Personal attitudes and beliefs and willingness to pay to reduce marine plastic pollution in Indonesia

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Abstract

Marine Plastic Pollution (MPP) is one of the most pressing issues especially for fast-growing economies in the Global South where addressing it involves both government and personal actions to achieve effective waste management policies. Alternative modelling strategies accounting for personal traits and beliefs (latent attitudes) which are unobservable characteristics are frequently overlooked in policy assessment studies. This study combines contingent valuation and latent traits questions to derive the willingness of Indonesian respondents to support MPP mitigation initiatives. One and two-step models are compared to test the sensitivity of results to modelling assumptions. Latent traits help to understand the willingness to pay (WTP) for MPP and one and two-step approaches produce comparable results. On average respondents are willing to pay £15, per person, per year to reduce MPP, or 2% of the average monthly salary. Local and international organizations should consider motivations and latent traits when designing MPP mitigation strategies.

Keywords:

Marine Plastic pollution; contingent valuation; principal component analysis; structural equation modelling; New Ecological Paradigm; behavioural norms;

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1. Introduction

Coastal areas suffer from multiple environmental impacts (e.g. urbanization) but solid waste pollution is currently receiving a lot of attention. Solid waste pollution affects rivers and ends up in oceans and of that waste, plastics represents the majority of litter in oceans (Moore, 2008) and the post-pandemic world might see a significant worsening of this trend (Klemeš et al., 2020, Vanapalli et al., 2021).

Marine plastic pollution (MPP) is a rising issue across the world as 300 million tons of plastics are produced each year and it is estimated, that about 150 million tons of plastics are currently in oceans (Gourmelon, 2015). From the 1960 to 2000 plastics in seas and oceans have increased by a factor of 25 and now represent between 60-80% of all waste in oceans (Moore, 2008), while accounting for up to 100% of floating debris (Galgani et al., 2015). It is estimated that between 1.15 to 2.41 million tonnes of plastics are annually dumped into oceans. Rivers, that flow through areas where 36% of the global population lives, are mainly responsible for this pollution (Lebreton et al., 2017). On their way to oceans, plastics also accumulate in riverbanks, primarily in river mouths and downwind sides (Gasperi et al., 2014, Rech et al., 2014). Once plastics reach the ocean, ocean currents and tides transport them either back to shores or towards ocean current systems where they form systems known as gyres which sometimes increase debris accumulation or accentuate their dispersal (Ingraham and Ebbesmeyer, 2001).

The reduction of MPP requires society-wide changes such as promoting recycling and discouraging consumption and production of products with low recyclability and increasing the efficiency in disposal of waste (Abbott and Sumaila, 2019). At the same time, national, regional and local governments might promote targeted initiatives to influence perceptions and culture of littering (Hartley et al., 2018) and promote beach and seabed clean-ups (Moore, 2008); bans of carrier bags (Xanthos and Walker, 2017); industry reuse of plastic materials (Moore et al., 2005) and individual and collective voluntary actions (Löhr et al., 2017). Such actions can be financially supported either by individual donations (Shah et al., 2017) or by changes in consumer behaviour (Zahedi et al., 2019). To capture such changes in behaviour in monetary terms, the use of the Willingness to Pay (WTP) approach has been employed considerably in studies valuing environmental protection (Mitchell and Carson, 1989) and particularly in studies examining pollution abatement (Tyllianakis and Skuras, 2016). This study contributes to the willingness to pay literature for MPP, reporting the results of a valuation study conducted in Indonesia and estimated with two alternative approaches to verify the impact of individual unobservable characteristics.

Asian rivers represent the world's top-polluting waterways and carry more than 90% of plastics into the oceans (Lebreton et al., 2017). The two most polluting countries are Indonesia and China (Shuker et al., 2018). However, since 2008 China has introduced a fee on plastic bags while Indonesia is still developing nationwide interventions[1]. Indonesia is the second-largest global emitter of plastics in the oceans (Lebreton et al., 2017). Shuker et al. (2018) report that the coastal population in Indonesia generates annually 3.22 million tons of waste, mainly comprising of plastics (buoyant or sinking), that are not currently adequately managed, resulting in 0.48 – 1.29 million metric tons of MPP. Lebreton et al (2017) report that just four rivers in Indonesia emit annually roughly 200,000 tonnes of plastics

[1] In 2020 a plastic bags fee was introduced in Indonesian major cities as Balikpapan and Bali. Source: https://www.thejakartapost.com/news/2020/07/01/jakarta-begins-new-chapter-in-plastic-waste-reduction.html

in the ocean, which is 14.2% of the global plastic pollution. Waste mismanagement and weather events are identified as the drivers of exacerbating MPP in Indonesia (Lebreton et al 2017).

To address MPP and lacking waste management practices, the Government of Indonesia has pledged in its Long-Term Urban Development Plan (2015-2045) to provide access to sanitation practices to all, including solid waste. Currently the level of recycling represents only 15% of the total country waste and, currently, the recycling strategy is not formally regulated (Shuker et al., 2018). Shuker et al report that the waste management annual spending amounts to US$ 5-6 per person, per year which is not enough to cover the needs of waste collection either land-based or waterborne (international averages consist of US$ 15-20 per person, per year). Shuker et al also highlight that Indonesia lacks operational funding to cope with the waste generated by its growing population, as well as urbanisation (Mitchell, 1994) and tourism (Syakti et al., 2017). The lack of a clearly defined governmental department responsible for country-wide waste management also further impedes reduction of waste (Shuker et al., 2018). Recently, Indonesia was one of the signatory countries of an ocean sustainability initiative that pledged to reduce MPP by moving to a circular economy, within the next 10 years (Stuchey et al., 2020). To meet such goals, a combination of government and private initiatives are urgently required and few private initiatives to incentivise waste collection at the neighbourhood level are already in place (Wijayanti and Suryani, 2015).

Economic impacts of MPP in Indonesia have been limited studied with few examples on beach surveys either in large population centres such as the Kuta beach in Bali (Husrin et al., 2017), Jakarta Bay (Willoughby et al., 1997) or in unmanaged islands in the Pulau Seribu Archipelago (with MPP located there originating though from large population centres such as the city of Jakarta according to Uneputty and Evans, 1997). Hermawan et al (2017) estimated that in 2016 the commercial cost of floating plastic debris in the South Sulawesi province caused annual damages to fishing vessels of 193 million Indonesian rupiahs (IDR) and 156 million IDR damages to fishing gear (£10 thousand and £8 thousand, accordingly).

Despite the growing literature on the economic impact of MPP on the economy, few studies focus on the global south and individuals' interest and attitudes towards MPP. Studies from the Global North on MPP exist but they limit the attention to the monetary estimates of the willingness to pay and not on the intrinsic motivation that drive citizens' choices for plastic (e.g., Loomis and Santiago 2013, Brouwer et al 2017). The relevance of behavioural norms in explaining willingness to pay has been proved for other public goods (e.g., Cooper et al 2004; Oleja and Loureiro, 2007) but relatively less for MPP. Abate et al. (2020) provide monetary measures to reduce MPP in Norway and include attitudinal questions to stress the importance to accommodate latent traits into economic valuation estimates.

Our paper focuses on the Global South and, similarly to Abate et al (2020), aims to study the willingness to pay and the behavioural attitudes of Indonesian respondents for policies that mitigate macro-plastic pollution. Our study focused on visible macro plastics defined by the UNEP (2009) as "fishing nets, consumer goods, such as plastic bags, plastic bottles, plastic packaging, [..]; nappies; smoking-related items, such as cigarette butts, lighters and cigar tips". Differently from Abate et al (2020) our paper compares different empirical approaches to accommodate latent traits in stated preference studies.

The paper is organized in a brief literature review (Section 2), a presentation of the different modelling approaches used and data collected (Section 3) while results and conclusions are presented in the subsequent sections.

2. Literature review

The literature on the economic values people place on MPP mitigation is limited and primarily focused on Western countries. By the nature of the research question ("how much is MPP mitigation worth to you?") the literature has been employing Stated Preference (SP) methods such as the Contingent Valuation Method (CVM) and the Discrete Choice Experiment (DCE). These methods are based on surveys where hypothetical markets or scenarios can be described and via a set of well-designed questions, researchers can infer respondents' preferences and values (Johnston et al., 2017). Nevertheless, SP methods are sensitive to the quality of the survey design, survey scope and dissemination as well as case study-specific cultural and institutional limitations, however guidelines and best practice exist to produce valid and robust results (Johnston et al., 2017). SP findings have been used during litigation proceedings (Bishop et al., 2017), policy decision making and research since the early 90s (Stevens, 2005; Carson, 2012).

The literature on SP surveys on MPP reduction has been limited but growing in the last few years. For example, Loomis and Santiago (2013) adopt both CVM and DCE to calculate how much beach goers of five beaches in Puerto Rico are, on average, willing to pay (WTP) to reduce MPP. The average per day spent on a beach is around 100 USD (CVM produced 103 USD and DCE 98 USD in 2011 price levels). Recently, Brouwer et al. (2017) measured the WTP of beach visitors for removing plastic litter from beaches in three European countries (Greece, Bulgaria and the Netherlands) using a DCE. Findings show that people are willing to pay between EUR 0.67 (Greek sample) and EUR 8.25 (Bulgarian sample) per beach visitor, per year to remove plastic litter washed ashore in beaches from the sea and plastic-containing cigarette butts. Choi and Lee (2018) adopted a CVM to determine that the WTP for removing microplastics in Seoul in South Korea is USD 2.59 per person, per year. Finally, the two most recent studies used also a CVM to measure WTP of respondents for mitigating MPP. The first is Abate et al. (2020) where Norwegian participants are reported to be willing to pay, on average, NOK 5,485 (USD 642) per person, per year to mitigate MPP in the archipelago of Svalbard in the Barents Sea while Zambrano-Monserrate and Ruano (2020) find a median WTP of USD7.65, per person, per year of Ecuadorians to reduce plastic pollution in the Galapagos Islands. Börger et al., (2020) developed a DCE to assess the relevance of different coastal and marine problems in Vietnam and they derive that the WTP for plastic waste collection is the most valuable coastal management service. They model respondents' heterogeneity but they do not formally include latent traits. Available monetary estimates in this literature are very diverse and span from a dollar to over 500 USD and the evidence from the global South most polluting countries is minimal, with Loomis and Santiago (2013) and Zambrano-Monserrate and Ruano (2020) being the only Global South studies. The variability in the range of values and the absence of studies in countries with heavily polluted waterways therefore merit examination.

Contrary, in the tradition of understanding the motivations behind decisions related to the provision of public good, combining latent traits (individual attitudes and beliefs that are unobserved to the researcher but can be approximated with a series of variables, usually pertaining to attitudinal and behavioural characteristics) and WTP is quite well developed (Kotchen and Reiling, 2000, Cooper et

al., 2004, Oleja and Loureiro, 2007, Liebe et al., 2011). Different sets of values such as biospheric values (demonstrating keen concern on the state of the environment) and altruism (putting the interests of others above their own and being genuinely concerned about others' well-being) (Steg et al., 2014) can influence people perceptions, behavioural norms and WTP.

Several theories exist on how individual's attitudes and beliefs predict behaviour such as the Value-Belief-Norm theory (Stern, 2000) and the Theory of Planned Behaviour (TPB) (Ajzen, 1991). The Value-Belief-Norm theory of environmentalism suggests that the "activation" of norms precedes behavioural actions (Stern et al., 1999). TPB assumes that there are three types of beliefs that explain human behaviour: behavioural beliefs (behaviour that leads to an outcome); normative beliefs (behaviour due to what other people think); and control beliefs (behaviour based on beliefs that respondents possess enough knowledge and skill to behave in a certain way) (Brown et al., 2010). Regarding environmental beliefs and attitudes, scales of attitudinal questions such as the New Ecological Paradigm (NEP) (Dunlap et al., 2000) have been extensively used. The NEP scale, in particular, measures the endorsement of an ecological worldview (captured by statements encompassing the existence of ecological limits and human growth, the importance of a balance existing between nature and humans, and statements rejecting the view that nature exists primarily for human use and it is valuable only if it has any human use) (Dunlap, 2008).

The assumed relationship between attitudes, beliefs and WTP is that when a respondent states their WTP they are also detailing a behavioural intention (Choi and Fielding, 2013) and that latent traits play a role on WTP (Spash et al., 2009, Meyerhoff, 2006), although findings provided a mixed message (Spash et al., 2009, Kahneman and Knetsch, 1992, Cooper et al., 2004). The divergence in the literature has been attributed to the existence of both use and non-use values in public goods/services such as biodiversity protection and water improvements (Tab. 1). In terms of pollution abatement and mitigation there is scant evidence on how latent traits and WTP relate, especially when the management of MPP is under scrutiny. We claim that this information is crucial to design effective waste management policies in Asia.

Latent traits cannot be directly included in standard WTP regressions as they induce endogeneity issues (Czajkowski et al., 2017) but if not accounted for the WTP results might be biased and of limited public use (Hess and Beharry-Borg, 2012). Therefore, in the literature what prevails in modelling latent traits and WTP responses is what can be called the "two-step approach". These approaches employ either Principal Components Analysis (PCA) or Factorial Analysis (FA) and incorporate attitudinal variables scores directly in the WTP regression analysis (e.g., Cooper et al., 2004; Halkos and Matsiori, 2018; Grilli et al., 2021).

What is not prevalent in the literature are what we call "one-step approaches" where, by the use of Structural Equation Models (SEM) latent traits are estimated jointly in the WTP regression. Of the only examples in the relevant literature, Meyerhoff (2006) estimates how much latent attitudinal traits moderate WTP. Abate et al (2020) also present a SEM although they called it as Integrated Choice and Latent Variable model.

The literature in Table 1 focuses on CVM studies alone and not CE studies and mainly features the use of TPB theory and the NEP scale.

Table 1 Review of contingent valuation studies that include latent traits

Study	Country	Public good	One-step	Method description	Scale used
Halkos and Matsiori (2018)	Greece	Coastal zone improvements	No	PCA	NEP (15 items)
Abate et al., (2020)	Norway	MPP reduction	Yes	SEM	Study-specific scales for CONCERN and EFFECT,
Cooper et al (2004)	UK	Water quality improvements	No	FA	NEP (15 items) and altruism scale (6 items)
Oleja and Loureiro (2007)	Spain	Biodiversity protection	No	FA	General Awareness of Consequences scale (GAC, 9 items)
Spash et al (2009)	Scotland	Biodiversity restoration	No	FA	TPB (13 items)
Aldrich et al. (2007)	US	Biodiversity protection	No	CA	NEP (15 items)
Kotchen and Reiling (2000)	US	Biodiversity protection	No	FA	NEP (15 items)
Liebe et al (2011)	Germany	Forest biodiversity increase	No	FA	TPB (6 items) and scales measuring the *Theory of Public Goods, Environmental Concern, Norm-activation model* and *Altruistic/moral Behaviour.*
Meyerhoff (2006)	Germany	Riparian ecosystem protection	Yes	SEM	NEP (8 items) and TPB (13 items)

Note: PCA=Principal Component Analysis, SEM=Structural Equation Modelling, FA=Factorial analysis

The literature review reveals that most previous studies utilise the two-step method but statistically this is not a superior model to incorporate latent traits into WTP. In this study we apply systematically the one and two-step approach to consider whether estimates remain stable. The environmental attitudes of respondents are captured through the well-established revised NEP scale (Dunlap et al., 2000) while personal attitudes and awareness of consequences from plastic pollution are expressed through a novel scale called PLASTIC which incorporates statements from Hartley et al (2018) and elements of Shuker et al., (2018) to determine respondents' motivations and awareness with respect to WTP for reducing MPP.

3. Materials and Methods

The questionnaire was designed to capture Indonesian attitudes and willingness to pay through the CVM. WTP can encompass use and non-use values for cleaned beaches and riverbanks and a new waste management plan was the service of interest (Basili et al. 2007). CVM can produce valid and reliable WTP estimates when bundles of goods and services are under consideration and in this case environmental direct and indirect use and non-use benefits were included (Bateman et al., 2008). CVM surveys are traditionally designed following Mitchell and Carson (1989) and lately Johnston et al (2017)'s guidelines. The method prescribes that one hypothetical scenario is presented to respondents with detailed information about the changes from the current situation (the *status quo*). In our case the new plastic collection and management strategy (W) is presented as alternative to the current – do-nothing situation. The survey participant i, faces two options supporting the plan new W (W_1) or preferring the status quo (W_0). The preference for W_1 implies paying for the waste fee (*b – this is a*

vector of fee prices). The respondent's unobservable utility for the two alternatives (*j*) is characterized as:

$$U_i = U_i(X_i, W_j) \quad (1)$$

where X_i is a vector of respondent-specific characteristics and traits. The respondent assigns a utility level to the two options (j= W_1, W_0) and reveals her preference. The analyst cannot observe the respondents 'utility (U) but just a function of observable characteristics (V_{ij}) and the error term u_{ij}. The probability of supporting W_1 is:

$$\Pr(Yes/b) = \Pr[V_{\mathrm{W1}}(X_i, b) + u_{i\mathrm{W1}} > V_{\mathrm{W0}}(X_i) + u_{i\mathrm{W0}}] \quad (2)$$

where $V_{i|W1}$ is the indirect utility respondent i enjoys under the new waste management plan and paying b to get it while $V_{i|\mathrm{W0}}$ is their indirect utility when respondent i prefers the status quo and rejects the bid amount. Assuming that error terms are (u_{ij}) independent and identically distributed (*i.i.d.*) and follows a normal distribution, the probability of accepting the bid amount for respondent i can be written as a binary probit model:

$$\Pr(yes|X_i, b) = \Phi(\frac{\beta X_i}{\sigma} - \frac{\delta}{\sigma} b) \quad (3)$$

with Φ denoting the cumulative standard normal distribution, σ the standard deviation from the mean and β and δ being parameters to be estimated. In a standard CVM approach, the vector X is characterized by only observable variables (e.g., income, age, etc.). However, to explicitly account for the latent traits, the researcher can disentangle the vector X in observable traits (OT) (e.g. age, income etc.) and latent traits (LT) which can be measured by attitudinal questions and different behavioral models (e.g., NEP).

Once latent traits are available, we can adopt a two-step approach as described by the majority of studies in Tab.1 (e.g. Halkos and Matsiori, 2018; Cooper et al 2004). Therefore Equation 3 becomes an expanded probit model as:

$$\Pr(yes|OT_i, LT_\iota, b\ ) = \Phi\left(\frac{\beta}{\sigma} OT_i + \frac{\gamma}{\sigma} LT_\iota - \frac{\delta}{\sigma} b\right) \quad (4)$$

where each element (*k)* of the LT vector, which was measured by a set of Likert scale attitudinal/beliefs questions, can be measured through indicators:

$$I_k^m = \zeta_k^m lt_i + \varepsilon_k \quad (5)$$

with ζ_k^m being the coefficient specific to latent variable k and the behavioural indicator m, and ε_k denoting the error term. These I_k^m are typically analyzed using multivariate techniques which reduce the *k=1,…K* latent traits into scores (either a factorial analysis or a principal component analysis) which can be directly included in Eq.4. In this approach, initially we model the indicators and then these measured are included in the expanded probit model estimation. Coefficients of Eq 3 and 4 are estimated with the standard likelihood function estimator.

Contrary, the one-step approach (e.g., Abate et al. 2020) follows the Structural Equation Modelling (SEM) approach where the latent traits are jointly modelled with the WTP responses:

$$\begin{cases} I_k^m = \zeta lt_i + \varepsilon_k \\ \Pr(yes \,|OT, b) = \Phi\left(\frac{\beta}{\sigma} OT_i - \frac{\delta}{\sigma} b\right) \end{cases} \quad (5)$$

The one step model adopted in this paper is outlined in Fig. 1. SEM models appear more efficient in statistical terms to estimate WTP but the majority of studies in environmental economics (see Table 1) have been choosing the two-step approach. Our research question therefore becomes: is this assumed efficiency significant and worthy of consideration?

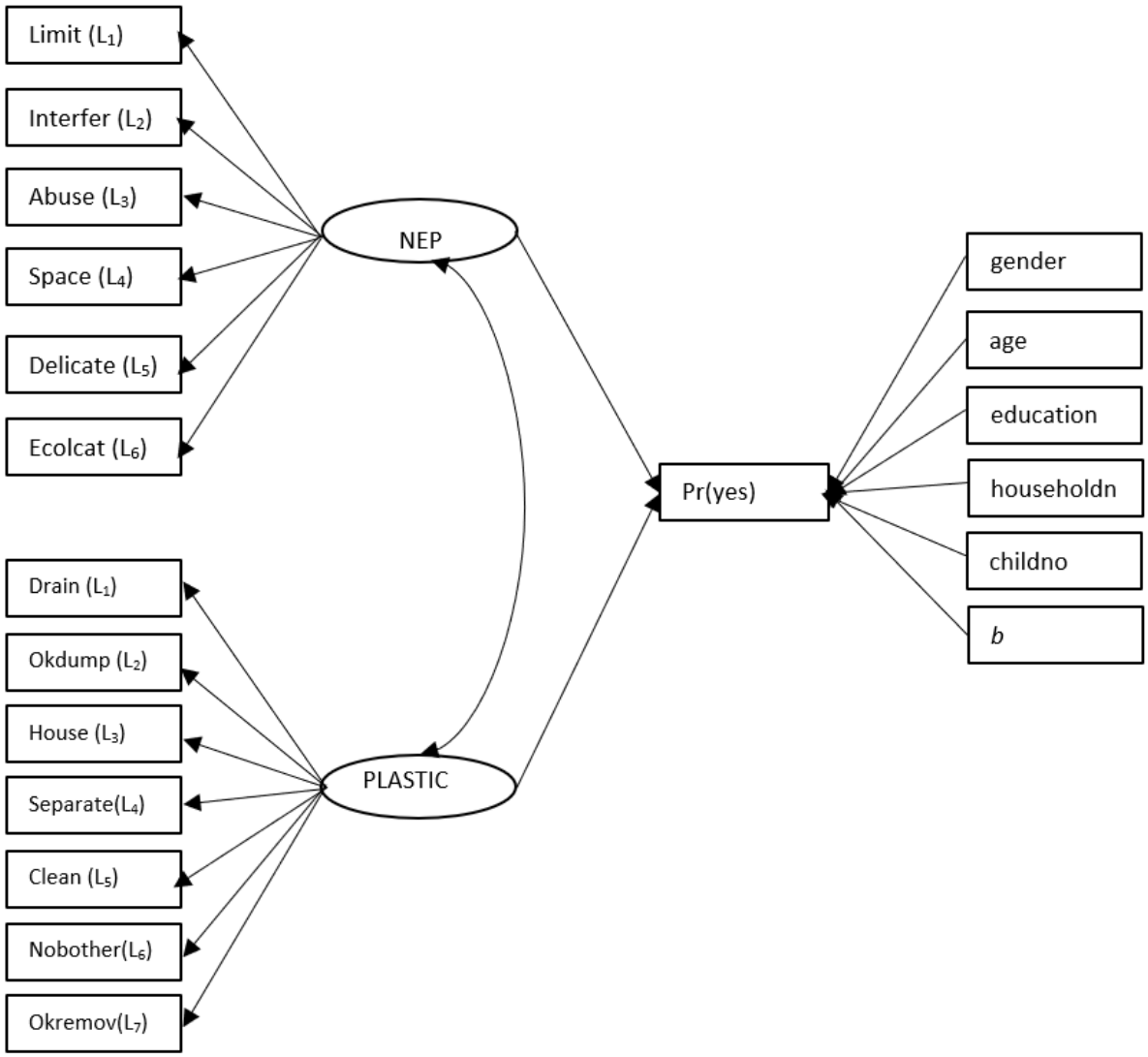

Figure 1*: Conceptual path diagram to explain the influence of unobserved attitudes in willingness to pay to mitigate marine plastic pollution.*

To capture the environmental attitudes of participants, 6 items from the revised 8-item NEP scale (Dunlap et al., 2000) were used. Similar to Hultman et al. (2015) and Grilli et al. (2021), two statements were chosen to represent each of the NEP topics directly influenced by MPP, namely the reaching

ecological limits, balance between humans and nature and the treat of an ecological catastrophe. Personal norms and awareness of consequences from plastic pollution, following the approach of Jakovcevic and Steg (2013) were also assessed. The statements used were adapted from the MPP-specific questions used in the Indonesia-wide study of Shuker et al (2018). Statements included from Hartley et al (2018) focused on behavioural intentions while the statements influenced by the survey of Shuker et al. (2018) intended on capturing problem awareness and concern. The list of statements and their analysis appear in the following section.

3.1. Questionnaire design

The questionnaire was designed for online survey dissemination and was organized in five sections. The first section included a short description of the current state of plastic waste in rivers and oceans in the country along with current practices that aim to address the issue of MPP.

The valuation section came next where the scenario presented to the participants was that an independent organization is set up to support local governments in collecting and disposing plastic waste from beaches and riverbanks. Trash racks (installed by local authorities in waterways that screen buoyant waste) and waste banks (a voluntary, neighborhood-level means of waste management) are the two mechanisms to reduce MPP[2]. The questionnaire then proceeded asking the financial support for the new organization through an annual donation. The choice of a voluntary donation was preferred over that of an increase in waste collection fees as waste collection is not available across the country (Shuker et al., 2018) and the trust of respondents to governmental organizations is quite diverse across the country. Finally, due to the presidential elections taking place during the survey period, the use of waste fees increase as a payment vehicle could have increased protest responses. The respondents' WTP was captured with single-bounded dichotomous choice[3]. Payment bids were equally distributed in five bids, with the country's average monthly waste collection fee used as the mean value. Bids were £5, £8, £11, £14 and £16[4]. A set of data control questions were asked to identify protesters following Johnston et al. (2017) and using the specific questions provided by McFadden and Train (2017).

In the last section, the questionnaire presented with the six NEP statements capturing the environmental orientation of Indonesians and how they perceive the natural environment following Dunlap et al. (2000). Seven statements on personal norms and awareness of consequences from plastic pollution were also presented. Finally, the questionnaire concluded with a series of socio-demographic questions.

3.2. Data collection strategy

A balanced sample in terms of gender of nearly 1000 Indonesians was secured via the online survey company Qualtrics. Internet-based samples are getting a prominent role in low-middle income

[2] Honingh (2018) presents trash racks as the largest scale of available means of waste management in Indonesia, although trash racks are also linked to blockage of waterways, sedimentation and eventually, increased frequency of flooding due to them over-accumulating of waste. In turn, Wijayanti and Suryani (2015) note that waste banks achieved a reduction in landfill waste in Surabaya, the second-largest city in Indonesia of up to 7,14 tons per week between 2008 and 2013.

[3] This format is considered incentive compatible (Carson and Grooves, 2007) and recommended by recent guidelines and adopted by eminent experts (e.g., Bishop et al., 2017).

[4] All payment bids were presented in Indonesian rupiah, here converted to British pounds. During the time of the survey, £1 =0.000054 rupiah.

country research and McFadden and Train (2017, p. 166) state that "professional" subjects who receive compensation and incentives due to their participation in online panels are more likely to give consistent responses and pay attention to the research questions. The quota sample collected mimicked the representativeness in terms of gender and age across the country, in accordance with the latest available country Census (2010). The questionnaire was translated by a native speaker and made available both in Bahasa Indonesian (the official language) and English. The questionnaire was pretested with 96 participants in January 2018 which confirmed the appropriateness of the payment vehicle and allowed for improving the framing of the attitudinal questions in the last section. Statements were phrased in more direct ways as is deemed appropriate in other studies in the country (e.g., Fossati, 2019). The final online survey returned 822 complete responses and the major response areas can be seen in Figure 2.

As MPP is a shared problem, all actors of a society are expected to act in support of its mitigation. Accounting for those that were not willing to support MPP mitigation options was imperative. Genuine zero bidders were retained and protesters were removed from the analysis, since the latter responses' truthfulness and validity is questionable (McFadden and Train, 2017). Protestors were identified as those who stated "No" in the WTP question and offered one of the following reasons for doing so: "There are enough things I pay money for, I have no interest/use of paying extra money", "Cleaning the environment is the responsibility of local authorities and they should pay for it, not me" and "I am not interested in paying anything about the natural environment". Most the respondents were willing to pay for the new MPP management service (16% of the sample was against this scenario and the main reasons were: not having enough to pay, they pay enough already and that it is the government's job to pay for MPP reduction were the prevailing responses). The quality of responses was also assessed by identifying "speeders" (those taking have the median time to complete the survey) and those taking more than the 4-times the sample's median time to go through the survey as well as if their geo-IP came from another country. This resulted in 751 valid responses being retained for analysis. Respondents from 33 Indonesian provinces are captured in this analysis (Figure 2).

Figure 2: Areas where online responses originated from, according to their geoIP

4. Results

Main respondents' characteristics are in Tab. 2 and, overall, they mimic the latest published census statistics (2010) with respect to gender (50.5% to 49.5% male to female split) and age (measured in economically active individuals, as those are expected to be able to contribute financially in the survey). In terms of age, the 18-24 group in the sample is 17% over 14% in the 2010 census, the 25-34 group is 20.2% in the sample compared to 28% in the 2010 census while the over 55 age group is 18.75% in the sample over 14% in the census. The sizes of rest of the age classes (35-44 and 45-54) are identical with those reported in the 2010 census, leading to an average participant age of 38.9 while that of the adult population reported in the 2010 census data can be approximated to an average of 35. Several responses came from large population centres in East Indonesia where population tends to be younger and Internet penetration is higher than in rural areas (Sujarwoto and Tampubolon, 2016) as can be seen in Figure 2, which can also explain the high number of university degree holders in the sample, along with the high internet penetration. Overall, despite the lack of equal access to internet, the sample closely resembled the 2010 census distribution as the survey company can always guarantee quota samples as they hold a large number of respondents to invite.

Table 2 Main descriptive statistics of the sample

Variable	**Description**	**Mean (st.dev)[%]**
gender	Gender of the respondent, 1= male, 0=female	0.50 (0.50)
age	Age of respondent	39 (14)
education	Education level: Elementary school Middle School High School Associates Degree University first stage University second stage University third stage	 0.35 1.98 24.94 10.26 53.96 6.99 1.52
Yearly income (in £)	Annual income of the respondent, continuous *	4062.40 (2188.44)
household_members	Number of household members	4.05 (1.32)
number_of_children	Number of children under 18 living in the house	2.48 (1.10)
*All bid amounts are reported in pounds, but were collected in Indonesian rupiah		

4.1. Environmental attitudes:

In almost all statements in the NEP scale, respondents showed strong concerns for the ecological state of the environment, apart from believing that the planetary resource boundaries are being pushed. No differences between women and men regarding high-scoring responses (those selecting consistently "Describes me a little" and "Describes me a lot" in all statements) in the scale existed in the sample, with the two-sample Kolmogorov-Smirnov tests rejecting this hypothesis.

Table 3 Responses in the New Ecological Paradigm scale questions

NEP statements	Does not describe be at all	Does not describe me	Neither does or does not describe me	Describes me a little	Describes me a lot
We are approaching the limit of the number of people the earth can support	2%	12%	18%	37%	31%

When humans interfere with nature it often produces disastrous consequences	1%	1%	3%	18%	77%
Humans are severely abusing the environment	2%	4%	7%	34%	54%
The earth is like a spaceship with very limited room and resources	2%	3%	8%	31%	56%
The balance of nature is very delicate and easy to upset	1%	2%	8%	30%	59%
If things continue on their present course, we will soon experience a major ecological catastrophe	1%	2%	5%	23%	70%

4.2. Behaviour in relation to MPP:

In these questions respondents demonstrated heightened levels of awareness and understanding of how the issue of MPP is unfolding. Respondents showed good understanding of the origins of MPP and its persistency (e.g., second statement). As with the NEP scale, no differences between women and men were found in the sample for those who demonstrate increased understanding of the issue of plastic pollution (those selecting consistently "Doesn't describe me at all" and "Doesn't describe me" in all 7 statements), with the two-sample Kolmogorov-Smirnov tests rejecting this hypothesis. Nevertheless, respondents appear to not entirely understand that MPP is a problem deeply rooted in the way modern societies operate, as recycling or plastic waste removal is not the ultimate solution, as seen by the varied responses in the final statement. This generates some questions on how the advanced the understanding of the intricacies of the MPP issue is in the Indonesian public.

Table 4: Responses in the PLASTICS scale

Behaviour in relation to dealing and managing plastics (PLASTIC)	Doesn't describe be at all	Doesn't describe me	Neither does or doesn't describes me	Describes me a little	Describes me a lot
Since waste operators do not come regularly where I live, I have no option than dumping waste in the drain	84%	10%	2%	2%	1%
Waste thrown indirectly in the ocean through the rivers or directly into the ocean is not a problem as trash is taken away by the sea	86%	9%	2%	1%	2%
It is very difficult to keep the area outside my house clean and I have to throw some waste in the drain	86%	9%	2%	1%	2%
Separating waste (for example, plastics from metal) is a waste of time as the bins are always full	59%	23%	10%	5%	3%
It is more important to have a house clean of waste than rivers and oceans free of waste	58%	22%	9%	6%	5%
I am not bothered by plastics in rivers, oceans or on beaches and riverbeds	78%	12%	4%	3%	2%

By removing the plastics from rivers and oceans the problem of waste is solved permanently	19%	18%	24%	20%	19%

The 13 NEP and behavioural and awareness MPP latent traits were jointly included in a PCA (with the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy being "very good" with an 0.84 average for all statements while no statement had a KMO lower than 0.80, showing good sampling adequacy). The first statement from NEP (*We are approaching the limit of the number of people the earth can support)* and the last statement of the suggested PLASTIC scale (*By removing the plastics from rivers and oceans the problem of waste is solved permanently)* were removed as during exploratory analysis of the data they showed low construct validity. The 11 remaining scoring coefficients can be seen in Table 5. From the results, the statements from NEP clearly are represented in the second component while the PLASTIC statements are grouped in the first component and are named accordingly.

Table 5: Factor loadings from the Principal Component Analysis of the 11 statements, with a varimax rotation.

Statements	PLASTIC	NEP
When humans interfere with nature it often produces disastrous consequences	0.01	0.43
Humans are severely abusing the environment	-0.03	0.45
The earth is like a spaceship with very limited room and resources	-0.02	0.39
The balance of nature is very delicate and easy to upset	-0.02	0.46
If things continue on their present course, we will soon experience a major ecological catastrophe	0.04	0.49
Since waste operators do not come regularly where I live, I have no option than dumping waste in the drain	0.43	0.01
Waste thrown indirectly in the ocean through the rivers or directly into the ocean is not a problem as trash is taken away by the sea	0.44	-0.02
It is very difficult to keep the area outside my house clean and I have to throw some waste in the drain	0.45	-0.02
Separating waste (for example, plastics from metal) is a waste of time as the bins are always full	0.36	-0.01
It is more important to have a house clean of waste than rivers and oceans free of waste	0.40	0.03
I am not bothered by plastics in rivers, oceans or on beaches and riverbeds	0.36	0.02

The dichotomous choice responses and behavioural and awareness statements were modelled in three ways:

- the standard WTP model including OT variables (only socio-demographic characteristics) but ignore latent traits, using Eq.4.
- two-step approach including OT variables and LT measured by PCA scores, using Eq. 4
- one-step approach jointly including OT and LT as in Figure 1 and using Eq.5.

Table 6 reports the results for the three models. The estimated coefficients have the expected signs for all variables and, apart from household size and number of children, all other variables are highly significant. The bid variable has the expected negative sign in all 3 models, aligned with economic theory, showing that respondents experience decreases in utility by paying higher amounts for MPP mitigation. The constant in all models is also positive and significant, indicating participants' willingness to move away from the status quo and secure more clean beaches and riverbeds. Younger participants are more willing to pay, as are men in the sample, while higher education also increases WTP. Focusing our analysis on the latent scores with the LT component being added to the OT for the two-step model yielded similar results. The sign of the coefficients is the same as in the standard regression model and the same variables remain significant. Including LT in the model renders only the NEP component significant which has, as expected, a positive influence on WTP. The PLASTIC component, although not statistically significant, also has a positive impact on WTP. Finally, the one-step model which jointly models CVM responses and latent traits was estimated. Coefficients' signs are very similar to the previous models, with all 11 variables for the two constructs (NEP and PLASTIC) being statistically significant and having a positive effect on a respondent choosing to pay the bid to mitigate MPP.

The average WTP and its corresponding 95% confidence intervals are obtained with the delta method and are very similar across models: £13.50, per person, per year for the simple regression model, rising to £15 for the models accounting for LT. In the one-step model average WTP is also £15.

Table 6. Modelling results for WTP responses and behavioural traits

	Standard model		2-step model for WTP and latent traits (PCA)		One-step model for WTP and latent traits (SEM)	
	Coef.	St.error	Coef.	St. error	Coef.	St. error
	Observable characteristics					
bid	-0.063 ***	0.014	-0.060***	0.014	-0.060***	0.014
gender	0.291 ***	0.107	0.285***	0.108	0.282***	0.105
age	-0.168 ***	0.042	-0.173***	0.042	-0.173***	0.042
education	0.104 *	0.53	0.097*	0.054	0.099*	0.055
Yearly income (in £)	0.000 ***	0.000	0.000***	0.000	0.001***	0.000
household_members	-0.032	0.048	-0.039	0.049	-0.039	0.051
number_of_children	0.054	0.058	0.059	0.058	0.061	0.063
plastic	-	-	0.014	0.029	0.098	0.097
nep	-	-	0.078***	0.030	1	constrained
constant	0.846 ***	0.330	0.904***	0.334	0.892***	0.346
	Latent characteristics					
Interfere ←NEP					3.03***	1.275
Abuse ←NEP					3.81***	1.599
Space ←NEP					3.11***	1.318
Delicate ←NEP					3.66***	1.523
Ecolcat ←NEP					4.13***	1.706
Drain ←PLASTIC					1	(constrained)
Okdump ← PLASTIC					0.92***	0.073

House ← PLASTIC			1.01***	0.070
Separate ← PLASTIC			0.99***	0.120
Clean ← PLASTIC			1.21***	0.123
Nobother ← PLASTIC			0.84***	0.102
LL	-384	-381.18059	-10202.71	
Pseudo R2	0.080	0.089	-	
WTP [CI]	£13.50[4-23]	£15 [5-25]	£15 [5-25]	
Numb. of observations	751	751	751	
*** denotes statistical significance at the 1% level,** at the 5% level, *at the 10% level				

5. Discussion

The different models confirm that preferences for MPP mitigation strategies are influence by personal characteristics and traits. Across the three models, estimates of the explanatory variables had the same sign. Men ("gender" coefficient) are generally more willing to pay for MPP reduction than women, similar to other studies in the literature (e.g., Abate et al., 2020). Age has a negative and significant effect on WTP. This implies that, the older are respondents the lower is their willingness to pay for newer management strategies, following the findings of similar studies (e.g., Oleja and Loureiro, 2007). Education has the expected positive impact on WTP, similar to the literature (e.g., Brouwer et al., 2017). Household size and number of children were statistically insignificant in all models. Income has a positive but very small impact on WTP with the income elasticity of WTP (the percentage of change in WTP if income increases by 1%) being positive (0,18) but very close to 0, meaning that policies that aim to reduce MPP in Indonesia will benefit neither high or low-income groups more than the other, making MPP mitigation a "normal good" (Tyllianakis and Skuras, 2016). Income elasticity for pollution control, such as MPP, being positive and below 1 is also consistent with the relevant literature (e.g., Barbier et al., 2017).

Despite 77 percent of responses coming from urban areas in East Indonesia (only 50% of the country lives in urban areas according to the 2010 Census) that have been documented to have higher rates of MPP (Shuker et al., 2018), their mean WTP was not statistically significant different from those coming from rural areas, indicating to a lack of self-selection biasness. Nevertheless, studies using online panels to elicit preferences have found online participants to be prone to inconsistencies and lack of engagement (Jiang et al., 2020) while samples can also suffer from lack of representativeness (Szolnoki and Hoffmann, 2013), especially as they tend to attract younger and more educated participants (Olsen et al., 2009). Despite that, online surveys have been found to yield similar value estimates with face-to-face (Windle and Rolfe, 2011; Mulhern et al., 2013). Finally, all survey modes have been found prone to lack of representativeness (e.g., Szolnoki and Hoffmann, 2013) but such findings tend to come from Global North surveys while studies measuring such discrepancies are virtually non-existent in Global South contexts.

Respondents scored generally high (i.e., selecting statements of "Strongly agree" and 'Does not describe me at all") in most questions dealing with plastics in their everyday lives, the importance of the environment and how they perceive themselves in relation to their use of plastics (see Tables 3 and 4). The revised NEP statements that were included were assumed to be directly affecting beliefs

around the issue of MPP while PLASTIC statements capturing awareness of consequences of plastic pollution and behavioural norms. The high ecological concern demonstrated by most participants in the NEP statements was not necessarily matched by high levels of awareness and behavioural practices that can effectively mitigate MPP (i.e. the mixed responses in the fourth and fifth statements in the PLASTIC scale). This might point to a salient lack of education and awareness-raising for the long-term impacts of MPP and its direct relation to everyday human welfare (Phelan et al., 2020). However, when latent traits are jointly modelled with WTP responses were mixed.

The two-step model in Table 6 is a better fit than the basic model (LR test significant at 1%). The NEP variable had a positive impact on WTP in both the two-step and one-step models showing that respondents who are sensitive to environmental issues are keener to support MPP mitigation programmes. This does not confirm some previous findings that found that environmental scales such as the NEP perform differently in non-Western contexts (Chatterjee, 2008). Similar to Cooper et al. (2004), who focused on a Western context, and Choi and Fielding (2013) based in a non-Western context, we find that high ecological concern does translate into a slightly positive effect on WTP to tackle MPP, but only marginally. This result can also indicate conviction on behalf of respondents that the proposed measures (beach clean-ups and trash racks carried out by an independent organisation) will be effective in reducing MPP. This is not a surprising finding, given the lack of clarity around which authority is responsible for the cleaning of rivers and beaches in Indonesia, which results in waste mismanagement (World Bank, 2018). Voluntary donations and charitable giving are deeply ingrained to Indonesians (Nelson et al., 2018) so we cannot assume any issue with the suitability of payment vehicle occurred which further re-enforces the findings. Nevertheless, socio-economic factors have the biggest impact on WTP and the inclusion of attitudinal and behavioural variables only marginally improved model fit between the basic and the two-step model (see Table 6). Such a finding should be tested in future primary valuation exercises that combine such questions and statements in a Global South context.

Contrary, the PLASTIC scale is not significant in the two-step approach or the one-step one. This can be attributed to the nature of the scale as it was devised for this study and has not been applied before in any latent traits model. Nevertheless, the PLASTIC construct was supported by the PCA results (KMO being close to 1) showing that its statements can be considered for studies measuring motivations and awareness with respect to MPP. The disparity between high scores to behavioural and attitudinal scales and the mixed effect on WTP can be explained by respondents' understanding of MPP consequences. When respondents were asked where plastics in rivers end up to, several respondents revealed an "out-of-sight, out-of-mind" approach, showing some lack of understanding concerning the persistency that MPP has and that it simply "does not get washed away by the water". Similar findings around plastic pollution have also been recently reported in fishing villages in Eastern Indonesia (Phelan et al., 2020) which signals that Indonesians still struggle to understand the magnitude of the MPP problem and its impacts to their welfare.

The WTP findings (£13.5- £15), are approximately 2% of the average monthly salary, and are highly similar across models, showing robustness of preferences. Regarding the payment levels, they suggest that respondents would be willing to support initiatives from independent organisations that can end up covering the funding gap for waste collection, when compared with the international levels of costs for waste management of US$15-20, per person, per year, as detailed by Shuker et al., (2018). The WTP estimates in Table 6 are more than double the average cost of waste collection across Indonesia

and this can signal the interest and level of monetary support of Indonesians for future waste management initiatives. WTP levels are also comparable with previous findings (e.g. Brouwer et al., 2017; Choi and Lee, 2018; Zambrano-Monserrate and Ruano, 2020) although in some cases, our estimates were higher than those of previous studies (e.g., Brouwer et al 's estimate for the Greek sample) which might be understandable given that MPP is a much more prevalent issue in Indonesia. Nevertheless, our estimates are much smaller than the £462 estimate of Abate et al. (2020) which is derived from Norwegian participants, even if we consider the differences in income between the two countries (Norwegian income is, approximately, 10-times higher than that of Indonesia).

The interpretation of our results requires caution. For example, the combination of unmanaged waste and seasonal influxes of MPP on beaches and riverbeds during the monsoon season has been assumed to discourage any responsible individual behaviour towards MPP (Phelan et al., 2020), therefore contributing monetarily towards mitigating such a recurring issue might appear useless. Nevertheless, our study was conducted at the end of the monsoon season that sees large amounts of MPP being washed ashore from the ocean and despite this, most respondents stated they would pay. Disparity between intended and actual behaviour has been reported by other studies in Indonesia (Parker et al., 2018) and this can translate into a lack of engagement in future real-life waste management initiatives.

Our valuation scenario presented a future with active participation of citizens to fund beach and river clean-ups through voluntary donations and this can translate in considering the government as detached from the management of MPP. This would not be ideal as multiple actors are required to improve the sustainable management of ocean resources. The MPP management options presented in our study focused only on activities reducing pollution in beaches and riverbeds such as trash racks and waste banks but did not address the issue of handling such waste. Given that recycling is not widespread or formalised in Indonesia, such a future scenario might perpetuate an "out-of-sight, out-of-mind" approach.

6. Conclusions

Addressing plastic pollution in the marine environment has become a pressing issue given the accumulation of waste, a phenomenon that coastal states are increasingly subject to. Countries in the global South that suffer disproportionately from MPP have seen an increase in litter and opinion surveys to better understand its impact and potential means of MPP mitigation. This study uses survey data on attitudinal, beliefs and socio-demographic characteristics to explain levels of financial support residents of Indonesia, a global South country, have for MPP mitigation. By doing that it fills a gap in primary valuation literature for mitigating MPP where evidence from the global South is scant. Furthermore, this study investigates whether unobserved awareness and attitudinal characteristics of respondents might offer better insights than more conventional modelling of human behaviour in non-market valuation. Although, the sample just resembles the basic sociodemographic census characteristics and is drawn from an online panel, results are in line with previous findings and confirms respondents' interest to alternative options to manage MPP.

The findings are, in principle, encouraging regarding the future of MPP abatement in global South countries. Indonesians appear concerned with the issue of MPP and demonstrate high environmental concerns. This translates into them being willing to pay to increase clean-up activities, with the average WTP amounts being driven up by young, educated and environmentally-conscious

participants. Nevertheless, our study reveals some lack of participants' knowledge on the true impact of MPP and improper plastic waste management. This highlights the need for further education campaigns for MPP initiatives and management needs. Nevertheless, having the public financially support MPP mitigation is shown to be equally benefiting high and low-income households.

In terms of modelling, results support more elaborate models as they can better explain latent characteristics of citizens, however simpler models also offer valuable insights. The robustness of findings from simpler models is quite encouraging for contexts where complex modelling and computational capacity are scarce. However, further studies in the Global South are needed to compare online and in-person surveys and to better characterized the willingness to pay for management strategies.

Finally, our findings suggest that country-wide actions and reforms are needed to effectively address the issue of MPP such as non-governmental initiatives as well as the government-funded practices. Overall, it appears that beginning to even consider solving the MPP issue in Indonesia and other countries with similar characteristics would require a holistic approach. No single solution can be found; instead MPP literacy, investment in waste management, incentivising personal actions and responsibility involving beach and river clean-ups and changes in everyday behaviour regarding use of plastics is required, if the goal of turning to a circular economy is to be realised. Recent pledges from the European Union of 9 million Euros to combat MPP in Southeast Asia (European Commission, 2018) can also be a source of financial support to support local and global pledges to reduce MPP.

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