UNIVERSITI PUTRA MALAYSIA

THE FINANCIAL FEASIBILITY OF RETAINING WALLS AND WINBREAKS AS MEASURES OF OIL CONSERVATION IN WADI ZABID, YEMEN

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To
all those people whom
I love, respect and in debt to.

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Wadi Zabid is one of the major agricultural areas of Yemen that faces serious soil erosion (SE) problem caused by water and wind. Some of the farmers in the area have constructed retaining walls (RW) and windbreak (WB) to conserve their farmland soil but many do not. As the SE is becoming serious and soil conservation activity is not progressing, there is a need to reveal the feasibility of soil conservation investment, obstructions to soil conservation and farmers SE perception.

Data for this study were collected through questionnaires during the agricultural season of 1999/2000. The total sample was 264 comprising four groups; i.e., "with" and "without" RW and "with" and "without" WB. The financial benefit cost analysis was the analytical technique and the decision criteria used were the net present value (NPV), internal rate of return (IRR) and benefit cost ratio (BCR). Order logit and logistic models have been applied to reveal farmers characteristics related to the perception of the soil erosion and to the decision of soil conservation, respectively.

The study found that the farmer age, number of family working force and number of permanent labourers all have positive relations with the serious perception of soil erosion by water. However, the family size, RW length and farmer experience all have shown negative relations. The model of RW adoption showed that farm–home distance, neighbours complaints and the minor perception of soil erosion by water have positive relation. On the contrary, the size of rented area and farm-market distance both have shown negative relations with RW adoption. In the perception of wind erosion model, the farming period, numbers of WB, presence of demoplots and awareness of soil conservation programmes all have shown positive relations. However, the farmer experience, WB age and neighbours complaints all have shown negative relations with the perception. Nonetheless, the farmer will not plant WB unless he is aged, literate, has more family working force, asked by neighbours and has attended the extension night gatherings. The size of the family and the size of rented farm area have shown negative relations with the adoption of WB measure.

In addition, the study found that the investments in RW and WB have been financially feasible. The farmer who has invested in RW has got Yemen Riyals (YRs) 33,652 as NPV (US$ 1= YRs 150). In term of BCR and IRR the farmer returns are 1.14 and 14 percent, respectively. The farmer who has invested in WB has got YRs 54,190 as NPV and 1.8 and 27 percent as BCR and IRR, respectively.

Therefore, as RW and WB proved to be financially feasible then government subsidies are justified and will attract more farmers to conserve their farmland soil. In addition, as the determinants of the perceptions of water and wind erosion are not identical then separate strategies and extension programmes are justified.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Doktor Falsafah

KEBERUNTUNGAN DINDING PENAMBAK DAN PERINTANG ANGIN BAGI PEMULIHARAAN TANAH DI WADI ZABID, YEMEN

Oleh

ALLADEEN MOHAMAD ABDALLA AL-SHARJABI

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Wadi Zabid sebagai salah satu kawasan pertanian terbesar di Yemen, menghadapi masalah hakisan tanah serius yang disebabkan oleh air dan angin. Hanya sesetengah petani telah membina dinding sebagai penambak (RW) atau perintang angin (WB) sebagai langkah kawalan, manakala sebahagian besar tidak berbuat begitu. Memandangkan masalah hakisan tanah menjadi semakin serius dan tiada usaha untuk menghalangnya, maka adalah perlu di kaji potensi pelaburan bagi pemuliharaan tanah, halangan pemuliharaan tanah dan persepsi petani terhadap status hakisan tanah.

Data kajian telah dikumpul melalu sessi soalselidik pada musim pertanian 1999/2000. Sejumlah 264 petani daripada empat kumpulan respoden merangkumi kumpulan 'dengan' dan 'tanpa' dinding penambak, dan 'dengan' dan 'tanpa' perintang angin. Teknik yang digunakan adalah analisis faedah kos sementara kriteria pemilihan adalah melalui nilai bersih semasa (NPV), kadar pulangan dalaman (IRR) dan kadar faedah kos (BCR). Model order logit dan logistic digunakan untuk

menentukan ciri-ciri petani berkenaan persepsi terhadap hakisan tanah dan keputusan berkenaan pemuliharaan tanah.

Secara ekonominya, kajian mendapati kedua-dua pelaburan untuk dinding penambak dan perintang angin adalah wajar. Petani yang melabur di dalam (RW) beroleh Yrs 33652, 1.14 dan 14 peratus masing- masing bagi NPV, BCR dan IRR. Petani yang menganggap hakisan air adalah serius berada dalam kumpulan berumur, tenaga kerja keluarga yang ramai, pekerja kekal yang lebih dan mempunyai RW yang kurang di ladangnya. Bagaimanapun petani tidak akan membina RW kecuali dia mempunyai dan menyewakan kawasan ladang yang kecil, jauh dari tempat tinggal tetapi dekat dengan pasar, menganggap hakisan sebagai ancaman kecil, tidak mengambil bahagian didalam program pengembangan malam dan mendapat gesaan dari jiran. Petani akan menganggap hakisan angin sebagai serius jika dia berpengalaman, ladangnya dekat dengan pusat pengembangan dan plot demonstrasi, sedar akan program pemuliharaan, mendapat gesaan jiran, mempunyai lebih WB dan telah menanam WB untuk jangkamasa yang lama. Bagaimanapun, keputusan untuk memilih WB ditentukan oleh faktor umur petani, celik huruf, jumlah tenaga kerja keluarga, keluasan ladang, jumlah sessi pengembangan yang dihadiri, jarak ke pusat pengembangan dan pasar, keselamatan hakmilik tanah dan gesaan jiran. Petani juga cenderung untuk membina WB jika bilangan ahli keluarga kurang dan menganggap hakisan tanah sebagai masalah kecil.

Memandangkan RW dan WB satu pelaburan yang menguntungkan, maka sejumlah kecil subsidi kerajaan dikira wajar dan akan menarik lebih ramai petani untuk memulihara tanah pertanian mereka. Selain itu, strategi berasingan dan program

pengembangan untuk kedua-dua jenis hakisan yang berbeza adalah perlu memandangkan perbezaan faktor-faktor yang berkaitan persepsi terhadap hakisan dan langkah-langkah adoptasi pemuliharaan tanah.

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LIST OF ABBREVIATIONS

ADB	Asian Development Bank
BCA	Benefit cost analysis
BCR	Benefit cost ratio
CBCA	Conventional benefit cost analysis
CoS	Consumer surplus
CP	Cut-off period
CS	Compensating surplus
CV	Compensating variation
EBCA	Economic benefit cost analysis
ES	Equivalent surplus
EV	Equivalent variation
FAO	Food and Agriculture Organisation of the United Nations
FBCA	Financial cost benefit analysis
GDFDC	General Directorate of Forests and Desertification Control
INB	Incremental net benefit
IRR	Internal rate of return
MAI	Ministry of Agriculture and Irrigation
NARR	Net average rate of return
NPV	Net present value
PBP	Pay-back period
PPI	Potential Pareto-improvements
PS	Producer surplus

pua	Per unit area
RW	Retaining wall
SA	Sensitivity analysis
SBCA	Social benefit cost analysis
SC	Soil conservation
SCM	Soil conservation measure
SE	Soil erosion
SRTDA	Southern Region of Tihama Development Authority
SV	Switching value
TDA	Tihama Development Authority
UNDP	United Nations Development Programme
WB	Windbreaks
WRW	With retaining wall
WTA	Willingness to accept
WTP	Willingness to pay
WtRW	Without retaining wall
WtWB	Without windbreaks
WWB	With windbreaks
YRs	Riyal of Yemen

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CHAPTER I

INTRODUCTION

General Background

Soil is an essential natural resource for the production of food that supports human life. However, the soil resource is exposed to many threats that lowered its potential for food production. One of the greatest problems that the soil resource is facing is the soil degradation. Oldeman (1994) defined soil degradation as human induced phenomenon that lowers the current and/or future capacity of the soil to support human life. The major forms of soil degradation are the soil erosion that initiated by water and wind actions. Usually, it is hard to draw a line that would segregate the term of soil erosion from soil degradation as the terms are interchangeably used to describe the same thing. However, Morgan (1995) defined soil erosion as the process that detrimentally affects the soil essential properties and subsequently reduces crop production and the farmer income.

Soil erosion is a worldwide problem that goes back to the time when man began cultivation of the land. The main factors of the soil erosion are wind and water, and it has become widely accepted to use the terms of water and wind erosion to distinguish between soil erosion that caused by water and wind, respectively. Nevertheless, water erosion is a major problem in non-arid regions while wind erosion is the major problem in the arid regions, because of the combined effects of drought and overgrazing. However, it is not unusual to notice both types in a country of relatively small area.

The soil erosion leads to the loss of topsoil and reduction in soil productivity; however the data that quantify such reduction are varied in quality and relevance (Schertz *et al.*, 1989). The effects of severe forms of erosion such as desert encroachment and gully erosion are easy to be identified, but a small change in the topsoil layer caused by soil erosion action might go on for years without notice. The use of fertilisers and improved seeds/seedlings varieties have in many times hidden the effect of soil erosion and prolonged the time to realise the reduction in crop productivity and loss of fertile topsoil. In addition, soil erosion deteriorates the soil production potential by affecting its physical characteristics.

The impacts and losses caused by soil erosion are striking. Kovda (1983) reported that 430 millions hectares of productive land worldwide have been destroyed by the soil erosion process and every year there is a loss of 5 to 7 million hectares of land due to soil erosion (Clarke, 1994). Unless efficient measures are applied to control soil erosion, the world will face a difficult time to meet the increasing population food requirement. The danger of soil erosion exaggerates when it is realized that the rate of soil erosion and population growth rate both are high in developing countries that already have many problems. These entails questions like: how would the coming generations meet the demand for food? Is there is enough land to produce sufficient food quantity? Does the existing land will continue to produce the same food quantity? What are the chances for protecting and reclaiming the existing land? Nonetheless, considering soil as a non-renewable resource then controlling erosion would become an ethical obligation for this generation to the future generations or an expression of land stewardship.

Problem Statement

Due to the diversity in Yemen physiographic characteristics two major forms of soil erosion; i.e., water and wind erosion, can be identified. Yet, the available old terrace system has implied that soil erosion by the runoff water is an old problem compared to the soil erosion by the wind action (Scholte *et al.*, 1991). The problem of wind erosion has advanced in recent decades due to incidences of drought, over-grazing and tree over-cutting in the marginal lands. In contrast, the two major forms of soil conservation measures in Yemen are retaining walls (RW) and windbreaks (WB). The former, RW, is a form of terrace system to control soil erosion by runoff water. The WB is a group of trees planted in certain arrangements to reduce the wind speed and to protect the farm land soil from blowing wind.

The impact of soil erosion (SE), either by runoff water and/or wind, will be noticed first at the farm level as the soil characteristics will experience gradual changes till it become economically and ecological unsuitable to support crop production. However, the uses of fertilisers have succeeded in compensating the loss of soil nutrients but not the changes in the soil characteristics. Moreover, the SE impacts at the macroeconomics level will be through the raising in the imported fertilizers and food bills. In sever SE incidences, farmers will abandon their farm lands and quit farming, which would mean that the rate of unemployment will proliferate then negatively affect the society welfare.

The government efforts in controlling the SE have been initiated in the early years of the 1980's. The government efforts have been in forms of technical assistant,