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Assessment of the Impact of Tuberculosis (Tb) On Farmer's Food Security, In the Gash Delta Scheme, Kassala State, Sudan

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Abstract: **The study is designed to evaluate the impact of TB on farmer's food security in the Gash delta. It depends mainly on primary and secondary data, the primary data was collected by questionnaire through direct interview of the respondents in the Gash delta agricultural scheme. The sample covers 100 farmers of TB morbidity and debility cases selected randomly from the farmers in the area, who cultivated their land, using the registration list in Aroma, Kassala and Wager hospitals after diagnosis of the disease, another 100 healthy farmers were selected using the same method of sample selection. (The total sample size was 200 farmers). Secondary data was collected from different sources including, Ministry of Agriculture, Ministry of Health, National TB programme (NTP), Gash delta agricultural scheme, Kassala, Aroma, Wager hospitals, institute of endemic diseases (University of Khartoum), WHO, different net web sites and others official reports related to the field of the study. To test the hypothesis of the study, (1) Descriptive statistics methods have been used throughout the study includes, (frequency distributions, percentage and means), to determine the frequency distributions of the infected and healthy farmers with respects to the selected variables. (2) Correlation matrix was used to determine the relationship between the variables.The main result of the study explains that, Food security is positively correlated with the Farmer's educational level, Family size, Health status, Total cultivated area, Sowing date, Harvesting time, Cultivation cost, Number of working daily hours, Labour cost, Farmer's productivity, And negatively correlated with the number of lost seasons. Finally, a set of recommendations were generated which aimed to reduce TB infection and disease in the Gash delta, (1) Periodic test and prevention of the disease, (2) Isolation of the patient farmers with active disease, before starting effective anti-tuberculosis therapy, so as to break the chain of transmission of the disease among the farmers, (3) Adequate TB control and management program is needed and integration into primary health care, (4) There is a need of health education to teach the farmers about TB disease and how to avoid its infection, (5) Nutritional programmes, to teach the Hadandwa women about the importance of the varieties of food and their processing, specially milk pasteralization, (6) Re-habitation of health units in the deferent areas of the Gash delta and provide them with the required health services so as the infected farmers need not to travel outside the area, (7) Aroma hospital should have to coordinate with the Gash delta agricultural scheme to play an effective role in reaching and looking after the patient farmers, (8) The Gash delta agricultural scheme management should have to seek a way for supporting the patient farmer's income, (9) Good ventilation of houses and avoid overcrowding as much as possible, (10)TB control programme in Kassala state should have nutrition- based intervention for the infected farmers, (11)The state government should have to compensate the infected farmers for the lost seasons, (12) Incorporate the international NGOs, (13)To make more studied on this subject by the researchers in the future.**

Keywords: **Tuberculosis, Farmer's food security, Nutritional programmes.**

I. INTRODUCTION

1-1 Socioeconomic Impact of Tuberculosis:

Tuberculosis (TB) is essentially a disease of social and economic deterioration (Barr and Menzies, 1994). In fact the close connection between social and economic deprivation and the emergence of tuberculosis is well known (Pocter and MC Adam, 1994). Many authors have acknowledged that people who are cut-off from income Opportunities become vulnerable for diseases like tuberculosis. Tomes, for instance, reflecting in her essay review on new work about the history of tuberculosis, cites an English public heath authority who, as early as 1903, noted that the drops in tuberculosis mortality closely parallels the decline in wheat prices (Tomes, 1989).

Tuberculosis is also called disease of poverty , because of the effectit has on increasing poverty as well as being resultof it. Poverty may be found not just in term of absoluteincome butmore significantly in term of ramification of poses for quality of life. For those who are poor, for example those living in poverty often have poor level of education, suffer from malnutrition unsanitary living environment, overcrowding and inadequate access to heath care all of which increase the likelihood of TB. The association between TB and poverty can be seen acting at different levels of society. For example at the country level; 17 out of the 222 countries that account for 80% of the world TB casesare considered low income countries .Within countries, TB prevalence is highest among poor sub-population or regions. For examples in Chiapas, a Mexican state with high poverty levels, estimates of TB are twice as high as natural average and US study found that the relative risk for TB among the poorest 25% of the population was 2.3 compared with the baseline of 1 for the wealthiest 25%. Various marker groups, vulnerable to effects of poverty have also been found to have higher prevalence's of TB. These include particular ethnic groups (black US prisoners), females in some countries, drug taking groups, the homeless.

At the household and individual level there is similar trend, it is estimated that over 50% of new TB patients are living in less than 2$ per day. We can observed that poverty worsen the chance of contracting TB and the development of chronic disease and death. Moreover the socioeconomic status of the individuals can affect their access to TB information treatment center or influence their choices to meet the demand for TB regime. Thus poverty will not only increase vulnerability to tuberculosis, but the TB will impoverish the patients and household members.

Sudan like other developing countries, and even worse, in that the country is at war for almost half a century, famine and desertification had lead to population dislocation and instability. Most of the persons from the southern part of the country, fleeing the war torn areas , has clustered in very huge squatter of displaced camps around the northern cities, living in sub-human condition with very scarce resources . People from the west of Sudan who immigrated to the north due to the droughts of 1985, for part of internally displaced population, These factors culminated in impoverishment , malnutrition , overcrowdings make tuberculosis to abound.

1-2 Food Security:

Food security is often defined in terms of food availability, food access and food utilization (USAID, 1995).Food availability is achieved when sufficient quantities of food are consistently available to all individuals within a country. Such food can be supplied through household production, other domestic output, and commercial imports of food assistance. Food access is ensured when households and all individual within them have adequate resources to obtain a appropriate food for a nutritional diet, access depend upon income available to the household, the distribution of income within the household and on the price of food. Food utilization is the proper biological use of food, requiring a diet providing sufficient energy and essential nutrients, potable water and adequate sanitation. Effective food utilization depends in large measure on knowledge within the household of food storage and processing techniques, basic principles of nutrition and proper childcare, W.F.S (1996).

1-3 The Study Area:

This study was conducted in the Gash delta in Kassala state in the eastern region of the Sudan. The area represents one of the main agricultural areas in the country. It was selected based on the fact that agriculture in this areaplays animportant role in the economical and social development of the region and it satisfied the local demand for food as well as the demand in other regions in the country. TB prevalence rate is high. (The rate of TB infection increased up to 4% i.e. 4000 persons out of 100,000 persons), Kassala Ministry of Health. (2003).

1-4 Problem Statement:

Tuberculosis is not only a health problem it is a social and economical disease.75% of cases of TB occur among the productive age group (20-50 years) .Studies have found that untreated TB can lead to 20-30% reduction of household annual wages. However, the long term economic effect and the compensatory effort by the household are not known in this respect . In global level TB leads to decline in worker productivity to the order of

12$billion annually. The commission on macro-economic and health suggest that the disease affect the level of growth of per capita GNP and also affect the life span and lifetime earnings lost by society.

The financial cost of TB involved going for diagnosis and treatment and also involved transport to the clinic , or cost in term of wages lost when taking time off work to get treated . A study in China identified financial reasons as contributing to 45% of cases of treatment delay . Higher rate of defaulting are Seen for many of the same reason. Social impoverishment the stigma associated with TB can cause impoverishment in term of social poison and power. Studies from Vietnam and India suggest that women fear the social ramifications of TB such as isolation and rejection more so than men.

In the Sudan studies suggested that the rate of infection was 1.8% i.e. 1800 persons out of 100,000 persons which considered to be the highest rate of infection in the world,WHO (2003).

1-5 Overall and Specific Objectives:

1-5-1-The Overall Objective:

The fundamental objective of the study is to assess the impact of Tuberculosis (TB) on farmer's food security in the Gash Delta in the eastern region of the Sudan; to achieve this objective the study sought the following specific objectives:

1-5-2- The Specific Objectives:

1. Determining the socioeconomic characteristics of the infected and healthy farmers in the Gash delta.
2. Determining the factors of food security in the study area.
3. Determining the impact of TB on food security in the study area.
4. To suggest some recommendations and issues forpolicies implications to enhance the state ofdevelopment, encourage farmer productivity, income andsecure food for population of the study area.

1-6 Justification:

- TB is essentially a disease of social andeconomic deterioration.
- 75% of cases of tuberculosis occur among theeconomically productive age group(20-60 years) .
- It affects productivity since it weakens farmerability to work.
- It has a negative impact on the householdincome due to cost of traveling to diagnosis, andnursing.
- TB causes social ramification due to isolationor rejection.

II. MATERIALS AND METHODS

2-1 Hypotheses to Be Tested:

1- Due to TB morbidity, there is a difference between the infected and healthy farmers with respect to**;**

A- Socioeconomic characteristics which include:.

B- Agronomic activities, which include:

2- Food security is positively correlatedwith:

A- Total cultivated area.

B- Farmer's productivity.

C- Farmer's annual income.

And negatively affected bynumber of lost seasons

2-2 Methodology:

2-2-1Methods of Data Collection:

The Information was collected using two main sources of data collection.

1. Secondary source: depending on references such as previous studies, different ministries reports, offices and websites.

2. Primary source: depending on direct observation and questionnaire technique.

2-2-2The Study Population:

All farmers in the Gash delta were considered for the purpose of this study. The population is more or less homogeneous, they are mostly of the Hadendwa tribe, they are similar in their customs and they grow the same crops mainly Dura. Random sample of 100 infected farmers were selected from the diagnostics cases (positive smear) in Aroma and Weger (Hadalya) hospitals using registered list as guide line. Another 100 healthy farmers is also selected using the same procedure of sample selection, which used as control, the total sample size will be (n=200).

2-2-3Determination of the sample size

For the determination of the sample size we use thefollowing equation: -

$$n = \frac{K \times V}{D}$$

K = Z value (the normal deviation of 0.90 probability) =1.78.
V = the estimated variance (2.8).
D = the magnitude of the difference to be detected (0.05).

$$n = \frac{1.78 \times 2.8}{0.05} = 99.7 = 100$$

2-2-4 Data analysis:

The data were processed and then transformed to computer coding form. The data were fed to the computer to calculate the following:

1- Frequencies.

2- Inter-correlation matrix for the selected variables.

III. RESULTS

3-1 Frequencies:

The Frequenciesdistribution of the two samples revealed that:

3-1-1Socioeconomic characteristics of the farmers in the Gash area:

3-1-1-1Sex*:* 100% of the farmers in the Gash area were male (table 1).

3-1-1-2- Age: 98% of the infected and 92% of the healthy farmers, fall within (20–60) year's age group, the mean age was 42.68 years for the infected farmers and 43.78 years for the healthy farmers (table 2).

3-1-1-3-Educational Level 7% of the infected and 23% of the healthy farmers, received between basic and secondary levels of education.59% and 72% received khalwa level of education. Illiteracy is 34% among infected and only 5% among healthy farmers (table 3).

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3-1-1-4-Family size: The mean family size of the infected farmers was 5.08 individuals and for the healthy farmers was 7 individuals (table 4).

3-1-1-**5-Secondary occupation**: 32% of the infected and healthy farmers did not have secondary occupation, they restrict themselves to agriculture (table 5).

3-1-1-6-Marital Status: 96% among the infected farmers in the Gash area were married, and only 4% were single. On the other hand 93% of the healthy farmers were married, while only 7% were single (table 6)

3-1-2Health status:

The majority of the infected farmers (83%) appeared that their health status was very poor, and 13% thought they were in good health. While (7%) of healthy farmers were in very poor health status, 20% thought they were in good health and 5% thought they were in very good health (table 7).

3-1-2-1-Health Services: 68% of the infected farmers are treated in the period 1999-2005 while 32% were left untreated, unfortunately, 100% of the healthy farmers were left untreated, table (8).

3-1-2-2- HealthUnits: Aroma hospital is responsible for all health services provided and there is no specialized doctor on respiratory diseases. Health units' facilities in the Gash delta is shown in table (9).

Table (1): Frequency distribution of farmers according tosex in the Gash area

Sex	Patient (n = 100)		Healthy (n = 100)		Total sample (n = 200)	
	Freq.	%	Freq.	%	Freq.	%
Male	100	100	100	100	200	100
Female	0	0	0	0	0	0
Total	100	100	100	100	200	100

Table (2): Frequency distribution of farmer's according to age in Gash area.

Age (group)	Patient (n =100)		Healthy (n = 100)		Total sample (n = 200)	
	Freq.	%	Freq.	%	Freq.	%
20 – 40	44	44	43	43	87	43.5
41 – 60	54	54	49	49	103	51.5
61 – 80	2	2	08	08	10	5
Total	100	100	100	100	200	100
Mean	42.68 years		43.78 years		43.23 years	

Table (3): Frequency distribution of farmers according to educational level in the Gash area

Educational level	Patient (n = 100)		Healthy (n = 100)		Total sample (n = 200)	
	Freq.	%	Freq.	%	Freq.	%
Illiterate	34	34	5	5	39	19.5
Khalwa	59	59	72	72	131	65.5
Basic school	05	05	11	11	16	08
Medium school	01	01	06	06	07	3.5
Secondary	01	01	06	06	07	3.5
Universities	0	0	0	0	0	0
Total	100	100	100	100	200	100

Source: field survey.

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Table (4): Frequency distribution of farmers according to family size in the Gash area

Valid	Patient (n = 100)		Healthy (n = 100)		Total sample (n = 200)	
	Freq.	%	Freq.	%	Freq.	%
5≤	65	65	38	38	103	51.5
6 - 10	34	34	48	48	82	41
11 - 15	1	1	10	10	11	5.5
16≥	0	0	04	04	04	02
Total	100	100	100	100	200	100
mean	5.08 individuals		7individuals		6.01individuals	

Source: field survey.

Table (5): Frequency distribution of farmers according to secondary occupation in the Gash area

Occupation	Patient (n = 100)		Healthy (n = 100)		Total sample (n = 200)	
	Freq.	%	Freq.	%	Freq.	%
labour	08	08	10	10	18	9
others	59	59	57	57	116	58
total	67	67	67	67	134	67

Table (6): Frequency distribution of farmers according to marital status in the Gash area

Marital Status	Patient (n = 100)		Healthy (n = 100)		Total sample (n = 200)	
	Freq.	%	Freq.	%	Freq.	%
Married	96	96	93	93	189	94.5
Single	4	4	7	7	11	5.5
Total	100	100	100	100	200	100

Source: field survey

Table (7): Distribution of farmers according to the health status

Health status	Patient1(n =100)		Healthy1(n =100)		Total sample (n =200)	
	Frequency	%	Frequency	%	Frequency	%
Very poor	4	4	7	7	11	5.5
poor	83	83	68	68	151	75.5
good	13	13	20	20	33	16.5
Very good	0	0	5	5	5	2.5
Total	100	100	100	100	200	100

Table (8): Health services in the Gash area

Health services	Patient (n =100)		Healthy (n =100)		Total sample (n =200)	
	Freq.	%	Freq.	%	Freq.	%
Treated	68	68	0	0	68	34
Untreated	32	32	100	100	132	66
Total	100	100	100	100	200	100

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Table (9): Health units in the Gash area

Health units	Aroma	Wager	Matatieb	Makali	Degien	Tendilie	Total
Hospital	1	1	0	0	0	0	2
Health center	0	1	1	1	1	1	5

Source: Field survey.

3-1-3Nutritional status:

3-1-3-1 Type of Daily diet: - 80%farmers and 70%of the healthy farmers have Dura more than one time a day. On the other hand, 60%of infected and 15% of the healthy have milk more than one time a day, table (10).

3-1-3-2Time and place of having diet:50% of infected farmers have regular diet, that in time and in the house, while 40% have it irregular and outside the house. 10% only have their daily diet when feel with hunger. Compared to (95%) of healthy farmers have their daily diet regular and in the house, only 5% have it when feel with hunger table (11).

3-1-3-5 Saving food: Heating is the main process of saving food among farmers (healthy and infected). Very little proportion (10%) among healthy farmers uses freezing for saving food. Table (12).

3-1-3-6 Food security (food availability):96% of the infected farmers have no available food for the year 2006, compared to 50% of healthy farmers, table (13).

3-1-4- Housing:

3-1-4-1 House design:-100% of the total sample live in random houses consists of one or two rooms with one window or rarely exceed that. Plate, (1**).**

3-1-4-2Building material:85% of the infected and healthy farmers in the Gash area use straw as building material for their houses, plate, (1).only 5% and 10% use red brick and mud respectively, table (14).

3-1-4-3 Number of individuals living in the house:-The house of the Hadandawa tribe is more or less overcrowded, because it is usually consists of one room and the family size may reach 16 individuals or more.

Table (10): Distribution of the farmers according to the type and time of daily diet in the Gash area

Type of food	Time of having food							
	One time a day				More than one time a day			
	Patient		Healthy		Patient		Healthy	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Dura	20	20	30	30	80	80	70	70
Sugar	40	40	25	25	30	30	55	55
vegetable	0	0	15	15	0	0	30	30
Fruits	0	0	10	10	0	0	10	10
Red meat	0	0	15	15	0	0	35	35
Whitemeat	0	0	0	0	0	0	0	0
Milk	20	20	10	10	60	60	15	15
Egg	0	0	0	0	0	0	0	0

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Table (11): Distribution of farmers according to the way and place of having diet

Time and placeof diet	Patient (n =100)		Healthy (n =100)		Total sample (n =200)	
	Freq.	%	Freq.	%	Freq.	%
Regular in the house.	50	50	90	90	140	70
Irregular outside the house.	40	40	5	5	45	22.5
When feel with hunger	10	10	5	5	15	7.5
Total	100	100	100	100	200	100

Source: field survey.

Table (12): Distribution of farmers according to the way of saving food

Way	Patient1(n =100)		Healthy1(n =100)		Total sample (n =200)	
	Freq.	%	Freq.	%	Freq.	%
Freezing	0	0	10	10	10	05
Heating	50	50	70	70	120	60
No saving	50	50	20	20	70	35
Total	100	100	100	100	200	100

Source: Field survey.

Table (13): Frequency distribution of farmers according to the food availability in the Gash area

Food availability	Patient (n =100)		Healthy (n =100)		Total sample (n =200)	
	Freq.	%	Freq.	%	Freq.	%
unavailable	96	96	50	50	146	73
available	4	4	50	50	54	27
Total	100	100	100	100	200	100

Source: Data from field survey.

Table (14): Distribution of farmers according to the Building material

Material	Patient (n =100)		Healthy (n =100)		Total sample (n =200)	
	Freq.	%	Freq.	%	Freq.	%
Red block	5	5	5	5	10	5
Mud	10	10	10	10	20	10
straw	85	85	85	85	170	85
total	100	100	100	100	200	100

Source: field survey

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Plate (1) House design

Plate (2) Building material

3-1-4Agronomic activities:

3-1-4-1Total cultivated area: The majority of the farmers grown crops in area ranges between 1 to 5 feddans, while a very few proportion cultivate land reaches up to 20 feddans. The mean cultivated area among the infected farmers in season 2005-2006 was found to be 2.8 feddans. Compared to 5.76 feddans among the healthy farmers table (15).

3-1-4-2 sowing date and harvesting time: 19% of infected farmers grow Sorghum off-season, compare to only 3% of healthy farmers. On the other hand, 22% of infected farmers and 5% of healthy farmers harvested it off-suitable time, table (16).

3-1-4-3Marketing of the crop Sorghum: 95% of both healthy and infected farmers in the Gash area marketed their crops locally; table (17).

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3-1-4-4 Numbers of seasons losses due to TB infection: 66% of the infected farmers left their land without cultivation for a number of agricultural seasons due to TB infection, table (18).

3-1-4-5 Numbers of daily working hours: The study found that the mean numbers of daily working hours of the infected farmer is 2.78 hours, compared to 10.31 hours of the healthy farmer. Table (19).

3-1-4-6 Cultivation cost: The mean cultivation cost among the infected farmers was found to be 134.6 SDG. Compared to 210.3 SDG. among the healthy farmers, table (20).

3-1-4-7 Crop market price: The mean crop market price among the infected farmers was found to be 43.5 SDG. Per sack, Compared to 49.6 SDG. among the healthy farmers, table (21).

3-1-4-8 Labour cost: The mean labour cost among the infected farmers was found to be 135.5 SDG. Compared to 201.3 SDG. among the healthy farmers, table (22).

3-1-4-9 Farmer productivity: The mean output/feddan per infected farmer was found to be 2.84 sacks. Compared to 8.87 sacks/faddan of the healthy farmers, with variation of 6.03 sacks/faddan, table (23).

Table (15): Distribution of farmers according to the Total cultivated area/farmer in the Gash area.

Total cultivated area/fed.	Patient (n =100)		Healthy (n =100)		Total sample (n =200)	
	Freq.	%	Freq.	%	Freq.	%
1-5	96	96	81	81	177	88.5
6-10	3	3	14	14	17	8.5
11-15	0	0	1	1	01	0.5
16-20	1	1	2	2	03	1.5
≥20	0	0	2	2	02	1
Total	100	100	100	100	200	100
Mean	2.8 (feddans)		5.76 (feddans)		4.28 (feddans)	

Table (16): Shows frequency distribution of farmers according to sowing date and harvesting timeof Sorghum in Gash area:

Item	Sowing date				Harvesting time			
	Patient		Healthy		Patient		Healthy	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Unsuitable	19	19	3	3	22	22	5	5
Suitable	81	81	97	97	78	78	95	95
Total	100	100	100	100	100	100	100	100

Table (17): Frequency distribution of farmers according to the marketing of the crop in the Gash area

Marketing type	Patient (n =200)		Healthy (n =200)		Total sample (n =200)	
	Freq.	%	Freq.	%	Freq.	%
Local	95	95	95	95	190	95
External	5	5	5	5	10	05
Total	100	100	100	100	200	100

Source: Data from field survey.

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Table (18): Numbers of working daily hours /farmer in the Gash area

Number of working hours	Patient (n =100)		Healthy (n =100)		Total sample (n =200)	
	Freq.	%	Freq.	%	Freq.	%
0< 2	30	30	1	1	31	15.5
2<4	30	30	3	3	33	16.5
4 <6	37	37	2	2	39	19.5
6 <8	2	2	9	9	11	5.5
8< 10	1	1	7	7	08	04
10< 12	0	0	23	23	23	11.5
12 < 14	0	0	51	51	51	25.5
14 < 16	0	0	4	4	04	02
Total	100	100	100	100	200	100
Mean	**2.78 (hours)**		**10.31(hours)**		**6.545 (hours)**	

Source: Field survey

Table (19): Frequency distribution of farmers according to the numbers of agricultural lost seasons

No. of seasons	Patient (n =100)		Healthy (n =100)		Total sample (n =200)	
	Freq.	%	Freq.	%	Freq.	%
1	32	32	0	0	32	16
2	22	22	0	0	22	11
3	07	07	0	0	07	3.5
4	03	03	0	0	03	1.5
5	02	02	0	0	02	01
Total	66	66	0	0	66	33

Source: field survey.

Table (20): Frequency distribution of farmers according to the cultivation cost per feddan in the Gash area

Cost SDG. Per feddan	Patient (n =100)		Healthy (n =100)		Total sample (n =200)	
	Freq.	%	Freq.	%	Freq.	%
0 < 500	15	15	1	1	16	08
500< 1000	4	4	5	5	09	4.5
1000< 1500	43	43	31	31	74	37
1500< 2000	21	21	30	30	51	25.5
2000<2500	9	9	11	11	20	10
2500< 3000	4	4	3	3	07	3.5
3000< 3500	1	1	4	4	05	2.5
3500<4000	1	1	2	2	03	1.5
4000< 4500	1	1	2	2	03	1.5
4500< 5000	1	1	3	3	04	02
5000< 5500	0	0	2	2	02	01
5500<6000	0	0	3	3	03	1.5
6000<6500	0	0	2	2	02	01
6500<7000	0	0	1	1	01	0.5
Total	100	100	100	100	200	100
Mean	134.6 (SGD).		210.3(SGD).		174.80 (SGD).	

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Table (21) Frequency distribution of farmers according to the crop marketprice

Price Per sack of Sorghum/ SGD	Patient (n =100)		Healthy (n =100)		Total sample (n =200)	
	Freq.	%	Freq.	%	Freq.	%
0< 20	13	13	1	1	14	07
20< 40	0	0	1	1	01	0.5
40<60	85	85	89	89	174	87
60<80	2	2	9	9	11	5.5
Total	100	100	100	100	200	100
Mean	43.5 (SGD).		49.6(SGD).		46.45(SGD).	

Source: Data from field survey.

Table (22): Frequency distribution of farmers according to the labour cost in the Gash area

Cost 1000 SD. Per feddan	Patient (n =100)		Healthy (n =100)		Total sample (n =200)	
	Freq.	%	Freq.	%	Freq.	%
0 < 100	20	20	15	15	35	17.5
100<200	66	66	40	40	106	53
200< 300	10	10	30	30	40	20
300<400	1	1	3	3	04	02
400<500	0	0	3	3	03	1.5
500<600	3	3	7	7	10	05
600< 700	0	0	1	1	01	0.5
700<800	0	0	1	1	01	0.5
Total	100	100	100	100	200	100
Mean	135.5(SDG).		201.3(SDG).		196.75 (SDG).	

Table (23): Frequency distribution of farmers according to the farmer productivity in the Gash area

Number of sacks per feddan	Patient (n =100)		Healthy (n =100)		Total sample (n =200)	
	Freq.	%	Freq.	%	Freq.	%
0< 2	36	36	1	1	37	18.5
2<4	23	23	1	1	24	12
4<6	36	36	4	4	40	20
6<8	3	3	3	3	06	03
8<10	2	2	36	36	38	19
10< 12	0	0	55	55	55	27.5
Total	100	100	100	100	200	100
Mean	2.84 (sack per feddan).		8.87 (sack per feddan).		5.905 (sack per feddan).	

Source: Data from field survey.

3-2 Results of correlation analysis:

This part will represent the significant correlation among the selected variables of the total sample (n=200). The matrix of Inter correlation computed for the sample is presented in, (Appendix 1).

3-2-1 Correlation of food security (food availability):

Food securityis positively correlated with:

1-Educational level (r=0.31320).

2-Health status (r=0.23018), family size (r=0.27792).

3-Total cultivated area (r=0.34078).

5. Sowing date (r=0.16584), harvesting time (r=0.14698).

5-Cultivation cost (r=0.25614), number of working daily hours (r=0.60744).

6-Labour cost (r=0.19002), annual income (r=0.24338), and farmer productivity (r=0.58796), and negatively correlated with number of lost seasons (r=-0.34403).

Fig (1) Food availability in the Gash area

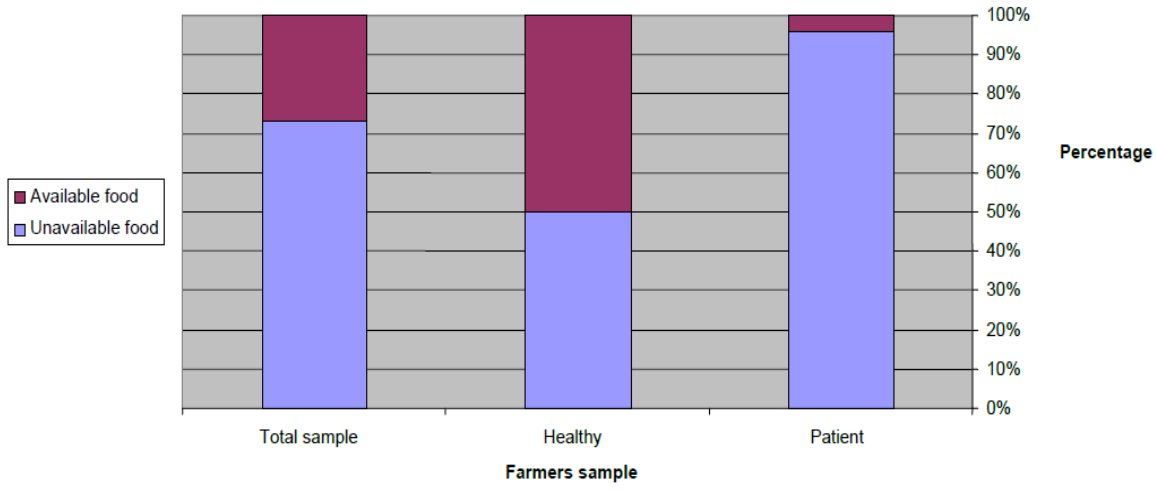
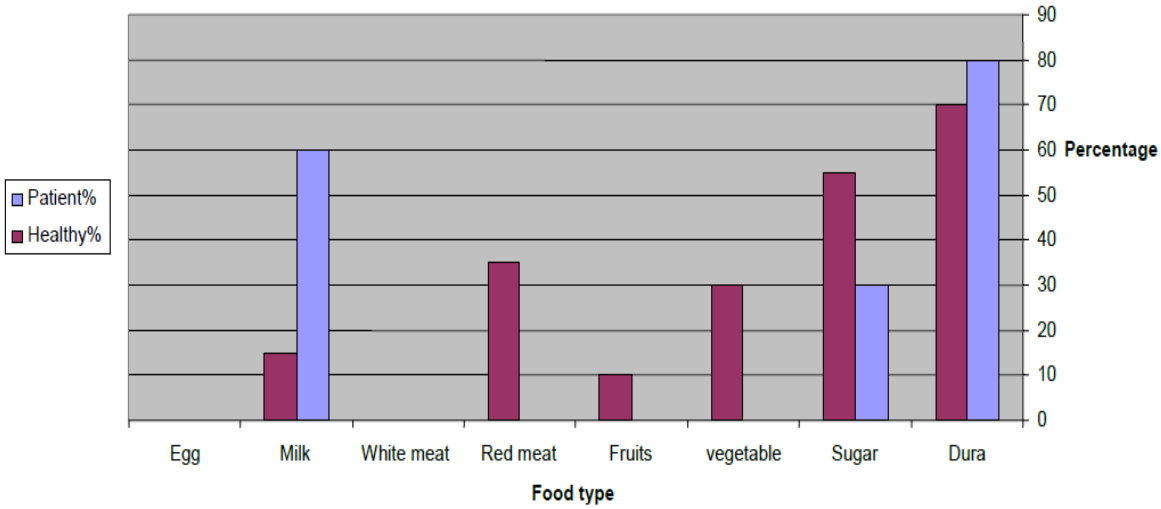


Fig (2) The distribution of the farmers with respect to daily diet in the Gash area



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IV. DISCUSSION

4 -1 The impact of TB on farmer's food security in the Gash area:

The study concluded that the negative impact of TB on food security in the Gash area comes from the finding, that TB negatively impacting the factors that were found to have strong positive and negative correlation with food security, which are:

1-Farmer's productivity: The reduction of farmer's productivity lead to unavailable food for family consumption and no income to purchase food, even so, no food will be secure for the coming time. Haddard and Gillespie, (2001) conducted that the impacts of TB on food security is through its effects on household productive capacity.

2- Harvesting time: TB delay harvesting time; it results in reducing household labour quality/productivity and quantity due to chronic illnesses which leads to poor crop yields due to untimely implementation of agronomic practices like planting and harvesting Haddard and Gillespie, (2001).

3-Sowing date: Sowing within the suitable time increases food security. The study found that 19% of infected farmers grown Sorghum off-suitable time, compared to only 3% of the healthyfarmers.

4-Total cultivated area: Increasing in total cultivated area increases food security. TB reducing area under cultivation by 2.96 feddan, which result in low yield, low income and hence food insecurity.

5-Health status: Good health status increases food security. TB worsening farmer health status, reducing farmer ability to work, farmer's productivity and income thereby causing food insecurity.

6-Educational level: High educational level increases food security. The negative impact of TB on food security can be discussed from the point that, due to TB morbidity the infected farmer cannot continue going to school which result in low level of education, low farmer's knowledge and innovation then low farmer,s productivity and low farmer's annual income, all of these factors cause food insecurity.

7-Number of working hours: Food security has a significant positive correlation with the number of working hours (r=0.60744). TB reducing number of working hours by 7.53 hours/day which reduces farmer's productivity by approximately 4.29sacks/feddan, and annual income by 882.5 (SDG.), thereby negatively impacting food security.

8-Labour cost: Food security has a significant positive correlation with the labour cost (r=0.19002. Increasing in labour cost increases food security, high labour cost indicates large cultivated area, high production, high income, and food security. Due to TB morbidity and income constrains the infected farmer can not hire labour for agricultural activities sometime he may neglects it, and reduces area under cultivation which decreases crop yield, and causes food insecurity.

9- Family size: Food security has a significant and strong positive correlation with the family size (r=0.27792), increasing in family size increases food security. The study found that large family size increases farmer's productivity and farmer's annual income thereby causes food security. Due to TB mortality and morbidity family size may negatively impacting farmer's productivity and farmer's annual income and thereby negatively impacting food security.

10-Cultivation cost: Food security has a significant and strong positive correlation with the cultivation cost (r=0.25614), increasing in cultivation cost increases food security. High cultivation cost indicates proper agricultural operations that result in high crop yield, high income and food security. Due to income constrains the infected farmer cannot hold all agricultural operations properly and timely this cause low crop yield, and again low income and food insecurity.

11-Marital status: Married farmers were in the case of food insecurity, married farmer with his family members means high food consumption, together with TB infection cause food insecurity.

12- Local marketing: Marketing of the crop locally increases food security by .001units. Local marketing restrict transportation cost and any other costs for marketing the crop externally thus supplements income and food security.

13- Age: Older farmer, due to his responsibilities tend to maintain his family members with enough food, he try to perform his field work to obtain high crop yield and income which leads to food security. TB weakened the farmer's ability to work, he cannot perform his work successfully, low crop yield, low income and food insecurity.

14- Number of lost seasons: Food security has a significant negative correlation with the number of lost seasons (r=-0.34403), loosing an agricultural season decreases food security, because it decreases crop yield and income. TB is the main causes of loosing agricultural seasons that causes food insecurity.

V. RECOMMENDATIONS

Understanding the extent to which TB is affecting farmer's food security is important for generating policy insight on how to minimize the impact of the epidemic by introducing mitigation strategies so as to increase farmer's food security in the Gash Delta.

A set of recommendations were generated which aimed to reduce TB infection and disease in the Gash delta, thereby improving farmer's food security:

1- Periodic test and prevention of the disease.

2- Isolation of the patient farmers with active disease, before starting effective anti-tuberculous therapy, so as to break the chain of transmission of the disease among the farmers.

3- Adequate TB control and management program is needed and integration into primary health care.

4- There is a need of health education to teach the farmers about TB disease and how to avoid its infection.

5- Nutritional programmes, to teach the Hadandwa women about the importance of the varieties of food and their processing. specially milk Pasteralization.

6- Re-habitation of health units in the different areas of the Gash delta and provide them with the required health services so as the infected farmers need not have to travel outside the area.

7- Aroma hospital should have to coordinate with the Gash delta agricultural scheme to play an effective role in reaching and looking after the patient farmers.

8- The Gash delta agricultural scheme management should have to seek a way for supporting the patient farmer's income.

9- Good ventilation of houses and avoid overcrowding as much as possible.

10- TB control programme in Kassala state should have nutrition- based intervention for the infected farmers.

11- The state government should have to compensate the infected farmers for the lost seasons.

12- Incorporate the international NGOs.

13- To make more studied on this subject by the researchers in the future.

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APPENDIX (A)

Variables	Secondary occupation	Educational level	Marital status	Health status	Family size	Total cultivated area	Sowing date	Harvesting time	Cultivation cost	Local marketing
Working hours	.08790	.35998	-.11862	.20445	.27615	.25884	.27112	.25938	.39302	-.03920
Lost seasons	-.12252	-.21088	-.00980	-.06622	-.16044	-.16682	-.23077	.23195	-.17866	.07584
Labour cost	-.0538	.18713	.02500	.00678	.04568	.52058	.10825	.10291	.03079	.03243
Annual income	.33043	.18641	-.03985	.24540	.22314	.12624	.09846	.08645	.06379	.03521
Annual expenditure	.10894	-.11015	.14916	.08641	.10902	.05047	.03283	-.03633	-.06896	-.08198
Price per unit of output	-.01678	.14838	-.03775	.04752	.02866	.15489	.68701	.57832	.33266	-.09821
Age	-.26827	-.18532	.18947	.40166	.52419	.03287	.04087	.04647	.17694	-.10308
Food security	.06131	.31320	-.02344	.23018	.27792	.34078	.16584	.14698	.25614	-.00700
External marketing	.10247	-.01055	-.11088	.17185	-.00039	-.02356	-.09192	-.06601	.14069	-.33109
Farmer's productivity	.7910	.32818	-.12539	.16216	.32594	.26255	.34119	.35346	.36886	.02419

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Appendix (1): Continue.

Variables	Working hours	Lost seasons	Labour cost	Annual income	Annual expenditure	Price per unit of output	Age	Food security	External marketing	Farmer's productivity
Working hours	1.0000									
Lost seasons	-.49861	1.0000								
Labour cost	.16181	-.10382	1.0000							
Annual income	.33274	-.22961	.13439	1.0000						
Annual expenditure	-.11243	.11819	.02704	.19273	1.0000					
Price per unit of output	.29182	-.16553	.09713	.14559	.05542	1.0000				
Age	.07504	.00406	-.03088	.11934	.11613	.07237	1.0000			
Food security	.60744	-.34403	.19002	.24338	-.11662	.09042	.09741	1.0000		
External marketing	.06764	-.07162	-.01284	.09054	.03137	.06441	.05870	-.07315	1.0000	
Farmer's productivity	.85575	-.45799	.15792	.38089	-.06015	.35135	.11347	.58796	.01474	1.0000

CRITICAL VALUE (1-tail, .05) = + or - .11668
CRITICAL VALUE (2-tail, .05) = +/- .13877
Source: Data from field survey (2006).