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Title: Immediate impacts of COVID-19 crisis on agricultural and food systems in the Caribbean

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Abstract:

CONTEXT

In a region already plagued by food insecurity and challenges to the sustainability of the agricultural sector, the COVID-19 pandemic was a brutal shock in the Caribbean with immediate and significant socio-economic consequences.

OBJECTIVE

In this paper, we assessed what are the immediate impacts of the COVID-19 crisis on the agricultural and food systems of the Caribbean.

METHODS

To this end, we conducted online surveys among farmers, households and experts of the region. We assessed the nature, strength and reversibility of the impacts but also the factors of resilience in the face of the crisis.

RESULTS AND CONCLUSIONS

Our study shows that the COVID-19 crisis has had strong impacts on Caribbean farmers and has weakened agricultural systems. The main impacts identified were a drop in income, production losses due to difficulties in marketing through conventional channels, but also difficulties in managing the farming systems due to reduced access to inputs and labor. In order to cope, farmers have adapted to be more self-sufficient: reduction in the size of cultivated areas, search for short marketing channels, diversification of production and reorientation towards the needs of the local market, recourse to mutual aid between farmers. If these effects appear to be non-irreversible in an island like Guadeloupe, the situation is

29 different in other islands of the region where farmers have had to sell livestock, seek new off-
30 farm income and sometimes sell land to cope. In terms of impacts on food systems, the crisis
31 has led to strong constraints such as a reduction in food intake and diversity and increased
32 reliance on family and social mutual aid. Our study also shows that the crisis has had an
33 impact on consumer behavior and their perception of the importance of the agricultural sector:
34 reduction of food waste, return to fresh and local products, adaptation of the diet,
35 consumption of new products, and cultivation of food gardens. Finally, our study shows that
36 the crisis has had an effect of strengthening the links between farmers and the rest of the
37 population.

38 SIGNIFICANCE

39 Thus if the crisis has had seriously damaging consequences, it can also be the trigger and
40 catalyst for an agro-ecological transition and the development of a circular and territorialized
41 bio-economy to strengthen the resilience of Caribbean agricultural and food systems and
42 facilitate the achievement of sustainability and food security objectives.

43 **Keywords:** COVID-19; impacts; resilience; survey; farming system; Caribbean

1. Introduction

The COVID-19 pandemic caused a serious health crisis and generalized lockdowns throughout the World. It was a sudden and unprecedented shock in the Caribbean that had immediate and significant socio-economic consequences at the local and regional levels due to health impacts, containment measures, the halt of tourism and the slowing down of the flow of imported and exported goods. How has the crisis impacted the agricultural and food systems of the Caribbean? In this article, we present the results of a study aimed at answering this question through a survey of farmers, households and experts in the region. In addition to the immediate consequences, we sought to see what are the factors of resilience of these two sectors in the face of such a strong crisis. Before presenting in detail the survey methodology and the results obtained, we present in this introduction some scoping data on the structure of the agricultural and food systems and on the COVID-19 epidemic in the Caribbean region.

1.1 Agricultural and food systems in the Caribbean

The Antilles are a vast archipelago located around the Caribbean Sea (Greater and Lesser Antilles) and between the Gulf of Mexico and the Atlantic Ocean. The archipelago forms an arc more than 4000km long extending from the Gulf of Mexico to off the coast of Venezuela (Fig. 1). The region represents 235,830km² of land for 42 million inhabitants and includes sovereign states and dependencies. Table 1 presents demographic, social, agricultural and health variables for 21 countries in the region for which we were able to compile structural data. The Caribbean represents a heterogeneous region with large islands and very small islands where the weight of agriculture varies greatly, from practically none to very important. For the Greater Antilles, there are three neighboring countries (Cuba, Dominican Republic and Haiti) with about 11 million inhabitants and Jamaica, which is less populated (3 million). Within the Lesser Antilles, the population differences are very marked (from 30,000 to 1.4 million inhabitants). The median age (35 years) is slightly higher than that of the World (30 years) but it is significantly lower than that of Organisation for Economic Co-operation and Development (OECD) countries (e.g. 43 years for Europe). The Human Development Index (HDI; UNDP, 2019) is equivalent to that of the world as a whole (0.728). On average, the HDI is very similar between the Lesser and Greater Antilles, but there is a very high variability among the islands of the Lesser Antilles.

< insert Table 1 >

76

77 The latter are territories whose economic development is constrained due to their isolation and
78 small size. These geographical characteristics are presented in the literature as structural
79 handicaps that underpin the vulnerability of small island economies (Angeon and Bates,
80 2015). For example, in the French West Indies, the unemployment rate is high (20% on
81 average compared to 9% in metropolitan France), gross domestic product (GDP) per capita is
82 lower than the European average and prices of products and services are on average 30%
83 higher. Socio-economic inequalities are also greater.

84 < insert Figure 1 >

85

86 For the Greater Antilles the share of the territory in agriculture is high (more than half) while
87 it is very variable in the Lesser Antilles, from 1% to 46%. There are islands without
88 agriculture, which are economically oriented towards tourism and finance, while for some
89 other islands agriculture has an important economic weight. The agricultural sector is highly
90 specialized in export crops (sugar cane, banana, coffee and cocoa) and the local supply of
91 products for the domestic market (especially fresh fruits and vegetables) is unable to cover
92 demand (Chopin et al., 2015). This situation leads to a strong dependence on external
93 supplies, especially from America and Europe. The French West Indies territories, for
94 example, have an overall coverage rate of their food needs of less than 25% (ODEADOM,
95 2018). Historically, agriculture has played a central role in the Caribbean economies. Large
96 plantations of especially sugar and bananas produced agricultural commodities for export
97 representing an important sector of the economy. Today, the Caribbean agriculture is more
98 diversified. Reforms of the EU agricultural policies had a dramatic effect on export demand
99 for sugar and bananas, and stimulated a restructuring of farming systems and a shift of exports
100 from raw materials (agricultural products) to processed food products. According to FAO
101 (2019), agriculture also makes up a smaller share of the economy. In several countries (e.g.
102 Cayman Islands) agriculture represents less than 1 percent of GDP. However in countries
103 such as Haiti, Dominica, Guyana, and Grenada agriculture is still an important sector in the
104 economy. It contributes between 7% and 17% of GDP, but has a significantly larger share of
105 employment (typically between 10 percent and 25 percent, and almost 50 percent in Haiti).
106 The Caribbean region faces major challenges to improve the competitiveness and
107 sustainability of the agriculture sector and its poverty-reducing capacity. An important factor

is the historical difficult structural adjustment of the region's agricultural sector after the end of the preferred EU market access for sugar and bananas. Growth in agricultural productivity has been slow and the sector suffers from high trade costs and a low capacity to comply with modern food safety and quality standards. Consequently, it has been unable to adequately respond to rapidly growing demand for high-standard agrifood products from the tourism, processing, and retailing sectors in and outside the region. Instead, the growing demand by these sectors in the region is mainly fulfilled by imports. The region's agricultural sector is also constrained by increasingly large pressures on natural resources and a high vulnerability to climate change (FAO, 2019).

Undernourishment is widespread in the Caribbean. While Haiti, with undernourishment levels as high as 77 percent, pulls up the average level, still in 10 other countries undernourishment levels concern more 20 percent of their population. Moreover, undernourishment has only slowly decreased over the past 20 years. A cause of even greater concern, while undernutrition indicators have only slowly declined over the past 20 years, other forms of malnutrition and its consequences are on the rise. Obesity has significantly increased since 2000 in all Caribbean countries. This suggests that the region is increasingly vulnerable by "the double burden of malnutrition", the combination of undernutrition and of poor diets leading to obesity (FAO, 2019). Thus, the Caribbean faces urgent public health problems with increasing rates of obesity and diet-related chronic diseases (Colombet et al., 2019a, 2019b; Sinha, 1995). Caribbean adults present a worrying health profile: approximately 24% are obese (9% for children), 11% are diabetic, 40% are hypertensive and 23% present a metabolic syndrome (Méjean et al., 2020). Diabetes and especially obesity are therefore more marked than in the world as a whole (8.5 and 13%). The inadequacy of diets to nutritional recommendations, particularly in the most disadvantaged populations, helps to explain these high prevalence (Méjean et al, 2020).

1.2 Health impact of the COVID-19 and associated measures the region

The data describing the COVID-19 pandemic in the Caribbean region were obtained from institutions that aggregate official data from different countries: Johns Hopkins University (USA) for the temporal evolution of cases (confirmed, deceased), and the University of Oxford (UK) for the policy measures taken by local authorities in response to the pandemic with the use of the Stringency Index (SI) that compiles several measures such as the level of

lockdown, or the interruption of commercial flights (Hale et al., 2020). To compare the health situation in different countries, in addition to the raw data, we have calculated different indices based on population size (COVID-19 cases per million inhabitants).

< insert Figure 2 >

< insert Table 2 >

Parts of the Caribbean have become hotspots of the COVID-19 pandemic, exacerbated by weak social protection, fragmented health systems and profound inequalities (United Nations, 2020). The pandemic was officially declared in March 2020 (between March 1 and March 25, depending on the country) and has since developed in a very heterogeneous manner, being weak to very marked depending on the country (Fig. 2). As of August 31, 2020, the average incidence of the disease in the Caribbean (number of confirmed cases per million people) was about 3100 and the average mortality rate (number of deaths attributed to COVID-19 per million people) was 41; these values are lower than the worldwide numbers, and this is very clear for mortality (average worldwide incidence and mortality values on the same date were 3267 and 109, respectively). Looking at the situation among caribbean countries (Tab. 2), a dichotomy is observed, with a group of five countries (Aruba, the Bahamas, Bermuda, Dominican Republic, Turk & Caicos Islands) differing from the others by both a higher incidence of the disease (above 5000) and a higher mortality rate (above 50). On average, there is more incidence in the Lesser Antilles than in the Greater Antilles (3200 vs 2700) but lower mortality (40 vs 48). The heterogeneity between countries can also be seen when looking at the temporal dynamics of the epidemic (Fig. 2a): for the four countries most affected on August 31, it is in fact explained by a delayed explosion of the epidemic, after June, which is particularly visible for Aruba and Turk & Caicos Islands.

The various governments have implemented a range of restrictive measures, with varying degrees of stringency depending on the evolution of both the domestic health situation (restrictions on population's movement) and that of other countries (suspension of commercial flights). Some countries have begun to take measures before the first domestic cases were reported, seen as a positive SI by March 1 for a majority of countries (Fig. 2b). The measures generally reached their strictest level in April, except for Cuba, where the level

was only raised to its maximum during the month of May. Then, from May onwards, each country followed a different trajectory: for some countries (e.g. Dominica, Bermuda, Barbados) there was a slight easing of restrictions, while for others (e.g. Trinidad & Tobago, Cuba, Jamaica) there was strengthening of the already high level of restrictions.

2. Methods

2.1 Sampling and on-line survey diffusion

In order to measure the immediate impacts of the COVID-19 pandemic on Caribbean food and agricultural systems, we conducted an online survey. We targeted three populations for each of which we developed a specific questionnaire: households, farmers and agricultural production and food experts. For consumers and farmers we conducted our surveys only in Guadeloupe using email databases available to our research team. It was indeed not possible for us to target with certainty and in a representative way the consumers and agricultural producers of the other Caribbean countries. Nevertheless, in order to have a measure of impact in the Caribbean, the survey was also distributed to a network of experts from the Caribbean Food Crops Society. We contacted a representative sample of 150 consumers in Guadeloupe and collected 38 usable responses. We were also able to contact by email a representative sample of 150 agricultural producers in Guadeloupe and collected 32 validated responses. For the experts we solicited a little more than 150 people from a dozen Caribbean countries and about 200 experts in Guadeloupe and obtained 62 exploitable responses (24 from Caribbean countries, 38 from Guadeloupe), from 10 different countries. All the persons solicited were contacted twice by e-mail. In the e-mail, we explained the framework and purpose of our research and provided the link to complete the online survey. It was specified that all responses to these questionnaires are anonymous. The questionnaires were administered using LimeSurvey, INRAE's survey platform. We translated the questionnaires into three languages, English, Spanish and French, and each person was directed to the questionnaire for their category (consumer, farmer or expert) and language.

2.2 Questionnaire design

2.2.1 Impacts for farmers and adaptation of their farming system

After 9 questions aimed at describing the farm (size, type of production, age of the farmer, etc.) and subsequently assessing the representativeness of the sample, the first section of the questionnaire included 10 direct yes/no questions (with a DK option: "don't know") on the consequences felt by the farmer during the crisis. A final question of this section asked farmers if their agricultural system has been resilient enough. A second section of 15 questions was designed to assess, using a semi-quantitative scale of four levels ranging from 0 (no consequences) to 3 (strong consequences), the strength of the immediate consequences of the crisis on the functioning and performance of the agricultural system but also on the adaptations that farmers had to implement. At the end of this section, two open-ended questions focused on possible other consequences and on the factors of resilience of the farming system under the circumstances of the crisis from the farmers' point of view. A third and final section asked five questions to producers about how they envisioned their immediate future at the end of the crisis. The aim was to see whether the impacts and adaptations implemented during this exceptional situation would be maintained over time.

2.2.2. Impacts on household nutrition and food habits

The "consumer" questionnaire asked the respondents about the families' diet during the health crisis. The purpose of the questionnaire was to assess the impact of the health crisis and associated measures on the modification of dietary practices, food purchases and their consequences. A first section of the questionnaire included seven direct yes/no questions (with a DK option: "don't know") on what the households had to modify in their feeding habits during the lockdown. A second section dealt with the intensity of food consequences of this crisis with 8 criteria to be evaluated according to a semi-quantitative scale of 4 levels ranging from 0 (no consequences) to 3 (strong consequences). In addition, there was an open-ended question to allow the respondents to indicate other possible consequences for the household.

2.2.3. The questionnaire for agricultural and food systems experts

The purpose of this questionnaire was to get a complementary view of impacts from particularly knowledgeable individuals who had the opportunity to get an overall view of the impacts, with the aim of reinforcing the impressions gathered from individual consumers and

farmers. It also allowed us to have a vision of the impacts in other Caribbean countries and to compare them with those in Guadeloupe. The questionnaire for the experts is a transposition of the questions asked to consumers and farmers but formulated in a more general way, at the scale of the country. After questions aimed at identifying the country and the field of activity of the experts, a first part of the questionnaire asked the experts their opinion on the agricultural producers of their country with 13 questions (yes/no/dk) on the consequences of the crisis for farmers. Then 11 semi-quantitative evaluation questions were asked on the intensity of the consequences for producers (with a scale from 0 to 3) plus an open question on other possible consequences and factors of resilience of farms. The second section included 12 evaluation questions on the strength of the overall consequences for the agricultural community plus an open-ended question on the resilience factors of agricultural systems to cope with the COVID-19 crisis. The third section aimed to identify the impacts of the crisis on households consumption and food habits. A final open-ended question aimed to get the experts' opinion on the resilience factors of their country's food systems.

3. Results

3.1 Impacts on farming systems

3.1.1 Perception at the local scale: the situation in Guadeloupe

The final sample is composed of farmers of which 60% manage at least 5 ha, 85% are between 40 and 60 years old, more than 50% are the majority owner of the farm and 80% are members of a professional agricultural organization (PAO). All of Guadeloupe's main crops (sugarcane, banana, market gardening, tubers, and livestock) are represented, and the structure of production systems is close to that of the diversity of the entire farming population (Chopin et al., 2015). Production is intended both for export (sugar cane in the form of sugar and rum, banana and melon in the form of fresh products) and for the local market (tubers, market gardening, livestock, arboriculture). Thirty-eight Guadeloupean experts responded, the majority of them claiming to be experts in agriculture and food systems. They work either in a professional agricultural organization with farmer members, or in a public institution dealing with agriculture and food, or in the field of research in these areas.

263

< insert Table 3 >

264

265 In Guadeloupe, 69% of farmers have experienced a reduction in the volume of their
266 production (Tab. 3). The other two main consequences were that a strong majority (about
267 63%) had to strengthen the share of short marketing channels in their sales mode. It should be
268 noted that more than a third of the producers lost part of the production they had to throw
269 away because they were unable to sell it. The partial closure of markets and restrictions on
270 movement are the direct cause. Approximately 41% decided to diversify production. All
271 productions have been affected but it is mainly market gardeners and food producers who
272 have been strongly affected. Difficulties of movement and availability of labor explain this.
273 Approximately 44% of farmers had to stop part of their production completely, and less than
274 10% had to stop all production during the crisis. None had to sell land and about 13% had to
275 sell livestock. Nevertheless, about 20% of the farmers had to take up a new off-farm activity
276 to compensate for the loss of income and only 44% stated that their system seemed
277 sufficiently resilient to absorb the shock of COVID-19.

278

279

< insert Table 4 >

280

281 When we asked farmers about the importance of the consequences of the COVID-19 crisis,
282 none of them stated that the crisis had no consequences for them and the "strong" level was
283 the most reported, which translated into a strength index of 0.74 (Tab. 4). Consistent with the
284 results previously found, another consequence that has had a strong intensity is the change in
285 marketing channels (0.66) and losses due to difficulties in selling production (0.58). When
286 asked about the intensity of the decrease in income for the farm, 70% said that they had an
287 average impact, and the calculated value of the average intensity of the consequence is 0.64.
288 This can be explained by both production losses and lower sales prices. When we look at two
289 technical aspects of agricultural production, inputs and labor, we see that more than 75% have
290 experienced difficulties in the supply of inputs, mostly medium or high (index value of 0.56),
291 and 67% have encountered medium difficulties related to the unavailability of labor, which
292 translates into an index value of impact strength of 0.46. Very few producers had to lay off
293 staff (index value of 0.09). It is interesting to note that almost half (45%) of the producers had

more than usual to resort to mutual aid with their colleagues. This shows that solidarity among the farming population has been expressed and strengthened in the face of the crisis. It should be noted that 25% of the farmers indicated that they have benefited, moderately or strongly, from this period of lockdown (index of 0.29). Through certain production niches or very short marketing channels, some were able to take advantage of a period that was nevertheless largely detrimental to agricultural producers.

The open-ended question on other possible consequences and difficulties related to the crisis highlights three main points: cash flow problems, increased theft of products from their farms and drought. On this last point indeed, a very marked drought accompanied the lockdown period in Guadeloupe, adding to the difficulty. It is very interesting to note that in the open-ended question on the strengths of their farming system in the circumstances of the crisis, farmers highlighted three strong points: the use of marketing in short channels and direct sales, the diversification of production and the small size of farms, which led to autonomy and flexibility of operation.

The last part of the questionnaire asked farmers about their immediate future at the end of the crisis when the generalized lockdown was over but the health crisis and social distancing measures still were. For the majority of farmers (about 62%), the objective was to return to the production system before the crisis, but for the same proportion, the wish expressed was to keep some of the changes implemented during the crisis. 15% of farmers said they wish to keep on with the crisis system. The same proportion was considering abandoning farming activity, these are older farmers. It should be noted that 60% of farmers thought that the crisis will have a lasting impact on their agricultural activity.

< insert Table 5 >

In the rest of this section, we present the impacts of the COVID-19 crisis from the experts' point of view. The comparison of the responses shows us a great homogeneity of perception between farmers and experts in Guadeloupe (Tab. 3). The responses are very similar among them on both the nature and the strength of the consequences. The analysis of the situation seen "from the outside" thus joins that seen "from the inside". Regarding the consequences as a whole, almost all responses from experts indicate that the crisis had real impacts for all

farmers and that they had to innovate to adapt, which confirms the medium-resilience level of Guadeloupe's producers in the face of this crisis (50%). There are still some slight differences on the ranking of the consequences. According to them, the main adaptation measure that farmers have implemented to adapt is the change in marketing channels (82%), followed by economic damage (71%) and reduced production (55%).

The experts' opinions were also very close to those of the farmers with regards to the strength of the consequences (Tab. 4). However, they sometimes had stronger opinions. They thought that the impacts of the crisis on the change of marketing channels and the layoff of labor were stronger (respectively strength of 0.79 and 0.19 for experts Vs 0.66 and 0.09 for farmers), while the impacts on the reduction in the number of productions and the decrease in selling prices were less strong than according to the farmers' point of view. As concerns the strength of short and mid-term consequences of COVID-19 crisis on agricultural systems, if the experts thought that Guadeloupean producers have been weakened by the crisis (value of 0.63) they also thought that producers were globally resilient because they had been able to adapt and innovate (0.66). It should be noted that the experts believed that this crisis will have lasting consequences for agricultural systems (0.43), following the example of what farmers themselves say, and that according to them one of the positive consequences of this crisis is the strengthening of links between farmers and the population (0.68). The last open-ended question asked the experts what, in their opinion, are the factors of resilience of agricultural systems facing the crisis. The elements most highlighted as factors of resilience were: direct sales or very short circuits for the local market so as not to be dependent on export markets; diversification of crops, mainly on small farms; membership of well organized professional agricultural organization; enhancement of agro-diversity; autonomy with regard to the supply of inputs and the capacity to reduce dependence on external resources; access to institutional support. The factors mentioned by the experts thus overlapped with those of farmers and brought other interesting avenues.

3.1.2 Perception at the local scale: the situation in Caribbean

The analysis of the answers of the 24 Caribbean experts from 9 countries on the immediate effects of COVID-19 control measures (local and international) on agricultural systems show that impacts have been the same than in Guadeloupe though with a greater intensity. On what the producers in their country did during the crisis, the answers were in line with those of the

Guadeloupean experts (Tab. 3). Nearly 84% of the experts believed that the majority of farmers have suffered economic damage because of the crisis. As in Guadeloupe, this is explained by the reduction or halt of the production (resp. 67% and 54%) and the fact of having had to throw away part of the production because of an inability to market them (54%). As a result, producers sought to reorient themselves to short marketing channels (58%), but to a lesser extent than in Guadeloupe. On the other hand, some consequences were more marked than in Guadeloupe: Caribbean farmers have more diversified their production (75%), but above all they had to rely much more on the sale of livestock and farmland (29% and 13% Vs 18% and 8% for Guadeloupe) and engaged in extra-agricultural activities (42% in the Caribbean Vs 16% in Guadeloupe). All this suggests that the crisis has had much more pronounced consequences in the Caribbean than in Guadeloupe. This is confirmed in the results on the measurement of the strength of impacts with an average impact value of 0.62 for the rest of the Caribbean Vs 0.47 for Guadeloupe (Tab. 4). In particular, it can be seen that the impacts were stronger with regard to the drop in income, losses related to difficulties in marketing production and especially for difficulties related to labor management. The capacity to innovate and adapt was less strong than in Guadeloupe (Table 5), and Caribbean producers seemed to have been more vulnerable. The risk of decrease in the number of producers and the risk of land abandonment is real (strength of 0.52 for the risk of decrease in the number of farmers and 0.36 for agricultural land abandonment Vs respectively 0.22 and 0.04 in Guadeloupe). Logically, Caribbean experts thought that the long-term modification of agricultural systems due to the COVID-19 crisis is much more important than Guadeloupean experts: for 70% of the former this risk is "medium" or "strong" against 40% for the latter, which results in a strength of impact score of 0.67 vs 0.43, respectively.

These results show that, even if the trends were very similar between Guadeloupe and other Caribbean countries, the COVID-19 crisis and the lockdown period have had a much greater impact on agriculture in other Caribbean countries and that the consequences seemed to be more pronounced, less reversible and more lasting than in Guadeloupe. As we saw in the introduction, the place of agricultural systems and many other structural variables are very heterogeneous within the Caribbean islands. Guadeloupe's socio-economic structure and its membership in the French national community may explain why it has suffered less from the consequences of the COVID-19 crisis.

< insert Table 6 >

3.2. Impacts on food habits

3.2.1 Food habits condition in Guadeloupe

Our results show that for the 38 Guadeloupean households analyzed, the COVID-19 crisis, the lockdown and the closure of certain commercial spaces had consequences and induced changes in food habits, even if these were never very strong (Tab. 6). For 22% of the families, confinement led to a reduction in food consumption. The reduction in the diversity of products consumed was more pronounced, impacting one third of the households. Significantly (29%), families developed allotment gardens and produced some of their food. On the other hand, none had to resort to social assistance and only one household in ten had to rely on familial mutual aid. The lockdown thus led to some modified eating behaviors and practices. In terms of households' assessment of the strength of the consequences of confinement, the overall impacts were "medium", with values ranging from 0.41 to 0.52 for the seven criteria "Suffered economic damage"; "Consumed new products"; "Changed food buying places"; "Increased food stocks"; "Reduced food waste"; "Modified diet" and "Adjusted diet". The impact on time spent preparing meals appears to have been greater (0.61). Analysis of the responses to the open-ended question showed that for some families, it was necessary to prepare more meals instead of those usually eaten at school or professional canteens; that supplies of fresh products were more complicated; that purchases were made more in supermarkets. However for some families the crisis has allowed to better know the farmers located nearby. The COVID-19 crisis had therefore real but moderate immediate impacts on the eating habits and purchasing practices of Guadeloupean households.

< insert Table 7 >

When comparing consumer responses with those of experts on the strength of the impact the crisis has had on consumers, the experts' responses often pointed in the same direction as those of consumers, but were often more accentuated. This is particularly marked for the reduction in dietary diversity (experts 50% vs. consumers 34%) and the reduction in the production of part of the food by consumers (experts 61% vs. consumers 29%). Regarding the call for social or familial mutual aid, the experts had a very different opinion: they thought it

is real (respectively 54 and 68%) while consumers declared it almost non-existent. With regard to the intensity of the consequences for households (Tab. 7), the experts' answers always indicated more pronounced consequences for "consumed new products"; "changed food buying places" and "adjusted diet". This is particularly true for "Increased food stocks" (0.74 for experts Vs 0.52 for households). Above all, they also indicated that this crisis has made consumers more aware of the importance of the agricultural sector (0.77) and they also believed that the COVID-19 crisis will lead to a long term change in the Guadeloupean food system (0.77 for experts vs. 0.52 for households).

3.2.2 Food habits condition in Caribbean

The analysis of the responses of Caribbean experts on the immediate consequences of the COVID-19 crisis on household nutrition shows that the crisis has had strong impacts in the Caribbean (Tab. 6). Sixty-four percent of the experts indicated that the crisis has led to a reduction in dietary diversity but also to a reduction in quantity (57%). These values are much higher than in Guadeloupe. Logically this is reflected in the fact that the experts mentioned very frequently the impacts on the use of family or social assistance for food (86% and 77%) but also the development of food-producing allotments. The results presented in Table 7 confirm that the impacts on food systems have been strong in the Caribbean. According to the experts, the economic impact of the COVID-19 crisis on households has been very important since with a value of 0.89, the given score is close to the maximum value of 1.00 (Tab. 7). The impact on the time spent on food purchases and the need to change purchasing networks was very often moderate to strong (score of 0.71 and 0.76 respectively). As for the need to adapt the diet, to reduce waste, to consume different products, to arbitrate between food and other purchases and to change one's diet, the "strong" response that was the most frequent, resulting in impact strength scores between 0.6 and 0.8. Analysis of the responses given by Caribbean experts on the food consequences shows that the crisis has been hard on households because access to food has been more difficult and adaptations have been necessary. It is interesting to note that the crisis has had a very significant impact on food behavior (e.g. for the reduction of food waste and for diet modification) and the perception of the importance of the agricultural sector (0.86). These results show that while the COVID-19 crisis had very negative immediate consequences for Caribbean households and food security in the region, it may also contain the seeds for a rising awareness of the need to strengthen food autonomy and to modify diets by making less use of imported foods.

454

455 **4. Discussion**

456 In this article, we analyzed the immediate consequences of the COVID-19 crisis on the
457 agricultural and food systems of the Caribbean based on a survey of farmers, households and
458 experts. In order to capture the immediate impacts of the crisis and for practical reasons, this
459 survey was conducted online and required the use of e-mail databases to distribute the
460 questionnaire. Out of approximately 500 people contacted, we had a response rate of about
461 28%, which is satisfactory. Nevertheless, this mode of survey had several consequences that
462 we must emphasize here in order to properly measure the scope and limitations of this study.
463 Regarding the evaluation of impacts in Guadeloupe, the respondents among farmers and
464 consumers are people from the rather well-off classes from a socio-economic point of view.
465 Thus it is likely that the impacts are actually higher than what we have identified and
466 measured, in terms of intensity. In some families, income losses and food impacts may have
467 been more pronounced. Outside of Guadeloupe, it was not possible for us to mobilize reliable
468 contact databases for farmers and households. We therefore proceeded by consulting experts
469 and obtained 24 responses from 9 other Caribbean countries, covering both the Greater and
470 Lesser Antilles. The comparison in Guadeloupe of the experts' answers with those of farmers
471 and households highlights two interesting points: 1) in both cases, the consequences identified
472 are the same and the hierarchy of the strength of the impacts is very similar, which proves the
473 interest of mobilizing experts when one does not have direct access to the target populations;
474 2) the experts' answers on the intensity of the consequences are nevertheless sometimes more
475 marked than those of the target individuals directly consulted, and this not only for farmers
476 but also, and especially, for consumers. This second point can be interpreted in two ways.
477 Firstly, our sample of individuals reached a fringe that is better off than the average
478 population, and the experts therefore have a broader vision that also includes more less
479 comfortable situations. Another hypothesis, specifically concerning impacts on farmers, is
480 that experts have structurally stronger views on the intensity of a consequence (all or nothing)
481 because they are not directly affected. Only a larger sample size would make it possible to
482 decide between these two hypotheses. This is particularly true for the Caribbean-wide study,
483 as our survey collected data from only 24 experts and for 10 Caribbean islands. Due to the
484 geographical extent of the region, the isolation linked to insularity and the diversity of the
485 countries' situations, from a social, cultural, economic, health and regulatory point of view,
486 the study covers a set of heterogeneous characteristics. This makes interpretations more

487 complex and reinforces the need for a study of broader scope (in the spatial sense), with a
488 larger sample, and with more historical hindsight on the consequences of an unprecedented
489 crisis that has just emerged and is still in progress. Nevertheless, due to the impossibility of
490 having thorough national and regional statistics on the immediate effects of the crisis, our
491 study provides a first idea of the very short-term consequences of the COVID-19 crisis on the
492 agricultural and food systems of the Caribbean. This first study should be followed by a
493 similar study within 2 or 3 years.

494 Our study shows that the COVID-19 crisis has had strong impacts on Caribbean farmers.
495 When comparing the results between Guadeloupe and the other Caribbean islands, the main
496 consequences of the crisis are similar: loss of income due to the inability to sell production
497 and difficulty of access to inputs and labor. The crisis has led to a necessary adaptation
498 consisting mainly in a temporary halt or reduction of certain productions, the search for new
499 marketing channels, diversification of production and resort to mutual aid. However if these
500 effects do not appear irreversible in Guadeloupe, because we did not observe any sale of land
501 or livestock or the start of new non-agricultural activities, the situation is different in the other
502 islands of the region. In particular, many farmers have had to sell livestock or seek new non-
503 agricultural income to cope. The agricultural sector in Guadeloupe, like that of the Caribbean,
504 faces structural difficulties: limited size of structures; competition from imports; climatic
505 risks. The crisis has therefore added an additional layer of difficulty. This situation is
506 particularly worrying in the Caribbean context insofar as many small islands are economically
507 dependent on tourism and a strong recession is expected in these countries. According to the
508 International Monetary Fund (IMF), the gross domestic product decline is projected to be
509 10.3% in 2020 and the decline in economic growth in 2020 is expected to exacerbate income
510 inequality and poverty throughout the region (Sullivan et al., 2020).

511 In the short term, it can be said that the crisis has weakened agricultural systems in the
512 Caribbean region, which is particularly worrying in a context where food insecurity is very
513 present. Nevertheless, the affected farmers have found solutions and if they mainly declare
514 today that they wish to return to the pre-crisis system, they also declare that they wish to
515 maintain certain features of the crisis system: reduction in the size of their system,
516 diversification of production and search for greater autonomy with regard to inputs, labor and
517 the sale of their products. We can therefore think that the crisis may be the medium-term
518 trigger for a transition to systems based on agro-ecological principles and contributing to the
519 development of a territorial bio-economy. The COVID-19 crisis may therefore hold out hope

for evolution to adapt to many other challenges facing the Caribbean agricultural sector such as adaptation to climate change, biodiversity conservation and greater food autonomy.

Regarding the consequences on the food systems, our study shows that they have been medium to strong, depending on the islands. They mainly consisted in a reduction in the diversity of the diet and the overall volume of food consumption. To cope, households have adopted various strategies such as adapting their diet, consuming new products and developing food gardens to produce part of their food themselves. Among the adaptations mentioned are also increasing food stocks and the use of family and social support. Finally, our study shows that the crisis can be the trigger for a change in the food diet as consumers reported having spent more time preparing meals, changed their places and networks of food purchases, reduced food wastage and become more aware of the importance of the agricultural sector. We can also see hope for the future with a more marked and important place for local production and a change in the population's diet in the direction of a healthier diet.

At the Caribbean scale, the pandemic is exacerbating existing food insecurity caused by environmentally driven food shortages, political turmoil, and dwindling purchasing power. According to the United Nations (2020), Latin America and the Caribbean has seen an almost three-fold rise in the number of people requiring food assistance. As smallholder farmers are key actors in addressing the food and nutrition insecurity challenges facing the Caribbean Community, while also minimizing the ecological footprint of food production systems (Saint Ville et al., 2015), the response to the COVID-19 pandemic should therefore go beyond short-term emergency measures to embrace an entirely new set of health, economic, social and agricultural policies. To face the crisis, regional economic integration could be an efficient option to support productive diversification, economic resilience, and regional cooperation in financing research, science and technology (United Nations, 2020). Fostering innovation in the region's smallholder farming systems will require more decentralized, adaptive and heterogeneous institutional structures and approaches than presently exist. As we saw in the introduction of this article, the Caribbean countries are very heterogeneous and their agricultural systems have undergone profound changes. From systems oriented mainly towards organized export channels, they must now evolve towards systems oriented towards satisfying domestic demand for food for local populations and tourism. Current institutions are mainly dedicated to traditional export channels and are therefore not adapted to the new needs of farmers. To accompany this transition, new institutions need to emerge to help a

diversity of farmers innovate to adapt to the new challenges and objectives of Caribbean agriculture and food systems. In this sense, Saint Ville et al. (2015) argue for a different approach to agricultural development in the Small Island Developing States of the Caribbean that draws primarily on socioecological resilience and agricultural innovation systems frameworks. Given the urgent issues of health and food security in the region, supporting the development of local agriculture in an agro-ecological approach to meet the nutritional needs of Caribbean populations is a major challenge. To cope with the major challenges that the agricultural sector of the Caribbean is currently experiencing, there is no other choice than to foster the agro-ecological transition in relation to the new challenges addressed by the emerging bio-economy (Ozier-Lafontaine, 2016). To this end, resilience issues need to be addressed with a focus on the regional context in which farming systems operate because farms, farmers' organizations, service suppliers and supply chain actors are embedded in local environments and functions of agriculture (Meuwissen et al., 2019). Research on agricultural systems has to provide conceptual and methodological frameworks to assess the resilience of farming systems, considering different resilience capacities (robustness, adaptability, transformability) and nested levels of farming systems (e.g. farm, farm household, supply chain, farming system). The framework and indicators to assess the resilience of farming systems proposed by Meuwissen et al. (2019) are a good basis to this end. It provides indeed a heuristic to analyze system properties, challenges (shocks, long-term stresses), indicators to measure the performance of system functions, resilience capacities and resilience-enhancing attributes.

Finally, our study shows that the crisis has had an effect of strengthening the links between farmers and the rest of the population. Crops for local consumption, which are currently in the minority, are expected to become more preponderant. In addition, if some sectors such as export crops could be weakened, others could be strengthened and contribute to increase food autonomy in the Caribbean territories. The search for greater food autonomy and autonomy from the inputs needed for production, greater adaptability, the adaptation of production to local consumption and innovations in commercial practices (e.g. development of very short circuits with the help of digital tools) is in filigree of all the opinions expressed in our survey. Thus it seems to us that one of the consequences of the COVID-19 crisis in the Caribbean islands is to create a unique opportunity to bring agricultural and food systems closer together and to drive an agro-ecological transition contributing to the development of a circular and territorialized bio-economy to strengthen their resilience.

586

587

588 **Conclusion**

589 The COVID-19 pandemic caused a global crisis that in the Caribbean had immediate and
590 significant socio-economic consequences at the local and regional levels. The lockdown
591 measures, the halt in air traffic and tourism and the slowdown in the flow of imported and
592 exported goods had significant consequences on agricultural and food systems. This crisis is
593 questioning many scientific fields, including agriculture and food. How has the crisis
594 impacted the systems and how can their resilience be strengthened? Our study, focused on the
595 Caribbean, helps to capture the immediate impacts and provides some avenues to answer this
596 question. Firstly, it shows the close link between health safety and food security, and the need
597 to re-territorialize food systems by strengthening the link between farmers and consumers to
598 enhance the resilience of food supply chains. At the level of agricultural systems, the main
599 impacts identified were economic losses due to difficulties in marketing products in
600 conventional channels, but also difficulties in managing production systems through reduced
601 access to inputs and labor. In order to cope with these problems, farmers have implemented
602 adaptations in the direction of a search for greater autonomy of their systems: reduction of the
603 size of cultivated areas, search for short circuits, diversification of production, reorientation of
604 production towards the needs of the local market, resort to mutual aid. All these elements are
605 factors of resilience that must be developed in the future. In the Caribbean, the crisis has had
606 such an impact that some farmers have had to stop some productions, seek extra-agricultural
607 activities and sometimes sell land or livestock. There is therefore a definite risk that if the
608 health crisis continues for a long time, the food security of certain countries will be
609 threatened. With regards to the impacts on food systems, it is noted that the crisis has imposed
610 strong constraints such as the reduction of the food ration and its diversity and the recourse to
611 family and social mutual aid. In addition, our study shows that the crisis has had an impact on
612 consumer behavior and their perception of the importance of the agricultural sector: reduction
613 of food waste, return to fresh and local products, consumption of new products, cultivation of
614 food gardens. All this is in line with the desired and desirable reinforcement of the links
615 between agricultural and food systems. Thus, while the crisis has had seriously damaging
616 consequences, it can also be the trigger and catalyst for the major changes needed in the
617 agricultural and food systems of the Caribbean, leading to a better achievement of sustainable
618 development goals (United Nations, 2015). The COVID-19 crisis can therefore be viewed as

opportunity to accelerate the agricultural and food transition towards a greater level of sustainability and food security.

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Supplementary Materials

The 3 questionnaires (farmers, consumers and experts) translated into 3 languages (English, Spanish and French) can be downloaded.

References

- Angeon V., Bates S., 2015. Reviewing Composite Vulnerability and Resilience Indexes: A Sustainable Approach and Application. *World Development*, 72, 140-162.
- Chopin, P., Blazy, JM., Doré, T., 2015. A new method to assess farming system evolution at the landscape scale. *Agronomy for Sustainable Development* 35, 325-337.
- Colombet, Z., Allès, B., Perignon, M., Landais, E., Martin-Prével, Y., Amiot-Carlin, M. J. & Méjean, C., 2019a. What can dietary patterns tell us about the Caribbean nutrition transition? *European Journal of Public Health*, 29 (4), ckz186-605.
- Colombet Z, Perignon M, Salanave B, Landais E, Martin-Prevel Y, Allès B, et al., 2019b. Socioeconomic inequalities in metabolic syndrome in the French West Indies. *BMC Public Health*, 19(1):1620.
- FAO, 2019. Current Status of agriculture in the Caribbean and implications for Agriculture Policy and Strategy. 2030 - Food, Agriculture and rural development in Latin America and the Caribbean, N°14. Santiago de Chile. FAO. 28p

646 Hale, T., Webster, S., Petherick, A., Phillips, T. and Beatriz Kira, 2020. Oxford COVID-19
647 Government Response Tracker, Blavatnik School of Government.
648 [https://www.bsg.ox.ac.uk/sites/default/files/Calculation%20and%20presentation%20of%20th](https://www.bsg.ox.ac.uk/sites/default/files/Calculation%20and%20presentation%20of%20the%20Stringency%20Index.pdf)
649 [e%20Stringency%20Index.pdf](https://www.bsg.ox.ac.uk/sites/default/files/Calculation%20and%20presentation%20of%20the%20Stringency%20Index.pdf)

650 Méjean C. et al. (dir.), 2020. Alimentation et nutrition dans les départements et régions
651 d’Outre-Mer. Marseille IRD Editions, coll. Expertise collective. 208p.

652 Meuwissen, MPM., Feindt, PH., Spiegel, A., et al. 2019. A framework to assess the resilience
653 of farming systems. *Agricultural Systems* 176, 102656.

654 ODEADOM. 2018. Quelles conditions pour améliorer la couverture des besoins alimentaire
655 dans les départements d’Outre-mer ? Novembre, 1,10.

656

657 Ozier-Lafontaine, H., 2016. Opening ceremony of 52nd Annual Meeting of the Caribbean
658 Food Crops Society. July 10 to 16, 2016 (CFCS), Le Gosier, Guadeloupe.

659 Saint Ville, AS., Hickey, GM., Leroy, EP., 2015. Addressing food and nutrition insecurity in
660 the Caribbean through domestic smallholder farming system innovation. *Regional*
661 *Environmental Change* 15:1325–1339.

662 Sinha, D. P. (1995). Changing patterns of food, nutrition and health in the Caribbean.
663 *Nutrition Research*, 15(6), 899-938.

664 Sullivan, MP., Beittel, JS., Meyer PJ., Seelke, CR., Taft-Morales, M., 2020. Latin America
665 and the Caribbean: Impact of COVID-19. Publication of the Congressional Research Service.
666 <https://crsreports.congress.gov>

667 United Nations, 2015. [http://www.un.org/sustainabledevelopment/sustainable-development-](http://www.un.org/sustainabledevelopment/sustainable-development-goals/)
668 [goals/](http://www.un.org/sustainabledevelopment/sustainable-development-goals/)

669 United Nations, 2020. The Impact of COVID-19 on Latin America and the Caribbean. Policy
670 Brief. July 2020.

671 UNDP, 2019. Human Development Report 2019. Beyond income, beyond averages, beyond
672 today: Inequalities in human development in the 21st century. New York.
673 <http://hdr.undp.org/en/content/human-development-report-2019>

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Tables

Table 1. Descriptive statistics of main human, agricultural, food, health and COVID-19 variables in the Caribbean region.

Variables	Whole Caribbean countries (n=21)	Greater Antilles countries (n=4)	Lesser Antilles countries (n=17)
Total human population*	40 491 736	36 538 214	3 953 522
Mean of median age (years)*	35.29	29.65	36.62
cv	0.16	0.28	0.11
Mean of Human Development Index*	0.72	0.72	0.73
cv	0.20	0.10	0.22
Mean of Rural population (%)*	39.86	32.73	41.75
cv	0.66	0.42	0.69
Mean of Agricultural land (%)*	26.14	54.10	19.15
cv	0.71	0.21	0.64
Mean of diabetes prevalence in adults (%)*	10.44	9.05	10.79
cv	0.22	0.21	0.22
Mean of obesity prevalence in adults (%)*	23.69	24.63	23.35
cv	0.16	0.12	0.17
Mean of mortality by metabolic disorders (‰)*	19.60	19.15	19.86
cv	0.19	0.27	0.16
COVID-19 confirmed cases per million**	3103	2660	3207
cv	1.56	1.52	1.59
COVID-19 death rate per million**	41	48	40
cv	1.24	1.54	1.20
Mean of maximum of Stringency Index (%) ***	89.66	94.45	87.27
cv	0.79	0.59	0.78

Notes: cv= coefficient of variation (standard deviation/mean); Greater Antilles: Cuba, Dominican Republic, Haiti, Jamaica, Puerto Rico; Lesser Antilles: Aruba, Antigua and Barbuda, The Bahamas, Bermuda, Barbados, Curacao, Cayman Islands, Dominica, Guadeloupe, Grenada, St. Kitts and Nevis,

684 St. Lucia, Martinique, Turks and Caicos Islands, Trinidad and Tobago, St. Vincent and the
685 Grenadines, British Virgin Islands.

686 Sources: *: World bank - World Development Indicators (data for the year 2018 accessed 04/23/2020
687 on worldbank website); **: John Hopkins University (USA); ***: University of Oxford (UK); the
688 latest Covid-19 data (Johns Hopkins and Oxford Universities) were downloaded on September 16,
689 2021.

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Table 2. Data on COVID-19 health impact for 21 Caribbean islands.

Country code ^(a)	Country name	Population (*1000)	COVID-19 incidence ^(b)	COVID-19 mortality ^(b)	Maximum of the Stringency Index ^(c)	Last value of the Stringency Index ^(d)
ABW	Aruba	107	18789	94	89	61
ATG	Antigua & Barbuda	98	960	31	-	-
BHS	The Bahamas	393	5638	127	-	-
BMU	Bermuda	62	2762	145	96	44
BRB	Barbados	287	605	24	89	39
CUB	Cuba	11327	356	8	100	82
CUW	Curacao	2	414	6	-	-
CYM	Cayman Islands	7	3119	15	-	-
DMA	Dominica	72	278	0	80	36
DOM	Dominican Republic	10848	8731	158	97	76
GLP	Guadeloupe	400	3171	40	88	43
GRD	Grenada	113	213	0	-	-
HTI	Haiti	11403	721	18	94	18
JAM	Jamaica	2961	830	7	87	79
KNA	St. Kitts & Nevis	53	320	0	-	-
LCA	St. Lucia	184	142	0	-	-
MTQ	Martinique	375	1639	43	88	43
TCA	Turks & Caicos Islands	39	13121	103	80	54
TTO	Trinidad & Tobago	1399	1257	16	91	81
VCT	St. Vincent & the Grenadines	111	541	0	-	-
VGB	British Virgin Islands	30	1554	33	80	80

Notes : (a) Country code following the ISO 3166-1 alpha-3 format (<https://unstats.un.org/unsd/tradekb/Knowledgebase/Country-Code>) ; (b) The COVID-19 incidence and mortality are given as number of confirmed cases per million people and number of deaths per million people, respectively ; (c) Maximum value of the Stringency Index recorded during the pandemic; (d) Last value of the Stringency Index, recorded on August 31, 2020

Table 3. Consequences of COVID-19 crisis on agricultural systems.

	Producers Guadeloupe (n=32)	Experts Gua- deloupe (n=38)	Experts Other Caribbean countries (n=24)
Reduced production	68.8%	55.3%	66.7%
Increased the share of short marketing channels	62.5%	81.6%	58.3%
Stopped certain crops or productions	43.8%	42.1%	54.2%
Diversified their production	40.6%	44.7%	75.0%
Threw away part of the production because it was impossible to sell it	37.5%	39.5%	54.2%
Engaged in a new non-farming activity	18.8%	15.8%	41.7%
Sold livestock	12.5%	18.4%	29.2%
Stopped all production	9.4%	2.6%	16.7%
Sold or separated from farm land	0%	7.9%	12.5%
A majority has suffered economic damage	*	71.1%	83.3%
Agricultural systems have been resilient enough to this crisis	43.8%	50.0%	50.0%

Notes: for farmers, the question was: “Due to the COVID-19 crisis, you have...”; for experts, the question was: “According to you, due to the COVID-19 crisis, agricultural producers in your country have...” ; *: question not asked to farmers. The values in the table correspond for each line to the proportion of the different subsamples indicating the presence of the considered impact.

Table 4. Strength of impacts of COVID-19 crisis on agricultural systems.

	Producers in Guadeloupe (n=31)	Experts in Guadeloupe (n=36)	Experts in other Carib- bean countries (n=24)
Overall impact of the COVID crisis on farmers' activities	0.74	0.74	0.82
Change in production flow; change in sales channel	0.66	0.79	0.76
Decrease in income	0.64	0.57	0.79
Reduction in the number of productions	0.60	0.40	0.54
Losses due to inability to market	0.58	0.53	0.76
Input supply problems	0.56	0.58	0.60
Regulatory constraints impacting their system	0.52	0.45	0.47
Lower sales prices	0.51	0.28	0.46
Problems with the availability of manpower for the operation	0.46	0.43	0.75
The lockdown period was favorable to them	0.29	0.26	0.28
Layoff of some staff members	0.09	0.19	0.53
Mean strength of impacts	0.51	0.47	0.62

Note: the values of impacts' strengths correspond to the aggregation of the proportion of the following weights given by the respondents on a semi-quantitative scale: 0: nil 1: low 2: medium 3: high. The final strength index given in the table has then been normalized so that a value of 0.00 corresponds to a nil impact and a value of 1.00 corresponds to the highest impact.

Table 5. Strength of short and mid-term consequences of COVID-19 crisis on agricultural systems.

	Experts in Guadeloupe (n=31)	Experts in other Caribbean countries (n=23)
Agricultural sectors will be weakened	0.63	0.71
Producers have been weakened	0.58	0.68
Certain agricultural sectors will be reinforced	0.48	0.65
Producers have been resilient	0.60	0.65
Producers have increased, strengthened the links with the population, consumers and the public	0.68	0.62
Producers have been able to innovate and adapt	0.66	0.59
The number of farmers will decrease	0.22	0.52
Crops for local consumption will replace export crops	0.39	0.41
Part of the agricultural land will be abandoned	0.04	0.36
There will be a concentration of farmland	0.17	0.29
Do you think that the COVID-19 crisis will lead to long-term changes in your country's agricultural systems?	0.43	0.67

Note: the values of consequences' strengths correspond to the aggregation of the proportion of the following weights given by the respondents on a semi-quantitative scale: 0: nil 1: low 2: medium 3: high. The final strength index given in the table has then been normalized so that a value of 0.00 correspond to a nil impact and a value of 1.00 correspond to a high level of consequence.

Table 6. Consequences of COVID-19 crisis on food systems.

	Households in Guadeloupe (n=38)*	Experts in Guadeloupe (n=28)**	Experts in other Carib- bean countries (n=22)
Used family assistance for feeding	11%	68%	86%
Produced some of their own food	29%	61%	82%
Used social assistance for feeding	0%	54%	77%
Reduced the diversity of products consumed	34%	50%	64%
Reduced the overall volume of their food consumption	22%	25%	57%
Spent less time shopping for food products	42%	43%	46%

Notes: * for households, the question was: “Due to the COVID-19 crisis, you have...” ; ** for experts, the question was: “According to you, due to the COVID-19 crisis, the households in your country have...”. The values in the table correspond for each line to the proportion of the different subsamples indicating the presence of the considered impact.

Table 7. Strength of impacts of COVID-19 crisis on food systems.

	Households Guadeloupe ** (n=38)	Experts Gua- deloupe *** (n=28)	Experts Other Caribbean countries *** (n=22)
Suffered economic damage	0.43	0.55	0.89
Realized the importance of the agricultural sector	*	0.77	0.86
Consumed new products	0.44	0.61	0.77
Changed food buying places	0.48	0.77	0.76
Increased food stocks	0.52	0.74	0.74
Spent more time for shopping food products	*	0.35	0.71
Reduced food waste	0.48	0.55	0.68
Modified diet	0.44	0.42	0.67
Adjusted diet	0.41	0.58	0.65
Arbitrated between food purchases and other goods	0.24	0.38	0.61
Spent more time preparing meals	0.61	0.65	0.56
Been subjected to harm impacting health	*	0.21	0.29
Do you think that the COVID-19 crisis will lead to a long-term change in your country's food system?	*	0.48	0.52

Notes: *: question not asked to households; **for households, the question was: “Due to the COVID-19 crisis, you have...” ; *** for experts, the question was: “According to you, due to the COVID-19 crisis, households in your country have...” ; The values of impacts' strengths correspond to the aggregation of the proportion of the following weights given by the respondents on a semi-quantitative scale: 0: nil 1: low 2: medium 3: high. The final strength index given in the table has then been normalized so that a value of 0.00 correspond to a nil impact and a value of 1.00 correspond to a high impact.



Figure 1. Map of the Caribbean region

Source: <https://ian.mackey.net/pat/map/cari/cariblu.gif>

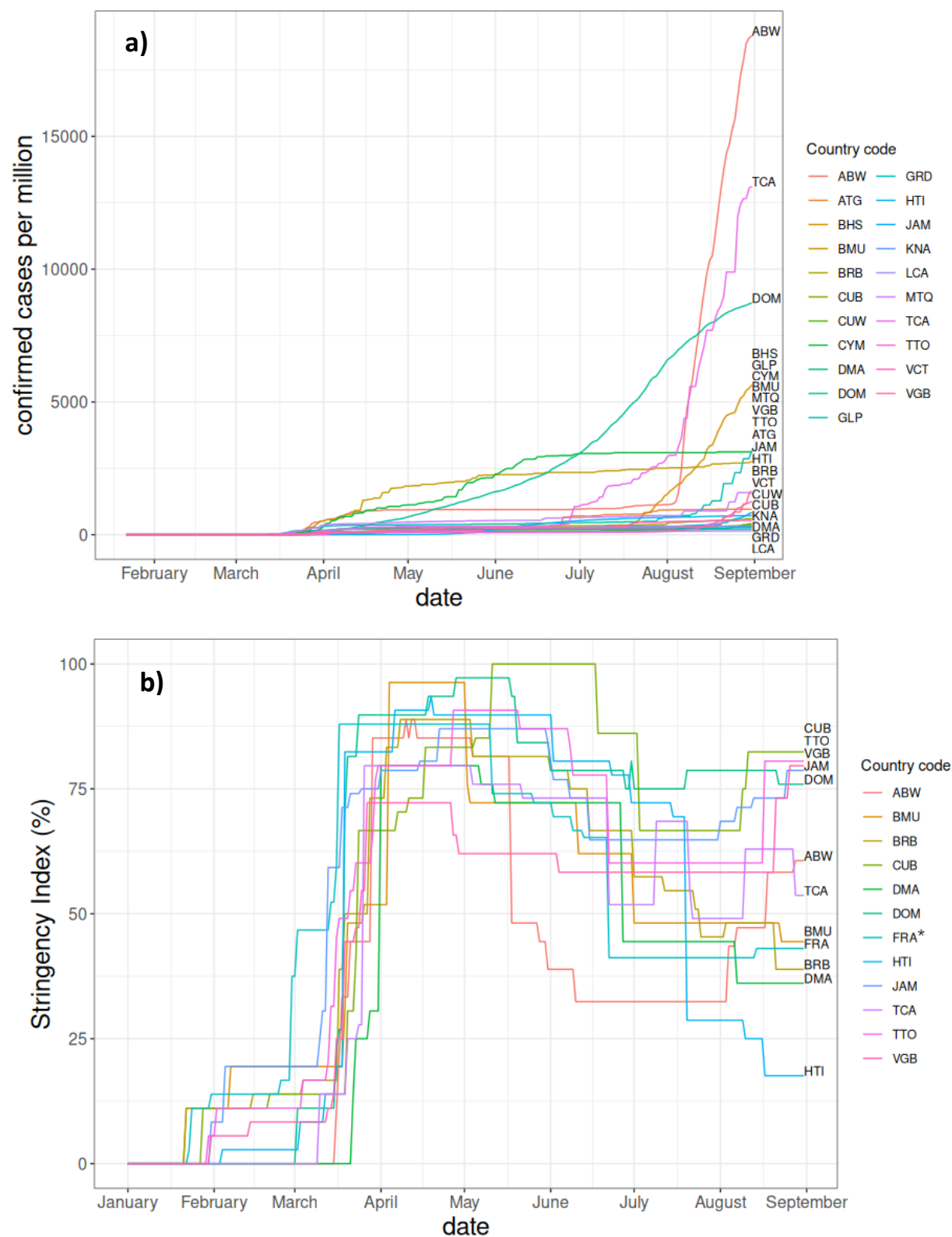


Figure 2. Dynamics of the COVID-19 and associated response policies in the Caribbean.

a) Temporal changes in COVID-19 incidence (confirmed cases per million people) for 21 countries and dependencies. b) Temporal changes of the strength of response policies (Stringency Index) for 12 countries and dependencies.

Note: * For Guadeloupe and Martinique, the Stringency Index of France is plotted as the local authorities of both French Caribbean islands followed the French national response policies.

- 27 Country codes are given in the ISO 3166-1 alpha-3 format
- 28 (<https://unstats.un.org/unsd/tradekb/Knowledgebase/Country-Code>)

Declaration of interests

☒ The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

☐The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: