Lake Tana Biosphere Reserve (LTBR): Socioeconomic, Institutional and policy assessments

EVAMAB closing workshop

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Focus points

- **2 applications**
- Willingness to contribute for water hyacinth control in villages around Lake Tana, Ethiopia
- Willingness to contribute for the protection and restoration of papyrus wetlands around Lake Tana, Ethiopia (first results)

Willingness to contribute for water hyacinth control in villages around Lake Tana, Ethiopia

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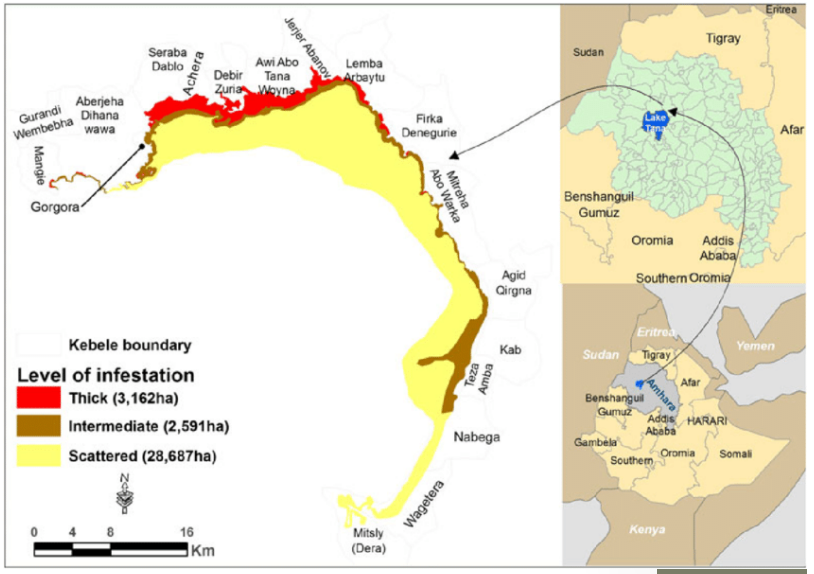
Problem Overview



- Since 2011, Lake Tana is officially infested with Eicchornia Crassipes (water hyacinth)
- "The worlds' worst aquatic weed" → Ecosystem disservice!
- Infestation stretches from north western part of Dembiya woreda northern Dera woreda. Ranging from scattered infestation in some places to thick coverage in others
- Disturbs the daily life of people
- Threats of water hyacinth to people around the Lake
  - It can quickly dominate a water way or aquatic system
  - It degrades habitat for waterfowl by reducing areas of open water used for resting, and when decomposing it makes water unfit for drinking
  - It displaces native aquatic plants used for food or shelter by other animals and wildlife species
  - Ideal breeding sites for mosquitoes and other vectors
  - Increases water losses from the lake, wetlands and tributary rivers because of the plant's high transpiration rate

Problem overview (2)

Thick water hyacinth coverage in Achera Mariam, Dembiya

Boats obstructed by water hyacinth mats around Tana Mitsil, Dera

Scattered water hyacinth plants invading irrigation canals in Achera Mariam, Dembiya

Thick water hyacinth coverage in Lemba Arbayitu kebele, Gonder Zuria

Water hyacinth plants floating on Lake Tana, on the way from Bahir Dar to Tana Mitsili, Dera

Study objective

- Research on the socio-economic impact of the water hyacinth infestation on smallholder farmers

- Through WTP expression by households inhabiting Lake Tana shores, express impact of the ecosystem disservice

- Useful input for cost-benefit analyses for (government) interventions

Study method & Survey design

- Contingent Valuation Method (CVM) structure
  - Stated-Preference
  - Disutility resulting from EDS
  - Hypothetical market, people don't actually have to pay
  - Information card, followed by WTC statement and personal information

- Creation of hypothetical market for water hyacinth control
  - Status Quo scenario: level of infestation remains as it is today
  - Improvement scenario: infestation completely removed (unrealistic)

- Labor, Cash and Mixed format

Data

- Total of 240 households interviewed

Experiment Area	**Number of Participants**
Tana Mitsili, Dera	59
Lemba Arbayitu, Gonder Zuria	123
Achera Mariam, Dembiya	58
Questionnaire Type	**Percentage**
Cash	31,67
Labour	25
Mixed	43,33

- Interval regression to estimate mean, confidence intervals and variable coefficients

Why Interval Regression?

- Data on the dependent variable in intervals
- Maximum likelihood method which explicitly accommodates the intervals
- OLS assumes information we don't have (point value)
- Broad intervals

Results (1)

Willingness to pay − status quo

Variable	
Age	-10.3 (4.8)**
Lemba Arbayitu	-124.2 (57.2)**
Tana Mitsili	
Farming Experience 6-10 years	24.08 (121.8)
Farming Experience 11-20 years	168.6(129.1)
Farming Experience > 20 years	176.6 (130.0)
No formal education	
Grades attended	
Local conference	98.0 (65.0)
Income	79.4 (34.6)**
Constant	252.5 (133.4)**

Willingness to pay − improvement

Variable	
Age	-4.6 (9.9)
Lemba Arbayitu	-300.1 (106.9)***
Tana Mitsili	
Farming Experience 6-10 years	-149.7 (156.2)
Farming Experience 11-20 years	98.3 (190.3)
Farming Experience > 20 years	60.4 (207.5)
No formal education	
Grades attended	
Local conference	166.2 (120.5)
Income	186.3(71.1)***
Constant	398.6 (178.0)**

Results (2)

Willingness to contribute labor – status quo

Variable	
Age	-0.3 (0.3)
Lemba Arbayitu	
Tana Mitsili	7.2 (3.0)**
Farming Experience 6-10 years	
Farming Experience 11-20 years	7.7 (3.8)**
Farming Experience > 20 years	12.2 (4.8)**
No formal education	
Grades attended	
Local conference	7.9 (3.4)**
Income	-1.8 (2.0)
Constant	27.5 (6.8)***

Willingness to contribute labor - improvement

Variable	
Age	-0.3 (0.5)
Lemba Arbayitu	
Tana Mitsili	9.4 (5.5)*
Farming Experience 6-10 years	
Farming Experience 11-20 years	12.3 (7.2)*
Farming Experience > 20 years	14.1 (9.0)*
No formal education	
Grades attended	
Local conference	14.2 (5.4)***
Income	
Constant	33.1 (6.8)***

Results (3)

- Extrapolating the results from interval regression for total population in infested kebeles in Gonder Zuria, Dembia and Dera

	Status quo	Improvement
Willingness to pay (Ethiopian Birr)	9,766,365 (or € 317,678)	16,932,206 (or € 550,767)
Willingness to contribute labor (man-days)	750,256	1,178,317

Discussion and conclusion

- Expected regressor effects: income, local conferences, age
- Severeness of the EDS may cause strategic overstatement
- ES-EDS perspective → adaptation
- The need for an integrated approach towards sustainable ecosystem management in Lake Tana

Willingness to contribute for the protection and restoration of papyrus wetlands around Lake Tana, Ethiopia

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Case study

- Wetlands of the lake Tana basin dominated by the *cyperus papyrus* reed

- Eastern and Southern shores of lake Tana and the river mouths are covered by papyrus

Papyrus wetlands

- Palustrine wetland
- “the kidneys of the landscape”
- “one of Earth’s most productive ecosystems” (Barbier et al., 1997)

- Ramsar Convention On Wetlands
- 10 general ecosystem services or functions

- Millennium Ecosystem Assessment
- Ecosystem services: provisioning, regulating, supporting and cultural

Papyrus wetlands

Supporting	Provisioning
Water cycling	Clean water
Photosynthesis	Fishing/hunting opportunities
Primary production	Fibre for commodities
Nutrient cycling	Fibre for fuel
Soil formation	Source of biochemical
Biodiversity support	Fibre for livestock
Regulating	**Cultural**
Regional climate regulation	Heritage values
Natural hazard control	Spiritual values
Water purification	Sense of place
Erosion control	Aesthetic values
Pollination values	

Papyrus main source of income for 33% of respondents

Papyrus wetlands

- Use of papyrus products:
- Tankwas
- Baskets
- Thatching material
- Ropes
- Matrasses
- …

Members of the Negede Weyto tribe making papyrus baskets

Papyrus wetlands

Member of Negede Weyto tribe making a papyrus basket

Papyrus used for construction and thatching material

Traditional papyrus reed boat: tankwa

Fisherman in a tankwa with papyrus vegetation in the background

Problem statement

- Wetlands in East-Africa under increasing threat

- The population of the cyperus papyrus plant around lake Tana has dramatically declined, even becoming locally extinct
- *”The papyrus wetland degradation is an environmental disaster for Ethiopia”* (Shewit et al., 2018)

- ➔ Loss of ecosystem services
- ➔ No effective wetland management

Problem statement

- Anthropogenic activities as the main reason for the papyrus wetland degradation:
- The conversion of wetlands to farm and grazing fields
- Urbanization
- Pollution form industrialization
- Sand mining
- Dam construction
- The over-exploitation of its resources
- The lack of cooperation among different community members
- But most importantly: the lack of wetland policies

- ➔ Case-studies of Debremariam and Dek-island

Study objective

- Provide quantitative data on the economic implications for local people concerning the degradation and reduction of papyrus wetlands

- Useful input for cost-benefit analyses for (government) interventions

- **Total Economic Value** (TEV) of papyrus swamps:
- use values & non-use values

➔ Contingent Valuation Method:
- includes direct & indirect use values and non-use values

Study method & Survey design

- Contingent Valuation Method (CVM) structure
  - Stated-Preference
  - Hypothetical market, people don't actually have to pay
  - Information about benefits papyrus, followed by WTP statement and personal information

Survey conducted in Zege

- Creation of hypothetical market
  - **Status Quo** scenario: the level of papyrus vegetation remains constant at current levels rather than having it deteriorate/disappear further
  - **Improvement** scenario: restore the impaired papyrus vegetation to the level it used to be 10 years ago

- 3 options: labour, cash or combination section

Data

- Total of 255 households interviewed: 248 were completed

Study areas	n	%
Bahir Dar	101	41
Zege	61	24
Wonjeta	86	35
Main occupational acitvity	**n**	**%**
Papyrus	82	33
Other: farming, coffee, merchant…	166	67

- Interval regression to estimate mean, confidence intervals and variable coefficients

Results WTP

Willingness to pay – status quo

Variable	Coefficient
Age	6.9*
Bahir Dar	194.6**
Zege	163.3***
Literate	12.5
Formal education	119.3*
Main occupational activity: Papyrus	106.07
Experience 6-10 years	-222.3**
Experience 11-20 years	-180.1
Experience >20 years	-148.4
Income: 12501-22500	34.8
Income: 22501-57500	74.2
Constant	-86.0

Estimated mean WTP: 263.83 ETB yearly
95% CI: [195.76 331.89]
Robust std. dev.: 255.20 ETB

Willingness to pay – Improvement

Variable	Coefficient
Age	15.8*
Bahir Dar	214.7
Zege	380.2***
Literate	67.5
Formal education	338.1**
Main occupational activity: Papyrus	297.5*
Experience 6-10 years	-376.4*
Experience 11-20 years	-314.8
Experience >20 years	-275.0
Income: 12501-22500	182.9
Income: 22501-57500	277.1*
Constant	-321.8

Estimated mean WTP: 609.75 ETB yearly
95% CI: [497.76 721.74]
Robust std. dev.: 419.89 ETB

- * p<0.10, ** p<0.05, *** p<0.01
- 54 respondents

Results WTCL

Willingness contribute labour – status quo

Variable	Coefficient
Age	0.17***
Bahir Dar	4.07**
Zege	9.55***
Literate	-0.20
Formal education	0.011
Main occupational activity: Papyrus	0.43
Income: 12501-22500	1.06
Income: 22501-57500	0.14
Constant	0.99

Estimated mean WTCL: 12.4 man-days yearly
95% CI: [11.24 13.56]
Robust std. dev.: 7.15 man-days

Willingness to contribute labour – Improvement

Variable	Coefficient
Age	0.31***
Bahir Dar	3.91
Zege	13.80***
Literate	2.34
Formal education	4.27*
Main occupational activity: Papyrus	5.28 **
Income: 12501-22500	0.03
Income: 22501-57500	2.62
Constant	2.07

Estimated mean WTCL: 24.07 man-days yearly
95% CI: [22.04 26.10]
Robust std. dev.: 12.48 man-days

- * p<0.10, ** p<0.05, *** p<0.01
- 145 respondents

Results mixed contribution

- Combination of yearly cash money **and** man-days contribution
- 41 respondents

Summarization	Status-Quo Mean	Improvement Mean
Combination	531.2 ETB + 13.9 MD	868.3 ETB + 25.3 MD
Combination in terms of cash*	827.0 ETB	1509.2 ETB
Combination in terms of labour**	38.9 MD	59.6 MD

*Note: * Status Quo: 1 MD = 263.83/12.4 ETB = 21.28 ETB, Improvement: 1 MD = 609.75/24.07 ETB = 25.33 ETB.*
*** Status Quo: 1 ETB = 12.4/263.83 MD = 0.047 MD, Improvement: 1 ETB = 24.07/609.75 MD = 0.0395 MD*

Results no contribution

- “I am on a limited budget and cannot contribute”: 3 respondents
- “I don't encounter problems due to the loss of papyrus vegetation”: 1 respondent
- “I don't feel responsible for this”: 4 respondents

Discussion and Limitations

- Expected regressor effects: age, location, main occupational activity: papyrus
- Variable main occupational activity “papyrus”: only significant in improvement scenario
- Interval regression: normality of data needed
  → not the case
- Potential additional explanatory variable: household size
- Limitations CVM

Conclusion

- The need for an integrated, comprehensive and sustainable wetland management for the Lake Tana region

- *Provision of quantitative data, more specific the financial impact on the local population of the degradation, in order to support the current management concerning the papyrus wetlands of the lake Tana biosphere and contributing to the goal of the restoration and preservation of the papyrus vegetation.*

Thank you

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