

The Total Economic Value of wetlands in an European Region

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Abstract: *The Contingent Valuation Method was used to elicit willingness to pay an annual tax to preserve the Region of Veneto (Italy) wetlands. The Total Economic Value of the regional wetlands was evaluated by means of a survey. The respondents were representative of the regional population in terms of spatial proximity to wetlands, socio-cultural membership, rural/urban distribution, and demographic and socio-economic characteristics. The mean value obtained was 62.12 €/year/family. The analysis of the social awareness of the multiple wetland functions was performed using a multivariate logit model, which suggested a clear perception of some functions (recreation and habitat), and a weak perception of other “environmental based” functions (water depuration, flood protection, etc.). The Total Economic Value was statistically explained by several expected variables for this kind of estimation (income level, study level, membership of interest groups), but not by the variables related to the awareness of the wetlands environmental functions (water reservoir, flood control, yields production, barrier against weather events, depuration). Given the growing role of wetlands in water resource management, a stronger public information-training effort on the multiple wetlands goods and services seems urgent.*

Keywords: *Contingent Valuation Method, wetlands, willingness to pay*

1. Introduction

In the first half of the XX century wetlands were perceived as noxious areas representing opposition to economic development, this belief brought about the destruction of a great part of these ecosystems. In recent decades this perception changed dramatically, linked to new scientific awareness of the ecological role performed by wetlands in terms of water cycles or biodiversity regulation.

One of the recognized wetlands functions for the sustainable management of water resources is the surface water depuration from several pollutants (Kadlec and Knight, 1996). Yet, as ecological systems, wetlands perform multiple functions that produce multiple benefits. Following the global scale ranking of Costanza et al. (1997), the multiple functions performed by wetlands could be: control of water cycles, including human water supply needs; control of water quality, including the sequestration of noxious compounds and elements; control of the water budget at the watershed scale; control of atmospheric gases exchange; control of disturbance regimes, including floods and extreme weather events; habitat-refuge functions for resident or migratory wildlife; food supply (fish, game, fruits, spices); renewable prime matter supply; recreational provision for the resident and non-resident population; and production of socio-cultural values and goods.

The value of the preservation of these functions (“externalities”) is easy to deduce in general terms, but difficult to quantify in monetary terms within a decision making process. The translation of these values into economic terms associated to an ideal market could facilitate decision making processes. For these reasons the economic evaluation of environmental goods, in terms of the monetary quantification of the benefits (or costs) that the preservation or the destruction of an environmental goods item represents for the community, is a more and more common practice at an international level.

The aim of the present paper was to evaluate the Total Economic Value (Turner et al. 2000) of a wetland in a European Region, namely Regione del Veneto, Italy. The Total Economic Value was estimated using the Contingent Valuation Method to elicit the willingness to pay a bid to preserve the wetland (Arrow et al. 1993).

The work was part of wider research about the role of wetlands (and particularly restored wetlands) in water cycle management. The core of the research field was an experimental constructed wetland located near Chioggia (Venice, Italy).

2. Materials and Methods

The Total Economic Value (TEV) of wetlands is defined as the total amount of resources that individuals would be willing to forego for an increased amount of wetland services (Turner et al. 2000).. The economic value of wetlands includes both use and non-use values (Arrow et al. 1993). Use values involve some human “interaction” with the resource and may be derived from outputs that can be consumed directly (e.g. water supply, recreation). Non-use values are derived from the knowledge that a resource is maintained (Lambert 2003). A widespread method to obtain the TEV is the Contingent Valuation Method (CVM) (Mitchell and Carson, 1989; Arrow et al., 1993 Meyerhoff and Liebe, 2006). The CVM elicits the willingness to pay or the willingness to accept (a fee) for a good/service, rather than renouncing it. By means of a survey, respondents may be asked to state they willingness to pay for natural resource protection or for related goods and services. This method has become one of the most widely used non-market valuation techniques, due to its flexibility and ability to estimate TEV, including non-use value. The validity of such surveys depends on numerous factors related to survey design and execution, as well as success in avoiding response and other biases.

An in-person open-ended (Mitchel and Carson, 1989) pre-test was undertaken on a respondents sub-sample (12% of the 421 interviewed), to verify and test the questionnaire robustness, and to identify likely bids to be used in the full survey (Arrow et al., 1993).

The survey questionnaire had a closed-end format, which is likely to provide the most reliable valuations (Arrow et al., 1993). The NOAA Panel on Contingent Valuation contains a number of recommendations about the design and implementation of CV surveys, among other things, the Panel suggests the use of a referendum CV question (Arrow et al., 1993).

The questionnaire was designed to reduce:

- The bias of a non-credible hypothetical contingent market. The payment mechanism must be credible to respondents: they should believe that they really could have to pay for the good (Arrow et al., 1993).
- Biased answers, giving context elements and information to allow the respondent to verify their comprehension and acceptance of the proposed scenario. As suggest from many studies a good practice is to remind succinctly the possible reasons for voting in favor or against the hypothetical public program before asking the referendum question (Arrow et al., 1993). For this scope some questions about the awareness of wetland functions were posed before the referendum question.
- Strategic bias that arise when the respondent provides a biased answer in order to influence a particular outcome, and which normally represents 15-30% of the sample (Meyerhoff and Liebe, 2006). The usual way to differentiate between a true zero WTP and a protest response is to present those respondents who are unwilling to pay with a set of debriefing questions. Based on the answers it should be possible to decide whether a zero WTP corresponds to the economic concept of value or whether respondents are protesting against the valuation scenario (Mitchell e Carson, 1989; Meyrhoff and Liebe 2006).

The questionnaire that was used included four sections: the first was aimed to introduce the respondent to the issue, the second aims to giving, in a non-explicit way, more context information and to elicit the respondent's awareness of the multiple functions performed by the wetlands, The third section was designed to create a hypothetical yet credible market, and a robust bid. To avoid problems relating to hypothetical and delayed payment, the test proper were made by simulating an opinion poll for the abrogation of a law on wetland preservation which provided a certain reduced fee for the taxpayer. The fourth section aimed to obtain a picture of the sample of respondents.

In the full survey the closed-end format WTP was estimated by means of a dose-response univariate logit model (Hanemann and Kanninen, 1998):

$$P(\text{yes}) = \frac{1}{(1 + e^{-\alpha + \beta A})} \quad (1)$$

where $P(\text{yes})$ is the probability of obtaining a positive answerer to pay the bid; α is the constant coefficient if no other independent variables than WTP have been considered; β is the bid coefficient and A is the bid. The curve integration represents the WTP mean value, expressed as:

$$\text{WTP}_{\text{mean}} = \left(\frac{1}{-\beta} \right) * \ln(1 + e^{\alpha}) \quad (2)$$

The median WTP is estimated by mean of

$$\text{WTP}_{\text{median}} = \frac{-\alpha}{\beta} \quad (3)$$

The algorithm used to obtain α and β was the maximum likelihood method, which estimates the parameters maximizing the probability of obtaining the observed data (Long, 1997).

We used a multivariate logit model to study the relationships among predictors (demographic, socio economic, spatial) and the WTP. To analyze how the selected variables influenced the understanding, or awareness, of the multiple functions performed by the wetlands we used again a logit multivariate model, because the survey format gave discrete variables.

In order to perform the analyses, the variables were transformed in ordinal values. Computation was undertaken using STATA software (StataCorp, 2005).

3. Results and Discussion

The sample (317 respondents, 52% male, 48% females) had a gender distribution comparable to that registered in the Veneto Region (male = 49%, female = 51%; Regione Veneto, 2004).

The comparison of the sample ages with the regional picture (Regione Veneto, 2003) indicated an under-representation of older people, despite the interviewer effort to involve them. In fact older people were less available to be interviewed and had no or little interest in the interview issue. The respondents with a lower study level (junior high school and lower school) were the least represented, while the high school group was over-represented. 54.3% of respondents lived in the province main towns, 45.7% in other towns. The sample was quite similar to the regional distribution of family size (Regione Veneto, 2004). It was made up of workers (61.2%), students (15.6%), pensioners (12.3%), housewives (6.9%) and unemployed (4.1%). The unemployment rate was similar to the 2003 region rate (3.4%, Regione Veneto, 2004).

Regarding the occupational allocation of workers the percentages of freelances and factory workers in the sample were reversed with respect to the regional percentages (CNEL, 2003). This result could be explained by a lower level of interest of factory workers in the survey.

The economic conditions were related to the declared annual income of the respondents. We asked respondents if they belonged to environmentalist, hunters, farmers or other associations: 242 interviewees did not belong to any association (76.3%), 15 belonged to environmental group (4.7%), 7 to farmers (2.2%) and 53 to other associations (16.8%).

To verify the influence of restored wetland on the respondents' answers we identified their location in relation to the distance from the reference wetland: 72.2% of respondents lived in the range of 22-44 km from the reference wetland, 15.1% lived in a place that was far from the wetland less than 14 km. The others respondents were equally distributed within a range of 100 km.

A high percentage of the sample recognized the habitat (91.8% full agreement) and the recreational functions (84.2% full agreement) of the wetlands, with a significant difference between these two functions and the others (Table 1).

Only 35% of the sample fully agreed with the statement that wetlands have a depurative function and 34% of the respondents could not answer on this point. The opinions expressed about this function did not differ significantly (Table 1) from those expressed about the flood control function

(24% could not answer) and the wind, waves and erosion barrier function (21%). The percentages of respondents who fully disagreed with these three functions were 13%, 15% and 15%, respectively.

Table 1 - Results of the ANOVA test of the wetlands functions rate estimations in the full survey sample. Clusters of the significantly different values are indicated

Wetlands functions	1	2	3
1) Habitat	xxx		
2) Recreational	xxx		
3) Water reservoir		xxx	
5) Economic goods		xxx	
4) Flood control			xxx
7) Barrier (wind, waves, erosion)			xxx
6) Depuration			xxx

From the logit multivariate analyses of the wetland function judgments, the agreement with the wetland habitat function statement appeared to be linearly dependent on the distance from the wetland taken as a reference. We repeated the analysis on the sample without the respondents living next to the wetland to verify if this outcome was due to a different awareness of those who lived next to wetlands, but the result did not change.

The agreement with the economical goods supply function statement was not predicted by any variable.

The agreement with the purifying function statement was related with gender (slightly lower agreement for women), and with the study level. In this case the agreement, unexpectedly, increased as the study level decreased.

Respondent age was the only significant variable for agreement with the water reservoir function statement, with an increasing agreement with increasing age.

For the barrier function (against sea storm, wind, erosion) statement, the probability of agreement grew proportionately with age, and moving from urban to rural areas, while it decreased with the study level. The probability of agreement with the flood risk control statement had the same positive relation with age and living location, but it was negatively related to the occupational level. The probability of agreement with recreational function statement had no significant predictor.

We considered that environmental functions awareness could be split in two perception/cognition categories. The first category could be represented by functions readily perceived by society, like the possibilities for 'exploration' (hunting, fishing, recreation, wildlife watching) or for the identification of a specific and characteristic habitat. In the last case the function has a higher value for urban people than for rural people living near a wetland (because of its "wilderness" image). The "distance from restored wetland" was actually the only significant predictor to explain the common and strong agreement with this function.

The second category related more to a functional image of landscape and nature, and could be represented by the "ecological/environmental functions" (water reservoir, flood control, yields production, barrier against weather events, depuration) that can be tied to a legacy of experience structured on (i) established knowledge and (ii), consciousness induced by handed down shared community know-how.

Considering these two categories, we observed two converging phenomena in the society under study. The first was that the uncertainty of judgment, given by a low level of awareness or extreme positions of denial, progressively increased towards the "ecological/environmental functions" as framed above (*Figure - 1*). The second was that the awareness of this kind of functions was generally explained by the respondent's age (and the related family size), the rural location and (in a weaker way) the male gender - linked to the hydraulic management role in a rural society of old

reclaimed landscapes. As a matter of fact, the comparison of the rural sub-sample vs. the survey sample showed a percentage increase of age and family units in the rural sub-sample.

The awareness of ecological/environmental functions is generally related to empirical experiences that are traditionally linked to rural areas near wide, old wet systems, as the Venice Lagoon is. The lack of awareness of these functions could be therefore related to a missed legacy of these experiences. The reasons could be different: (i) legacy was not culturally fixed, as for the “depuration function”, which answers to questions and/or implies current scientific know-how not handed down, until some decades ago, by rural communities; (ii) legacy was abandoned, as for the “economic goods function” (food and biomass) that today is seen by rural communities only in terms of leisure and welfare, and no longer in terms of necessity as in the past.

Of the 317 respondents sampled, 204 (64%) was favorable to the law abrogation. The 47% of these (94 respondents) would have not abrogated the law if they could pay less than the proposed bill (75 €), while the 53% (108 respondents) declared a zero WTP and 1% (2 respondents) did not answer. 99 among the 108 respondents that declared a zero WTP (28.4% of the whole sample) were classified as "protest bids" by means of the debriefing question (Mitchell and Carson, 1989). This percentage was similar to those normally detected in this kind of research (Halstead et al., 1992; Jakobsson and Dragun, 2001; Meyerhoff and Liebe, 2006).

The comparison between the whole sample judgments on the different functions and the judgments expressed by the sub-sample of respondent that assigned a zero WTP values referred to “protest bids” showed no significant differences (Figure 1). This result confirmed the hypothesis that these zero values do not correspond to a TEV actually equal to 0.

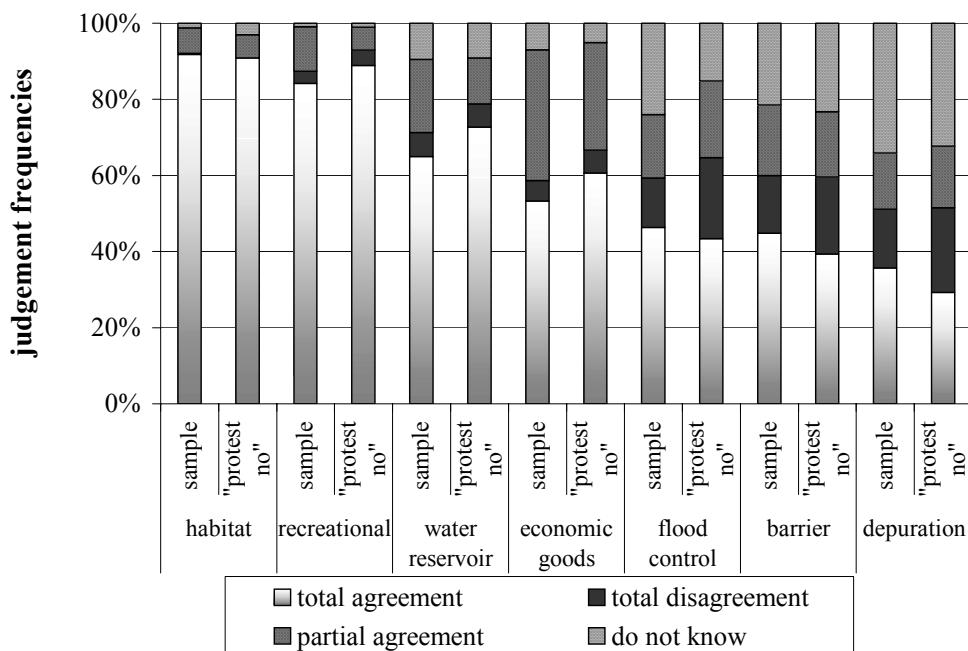


Figure - 1: Frequency distribution of the judgment expressed about the wetland functions in the full survey sample and in the “protest bids” sub-sample

Two respondents explained the zero WTP with the absence of any income and a minimum pension, and in this case we could suppose that the zero WTP should not necessarily correspond to a zero TEV.

Two respondents justified the zero WTP by their view that those who destroy the wetlands should pay for their preservation. It is interesting to note the analogy with ‘the polluter payer principle’ which today is a pillar of environmental policies.

The zero WTP due to a lack of interest in the wetlands was considered indicative of a zero TEV (7 respondents). The sample without the “protest bids” and the zero WTP that did not appear to correspond to a true zero TEV, was made of 215 respondents.

We proceeded to estimate the logit univariate model parameters of the whole sample and of the sample without “protest bids”. By means of the estimated parameters we obtained the mean and median WTP values. Excluding the “protest bids” increased the mean WTP from 42.25 Euro to 62.12 Euro, and the median WTP from 30.50 Euro to 59.74 Euro. The closeness of the mean and median values in the sample without “protest bids” indicated a good performance for the logistic function. In the sample without “protest bids” the abrogation percentage decreased to 47%, and the non-abrogation percentage increased to 53%.

The evaluation of the effect of the selected explicative variables on abrogation willingness was performed by means of a multivariate logit model on the sample without “protest bids”. The probability of an abrogation agreement was higher for women, and decreased with distance from the reference wetland and in respondents belonging to associations.

The same analyses on the WTP showed that the probability of willingness to pay:

- Increased proportionally to the study level, income, association and distance from the restored wetland.
- Decreased moving from urban to rural areas.

The last effect could be due to the fact that several urban respondents lived in Venice (inside a lagoon, which is a wetland), and therefore they could have developed a particular sensitivity for this issue. To verify this supposition, a new analysis was performed considering the new category “living in a wetland”, but the results did not differ.

We observed a distinction between the predictors of the wetlands functions awareness and the predictors of the WTP. In fact, the variables that significantly explained the WTP were those generally expected for these kinds of shared goods, like urban location, study level and income. The membership to interest groups, mostly the environmental ones, also influenced the estimate.

None of the variables related to the multiple wetlands functions awareness were significant predictor for the WTP, or when they were they had a opposite sign (e.g. study level, rural location). The variable “study level” was a significant predictor of the proportional probability of willingness to accept the bid, but a higher study level was unexpectedly linked to a lower awareness of wetlands environmental functions. In the same way, the rural location was related to a higher awareness of environmental function and to a lower WTP..

Together with the “rural location”, the “distance from a restored wetland” also positively influenced the WTP. This could suggest a lower sensitivity of rural people spatially concerned with wetland restoration.

This rural population stratum accounted for 26% of protest bids and for 27% of zero WTP, and was characterized by a high percentage of low study level persons, pensioners, workmen and low incomes category, all variables generally associated with low WTP (Balram and Dragičević, 2005; Jim and Chen, 2006). The low WTP assigned by the rural people living near a wetland could be therefore due to the socio-economic and demographic characteristics of this population, rather than the “distance from restored wetland” per se. We also verified that there were no significant differences among socio- economic and demographic profiles and the WTP of the “rural” and the “rural near to restored wetland” sub-samples. We could therefore assume that the decreasing WTP detected while moving from urban to rural areas was basically due to the socio-economic and demographic characteristics of the rural population, and not to any lack of perception of wetlands functions.

Differently from these results, a study on rural shared social goods (hedgerow networks) in the same area demonstrated that the higher awareness of rural people about hedgerows multiple environmental functions corresponded to a higher mean WTP (Franco et al., 2001). This disagreement could be explained by the historical perception of hedgerows and wetlands. The understanding of hedgerows environmental properties, historically and culturally valued by farmers,

counterbalanced the socio-economic characteristics of rural population, unfavorable to a high WTP as described above.

Differently from hedgerows, wetlands played a contradictory role in rural areas. On the one hand, in the Veneto region wet areas historically had water management and protective roles, institutionally administrated by government agencies and not by farmers (the Venice Republic maintained the Lagoon of Venice since the XIII century, ensuring its existence). On the other hand, wetlands were reclaimed for agricultural or malaria control purposes, and where the wetland represented the only exploitable component of the environment, life conditions were very marginal. In the course of time wetlands could have therefore produced: 1) the awareness about environmental roles managed by the whole community, but without any direct benefit to rural farmers, 2) the perception of a place to be reclaimed, or where it was hardly suitable to live. We could suppose that, although some wetlands functions were more clearly perceived by rural people, there could be a lack of shared tradition of the farmer's benefit and/or any clear sense of belonging of these 'goods' to the rural landscape, as in the case of hedgerows.

4. Conclusions

The study estimated the Total Economic Value of wetlands in a European Region (Veneto, Italy) by means of the Contingent Valuation Method, eliciting it from a survey on a fully representative sample of the Regional community, from the socio-economic and demographic point of view.

The analysis of the awareness of the multiple wetlands functions, performed by means of a multivariate logit model, showed that: (i) for certain functions there was a unanimous awareness, yet only slightly related to the selected explicative variables; (ii) for other functions the understanding was less shared but linked to explicative variables.

The unanimous recognized wetlands functions were those immediately perceived by society. They related to leisure and/or to the habitat specificity, or to the preservation of the shared resource water and/or to the generic production of economic goods (fish, game, and biomass). Instead the less perceived functions were not related to a common ethic or evocative idea. In fact, they derived from specific learning (depuration) and from legacies of empirical experiences shared among rural communities nearby wide wet areas (flood and extreme weather events protection). A specific case was the "economic goods function" (production of food and biomass) that was not more perceived, by the rural community nearby the Lagoon of Venice, as expected.

The hypothetical contingent market, created to estimate TEV, was robust: nobody questioned about the existence of the law and there was a good statistical fit between the full survey sample and the Region society for territorial, socio-economic, and demographic distribution. We obtained a reliable approximation of the regional wetlands TEV equal to 62.12 €/year/family.

The WTP was statistically explained by several variables that were expected for this kind of estimation (income, study level, membership to interest groups), but not by the same variables related to the awareness of the wetlands "environmental" services (mainly age, living location, and study level). The rural society stratum corresponded to a high awareness but to a low mean WTP. We could suppose that, although environmental wetlands functions were more clearly perceived by rural people, there was a lack of shared tradition of the farmer's benefit and/or a low recognition of these ecosystems as belonging to the rural landscape.

Finally, it seems important to underline that, even if the wetlands corresponded to a high TEV in this region, the awareness of the depuration service had no influence on the TEV. This wetland function today is a prevailing factor for the preservation and restoration of wetlands, in terms of landscape sustainable resource management. Considering the wetlands role in present day society, and in the EU and Regional policies, it is an urgent issue to back up this lack of understanding with a coherent public information and educational campaign.

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5. References

- Arrow K., Solow R., Portney P.R., Leamer E.E., Radner R. and Schuman, H. (1993). Report of the NOAA Panel on Contingent Valuation. <http://www.darp.noaa.gov/library/pdf/cvblue.pdf>
- Balram S. and Dragičević S. (2005). Attitudes toward urban green spaces: integrating questionnaire survey and collaborative GIS technique to improve attitude measurements. *Lands. Urb. Plan.* 71, 147-162.
- Costanza R., d'Arge R., de Groot R., Farber S., Grasso M., Hannon B., Limburg K., Naeem S., O'Neill R.V., Paruelo J., Raskin R.G., Sutton, P. and van den Belt M. (1997). The value of the world's ecosystem services and natural capital. *Nature* 387, 253-260.
- Franco D., Mannino I. and Zanetto G. (2001). The agroforestry networks role in the landscape socioeconomic processes: the potentiality and limits of contingent valuation method. *Lands. Urb. Plan.* 4, 239-256.
- Halstead J.M., Luloff A.E. and Stevens T.H. (1992). Protest bidders in contingent valuation. *Northeastern Journal of Agricultural and Resource Economics* 21, 160-169.
- Hanemann M.W. and Kanninen B. (1998). The Statistical Analysis of Discrete-Response Cv Data. *California Agricultural Experiment Station, Giannini Foundation of Agricultural Economics, Working Paper* 798.
- Jakobsson K.M. and Dragun A.K. (2001). The worth of a possum: valuing species with the contingent valuation method. *Environ. Resour. Econ.* 19, 211-227.
- Jim C.Y. and Chen W.Y. (2006). Recreation-amenity use and contingent valuation of urban green spaces in Guangzhou, China. *Lands. Urb. Plan.* 75, 81-96.
- Kadlec R.H. and Knight R.L. (1996). Treatment Wetlands: Theory and Implementation. *Lewis Publishers, Boca Raton, FL.*
- Lambert A. (2003). Economic valuation of wetlands: an important component of wetland management strategies at the river basin scale. Ramsar bureau. http://www.ramsar.org/features/features_econ_val1.htm
- Long J.S. (1997). Regression Models for Categorical and Limited Dependent Variables. *Sage Publications, USA.*
- Meyerhoff J. and Liebe U. (2006). Protest beliefs in contingent valuation: explaining their motivation. *Ecol. Econ.* 57, 583-594.
- Mitchell R. and Carson R. (1989). Using surveys to value public goods: the Contingent Valuation Method. *Resources for the Future, Washington, D.C.*
- Regione Veneto (2003). Statistiche. <http://www.regione.veneto.it/Temi+Istituzionali/Statistica/>
- Regione Veneto (2004). I numeri del Veneto – Anno 2004, La statistica in tasca. Assessorato alla Statistica, Regione Veneto, Venezia, Italy.