



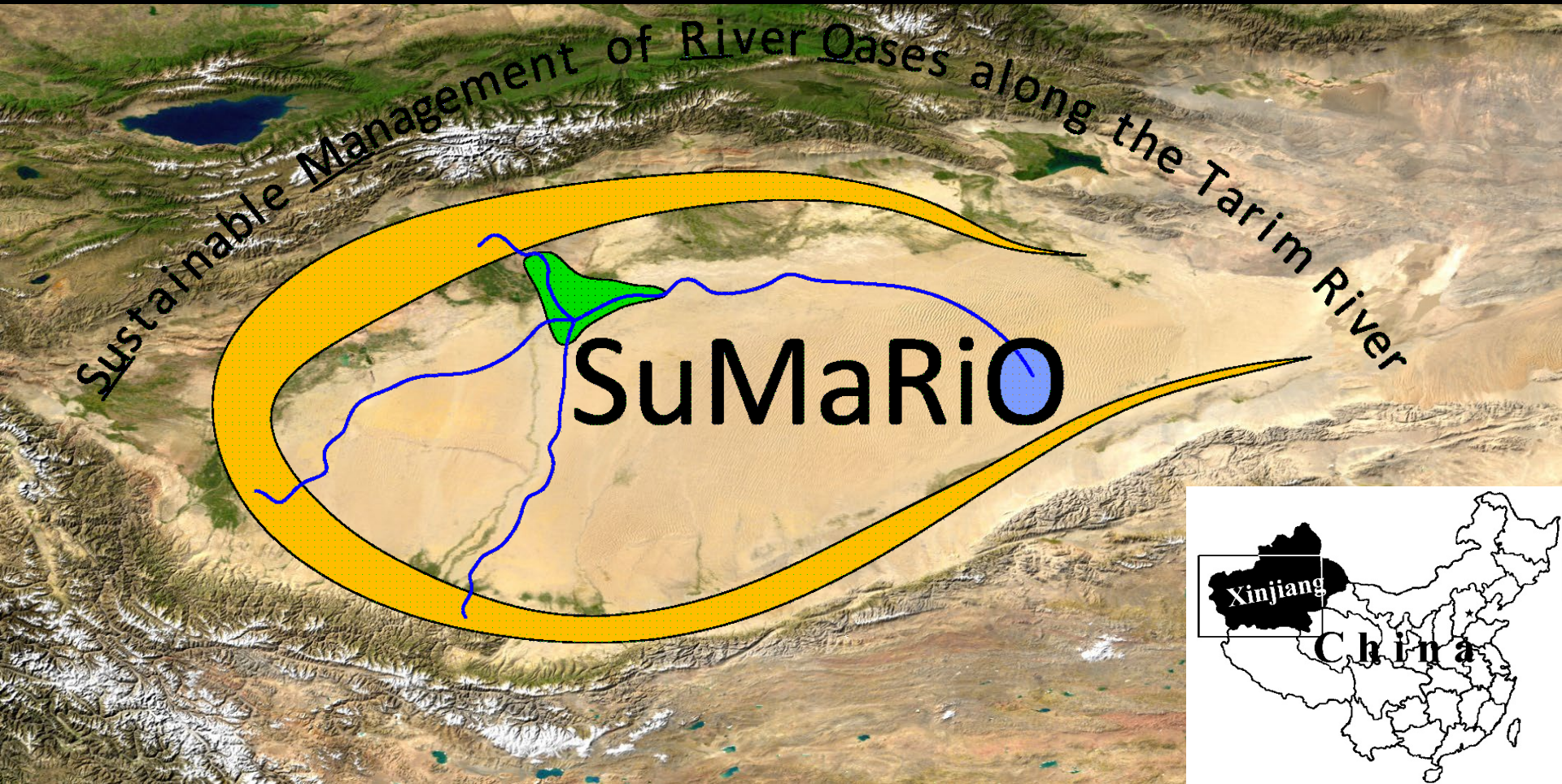
Welfare economic appraisal of a more sustainable water management in the Tarim Basin

- 1. Tackling water problems in the Tarim Basin: the SUMARIO project**
- 2. Environmental valuation – why and how?**
- 3. The importance of the elicitation question format**
- 4. Contingent valuation of a more sustainable water management in the Tarim Basin**
- 5. Results**
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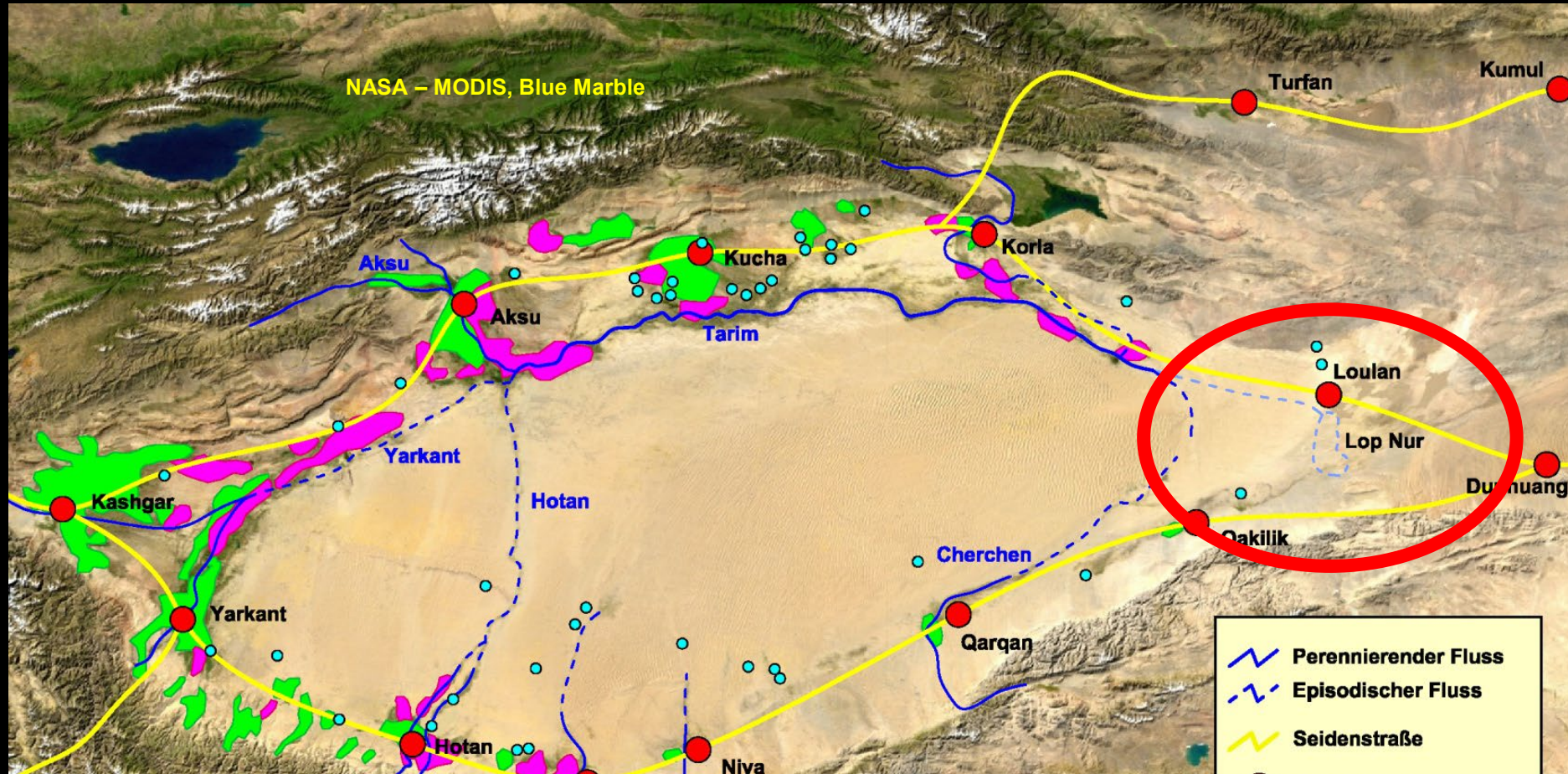
1.

Tackling water problems in the Tarim Basin: the SUMARIO project

Sustainable Management of River Oases along the Tarim River



Expansion of oases in the Tarim basin



• The lower reaches of the Tarim River have been dried up since 1972 (Length: app. 320 km)

→ Degradation of riparian forests

→ Drying up of the final lakes (Lop-Nur, Tetema)

2.

Environmental valuation – why and how?

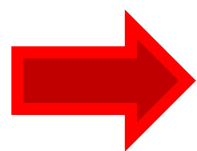
Why ?

Definitions of the governmental aims in the German Basic Law (Grundgesetz):

Article 56

[Oath of office]

On assuming his office, the Federal President shall take the following oath before the assembled Members of the Bundestag and the Bundesrat: "I swear that **I will dedicate my efforts to the well-being of the German people, promote their welfare, protect them from harm**, uphold and defend the Basic Law and the laws of the Federation, perform my duties conscientiously, and do justice to all. So help me God." The oath may also be taken without religious affirmation.



$$\max w(u_1(x^1, z), u_2(x^2, z), \dots, u_H(x^H, z)) \quad \left(\frac{\partial w}{\partial u_h} > 0 \ (\forall h) \right)$$

⇒ Environmental projects like the TARIM project increase environmental quality z , but they cause costs which decrease market consumption possibilities x → **are they worthwhile realizing ?**

The economic appraisal of environmental projects

CBA of a more sustainable oasis management in the Tarim basin

► Comparison: **social benefits** ↔ **social costs**

- preservation of **endangered plant** and **animal species** in the lower reaches of the Tarim for future generations
- better **living conditions** for **future generations** since less groundwater will be extracted
- aesthetic values, improved **landscape beauty** (no dried up riverbeds, new wetlands)

no market prices available !

- capital cost
- wages
- materials
- opportunity cost, forgone profits
- etc.

market prices available !

Special assessment methods needed !

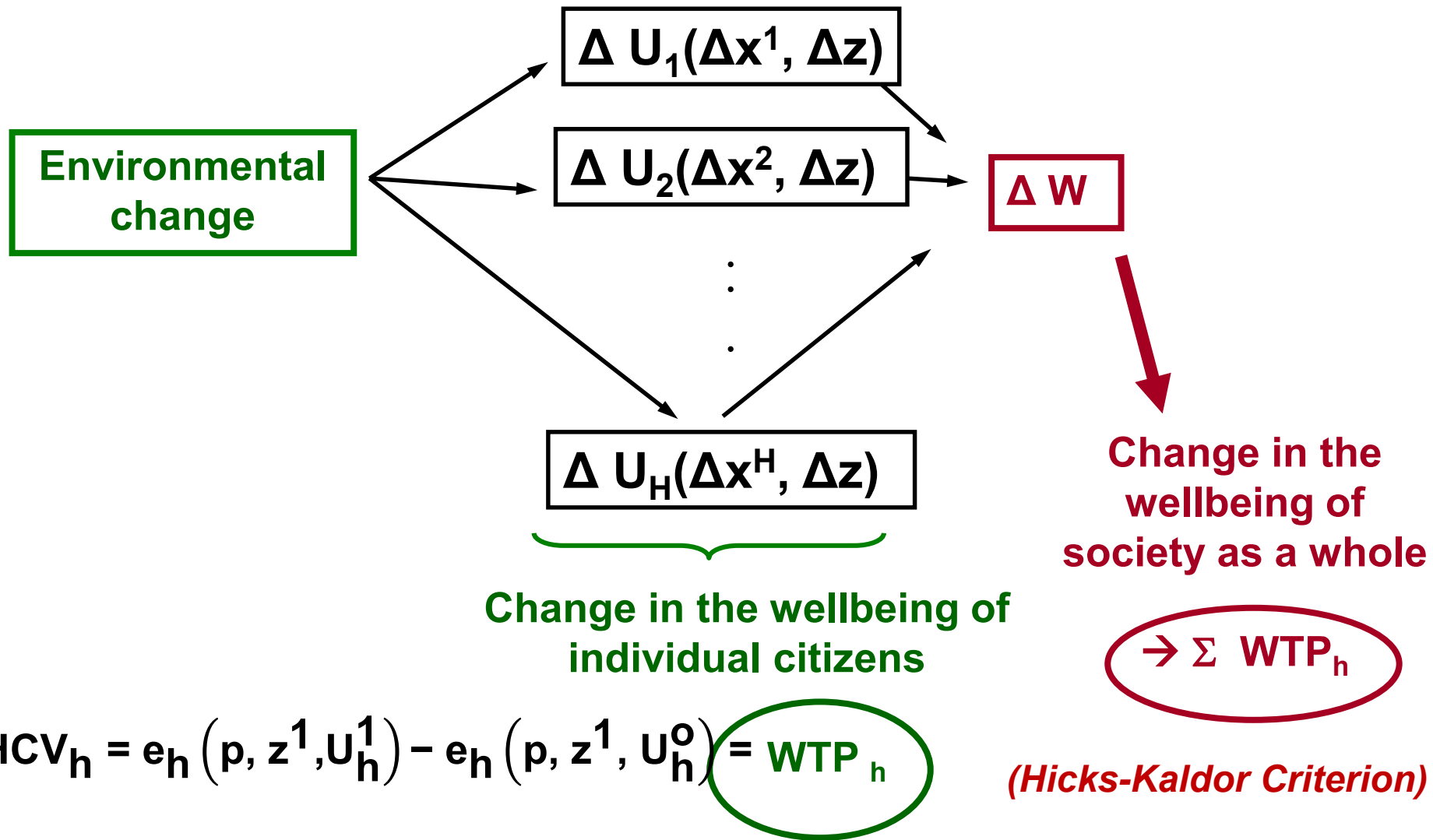
Expected results of a project appraisal study:

- ➔ **Comparison** of **social costs** and **benefits** accruing from a public project leads to the net social value of this project
 - ▶ Should the project be **implemented or not?**
 - ▶ If there are two alternative projects: Which of the **two alternative projects** should be implemented?
(➔ **efficiency aspects**)

- ➔ What are the characteristics of the socio-demographic groups that benefit most / least from the environmental project?
(➔ **distributional aspects**)

How ?

Typical structure of an environmental valuation study:



$$HCV_h = e_h(p, z^1, U_h^1) - e_h(p, z^1, U_h^0) = WTP_h$$

Assessment of WTP using the **Contingent Valuation Method (CVM)**:

Objectives: Assessment of

- the **social value** of a public project: $\sum_h WTP_h^{true}$ of all H people affected directly or indirectly by that project ($h = 1, 2, \dots, H$)
- the **determinants** of **WTP** (e. g. household size, attitudes, life style, income etc.)



Practical procedure:

- **Personal interviews** with a **representative random sample** of all households affected by the project $\Rightarrow WTP_s^{stated}$ ($s = 1, 2, \dots, S$)
- Determination of the **average WTP** of all respondents in the sample:

$$\overline{WTP}^{sample} = \frac{\sum_{s=1}^S WTP_s^{stated}}{S}$$

- **Aggregate WTP:** $WTP^{soc} = H \cdot \overline{WTP}^{sample}$

Problem: **Stated WTP** might **differ** from **true WTP** because of different kinds of **biases**.

Participation: Using "Citizen Expert Groups" (CEG) to improve the quality of the questionnaire and the validity of CVM results

Citizen

Expert

Groups

In a normal pretest interview only one respondent is confronted with the questionnaire to be tested. In a CEG the **group members can discuss with their peers**, so they feel encouraged to state doubts, questions etc. which they would not have mentioned if alone in a pretest

CEG members are no professional experts (e. g. for water management). They are employed as **"experts" for normal people's intellectual abilities, attitudes etc.**

Ideally, a **representative sample of citizens** is drawn from the group of all households potentially affected by the project to be valued

3.

The importance of the elicitation question format

Typical payment scenario:

"In order to finance the environmental project in question government will have to increase taxes / fees. This will increase the cost of living of all citizens."

- **Payment Card format** (Mitchell and Carson, 1981):

*"Please, tick in the following table **the interval with the maximum amount of money** you would be willing to pay every month (in terms of additional taxes, fees, higher cost of living etc.) for the realization of the environmental project in question?"*

<input type="radio"/>	0 €
<input type="radio"/>	1 – 5 €
<input type="radio"/>	6 – 10 €
<input type="radio"/>	11 – 17 €
<input type="radio"/>	18 – 26 €
...	...
...	...
...	...
<input type="radio"/>	150 – 200 €
<input type="radio"/>	> 200 €

- **Dichotomous Choice** format (*Bishop and Heberlein, 1979*):

"Would you vote for the realization of that project if you had to pay a monthly (yearly etc.) amount of X Euro in terms of an additional tax (fee, higher cost of living etc.) as a contribution to cover its cost?" (Payment rule)

Yes

(**X** = 0 €, 5 €, 10 € etc.)

No

➔ **"There is no strategic reason for the respondent to do other than answer truthfully ..."** (*Arrow et al. 1993 - Report of the NOAA Panel on Contingent Valuation, p. 21*)

But:

Several empirical studies find that the **DC** format systematically leads to **higher WTP** statements and therefore to higher project valuations **than** the **PC** format (*cf. e.g. Loomis et al. 1999, Brown et al. 1996, Cameron et al., 2002, Blaine et al., 2005, Xu et al., 2006, Antony and Rao, 2009, Vossler and Halloday, 2018*)

Why?

Possible explanations:

- **Cognitive effort too high** with PC format as compared to DC, therefore respondents state $WTP_{OE} = 0$ (*McCollum and Miller 1994*)
- **Preference uncertainty** (*Gregory et al. 1995; Ready et al. 1994*).

- **Conflicting objectives** of respondents if **WTP < bid**:

(1) answer DC question truthfully (→ "No"),

(2) express their approval of the suggested project (→ "Yes")

(Brown et al. 1996, Loomis et al. 1999, p. 582)

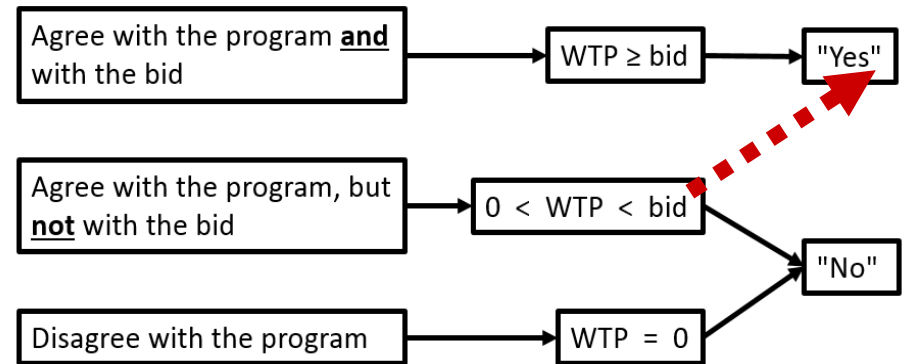
Dichotomous Choice:

Conflicting objectives with DC if $WTP^{true} < bid$:

➔ If respondents believe less in payment consequentiality than in policy consequentiality they will answer "yes".

➔ $WTP^{stated} = bid$, even though $WTP^{true} < bid$

"Would you vote for the suggested program if you had to pay the amount of ... [bid] ... Euros for its implementation?"



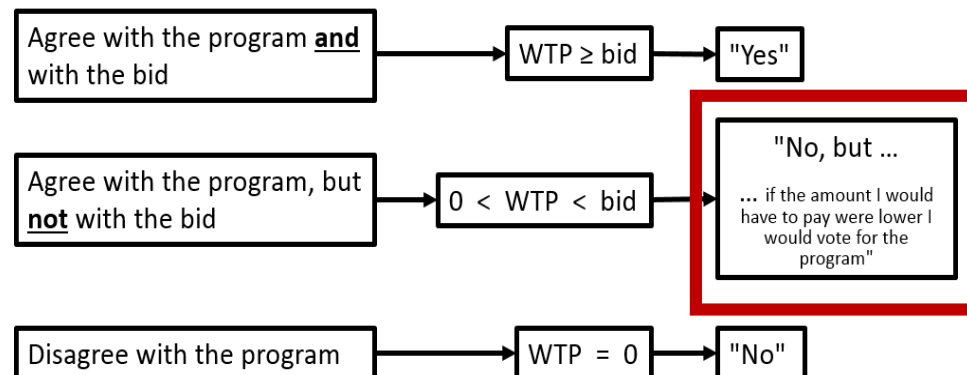
Trichotomous Choice:

Possible **solution:**

→ the trichotomous choice

elicitation format (Loomis et al. 1999)

"Would you vote for the suggested program if you had to pay the amount of ... [bid] ... Euros for its implementation?"



4.

**Contingent valuation of a more sustainable
oasis management in the Tarim Basin**

Use values and nonuse values of a more sustainable water management in the middle reaches of the Tarim:

Total value = use value + nonuse value

- existence value
- bequest value
- option value

- *less frequently* occurring periods of **water shortage** for the people living in the lower reaches of the Tarim
- **protection** of **roads** and **settlements against sandstorms** through new poplar forests
- possibility of building **new settlements**
- aesthetic values, improved **landscape beauty**
- better possibilities for **tourism** in the lower reaches of the Tarim

- tackling the **desertification problem** in China as a **national task**
- preservation of **endangered plant** and **animal species** in the lower reaches of the Tarim for future generations
- better **living conditions** for **future generations** since less groundwater will be extracted
- doing something for **minorities** in China
- ...

Permanent residents in Xinjiang

People living in other parts of China

Example Beijing

Empirical goals:

- Assessing the **willingness to pay** of **people living in the Tarim basin** for a more sustainable oasis management.
 - use + nonuse values
- Assessing **Beijing residents' willingness to pay** for a more sustainable oasis management in the Tarim Basin
 - nonuse values

Methodological goal (field experiments):

- Testing the influence of the **elicitation question format** on stated WTP (dichotomous choice vs. trichotomous choice)

General structure of our CVM interview:

(1) **Demographic and Warm-up questions** w.r.t. general information, previous knowledge about the project etc.



(2) Detailed description of the natural good or the project to be valued ("**project scenario**")

The project scenario:

"Scientists have developed a program with the overarching goal to **improve** the **living conditions** in the area along the Tarim River for man and nature. This program is called the **Tarim Environmental Preservation Plan** and implies a **science-based water management** that ensures that more and more water arrives in the lower reaches of the Tarim River, so that the **riparian forests and grasslands can recover** there. Once the river and its natural environment will have fully recovered, the area will be **less exposed** to **sandstorms** and **dust**; typical animals and plants will survive; also, the **living conditions** of **future generations** will **improve**."

General structure of our CVM interview:

(1) **Demographic and Warm-up questions** w.r.t. general information, previous knowledge about the project etc.



(2) Detailed description of the natural good or the project to be valued ("**project scenario**")



(3) Explanation of the market mechanism / payment vehicle ("**payment scenario**")



(4) **Elicitation question** (WTP)

*"In order to get the Tarim Environmental Preservation Plan financed, Central Government needs to transfer more money to the Tarim area. In order to finance these transfer payments **government** would have to **increase taxes** if TEPP was realized. This would lead to rising monthly expenditures for households. Economists estimate that the proposed program would **increase an average Beijing household's monthly expenditures by approximately x Yuan**."*

(x = 10 Yuan, 25 Yuan, 50 Yuan, 100 Yuan, 150 Yuan, 200 Yuan)

<u>Split sample:</u>	DC	TC
<p>Considering that your monthly household expenditures would increase by approximately x Yuan through the Tarim Environmental Preservation Plan would you personally be willing to support it?</p>	<p><input type="radio"/> Yes</p> <p><input type="radio"/> No</p>	<p><input type="radio"/> Yes</p> <p><input type="radio"/> No, but my household would support the Clean Fertilizer Program if the amount to be contributed were lower</p> <p><input type="radio"/> No</p>

Methodological research questions:

In order to test the plausibility of **conflicting objectives** as an explanation for $WTP^{DC} > WTP^{PC}$ (cf. Loomis 1999, p.582) we scrutinized the following questions

- (1) Is the **share of "Yes"-answers** for every bid **lower** if we use the **TC** elicitation question format **instead of DC**? Does the DC format, therefore, lead to an **overvaluation** of public projects?
- (2) Is the **number of straight "No"-answers constant** across **all bids** with the TC elicitation question format?
- (3) Are the **determinants** of answering **"Yes"** or **"No, but"** (i.e. of supporting the environmental project in question) plausible?

Empirical research question:

- (4) Do people living in an **urban environment in China** obtain **nonuse benefits** from an environmental project conducted in a **remote area far away from their city**, i.e. is their mean WTP for the proposed programs positive?

General structure of our CVM interview:

(1) **Demographic and Warm-up questions** w.r.t. general information, previous knowledge about the project etc.



(2) Detailed description of the natural good or the project to be valued ("**project scenario**")



(3) Explanation of the market mechanism / payment vehicle ("**payment scenario**")



(4) **Elicitation question** (WTP)



(5) **Debriefing and follow-up questions** w.r.t. income, marital status, children, attitudes towards environmental issues, government responsibilities etc.

5.

Results

The SUMARIO CVM survey in Beijing

- **2 438** completed (face-to-face) **interviews in Beijing**
- Street **intercept** interviews
- **1246 interviews** with a money gift of **20 Yuan or 40 Yuan** as an **incentive** to participate in the survey, **1192 interviews** with **no gift** at all
- **Quota sampling** to ensure a certain representatives of the sample: age, income, level of education

Overall size of sample	N = 2,472
Valid questionnaires	N=2,438

Socio-demographic characteristics:

	N	Mean	Std. dev.	Minimum	Maximum
Age	2438	40.209	15.417	18	84
Male	2437	0.504	0.500	0	1
Children	2391	0.345	0.475	0	1
Income (1000 Yuan)	2409	8.485	7.747	1	50

Different coding schemes for WTP assessment

Scheme 1: Code TC the same as DC responses

In this scheme, TC responses are recoded in a binary way, with

$$\text{"Yes"} \quad \Rightarrow \quad WTP_j = [bid_j, \infty)$$

$$\text{"No" or "No, but"} \quad \Rightarrow \quad WTP_j = (-\infty, bid_j)$$

Scheme 2: Recode "No" responses to zero

$$\text{"Yes"} \quad \Rightarrow \quad WTP_j = [bid_j, \infty)$$

$$\text{"No, but"} \quad \Rightarrow \quad WTP_j = (0, bid_j)$$

$$\text{"No"} \quad \Rightarrow \quad WTP_j = 0$$

Scheme 3: Recode **"No, but"** responses with the **open-ended follow-up point response** (*"Thus, which increase of your monthly expenditures would you accept in order to get the program realized?"*)

WTP estimates according to the different schemes

	N	WTP	95% CI		WTP/C I
DC	594	154	122	187	2.37
TC (Scheme 1)	594	89	73	105	2.79
TC (Scheme 2)	594	82	72	92	4.06
TC (Scheme 3)	594	81	72	89	4.83

Bid (in RMB):	10	25	50	100	150	200	Total
Dichotomous choice							
Yes	77.3 %	69.7 %	66.3 %	55.4 %	50.5 %	44.4 %	60.6 %
No	22.7 %	30.3 %	33.7 %	44.6 %	49.5 %	55.6 %	39.4 %
Trichotomous choice							
Yes	78.8 %	69.4 %	51.0 %	39.4 %	30.5 %	31.6 %	50.0 %
No, but	7.1 %	14.3 %	24.5 %	31.3 %	35.2 %	32.6 %	24.2 %
No	14.1 %	16.3 %	24.5 %	29.3 %	34.3 %	35.8 %	25.8 %
N	99	98	98	99	105	95	594

Bid (in RMB):	10	25	50	100	150	200	Total
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Yes	77.3 %	69.7 %	66.3 %	55.4 %	50.5 %	44.4 %	60.6 %
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N	99	98	98	99	105	95	594

Probit regression models displaying
determinants of supporting the
environmental project
*(dependent variable: "Yes" answers
in the pooled DC and TC samples)*

CONSTANT	0.517 (0.348)
BID	-0.006*** (0.001)
DC	0.301*** (0.082)
MALE	0.139* (0.081)
AGE	0.000 (0.003)
EDUCATION	0.051 (0.032)
INCOME	0.010* (0.005)
PROTEST	-0.419*** (0.053)
GOODCIT	0.314*** (0.043)
N	1132
Log likelihood	-650
Pseudo R ²	0.164

Multinomial
model for the
explanation of
"Yes" and "No,
but" answers
instead of
straight "No"
answers




	Beijing sample		
resp	Coef.		s.e.
"Yes"			
BID	-0.009	***	(0.001)
MALE	0.356	*	(0.186)
AGE	0.006		(0.006)
UNI	0.474	**	(0.195)
INCOME	0.000		(0.010)
AFFORDTAX	0.597	***	(0.188)
CONSOTHER	-0.317		(0.194)
PROTEST	-0.772	***	(0.131)
GOODCIT	0.475	***	(0.090)
CONSTANT	1.727	**	(0.716)
"No__but"			
BID	0.001		(0.001)
MALE	-0.104		(0.194)
AGE	-0.003		(0.006)
UNI	0.149		(0.201)
INCOME	-0.007		(0.011)
AFFORDTAX	0.509	***	(0.198)
CONSOTHER	0.599	***	(0.199)
PROTEST	-0.493	***	(0.136)
GOODCIT	0.150	*	(0.088)
CONSTANT	0.988		(0.761)
"No"	(base outcome)		
LL_0	-567		
LL	-467		
Obs.	548		
k	20		
McFadden R2	0.14		
BIC	1060		

5.

Concluding remarks

Methodological results:

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