

Full Length Research Paper

Assessment of poverty and its outcomes on farmers in the subsistence scheme in the White Nile state of Sudan

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This study aims to examine poverty and its outcomes on farmers of six Subsistence Schemes (SS) in Sudan. Stratified random samples were drawn from SS. Subjective (sufficient income) and objective (calories intake, food) poverty lines were constructed. The subjective poverty line estimated about 72% to be below the poverty line compared to 83% below food poverty line, thus there is a wide spread of poverty among farmers. The main causes behind this were unfavorable economic policies, and the interference of politicians in technical aspects. Poverty is associated with diseases identified as related, infectious, and neglected and water related diseases.

Key words: Infectious, neglected, water related, poverty, economic policies, politics.

INTRODUCTION

The agricultural sector is the leading sector in the Sudan economy since it contributes 40% to GDP, employs 70% of the labor force and constitutes 90% to non-oil exports (CBS, 2011). Besides, it is the main source of inputs to the agro-based manufacturing sub-sector. Many factors led to the superiority of this sector; among them are the vast fertile land, abundant cheap labor, favorite weather condition and availability of water (Salah 2002).

Many macroeconomic policies were formulated since independence of Sudan in 1956, but the most influential were those announced in 1992 under a package called Liberalization of the Economy. Before February 1992, Subsistence Schemes (SS) located in central Sudan (Figure 1) were managed by the government which was providing water, pesticides, fertilizers, guidance and marketing of cotton worldwide. Net receipts of production were shared between the government and farmers. Liberalization policies (LP) transferred the management of schemes to a committee of farmers in each scheme. Generally, the LP led to a widespread of poverty in the country in particular rural areas, those under poverty line are estimated to be between 40 to 90% (Ali, 1992).

The main objective of the LP was to increase production by easing all governmental restrictions on the private sector via privatization policy. This policy transferred the technical and agricultural tasks to a committee of inexperienced farmers at subsistence schemes (Figure 1). Before the application of this policy, farmers were self-sufficient in their stable food, that is, sorghum, which was grown besides the main cash crop (cotton). Sorghum and vegetables were grown free of charge whereas cost was endured solely by cotton receipts. The government was responsible for the provision of water, technical advice and marketing of cotton. Net Cotton receipts were shared by the government and the farmers. After privatization of SS, management committees (MCs) were appointed and fully responsible for land preparation, provision of water, and crop composition. In theory, these committees were planned to be elected by the farmers but the government interferes and appoints persons pro to the ruling party who have little experience and low education levels.

This research aims to study the impact of liberalization policies on farmers in Subsistence Schemes in terms of



Figure 1. Figure (1) Location of Subsistence Schemes in Sudan (red color)

income, education, health, and food security and identifying causes of decrease and difficulties facing production in addition to the determination of the extent of poverty.

Ramadan (2007) tried to handle urban poverty in the Sudan to a reasonable level of detail. It dealt with selected areas with regard to promotion of sustainable

human settlement. He identified some recent progress in Sudanese human settlements, that is, however, still accompanied by numerous serious instances of decline in the urban environment, especially that of the greater Khartoum. Ali (2007) said that the empirical evidence on the impact of public policies on poverty can best be characterized as mixed. Rui (2006) investigated the

rationale for persistence, the determinants of farmer participation and performance in cotton and tobacco schemes, and the economy-wide effects of expansion and shocks in cotton and tobacco sectors on poverty reduction in concession areas of the Zambezi valley of Mozambique. He found that in both sectors, contract farming is an institutional response to widespread failure in input, credit and output markets. In addition, poverty reduction effects of the scheme, the absence of a functional public and market based service provision network expansion and shocks are sizable in both areas, more so in tobacco growing areas where economic linkages are stronger. CIA World Fact book (2004) estimated 40% of the Sudanese are below poverty line based on surveys of sub-groups, with the results weighted by the number of people in each group. Ali (2003) showed that Sudan should have annual rate of growth of 7% to achieve Millennium Development Goals (MDG) on poverty starting from 2001. Alternatively, per capita of 2.2 or 5% growth will take 28 years to achieve MDG. Human Development Report (1997) indicated that one quarter of the third world population live in poverty according to the human poverty index. The problem of poverty in developing countries involves hunger, diseases, unavailability of health services and safe drinking water. Ali (1992) shows that 40% of Arab children seem to have lived in absolute poverty over the period of 1991 to 2001, a performance worse than the average for the developing world. Sampath (1999) analyzed poverty in Sudan in 1967 to 1968 and 1978 to 1980 in rural and urban areas and in Khartoum and in the nation as a whole. He used a modified version of the Foster, Greer and Thorbecke (FGT) model to estimate the number of poor people and the severity of their poverty. The estimates showed that while the level of poverty increased, its severity decreased in 1978 to 1980 compared to 1967 to 1968. In addition, the level of poverty and its severity must have increased considerably in the 1980s. Ali (1992) studied the impact of Structural Adjustment Programs on the dispersion of poverty in the Sudan. He compared the following poverty measures: Head-count Index, The Income Gap Ratio Index, Clark – Hemming – Ulph, Poverty Gap Index, Standard Poverty Gap Index, and Foster-Greer-

where z is the poverty line, y is the income of the poor, and q is the number of the poor.

(3) Poverty Gap Index is the mean over the population of the proportionate poverty gap, where the poverty gap is given by the distance of the poor below the poverty line, as a proportion of the line. It can be looked at as the minimum “cost” of eliminating poverty using perfectly targeted transfers. It is bounded by 0 and Head Count Index:

Thorbecke for the years 1968, 1978, 1986, and 1993. Farah (1999) believes that poverty in the Sudan is deeply entrenched and is largely rural. Poverty particularly affects farmers who practice rainfed agriculture. It is more widespread and deeper in rural areas in southern Sudan and in areas affected by conflict, drought and famine.

METHODOLOGY

White Nile state of the Sudan lies between latitude 13, 30-12 North, and longitude 33-30-31 East. It accommodates subsistence schemes (SS) which were erected in 1934 as compensation to the owners of land flooded by the construction of Jabal Alawliya Dam. They are seven schemes irrigated by pumps and they include Abgar, Alsaada, Alhashaba, Umjar, Wakara, Iraik and Wad Nimir covering vast areas and homes to more than three thousand farmers. They used to produce cotton, wheat, sorghum and vegetables. Data were collected by questionnaire from selected stratified samples of farmers. Interviews and secondary data are other sources of information. Two lines were calculated: the subjective poverty line based on the answers of respondents’ sufficient income that sustain a family and objective line, and the Calorie Intake Approach based on the WHO Technical Note No 61, 1983 which introduced the calories needed daily for various age distribution activities. Five measures of poverty were calculated as follows:

(1) Head-count Index (H) measures the “extent” of poverty:

$$P_0 = H = \frac{q}{n}$$

where P_0 is the head count index, q is the number of people under the poverty line, and n is the sample size.

(2) The Income Gap Ratio Index measures the “depth” of poverty and defines how poor the poor are. It gives the amount of resources needed to bring all poor people to the poverty-line level as shown thus:

$$PG = \frac{\sum_{i=1}^q (z - y_i)}{z}$$

$$P = \frac{1}{n} \sum_{i=1}^q \frac{z - y_i}{z}$$

where z is the poverty line, y is the income of the poor, and q is the number of the poor.

(4) Watts Poverty Index yields a “meaningful” measure with appealing ordinal properties and a natural interpretation in terms of the potential for economic

growth to alleviate poverty. The index reflects the average number of “years” that it would take the population to exit poverty if it were possible to ensure that all incomes grow at rate g :

$$W = \frac{1}{n} \sum_{i=1}^q \log \left(\frac{z}{y_i} \right)$$

where z is the poverty line, y is the income of the poor, q is the number of the poor, and n is the sample size.

(5) Foster-Greer-Thorbecke (FGT) index is a generalized measure of poverty within an economy. It combines information on the extent of poverty (as measured by the Headcount ratio), the “intensity” of poverty (as measured by the Total Poverty Gap) and inequality among the poor (as measured by the Gini and the coefficient of variation for the poor). The formula for the FGT is given by:

$$P_3 = \frac{1}{n} \sum_{i=1}^q \left(1 - \frac{y_i}{z} \right)^\alpha$$

where z is the poverty line, y is the income of the poor, q is the number of the poor, n is the sample size and α is a “sensitivity” parameter if it is low then the FGT statistic weighs all the individuals with incomes below z roughly the same. If α is high, those with the lowest incomes

(farthest below z) are given more weight in the measure. The higher the FGT statistic, the more poverty there is in an economy. If α is 2, “Foster-Greer-Thorbecke” is abbreviated as FGT (2), or the Squared Poverty Gap Index measures the severity of poverty for each area. It is bounded by 0 and the Poverty Gap.

Population and the sample

The population is composed of farmers of the seven Subsistence Schemes and their families in the White Nile in the central Sudan. A sample of 35 farmers (5 from each scheme) was drawn twice from the seven schemes for two weeks to calculate the reliability of the questionnaire which was found reliable with a correlation coefficient of 0.92 between the paired samples. The total population is 2915, and 270 (which is about 9% of the total population) was the sample size. Stratified random sampling (proportional) was used to determine the sample size as follows:

$$n = \sum_{h=1}^7 n_h; n_h = \frac{n_1}{N_1} = \frac{n_2}{N_2} = \frac{n_L}{N_L} = \frac{n}{N} \text{ prop} = \frac{N \sum_h N_h S_h^2}{N^2 D + \sum_h N_h S_h^2}$$

where n is sample size, N is population, S is standard deviation, D is error. Subscript indicates class, that is, scheme.

Theoretical Background

Ravallion (1992) defined relative poverty as the state of deprivation defined by social standards. It is fixed by a contrast with others in the society who is not considered poor. It can be seen as lack of equal opportunities. It is based on subjective measures of poverty. Sen (1999: 47) defined poverty as “the deprivation of basic capabilities rather than merely lowness of incomes, but the perspective does not involve any denial that low income is one of the major causes of poverty since lack of income can be a principal reason for a person’s capability deprivation”. The World Bank defines poverty as the inability of people to attain a minimum standard of living. Ali (1992) defined child poverty as severe deprivation in two or more basic needs of food, water, sanitation facilities, health, shelter, education and information. Like all other quantitative approaches, the study of child poverty requires specifying thresholds for severe deprivation for each of the basic needs, on the basis of which observations are aggregated to arrive at the percentage of children under 18 years living in poverty. Hermez (2007) defined the problem of poverty, its correlations, its measurement methods and national and international strategies for combating it via high economic growth rates, the expansion of creating job opportunities and achieving full employment, and improving the income and living standards and limiting poverty and its consequence. Poverty is also defined in monetary terms as an insufficiency of income or monetary resources. Most indicators like the U.S. dollar a day indicator or national poverty lines are defined in those terms. Other characteristics of poverty commonly used in the literature include rural and urban poverty, extreme poverty (or destitution), female poverty (to indicate gender discrimination), and food-ratio poverty lines (with calorie-income elasticities). Other indices such as the FGT (Foster, Greer, and Thorbecke) or the Sen Index, which combine both dimensions of incidence and depth of poverty, are also widely used. The type of poverty experienced by individuals will therefore differ for different rates and levels of biodiversity and ecosystem services loss and if the loss is transitory or permanent.

Poverty is associated with diseases identified as related, infectious, and neglected and water related diseases. Poverty-related diseases (PRDs) are the major cause as well as the consequence of considerable poverty in Developing Countries (DCs), particularly in Sub-Saharan Africa. The burden of PRDs, especially HIV/AIDS, malaria and tuberculosis (TB) is mostly borne by the poorest countries, which are facing a fundamental health crisis (EEC 2002). Infectious diseases, also known

as transmissible diseases or communicable diseases comprise clinically evident illness (that is, characteristic medical signs and/or symptoms of disease) resulting from the infection, presence and growth of pathogenic biological agents in an individual host organism. Neglected tropical diseases survive and thrive on poverty. They concentrate in places with unsafe water, poor sanitation and limited access to basic health services. They affect the poorest people, often living in remote, rural areas, urban slums, conflict zones or areas of natural disaster. Sub-Saharan Africa faces the biggest burden, but over 100 countries are affected across Africa, Asia and Latin America. Many neglected tropical diseases can severely limit an individual's ability to work, generate income, or care for their families (Claire, 2009).

Waterborne disease is reserved largely for infections that predominantly are transmitted through contact with or consumption of infected water. "Malaria" is the most predominant water-related disease just because mosquitoes have aquatic phases in their life cycle. It is a mosquito-borne infectious disease of humans and other animals, causing symptoms that typically include fever and headache, in severe cases progressing to coma or death. It is widespread in tropical and subtropical regions, including much of Sub-Saharan Africa, Asia, and the Americas. "Diarrhea" occurs world-wide and causes 4% of all deaths and 5% of health loss to disability. It is most commonly caused by gastrointestinal infections which kill around 2.2 million people globally each year, mostly children in developing countries. Contaminated water is an important cause of diarrhea. Cholera and dysentery cause severe sometimes life threatening forms of diarrhea. "Hepatitis" is any disease featuring inflammation of the liver. Two of the viruses that cause hepatitis (hepatitis A and E) can be transmitted through water, food and from person to person. Hygiene is therefore important in their control. "Malnutrition" has long been recognized as a consequence of poverty. It is widely accepted that higher rates of malnutrition will be found in areas with chronic widespread poverty. Malnutrition is the result of marginal dietary intake compounded by infection. In turn, marginal dietary intake is caused by household food insecurity, lack of clean water, lack of knowledge on good sanitation, and lack of alternative sources of income. It is also compounded by, inadequate care, gender inequality, poor health services, and poor environment. While income is not the total sum of people's lives, health status as reflected by level of malnutrition is.

The incidence of poverty is most prevalent among those dependent on the major agricultural crops. The outcome of these policies was spread of poverty among farmers' families. Research shows that children who grow up in poverty can be more vulnerable to some forms of maltreatment, particularly neglect and physical abuse. They also have an increased risk of adverse experiences

and negative outcomes, both in the short and long term (NSPCC, 2008). The poor suffered and landlessness became more severe. Some farmers having their land and migrate for work heading for the biggest cities in particular the big cities, adding to the rural poor. Casual workers face more difficulties in finding new jobs when the current one is terminated. Thus the proliferation of urban poor is an impact of government policies (Perla, 1997).

As regards poverty and education, while those children living in absolute poverty cannot afford basic education, those in relative poverty are forced to dropout half way into their elementary or middle schooling. There may be many reasons for dropout, ranging from inability to pay fees for further education to shouldering family responsibilities (Ron, 1993).

Poor children suffer higher incidences of adverse health, developmental, and other outcomes than nonpoor children (annex 5). The specific dimensions of the well-being of children and youths considered in some detail in this article include: (1) physical health (low birth weight, growth stunting, and lead poisoning), (2) cognitive ability (intelligence, verbal ability, and achievement test scores), (3) school achievement (years of schooling, high school completion), (4) emotional and behavioral outcomes, and (5) teenage out-of-wedlock childbearing (Jeanne, 1997).

Gordon et al. (2003) displayed Bristol's Deprivation Indicators: (1) Access to food, (2) access to clean water, (3) access to sanitation facilities, (4) access to healthcare service, (5) access to shelter, (6) access to formal education, and (7) access to information.

EMPIRICAL RESULTS

Data were collected from six schemes. The total number of farmers population was 2915 a sample of 294 was selected that is about 10% of the population (annex 1).

Table 1 displays the causes of reduction of sorghum and cotton output. The selection of the inappropriate varieties and crop composition, and insufficient amount of fertilizers and pesticides which can be labeled mismanagement were the main cause of reduction of production (Schemes' failure). Insufficient water supply was another cause due to the failure of management committees to repair pumps and rehabilitate canals and even to operate pumps in a proper way.

Poverty indicators

Families having a family size of five and six people compose 22 and 60% respectively with average family size of six persons. In order to calculate the poverty line based on sufficient income, only 250 questionnaires were used because the other 20 did not answered the question of the amount of sufficient income for their livelihood so the poverty line was found to be 881 Sudanese Pound

Table 1. Causes of reduction of production percentages.

Scheme	What to grow? (%)	Irrigation (%)	Mismanagement (%)	All Three (%)	Others (%)
Umjar	6	10	3	7	1
Wakara	4	4	1	3	0
Iraik	1	1	0	2	1
Wad Nimir	5	1	3	3	0
Alhashaba	3	4	5	1	1
Abgar	10	1	3	12	3
Total	30	22	13	28	7

Source: Researcher's own calculation.

Table 2. Poor per poverty measure.

Scheme	Sufficient Income	Percent	Calorie Intake	Percent
Umjar	48	26	67	30
Wakara	17	9	24	11
Iraik	6	3	9	4
Wad Nimir	22	12	25	11
Alhashaba	31	17	31	14
Abgar	60	33	64	29
Total	184	100	220	100

Source: Researcher's own calculation.

Table 3. Foster-Greer-Thorbecke.

Umjar	Wakara	Iraik	Wad Nimir	Alhashaba	Abgar
0.045	0.012	0.009	0.019	0.016	0.266

Source: Researcher's own calculation.

Table 4. Families without Sufficient Food and Animals.

Lack of	Umjar (%)	Wakara (%)	Iraik (%)	Wad Nimir (%)	Alhashaba (%)	Abgar (%)	Total (%)
Food	39.2	30	36	87.1	49	69	55
Animals	39	55	23	62	50	74	51

Source: Researcher's own calculation.

(LS). Using Head count index of 72% is below this line. Poverty Line based on Calories Intake Approach is 2393 calories calculated on the basis of WHO Technical Note, 83% were below this line according to Head count index. Table 2 shows the number of poor in each scheme. Iraik has the lowest rank followed by Wakara and the highest rank was for Abgar. The Income Gap Ratio Index shows that the average amount of resources needed to bring all poor people to the poverty-line level is 386 Sudanese Pounds.

Poverty Gap Index which gives the minimum cost of eliminating poverty using perfectly targeted transfers is

0.315. The Watts index provided a growth rate of 0.204. Accordingly, the number of years required to bring a poor with the lowest income to the poverty line is 11 years.

Table 2 presents the number and percentage of poor in the six schemes; Umjar and Abgar accommodate the highest poor, while Iraik has the lowest (annex 2 and 3).

Foster-Greer-Thorbecke is 0.165 for the six schemes jointly and for each scheme as shown in Table 3. FGT measure indicated that the intensity of poverty was highest in Abgar, while Iraik was the lowest due to remittances from abroad and the Capital.

Table 4 shows that there is an association between

Table 5. Number and Percentage of Poor.

	Malaria	Bilharzias	Diarrhea	Inflammation	Malnutrition	Malaria, Inflammation	Others
Poor	77	51	8	14	128	1	31
%	42	28	4	8	84	0.5	17

Source: Researcher's own calculation.

lack of food and animal, thus the estimated correlation result is proven by the table, which shows that correlation of food and animals = 0.657; P-Value = 0.10.

Spread of poverty increased the infection by diseases specifically malnutrition, malaria, and bilharzias. The ratios of population infected by malaria and bilharzias are 42 and 28% respectively and 84% of children suffered from malnutrition as seen in Table 5.

DISCUSSION

Empirical evidences above show the spread of poverty among the farmers of SS and Bristol's Deprivation

Indicators are realized. The consequences of poverty are reflected mainly by the ratio of child malnutrition. Sharp decrease of cultivated and harvested area of the main cash crop is due to delays in land preparation, inappropriate crop composition, and insufficient water supply resulting in a decrease in farmers' income and the situation was aggravated by lack of other job opportunities, and lack of animal wealth. The production of sorghum (stable food) was affected adversely by the decisions of MCs in terms of paid cost of water and delays in land preparation and insufficient water supply.

Decrease of food production and the rising cost of production, associated with decrease in incomes led to the lack of food and animal for more than half of the farmers in addition to the risk of deforestation and desertification specifically in the northern schemes, that is, Iraik, Abgar, Wad Nimir and Alsaada, taking into account that farmers' family is characterized by its large size. Hence, children are more vulnerable to some forms of maltreatment, particularly neglect and physical abuse in addition to an increased risk of adverse experiences and negative outcomes, both in the short and long term. It is clear that a considerable portion of the farmers are infected by malaria, bilharzias, diarrhea, and inflammation, respectively. This is due to favorable environmental conditions for the growth of mosquitoes, bilharzias parasites, whereas weeds impede natural flow of water through canals creating the ideal environment (annex 4 and 6). People and their animals used to drink from these canals. The decisions taken by the committees to reduce areas assigned to growing cotton caused spread of malaria whereas air spray of pesticides on cotton kills mosquitoes. Moreover, most people lack WC because they cannot afford constructing them, so

they use latrines or uncovered areas. This practice leads to growth of flies, in addition to interaction of latrines with shallow well causing diarrhea. Thus people infections are indirectly through other factors such as insufficient income, large family size, water sources, and total return. Moreover, there are also insufficient numbers of health entities.

The spread of poverty encouraged some farmers – in particular those in the northern part of White Nile state - to migrate for work heading for the biggest cities in particular the Capital city Khartoum, adding to the numbers of the urban poor there. Most migrants are young people who are forced to dropout half way from their basic or secondary schooling. Casual workers faced more difficulties in finding new jobs when the current one is terminated also when they migrated to big cities.

Conclusion

Subsistence schemes typically depict the picture of developing countries mentioned in the previous studies and theoretical background. The incidence of poverty is most prevalent among farmers. Macroeconomic policies were the main cause of production decrease and spread of poverty. Poverty was associated with diseases identified as related, infectious, and neglected and water related diseases, poor sanitation conditions, as well as migration to big cities.

It is recommended that to review Liberalization policies, experienced management should be appointed to help choose the right crop package, animals should be integrated in agriculture rotation, and small scale projects dependent on the inputs of subsistence schemes should be created. Those below the poverty line are: 72 and 83.3% according to sufficient income and food deficiency respectively, accompanied with the spread of diseases. Malnutrition infected 84% of poor children, while malaria and bilharzias infected 42 and 28% respectively. It is recommended that the economic and agricultural policies that led to the deterioration of these schemes should be reconsidered and the food and environmental concepts should be improved upon.

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Annex 1. Selected sample

Scheme	Farmers	Sample
Umjar	734	74
Wakara	272	28
Iraik	162	16
Wad Nimir	260	26
Alhashaba	556	56
Abgar	931	94
Total	2915	294

Annex 2. Required Calories and Protein.

Age and Sex	Kilocalorie	Protein /Gram
Children Males and Females 0 - 9	1550	18.8
Males 10 -19	2857	35.0
Females 10 -19	2383	30.0
Male Adults 20+	3000	37.6
Female Adults 20+	2200	29
Average	2393	30

Source: WHO Technical Note no .61, 1983.

Annex 3. Calories intake.

Meal	Food	Quantity	Kilocalorie	Total
Morning Tea	Milk	30	6.715	22
	Sugar	15	3.604	54
	Tea	2	-	-
Breakfast	Loaf	150	2.530	380
	Broad Beans	150	0.740	111
	Audible Oil	5	8.840	44
Diner	Cooking	200	0.780	156
	Loaf	100	2.530	253
	Kisra	400	1.800	720
	Umrigaiga	200	0.020	120
	Green Salad	154	0.220	34
	Sugar	15	3.604	54
	Tea	1	-	-
Supper	Loaf	150	2.530	380
	Broad Beans	150	0.740	111
	Audible Oil	5	8.000	44
Total		1737		2487

Source: Nur (1992).

Annex 4. Water-related diseases.

Disease/Water Source	Pipes	Shallow Well	Nile	Deep Well	Canal	Total
Malaria	27	21	18	27	25	118
Bilharzias	19	11	6	7	27	70
Diarrhea	3	4	1	1	4	13
Inflammation	1	1	1	5	12	20
Night Blindness	1	1		1	1	4
Others	-	10	1	16	15	42
Malaria + bilharzias + Inflammation	-	-	1	-	-	1
Malaria + Inflammation	-	-	-	1	-	1
Total	51	48	28	58	84	269
Ratio	19%	18%	10%	22%	31%	-

Annex 5. Malnutrition among poor and non-poor children.

Number	Non-poor	Poor	Count/Ratio
1	24 16.2%	124 83.8%	148 100.0%
2	1 50.0%	1 50.0%	2 100.0%
3	0 0	3 100.0%	3 100.0%
Total	25 16.3%	128 83.7%	153 100.0%

Annex 6. Disease infections according to food poverty line.

Disease	Non-Poor	Poor	Count/Ratio
Malaria	21 18.6%	92 81.4%	113 100.0%
Bilharzias	14 20.0%	56 80.0%	70 100.0%
Diarrhea	2 15.4%	11 84.6%	13 100.0%
Inflammation	6 30%	14 70%	20 100.0%
Night Blindness	0 -	1 100%	1 100.0%