Supporting information

Areas requiring restoration efforts are a complementary opportunity to support the demand for pollination service in Brazil

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Table S1. Pollinator dependence ratio (following Gallai & Vaissière 2009) of crops produced in Brazil in 2017. Dependence class follows Klein et al. 2007: Essential (dependence ratio 0.90-1.00), great (0.40-0.65), modest (0.10-0.25), little (0.01-0.10). Dependence source refers to the publication source for dependence ratio and class data. To compile our database, we first gathered PDR values from national databases (Giannini et al. 2015, BPBES-REBIPP 2019). For 17 crops not included in this database (abobrinha, algodão arbóreo, andiroba, babaçu – amendôa, babaçu – óleo, bacuri, camu-camu, cumaru, jaboticaba, jaca, licuri, maxixe, pimenta, pitaia, quiabo, tucumã), we estimated PDR from field studies conducted in Brazil following Klein et al. (2007) methodology. Then, we gathered PDR values for crops not available in national dabatases and from field studies in Brazil in Klein et al. (2007) international database. For three remaining crops (bucha, chuchu, jiló) with no data available after conducted these previous steps, we estimated PDR from field studies conducted outside of Brazil following Klein et al. (2007) methodology.

Crop	**Crop (portuguese)**	**Scientific name**	**Dependence ratio**	**Dependence class**	**Dependence source**	**Methodological details from field studies**
Avocado	Abacate	*Persea americana*	0.65	Great	BPBES-REBIPP 2019	
Pineapple	Abacaxi	*Ananas comosus*	0	No increase	Klein et al. 2007	
Pumpkin	Abóbora, moranga, jerimum	*Cucurbita maxima, C. mixta, C. moschata, C. pepo*	0.95	Essential	BPBES-REBIPP 2019	
Squash	Abobrinha	*Cucurbita maxima, C. mixta, C. moschata, C. pepo*	0.95	Essential	Serra & Campos 2010	Yield (fruit set) from a pollinator-exclusion treatment and from an open treatment. N= 20 flowers per treatment.

Assai palm	Açaí	*Euterpe oleracea (Mart.)*	0.65	Great	Campbell et al. 2018	Yield (fruit set) from a pollinator-exclusion treatment (N = 12610 flowers) and from an open treatment (N = 2630 flowers).
Chard	Acelga	*Beta vulgaris*	0	No increase	NA	
Acerola, barbados cherry	Acerola	*Malpighia emarginata*	0.95	Essential	BPBES-REBIPP 2019	
Agave (fiber)	Agave, sisal (fibra)	*Agave sisala*	0	No increase	NA	
Agave (leaves)	Agave, sisal (folha)	*Agave sisala*	0	No increase	NA	
Cress	Agrião	*Nasturtium officinale*	0	No increase	NA	
Celery	Aipo	*Apium graveolens*	0	No increase	Klein et al. 2007	
Artichoke	Alcachofra	*Cynara scolymus*	0	No increase	NA	
Caper	Alcaparra	*Capparis spinosa*	0.65	Great	Klein et al. 2007	
Rosemary	Alecrim	*Salvia rosmarinus*	0	No increase	NA	
Lettuce	Alface	*Lactuca sativa, Cichorium intybus, C. endivia*	0	No increase	NA	
Alfalfa	Alfafa fenada	*Medicago sativa*	0	No increase	NA	
Cotton	Algodão arbóreo	*Gossypium arboreum*	0.25	Modest	Klein et al. 2007	
Cotton	Algodão herbáceo	*Gossypium hirsutum*	0.25	Modest	Junior & Malerbo-Souza 2004	Yield (seed set) from a pollinator-exclusion treatment and from an open treatment. N= 20 fruits per treatment.
Garlic	Alho	*Allium sativum*	0	No increase	NA	
Leek	Alho-porró	*Allium porrum*	0	No increase	NA	
NA	Almeirão	*Cichorium intybus*	0	No increase	NA	

Plum	Ameixa	*Prunus domestica, P. salicina, P. spinosa*	0.65	Great	BPBES-REBIPP 2019	
Groundnut	Amendoim	*Arachis hypogeae*	0.05	Little	Klein et al. 2007	
Black mullberry	Amora	*Morus nigra, Rubus ulmifolius*	0.65	Great	BPBES-REBIPP 2019	
NA	Andiroba	*Carapa guianensis*	0.95	Essential	Mello Junior et al. 2011	Yield (fruit set) from a pollinator-exclusion treatment (N = 1919 flowers) and from an open treatment (N = 324 flowers).
NA	Araticum	*Annona crassiflora*	0.95	Essential	BPBES-REBIPP 2019	
Rice	Arroz	*Oryza spp*	0	No increase	NA	
Aspargus	Aspargo	*Asparagus officinalis*	0	No increase	NA	
Atemoya	Atemoia	*Annona squamosa*	0.95	Essential	BPBES-REBIPP 2019	
Oat	Aveia	*Avena sativa*	0	No increase	NA	
Olive	Azeitona	*Olea europaea*	0	No increase	NA	
Babassu palm (nut)	Babaçu (amêndoa)	*Orbignya phalerata, Attalea phalerata*	0.25	Modest	Anderson et al. 1988	Yield (fruit set) from a pollinator-exclusion treatment and from an open treatment. N= 180 flowers per treatment.
Babassu palm (fruit)	Babaçu (coco)	*Orbignya phalerata, Attalea phalerata*	0.25	Modest	Anderson et al. 1988	Yield (fruit set) from a pollinator-exclusion treatment and from an open treatment. N= 180 flowers per treatment.
Turu palm	Bacaba	*Oenocarpus bacaba*	Unknown	Unknown	NA	
NA	Bacuri	*Platonia insignis*	0.95	Essential	Maués et al. 1997	No yield (fruit set) in the pollinator-exclusion treatment.
Banana	Banana	*Musa paradisiaca*	0	No increase	BPBES-REBIPP 2019	
NA	Baru	*Dipteryx alata*	0.95	Essential	BPBES-REBIPP 2019	

NA	Batata-baroa, mandioquinha	*Arracacia xanthorrhiza*	0	No increase	NA	
Sweet potato	Batata-doce	*Ipomoea batatas*	0	No increase	NA	
Potato	Batata-inglesa	*Solanum tuberosum*	0	No increase	NA	
Eggplant	Berinjela	*Solanum melongena*	0.95	Essential	BPBES-REBIPP 2019	
Malabar spinach	Bertalha	*Basella alba*	0	No increase	NA	
Beetroot	Beterraba	*Beta vulgaris*	0	No increase	NA	
NA	Boldo	*Peumus boldus*	0	No increase	NA	
Rubber tree	Borracha	*Hevea brasiliensis*	0	No increase	NA	
Broccoli	Brócolis	*Brassica oleracea*	0	No increase	NA	
Sponge gourd	Bucha (esponja vegetal)	*Luffa aegyptiaca*	0.95	Essential	Mensah & Kudom 2010	Yield (fruit set) from a pollinator-exclusion treatment and from an open treatment. N= 30 flowers per treatment.
NA	Buriti	*Mauritia flexuosa*	0.95	Essential	BPBES-REBIPP 2019	
NA	Butiá	*Butia capitata*	0	No increase	NA	
Cocoa	Cacau	*Theobroma cacao*	0.95	Essential	Klein et al. 2007	
Coffee (Arabica)	Café Arábica	*Coffea arabica*	0.25	Modest	BPBES-REBIPP 2019	
Coffee (Canephora)	Café Canephora	*Coffea canephora*	0.65	Great	Klein et al. 2007	
NA	Cagaita	*Eugenia dysenterica*	0.65	Great	BPBES-REBIPP 2019	
Mombin	Cajarana	*Spondias mombin*	0.95	Essential	BPBES-REBIPP 2019	
Cashew	Caju	*Anacardium occidentale*	0.95	Essential	BPBES-REBIPP 2019	
Chamomille	Camomila	*Matricaria chamomilla, M. reticula*	0	No increase	NA	

NA	Camu-camu	*Myrciaria dubia*	0,65	Great	Cruz & Resende 2008	Yield (fruit set) from a pollinator-exclusion treatment (N = 4705 flowers) and from an open treatment (N = 3006 flowers).
Sugar cane (hay)	Cana para forragem	*Saccharum spp.*	0	No increase	NA	
Sugar cane	Cana-de-açúcar	*Saccharum spp.*	0	No increase	NA	
Persimmon fruit	Caqui	*Diospyros kaki*	0.65	Great	Klein et al. 2007	
Yam	Cará	*Dioscorea spp*	0	No increase	NA	
Star fruit	Carambola	*Averrhoa carambola*	0.65	Great	Klein et al. 2007	
NA	Carnaúba (cera) (Toneladas)	*Copernicia prunifera*	0	No increase	NA	
NA	Caruru	*Amaranthus viridis*	0	No increase	NA	
Wilco tree	Casca de angico (Toneladas)	*Anadenanthera spp*	0	No increase	NA	
Cashew nut	Castanha de caju	*Anacardium occidentale*	0.95	Essential	BPBES-REBIPP 2019	
Brazil nut	Castanha-do-Brasil (castanha-do-Pará) (Toneladas)	*Bertholletia excelsa*	0.95	Essential	BPBES-REBIPP 2019	
Rubber tree	Caucho (goma elástica) (Toneladas)	*Hevea brasiliensis*	0	No increase	NA	
Onion	Cebola	*Allium cepa*	0	Indirect benefit (Great)	BPBES-REBIPP 2019	
Chive	Cebolinha	*Allium schoenoprasum*	0	No increase	NA	
Carrot	Cenoura	*Daucus spp*	0	No increase	NA	
Rye	Centeio	*Secale cereale*	0	No increase	Klein et al. 2007	
Barley	Cevada	*Hordeum vulgare*	0	No increase	Giannini et al. 2015	
Tea	Chá-da-índia	*Camellia sinensis*	0	No increase	NA	

Endive	Chicória	*Lactuca sativa, Cichorium intybus, C. endivia*	0	No increase	NA	
Chayotte	Chuchu	*Sechium edule*	0.95	Essential	Wille & Orozco 1993	No yield (fruit set) in the pollinator-exclusion treatment.
Coconut	Coco-da-baía	*Cocos nucifera*	0.25	Modest	Klein et al. 2007	
Cilantro	Coentro	*Coriandrum sativum*	0	No increase	NA	
Mushroom	Cogumelos	*Several spp*	0	No increase	NA	
Rapeseed	Colza, canola	*Brassica napus*	0.65	Great	BPBES-REBIPP 2019	
NA	Copaíba	*Copaifera langsdorfii*	0	Indirect benefit (Essential)	BPBES-REBIPP2019	
Cabbage	Couve	*Brassica oleracea*	0	No increase	NA	
Cauliflower	Couve-flor	*Brassica oleracea*	0	No increase	NA	
Clove	Cravo-da-Índia	*Syzygium aromaticum*	0	No increase	NA	
NA	Cumaru	*Dipteryx odorata*	0.95	Essential	Souza 2004	Yield (fruit set) from a pollinator-exclusion treatment (N = 8255 flowers) and from an open treatment (N = 3091 flowers).
NA	Cupuaçu	*Theobroma grandiflorum*	0.95	Essential	BPBES-REBIPP 2019	
Oil palm	Dendê	*Elaeis guianensis*	0.05	Little	BPBES-REBIPP 2019	
Fennel	Erva-doce	*Pimpinella anisum*	0	No increase	NA	
Yerba mate	Erva-mate	*Ilex paraguariensis*	0	Indirect benefit (Great)	BPBES-REBIPP 2019	
Pea	Ervilha	*Pisum sativum*	0	No increase	Klein et al. 2007	
Spinach	Espinafre	*Spinacia oleracea*	0	No increase	NA	
Broad bean, horse bean	Fava	*Vicia faba*	0.25	Modest	Klein et al. 2007	

Bean	Feijão	*Phaseolus vulgaris*	0.25	Modest	BPBES-REBIPP 2019	
NA	Feijão de corda, feijão verde	*Vigna unguiculata*	0	No increase	BPBES-REBIPP 2019	
Fig	Figo	*Ficus carica*	0.25	Modest	Klein et al. 2007	
Atemoya	Fruta-de-conde	*Annona squamosa*	0.95	Essential	BPBES-REBIPP 2019	
Nicotine	Fumo	*Nicotiana tabacum*	0	No increase	NA	
Ginger	Gengibre	*Zingiber officinale*	0	No increase	NA	
Sesame	Gergelim	*Sesamum indicum*	0.05	Little	BPBES-REBIPP 2019	
Sunflower	Girassol	*Helianthus anuus*	0.65	Great	BPBES-REBIPP 2019	
Guava	Goiaba	*Psidium guajava*	0.65	Great	BPBES-REBIPP 2019	
Soursop	Graviola	*Annona muricata*	0.65	Great	BPBES-REBIPP 2019	
NA	Guaraná	*Paullinia cupana var. sobilis*	0.95	Essential	BPBES-REBIPP 2019	
Mint	Hortelã	*Mentha spicata*	0	No increase	NA	
Hog plum	Imbú, umbú	*Spondias tuberosa*	0.95	Essential	BPBES-REBIPP 2019	
Yam	Inhame	*Dioscorea spp*	0	No increase	NA	
NA	Ipecacuanha	*Carapichea ipecacuanha*	0	No increase	NA	
NA	Jaborandi	*Pilocarpus spp*	0	No increase	NA	
NA	Jabuticaba	*Myrciaria cauliflora*	0.65	Great	Vilela et al. 2012	Yield (fruit set) from a pollinator-exclusion treatment (N = 58 flowers) and from an open treatment (N = 88 flowers).
Jackfruit	Jaca	*Artocarpus heterophyllus*	0.95	Essential	Oliveira 2018	No yield (fruit set) in the pollinator-exclusion treatment.
NA	Jambo	*Eugenia malaccensis,*	0.65	Great	BPBES-REBIPP 2019	

		Syzigium malaccensis				
NA	Jambu	*Acmella oleracea*	0	No increase	NA	
Scarlet eggplant	Jiló	*Solanum aethiopicum*	0.25	Modest	Oyelana & Ogunwenmo 2012	Yield (fruit set) from a pollinator-exclusion treatment and from an open treatment. N= 4 flowers per treatment.
Palm heart fruit	Juçara	*Euterpe edulis*	0.95	Essential	BPBES-REBIPP 2019	
Jute	Juta	*Corchorus capsularis*	0	No increase	NA	
Kiwi	kiwi	*Actinidia deliciosa*	0.95	Essential	Klein et al. 2007	
Orange	Laranja	*Citrus aurantium, C. sinensis*	0.25	Modest	BPBES-REBIPP 2019	
Wood	Lenha	*NA*	0	No increase	NA	
Lentil	Lentilha	*Lens esculenta*	0	No increase	Klein et al. 2007	
Litchi	Lichia	*Lichia chinensis*	0.05	Little	Klein et al. 2007	
NA	Licuri	*Syagrus coronata*	0.65	Great	Rocha 2009	Yield (fruit set) from a pollinator-exclusion treatment (N = 1243 flowers) and from an open treatment (N = 818 flowers).
Lime	Lima	*Citrus aurantium*	0.05	Little	Klein et al. 2007	
Lemon	Limão	*Citrus maxima, C. limon, C. limmetta*	0.05	Little	Klein et al. 2007	
Lineseed	Linho	*Linum usitatissimum*	0.05	Little	Klein et al. 2007	
Bay leaf	Louro	*Laurus nobilis*	0	No increase	NA	
Apple	Maçã	*Pyrus malus*	0.95	Essential	BPBES-REBIPP 2019	
NA	Macaúba	*Acrocomia aculeata*	0.65	Great	BPBES-REBIPP 2019	
Malve	Malva	*Malva spp*	0	No increase	NA	

Papaya	Mamão	*Carica papaya*	0.05	Little	Klein et al. 2007	
Castor bean	Mamona	*Ricinus communis*	0.25	Modest	BPBES-REBIPP 2019	
Cassava	Mandioca	*Manihot spp*	0	No increase	NA	
Mango	Manga	*Mangifera indica*	0	No increase	BPBES-REBIPP 2019	
NA	Mangaba	*Hancornia speciosa*	0.95	Essential	BPBES-REBIPP 2019	
NA	Maniçoba	*Manihot spp*	0	No increase	NA	
Basil	Manjericão	*Ocimun basilicum*	0	No increase	NA	
Passion fruit	Maracujá	*Passiflora edulis*	0.95	Essential	BPBES-REBIPP 2019	
Quince	Marmelo	*Cydonia oblonga*	0.65	Great	Klein et al. 2007	
NA	Maxixe	*Cucumis anguria*	0.95	Essential	Sousa et al. 2013	Yield (fruit set) from a pollinator-exclusion treatment (N = 20 flowers) and from an open treatment (N = 10 flowers).
Watermelon	Melancia	*Citrullus lanatus*	0.95	Essential	BPBES-REBIPP 2019	
Melon	Melão	*Cucumis melo*	0.95	Essential	BPBES-REBIPP 2019	
Corn	Milho	*Zea mays*	0	No increase	Klein et al. 2007	
Strawberry	Morango	*Fragaria spp*	0.65	Great	BPBES-REBIPP 2019	
Mustard	Mostarda	*Brassica spp*	0	No increase	Klein et al. 2007	
Nance	Murici	*Byrsonima crassifolia*	0.95	Essential	BPBES-REBIPP 2019	
NA	Murumuru	*Astrocaryum murumuru*	Unknown	Unknown	NA	
NA	Nabiça	*Raphanus raphanistrum*	0	No increase	NA	
Turnip	Nabo	*Brassica rapa*	0	No increase	NA	
Nectarine	Nectarina	*Persica laevis*	0.65	Great	Klein et al. 2007	
Loquat	Nêspera	*Eriobotrya japonica*	0.65	Great	Klein et al. 2007	
Walnut	Noz	*Carya illinoiensis*	0	No increase	Klein et al. 2007	

NA	Oiticica	*Licania rigida*	Unknown	Unknown	NA	
Oregano	Orégano	*Origanum vulgare*	0	No increase	NA	
Palm heart	Palmito	*Euterpe edulis*	0	Indirect benefit (Great)	BPBES-REBIPP 2019	
Cucumber	Pepino	*Cucumis sativus*	0.65	Great	BPBES-REBIPP 2019	
NA	Pequi	*Caryocar brasiliense*	0.95	Essential	BPBES-REBIPP 2019	
Pear	Pera	*Pyrus communis*	0.95	Essential	BPBES-REBIPP 2019	
Peach	Pêssego	*Prunus persica*	0.25	Modest	BPBES-REBIPP 2019	
Nance	Piaçava	*Attalea funifera*	0	No increase	NA	
Pepper	Pimenta	*Capsicum annuum var. annuum*	0.25	Modest	Oliveira et al. 2011	Yield (fruit set) from a pollinator-exclusion treatment and from an open treatment. N= 90 flowers per treatment.
White pepper	Pimenta-do-reino	*Piper nigrum*	0	No increase	NA	
Bell pepper	Pimentão	*Capsicum annuum*	0.25	Modest	BPBES-REBIPP 2019	
Araucaria	Pinhão	*Araucaria angustifolia*	0	No increase	BPBES-REBIPP 2019	
Dragon fruit	Pitaia	*Pitaya spp*	0.25	Modest	Muniz et al. 2019	Yield (fruit set) from a pollinator-exclusion treatment and from an open treatment. N= 60 flowers per treatment.
Cherry	Pitanga	*Eugenia uniflora*	0.65	Great	BPBES-REBIPP 2019	
NA	Pupunha	*Bactris gasipaes*	Unknown	Unknown	NA	
Okra	Quiabo	*Abelmoschus esculentus*	0	No increase	Malerbo-Souza et al. 2001	Yield (fruit set) from a pollinator-exclusion treatment and from an open treatment. N= 40 flowers per treatment.
Radish	Rabanete	*Raphanus sativus*	0	No increase	NA	

NA	Rami	*Boehmeria nivea*	0	No increase	NA	
Cabbage	Repolho	*Brassica oleracea*	0	No increase	NA	
Pommegranate	Romã	*Punica granatum*	0.25	Modest	Klein et al. 2007	
Arugula	Rúcula	*Eruca vesicaria*	0	No increase	NA	
Pearsley	Salsa	*Petroselinum crispum*	0	No increase	NA	
Agave	Sisal	*Agave sisalana*	0	No increase	NA	
Soybean	Soja	*Glycine max*	0.25	Modest	BPBES-REBIPP 2019	
Sorghum	Sorgo	*Sorghum bicolor*	0	No increase	Klein et al. 2007	
Rowan	Sorva	*Sorbus domestica*	0	No increase	NA	
NA	Taioba	*Xanthosoma sagittifolium*	0	No increase	NA	
Tangerine	Tangerina	*Citrus reticulata*	0.65	Great	BPBES-REBIPP 2019	
Tomato	Tomate	*Lycopersicum esculentum, Solanum lycopersicum*	0.65	Great	BPBES-REBIPP 2019	
Wheat	Trigo	*Triticum durum*	0	No increase	Klein et al. 2007	
NA	Triticale	*Triticosecale rimpaui*	0	No increase	BPBES-REBIPP 2019	
NA	Tucumã	*Astrocaryum aculeatum, A. vulgare*	0.65	Great	Lima 2004	Yield (fruit set) from a pollinator-exclusion treatment (N = 522 flowers) and from an open treatment (N = 3440 flowers).
Tung	Tungue	*Vernicia fordii*	Unknown	Unknown	NA	
NA	Ucuuba	*Virola surinamensis*	Unknown	Unknown	NA	
Annatto	Urucum	*Bixa orellana*	0.65	Great	BPBES-REBIPP 2019	
Grape (fruit)	Uva	*Vitis spp*	0.05	Little	BPBES-REBIPP 2019	

Grape (wine / juice)	Uva	*Vitis spp*	0.05	Little	BPBES-REBIPP 2019	
Bean pod	Vagem	*Phaseolus vulgaris*	0.25	Modest	BPBES-REBIPP 2019	

Table S2. Correlation between crop pollination metrics (demand for crop pollination based on crop value; on crop production; on crop area and diversity of pollinator-dependent crops). Correlation coefficient is the Spearman's rho and bold values indicate significant results ($p < 0.05$).

	Crop value	**Crop production**	**Crop area**	**Diversity**
Crop value	-	-	-	-
Crop production	**0.87**	-	-	-
Crop area	**0.85**	**0.76**	-	-
Diversity	**-0.09**	**-0.06**	**-0.14**	-

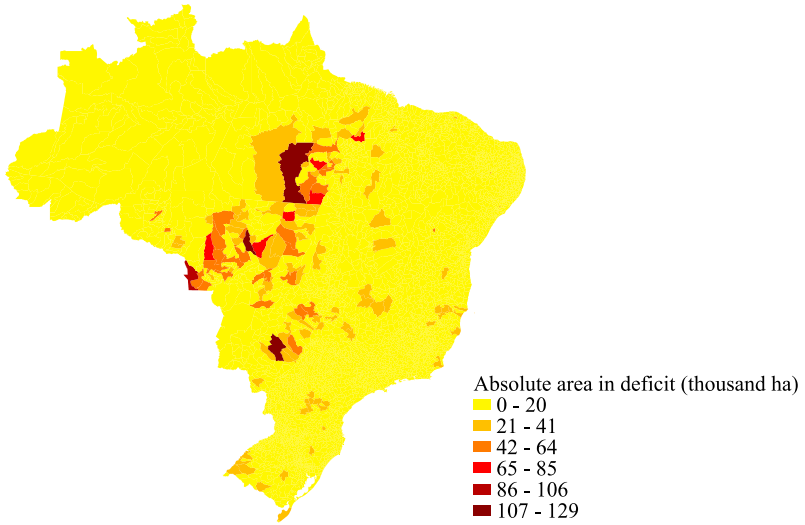

Fig. S1. Absolute area in legal deficit in Brazilian municipalities.

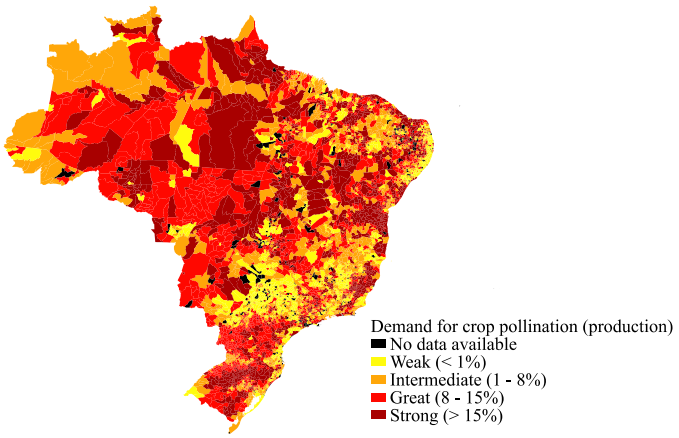

Fig. S2. Demand for crop pollination in production (percentage of crop production attributable to animal crop pollination).

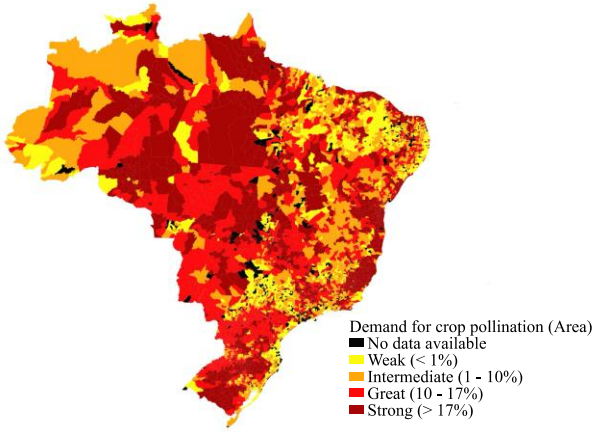

Fig. S3. Demand for crop pollination in area (percentage of crop area attributable to animal crop pollination).

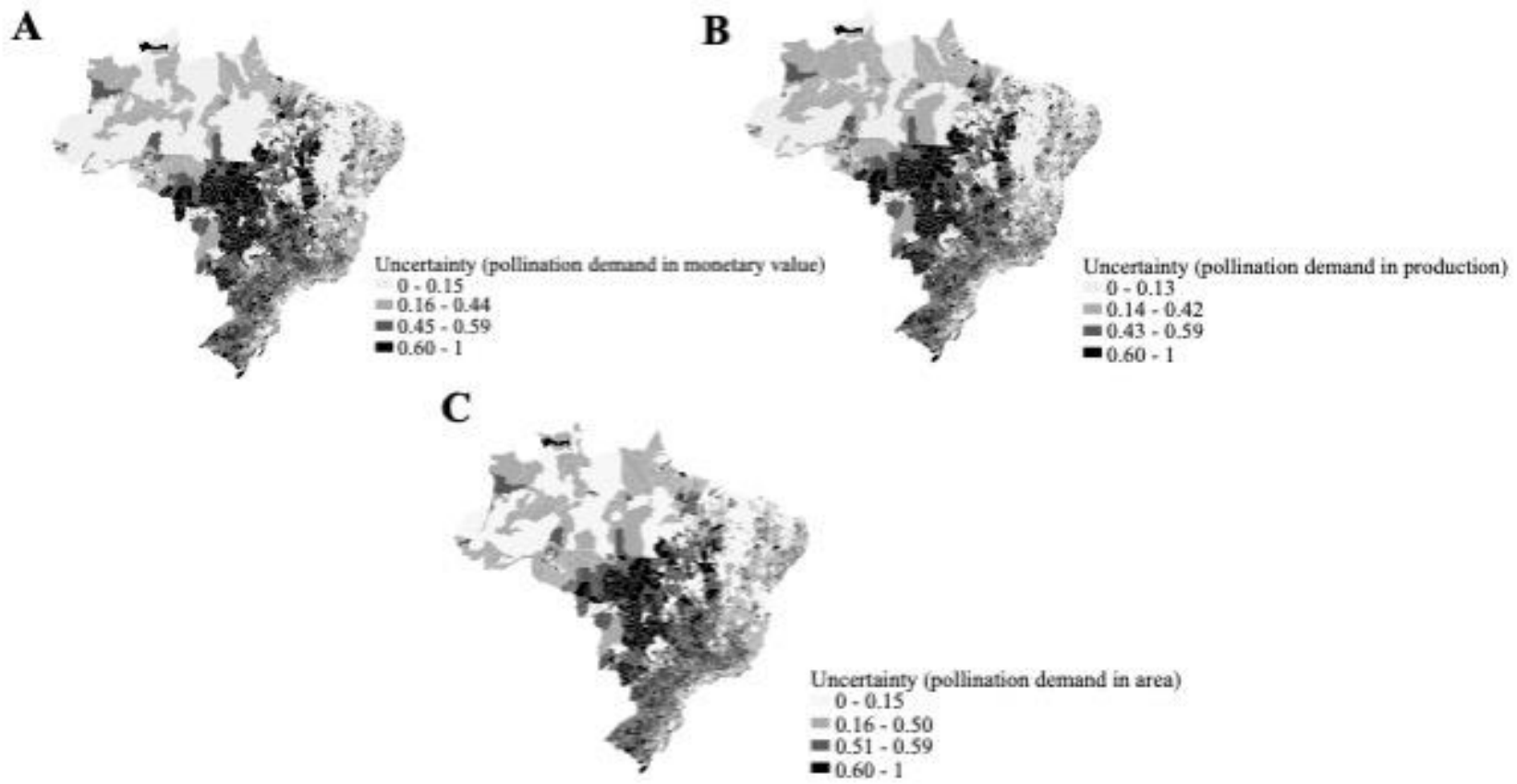

Fig. S4 Uncertainty in pollination demand metrics (expressed as percentage of change in pollination demand metrics relative to its upper and lower bounds). A. Uncertainty in demand for crop pollination in monetary value. B. Uncertainty in demand for crop pollination in production. C. Uncertainty in demand for crop pollination in area.

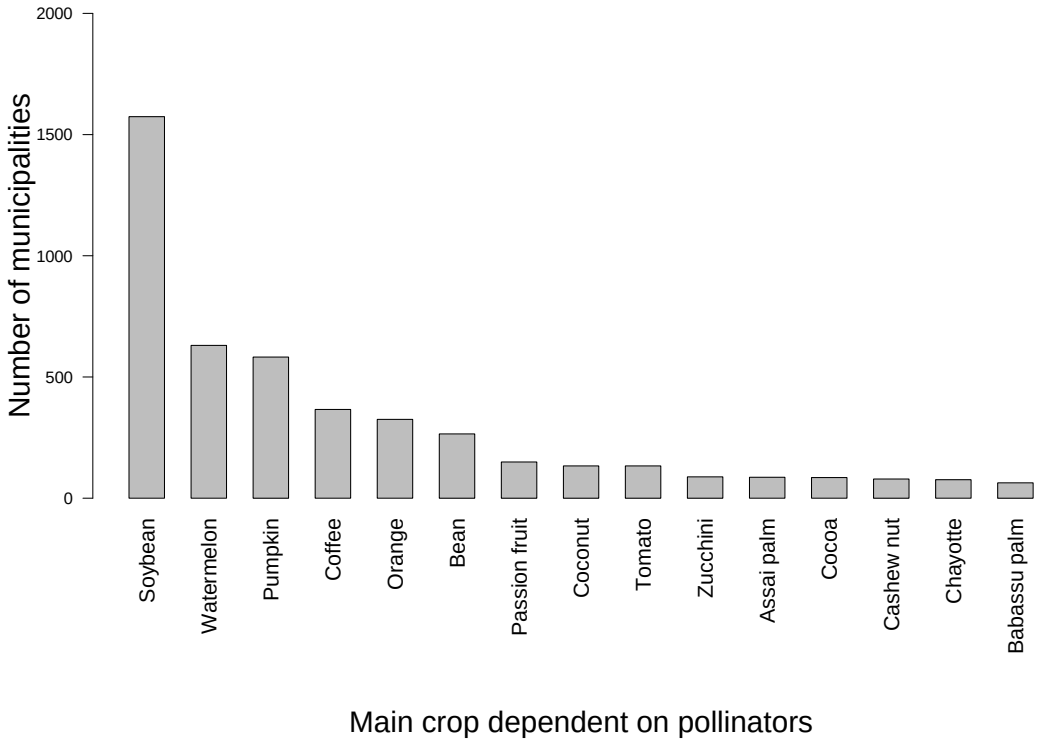

Fig. S5. Pollinator-dependent crops that contributed the most to the estimate of demand for pollination (based on crop production in ton). Bars represent the number of municipalities on which a given pollinator-dependent crop contributed the most.

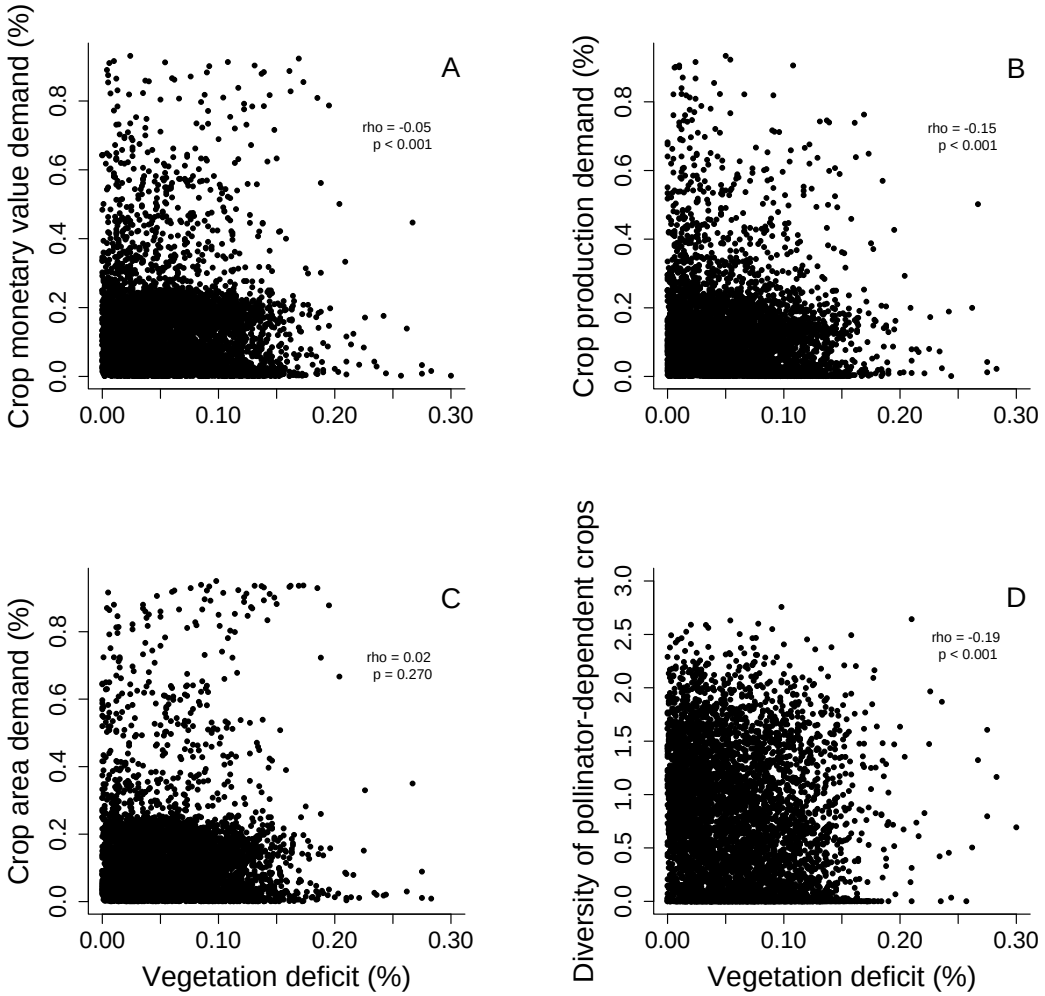

Fig. S6. Correlation between crop pollination metrics and vegetation deficits in Brazilian municipalities A. Demand for crop pollination based on value B. Demand based on crop production C. Demand based on crop area. D. Diversity of pollinator-dependent crops.

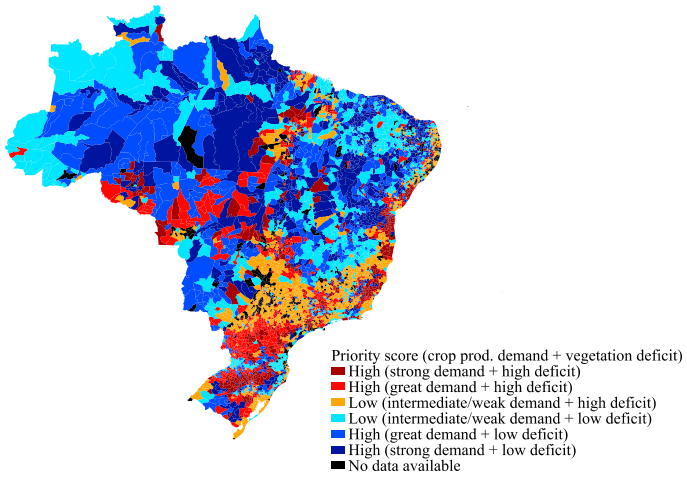

Fig. S7. Combination of demand for crop pollination in production and vegetation deficit in Brazilian municipalities. Municipalities were classified in high restoration priority (strong/great crop pollination demand + high deficit) and low restoration priority (low demand + high deficit). Municipalities with low vegetation deficit were given priority scores for conservation of natural areas and maintenance of restoration efforts in relation to crop pollination: high conservation priority (strong/great demand + low deficit) and low conservation priority (low demand + low deficit).

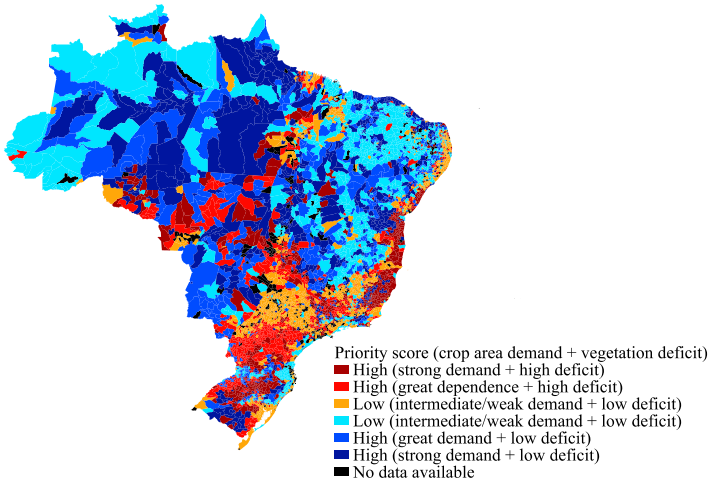

Fig. S8. Combination of demand for crop pollination in area and vegetation deficit in Brazilian municipalities. Municipalities were classified in high restoration priority (strong/great crop pollination demand + high deficit) and low restoration priority (low demand + high deficit). Municipalities with low vegetation deficit were given priority scores for conservation of natural areas and maintenance of restoration efforts in relation to crop pollination: high conservation priority (strong/great demand + low deficit) and low conservation priority (low demand + low deficit)