGSD	
inicio_2019	BGSD	



Variables	Base	Description
final_1992	BGSD	
final_1993	BGSD	
final_1994	BGSD	
final_1995	BGSD	
final_1996	BGSD	
final_1997	BGSD	
final_1998	BGSD	
final_1999	BGSD	
final_2000	BGSD	
final_2001	BGSD	
final_2002	BGSD	
final_2003	BGSD	
final_2004	BGSD	
final_2005	BGSD	Variável criada para verificar quantos seguros foram finalizados em cada ano [variable created to verify how many insurance policies were completed each year]
final_2008	BGSD	
final_2011	BGSD	
final_2014	BGSD	
final_2017	BGSD	
final_2006	BGSD	
final_2009	BGSD	
final_2012	BGSD	
final_2015	BGSD	
final_2018	BGSD	
final_2007	BGSD	
final_2010	BGSD	
final_2013	BGSD	
final_2016	BGSD	
final_2019	BGSD	



Variables	Base	Description
ano_descricao_inicio_1992	BGSD	
ano_descricao_inicio_1993	BGSD	
ano_descricao_inicio_1994	BGSD	
ano_descricao_inicio_1995	BGSD	
ano_descricao_inicio_1998	BGSD	
ano_descricao_inicio_2001	BGSD	
ano_descricao_inicio_2004	BGSD	
ano_descricao_inicio_1997	BGSD	
ano_descricao_inicio_2000	BGSD	
ano_descricao_inicio_2003	BGSD	
ano_descricao_inicio_1996	BGSD	
ano_descricao_inicio_1999	BGSD	
ano_descricao_inicio_2002	BGSD	
ano_descricao_inicio_2005	BGSD	
ano_descricao_inicio_2008	BGSD	<i>Variável criada para verificar a localidade do seguro recebido em cada ano [variable created to verify the location of the insurance received each year]</i>
ano_descricao_inicio_2011	BGSD	
ano_descricao_inicio_2014	BGSD	
ano_descricao_inicio_2017	BGSD	
ano_descricao_inicio_2020	BGSD	
ano_descricao_inicio_2006	BGSD	
ano_descricao_inicio_2009	BGSD	
ano_descricao_inicio_2012	BGSD	
ano_descricao_inicio_2015	BGSD	
ano_descricao_inicio_2018	BGSD	
ano_descricao_inicio_2007	BGSD	
ano_descricao_inicio_2010	BGSD	
ano_descricao_inicio_2013	BGSD	
ano_descricao_inicio_2016	BGSD	
ano_descricao_inicio_2019	BGSD	



Variables	Base	Description
valor_parcela_inicio_1992	BGSD	
valor_parcela_inicio_1993	BGSD	
valor_parcela_inicio_1996	BGSD	
valor_parcela_inicio_1999	BGSD	
valor_parcela_inicio_2002	BGSD	
valor_parcela_inicio_2005	BGSD	
valor_parcela_inicio_2008	BGSD	
valor_parcela_inicio_2011	BGSD	
valor_parcela_inicio_2014	BGSD	
valor_parcela_inicio_2017	BGSD	
valor_parcela_inicio_2020	BGSD	
valor_parcela_inicio_1995	BGSD	
valor_parcela_inicio_1998	BGSD	
valor_parcela_inicio_2001	BGSD	
valor_parcela_inicio_2004	BGSD	<i>Variável criada para verificar o valor da parcela paga do seguro em cada ano</i> [variable created to check the amount of insurance paid in each year]
valor_parcela_inicio_2007	BGSD	
valor_parcela_inicio_2010	BGSD	
valor_parcela_inicio_2013	BGSD	
valor_parcela_inicio_2016	BGSD	
valor_parcela_inicio_2019	BGSD	
valor_parcela_inicio_1994	BGSD	
valor_parcela_inicio_1997	BGSD	
valor_parcela_inicio_2000	BGSD	
valor_parcela_inicio_2003	BGSD	
valor_parcela_inicio_2006	BGSD	
valor_parcela_inicio_2009	BGSD	
valor_parcela_inicio_2012	BGSD	
valor_parcela_inicio_2015	BGSD	
valor_parcela_inicio_2018	BGSD	
soma_valor_parcela_paga	BGSD	<i>Total recebido</i> [total received]
num_year_parc	BGSD	<i>Número de anos que a pessoa recebeu o seguro</i> [number of years the person has received insurance]
seguro_familia	BGSD	<i>Identificador se a pessoa é segurada ou requerente</i> [identifier if the person is a beneficiary or an applicant]
seguro_pessoa	BGSD	<i>Identificador se a família é segurada ou requerente</i> [identifier if the family is a beneficiary or an applicant]

Source: BGSD, 1991–2020.

APPENDIX 4: METHODOLOGY

A4.1) Theory

We estimated dose–response functions described in Hirano and Imbens (2004) in a flexible way to estimate the generalized propensity score because the treatment variable is not necessarily normally distributed. To do this, the estimation of a generalized linear model for the maximum likelihood estimator is the first step (Guardabascio and Ventura, 2014; Bia and Mattei, 2008).

First, a set of potential outcomes $\{Y_i(t)\}$ for $t \in T$ is defined, where T represents the continuous set of potential treatments defined over the interval $[t_0, t_1]$, and $Y_i(t)$ is referred to as the unit-level dose–response function. With a random sample of N units, for each unit i , a $k \times 1$ vector of pre-treatment covariates, X_i ; the level of the treatment delivered, T_i ; and the outcome corresponding to the level of the treatment received, $Y_i = Y_i(T_i)$, are observed. The interest is in the average dose–response function $\psi(t) = E\{Y_i(t)\}$.

The generalized propensity function is defined by Hirano and Imbens (2004) as the conditional density of the actual treatment given the observed covariates, under some regularity conditions of $\{Y_i(t)\}$, X_i and T_i : (i) for each i , $\{Y_i(t)\}$, X_i , and T_i are supposed to be defined on a common probability space; (ii) T_i is continuously distributed; and (iii) $Y_i = Y_i(T_i)$ is a well-defined random variable. Defining $r(t, x) = f_{T|X}(t|x)$ as the conditional density function of the treatment given the covariates, the GPS is

$$r(t, x) = f_{T|X}(t | x) \rightarrow \text{GPS} = R = r(t, x)$$

The GPS has a balancing property similar to that of the standard (binary) propensity score; that is, within strata with the same value of $r(t, x)$, the probability that $T = t$ does not depend on the value of X :

$$X \perp\!\!\!\perp (T = t) \mid r(t, x)$$

where $I(\cdot)$ is the indicator function. Hirano and Imbens (2004) show that, along with the unconfoundedness assumption, this balancing property implies that assignment to treatment is unconfounded, given the GPS. The theorem of weak unconfoundedness given the GPS implies that assignment to the treatment is weakly unconfounded, given pre-treatment variables X :

$$Y(t) \perp\!\!\!\perp T \mid X \text{ for all } t \in T$$

Then, for every t ,

$$f_T \{t \mid r(t, X), Y(t)\} = f_T \{t \mid r(t, X)\}$$

This means that the GPS can be used to eliminate any biases associated with differences in the covariates (Hirano and Imbens, 2004). If assignment to the treatment is weakly unconfounded, given pre-treatment variables X , then the dose–response function can be obtained as

$$\beta(t, r) = E \{Y(t) \mid r(t, X) = r\} = E (Y \mid T = t, R = r)$$

and

$$\mu(t) = E [\beta\{t, r(t, X)\}]$$

The dose–response function is defined as $\mu(t) = E\{Y(t)\}$, denoting the average response in the population (or sample) if all households were to receive $T = t$. By comparing $\mu(t_1)$ with $\mu(t_2)$, we can estimate the mean change in the outcome if all subjects were exposed with $T = t_2$ instead of $T = t_1$. A variety of methods have been proposed for using the GPS to estimate the dose–response function;⁴⁵ here we applied a combination of the covariate adjustment approach adding the GPS, $\{P_1, P_2, \dots, P_{k-1}\}$ into the final model as covariates with stratification on the GPS. When using the covariate adjustment method to estimate $E\{Y(t)\}$ and average treatment effects, a direct parametric implementation of the covariate adjustment using a generalized linear model that can be fitted for the outcome on the estimated GPS at each treatment level t , using linear and logistic regression models for continuous and dichotomous outcomes, respectively. In contrast to other GPS methods, covariate adjustment is relatively flexible in that we can adjust multiple GPS at the same time. The stratification on the GPS is a technique in which conditional expectation of the potential outcome is estimated based on quantiles of $\Pr(t, X)$. To evaluate the average potential outcome $E\{Y(k)\}$ at treatment level k , we first rank all subjects based on their estimated GPS at this treatment level. The subjects are then subclassified into strata based on GPS quantiles (e.g. quintiles), assuming that each subgroup is a homogeneous subpopulation. Within each subgroup, we estimate the average potential outcome by the mean outcome of the subjects who actually received treatment k in this subgroup. The overall value of the average potential outcome $E\{Y(k)\}$ is a weighted average of the within-strata estimates with the weight for each subgroup equalling the fraction of the sample within that subgroup. This procedure is repeated for each of the treatment levels to obtain all the values of $E\{Y(k)\}$, so that the pairwise average treatment effects can be estimated.

A4.2.) Implementation

The practical implementation of the GPS methods for dose–response models is accomplished in three steps (Bia and Mattei, 2008; Guardabascio and Ventura, 2014):

Step 1: treatment assignment model: estimation of the GPS, $\Pr(t, x)$: conditional distribution of the treatment given the covariates and test of the balancing property:

The steps to estimate the GPS and test the balancing property are:

- I. Estimation of the parameters of the conditional distribution of the treatment given the covariates by maximum likelihood and assessment of the validity of the assumed normal distribution model by a goodness-of-fit test. The distribution of T is specified from the exponential family through the family and link options. If the family selected is normal, assess the validity of the assumed normal distribution model by the Kolmogorov–Smirnov goodness-of-fit test for normality. If the normal distribution model is not statistically supported, the assumption of normality is not satisfied, and we need to use different family and link options or a different transformation of the treatment variable. Optimal propensity scores include confounding variables and variables that predict outcome, while variables that are purely predictors of treatment should not be included in the model (Brookhart *et al.*, 2006; Austin, 2007). The GPS is estimated as

$$\hat{R}_i = r(T, X) = c(T, \hat{\varphi}) \exp \left\{ \frac{T\hat{\theta} - a(\hat{\theta})}{\hat{\varphi}} \right\}$$

45. The methods of [A] covariate adjustment, [B] inverse probability of treatment weighting, [C] matching, and [D] subclassification [stratification] could be applied to our dataset to obtain the estimate of potential outcome, $E\{Y(t)\}$, the average treatment effects and dose–response effects.

If the distribution is normal, then

$$\hat{R}_i = \frac{1}{\sqrt{2\pi\sigma^2}} \exp \left[-\frac{1}{2\sigma^2} \{g(T_i) - h(\hat{\gamma}, X_i)\} \right]$$

where $\hat{\gamma}$ and σ^2 are the estimated parameters of the conditional distribution.

II. Test the balancing property of covariates, i.e. whether and to what extent the balancing property is supported by the data, following Hirano and Imbens (2004), according to the following scheme:

- a. Divide the set of potential treatment values, T , into K intervals, denoted by G_1, \dots, G_K , according to a specific rule, defined on the basis of the sample distribution of the treatment variable.
- b. Within each treatment interval, G_k , $k = 1, \dots, K$, the GPS is computed at a representative point (e.g. mean, median or another percentile) of the treatment variable, t_{G_k} , for each unit. $r(t_{G_k}, X_i)$ is the value of the GPS computed at $t_{G_k} \in G_k$ for unit i . We chose the quantiles of the treatment variable to divide the sample into groups. For instance, compute the median of the group, and evaluate the GPS for each individual in the sample by setting $t = \text{median of the group}$. This will generate a distribution of the GPS with N elements for each group.
- c. For each k , $k = 1, \dots, K$, block on the scores $r(t_{G_k}, X_i)$, using m intervals, defined by the quantiles of order j/m , $j = 1, \dots, m - 1$, of the GPS obtained in step b and evaluated at t_{G_k} , $r(t_{G_k}, X_i)$, $i = 1, \dots, N$. $B_1^{(k)}, \dots, B_m^{(k)}$ denote the m GPS intervals for the k th treatment interval, G_k .
- d. Within each block or interval $B_j^{(k)}$, $j = 1, \dots, m$, compare individuals who are treated—that is, who belong to group k (according to step a)—with individuals who are in the same block but belong to another group. Specifically, within each block, calculate the mean difference of each covariate between units belonging to treatment interval, G_k , $\{i: T_i \in G_k\}$, i.e. group k , and units that are in the same GPS interval, $\{i: r(t_{G_k}, X_i) \in B_j^{(k)}\}$, but belong to another treatment interval, $\{i: T_i \notin G_k\}$, i.e. units not belonging to group k .
- e. Combine the m differences in means, calculated in step d, by using a weighted average, with weights given by the number of observations in each GPS interval $B_j^{(k)}$, $j = 1, \dots, m$. Specifically, the following weighted average is calculated for each of the p covariates X_i , $i = 1, \dots, p$:

$$\frac{1}{N} \sum_{j=1}^m N_{B_j^{(k)}} \{ \overline{x_{i,j}}(G_k) - \overline{x_{i,j}}(G_k^c) \}$$

- f. where $N_{B_j^{(k)}}$ is the number of observations in the $B_j^{(k)}$ GPS interval; $\overline{x_{i,j}}(G_k)$ is the mean of the covariate X_i for units i , such that $r(t_{G_k}, X_i) \in B_j^{(k)}$ and $T_i \in G_k$; and $\overline{x_{i,j}}(G_k^c)$ is the mean of the covariate X_i for units i , such that $r(t_{G_k}, X_i) \in B_j^{(k)}$ and $T_i \notin G_k$. The test statistics to evaluate the balancing property are functions of this weighted average.
- g. Go to step b, set $k = 2$, and go through steps b–e. For each group G_k , $k = 1, \dots, K$, test statistics (the student's t statistics or the Bayes factors) are calculated. The most extreme value of the test statistics (the highest absolute value of the student's t statistics or the lowest value of the Bayes factors) is

compared with reference values, and the extent the balancing property is supported by the data is obtained. If adjustment for the GPS properly balances the covariates, all differences are statistically not significant.⁴⁶ In any case, failure to reject the null hypothesis of perfect balance does not imply balance and hence the diagnostics must be interpreted carefully. In fact, a small within subclass sample size may limit the ability to detect a lack of balance.⁴⁷

Step 2: estimation of the conditional expectation of the outcome as a function of two scalar variables, the treatment level T and the GPS R : $\beta(t, r) = E(Y | T = t, R = r)$.

Following Bia and Mattei (2008) and Guardabascio and Ventura (2014), we estimated the conditional expectation of the outcome, Y_i , given the treatment, T_i , and the GPS, R_i , as alternative flexible functions, defining the treatment levels and the maximum power of the treatment variables and of the estimated GPS in the polynomial function (linear, quadratic or cubic). The model for the conditional expectation of the outcome given the treatment and the GPS also can include the interaction between treatment and GPS. When using covariate adjustment using the GPS, we regressed the occurrence of the outcomes on the continuous treatment and the estimated GPS using regression models. When fitting the selected model, we considered the nature of the outcome variable (binary, categorical, or continuous) in a generalized linear model approach, by choosing the appropriate link function, e.g. an identity or logit link function (Bia *et al.*, 2014; Flores *et al.*, 2012).

Formalizing, the conditional expectation for the outcome Y_i , given T_i and R_i , can be a flexible function of its two arguments, using polynomial approximations of order not higher than three. Specifically, the most complex model considered to be tested is:

$$\phi\{E(Y_i|T_i, R_i)\} = \lambda(T_i, R_i; \alpha) = \alpha_0 + \alpha_1 T_i + \alpha_2 T_i^2 + \alpha_3 T_i^3 + \alpha_4 R_i + \alpha_5 R_i^2 + \alpha_6 R_i^3 + \alpha_7 T_i R_i$$

where $\phi(\cdot)$ is a log-normal function that relates the predictor, $\lambda(T_i, R_i; \alpha)$, to the conditional expectation $E(Y_i|T_i, R_i)$. The main effects of T_i and R_i cannot be removed so that we have 18 possible submodels, which are estimated by using the estimated GPS, \hat{R}_i . As Hirano and Imbens (2004) emphasize, there is no direct meaning to the estimated coefficients in the selected model, except that testing whether all coefficients involving the GPS are equal to zero can be interpreted as a test of whether the covariates introduce any bias.

Based on the fitted outcomes regression models, we estimated the probability of the occurrence of the outcome for a given subject if their exposure was set equal to $T = t$. By taking the mean of this quantity over the study sample, the dose–response function: $\mu(t) = E[Y_i(t)]$ is estimated, i.e. the dose–response functions were estimated by calculating the mean probability of the occurrence of the outcome across all levels of exposure.⁴⁸

46. For binary treatments, although the GPS is correctly calculated, the dose–response function reduces to a point rather than a curve (Becker and Ichino, 2002; Leuven and Sianesi, 2003). When the family is binomial, the balancing mechanism is slightly different: the GPS is independent of t because $r(t, x) = F(\beta'x)$. Therefore, going through step b, the algorithm will generate k times the same GPS vector. It means that step f becomes ineffective because the GPS does not change by changing the representative point of t .

47. To assess the extent of overlap in the supports of different levels of the treatment, Flores *et al.* (2012) divide these values into quintiles (and deciles), and for each quintile, they computed the value of the GPS for each individual at the median level of the treatment for the quintile and the value of the GPS at the same median level of the treatment for all individuals that are not part of the quintile in question. Thus, they compare the supports of the values of the GPS for these groups (individuals in the quintile in question and the rest) by superimposing their histograms. This exercise is repeated for each quintile in turn, resulting in plots for each of their samples.

48. Imbens (2000) and Robins, Mark and Newey (1992) showed that weights could be derived from the GPS, and these weights can then be used to estimate the dose–response function. When using GPS-based weights, we can use stabilized weights (Robins, Mark and Newey, 1992), in which the numerator is based on the marginal density of the continuous exposure variable. This density function can be determined by calculating the mean and the standard deviation of the quantitative exposure variable in the overall sample.

Step 3: estimation of the dose–response function, $\mu(t) = E[\beta\{t, r(t, X)\}]$, $t \in T$, by averaging the estimated conditional expectation, $\{\hat{t}, \hat{r}(t, X)\}$, over the GPS at each level of the treatment of interest.

Dose–response methods average the estimated regression function over the score function evaluated at the treatment levels. The propensity function was designed to estimate the average causal effect, averaging across all units. Specifically, in order to obtain an estimate of the entire dose–response function, we have to estimate the average potential outcome for each level of the treatment we are interested in, or, alternatively, the average potential outcome for each level of the treatment belonging to a set of evenly spaced values, t_0, t_1, \dots, t , that cover the range of the observed treatment, or the treatment effect function considering a #-treatment gap, which is defined as $\mu(t+\#) - \mu(t)$. If # is 0, only the dose–response function, $\mu(t)$, is estimated. We can then determine the dose–response function at a predetermined number of values of the continuous exposure variable, such as 9 deciles of the distribution of the continuous exposure, i.e. at these 9 exposure thresholds. Averaging the estimated regression function over the propensity score function evaluated at the desired level of the treatment is used to obtain an estimate of the entire dose–response function, that is, estimating the average potential outcome for each level of the treatments by applying the empirical counterpart of (1) and (2); that is,

$$E\{\widehat{Y}(t)\} = \frac{1}{N} \sum_{i=1}^N \hat{\beta}\{t, \hat{r}(t, X_i)\} = \frac{1}{N} \sum_{i=1}^N \varphi^{-1}[\hat{\lambda}\{t, \hat{r}(t, X_i); \hat{\alpha}\}]$$

where $\hat{\alpha}$ is the vector of the estimated parameters in the second step.

The role of the GPS in estimating the average potential outcome suggested by Imbens (2000) and applied by Moodie and Stephens (2012) and Hirano and Imbens (2004) is in line with the estimation of the dose–response effect within strata defined by the linear predictor of the treatment density function, and then combining these estimates to form a single weighted average. This approach is straightforward to implement and often provides an estimate of the dose–response relationship that has little or no residual bias, although it may be less efficient than the regression approach, according to Ertefaie and Stephens (2010).

Then it is necessary to estimate standard errors of the dose–response function, e.g. via bootstrapping. Hirano and Imbens (2004) state that asymptotic standard errors of the estimated dose–response function could be calculated by using expansions based on the estimating equations. Bia and Mattei (2008) use bootstrap methods to obtain standard errors and confidence intervals of the dose–response function; they point out that in each bootstrap iteration, the GPS can be re-estimated without testing either the normality assumption or the balancing property. Alternative methods such as kernel smoothing and spline regressions to estimating the dose–response function also can be used (Flores *et al.*, 2012; Bia and Mattei, 2008). In practice, we are interested in the relative dose–response function, which compares the average outcome under each treatment level with that under the control.

Finally, the estimated dose–response function and its confidence intervals are plotted, describing the relationship between average treatment and the probability of the outcome, that is, the treatment effects are estimated. When the outcome variable is categorical, it is done for each category i of the outcome variable.⁴⁹ Plots show both the estimated dose–response function and the estimated treatment effect function, which can be interpreted as a derivate, because we have specified a treatment gap equal to 1 ($\delta[1]$).

In the longitudinal setting, estimation of the causal effect of a time-dependent exposure in the presence of time-dependent covariates that are themselves affected by previous treatment also requires adjustment approaches. Stuart and Rubin (2007) argue that causal methods for estimating treatment effects from repeated measures data

49. Austin (2007, 2019) describes how the GPS can be used to estimate the effect of continuous exposures on binary outcomes (2017) and survival outcomes (2019), modifying the concept of the dose–response function.

are not readily implemented for continuous doses and extended a causal modelling approach to account for the within-household correlations of responses and doses, and the potential confounding of the cross-sectional effect of dose on response by previous doses. Ertefaie and Stephens (2010) use an extension of the GPS approach to the longitudinal setting. These authors also point out that the propensity score approach performs better than the inverse probability weighting in the presence of mediating variable, i.e. for an independent covariate X_i , there is a posttreatment intermediate variable M_i that may serve as a mediator for the treatment outcome and response Y_i . Moodie and Stephens (2012) also consider the correlation structure in the data, in the case of dose response estimation from repeated measures or multi-interval data, arguing that the potential patterns of time-varying confounding are more complex than can be dealt with using a univariate GPS approach and that non-compliance should be considered. In this sense, the GPS approach would be suitable for the analysis of repeated measures response data with interval-dependent dose assuming a sequential weak unconfoundedness. At each interval, assignment to dose D_{ij} is weakly unconfounded with the response during interval j given covariates, previous response, and dose values measured up to the start of the j th interval. Moodie and Stephens (2012) also show that if a history of covariates, response and previous doses are defined, current potential response Y_{ij} (d is conditionally independent of the distribution of dose received D_{ij}). So, this GPS approach is able to take into account the correlation between observations and can be modified to keep the balancing property in the context of repeated measures data.

A4.3.) Empirical literature

When analysing longitudinal data from the *Seguro-Defeso* payments database over 1992 to 2018 and the Single Registry of 2018, we assumed a repeated measure structure, with each participant providing repeated time-varying covariate data over a number of intermediate measurements, as well as a final, end-of-study measurement, and where the response is taken to be the vector of outcome measurements.

Regarding the nature of duration of the *Seguro-Defeso* treatment, it is important to consider how methods for the estimation of causal effects from continuous treatments can be used to learn about the consequences of heterogeneous lengths of enrolment in the evaluation of the *Seguro-Defeso* programme. Flores *et al.* (2012) estimate the effects of length of exposure to a training programme in the United States of America. Following this study, we applied a strategy to estimate average causal effects of different lengths of exposure using GPS under the assumption that the length of the household spell is random, conditional on a set of covariates. Using this approach, we explored differences across different spell lengths and across groups of participants, highlighting the type of insights that can be gained about the effects when their continuous nature is considered. Considering the different lengths of programme participation potentially provides more information regarding the effectiveness of the programme, enabling the capture of the heterogeneity in effects arising from different dosages of the treatment.

Kluve *et al.* (2007) and Flores *et al.* (2007) applied the GPS in the context of evaluating active labour market policy. As well as Kluve *et al.* (2007), we intended to assess the dynamics of treatment effects arising from variation in the duration of the benefits, using administrative data that feature the amount of treatment that varies continuously to estimate a continuous dose–response function, which relates each value of the dose to the household outcome probability (the response). Kluve *et al.* (2007) estimated a dose–response function after adjusting for covariate imbalance using the generalized propensity score for an evaluation of effects of training programmes with different durations on employment. They also consider that treatment effects may only materialize in the long run, and programme effectiveness can show a considerable dynamic ranging from often severe short-term locking-in effects to long-term gains.

Finally, it is important to note that the performance of GPS methods is addressed by several studies (Austin, 2007, 2019; Morgan and Winship, 2007; Stuart and Rubin, 2007; Bia and Mattei, 2008; Pizer, 2009; Stuart, 2010; Feng *et*

al., 2012; Liu, Nickleach and Lipscomb, 2013; McCaffrey *et al.*, 2013; Guardabascio and Ventura, 2014; Linden *et al.*, 2016; Yang *et al.*, 2016; Zhang *et al.*, 2016; Lopez and Gutman, 2017; Fong, Hazlett and Imai, 2018; Nian *et al.*, 2018; Brown, 2019; and Zhao, van Dyke and Imai, 2020).⁵⁰ Austin (2019) examined covariate adjustment using the GPS and weighting using weights based on the inverse of the GPS, analysing the use of ordinary least squares to estimate the propensity function and the use of the covariate balancing propensity score algorithm, for the estimation of dose–response function. All methods resulted in essentially unbiased estimation of the population dose–response function. According to the author, amongst the two GPS-based methods, covariate adjustment using the GPS tended to have the better performance, with lower variability and mean squared error when the magnitude of confounding was strong. GPS-based weighting tended to result in estimates that displayed greater variability and had higher mean squared error when the magnitude of confounding was strong.

Estimates of average multiple treatment effect on treated using inverse probability weighting

We also conducted an alternative estimation of the treatment effects using IPW, considering the intervals of years of entrance into the *Seguro-Defeso* programme, to take account of legislation changes. We split the data series over five categories of years of first payment (entry cohorts): 1997–2002, 2003–2008, 2009, 2010–2014, 2015–2018 and use the group of non-applicant beneficiaries as the reference group. In addition, we can interpret these breaks in periods as dose grades. IPW estimators use estimated probability weights to correct for the missing-data problem arising from the fact that each subject is observed in only one of the potential outcomes. Applying a flexible functional form of the model, i.e. multinomial, to predict treatment, we allowed multivalued treatment. Also, the outcome models are flexible: our outcome variables are continuous or binary. IPW estimators use a two-step approach to estimating treatment effects:⁵¹

Step 1) Estimation of the parameters of the treatment model (probabilities of participation in different treatment group) and of the inverse probability weights;

Step 2) Use of the estimated inverse probability weights to compute weighted averages of the outcomes for each treatment level. The contrasts of these weighted averages provide the estimates of the ATEs. Using this weighting scheme corrects for the missing potential outcomes.

These steps produce consistent estimates of the effect parameters, the potential outcome means (POM) and the average treatment effects on the treated (ATT), because the treatment is assumed to be independent of the potential outcomes after conditioning on the covariates. The overlap assumption ensures that predicted inverse probability weights do not get too large. Both steps are implemented at once so that we do not need to correct the standard errors in the second step to reflect the uncertainty associated with the predicted treatment probabilities.

The treatment effects are interpreted as the change in an outcome caused by a household getting one treatment instead of another (different entry cohorts). The counterfactual model, i.e. potential outcome approach, provides a solution to the missing data problem of observing each household getting only one treatment, and allow us to estimate the distribution of household-level treatment effects. A potential-outcome model specifies the potential outcomes that each household would obtain under each treatment level, the treatment assignment process, and the dependence

50. More recently, Wu *et al.* (2020) extends the approach of matching on GPS to the continuous exposures setting, arguing that GPS methods which rely on weighting or regression have limitations, in the sense that they require a correctly specified outcome model, they are sensitive to extreme values of the estimated GPS, and it is not straightforward to assess covariate balance when using these approaches. Specifically, the authors propose an approach for GPS caliper matching in a setting with continuous exposures, introducing an assumption of identifiability, the local weak unconfoundedness, under which their proposed matching estimators attain consistency and asymptotic normality. They also introduce measures of covariate balance under the matching framework and construct a continuous causal exposure–response curve for long-term exposure on outcomes. This can be an additional future alternative to identify effects of *Seguro-Defeso*.

51. For details of the IPW approach, see Heckman (1997); Heckman and Navarro-Lozano (2004); Imbens (2004); Cameron and Trivedi (2005); Imbens and Wooldridge (2009); Wooldridge (2010) and Gertler *et al.* (2016).

of the potential outcomes on the treatment assignment process. When the potential outcomes do not depend on the treatment levels, after conditioning on covariates, inverse probability-weighted estimators can be used.

The multivalued treatments refer to cases in which each subject could receive one of several different treatments or else not receive treatment at all. Here, the different treatments refer to different entry cohorts in the *Seguro-Defeso* programme, which proxy doses (older cohorts are likely to have stayed longer) or no dose (non-beneficiary applicants). We want to be able to compare a household in each period with one receiving no dose (non-beneficiary applicant). Once we can make those comparisons, we can then compare the groups in relation to each other. Multivalued treatments increase the number of parameters that must be estimated; aspects of the treatment effects estimation with multivalued treatments are discussed by Cattaneo (2010), Imbens (2000) and Wooldridge (2010).

The parameters of interest summarize the distribution of the unobservable individual-level treatment effect $y_t - y_0$. In defining the parameters, t denotes a random treatment, t_i denotes the treatment received by individual i , $t \in \{1, \dots, q\}$, and $t = 0$ is the control level. For the potential outcome that the household i would obtain to a given treatment-level t , y_{it} , and the potential outcome of a subject who did not receive any treatment, y_0 , in this case of multivalued treatments, the definition of the unobservable, individual-level treatment effects is $y_t - y_0$. The parameters of interest are the POM and the ATT. The average potential outcome for each treatment level, POM_t , is $E(y_t)$; and the ATT is the average effect among those subjects that receive treatment level t of giving each subject this level of treatment instead of treatment 0 ($E(y_t - y_0 | \text{for each } t)$). Defining the ATT in the multivalued treatment case requires at least three different treatment levels: the treatment level of the treated potential outcome, of the control potential outcome; and the restriction of the expectation to include only those individuals who actually received treatment level t .

The potential outcome model generates data in which y_i is the observed outcome variable, t_i is the treatment variable, x_i is a vector of covariates that affect the outcome, and w_i is a vector of covariates that affect the treatment assignment. The functional forms for y_t are $y_t = x_t' \beta_t + \varepsilon_t$, where β_t are coefficients to be estimated, and ε_t are exogenous error terms. This potential outcome model separates each potential outcome into a predictable component, $x\beta_t$, and an unobservable error term, ε_t . The model separates the potential outcomes and treatment assignment into observable and unobservable components, and the coefficient vectors are auxiliary parameters used to estimate the POM and the ATT. Y_t can be represented as linear functions or other functional forms. The conditional independence assumption restricts the dependence between the treatment model and the potential outcomes, the overlap assumption ensures that each individual could receive any treatment level and the independent and identically distributed sampling assumption ensures that the potential outcomes and the treatment status of each individual are unrelated to the potential outcomes and treatment statuses of all other individuals in the population.

As mentioned before, the conditional independency assumption (i.e. unconfoundedness or selection-on-observables) ensures that, after conditioning on covariates, when no unobservable variable affects both treatment assignment and the potential outcomes, the potential outcomes are conditionally independent of the treatment, i.e. there are no unmeasured confounders and the selection rests only on observables. If we observe enough covariates, the potential outcomes may indeed be conditionally independent of the treatment. Intuitively, the assumption says that only the covariates x affects both the treatment and the potential outcomes. Any other factors that affect the treatment must be independent of the potential outcomes, and any other factors that affect the potential outcomes must be independent of the treatment. This assumption allows us to estimate the effects by IPW methods; for our potential-outcome model, it can be viewed as a set of restrictions on the covariance matrix of the error terms. Unobserved shocks that affect whether a subject is treated do not have any effect on the potential outcomes, and unobserved shocks that affect a potential outcome do not affect treatment (Rosenbaum and Rubin, 1983; Heckman, 1997; Heckman and Navarro-Lozano, 2004; Cameron and Trivedi, 2005; Angrist and Pischke, 2009; Imbens and Wooldridge, 2009; Wooldridge, 2010; Becker and Caliendo, 2007; Nichols, 2007; StataCorp, 2019. In fact, this full assumption is stronger than what we need to estimate the ATT or the POMs; we only need a conditional mean independence assumption, which says that after accounting for the covariates x_t , the treatment does not affect the conditional mean of each potential outcome, allowing the conditional variance to depend on the treatment (Wooldridge, 2010; Cattaneo, Drukker and Holland, 2013).

The overlap assumption requires that each individual has a positive probability of receiving each treatment level. Formally, the overlap assumption requires that for each possible x in the population and each treatment level t , $0 < \Pr(t = t|x) < 1$. The combination of the CI and overlap assumptions constitutes the strong ignorability (Rosenbaum and Rubin, 1983; Abadie and Imbens, 2006; Imbens and Wooldridge, 2009).

The IPW estimators use weighted averages of the observed outcome variable to estimate means of the potential outcomes. The weights account for the missing data inherent in the potential outcome framework. Each weight is the inverse of the estimated probability that an individual receives a treatment level. IPW estimators model the probability of treatment without any assumptions about the functional form for the outcome model and have been used extensively in the treatment effect estimation literature (Imbens, 2000; Hirano, Imbens, and Ridder, 2003; Tan, 2010; Wooldridge, 2010).

APPENDIX 5: DATABASE LINKAGE BY INDIVIDUAL IDENTIFICATION—INDIVIDUAL TAXPAYER REGISTRY RESTRICTED TO 2016–2018

In order to double check the linkage, the list of unique CPFs that requested the *Seguro-Defeso* (approved or not in the BGSD application) was restricted to those beneficiaries who received the last benefit of *Seguro-Defeso* between 2016 and 2018 (this restricted database represent 40 per cent of the original database with all beneficiaries and non-beneficiary applicants). This restricted database was linked with the Single Registry (2018) as was done previously in the report.

Table A5.1 Database linkage and composition by sex—BGSD (2016–2018) and Single Registry (2018)

Sex group	In Single Registry	Out Single Registry	Total	% in Single Registry	Sex Composition (%)			
					In Single Registry (A)	Out Single Registry (B)	Dif C= (A–B)	BGSD Total
Women	295,982	7,680	303,662	97.5	61.2	33.5	27.6***	59.9
Men	188,010	15,233	203,243	92.5	38.8	66.5	-27.6***	40.1
Total	483,992	22,913	506,905	95.5	100	100	–	100

Note: The difference in the proportion by sex of beneficiaries in each database, merged with Single Registry and not merged, was statistically tested using a chi-square test (***p < 0.01; **p < 0.05; *p < 0.1).

Source: Authors' elaboration based on BGSD (2016 to 2018) and Single Registry.

Table A5.2 Database linkage and composition by age—BGSD (2016–2018) and Single Registry (2018)

Age group	In Single Registry	Out Single Registry	Total	% in Single Registry	Age Composition (%)			
					In Single Registry (A)	Out Single Registry (B)	Dif C= (A–B)	BGSD Total
18–24	13,180	3,424	16,604	79.4	2.7	14.9	-12.2***	3.3
25–29	51,759	4,072	55,831	92.7	10.7	17.8	-7.1***	11.0
30–39	163,889	5,422	169,311	96.8	33.9	23.7	10.2***	33.4
40–49	143,020	5,014	148,034	96.6	29.6	21.9	7.7***	29.2
50–64	108,487	4,794	113,281	95.8	22.4	20.9	1.5***	22.3
65+	3,657	187	3,844	95.1	0.8	0.8	-0.06***	0.8
Total	483,992	22,913	506,905	95.5	100	100	–	100

Note: The difference in the proportion by age group of beneficiaries in each database, merged with Single Registry and not merged, was statistically tested using a chi-square test (***p < 0.01; **p < 0.05; *p < 0.1).

Source: Authors' elaboration based on BGSD (2016 to 2018) and Single Registry.

Table A5.3 Database linkage and composition by educational level—BGSD (2016–2018) and Single Registry (2018)

Educational Group	In Single Registry	Out Single Registry	Total	% in Single Registry	Education composition (%)			
					In Single Registry (A)	Out Single Registry (B)	Dif C= [A–B]	BGSD Total
Illiterate	60,171	127	60,298	99.8	12.4	0.6	11.9***	15.7
Incomplete elementary	169,636	319	169,955	99.8	35.0	1.4	33.7***	36
Elementary	13,208	40	13,248	99.7	2.7	0.2	2.5***	2.8
Secondary	7,128	13	7,141	99.8	1.5	0.1	1.4***	1.5
College graduates	34	0	34	100.0	0.0	0.0	0.0	12.3
Missing	130,038	22,315	152,353	85.4	26.9	97.4	-70.5***	16.6
Response error	103,777	99	103,876	99.9	21.4	0.4	21.0***	15.7
Total	483,992	22,913	506,905	95.5	100	100	-	100

Note: Categories and values based on BGSD responses.

The difference in the proportion by educational group of beneficiaries in each database, merged with Single Registry and not merged, was statistically tested using a chi-square test (**p < 0.01; *p < 0.05; *p < 0.1).

Source: Authors' elaboration based on BGSD (2016 to 2018) and Single Registry.

APPENDIX 6: ADDITIONAL VARIABLES CONSTRUCTED FROM THE SINGLE REGISTRY AND TESTED AT MODELS' SPECIFICATIONS, BUT NOT USED AT FINAL MODELS

Table A6.1 Outcome variables

Presence of at least one adult with a labour income greater than 1 minimum wage	1=yes (presence); 0=no(absence)
Presence of at least one adult with a labour income greater than 2 minimum wages	1=yes (presence); 0=no(absence)
Is any adult of the household currently employed?	1 - yes, 0 - no adult of the household is employed, NA - does not apply
Polarization	1 = everyone works, 0 = someone works, -1 = nobody works
Work intensity	0 = no one works, 1 = up to 20% work, 2 = between 20 and 50%, 3 = more than 50% of working adult members
% of registered persons	With a Birth Certificate
Absence of child labour (up to 14 years)	1=yes (absence); 0=no(presence)
Absence of child labour (up to 16 years)	1=yes (absence); 0=no(presence)
Absence of child up to 6 years out of school	1=yes (absence); 0=no(presence)
Absence of child 7 to 14 years out of school	1=yes (absence); 0=no(presence)
Absence of child 7 to 17 years out of school	1=yes (absence); 0=no(presence)
Absence of child up to 14 years of age with more than 2 years of age-grade distortion	1=yes (absence); 0=no(presence)
Absence of illiterate children (10–14)	1=yes (absence); 0=no(presence)
Absence of illiterate youth (15–17)	1=yes (absence); 0=no(presence)
Share of children and youth not attending school (6–17)	
Share of age-grade distorted children and youth (8–17)	
More than half of working-age members work (in the year)	1=Yes, 0=No
Household type	1= permanent private; 2= improvised private; 3=collective
Permanent household	1=Yes, 0=No
Number of rooms	
Number of rooms as dormitories	
Density of residents per bedroom	
Adequate number of residents per bedroom	1=adequate (up to 2); 0 = inadequate (3 or +)
Floor material	1 – Terra; 2 – Cimento; 3 – Madeira aproveitada; 4 – Madeira aparelhada; 5 – Cerâmica, lajota ou pedra; 6 – Carpete; 7 – Other
Quality of floor material	2=high (4-7); 1=medium (2-3); 0=low (1)
Walls material	1 – Alvenaria/tijolo com revestimento; 2 – Alvenaria /tijolo sem revestimento; 3 – Madeira aparelhada; 4 – Taipa revestida; 5 – Taipa não revestida; 6 – Madeira aproveitada; 7 – Palha; 8 – Other
Quality of walls material	2=high (1); 1=medium (2); 0=low (3-8)
Type of water supply	1 – Rede geral de distribuição; 2 – Poço ou nascente; 3 – Cisterna; 4 – Other
Type of lighting	1=Elétrica com medidor próprio, 2=Elétrica com medidor comunitário, 3=Elétrica sem medidor; 4=Óleo, querosene ou gás, 5=Vela, 6=Other
Electric lighting	1=yes (1-3); 0 = no (4-6)
Type of pavement	1 = total, 2 = partial, 3 = none
Quality of pavement	2 = total, 1 = partial, 0 = none
Sewage disposal	1 – Rede coletora de esgoto ou pluvial; 2 – Fossa séptica; 3 – Fossa rudimentar; 4 – Vala a céu aberto; 5 – Direto para um rio, lago ou mar; 6 – Other
Quality of sewage disposal	2 – Public sewage system network; 1 – Septic tank; 0 – other
Trash destination	1=yes (1-2); 0 = no (3-6)

Note: The variable of household type (permanent private household, improvised private household, collective household) was expected to be used, however it was not possible because the other variables refer only to permanent private households.

Source: Authors' elaboration based on BGSD and Single Registry.

Table A6.2 Covariates

Variable	Description
Municipality	
Local of residency	1=Capital, 2=Metropolitan Areas, 3=Others
State	
Indigenous family	1=Yes, 0=No
<i>Quilombola</i> family	1=Yes, 0=No
Traditional and specific groups	202 – Artisanal Fishers Families
Number of household members	
Migration status (place of birth—municipal)	1=migrant; 0 = native born
Years of schooling	0 to 15
Person's share of family labour income	
Breadwinner (relative—labour income)	1=Yes, 0=No
Breadwinner (absolute—labour income)	1=Yes, 0=No
Highest household level of education	
Absence of illiterate adult in the household	1=yes (absence); 0=no (presence)
Absence of functional illiterate adult in the household in the household	1=yes (absence); 0=no (presence)
Presence of at least 1 adult with concluded elementary school in the household	1=yes (presence); 0=no (absence)
Presence of at least 1 adult with concluded high school in the household	1=yes (presence); 0=no (absence)
Presence of at least 1 college graduate adult in the household	1=yes (presence); 0=no (absence)
Presence of at least 1 worker with medium or high qualification (high school)	1=yes (presence); 0=no (absence)
Per capita household income	
Poverty (below R\$170 line)	1=Yes, 0=No
Household total gross earnings 12 months	Sum of earnings of all household members
Household total amount received donation	Sum of amounts of donation received by all household members
Household total amount received retirement	Sum of amounts of retirement benefits received by all household members
Household total amount received unemployment insurance	Sum of amounts of unemployment insurance benefits received by all household members
Household total amount received alimony	Sum of amounts of alimony benefits received by all household members
Household total amount received other sources of income	Sum of amounts of other sources of income benefits received by all household members
Household total income 12 months	Sum of total annual income of all household members
Share of labour income in total household income	
Share of retirement income in total household income	
Share of unemployment insurance income in total household income	
Net family income of person's labour income	
Per capita net household income of person's work income	
Household capacity to generate income (from work)	Above 50% share of labour income in total household income
Is there a partner at the household?	1=Yes, 0=No
Is there a child/stepchild at the household?	1=Yes, 0=No
Are there other relatives at the household?	1=Yes, 0=No



Variable	Description
Are there other unrelated residents at the household?	1=Yes, 0=No
Is there a grandchild at the household?	1=Yes, 0=No
Are there parents or stepparents at the household?	1=Yes, 0=No
Household living arrangement	1= lone person, 2=nuclear, 3=extended, 4=composite
Multigenerational household (by kinship ties)	1=Yes, 0=No (there is a grandchild and/or a grandparent)
Number of children (up to 14 years old)	
Number of elderly (above 65 years old)	
Number of children/youth by age group: 0–3, 4–6, 7–10, 11–14, 15–17, 18–24, 25–29	
Total number of children/youth	
Total number of working age members (15–64)	
Household dependency ratio	Ratio: (children+elderly)/working age household members
Elderly household dependency ratio	
Share of working age members	
More than half of working-age members	1=Yes, 0=No
Is there a disabled person at the household?	1=Yes, 0=No
Type of <i>Defeso</i> based on the locality and/or species (dummy variables for each group of species, indicating if the individual fishes the respective species or not)	

Source: Authors' elaboration based on BGSD and Single Registry.



International Policy Centre for Inclusive Growth (IPC-IG)

SEPS 702/902, Centro Empresarial Brasília 50, Torre B — Asa Sul
70.390-025 Brasília/DF, Brazil +55 61 2105 5000

