



بسم الله الرحمن الرحيم

∞∞∞∞

تم رفع هذه الرسالة بواسطة / سامية زكى يوسف

بقسم التوثيق الإلكتروني بمركز الشبكات وتكنولوجيا المعلومات دون أدنى

مسئولية عن محتوى هذه الرسالة.

ملاحظات: لا يوجد



**REHABILITATION OF DEGRADED SOIL  
BY WATER EROSION FOR SOME WADIS  
IN NORTHWESTERN COAST – EGYPT  
USING SOME PLANTS  
(CASE STUDY-SLOPING SOIL)**

**Submitted By**

**Galal Mohamed Abd El-Hamed El-Sherbeny**

B.Sc. of Agricultural Cooperative, Higher Institute of Agricultural Cooperative, 2000

M. Sc. in Environmental Sciences, Faculty of Graduates Studies & Environmental  
Research, Ain Shams University, 2018

A Thesis Submitted in Partial Fulfillment  
Of  
The Requirement for the Doctor of Philosophy Degree  
In  
Environmental Sciences

Department of Environmental Agricultural Sciences  
Faculty of Graduates Studies & Environmental Research  
Ain Shams University

**2022**

APPROVAL SHEET  
**REHABILITATION OF DEGRADED SOIL BY WATER  
EROSION FOR SOME WADIS IN NORTHWESTERN  
COAST – EGYPT USING SOME PLANTS  
(CASE STUDY-SLOPING SOIL)**

**Submitted By**  
**Galal Mohamed Abd El-Hamed El-Sherbeny**

B.Sc. of Agricultural Cooperative, Higher Institute of Agricultural Cooperative, 2000  
M. Sc. in Environmental Sciences, Faculty of Graduates Studies & Environmental  
Research, Ain Shams University, 2018

A Thesis Submitted in Partial Fulfillment  
Of  
The Requirement for the Doctor of Philosophy Degree  
In  
Environmental Sciences  
Department of Environmental Agricultural Sciences

**This thesis was discussed and approved by:**

Name

Signature

**1-Prof. Dr. Mohamed El-Sayed El-Nennah**

Prof. of Soil & Water Chemistry  
Faculty of Agriculture  
Ain Shams University

**2-Prof. Dr. Saad Fawzi Tadros**

Prof. of Soil & Water Environment  
Desert Research Center (D.R.C)

**3-Prof. Dr. Hesham Ibrahim El Kassas**

Prof. of Water Drift  
Former Dean of Faculty of Graduate Studies and Environmental Research  
Ain Shams University

**4-Prof. Dr. Alaa El-Din Abd El-Fattah Ali**

Prof. of Soil, Soil & Water Conservation Department  
Desert Research Center (D.R.C)

**5-Prof. Dr. Khaled Abdel-Moneim Hammam**

Prof and Head of Research, Medical and Aromatic Plants Department,  
Horticulture Research Institute, Agricultural Research Center

**2022**

**REHABILITATION OF DEGRADED SOIL  
BY WATER EROSION FOR SOME WADIS  
IN NORTHWESTERN COAST – EGYPT  
USING SOME PLANTS  
(CASE STUDY-SLOPING SOIL)**

**Submitted By**

**Galal Mohamed Abd El-Hamed El-Sherbeny**

B.Sc. of Agricultural Cooperative, Higher Institute of Agricultural Cooperative, 2000

M. Sc. in Environmental Sciences, Faculty of Graduates Studies & Environmental  
Research, Ain Shams University, 2018

A Thesis Submitted in Partial Fulfillment  
Of  
The Requirement for the Doctor of Philosophy Degree  
In  
Environmental Sciences  
Department of Environmental Agricultural Sciences

Under The Supervision of:

**1-Prof. Dr. Hesham Ibrahim El Kassas**

Prof. of Soil & Water Environment  
Faculty of Graduate Studies and Environmental Research  
Ain Shams University

**2-Prof. Dr. Alaa El-Din Abd El-Fattah Ali**

Prof. of Soil, Soil & Water Conservation Department  
Desert Research Center (D.R.C)

**3-Dr. Khaled Abdel-Moneim Hammam**

Senior Researcher, Medical and Aromatic Plants Department,  
Horticulture Research Institute, Agricultural Research Center

**2022**

# ACKNOWLEDGEMENT

First and for most, let me praise and honor the Almighty **God** for the opportunity and capacity given to me to realize my aspiration. I really thank him for giving me the wisdom, knowledge and all the support I needed to complete this study, this far through all and difficult times. Then I would like to express my appreciation and gratitude to Prof. Dr. **Hesham Ibrahim El-kassas**, Prof. of Soil Water Environment, IESR, Ain Shams University, for suggesting the problem of study and for his kind supervision throughout this work. It is a great honor to work under his supervision.

I would like to express my sincere gratitude for my supervisor prof. Dr. **Alaa El-Din Abd el-Fatah Ali**, Prof. of Soils and Water, soil conservation Department, Desert Research center (DRC), Materia, Cairo, for supervision, continuous encouragement, his valuable guidance throughout my thesis work.

I really would like to express my deep gratitude and appreciation to Head of research Prof.Dr. **Khalid Eabd-Almneim Humam Zaid**, Medicinal and Aromatic Plants Researches Department, Horticulture Research Institute, ARC, Giza, Egypt, forProvide me with special information about the Indian vetiver grass, provide me with vetiver seedlings, continuous encouragement and valuable advices throughout this work.

All thanks and deepest gratitude to **Prof Dr. Saad Fawzy Tadros Sharkawy**, prof. of Soils and Water, Soil Conservation Department, Desert Research Center, Materia, Cairo, Egypt, for his valuable scientific assistance, advice throughout the research and helping during writing this thesis.

The author wishes also to extend his thanks to all **staff members of Soil Conservation Department**, Desert Research Center, Materia, Cairo, Egypt, for their valuable advices and helping during carrying out the research.

**My beloved families**, especially, my wife and sons, thank you very much for your love and their continuous encouragement, helping me to accomplish this work. I want to express my appreciation to all people who in one way or the other contributed to the accomplishment of my thesis.

## ABSTRACT

Hazards of soil erosion by rainfall are serious problems in Northwestern coast of Egypt (NWCZ) and lead to reducing the soil quality and increasing the degradation of soil resources. The present study includes field experiments for a one-year during the winter season of 2019/2020 in Wadi El-Raml area in the Northwestern Coast zone, NWCZ. The total treatments are as follow: Control without cultivation (C), barley without mulch cover (B), barley with mulch cover of rice straw of  $0.5\text{t.fed}^{-1}$  (BM0.5), barley with mulch cover of rice straw of  $1\text{t.fed}^{-1}$  (BM1), vetiver grass without mulch cover (V), vetiver grass with mulch cover of rice straw of  $0.5\text{t.fed}^{-1}$  (VM0.5), vetiver grass with mulch cover of rice straw of  $1\text{t.fed}^{-1}$  (VM1), Strip cultivation (vetiver grass – barley) (SVB), and Strip cultivation (barley - vetiver grass) (SBV). Six storms are effective during the study period as they caused runoff and consequently soil loss. The decrement percent runoff for different treatments varied from 31 to 72%. The runoff coefficient approaches 5.1, 3.5, 2.7, 2.3, 1.8, 1.5, 1.4, 1.9 and 2.2 % for (C), (B), (BM0.5), (BM1), (V), (VM0.5), (VM1), (SVB) and (SBV) treatments, respectively. The highest decrement is evident with the treatments cultivated by vetiver grass as compared to that cultivated by barley crop. The average reduction efficiency for soil loss due to cultivation by barley and vetiver grass on the sloping soil ranged from 43 to 57% and from 65 to 81%, respectively, compared with bare soil treatment. The soil loss ratio approaches 0.57, 0.48, 0.43, 0.35, 0.33, 0.29, 0.36 and 0.39 for (B), (BM0.5), (BM1), (V), (VM0.5), (VM1), (SVB) and (SBV) treatments, respectively. Fresh dry matter of Indian vetiver grass is

6.66 t.ha<sup>-1</sup>. The percentage increment of vetiver grass fresh dry matter was greater than the percentage increment of barley biological yield.

In conclusion, the results suggested that vetiver grass is a promising feed resource for soil protection from water erosion hazards, and as well as, feeding animals under environmental conditions of Northwestern Coast of Egypt.

**Keywords:** Vetiver grass, land degradation, water erosion, soil loss, runoff, North Western Coast zone of Egypt



# **List Of Contents**

<b>Contents</b>	<b>Page</b>
<b>1. INTRODUCTION.</b>	<b>1</b>
<b>2. REVIEW OF LITERATURE.</b>	<b>4</b>
<b>2.1. Natural Resources of Northwestern Coast Zone of Egypt.</b>	<b>5</b>
<b>2.2. Soil Erosion.</b>	<b>8</b>
<b>2.3. Water Erosion.</b>	<b>9</b>
<b>2.4. Factors Affecting Water Erosion.</b>	<b>11</b>
<b>2.4.1. Soil Properties.</b>	<b>11</b>
<b>2.4.2. Rainfall Intensity and Runoff.</b>	<b>13</b>
<b>2.4.3. Soil Topography.</b>	<b>13</b>
<b>2.4.4. Vegetation Cover and Management.</b>	<b>14</b>
<b>2.5. Water Soil Erosion Mechanisms.</b>	<b>15</b>
<b>2.6. Measurement of Water Soil Erosion.</b>	<b>16</b>
<b>2.7. Water Soil Erosion Hazards on the Environment.</b>	<b>17</b>
<b>2.8. Technologies and Means to Control Water Soil Erosion.</b>	<b>20</b>
<b>2.9. Water Soil Erosion Studies in Egypt.</b>	<b>20</b>
<b>2.10. Soil Degradation.</b>	<b>23</b>
<b>2.11. Soil Degradation in Egypt and Its Causes.</b>	<b>29</b>
<b>2.12.. Rehabilitation of land degraded.</b>	<b>30</b>
<b>2.13. Why is Vetiver Grass Now to Rehabitat the Degraded Sloping Soil under Egyptian Environment?</b>	<b>32</b>
<b>3. MATERIALS AND METHODS.</b>	<b>38</b>
<b>3.1. Description of the Study Area.</b>	<b>39</b>

<b>Contents</b>	<b>Page</b>
<b>3.2. Rainfall Data.</b>	<b>39</b>
<b>3.3. Experimental Design.</b>	<b>39</b>
<b>3.4. Cultivation Operation.</b>	<b>43</b>
<b>3.5. Runoff Volume and Soil Loss Measurements.</b>	<b>46</b>
<b>3.6. Experimental Treatments.</b>	<b>47</b>
<b>3.7. Yield Measurements.</b>	<b>54</b>
<b>4. RESULTS AND DISCUSSION.</b>	<b>55</b>
<b>4.1. Soil Characteristics of the study area.</b>	<b>56</b>
<b>4.2. Precipitation Events Characterizes.</b>	<b>57</b>
<b>4. 3. Runoff Yield.</b>	<b>60</b>
<b>4. 4. Soil Loss.</b>	<b>69</b>
<b>4. 5. Yield.</b>	<b>76</b>
<b>5. SUMMARY AND CONCLUSION.</b>	<b>81</b>
<b>6. REFERENCES.</b>	<b>91</b>
<b>ARABIC SUMMARY.</b>	<b>1-8</b>

## **LIST OF TABLES**

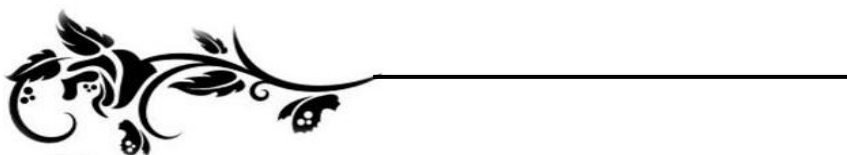
<b>No.</b>	<b>Title</b>	<b>Page</b>
<b>1.</b>	Regional food production statistics for 1995 with (a) and without (b) soil erosion (Lal, 2001).	<b>28</b>
<b>2.</b>	Global extent of human-induced soil degradation (Lal, 2001).	<b>28</b>
<b>3.</b>	Some physical and chemical properties of the studied soil at wadi El-Raml area, NWCZ of Egypt.	<b>57</b>
<b>4.</b>	Distribution of rainfall during the winter Season (2019 / 2020) at Wadi El-Raml area, NWCZ of Egypt.	<b>59</b>
<b>5.</b>	Amount runoff (mm) under both barely and vetiver grass at Wadi- El-Raml, Northwestern Coast zone of Egypt.	<b>62</b>
<b>6.</b>	Soil loss under both barely and vetiver grass at Wadi El-Raml, Northwestern Coast zone of Egypt.	<b>70</b>
<b>7.</b>	Yield of both barely and vetiver grass at Wadi El-Raml, Northwestern Coast zone of Egypt, as affected by treatments.	<b>78</b>

## **LIST OF FIGURES**

<b>No.</b>	<b>Title</b>	<b>Page</b>
<b>1.</b>	Estimates of the level of soil degradation at a global level, Rekacewicz, P. (2008)	<b>27</b>
<b>2.</b>	Causes of soil degradation, Oldeman et al. (1991).	<b>27</b>
<b>3.</b>	Vetiver Grass.	<b>33</b>
<b>4.</b>	Location map of the study area at Wadi EL-Raml, NWCZ of Egypt.	<b>40</b>
<b>5.</b>	Schematic diagram of the recording automatic weather station mounted on the study area at Wadi El-Raml, NWCZ of Egypt.	<b>41</b>
<b>6.</b>	Plowing soil of the Experimental field with a chisel plow.	<b>42</b>
<b>7.</b>	Experimental plot with dimensions (2m x 24m).	<b>43</b>
<b>8.</b>	Cultivation of barley by broadcasting after carry out the tillage operation for the total experimental area.	<b>44</b>
<b>9.</b>	Cultivation of vetiver grass on a ridge perpendicular on the slope direction.	<b>44</b>
<b>10.</b>	Irrigation for vetiver grass treatments from the time they were planted up to the time the rains came in November, 2019.	<b>45</b>
<b>11.</b>	Mulching by rice straw with rate of 0.5t/fed for vetiver grass after cultivation of seedlings.	<b>45</b>
<b>12.</b>	The different stages of growth for vetiver grass under Egyptian environmental conditions.	<b>46</b>
<b>13.</b>	Outlet pipe of Gerlach trough located at the experimental field to collect surface runoff and soil loss after each storm of rain.	<b>47</b>

<b>No.</b>	<b>Title</b>	<b>Page</b>
<b>14.</b>	Experimental layout showing the arrangement of the treatments at the experimental field, Wadi El-Raml, NWCZ of Egypt.	<b>48</b>
<b>15.</b>	The experimental field design and treatments used during the study period (i.e. winter season of 2019/2020) at Wadi El-Raml, NWCZ of Egypt.	<b>49</b>
<b>16.</b>	Strip cultivation (vetiver grass – barley) treatment (SVB), where vetiver grass and barley are cultivated	<b>50</b>
<b>17.</b>	Strip cultivation (barley - vetiver grass) (SBV), where barley and vetiver grass are cultivated at the top and down-slope, respectively.	<b>50</b>
<b>18.</b>	Vetiver grass without mulch cover (V) treatment.	<b>51</b>
<b>19.</b>	Barley without mulch cover (B) treatment.	<b>51</b>
<b>20.</b>	Vetiver grass with mulch cover of rice straw of 1t/fed (VM <sub>1</sub> )treatment.	<b>52</b>
<b>21.</b>	Vetiver grass with mulch cover of rice straw of 0.5t/fed (VM <sub>0.5</sub> )treatment.	<b>52</b>
<b>22.</b>	Barley with mulch cover of rice straw of 1t/fed (BM <sub>1</sub> )treatment.	<b>53</b>
<b>23.</b>	Barley with mulch of rice straw of 0.5t/fed (BM <sub>0.5</sub> )treatment.	<b>53</b>
<b>24.</b>	Control without cultivation treatment.	<b>54</b>
<b>25.</b>	Distribution of rainfall during the winter Season (2019 / 2020) at Wadi El-Raml area, NWCZ of Egypt.	<b>60</b>
<b>26.</b>	Rate of runoff (mm) under both barely and vetiver grass in Wadi- El-Raml, NWCZ of Egypt.	<b>63</b>
<b>27.</b>	Runoff coefficient under both barely and vetiver grass	<b>68</b>

<b>No.</b>	<b>Title</b>	<b>Page</b>
	in Wadi- El-Raml, NWCZ of Egypt.	
<b>28.</b>	Soil loss (kg.fed. <sup>-1</sup> ) under both barely and vetiver grass in Wadi- El-Raml, NWCZ of Egypt.	<b>71</b>
<b>29.</b>	Soil loss ratio under both barely and vetiver grass in Wadi- El-Raml, NWCZ of Egypt.	<b>76</b>
<b>30.</b>	Biological yield for barely and fresh dry matter for vetiver grass for the studied treatments in Wadi- El-Raml, NWCZ of Egypt.	<b>78</b>



# INTRODUCTION

