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1 INTRODUCTION

1.1 General setting of this thesis

The United Nation University – Land Restoration Training (UNU-LRT) provides postgraduate training for specialists from the developing countries in the broad field of restoration of degraded land and sustainable land management, and aims at assisting developing countries in capacity development within this field (UNU n.d.). The program was founded in 2007 by the Icelandic Ministry for Foreign Affairs (MFA), in partnership with the Agricultural University of Iceland (AUI) and the Soil Conservation Service of Iceland (SCSI), and with support from United Nations University (UNU), as a part of the government's development co-operation efforts (UNU n.d.). An agreement of co-operation between UNU, the Government of Iceland, SCSI and AUI was signed by all parties in February 2010. The program is built base on the experience of Iceland on land restoration for more 100 years (UNU n.d.).

The present proposal outlines gives an overview of a project with the goal to assess the ecological status of a river. The case study is in Iceland, but the methods used within this project can be applied anywhere in the world. The present proposal summarizes background information on Niger Republic, the case study investigated in Iceland, reviews relevant literature, presents materials and methods, outlines the work plan and defines the budget of the project.

1.2 Background information on Niger Republic

Niger Republic is a Sahelian country located in the very heart of the Sahelo-Saharan zone (ADB [African Development Bank] 2011). It is situated between latitude 12º and 23º North and longitude 00º and 16º East. It covers a surface area of 1 267 000 km^2 (CPM [Cabinet of Prime Minister] 2009). Three quarters of its surface area is desert and the southern band which represents a quarter of the total area is a shelter of ¾ of the total population (Seyni 2006) and constitutes the agro-pastoral zone where agriculture and animal rearing are possible.

Niger faces recurrent food crises due to erratic and insufficient rainfall and has observed frequent droughts and desert encroachment where cereal deficit occurs about every three year (ADB 2011). The population of Niger is estimated to more than 16 Million in 2011(FAO 2013) with a birth rate of 3.45% one of the highest in the world (Tidjani 2008). More than 83% of this population live in rural area and their principal activities is agriculture (FAO 2013). The soil is mostly sand very sensitive to wind and water erosion, untapped fossils aquifers and multiple surface water basin which in most cases are shared with upstream and downstream riparian (Zakari et al. 2011). These water basins receive little rainfall due to the frequent droughts but withstand strong anthropogenic pressure affecting surfaces water courses. The rainfall pattern analysis showed a chronic deficit of rainfall after the wet years of 1950s over almost a continuous period of more than 25 years (Botonie & Chris 2009) which affect the whole Sahel region mainly the western part. The country has two seasons: rainy season from June to September and lengthy dry season from October to May. The rainfall varies from south to north. The Soudano-sahelian zone receives up to 800 mm of rainfall per year while more than half of the country receives less than 100 mm per year trough out the rainy season (Tidjani 2008).

Like in various parts of the world, the surface water bodies in Niger Republic are facing serious challenges: limited quality, lack of good environment and adequate water policy which are key issues of increasing concern for sustainable natural resources management (Zakari et al. 2011). Freshwater ecosystems of rivers, lakes and other water courses are threatened by the construction of dams and irrigation systems that divert water to farmers' field and city water supply. Dams and channelization destroy habitats of local flora and fauna, cut river off from floodplains and alter natural flow on which plants and animals depend. Invasive species crowed river banks. Climate change, pollution from agricultural land spreads and tempered the quality of rivers. The strong population pressure of 75% of the population on a quarter of the total surface area of the country, with its competitive uses of natural resources along rivers provoked a deep ecological imbalance among the riparian and could lead to ecosystems damaged.

The challenges cited above are waiting for solutions when back home. The current case study links directly to the situation faced by the Niger River, the longest in West Africa (4200 km) and the third river in Africa continent. The Niger River is shared by 9 countries and approximately 100 million people live along its watershed (Zakari et al. 2011). This natural treasury is seriously threatened.

2 OBJECTIVES

Within this project river sections of the Hróarslækur River will be classified from its source to the conjunction with the Ytri Ranga into four categories: 1) natural parts where no human activities have impacted the river morphology and the water quality, as well as the environmental status of the riparian area 2) light anthropogenic impacts with minor corrections of the hydro morphology of the river 3) anthropogenic highly affected river sections characterized by channelling and degradation of water quality due to intense farming around the river and 4) restored river sections characterized by restoration activities . We will try through the present study to assess the water quality and environmental status of the four different parts of this Ytri River tributary.

In order to classify the river sections, we will assess water quality and river morphology in order to identify the ecological status of an Icelandic river within the UNU-LRT program (section 1.1).

The methods and model used to assess the water quality and environmental status of the Hróarslækur River in Southern Iceland could help to setup a similar evaluation of rivers, lakes and other surface water bodies in Niger. To assess and monitor the water quality and ecological status of rivers is of major importance for local residents. This research is also a capacity building for institutions in Niger as the knowledge will be shared among other research to move research forward. The results will help policy-makers in designing surface water management programs.

In summary, the overall goal of this study is the classification of the Hróarslækur River, a tributary of Ytri Ranga River, in Southern Iceland.

The main objectives of the study are:

1. To classify all river sections of the Hróarslækur River according to their ecological status;
2. To assess the integrated ecological quality of the Hróarslækur River;
3. To describe the hydro morphology of the Hróarslækur river and
4. To assess the impact of the ecological status of the Hróarslækur river on local residents.

2.1 The case study of the Hróarslækur River

2.1.1 Description of the study area

This study focuses on the Hróarslækur River, a tributary of Ytri Ranga River located in southern Iceland. The Hróarslækur is located between the Ytri Ranga (West Ranga) and the Eystri Ranga (East River) (Figure 1). The discharge in the Hróarslækur comes mainly from its source, a spring north east of the town of Hella, close to Hekla, one of Icelandic most active volcano. The river is about 10 km long.

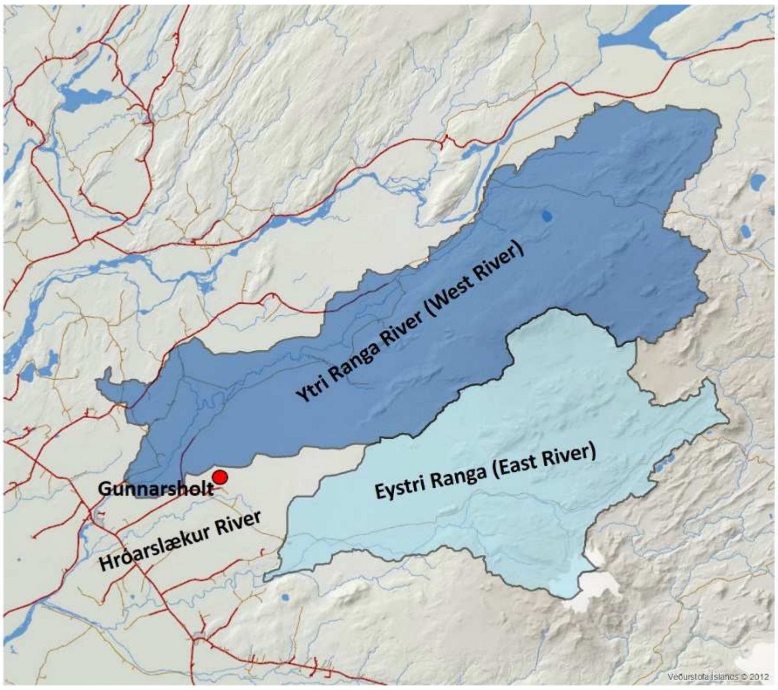

Figure 1: Overview of the study site: the Hróarslækur River and its surroundings. Red point locates Gunnarsholt.

2.1.2 The Ytri (West) Ranga River

The Ytri (West) Ranga river is situated on the South West coast of Iceland (Figure **2**). It is within an hour driven from Reykjavik and about 35 km east of Selfoss. It rises from north Hekla passing to the west of the town of Hella (Figure **3**) before 10 km further sought joining to the river Pvera to become the Holsa. From the source of Ytri Ranga to sea is 70 km. From its junction with Eystri (East) Ranga River to sea, is about 10 km from the sea.

The average width of Ytri Ranga River is about 50 m and the average depth is below 2 m. The river bed consists mainly of black and grey volcanic sand. The river is known of its fishing activities and tourism in Hella Community Town. The district's most populated area is the town Hella with 1545 inhabitants. Hella's primary businesses are service for the agriculture and the tourism industry (Discover South Iceland n.d.). The study river and others tributaries discharge their water into Ytri Ranga. As stated above, within the present study we will assess the ecological status of the Hróarslækur River and compare it to some river sections of the Ytri Ranga River (Discover South Iceland n.d.).

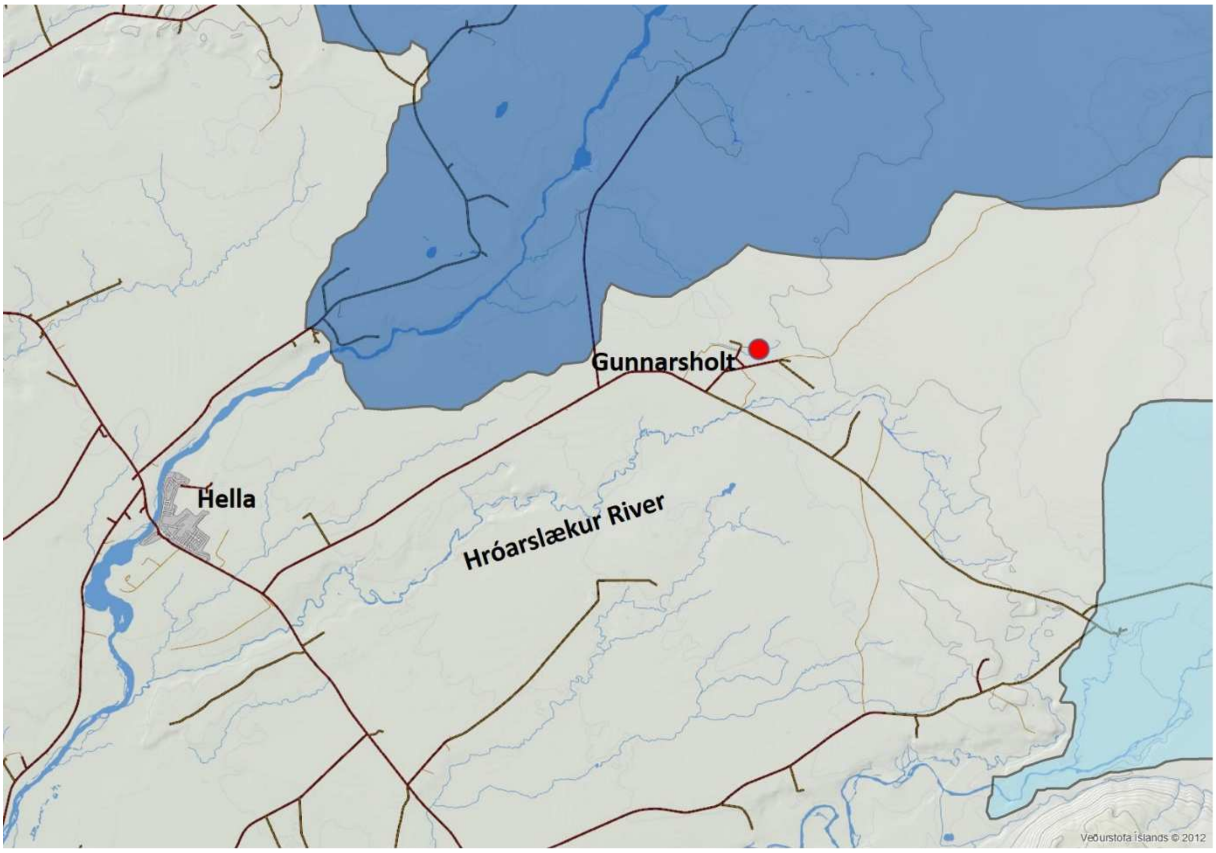

Figure 2: The Hróarslækur River from its source to its estuary into the Ytri-Rangá River.

Figure 3: Arial picture of the town of Hella (Discover South Iceland n.d.).

3 LITERATURE REVIEW

Rivers are the most important freshwater resource for man (UNESCO 1996). Social, economic and political development has, in the past, been largely related to the availability and distribution of fresh waters contained in riverine systems (UNESCO 1996).

The growing demand for ecosystem services by human beings threatens the sustainability of natural resources (Elosegi et al. 2012). In some areas of the world the threshold of sustainable use of natural resources has been exceeded. In developing countries as well as in developed countries, rivers play an important role in economics health regulation and biodiversity conservation. The report of UNEP (2007) stated that the rivers provide key services to society. In the policy context of Water Frame Directive (WFD) of the European Union water managers aim to achieve and maintain good water quality through biological, physicochemical and hydro-morphological assessments (Trent 2003). Nevertheless, rivers are facing serious challenges due to natural and anthropogenic factors (Baattrup-Pedersen et al. 2011). This has endangered biodiversity throughout the world (Spanhoff et al. 2012).

Serious effects of pollution on water quality and subsequent impacts on human health have drawn the attention of policy-makers and water agencies to water quality issues beside the other aspects of river condition (Elosegi et al. 2010; Moss 1998). One main concern in many areas of the world is eutrophication of freshwaters, due to an oversupply of nutrients (Finger et al. 2013). These anthropogenic factors in combination to weak policies and environmental factors have endangered ecosystems resilience and contributed to global degradation. Finally, effective ecological restoration leading to ecosystem resilience can only be achieved if the sustainable management of water and soil resources is in line with local societies (Petursdottir and Finger 2014).

Different human interventions such as sediment mining, channelization, dams, reforestation and control works have been identified as the causes of channel modification (Comiti 2010).

According to Elosegi (2010) the channel form and hydraulics of a river provide the structural environment for ecological processes important for river biodiversity and functioning. The channel form and water flow are key components for the ecological status of a river. Accordingly, the river morphology plays an important role in the benefits that ecosystems provide to the society (Elosegi et al. 2012; Gurnnell 2009). The conservation of aquatic habitats and the preservation of natural flow regimes impact on biodiversity and functioning of river ecosystems. Nevertheless, the relationships between these components are often complex (Elosegi et al. 2010) and their interaction has to be assessed in order to achieve a sustainable management of rivers (Elosegi et al. 2012). The degradation of riparian areas has an adverse effect on rivers water quality.

The environmental objectives include the achievement of good surface water status and preventing of deterioration of existing status (Trent 2003).

The classification of the ecological status of rivers is the basis for the future sustainability of management of natural water resources (Spanhoff et al. 2012). The WFD sets the guidelines for an integrative assessment of the ecological status of all rivers across Europe (Spanhoff et al. 2012). Furthermore, the WFD aims to achieve and maintain good water quality through Integrated River Catchment Management (Trent 2003).

Rivers are complex systems of flowing waters draining specific land surfaces which are defined as river basins or watersheds (UNESCO 1996). The characteristics of rivers within the total basin system are related to a number of features. These features include the size, form and geological characteristics of the basin and the climatic conditions which determine the quantities of water to be drained by the river network and the riparian communities (UNESCO 1996; Murray 2008). Several methods have been used to classify rivers. For the present study and due to the time factor, we will limit us here to electrical conductivity, temperature and the description of river morphology to assess the quality of water and environmental status of the study river.

4 GENDER EFFECTS

The gender inequality imposes significant cost on society in terms of lost agricultural output, food security and economic growth. Promoting gender equality is not only good for women but also for sustainable agricultural development. There is growing competition for water from different users and sectors, including industry, agriculture, power generation, domestic and the environment (Zakari 2012) which makes it difficult for poor people, especially women, to access this scarce resource. According to IFAD (2011), most of the world's 1.4 billion poor people, two-thirds of whom are women, live in water-scarce countries and don't have access to safe and reliable supply of water. In developing countries securing water is critical in achieving food security improving rural livelihood in most parts of the world particularly in arid and semi-arid areas.

According to FAO (2012) gender mainstreaming means taking into account the different implications for women, men, boys and girls of any project, programme or policy.

Incorporating gender issues will enable water managers to make informed choices during planning, design, and construction and operation of water management projects and programmes, which will make water management in agriculture more effective, efficient, equitable and sustainable (IFAD 2011). In most developing countries such as Niger Republic women are mostly involved into small scale farming systems. Their plots are located in river watershed discharging directly into rivers. Women use water directly from rivers for drinking and daily uses. It is therefore necessary to include women while talking about the water quality and environmental status of rivers assessment and their surroundings as there is directly involved (FAO 2012).

5 MATERIALS AND METHODS OF STUDY

5.1 Materials of the study

The following materials will be used for this study:

- Electrical Conductivity meter for water quality investigation;
- PH-meter;
- Water flow measurement meter;
- GPS unit for taking coordinates;
- Digital camera for taking photos;
- Atlas map for locating the area of study;
- Soil map and hydrography map of the area of study;
- Computer (Excel, ArcGIS) for data treatment and analysis;
- Meter for measuring the cross-section of the river;
- Boot for crossing the river
- Block-notes, pencils eraser for data collection on the field.

5.2 Water quality investigations

Due to time constraints the water quality assessment will be limited to measuring Electrical Conductivity and water temperature of the water along the river from the source to the downstream (Wikipedia 2007). For this purpose electrical conductivity will be measures along the entire river in order to identify locations of potential nutrient sources or other dissolved substances sources. Although electrical conductivity does not reveal to nature of pollutants, it is an indicator of the amount of dissolved substances in the water. Accordingly, it is an ideal parameter for Preliminary River monitoring (Wikipedia 2007).

5.2.1 Description of Electrical Conductivity meter

Electrical conductivity meter (EC meter) measures the electrical conductivity in a solution. It is commonly used in hydroponics, agriculture and freshwater systems to monitor the amount of nutrients, salts or impurities in the water (Wikipedia 2007).

Figure 4: Electrical Conductivity meter (EC meter) (Wikipedia 2007)

The conductivity meter employs a potentiometric method and four electrodes (Figure 4). The electrodes are usually made of platinum metal. An alternating current is applied to the outer pair of the electrodes (Wikipedia 2007). The potential between the inner pair is measured Conductivity could in principle be determined using the distance between the electrodes and their surface area using the Ohm's law but generally, for accuracy, a calibration is employed using electrolytes of well-known conductivity (Wikipedia 2007).

5.2.2 Water temperature and conductivity measurements

The conductivity is temperature dependant. Conductivity measurements are used in industrial and environmental applications as a reliable way of measuring the ionic content in a solution (Wikipedia 2007). The conductivity of an electrolyte solution is a measure of its ability to conduct electricity. Conductivity is linked directly to the total dissolved solids (Wikipedia 2007). The primary sources for Total Dissolved Solids in receiving waters are agricultural and residential runoff, leaching of soil contamination and point source water pollution discharge from industrial or sewage treatment plants (Wikipedia 2007). The most common chemical constituents are calcium, phosphates, nitrates, sodium, potassium and chloride, which are found in nutrient runoff, general storm water runoff and runoff from snowy climates where road de-icing salts are applied (Wikipedia 2007).

5.3 River morphology investigations

The ecomorphological status of the river will be determined using the classification criteria defined by Werth (1987). As Werth established the criteria for rivers in Austria, we will first revise the criteria so that they fit to Icelandic conditions. Furthermore, the morphological investigations of the river will be carried out by using the variables include channel width, radius of curvature and mean depth, while the watershed characteristics include drainage area, maximum flow length, stream order, and relief (Venkatesh et al. 2004) for mapping the river with the use of GIS technology (Miller et al. 1996). Furthermore, the riverbanks will be qualitatively described and classified according to the following factors (to be completed during the project): i) vegetation, ii) channelization, iii) erosion, iv) diversity of habitats.

5.4 Impacts on residents

The impacts on residents of the river will be assessed through qualitative interview with local residents. During these interviews the gender aspect will be accounted for. A maximum of two residents on the watershed will be interviewed. The interview will include gender issues in order to assess the particular situation of woman in the vicinity of the Hróarslækur River.

6 WORK PLAN / TIME SCHEDULE

This project will be carried out between Mai 2014 and 18th of September 2014. A detailed time schedule is given in (Table 1).

Table 1: Work plan

Work and Time plan	April-May								June				July				August				September			
	Weeks								Weeks				Weeks				Weeks				Weeks			
	1	2	3	4	5	6	7	8	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Planning Project proposal research questions																								
Introduction literature																								
Methods, budget, work plan, literature,																								
Project Proposal ready										10														
Project Proposal seminar										13														
Data collection																								
Data analysis																								
1st draft of the report																	4				1	8	15	

Note: yellow: time allocated to working task; red: deadline for milestones

List of Milestones and important deadlines:

- 10th June 2014: deadline for draft proposal
- 13th June 2014: draft proposal approved
- 4th August 2014: Turn in 1st draft of the project report
- 1st September 2014: Turn in 2nd draft of the project report
- 8th September 2014: Project Seminar
- 15th September 2014: Hand in Final Project Report

7 BUDGET

The detailed budget of the project is given in the Table 2 below.

Table 2: Proposed budget for the project

Sections	Details	Quantity	Quantity	Unit cost (ISK)	Total cost (ISK)
Supervisors	Transport Reyk-Gun-Reyk= 220km	3 x220km	660	116	76560
	Transport Gun-Field-Gun	2x25 km	50	116	5800
	Transport within Reyk for testing proposal	25 km	25	116	2900
	Accommodation at Gun	3 nights	3	3600	10800
	Catering: (1 lunch+1breakfast+1diner) per trip to Gun	3 trips	3	5300	15900
Subtotal 1					**111960**
Student	Pub transp: Gun-Reyk-Gun	1	1	4900	4900
	Transp. Within Reyk	7 bus tickets	7	350	2450
	Accommodation	1 night	1	14000	14000
Subtotal 2					**21350**
Batteries for GPS	For GPS Unit	5 packets	5	498	2490
Robber boot	For river crossing	1	1	10000	10000
Blocknote+pens+file + communication				4000	4000
Subtotal 3					**16490**
Grand total					**149800**

Trans= transport, Pub= public, Reyk= Reykjavik, Gun= Gunnarsholt

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