# Integrated Assessments of Ecosystem Services for Sustainable Management of Natural Resources:

## *A cases of Lake Hawassa Sub Basin (LHB), Ethiopia*

**By**

**Bedilu Amare Reta**

**beamreta@gmail.com**

**1st supervisor: Prof. Dr. Felix Müller**

**2nd supervisor: PD Dr. Benjamin Burkhard**

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# Outline

Introduction, Objective and Methodology

Results

ESS Mapping for LHB ESS

Impacts on ESS

Conclusions and Recommendations

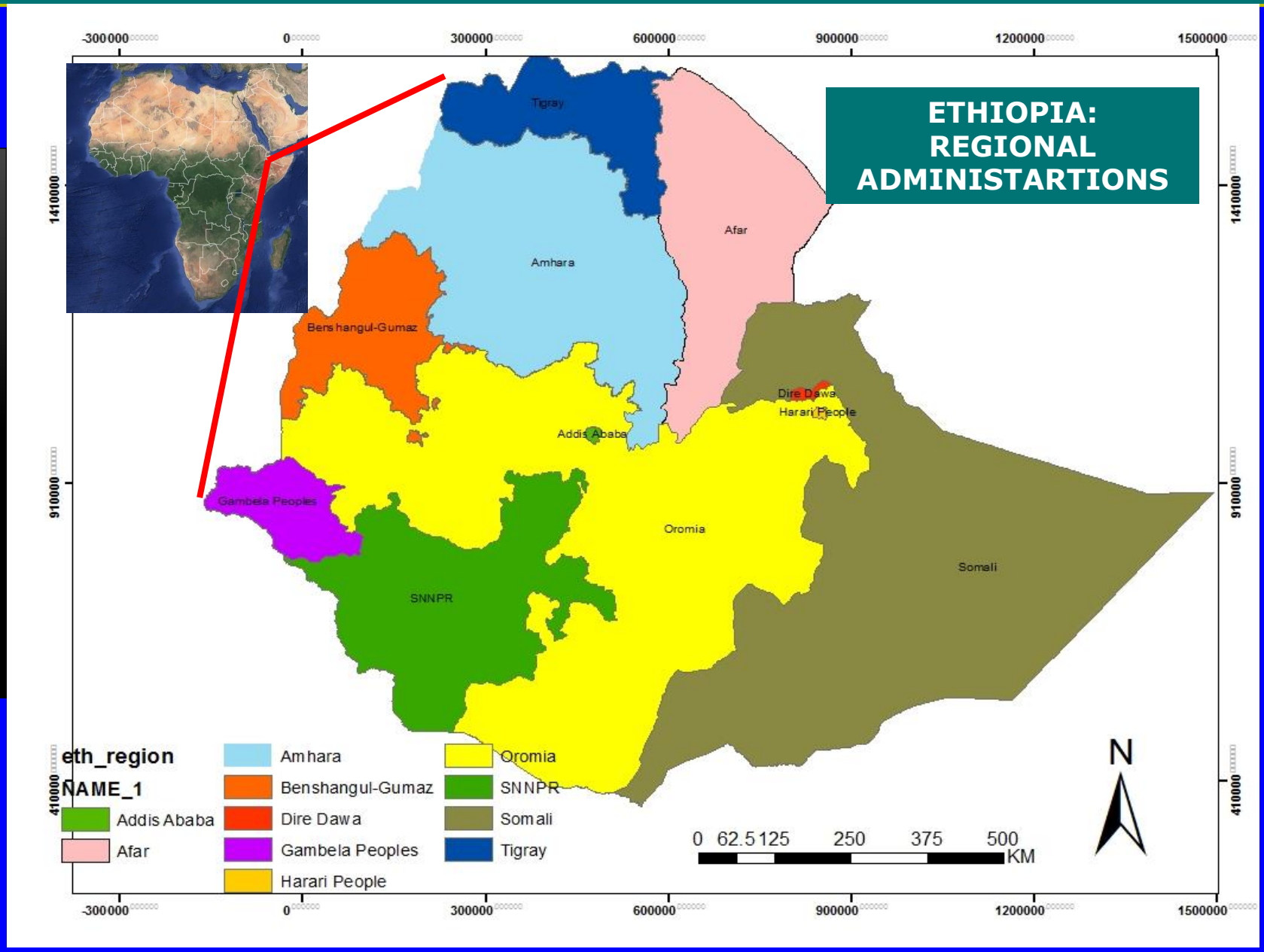
# Introduction- Study Area

12 Basins

8 - River basins

1-Rift Valley Lake basins (RVLB)

3- Dry basins



# Introduction

**Ethiopian surface water resources by major river basins**

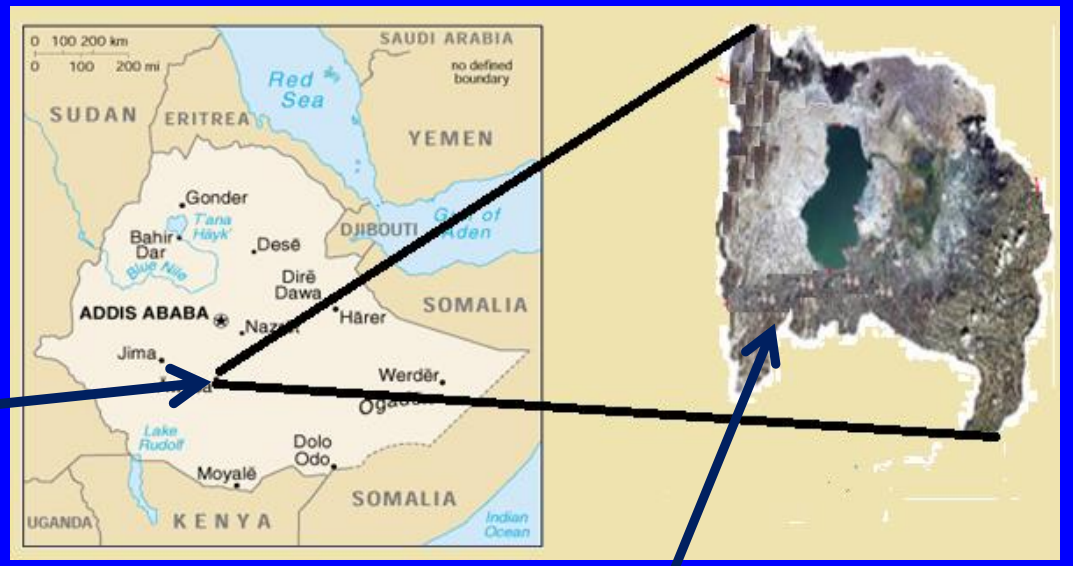
| No | Basin | Basin name | Catchment area ($km^2$) | Annual runoff ($BM^3$) | Specific discharge ($l/s/km^2$) | Share out of total |
|---|---|---|---|---|---|---|
| **1** | **Lake Basin** | **Rift Valley** | **52 740** | **5.6** | **3.4** | **4.63** |
| **2** | River Basin | Abbay | 199 812 | 52.6 | 7.8 | 43.05/17.56 |
| **3** | | Awash | 112 700 | 4.6 | 1.4 | 3.76/9.9 |
| **4** | | Baro-Akobo | 74 100 | 23.6 | 9.7 | 19.31/6.51 |
| **5** | | Genale –Dawa | 171 050 | 5.8 | 1.2 | 4.81/15.03 |
| **6** | | Mereb | 5 700 | 0.26 | 3.2 | 0.21/0.52 |
| **7** | | Omo-Gibe | 78 200 | 17.9 | 6.7 | 14.7/6.87 |
| **8** | | Tekeze | 89 000 | 7.63 | 3.2 | 6.24/7.9 |
| **9** | | Wabe Shebele | 200 214 | 3.15 | 0.5 | 2.59/17.59 |
| **10** | Dry Basin | Afar-Danakil | 74 000 | 0.86 | - | 0.7/6.5 |
| **11** | | Ogaden | 77 100 | 0 | - | 0/6.77 |
| **12** | | Aysha | 2 200 | 0 | - | 0/0.19 |
| **Total** | | | 1 136 816 | 122 | | |

***(MoWR, 2002; Different master plan studies)***

# Introduction - Study Area

**Lake Hawassa**

- Average area of 96 km$^2$
- Depth: average 13.6 m
- maximum of and 32.2 m (WWDSE, 2001)

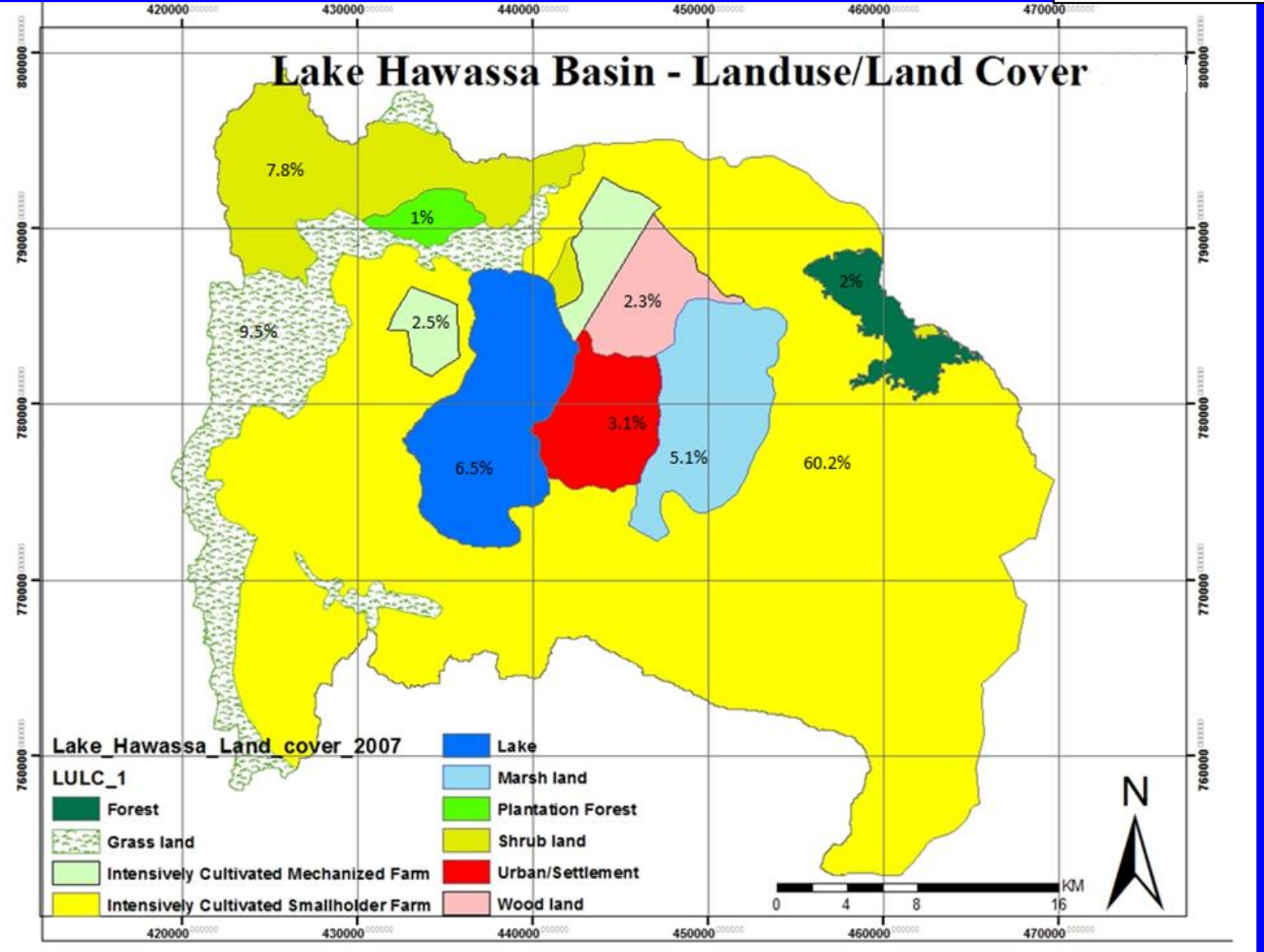



- Lake Hawassa sub basin:
- Located in RVLB
- Area:1,436 km$^2$
- Population: 839,585
- 77% rural and 23% urban

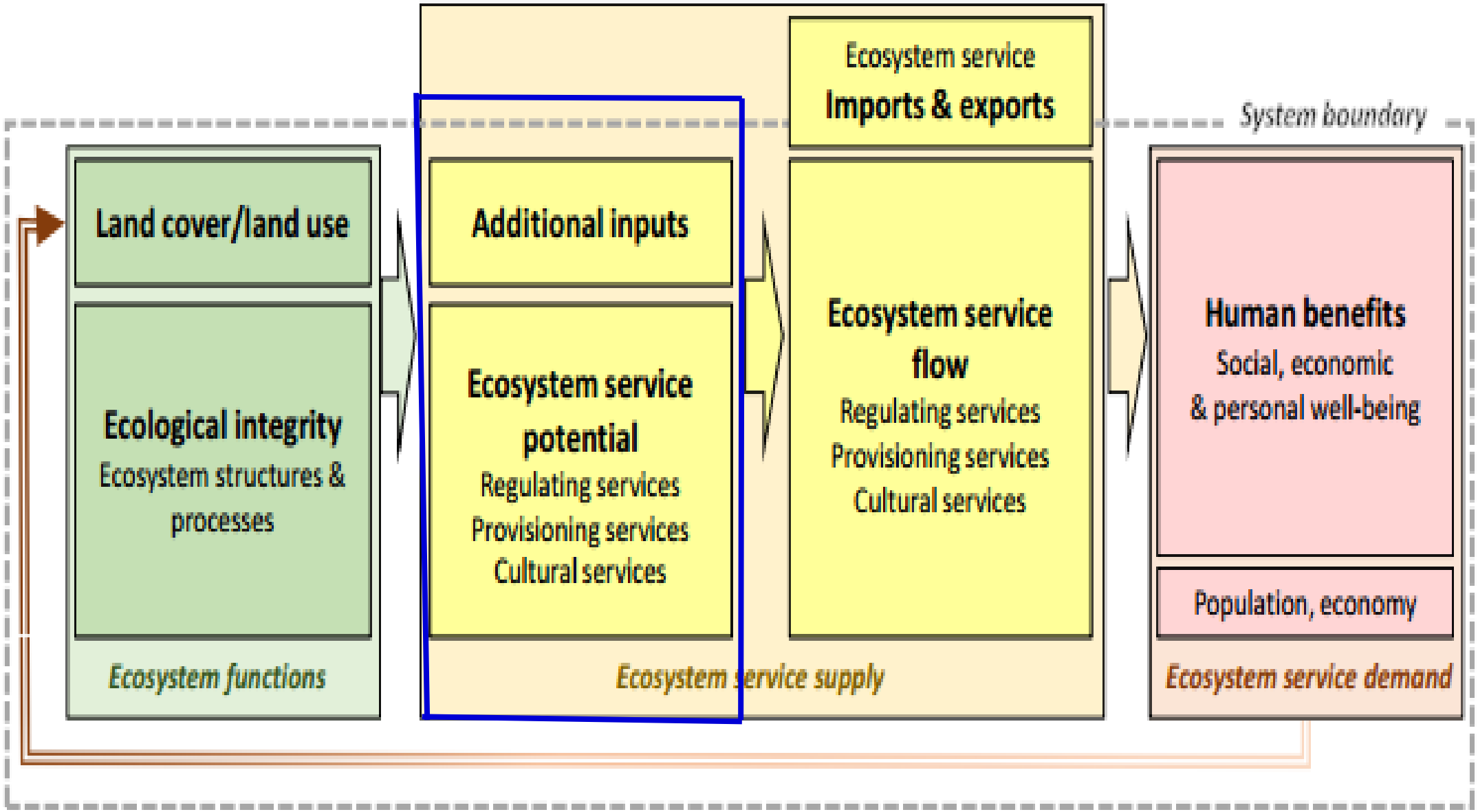
(MoWRa, 2010)

# Introduction – Lake Hawassa Basin LULC

Source: MoWR, 2007



# Introduction: Conceptual model showing relations of ecosystem functions, services and benefits (Burkhard et al., 2014)



# Introduction: Benefit-LHB Ecosystem services:

## 1-Provisioning services:

Food_CROP

FOOD_Fish


## 2- Regulating Services:

Erosion regulation, Waste regulation, Flood regulation, etc

# Introduction: Ecosystem services:

## 3- Cultural services:

**Aesthetic, spiritual, Cultural**

**Tourism**

**Recreation**

# Introduction

**Previous studies:**

- Focused on single ESS and/or specific problem

**Gaps and limitations:**

- **Existing** ecosystem services and associated problems were not assessed in an integrated manner
- Lack of data, awareness and Knowledge on ESS
- possible conflict of interest

➢ **Impacts on ESS due to:**

- ✓ point and non point source pollutions impacts
- ✓ Land use and land cover change,
- ✓ land degradation
- ✓ population pressure and urbanization
- ✓ Regular Water abstraction

# Impacts on LHB ESS

Impact on Sensitive fauna and flora species

Soil/land degradation

Gullying from poor drainage control

Impact from point and nonpoint sources pollution

**Over Fishing**

# Introduction

FOCUS !!!

- ✓Prioritize and assessment of the existing potential ecosystem services
- ✓Identification of associated benefits
- ✓Mapping of the selected ESS
- ✓Determine sources of impacts and mitigation

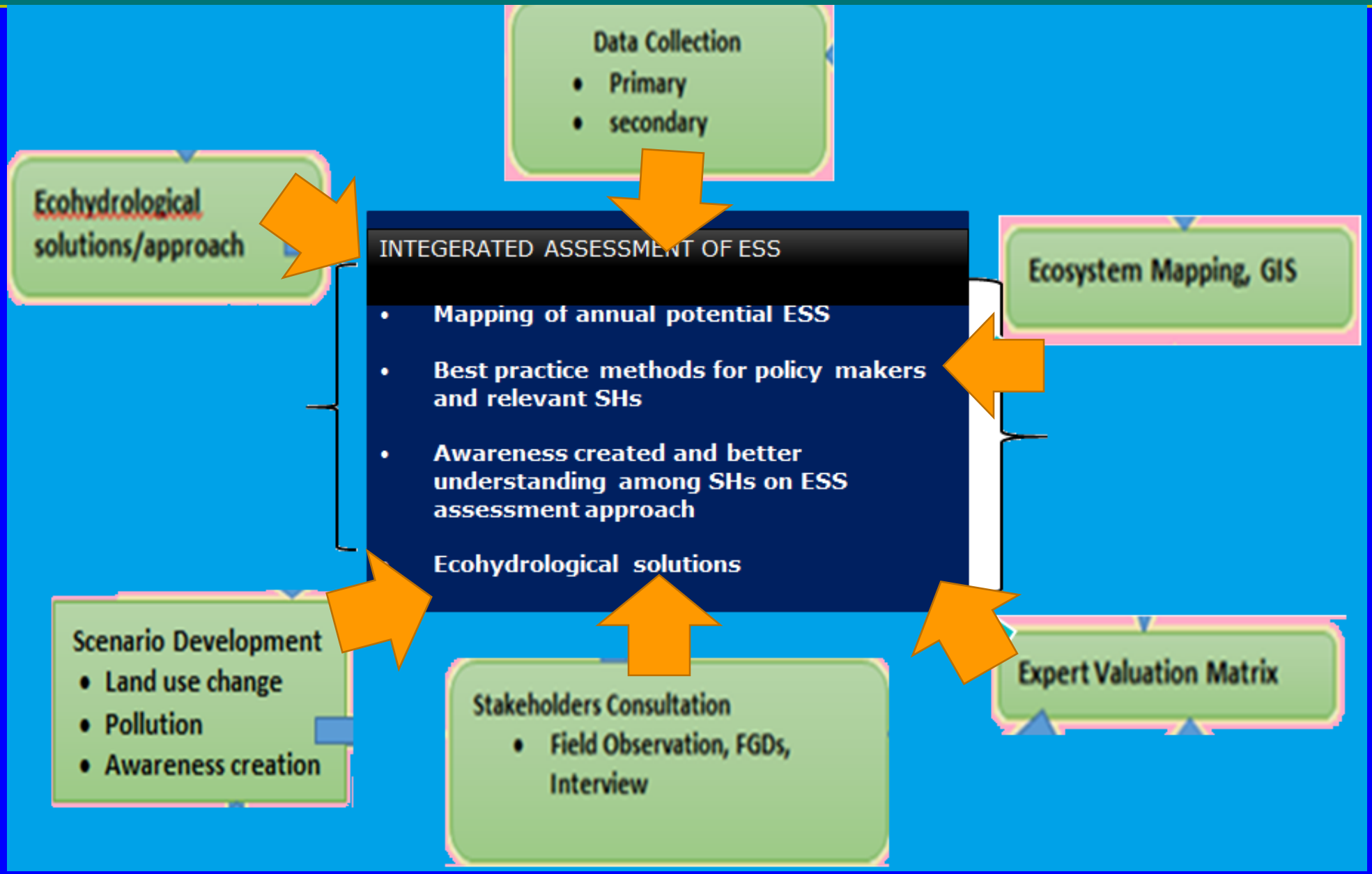
Importance !!!

- ✓alternative management options or practices for policy makers
- ✓awareness creation for relevant stakeholders
- ✓integration of ESS approach in the future watershed management plan and activities
- ✓Ensuring the natural habitat quality

# Objectives:

- To **prioritize and asses** the importance of ecosystem services (ESS) of Lake Hawassa Basin (LHB)
- To **mapping of LHB ESS** and recommend to be used as a tool for decision makers and development partners
- To identify the **major stakeholders and create awareness** on the importance and use of LHB's ESS
- To identify **the impact on ESS** and respective measures
- To **identify alternative best management practice** and propose means of embedding in the existing and future LHB watershed management plans and activities

# Research Methods



# Research Method: Mapping Ecosystem services

PRIMARY AND SECONDARY *data and shape file were collected*

Data and Information were reviewed

Important ESS Were assesses and prioritized

Use - Expert evaluation matrix

| No. | LULC | Provisioning Services | Crop | Fish | Livestock | Fresh water | Fuel wood | Fodder, Grazing for livestock | Regulating Services | Global Climate Regulation | Water Purification | Flood Regulation | Erosion Regulation | Waste Regulation | Cultural Services | Recreation and Tourism | Cultural Heritage and diversity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Intensively Cultivated Smallholder farm | | | | | | | | | | | | | | | | |
| 2 | Intensively Cultivated Mechanized Farm | | | | | | | | | | | | | | | | |
| 3 | Forest | | | | | | | | | | | | | | | | |
| 4 | Plantation Forest | | | | | | | | | | | | | | | | |
| 5 | Grassland | | | | | | | | | | | | | | | | |
| 6 | Lake | | | | | | | | | | | | | | | | |
| 7 | Marshland | | | | | | | | | | | | | | | | |
| 8 | Shrub land | | | | | | | | | | | | | | | | |
| 9 | Settlement/Urban | | | | | | | | | | | | | | | | |
| 10 | Woodland | | | | | | | | | | | | | | | | |

**Burkhard *et. al.*2009**

Wereda Experts

- Ranking potential ESS
- Filling Expert valuation matrix after consultation

Mapping - existing potential ESS

# Research Method: Stakeholders consultations

**Consultations**

**with** *relevant stakeholders*


**CONSULTATIONS**
**FGDs**

Consultation matrix:

*Rank importance and value of ecosystem services (0-5)*

***I*nterviews and focal group discussions**

***(Snow ball sampling method)***

- **To identify relevant SH**
- **To select the best indicators and ESS**
- **To fill the expert valuation matrix**

# Results: Prioritized ESS by SH

| Provisioning Services | Rank |
|---|---|
| Crop | 1 |
| Fish | 2 |
| Livestock | 3 |
| Fresh water | 4 |
| Fuel wood | 5 |
| Fodder, Grazing for livestock | 6 |
| Biomass energy | 7 |
| Fiber | 8 |
| Timber | 9 |
| aquaculture | 10 |
| wild food | 11 |
| Biochemical, Medicine | 12 |
| Mineral resources | 13 |
| Abiotic energy sources | 14 |

| Regulating Services | Rank |
|---|---|
| Erosion Regulation | 1 |
| Flood (Water flow) regulation | 2 |
| water purification | 3 |
| Waste Regulation | 4 |
| Global climate regulation | 5 |
| Air quality regulation | 6 |
| Local climate regulation | 7 |
| Nutrient regulation | 8 |
| Natural hazard regulation | 9 |
| Pest and disease control | 10 |
| Pollination | 11 |

| Cultural services | Rank |
|---|---|
| Recreation and Tourism | 1 |
| Cultural heritage and diversity | 2 |
| Natural heritage and diversity | 3 |
| Landscape aesthetics | 4 |
| Religious experience | 5 |
| Knowledge system | 6 |

Only 13 ESS were selected by SH

# Research Method :Assessment Matrix

**expert evaluation matrix/Assessment Matrix: 0-5- Relevant capacity to provide the service**

At the basin land scape level

| Scale | Value |
|---|---|
| Zero(0) | No relevant capacity |
| One(1) | Very low relevant capacity |
| Two(2) | Low relevant capacity |
| Three(3) | Medium relevant capacity |
| Four(4) | High relevant capacity |
| Five(5) | Very high relevant capacity |

- Use 2007 Land use/land cover (LULC) data

- identify the potential existing ecosystem services (Provisioning, regulating, and cultural ecosystem services) capacities

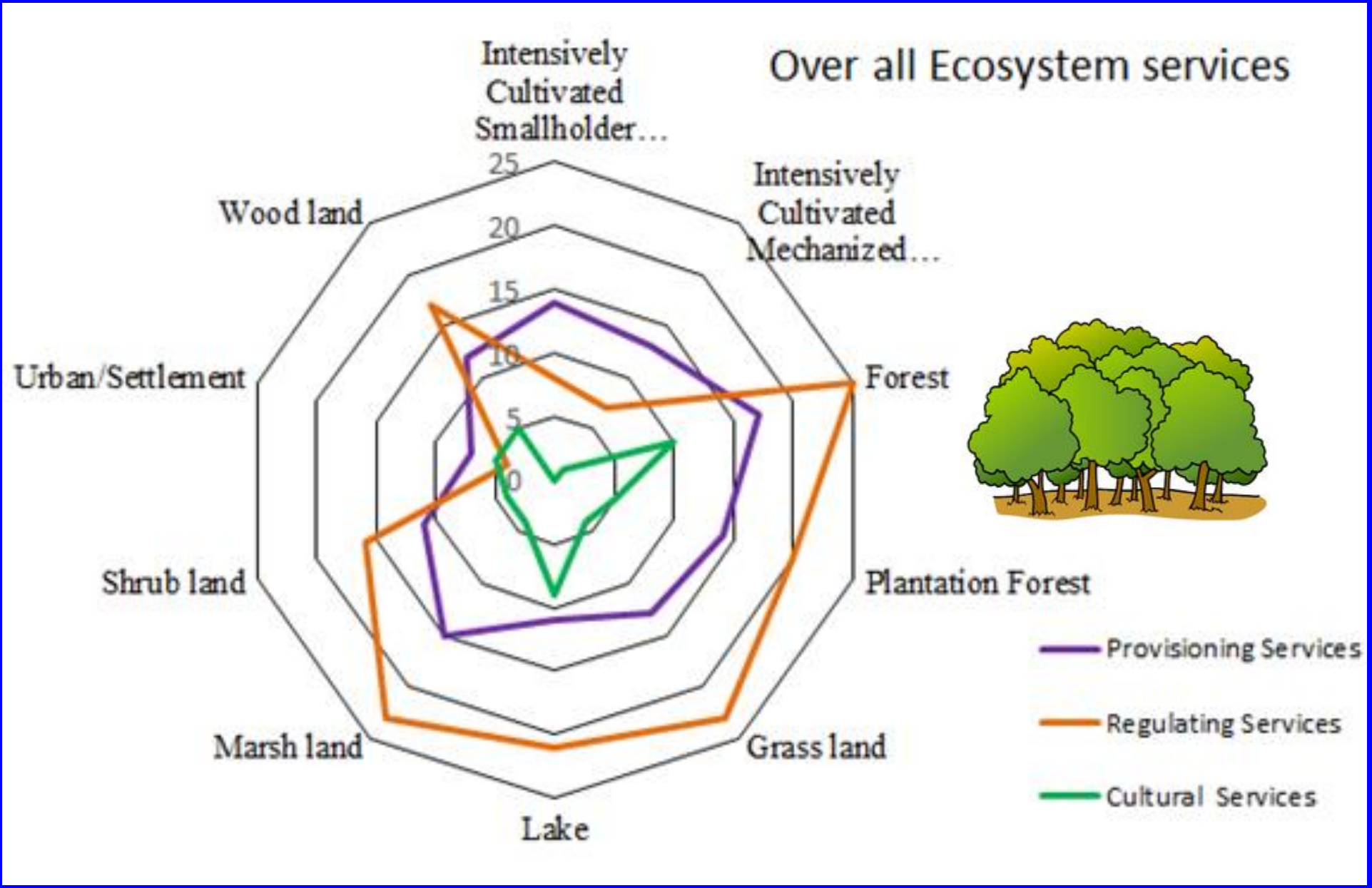
# Result: Ranking: Expert Valuation Matrix

| No. | LULC | sum Provisioning Services | Food-Crop | Food-Fish | Food-Livestock | Fresh water | Fuel wood | Fodder, Grazing for livestock | sum Regulating Services | Global Climate Regulation | Water Purification | Flood Regulation | Erosion Regulation | Waste Regulation | sum Cultural Services | Recreation and Tourism | Cultural Heritage and |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Intensively Cultivated Smallholder Farm | 14 | 5 | 0 | 3 | 0 | 2 | 4 | 8 | 2 | 0 | 3 | 2 | 1 | 0 | 0 | 0 |
| 2 | Intensively Cultivated Mechanized Farm | 13 | 5 | 0 | 3 | 0 | 2 | 3 | 7 | 2 | 0 | 3 | 1 | 1 | 1 | 1 | 0 |
| 3 | Forest | 17 | 3 | 0 | 2 | 3 | 5 | 4 | 25 | 5 | 5 | 5 | 5 | 5 | 10 | 5 | 5 |
| 4 | Plantation Forest | 14 | 2 | 0 | 2 | 2 | 5 | 3 | 20 | 5 | 5 | 4 | 3 | 3 | 5 | 4 | 1 |
| 5 | Grass land | 13 | 0 | 0 | 5 | 2 | 1 | 5 | 23 | 3 | 5 | 5 | 5 | 5 | 4 | 2 | 2 |
| 6 | Lake | 11 | 0 | 5 | 1 | 5 | 0 | 0 | 21 | 4 | 4 | 4 | 4 | 5 | 9 | 5 | 4 |
| 7 | Marsh land | 15 | 0 | 2 | 3 | 4 | 2 | 4 | 23 | 3 | 5 | 5 | 5 | 5 | 4 | 2 | 2 |
| 8 | Shrub land | 11 | 1 | 0 | 2 | 2 | 3 | 3 | 16 | 4 | 3 | 3 | 3 | 3 | 4 | 2 | 2 |
| 9 | Urban/Settlement | 7 | 0 | 0 | 2 | 3 | 1 | 1 | 4 | 1 | 1 | 1 | 1 | 0 | 5 | 3 | 2 |
| 10 | Wood land | 12 | 1 | 0 | 2 | 2 | 4 | 3 | 17 | 4 | 3 | 4 | 3 | 3 | 5 | 3 | 2 |
| Mean Value | | 13 | 2 | 1 | 3 | 2 | 3 | 3 | 16 | 3 | 3 | 4 | 3 | 3 | 5 | 3 | 2 |

**Burkhard *et. al.*2009**

# Result

**sum value of radar diagrams** for total value of annual potentials **all ESS**

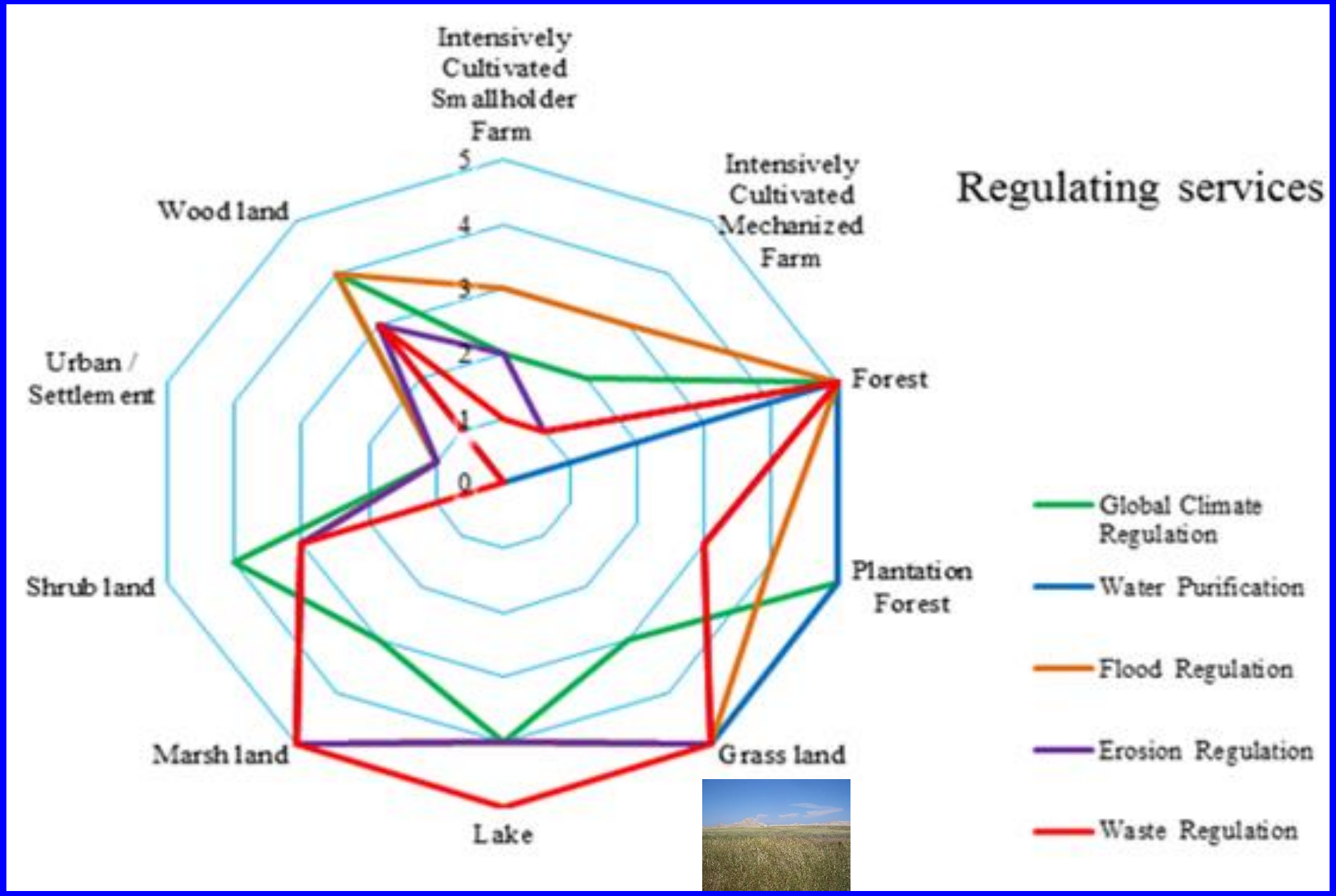


# Result

Radar diagrams of 0-5 assessment scale for mean value of annual potentials- **Provisioning ESS**

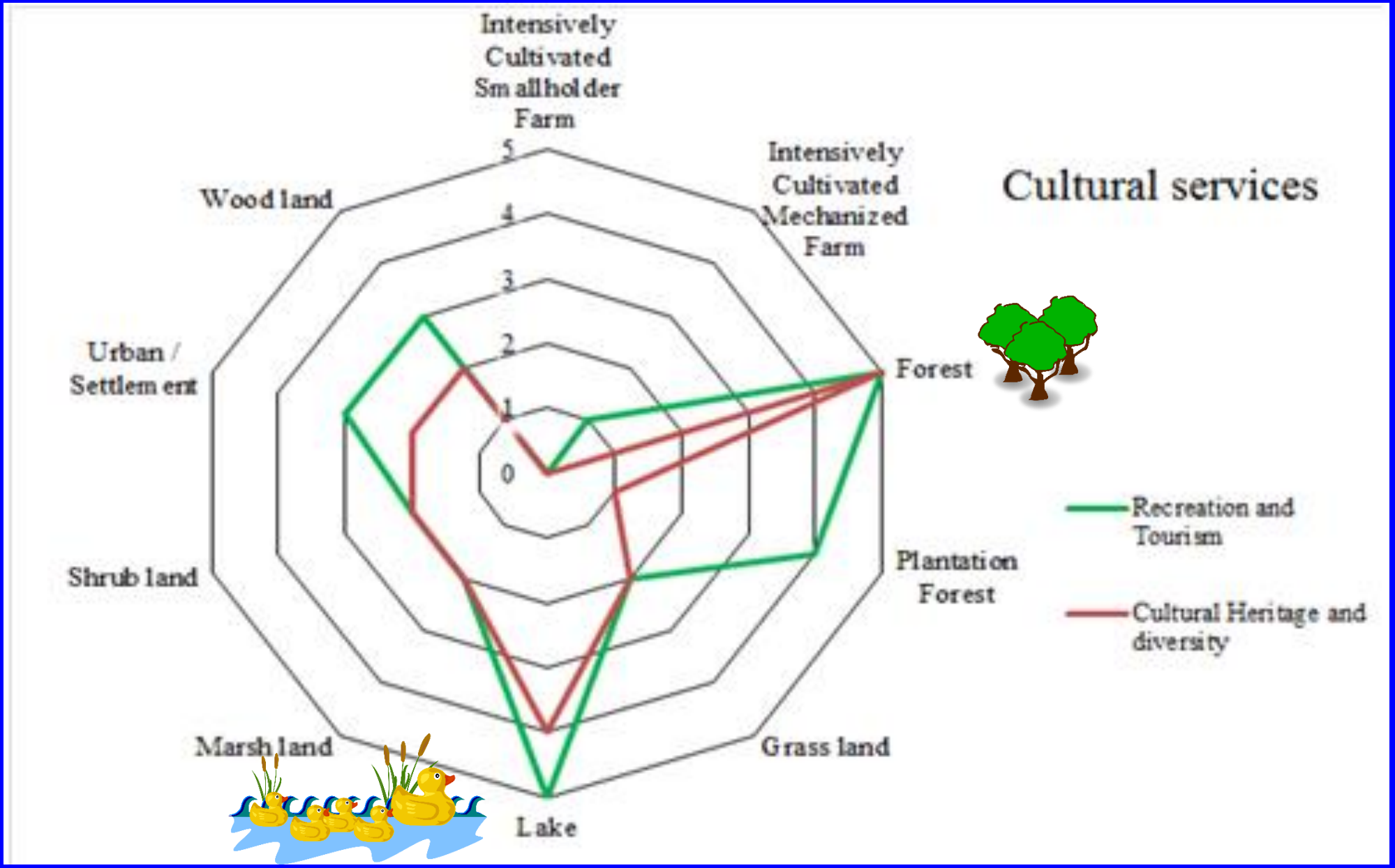
# Result

## Radar diagrams of 0-5 assessment scale for mean value of annual potentials -Regulating ESS



# Result

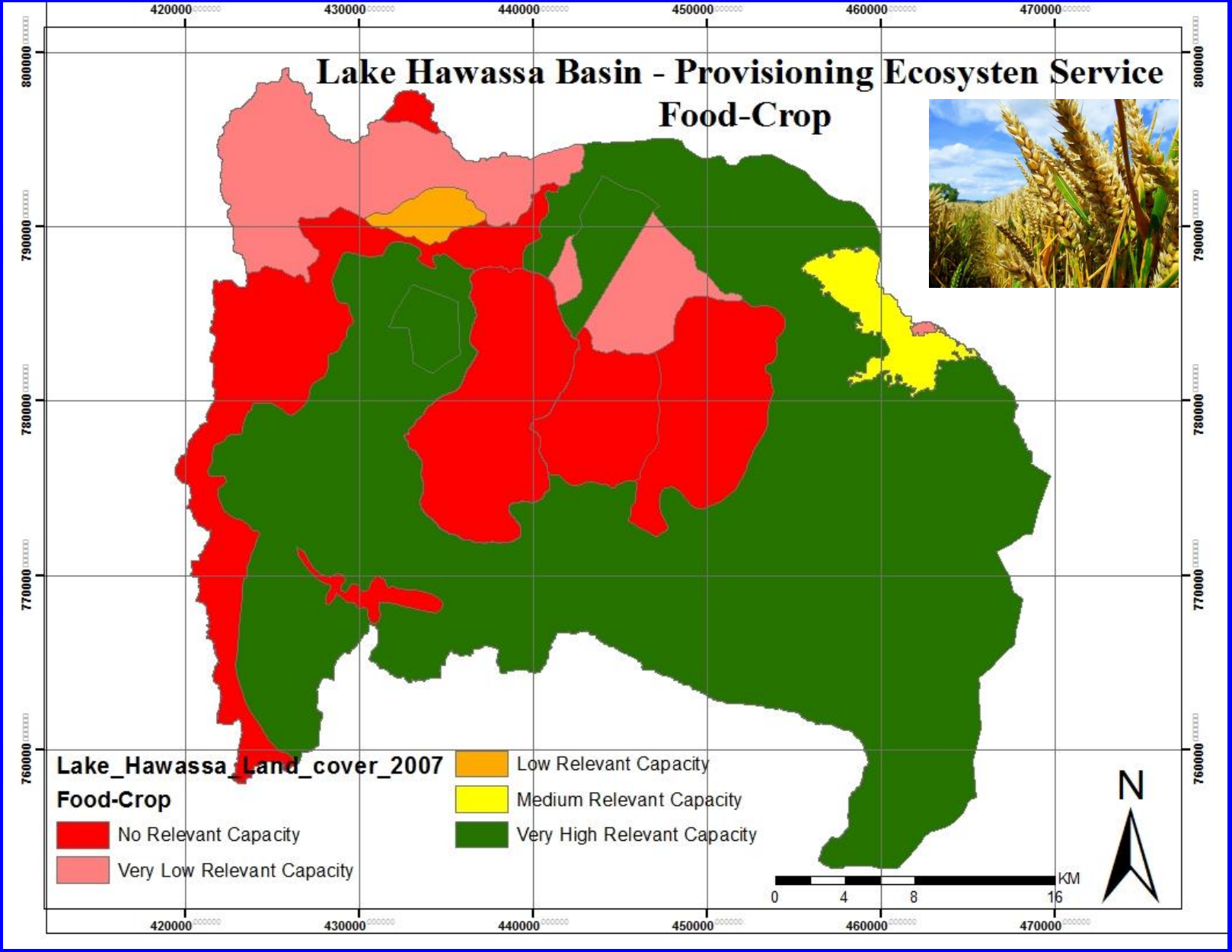
## Radar diagrams of 0-5 assessment scale for mean value of annual potentials **Cultural ESS**



# Result: Provisioning ESS

High Relevant capacity – Eastern side of LHB & western side: No Relevant capacity

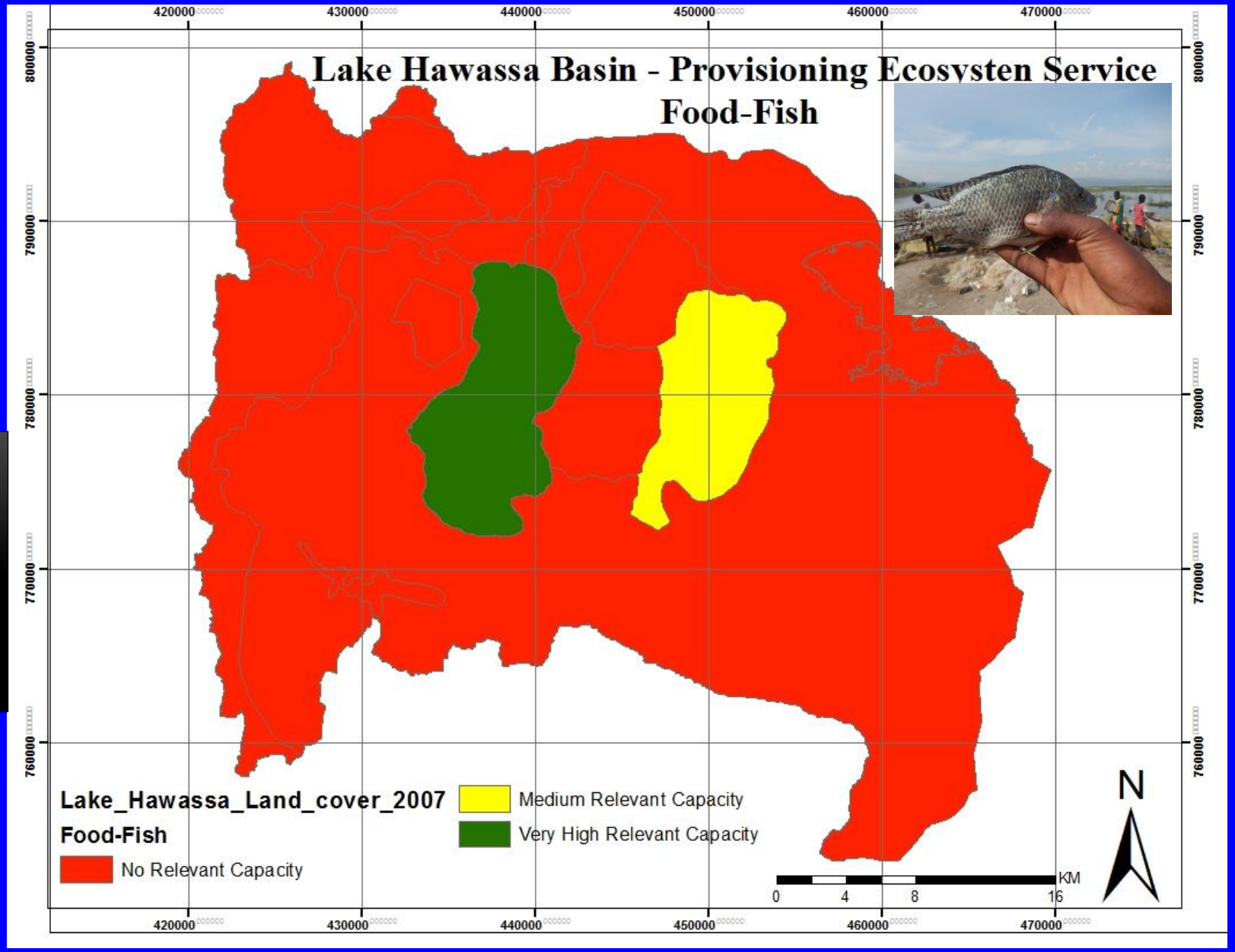
Information about LHB's potential ESS: food- crop



# Result: Provisioning ESS

High Relevant capacity – Lake Hawassa

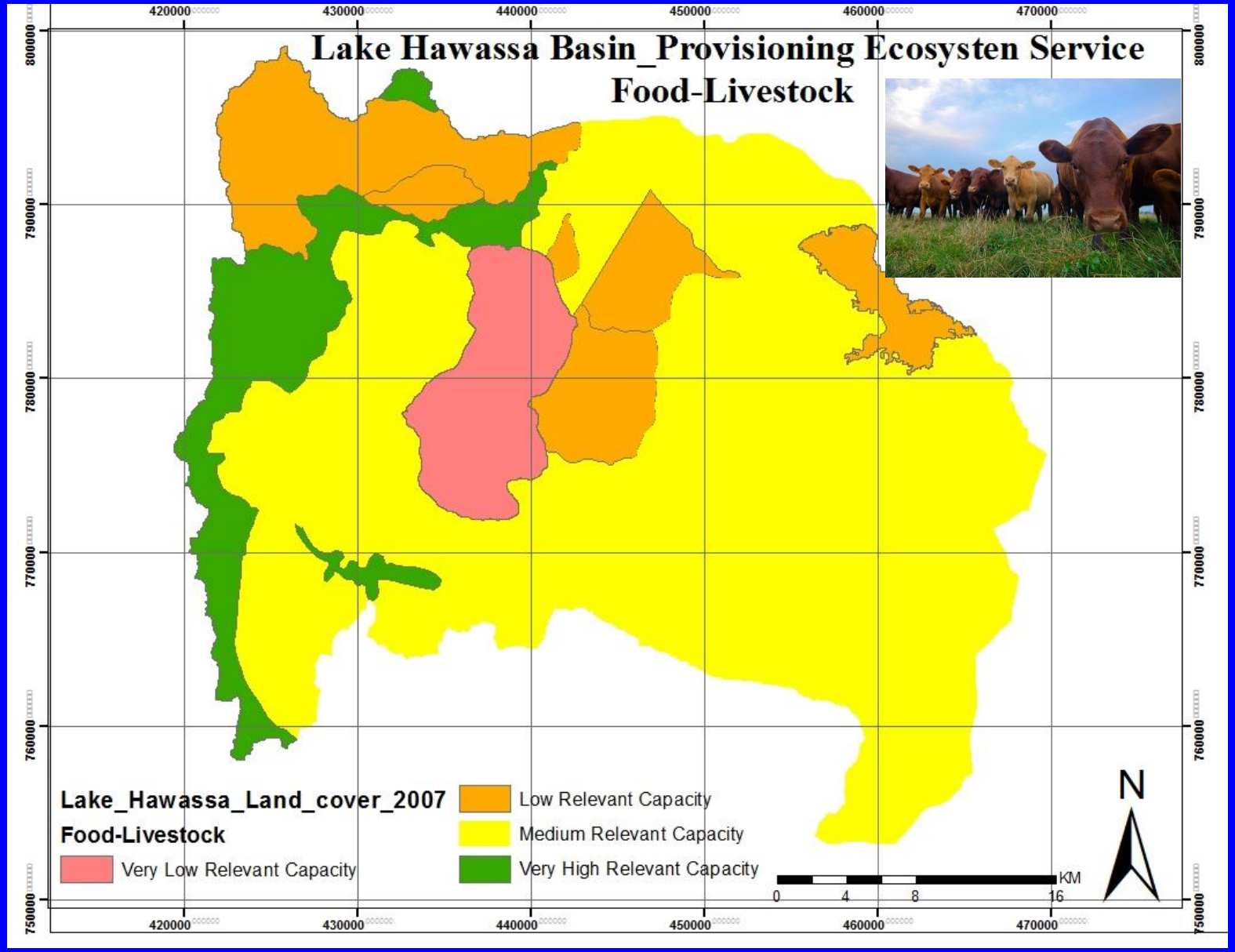
Define the potentials and focuses on future fishing practice



# Result: Provisioning ESS

Large area showed Very high to medium relevance capacity of ESS- food from livestock

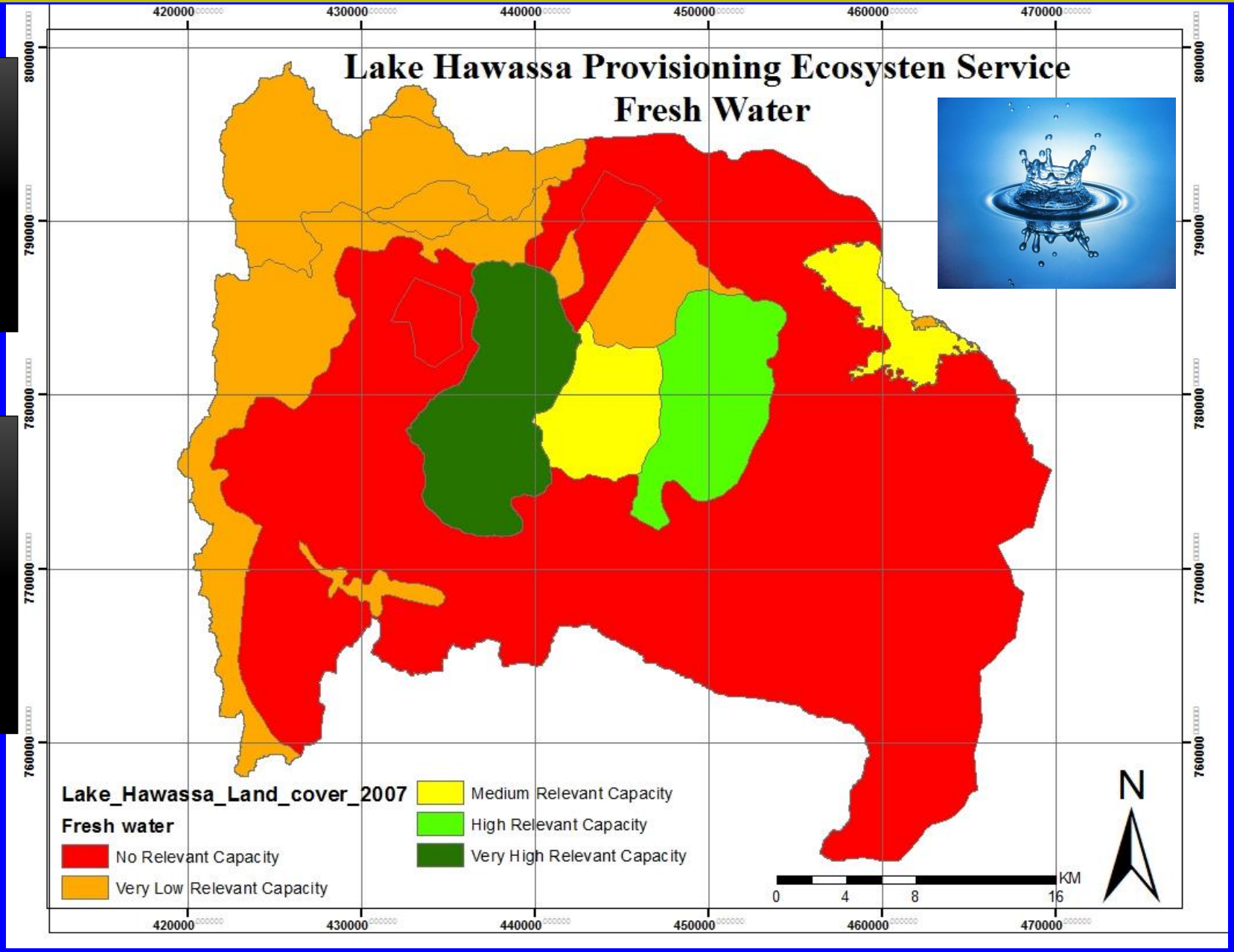
Helps to have information about communities benefit of food from livestock



# Result: Provisioning ESS

ESS Mainly depend on lake water and marsh areas

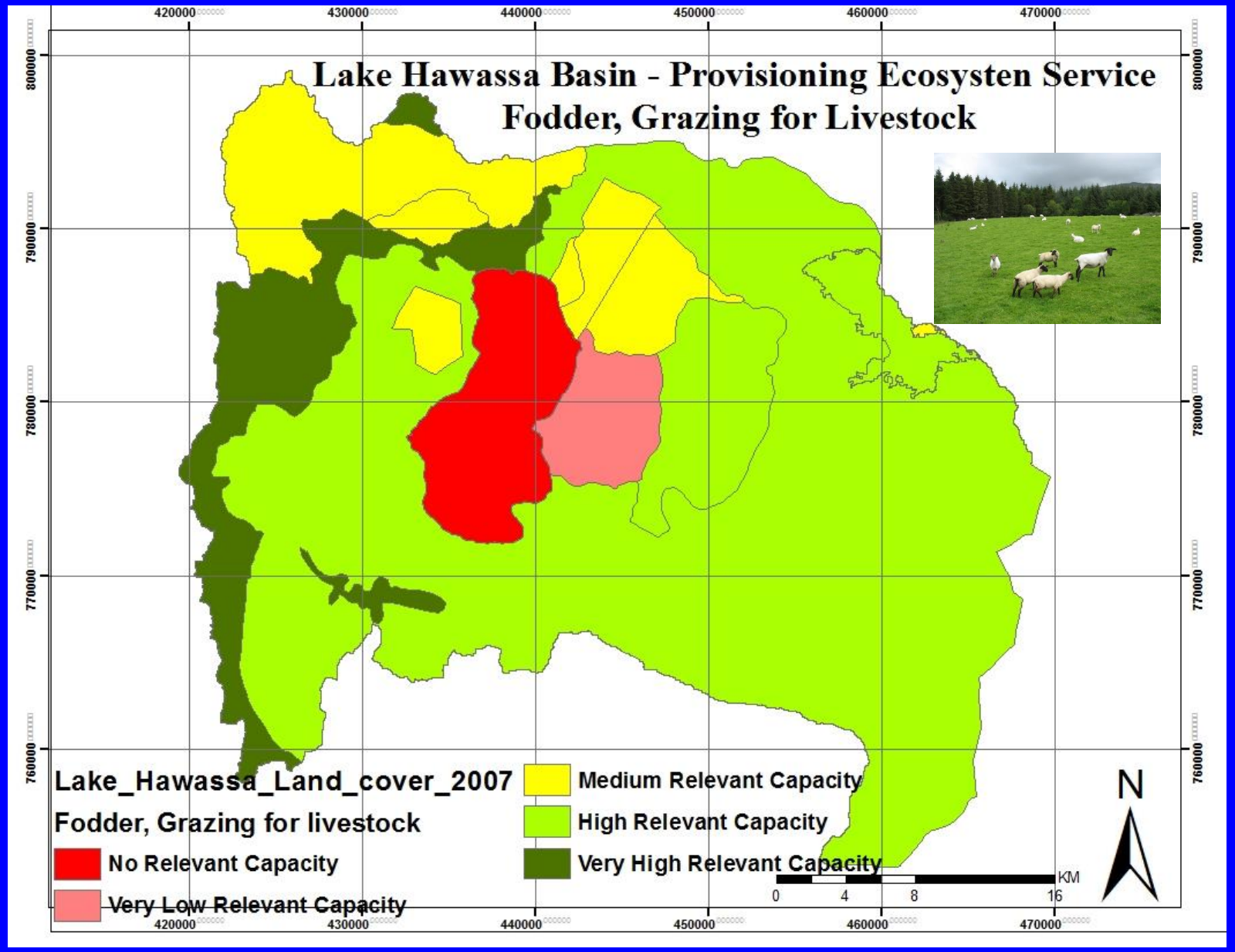
Shrub and forest areas are also contributed fresh water ESS within the basin



# Result: Provisioning ESS

Helps to define the planning agenda on future LHB's livestock management

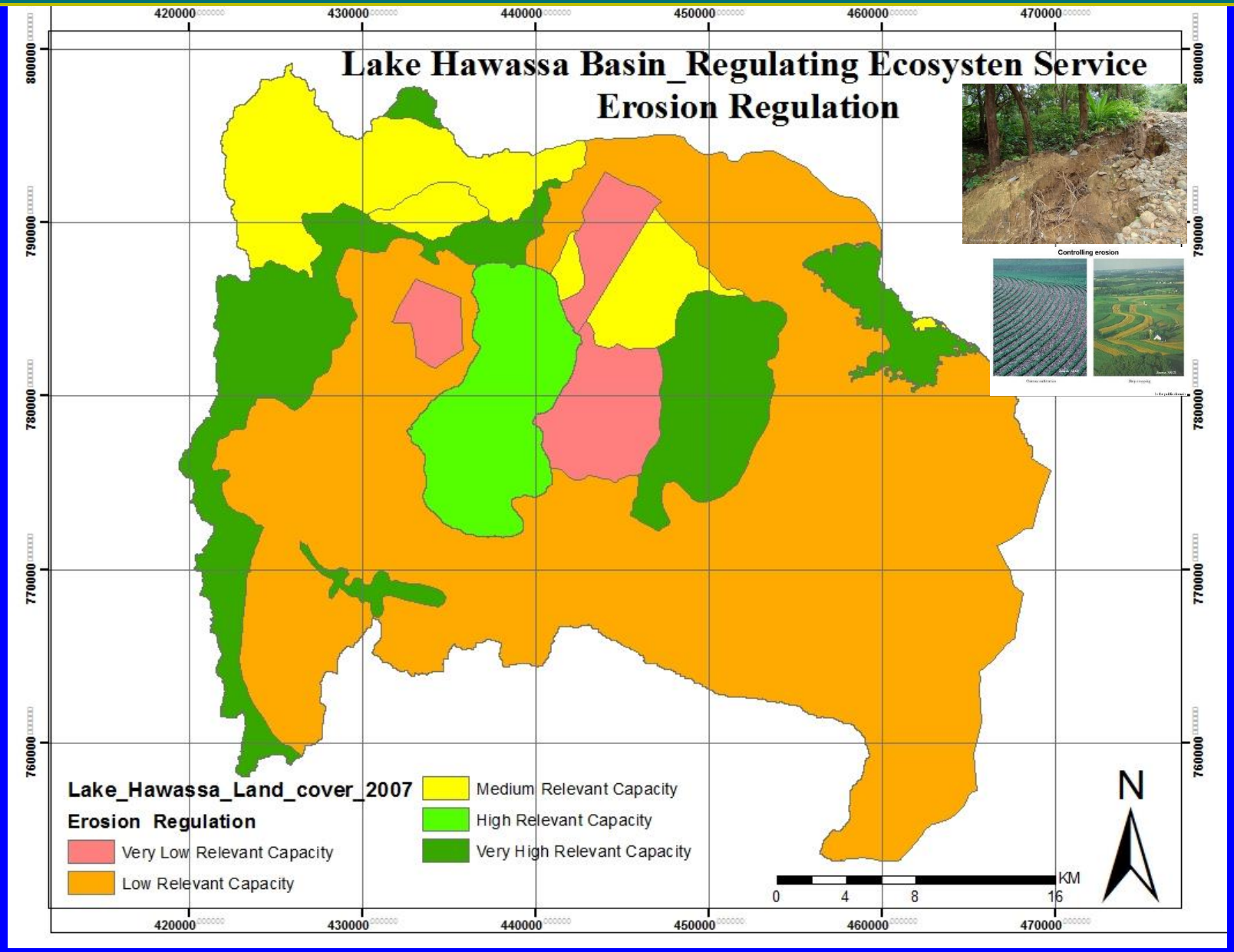
Proper planning to avoid any conflict of interest on the land use of Land cover and the respective ESS



# Result: Regulating ESS

Above 50% of the basin area are below low relevant capacity value

Helps to define the level of interventions during future conservation management planning within the LHB

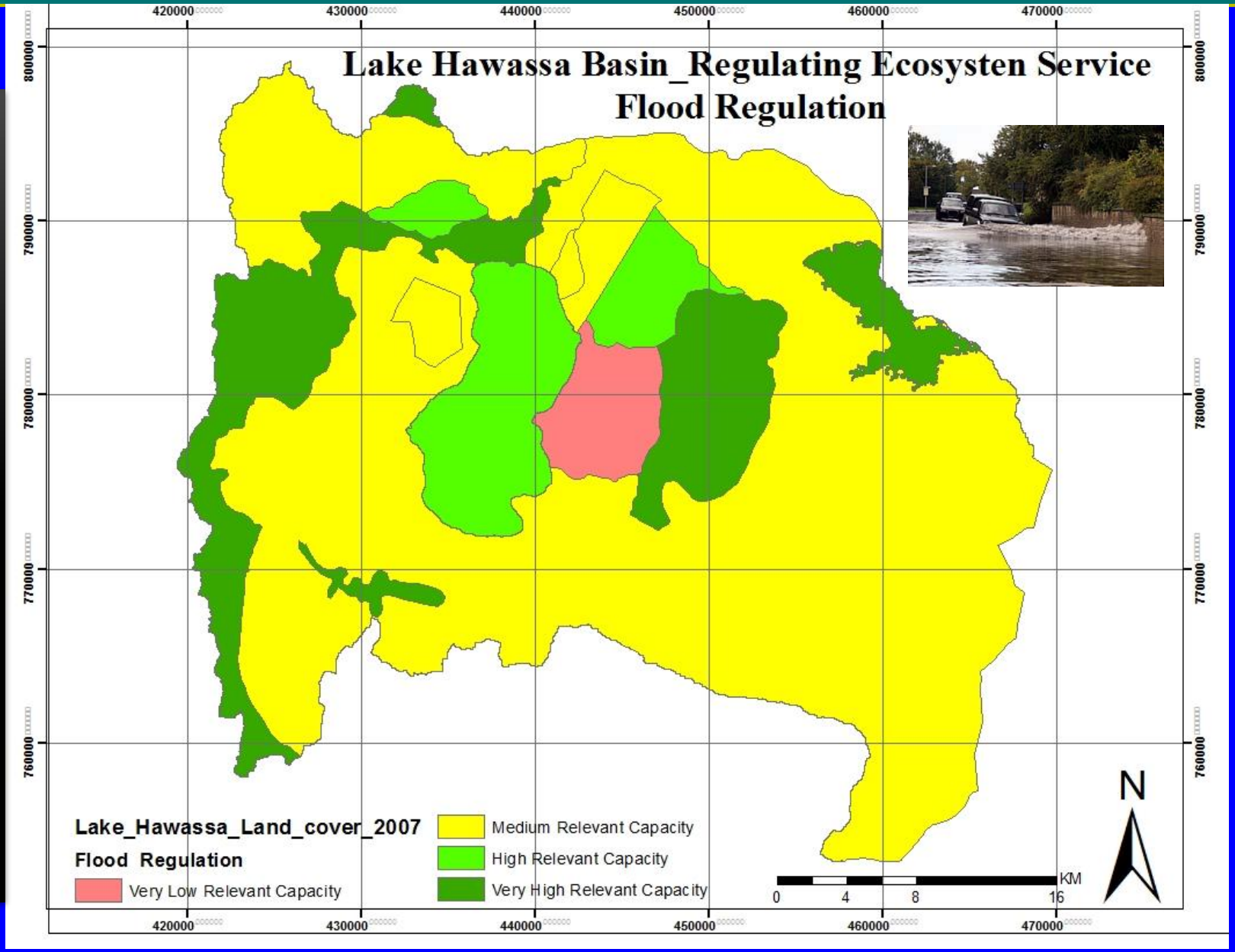


# Result: Regulating ESS

Helpful to know the possible occurrence any flood risks in the basin

&

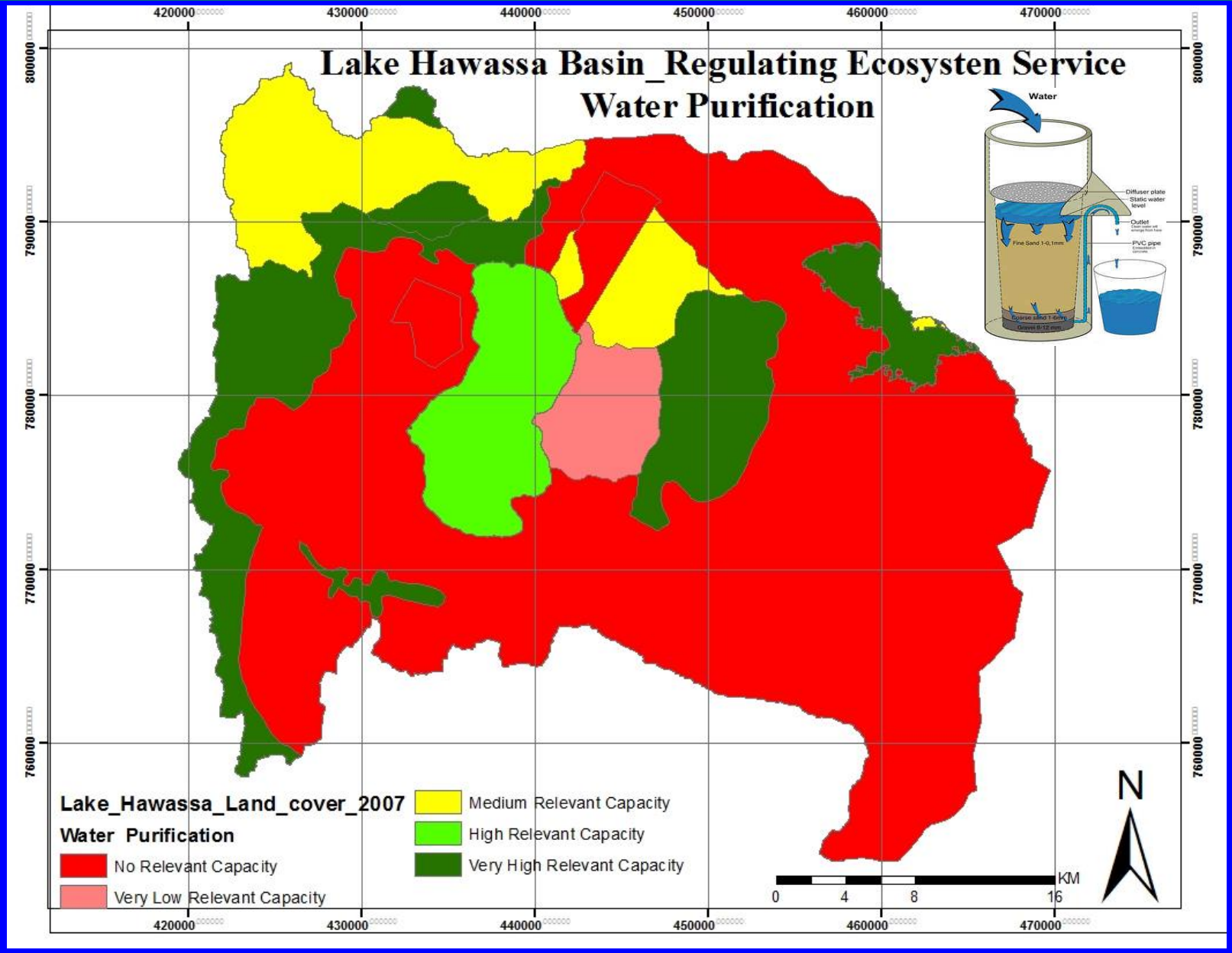
guide during the planning of future flood risks management in the LHB



# Result: Regulating ESS

Indicate areas with high relevance capacity and potentials to purify water sources within the LHB

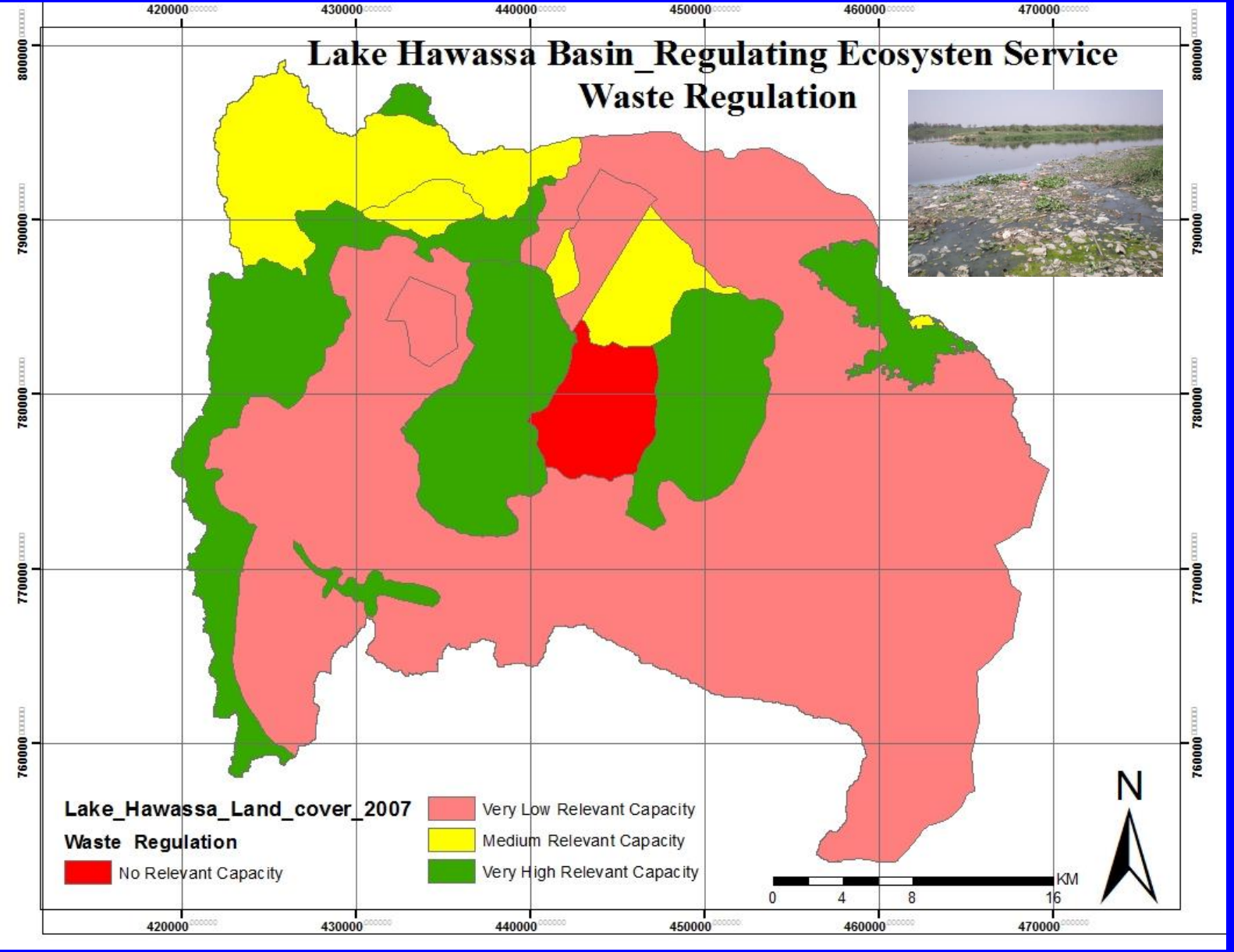
Helps to prioritize the area and define the scale of future water sources development intervention



# Result: Regulating ESS

Helps to define areas that are required proper planning in terms of future waste management practice

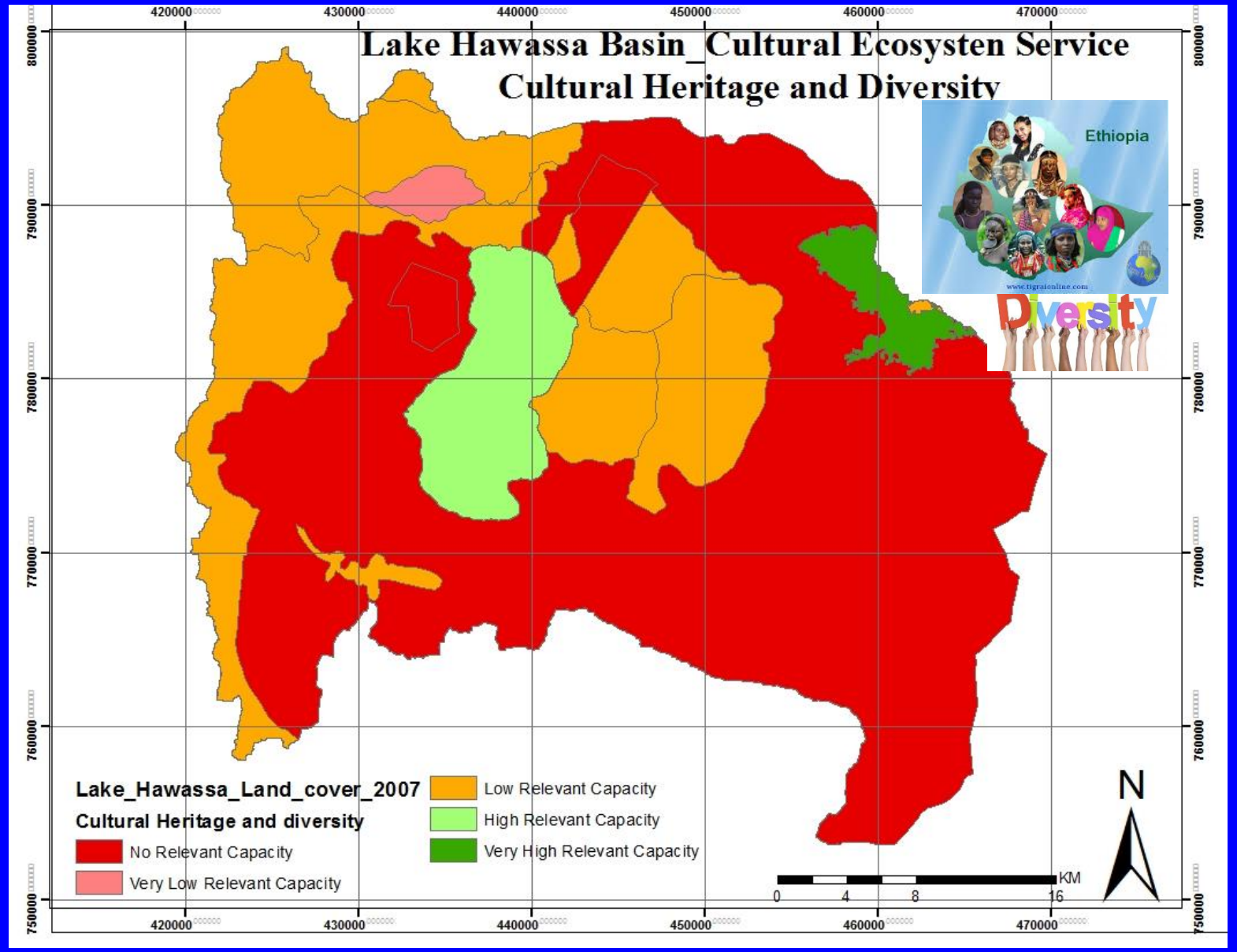
Eastern side considered with very low relevant capacity



# Result: Cultural ESS

Indicate the relevant capacity of the LHB on cultural heritage and diversity ESS

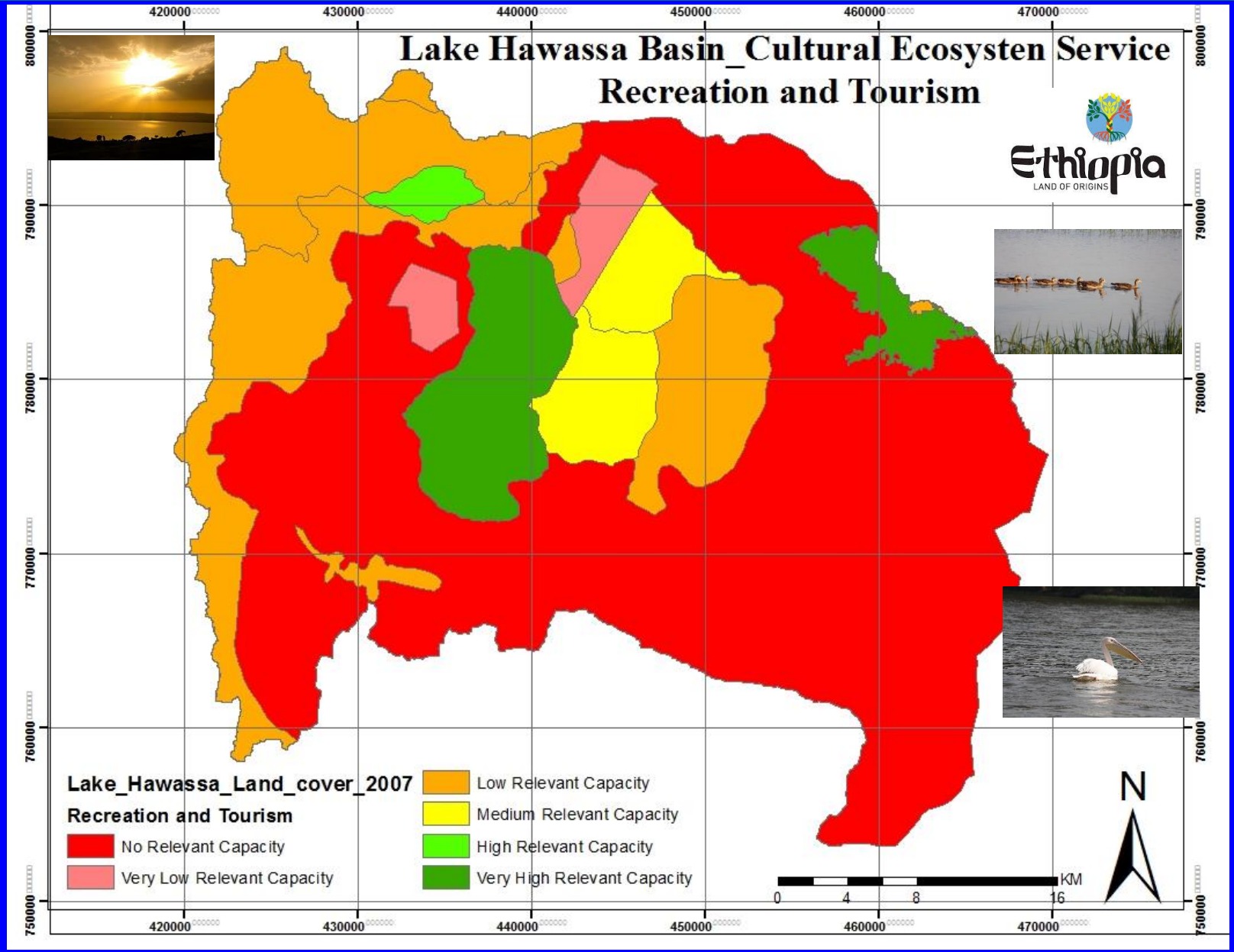
Eastern side of LHB has considered no relevant capacity



# Result: Cultural ESS

Helps to :

- ✓ define the future planning on tourism and recreation services
- ✓ Off farm benefit for the community members



# Conclusions

- Ecosystem service **(ESS) Assessment is the very new approach** in Ethiopia and No ESS mapping is available for Lake Hawassa Basin (LHB) ESS
- The level of awareness and knowledge on the application, use and importance off ESS is very limited
- The study identified the status existing potential ESS
- Variation of relevant capacities of LULC on LHB's ESS potential were identified
- Further networking with MoWIE River Basin Directorate initiated and Interest to know more about and adapt this methods for other basins were raised
- ESS maps helps to decision makers and other development partners during design and implementation of development projects
- Potential effluent sources and impacts on the existing ESS were identified
- Alternative development options and best practice for policy makers and relevant stakeholders presented through mapping of ESS

# Recommendations

- Strong coordination and cooperation among the different stakeholders
- Regular training and awareness campaign on ESS assessment, use and importance
- Training and active participation of experts and SH, including community members/beneficiaries on assessing and mapping of ESS
- Detail research on the value of LHB ESS, Identification of the potential link between ESS and community's demand
- Research on the extent of pollution impacts on LHB ESS and the respective mitigation measures
- Support to implement and adapt this approach and mapping for the rest of river basin
- Further study on integrating the ESS assessment approach with the current EIA practice
- Defining the key actors for doing the ESS assessment


THANK YOU
Bedilu Amare Reta
Environmental Compliance adviser
Email-beamreta@gmail.com
Tel. +251924953275 (Ethiopia)
for your attention