Japanese Citizens' Views on Using Voluntary Carbon Offsets for Collaboration with Developing Countries: An Experimental Social Survey of Yokohama and Kitakyushu

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Abstract

This study explores the citizens' attitude towards international collaboration on low carbon development in developing countries through voluntary carbon offsetting, using an experimental social survey in two Japanese large cities. In particular the authors focus on additionality of greenhouse gas emissions reductions through voluntary carbon offset by Kyoto credits generated from climate change mitigation projects in developing countries, providing the respondents of the survey with the opportunity to offset their emissions instead of receiving a gift certificate as remuneration. The study finds around 40% of respondents choose carbon offsetting, of which around half choose carbon offset contributing to the world beyond the Kyoto target of the Japanese government although most of the current Japanese carbon offset providers utilise carbon offset contributing to the Japanese government by means of Kyoto credits. Japanese citizens could conduct more carbon offset using the credits generated from the projects in developing countries, including offset beyond the Kyoto targets, though difficulties in understanding the mechanism of carbon offsetting shall be resolved. Carbon offset providers in Japan and other countries that may have nationally binding target and allow using international carbon offsetting, should consider proving users with both options of offset to meet the national target and offset beyond the national target.

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1. Introduction

A transition to low carbon society is considered urgent to cope with the serious threat of climate change. It is also argued to be important for global society to provide cooperation to developing countries in terms of finance, technology, and capacity development so that developing countries integrate and mainstream climate policy into their development policies (Hamanaka, 2010). One of the measures to tackle this issue is to reduce emitting anthropogenic greenhouse gases (GHGs) in developing countries. Conversely, parties in developed countries that have GHG emissions reduction targets under international agreements purchase the credits produced by the GHG emissions reduction projects in developing countries. This is the clean development mechanism (CDM) under the Kyoto protocol (World Bank, 2010). However, there is also a voluntary mechanism where companies and individuals purchase the credits of emissions reductions in order to offset their emissions for which they are responsible, without regulatory requirements. This is called voluntary carbon offset since carbon dioxide is a major GHG.

Even if the credits produced from climate change mitigation projects in developing countries are small, the projects could contribute to low carbon development in developing countries (Kirkman, 2011; Nakamura, et al., 2009). Voluntary carbon offsetting in developed countries by the non-national parties who do not have a regulatory limitations of the emissions could strengthen financial flow to climate change mitigation projects in developing countries, when the credits for carbon offsets are generated from the projects in developing countries. It is clearly additional GHG emissions reduction when verified emissions reduction (VER) is used for voluntary carbon offsetting. However this is not necessarily the case when the carbon credits issued based on the Kyoto protocol (Kyoto credits) are used for voluntary carbon offset. In Japan, many of the carbon offset providers use Kyoto credits for customers' offsetting because they think Kyoto credits are more credible than VERs (Recycle One, 2010). However, they tend to donate the credits used for offsets to the Japanese government aiming to meet the Kyoto target of the government, instead of cancelling the credits. The former way of carbon offsetting is called "retirement" where the credits are used to meet the GHG reduction targets of Annex-I countries under the United Nations Framework Convention on Climate Change (UNFCCC). The latter way of carbon offsetting is called "cancellation" where the credits are used outside the Kyoto targets, disabling for anyone to use them to satisfy the requirement under the Kyoto

targets. So if the Kyoto targets are met, “cancellation” implies additional GHG reductions on top of the Kyoto targets.

In Japan, the tendency to use “retirement” instead of “cancellation” exists despite that fact that Japanese government has secured enough Kyoto credits by means of Green Investment Scheme to achieve its Kyoto target (Ministry of the Environment, 2011). Once the credits are “retired” to Japanese national government account, they ultimately support the Japanese government to use the equivalent amount of public expenditure for other purposes. In contrast, when the credits are “cancelled,” the money used for carbon offsetting is additional financial flow to the GHG emissions reduction projects in developing countries or elsewhere.

Since voluntary carbon offset in Japan has just started and is not yet popular, it is necessary to examine if a preference of contribution to one’s own government’s achieving the target through retiring credits is actually observed among general Japanese citizens. Moreover, the reasoning of selecting carbon offset contributing to Japanese government is to be clarified to see what hinders Japanese people’s potential contribution to financing low carbon development in developing countries.

The two options of carbon offsetting, i.e., retirement and cancellation, might be considered when the countries currently listed as non-Annex I countries under the UNFCCC set national GHG emissions reduction targets and allow companies and individuals in their countries to use carbon credits produced by the projects in developing countries that do not have regulatory targets, under a certain certification mechanism. Carbon offset providers in these countries also have to consider options to be used based on market preference and additionality. So exploring Japanese case could have implications for future voluntary carbon offset market in other countries that may have national self-binding targets.

This study explores Japanese citizens’ attitudes towards international collaboration on low carbon development in developing countries through voluntary carbon offsetting by individuals in two large Japanese cities, using a social survey on the opportunity of actual carbon offsetting. In particular the authors evaluate the current state and challenges from the perspective of general citizens, focusing on additionality of GHG emissions reduction through carbon offsetting by Kyoto credits generated from climate change mitigation projects in developing countries, providing the respondents of the

survey with the opportunity to offset their emissions instead of receiving a gift certificate as remuneration. Though MacKerron et al. (2009) studies willingness-to-pay for carbon offset and co-benefits among young British adults, they conduct the survey in the United Kingdom (UK) context and do not focus on the types of credit utilisation either to retire or to cancel. Akter et al. (2009) investigates air travellers' willingness-to-pay for mandatory travel tax or voluntary contribution to offset carbon emissions from flying at an international airport in Europe. Yet this study does not differentiate the types of credit utilisation either. Jacobsen (2011) conducted natural experimental analysis of effects of the film on voluntary carbon offsetting purchase behaviour in the US, but the types of credits is not the focus of the study either. In Japan, the Foundation for Promoting Personal Mobility and Ecological Transportation conducted an internet survey with registered individuals regarding willingness to participate in and willingness-to-pay for carbon offsetting for various transportation modes, yet it does not specify the type of utilisation of credits, it is not randomised survey, and it is hypothetical survey (Foundation for Promoting Personal Mobility and Ecological Transportation, 2008). This study examines preferences of Japanese citizens in two large cities on two different types of carbon offsets in terms of how to deal with the credits.

The study finds around 40% of respondents choose carbon offsetting instead of receiving gift certificate as remuneration for the survey, of which around half choose offset contributing to the world beyond the Kyoto target of Japanese government. Japanese citizens could conduct more carbon offset using the credits generated from the projects in developing countries, including those beyond the Kyoto targets.

The next section explains the state of voluntary carbon offsetting in Japan. An explanation of the methodology used for the study follows, including the questionnaire used in the social survey, the data collection process and the statistical analysis used. Then the results of the study are reported and the paper concludes with discussion and international implications based on the findings.

2. Voluntary carbon offsets in Japan

Voluntary carbon offset markets have been growing both globally and in Japan though it represents a small fraction of the total carbon market and economic recessions that made a significant impact on the global market in 2009 (Table 1). The figures for 2009

were estimated values. The Japanese government developed a guideline on carbon offsetting in Japan in 2008 (Ministry of the Environment, 2008) and has initiated several actions for promoting carbon offset and securing credibility of carbon offsetting including standard setting for third party verification or carbon offset labelling (Ministry of the Environment, 2010).

Table 1: Japanese and Global Carbon Markets

	Volume ($ktCO_2e$)			Value		
Year	2007	2008	2009	2007	2008	2009
Regulated market (Global)	2,920,000	4,713,000	8,625,000	63,711 (US$ mil)	134,415 (US$ mil)	143,897 (US$ mil)
Voluntary market (Global)	66,000	127,000	94,000	335 (US$ mil)	728 (US$ mil)	387 (US$ mil)
Voluntary market (Japan)	85	516	905	396 (mil yen)	2,204 (mil yen)	3,748 (mil yen)

Sources: Hamilton et al. (2009), Hamilton et al. (2010), Yano Research Institute (2009)

In Japan, the way of carbon offsetting in terms of credit handling has characteristic features. Table 2 shows the way of carbon offsetting of Japanese offset providers that are members of Carbon Offset Associations, indicating if they are using Kyoto credits (mostly certified emissions reduction (CER)) to offset and how to deal with Kyoto credits when they are used by customers. In Table 2, ktCO2e refers to kilotons of CO_2 equivalent. Kyoto credits are preferred for offsetting in Japan because of the high validity and credibility of the credits due to its rigorous review and monitoring mechanism while mostly VER are used for offsetting elsewhere (PEAR Carbon Offset Initiative, 2008; Recycle One, 2010). As Table 2 shows, four offset providers use retirement to expire Kyoto credits and three are using only retirement, among five providers using Kyoto credits for their offsets and whose disabling ways are disclosed. Although there are no official statistics to see the actual amount of Kyoto credits that are retired and cancelled by Japanese offset providers, it is considered that retirement is a major way of disabling credits in Japan according to one of the major offset providers (Recycle One, 2010).

Table 2: Methods for disabling Kyoto credits by Japanese offset providers

Offset provider	Kyoto credits are used for offsets	Method of disabling Kyoto credits	
		Retirement	Cancellation
A	Yes	√	-
B	Yes	√	-
C	NA	NA	NA
D	Yes	√	√
E	Yes	√	-
F	Yes	-	√
G	No	-	-
H	Yes	NA	NA

Sources: Each provider, Certification Center on Climate Change, Japan (2010)

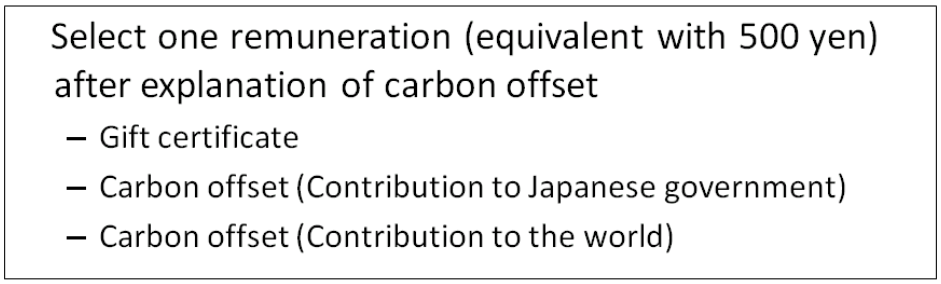
3. Methodology

3.1. Survey design

A social survey was conducted in two Japanese cities, namely Yokohama and Kitakyushu, which are considered characteristic in their international environmental cooperation, to understand the citizens' attitudes toward carbon offset utilisation that may contribute to low carbon development in developing countries. Yokohama emphasises a contribution to global society while Kitakyushu intends to conduct industrial development in the long term (Nakamura et al., 2010). The first questionnaire was mailed to 1,757 citizens over 20 years old from each city of Yokohama and Kitakyushu, randomly drawn from a citizen registry, and collected by mail, during February to March 2010. The response rates were 38% for Yokohama and 39% for Kitakyushu. The survey asked about interests in climate change and international development, daily actions to mitigate climate change, and other information used for other purposes. In addition, the survey provided the opportunity of carbon offsetting instead of receiving a gift certificate as remuneration. In the survey, the mechanism of carbon offsetting was explained in a plain manner and the respondents were asked to select either a gift certificate of JPY500 as remuneration, or conduct carbon offset with an equivalent value (reduction of 100 kg of GHG emissions). See Fig. 1 shows the list of alternative in the questionnaire. It was explained in the study that the amount of emissions was around 5% of averaged GHG emissions from Japanese household. Offsetting of daily emissions was used here since offsetting specific activities such as flying or driving could not be expected for randomly selected citizens. The credits used are those of the United Nations (UN), registered and produced by a biomass power generation project in India. There were two alternatives: One was to contribute to the

Japanese government, the other was to contribute to the world (additional reduction to the government's commitment). The former offset was named "offset contributing to the Japanese government" while the latter was named "offset contributing to the world" in the questionnaire. The order of listing the types of carbon offset was randomly allocated to avoid possible bias of order effect, i.e. the respondent tends to select the alternative listed at the top of the list. Offset certificates were sent to the respondents who selected offsetting after the carbon offset provider executed the offsetting.

Fig. 1: Alternatives for remuneration and carbon offsetting listed in the questionnaire of first survey



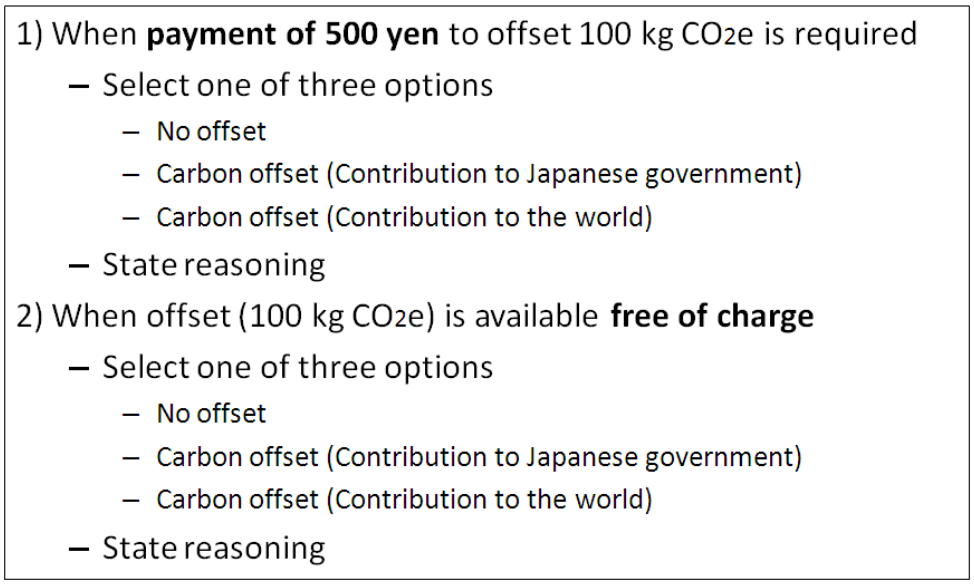
Source: Author

The second questionnaire was mailed in July 2010 to 539 citizens in Yokohama and 590 citizens in Kitakyushu, who had responded to the first survey and replied that they would consider participation in the second survey at that time. The answers were collected during a period from July to September 2011. The response rates for the second survey vis-à-vis the original target of the first survey were 23% for Yokohama and 24% for Kitakyushu, respectively. The second survey asked hypothetical questions on whether a respondent does carbon offset that costs JPY500 for 100 kg of GHG emissions or not, soliciting the types of offsetting (either donation to Japanese government or not) in case of carbon offsetting (See Fig. 2 for the alternatives used in the survey). It also asked the same question supposing the respondent can offset free of charge. In both cases, the respondents were asked to provide their reasoning for their selection in an open-ended manner. An additional question on understanding of carbon offset was provided, which allowed for multiple answers to the following alternatives: 1) "I realised soon which carbon offset was desirable for me," 2) "I realised soon which carbon offset is more useful for climate change mitigation," 3) "I did not know the difference of two carbon offset types," and 4) "I do not think carbon offset is necessary regardless of the types." The second survey asked if the respondent also replied to the first survey. Answers for the second survey from respondents who answered that he or

she did not answer the first survey questions are removed from the data set.

Since the study used only one case of the price for carbon offset when it is not free of charge, citizens' responses to carbon offsetting for different prices is not clarified. Additional study is required to see the effects of price on individuals' carbon offsetting.

Fig. 2: Alternatives carbon offsetting listed in the questionnaire of second survey



Source: Author

3.2. Statistical analysis

The respondents' attitudes and behaviour in terms of environmental protection and international cooperation were studied in the first survey and the state of understanding and ideas on carbon offsetting was asked about in the second survey. The relationship between the individual characteristics and the selection of remuneration and types of carbon offset is analysed by a cross-table and regression analysis. The regression uses a logit model that includes the variable depending on alternative – carbon offset dummy – as well as socio-economic variables that do not change over alternatives such as gender, age, household income, city of residence and those indicating attitudes on environment and international cooperation.

4. Results

4.1. Offset selection

As for actual carbon offsetting in the first survey, more than half of the respondents did not know what it was and only around one percent of them had actually done it themselves. Table 3 shows the selection results of remuneration and actual carbon offsetting by city. Out of respondents who showed a preference for remuneration, around 40 percent chose carbon offsetting. The ratio of respondents in Yokohama who chose offsetting was higher than that in Kitakyushu. The number of respondents who selected an offset contributing to the Japanese government and that of respondents who selected an offset contributing to the world are almost the same in Yokohama, while an offset contributing to the Japanese government was slightly preferred in Kitakyushu. Statistical analysis will be presented in the section 4.3 to see the statistical significance.

Table 3: Selection results of remuneration and actual carbon offsetting

Choice	Gift certificate	Offset contributing to Japanese government	Offset contributing to the world	Total
Number of observations in Yokohama	317	110	114	541
Ratio in Yokohama (%)	58.6	20.3	21.1	100.0
Number of observations in Kitakyushu	356	118	91	565
Ratio in Kitakyushu (%)	63.0	20.9	16.1	100.0

Source: Author

Table 4 shows the selection results of hypothetical carbon offsetting as seen in the questionnaire for the second survey where payment of JPY500 is assumed. Table 5, on the other hand, indicates the results of hypothetical carbon offsetting where the offset is assumed to possibly be free of charge.

The above results show that more respondents select carbon offsetting when they are free-of-charge and that the degree of preference to offset contributing to the Japanese

government and that to offset contributing to the world seem quite similar. Statistical analysis on this observation will also be provided in the section 4.3.

Table 4: Selection results of hypothetical carbon offsetting with payment

Choice	No offset	Offset contributing to Japanese government	Offset contributing to the world	Total
Number of observations in Yokohama	154	110	120	384
Ratio in Yokohama (%)	40.1	28.6	31.3	100.0
Number of observations in Kitakyushu	168	113	126	407
Ratio in Kitakyushu (%)	41.3	27.8	31.0	100.0

Source: Author

Table 5: Selection results of hypothetical carbon offsetting free of charge

Choice	No offset	Offset contributing to Japanese government	Offset contributing to the world	Total
Number of observations in Yokohama	98	139	143	380
Ratio in Yokohama (%)	25.8	36.6	37.6	100.0
Number of observations in Kitakyushu	100	137	162	399
Ratio in Kitakyushu (%)	25.1	34.3	40.6	100.0

Source: Author

4.2. Reasoning of selection / non-selection and state of understanding

Table 6 summarises the major answers written in the open-ended manner to the question that asked about the reasoning of selection of carbon offsetting types or no offsetting in the hypothetical setting where payment of JPY is assumed to be needed to offset 100 kg of GHG emission from daily lives. The reasons are first classified into different groups and then the distribution of different answers is confirmed for each city. The authors conducted this classification even though it may be arbitrary to a certain degree since classification using automatic word-analysis software does not provide rational results. Here the major answers that consist of more than 4% of effective answers for both of the cities are shown. Table 6 also shows the frequency and ratio of each answer among effective answers. The distribution of the reasoning for the case of offsetting free-of-charge is similar to that of the case that payment is needed.

Table 6: Main reasons for selecting offsetting and offsetting types

Choice	Reasoning
No offset	• Because I should reduce the GHG emissions by means of my actions (21.0%) • Because mitigation of my emissions shall not be purchased; mitigation shall not be a business (5.5%)
Offset contributing to Japanese government	• Since it is natural to start from contribution to Japanese government; since I am a Japanese (10.9%) • To contribute to Japanese government's achieving the target (6.3%)
Offset contributing to the world	• Since this is a global issue which cannot be solved by mitigation of only one country (23.7%)

Source: Author

Table 7 indicates the each city's distribution of respondents' ideas on two types of carbon offsetting. Multiple choices are allowed here. The Table shows around one fourth to one fifth of respondents are sceptical about carbon offsetting and do not think it is useful regardless of the type. Around one third do not understand the difference very well. In contrast, around one third to one fourth understands which type of carbon is more suitable for them and more effective for climate change mitigation.

Table 7: Distribution of the number of respondents who support the various ideas on two types of carbon offsetting

Choice	"I realised soon which carbon offset was desirable for me."	"I realised soon which carbon offset is more useful for climate change mitigation."	"I did not know the difference of two carbon offset types."	"I do not think carbon offset is necessary regardless of the types."	"Others"	Number of effective respondents
Number of observations in Yokohama	97	115	110	71	65	372
Ratio in Yokohama (%)	26.1	30.9	29.6	19.1	17.5	100.0
Number of observations in Kitakyushu	105	125	121	97	49	402
Ratio in Kitakyushu (%)	26.1	31.1	30.1	24.1	12.2	100.0

Source: Author

4.3. Analysis of carbon offset choice

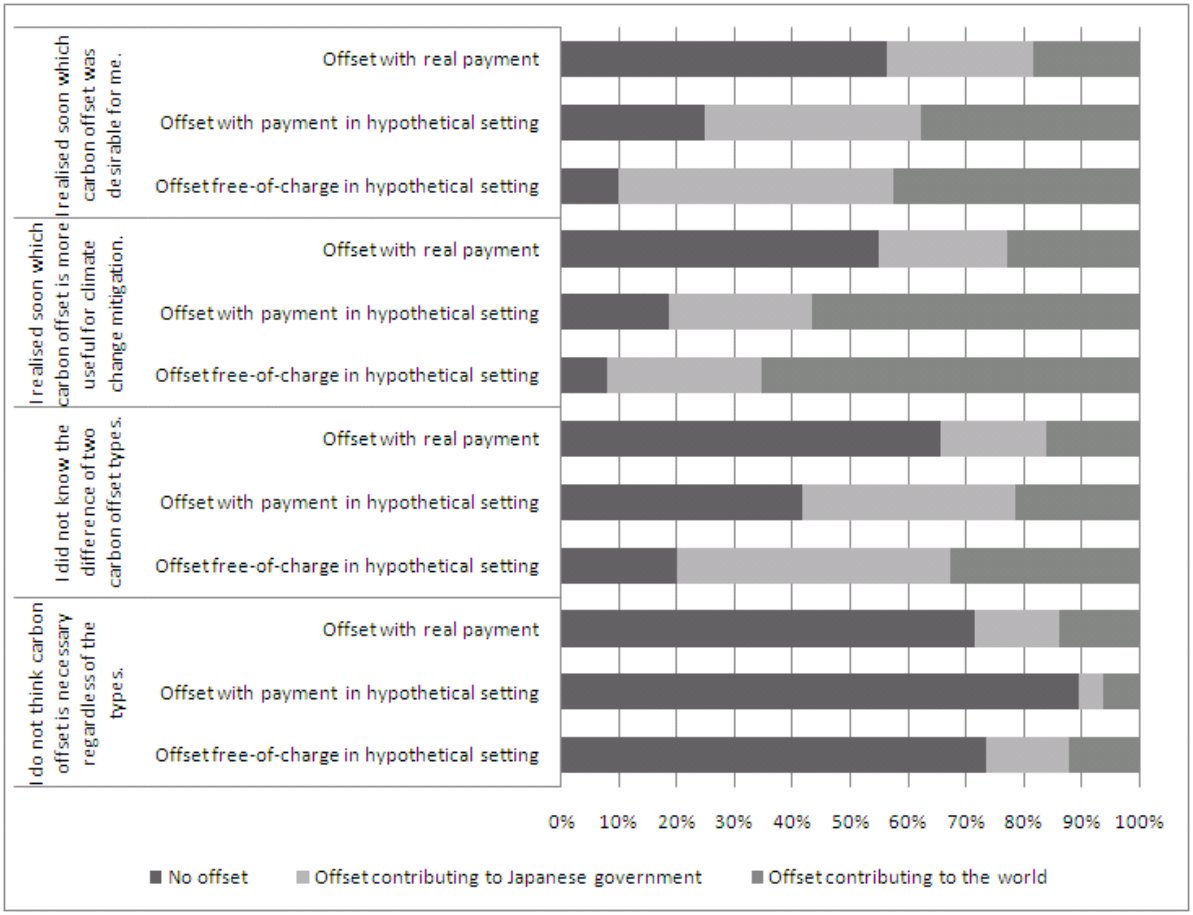
4.3.1 Relation between carbon offset choice and ideas on carbon offset types

Fig. 3 shows distribution of carbon offset choices by different ideas on two types of carbon offsetting for three cases: offset with real payment, offset with payment in hypothetical setting, and offset free-of-charge in hypothetical setting. More than 70% of the respondents who do not think that carbon offset is necessary regardless of types chose "no offset" not only in the cases of real payment and payment in hypothetical setting, but also in the case of free-of-charge. It is considered that the respondents chose "no offset" in the case of free-of-charge mostly based on their senses of environmental responsibility, i.e., the belief that they should reduce their own GHG emissions by changing their behaviours in daily lives, since reduction through offsetting requires no cost while reduction through their behavioural change requires at least some cost.

It is also found that respondents who answered they recognised which carbon offset type is more useful for climate change mitigation chose “carbon offset contributing to the world” two times more than “carbon offset contributing to the Japanese government” in a hypothetical setting. This suggests that respondents who chose “carbon offset contributing to the world” have a stronger belief of environmental effectiveness of carbon offset contributing to the world though this does not imply all of them have deep understanding of additionality beyond the description given in the survey. On the other hand choices of carbon offset types for respondents who stated they understood which carbon offset type was desirable for them do not differ very much between carbon offset contributing to the Japanese government and that contributing to the world in a hypothetical setting.

Lastly the respondents who stated they did not know the difference between the two types of carbon offsetting preferred carbon offset contributing to the Japanese government to that contributing to the world. This implies that insufficient understanding of the types of carbon offset resulted in respondents’ choosing “carbon offset contributing to the Japanese government.” Such respondents might have thought contribution to the Japanese government was natural when the difference is unclear, as indicated in reasoning for selecting carbon offset contributing to Japanese government (Table 6).

Fig. 3: Relation between ideas on carbon offset and carbon offset choices



Source: Author

4.3.2 Regression analysis of carbon offset choice

In this sub-section, the results of regression analysis of carbon offset choice are provided to see the effects of different settings and individual attributes on choice. First, regression analysis using a logit model is presented for selection of carbon offset for 665 respondents who selected alternatives in all cases of carbon offset choice setting. A logit model is a representative regression analysis model that explicitly incorporates the discrete nature of responses. There are three alternatives. The fixed term of the utility function for no offset V_1 is defined as zero while the fixed terms of the utility function for two types of offset are defined as follows, where v is a dummy variable indicating carbon offset, β and ASC_3 are coefficient and constant to be estimated:

$$V_2 = \qquad \beta v \qquad (1)$$

$$V_3 = ASC_3 + \beta\, v \qquad (2)$$

The coefficients are considered significant at 5% significance level. The results in Table 8 indicate carbon offsetting is avoided in the cases of real and hypothetical payment while it is preferred in the case of offset free-of-charge in hypothetical setting. The Models 1a to 3a also find no alternative specific constants are significant in all three cases. Therefore it is confirmed that no specific preference is observed either of carbon offset contributing to Japanese government or of that contributing to the world, when the preference of the population is averaged.

Table 8: Estimation results for selection of carbon offset

	Offset with real payment		Offset with payment in hypothetical setting		Offset free-of-charge in hypothetical setting	
	Model 1a		Model 2a		Model 3a	
Variable	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
Carbon offset	-1.096	0.000	-0.339	0.000	0.368	0.000
Offset contributing to the world						
Altarnative specific constant	-0.149	0.235	0.159	0.112	0.108	0.228
Sample size	665		665		665	

Source: Author

Table 9 shows the estimation results that include individual attributes such as gender, age, household income, city of residence, climate change concern, international development concern, and number of climate change mitigation actions in daily life, in order to understand the effects of individual attributes on choices of carbon offset. Descriptive statistics of these individual attributes are summarised in Table 10. The fixed term of the utility function for no offset V_1 is defined as zero while the fixed terms of the utility functions for two types of offset are defined as follows, where v is a dummy variable indicating carbon offset, X is a vector of individual attributes, β, θ, and ASC_3 are coefficients and constant to be estimated:

$$V_2 = \beta\, v + \theta_2 X \qquad (3)$$

$$V_3 = ASC_3 + \beta\, v + \theta_3 X \qquad (4)$$

Models 1b, 2b, and 3b include all individual attributes whereas Models 1c, 2c, and 3c include only individual attributes that are significant in all cases of carbon offset choice setting. The model estimation results of Models 3a to 3c indicate the following: concern about international development increases the probability of choosing carbon offset contributing to the world in all choice settings. The older a respondent is, the more respondents choose offsetting regardless of the types of offset when it requires real payment. The same effect of age is observed only for offsetting to contribute to the Japanese government when there is a hypothetical payment setting. Lastly, the higher the household income, the more respondents chose offset contributing to the world in a real payment context.

Table 9: Estimation results with individual attributes

	Offset with real payment				Offset with payment in hypothetical setting				Offset free-of-charge in hypothetical setting			
	Model 1b		Model 1c		Model 2b		Model 2c		Model 3b		Model 3c	
Variable	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
Carbon offset	-4.098	0.000	-2.822	0.000	0.051	0.947			0.595	0.473	0.350	0.000
Offset contributing to Japanese government												
Female	0.055	0.741			-0.188	0.322			0.043	0.835		
Age	0.257	0.000	0.271	0.000	0.208	0.001	0.164	0.001	0.016	0.808		
Household income	0.289	0.002			0.103	0.312			-0.029	0.792		
Kitakyushu city	0.115	0.492			-0.112	0.557			0.033	0.873		
Concern about climate change	0.207	0.103			-0.005	0.969			0.126	0.394		
Concern about international development	0.067	0.460	0.302	0.001	-0.315	0.002	-0.263	0.000	-0.302	0.007		
Number of climate protection actions	-0.010	0.768			0.036	0.316			0.040	0.297		
Offset contributing to the world												
Altarnative specific constant	-1.674	0.090	-1.921	0.001	-2.820	0.002	-1.925	0.000	-2.138	0.007	-1.241	0.000
Female	0.272	0.138			-0.043	0.820			0.263	0.192		
Age	0.250	0.000	0.237	0.000	0.107	0.084			-0.049	0.467		
Household income	0.452	0.000	0.471	0.000	0.013	0.893			-0.064	0.548		
Kitakyushu city	-0.049	0.785			0.044	0.816			0.305	0.129		
Concern about climate change	0.280	0.052			0.197	0.183			0.233	0.123		
Concern about international development	0.336	0.002	0.382	0.000	0.340	0.003	0.421	0.000	0.187	0.113	0.349	0.000
Number of climate protection actions	-0.063	0.080			-0.018	0.613			-0.036	0.345		
Sample size	1020		1053		727		768		717		757	

Source: Author

Table 10: Descriptive statistics of individual variables

Gender	
Female	51.2%
Male	47.4%
Unknown	1.5%
Age	
20 - 29	9.7%
30 - 39	16.4%
40 - 49	19.4%
50 - 59	17.1%
60 - 69	20.5%
70 or older	15.3%
Unknown	1.7%
Household income	
< JPY 2 million	11.3%
JPY 2 - 5 million	41.6%
JPY 5 - 10 million	31.8%
JPY 10 - 15 million	8.7%
JPY 15 - 20 million	1.9%
JPY 20 million or more	0.7%
Unknown	4.0%
City	
Yokohama	48.1%
Kitakyushu	51.9%
Climate change concern	
Concerned	45.9%
Concerned, if anything	41.9%
Hard to say	7.4%
Not concerned, if anything	1.6%
Not concerned	1.1%
Unknown	2.1%
International development concern	
Concerned	22.7%
Concerned, if anything	43.3%
Hard to say	22.3%
Not concerned, if anything	6.7%
Not concerned	3.4%
Unknown	1.7%
Number of climate protection actions	
Mean	6.5
Standard deviation	2.8

Source: Author

5. Discussion and conclusion

The study found carbon offset is still a new tool and has not yet been widely known and used in two large Japanese cities. The first survey found more than half of the respondents did not know what it was and only around one percent of them had actual offset experiences. Some respondents answered they do not offset because they do not

know about the offsetting mechanism clearly. Around one third of respondents do not understand the difference between the two types of carbon offsetting in the second survey. The responses to the reasoning of selection or no selection of hypothetical carbon offsetting in the second survey revealed that some respondents mistook an offset contributing to the Japanese government as a mitigation project in Japan, and an offset contributing to the world as a mitigating project in developing countries. In fact, the point is how to deal with the credit (either to retire or to cancel) and it was stated that the mitigation project that produces the credits for offset is located in a developing country.

Despite the citizens' current low level of knowledge of and engagement in carbon offsetting, the study also found there is possibility for Japanese citizens to conduct carbon offset using the credits produced from climate change mitigation projects in developing countries, since around 40% of respondents in real payment setting and around 60% of respondents in hypothetical payment setting conducted or selected carbon offset to offset 100 kg CO_2e with the payment of 500 yen. These participation rates might be higher than actual figures in population since response rates for these two cases are 38% and 23% respectively, and there might be selection bias; i.e., the respondents who participated in the survey might have a higher participation rate in carbon offsetting than those who did not participate in the survey.

One of the reasoning of no offsetting seems to be a kind of sense of responsibility when we infer from stated reasoning (Table 6). Around a quarter of respondents in the second survey do not use offset since they believe that they should reduce their GHG emissions by changing their behaviours. They also believe that it is not desirable to spend money so that others carry out reductions of GHG emissions. In addition more than 70% of the respondents who do not think that carbon offset is necessary regardless of types chose "no offset" even in the case of free-of-charge (Fig. 3). From the viewpoint of the utility theory of altruism, the person who chooses no offsetting because of a sense of environmental responsibility increases their utility not by simply seeing the increase of environmental quality but by the increase of environmental quality through their actions, assuming that the protection of the environment is altruistic behaviour (Arrow, 1972; Usami, 1993). Another reason for no offsetting would be no sense of obligation regarding climate change mitigation high enough to pay for offsetting, though this reason is stated only by one respondent among 490 effective responses.

Among the respondents who chose offsetting, around half of them prefer to choose carbon offset contributing to the Japanese government (credit to be retired in the national registry) while the other half prefer to choose carbon offset contributing to the world (credit to be cancelled) as shown in Table 3. This tendency does not largely change whether offset is actual or hypothetical. The neutral preference between offset contributing to Japanese government and that contributing to the world is also confirmed in regression analysis as indicated by the insignificance of an alternative specific constant for offset contributing to the world (Table 8). Those who choose carbon offset contributing to the Japanese government think that selection is natural for them, while those who choose offset contributing to the world point out the global nature of climate change (Table 6). The regression analysis with individual attributes also finds the respondents who are concerned about international development prefer an offset contributing to the world (Table 9). Around 15 - 20 % and 30 % of respondents prefer to choose an offset contributing to the world in real and hypothetical payment conditions respectively (Tables 3 to 5). It is also suggested that citizens who choose carbon offset contributing to the world more often believe the environmental consequences through their choice (Fig. 3). Although most of the Japanese carbon offset providers currently provide opportunities of an offset contributing only to the Japanese government, they should pursue more utilisation of offsets contributing to the world, which is common outside of Japan, since the survey on general citizens shows a certain degree of preference for such offsets.

When the countries that do not currently have internationally binding GHG emissions reduction target set nationally binding target, allowing international carbon offsetting using the credits produced in developing countries that do not have mandatory reduction target, the carbon offset providers working in such countries will be faced by the question of how to set the options of carbon offset, either retirement or cancelation, or both. Since voluntary carbon credit users may show the preference to offset beyond their national governments' target as shown in the survey in Japanese two cities, at least providers should provide opportunities so that users can choose whichever they like. They do not need to limit the option only to the retirement, i.e., donation to their governments.

As discussed above, carbon offsetting seems to be avoided partly because of difficulties of understanding the mechanisms of carbon offsetting. It would be possible that information dissemination on reliable mechanisms of credit verification and registration

system such as the one used to manage Kyoto credits, and more diffusion of offsetting practices in Japan may dissolve the barrier of perceived unclear mechanism of carbon offsetting.

Although there is some controversy on the utilisation of carbon offsetting to mitigate global climate change (Liverman, 2010), voluntary carbon offsetting would promote mitigation projects in developing countries with the support of citizens when transparent and credible mechanisms and co-benefits of the projects are secured and effective communication is made on these issues. It is also remaining research agenda to explore how Japanese citizens would respond if their local governments provide them with matching funds, for example 50%, to purchase carbon credits when they offset their GHG emissions from their daily activities such as car and airplane transportation.

To understand the citizens' attitudes towards individual carbon offsetting that could contribute to international low carbon development with different price setting, further investigation is needed. Lower price may result in larger sum of carbon offset amount thorough more participation in carbon offsetting.

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