

The Impact of Social Factors of Rural Households on Livestock Production and Rural Household Income in White Nile State of Sudan

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Abstract

Livestock is not only an important source of food and income, but also the sign of assets in rural areas for poor people. In order to estimate how social-economic factors influence livestock production and income with the help of empirical model, the authors use the data collected from 360 household samples selected from 24 villages of 6 localities in White Nile State of Sudan. The result found that weight of animal feed and labor-cost have significantly influenced the total livestock production and income trend in the study area. Furthermore, social factors (gender, age, education level and off-farm activities of household head; family labor, family size and number of children) have been confirmed to influence livestock production or income at different levels. Finally, based on the results of this study, it is strongly suggested that stakeholders should look forward to the livestock production system in rural White Nile State to have clear strategies and good policies.

Key words: *livestock, socio-economic factors, empirical model, rural household, White Nile State of Sudan*

1. Introduction

Livestock plays an important role in Sudanese Economics. According to the report from FAO/WFP (2010), Agriculture production constitutes the backbone of Sudan's economy in terms of its contribution to GDP. Agriculture represents 45% of GDP in 2005, among which, 20% is from livestock production. Sudan owns about 135 million heads of livestock, according to 2006 inventory data, which is the second largest livestock population in Africa next to Ethiopia (MAR, 2008). Livestock form an essential

component of the agriculture sector which provides employment and household income in rural areas.

Livestock is considered as an indispensable source of income for small producers in White Nile State, which is in the central part of Sudan before its separation in 2009. Musa et al. (2005) reported that the rural Sudan communities own 80% of the livestock. According to reported information from FAO (2011) that White Nile State accommodates about 6% of Sudan's livestock wealth and ranks fourth in the total livestock numbers and livestock

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density per square kilometer (7.1 TLU/ km²) among the 15 states in Sudan.

Livestock distribution depends on ecological diversity of the State. Traditionally, huge animals (including Camel, Cow, sheep and goat) lived in dry weather there. According to the annual report of Ministry of Agriculture, Forestry, Animal Wealth and Irrigation, White Nile State of Sudan (MAFAWI, 2012), most of livestock are sheep and goats, accounting for 59%, while the cattle accounts for about 41%, there are fewer camels, no more than 0.4%. The residents in rural areas feed animals not only for food, such as milk, eggs and meat, but also for income by marketing. Furthermore, rural people like to have more animal as a sign of wealth (Pica-Ciamarra et al., 2011; Elzaki et al., 2010).

Livestock production system in White Nile State like other parts of Sudan is influenced by many social patterns, and through the survey it is observed that some rural households heads are agro-pastoralist and others are transhumant pastoralist and often small ruminant livestock like goats and sheep are followed by children or women which feed in open graze lands; cows are monitored by the males of household who are over 18 years old. Whereas, livestock production is actually managed by the head of the household (Elzaki et al., 2010) reported that households in the Nile State community consist of large compound houses 95% headed by male and 5% of the household are headed by female. About 55.7% of household heads have not received any education. The family size of livestock producers in rural areas is 8 persons and 63% of them have no secondary career.

The Baseline survey for livestock production by MAFAWI, (2010), mentioned that the productivity of livestock is low due to several factors; breeding, livestock nutrition and poor quality (often overgrazed) pasture lands, health and husbandry management, but it can be improved with good management in more favorable conditions. Regarding livestock production FAO (1991), reported that livestock production in the developing countries is influenced by the quality of pasture land, even the fertility of soil with species of weeds, crop standing and crop residues generally contribute to livestock production and is considered a source of animal feed.

In previous studies, there was more focus on the role of livestock production. Animal productions can result in reducing the poverty level; it also could provide animal traction and manure (Elzaki et al., 2010). Though Pica-Ciamarra et al. (2011) studied the livestock role in the asset and income for rural households in 12 developing countries, Sudan is not included in this study. In contrast, Elzak et al., (2011) investigated animal producers (most of them are nomadic without education and land), the research concentrated on estimating the importance of livestock production on food security in the White Nile State. Anyway, the rural residents' issues are not mentioned exactly. More specifically, this paper aims: (1) to investigate the livestock asset possession of rural households in White Nile State of Sudan. (2) To find out different ways of how households can manage their own livestock production through some socio-economic aspects. (3) To study the role that livestock can play in increasing the household's income in rural area of White Nile State of Sudan.

2. Data and Sampling

Data Collection and Sampling Techniques

Both primary and secondary data were collected from White Nile State of Sudan using the National Baseline Household Survey (NBHS) conducted in 2009. During the survey, we selected 24 villages from all 6 localities (Kosti, Ed-Dueim, El-Jebelean, Rabak, Alssalam and Tendelti) in White Nile State. Structured questionnaire based primary data was collected from a total of 360 randomly selected households. In each of the villages, sampling was done with the help of local authorities. List of all households in a village was taken as a sampling frame during assignment of primary data source (PDS). From the list, the starting point was chosen at random using lottery technique. First, in every locality, we listed all village names in alphabetical order, and give each one numeric code; then choose sample villages at random. In the same way, for each selected village, we listed all household in the list, and given every household a code; and then chose the sample by lottery for 15 times. The reason that we use this method is nearly the same situation among the households, for example, the animal type, the

income source, and ...etc. The selected samples information is listed in Table 1 as the following.

Table 1

The sample distribution in each locality of White Nile State, Sudan

Locality	Number of villages	Samples	Percentage (%)
Kosti	6	90	25
Alssalam	3	45	13
Tendelti	4	60	17
ED-Dueim	6	90	25
El-Jebelean	3	45	13
Rabak	2	30	8
Total	24	360	100

Data Source: the data collected by the author's survey.
Note: Kosti samples (include Guli area) and ED-Dueim samples (include um-rimtta & Alquiteina areas), that because these localities have the features widely area densely populated for that we selected more samples to represent these areas.

3. Analysis and Discussion

White Nile and Livestock Overview

White Nile State has strategic location, it lies in the South of North Sudan, (Latitude: 13° 16' 27" N and Longitude: 32° 26' 59" E), population of the state is estimated at 1.73 millions of inhabitants (NBHS, 2009), about 2/3 of them live in rural area (Central Bureau of Statistics, Kosti, White Nile state, 2009).

The potential of White Nile area for grazing is varied from one area to another, and mostly dependant on the availability of vegetation and water, and the area is free of insects and diseases. Livestock of various types form an integral traditional part of the lives of most of the farmers in the study area. The estimated livestock in White Nile state is approximately 8 million heads, which are concentrated in the water accessible areas of western and eastern parts of the state. Cattle constitute the significant animal wealth in further southern parts, whereas camels in the north and sheep and goats in central rain lands are considered as a secondary source of income (FAO/WFP, 2009). The livestock raised in the rural area are mainly cows, sheep and goats, with very few

camels. Most of the livestock in the region, whether raised by settled or nomadic folks, subsist mainly on natural grazing and to some extent on crop residues. The introduction of ombaz (oil cake) and molasses (sugar cane residues) are recent phenomena in rural areas which is located close to big cities, to supplement dry fodder in dry seasons and drought periods.

Through interviews with all respondents in the survey it is summarized that for the rural households, livestock and its production is considered an important source of protein, for example, chicken provides meat and egg, and goat, sheep and cow are mostly considered as sources of milk. It is observed that a high percentage of households were coping by keeping small ruminant stocks in order to avoid losses of animals by recurrent droughts in the study area. Most communities interviewed suggest an improvement in veterinary services, provision of animals for vulnerable households and in pasture composition in the study area, which will improve their livelihoods thereby increasing their goods livestock beside their income from livestock.

Household Income Source

To survive under disadvantageous conditions in the study area, rural households tend to diversify their income sources between farm and non-farm activities, and between family-owned enterprises and wage labor. In Table 3 the surveyed area show the main activities of the household's income in numbers (360) of the respondent household and the total percentage by locality considering the household activities as in livestock, agriculture, "forest" activities: like wood selling and charcoal selling, some rural households are "GE" Government Employee or have "Busen" private business and some have "Oth" other income source for example, slaughter and butcher, some work in private companies and so on. It was found that 83% of households depend on agricultural activity as main their income source and the second one is the livestock activity which represent 32% of the household income source in the study area, beside 25% of others income sources for the household income. Whereas 17% of respondent household are government employee dependent on wage and salary as an income, other income sources are forest labor 3% (their livelihood depends on selling

wood or charcoal) and 9% household depend on private business.

Household and Livestock Asset

According to the Ministry of Agriculture, Forestry, Animal Wealth and Irrigation, Kosti, White Nile State, Sudan Annual Report (2012), the average animal holdings of a rural household in White Nile State are 2 heads of cows, 8 heads of Goats, 1 head of sheep and 1 head of Camel. The present study show that the average number of rural family members in White Nile State is estimated to be 6.9 persons per one family, furthermore, the land ownership of the resource utilization is estimated in average as 11.9 feddan owned by one household, in addition, the survey indicate that livestock rearing is one of rural income generating activities in the rural areas in White Nile State. We used function [1] to get the average of the livestock asset as below:

$$\text{Asset}_{\text{livestock}} = f((\text{stkl} + \text{stkt})/2) \quad [1]$$

Where “stkl” is the stock of livestock in last year and the “stkt” is the stock of livestock in this year; due to the above function the survey revealed that about 20 % of households own cows, 29.7% owns chicken and almost 50% own shoats. The problem is that usually there are more animals in each locality, and more than one kind of animals in one household. The question was how to get a way to compare the livestock scale gap from these localities? FAO (1999) have provided a convenient method for quantifying a wide range of different livestock types and sizes in a standardized manner. Here the unit is defined as one Tropical Livestock Unity (TLU) as animal asset, 1 TLU is approximately 250 kg here such as in the function [2].

$$\text{TLU} = \frac{\text{sheep}}{1} = \frac{\text{goat}}{1} = \frac{\text{cow}}{0.125} = \frac{1}{11.4} * \text{chicken} \quad [2]$$

After summarizing, 6 localities' livestock assets are taken in Table 2 where the STDEV (standard deviation, $(S=\text{Sqrt}(S^2))$, mu (MEAN) (average value) and C.V (coefficient of variation, (S/mu)) is calculated, as show the dispersion of livestock among these 6 localities. From Table 2, the

variation of different livestock asset is considerable using TLUs comparison between localities in the following:

- (1) From the MR (Maximum Rang= MAXIMUM - MINIMUM) of livestock, the average gap of goat and cow size per household among localities is less, while the size of sheep or chicken is more.
- (2) From the TLUs, household livestock assets are different among localities, where, Tendelti has 7.9 TLUs in lowest level, El-Jebelean has 27.5 TLUs in highest level.
- (3) From the CV, goats and cows have lower dispersion than sheep and chicken among localities.

As in Table 3 the result show that on the average a household owns 2.7%goats and 1.6% cows respectively, for all surveyed area. While the average per household ownership of sheep and chicken 1.4% and 9.3%, respectively. That is due to the distribution of livestock in study area where it is observed that livestock is concentrated in areas where there is water, grazing land and vegetation, these are mainly areas of western and eastern parts of White Nile State. It is due to the contribution of that livestock makes to the income of rural families that they get a strong desire to keep livestock. in addition livestock provides a wide range of other benefits such as, Family income source, Food Diversification, ostentatious power (owning folk of cattle), organic manure for land cultivation, source of some social services and social capital for example, Savings and Insurance etc.

Household Characteristic and Livestock Income

Generally, livestock is considered the second source of farmer income in White Nile State (Table 3). Cows, sheep, goats and chicken constitute the animal wealth in the area. It is supposed that household characteristics, such as heads' age, gender, education, and so on, would influence livestock production and income. So the groups arranged on related characters are listed in Table 4. From the group by the age of household head, it is found that the household with old heads tend to get more income from grazing animals (sheep, goat and cow), but less from chicken.

Table 2

The main activities of the household's income in the surveyed area in White Nile State

Locality	Samples	Agri.	Livestock	Forest.	GE.	Busen.	Oth.
Kosti	90	73	15	3	19	-	15
Alssalam	45	44	13	1	3	1	14
Tendelti	60	60	13	1	8	5	12
ED-Duem	90	57	32	2	21	14	30
El-Jebelean	45	36	16	2	7	5	12
Rabak	30	30	26	-	4	7	6
Total	360	300	115	9	62	32	89
Percentage	100%	83%	32%	3%	17%	9%	25%

Data Source: the data collected by the author's survey.

Table 3

Household size, land area and livestock assets in each locality of White Nile State

Locality	Size	Area	Goat	Sheep	Cow	Chicken	TLUs
Asslam	7.2	17.8	1.3	0.0	1.7	8.6	15.7
ED-Dueim	6	9.4	3.4	0.8	2.2	0.5	22.0
El-Jebelean	6.7	9.3	3.8	4.7	2.3	4.1	27.5
Kosti	7.5	10	3.3	0.6	1.0	11.0	13.1
Rabak	9	11.5	2.3	1.4	1.7	20.5	18.6
Tendelti	6.4	16.2	2.3	1.1	0.4	11.3	7.9
MR	3	8.5	2.5	4.7	1.9	20	19.6
mean	7.1	12.4	2.7	1.4	1.6	9.3	17.5
stev	1.1	3.7	0.9	1.7	0.7	6.9	6.9
cv	0.1	0.3	0.3	1.2	0.5	0.7	0.4

Data Source: the data collected by the author's survey

Read the material: get to know the concept: (1) MEAN; (2) STDEV-stand deviation; (3) CV=STDEV/MEAN (4)

MR, <http://apacgemba7.wikidot.com/statistics:variance-standard-deviation-and-coefficient>

The education levels has been descript as: less education is in the level "1", no more than 4 years education in school is defined as level "2", over 8 year education is in level "3", level "4" is no more than 11 year official education; and level "5" is 15 years education. The mode of household head education is calculated, the mode is 1. Here the edu_w is defined as education level, and education is divided into 2 groups: one is illiteracy with less education, defining edu_w as the value "0", while the other group includes all kind of official education, defining edu_w as "1". From Table 4, we found that there is less difference between income from chicken, goats and sheep, excluding cows.

In viewing the family headship gender it was found that only "50" of household heads are female in the total of surveyed 360 samples; compared with male household heads, they have less income from ruminant animals except chicken. The situation is nearly the same for both the trained group and untrained group, but there is less gap of income from sheep. In case of household head marital status it is observed that 25 of 360 surveyed samples are single (unmarried) household head and they have high total income from sheep and chicken. On the other hand, married household heads have higher total income from cows in surveyed area.

Table 4

Socio-economic factors and livestock income of rural HHs in White Nile State, (income in SGD)

The groups	sub_group	No. of Obs	tin_ch~k	tin_goat	tin_sh~p	tin_cow
age	<50	179	173.2	538.0	143.9	1323.4
	=>50	181	141.0	895.2	212.6	2231.9
edu_w	0	161	164.3	724.5	172.6	2856.7
	1	198	151.9	698.5	184.1	913.8
gend	0	50	321.8	426.2	34.3	183.4
	1	310	130.4	764.6	201.7	2037.7
trained	0	157	258.3	546.2	185.6	1728.3
	1	203	78.6	850.2	172.9	1820.4
marital	0	25	235.6	472.8	253.1	200.5
	1	335	151.1	735.9	172.9	1898.1
Ability	0	64	256.4	761.7	117.4	2511.4
	1	296	135.5	708.1	191.6	1622.1
Off-farm	0(no salary)	48	164.9	642.4	219.4	326.2
	1(salary)	312	155.8	729.2	172.1	2003.9
home living	<=6	71	193.7	441.7	149.4	420.9
	>6	289	148.0	785.4	185.6	2114.2
workout	<=6	330	156.7	718.3	189.6	1884.3
	>6	30	160.4	709.9	55.2	635.6
size_hh	<7	171	126.3	757.2	176.8	1831.0
	>=7	189	184.8	681.8	179.9	1734.2
size_labor	<4	194	116.5	632.2	123.5	1350.2
	>=4	166	204.3	817.5	242.6	2282.7
size_child	<=2	194	147.6	846.2	227.3	2222.6
	>2	166	168.0	567.4	121.4	1263.2

Data Source: the data collected by the author's survey

Variable- group; Factors: e-s; 2 kinds –dummy (01).

Note: in the off-farm (0; farm job “it means that the income of household comes from agricultural activities” and !=0 off- farm job; “it means that the income of household comes from non agricultural activities”).

Obs; Observations

In the category ability to job “Ability” household heads’ ability to do other jobs beside breeding livestock is explained, it was found that 296 respondent of 360 surveyed samples have the ability to do other jobs, especially those who has lower total income from chicken and cows, on the other hand, the income from goats and sheep almost the same. Typically, the existing categories, of household head education, work out and ability to do jobs- relating to off farm job; here it is found that the farm job out (no salary) of resided village has minor difference. More total income is from chicken, and less total income from goats and cows and high total income from sheep, compared to the

farmer who has farm job (salary) in his/her resided village.

On the other hand, data is set into two categories, one is home living recognized as (“<=6” (6months and less) and “>6” (more than 6 months)) to explain the impact of staying of household heads in the village on total income from livestock, it was found that the household heads who stayed home for 6 months or less earn lower total income from all the livestock except from chicken and sheep where he/she get minor difference in income. Compared to the second group (“workout” working out of village); the same categories is taken in home living, it is found that total income

from chicken and goats has minor difference, compared to high total income from sheep and cows for the household head category who stays home for 6 months and less.

Household size characters are arranged in groups as in “size_hh,” size_labor “and “size_child” according to the size of family, number of children and number of labor respectively, income from all kinds of livestock have minor difference except goats, where it was found that the family with more than 7 persons has higher total income. On other hand, it was found the size of labor with less than 4 persons in family have lower earnings from all livestock. Moreover, it was found that the number of children in a family has minor difference in income from chicken, high total income from goat and sheep, and higher income from cows in group “size_child” 2 persons and less.

Milk Production, Good's Livestock and Livestock Income

Livestock is considered as an important source of income for the rural household in White Nile State (Table 3). Milk is widely used as food for different levels of household in rural areas, even those who have no livestock. The ruminant animals and poultry constitute the animal wealth in the study area. As a result, it seems that most households prefer rearing livestock as investments to improve the chances of economic security and an added advantage is that they provide nutritional benefits (milk and meat). According to the annual report (MAFAWI, 2012), the average livestock holdings of a rural household in White Nile State are 2 heads of cows, 8 heads of goats, 1 head of sheep. Whereas productivity of the livestock in terms of milk production per day: cows give 8.9kg for a total of 7 months and sheep and goats gives 1.3kg per day for a total of 6 months. Table 5 shows the analysis of different models incorporating binary information into regressions using household livestock production (goat, sheep, cow and chicken) and their trade income when the animal sell in market. Some of the independent social variables like gender, trained, marital status, home living (homel) and (Abilityj) ability to job are single dummy explanatory variable. Estimation of the regression function [3]. 10 functions are listed in Table 5; Functions 1-3 explain the relationship between milk output and the household characters.

Just following the MAFWI report (2012), milk is separated into 3 groups: group of (goat and sheep), cow group and mixed group (including goat, sheep and cow). The reason that milk group is separated is that it could not be identified which kind of animal produce milk. Anyway, the total annual output from household survey and animal structure is already known.

4. Milk and Egg

Milk output is related to the livestock size, feed and labor fee, but it is also important to identify how the characteristic of household head and family number characteristic, such as, the size of family, labors or children influence milk output. So the empirical concept model in the following function is:

$$\text{output}_{\text{milk/egg}} = a_0 + \beta_1 * w_{\text{feed}} + \beta_2 * \text{cost_labor} + \sum_{k=1}^9 (\gamma_k * f_{\text{soceco}_k}) + \mu \quad [3]$$

So the independent variables are defined as same as in Models (M1-M3), the estimation of the results are summarized in Table 5. Where “stkl” is the number of livestock that the household raise and owned at the end of the previous year as asset; “w_feed” is the weight of animal feeding; “c_labor” is the labor fee to take care of the animal. Others are social factors related to the household demography, for example, “gend” indicates the gender of head household male or female; “age” is the real age of the household head; “edu” is the educational level of the household head; “trained” indicates whether the household obtained small training program for example, the program build the capacity of small farmers and traditional producers in rural area for livestock mentioned as (Para Vets; it mean “Veterinary Assistant”); “workout” explain the period of household working out of his village; “size_labor_hh” explains the number of household members above 18 years old and less than 60 years old (legal working age); “size_child_hh” is explaining the number of children in household less than 18 years old.

M1-M3 is the models about milk. From the results in Table 5, milk production per kg is directly and significantly influenced by livestock, feed using and labor cost.

Table 5

The socio-economic factors influence milk/egg production, goods livestock and trend income of livestock

Milk	M1 Goat&sheep		M2 goat,sheep&cow		M3 cow		Egg	M4 poultry	
	Coef.	t	Coef.	t	Coef.	t		Coef.	t
Stkl	0.6324	2.78*	0.9918	3.12**	186.8754	6.87***		0.0137	0.18
w_feed	0.5881	3.28**	0.4118	2.01*	0.4637	2.21*		0.1091	1.76*
cost_labor	3.4695	3.64**	-0.4772	-2.09*	-103.6017	-3.24***		omitted	
Age	3.8748	3.28**	-0.0112	-2.01*	-31.3650	-2.00*		0.1529	0.86
Edu	0.6280	0.03	0.5833	0.76	-288.1609	-1.42		1.0475	0.44
Gend	151.5512	2.28*	7.0669	4.87	-910.5022	-1.16		4.8357	0.84
Trained	0.0136	0.05	0.4382	0.93	478.0635	1		-1.3686	-0.26
workout	-0.0256	-0.73	-0.0431	-2.24*	-22.4331	-0.32		-0.6431	-0.95
size_hh	-3.8093	-0.43	-0.1728	-0.81	153.3621	0.77		0.7597	0.35
size_labor	-0.0066	-0.06	0.0036	0.01	-148.3873	-0.75		1.9212	0.78
size_child	-0.0064	-0.07	0.2427	1.1	-33.1449	-0.18		0.7709	0.38
_cons	3.2171	3.63**	7.7468	7.10***	3520.2720	2.49*		-4.7950	-0.42
	Number of obs = 77		Number of obs = 23		Number of obs = 38			Number of obs = 80	
	F (6, 71) = 45.95		F (7, 16) = 278.96		F (11, 26) = 9.66			F (10, 69) = 2.05	
	Prob > F = 0.0000		Prob > F = 0.0000		Prob > F = 0.0000			Prob > F = 0.0412	
	R-squared = 0.7952		R-squared = 0.9919		R-squared = 0.2288			R-squared = 0.8033	
	Adj R-squared= 0.7779		Adj R-squared = 0.9883		Adj R-squared = 0.1170			Adj R-squared= 0.72	

Income	M5 Goat&sheep		M6 Goat,sheep&cow		M7 cow	
	Coef.	t	Coef.	t	Coef.	t
number sale	1.1755	3.93**	0.4566	3.61*	0.7067	3.11**
age	0.0280	2.14*	0.0091	0.37	0.0255	2.14*
edu	0.4543	2.94	-0.2994	-3.95**	0.3104	2.19*
gend	0.2913	0.4	1.6510	2.57*	1.9916	3.21**
trained	-1.2097	-3.06**	0.1549	0.46	-0.9141	-2.09*
Homeliving	0.1209	2.43*	0.0185	0.62	0.2267	3.31
Job-ability	0.4690	1.83*	-0.4031	-1.94	1.2854	2.77**
size_hh	0.1221	1.58	-0.0576	-1.91*	0.0705	0.85
size_labor	-0.0047	-0.08	0.0626	0.85	-0.0264	-0.28
_cons	4.3382	6.00**	5.2357	5.64	6.8958	14.21
	Number of obs = 25		Number of obs = 13		Number of obs =42	
	F (8, 17) = 188.43		F (5, 7) = 33.93		F (8, 34) = 386.04	
	Prob > F = 0.0000		Prob > F = 0.0001		Prob > F = 0.0000	
	R-squared = 0.9888		R-squared = 0.9604		R-squared = 0.9891	
	Adj R-squared = 0.9836		Adj R-squared = 0.9321		Adj R-squared = 0.986	

Trend income	M8 Goat&sheep		M9 Goat,sheep&cow		M10 cow	
	Coef.	t	Coef.	t	Coef.	t
cost_feed	-0.0518	-1.21*	0.2711	5.88***	1.0078	6.12***
cost_labor	10.5749	9.69***	17.7782	8.82***	2.1901	1.27*
age	47.3546	3.02**	-5.0435	-0.19	-0.7016	-0.06
edu	209.2027	1.07*	51.4505	0.22	-249.6541	-1.99*
gend	-347.5363	-0.59	-953.8982	-1.48	249.3756	0.59
trained	-687.5044	-1.49*	308.1262	0.55	645.7113	2.05*
Homeliving	16.8638	0.26	-7.1635	-0.11	0.1176	0
Job-Ability	1460.3550	2.35*	715.5131	0.87	-40.7237	-0.11
size_hh	-149.3302	-1.86*	294.3745	2.33*	1.9198	0.03
size_labor	-36.7905	-0.27	-139.9919	-0.84	20.8013	0.25
_cons	-2212.1940	-2.49	-934.0408	-0.57	313.2302	0.36
	Number of obs = 74		Number of obs = 54		Number of obs =115	
	F (11, 62) = 10.78		F (11, 42) = 25.72		F (10, 104) = 8.18	
	Prob > F = 0.0000		Prob > F = 0.0000		Prob > F = 0.0000	
	Adj R-squared = 0.5957		R-squared = 0.8707		R-squared = 0.4403	
	R-squared = 0.6566		Adj R-squared = 0.8369		Adj R-squared = 0.3865	

Note: *--statistically significant at 10%; **-- statistically significant at 5%; ***-- statistically significant at 1%

Normally, cost of labor has positive relationship with the milk output, but in this area, the situation is different, for that the cost of labor is more, which means that these animals would go out for grazing more, and walk more, so they have to waste more energy on the road, especially cows. This influences milk output. That is why the model with cow has negative coefficient to the variable “cost_labor” in M2 and M3.

In the models, the characters of household head include age, edu, gend, trained and Workout. According the authors’ knowledge, older population in rural area likes goats or sheep more than cows, but younger persons like milk-cow more. That is why the coefficient of “Age” is negative in M2 and M3 (Table 5). However, the household head characters (edu, gend and trained) lost the significant except “gend” gender in M1 that is due to the communities’ habits; women prefer to follow and care goats and sheep in the family. For the family characteristic (size_hh, size_labor, size_child), it was found that milk production from M1, M2 and M3 has negative relationship to the milk output that means that the family characteristics’ role have not been mentioned in milk output in the study area.

In the model M4, egg production and poultry keeping in the rural areas of the White Nile State is one of the most ancient households activity practiced in both transhumant and in settled life areas, usually the family keeps a different number of chickens from local breeds, around the homestead and non distinct system of poultry is followed. The chickens are kept freely around the compound and using the same shelter with the family, this is why labor fee was omitted because in the study area no household employ labor for the rearing of chicken. The model explains that weight of feed has significant effect on egg production at level 10%.

Income from Good’s Livestock

In the models M5, M6 and M7, function [4] is used to estimate the relationship between rural household goods income and the social –eco factors as seen in the function below:

$$\text{goods' income} = a_0 + \beta_1 * \text{number sale} + \sum_{k=1}^8 (\gamma_k * f_{\text{soceco}_k}) + \mu \quad [4]$$

Where a_0 is constant item, the social and economic factors (variable f_{soceco}) include the following: age, edu, gend, trained, home living, job-ability, size_hh, size_labor, Their estimated parameters are denoted as $\beta_1, \beta_2, \gamma_k$ ($k=1,2,\dots,8$), “ μ ” is the error term.

In models (M5, M6 and M7) in Table 5 economic variables such as, the number of livestock sold, and social factors are used to estimate household income, (here, income includes the cash income traded in the market and expenditure for meat supplied by their own livestock, the expenditure is equal to the weight of meat multiplied by market-price) from the livestock: in (M5), number of sale animal, age, trained, homel, and ability to job are significant to the income from selling goats and sheep. On the other hand, it is found that education is significant to livestock sale in models where there are 3 kinds of livestock and cows in (M6 and M7), where it is indicated that farmers rearing only cows have better chances of increasing their income with higher education level, on the contrary it has negative impact on selling for the M6. As for the trained farmers, we found there is a level of significance; training has a negative coefficient to M5 and M7. That is due to the social habits and the cultural life of rural communities in the study area, it is observed that rural household are more proud of possessing different kinds of animals, mainly those which are leaders of rural communities this is in agreement with Tarig M. (2002) where he mentioned, Livestock is considered as a means of "savings" throughout the rural household in all parts of Sudan, and more specifically for the farms families, this is consistent with the recently earned livestock, especially goats and sheep. During hard times, goats will be the last of assets to be sold and sheep are more susceptible to be fattened and sold in the market earlier. In addition (Alary et al., 2011; Moll, 2005; Moll et al., 2007), mentioned that, livestock contribute to household activities through different ways, some are direct and other's are indirect. Direct way is that livestock can provide cash income or income in kind through the sale of animals like small ruminant animals. And the indirect way is that, livestock can represent a format of savings (capital growth through flock growth), insurance, and sale of animals provides immediate cash to deal with nonfarm expenses for example, education fee, medical fees and so on.

Trends Income

In the models M8, M9 and M10, we used the function [5] to estimate the relationship between rural household trend income and social –eco factors. The specific function is as following:

$$\text{trend income} = a_0 + \beta_1 * w_feed + \beta_2 * \text{cost_labor} + \sum_{k=1}^8 (\gamma_k * f_soceco_k) + \mu \quad [5]$$

Where a_0 is constant item, the social and economic factors (variable f_soceco) include the following: age, edu, gend, trained, home living, abilityj, size_hh, size_labor, Their estimated parameters are denoted as $\beta_1, \beta_2, \gamma_k$ ($k=1,2,\dots,8$), “ μ ” is the error term.

For the household trend income authors tried to get the household total income from the trade livestock in the market, expenditure for meat produced by them and the livestock asset (stock changed). Above in Table 5, models M8, M9 and M10 researchers used “cost_feed” the cost of livestock feed and “cost_labor” cost of labor fee as independent economic variables in addition to the social factors mentioned before, so the result indicates that the household raising three kinds of livestock M9 have strong significance to cost of feed (cost_feed) and cost of labor (cost_labor) on trend income, in a way that more livestock feed and more employee labors follow rearing livestock get positive coefficient to increase a household’s total income to support their real needs, this is in agreement with Elzak et al. (2011), where they suggest that the income of livestock producers is used as it is a good indicator of the relative purchasing power of people to buy food and have access to other resources.

The household characteristics (age, edu, gend, trained, home living, abilityj) influence the family total income in rural study area, for that it is found that household head age is significant and has strong and positive impact on M8. For the household knowledge criteria through education and training level, it was found that education is significant in the models (M8 and M10) indicating that farmers rearing just cows have better chances of increasing their income with higher education, on the other hand, household head’s level of training is significant in model M10 and has positive impact.. In the study area normally women and younger family member are biased to rearing

smaller animals like goats as in models M8 and M9 which has negative impact on family trend income, whereas, men prefer to rear animals like cows which have higher price and increase family income, for that model M10 has positive impact. For the household head “home living” has negative impact in model M9, ability to job has positive impact and is statistically significant in model M8. It is observed that household head living in the village and not concentrating in breeding livestock have small chance to increase family trend income.

Also we found that family structures for example, “size_hh” size of family is significant in (M8 and M9), and has negative coefficient in (M8) and influence the household total income, in contrast, in M9 size of family plays an important role in increasing family’s total income, which means that it is directly proportional to family size, as in study area it is found that families and their relatives have close relationship, for this reason M9 has positive influence on family trend income. Size of labor has negative coefficient and has no significant influence on household trend income, that's due to the habits of household who prefer the family members to follow and care for their animals. This outcome of the study may give an idea about how household economics can help in many ways to own some technologies for rural household breeders’ livestock to changing their life for the better where generally it is agreed with (Sansoucy et al., 1995) in discussion groups, they mentioned Sale livestock and their products directly provide income to farmers. Livestock is the Bank of Living for many farmers and play a great role in the process of agricultural intensification by providing energy manure project for the production of fertilizers and fuel. It is also closely linked to the social and cultural lives of millions of resource-poor farmers whose animal ownership ensures varying degrees of sustainable agriculture and economic stability.

6. Conclusions and Recommendations

According to our survey of all the six localities of White Nile State, our findings support that ruminant livestock are of considerable economic importance in rural White Nile State of Sudan and it plays an important role for rural household which could be crucial to sustaining rural live-

lihood. In general, livestock provide saving and insurance for the rural households and provide an important source of farm income to the rural household in White Nile State. Cows, sheep and goats represent the rural animal wealth in the study area, beside milk and eggs production provide food and are a source of income generation.

There is also a significant positive correlation between social factors of the household and livestock economy in the study area. On the other hand, there are great opportunities for using livestock mainly, Livestock Production in rural White Nile State. Finally, the author strongly recommended looking forward to the Systems of Livestock Production in rural White Nile State through some strategies and good policies which can change the habit of rearing and keeping livestock not just for ostentatious purposes but to increase household income through trend income, so that it can provide more considerable chances for rural households to improve their livelihoods and increase their income in addition to improving their nutritional situation.

Recommendations

Accordance to our survey we can strongly suggest that:

- Looking forward to the Systems of Livestock Production in rural White Nile State through some Strategies and good policies can change the habit of rearing livestock just for ostentatious reasons, so that it can provide more considerable chances for the rural household to improve their livelihoods and

increase their income in addition to meeting their nutritional needs.

- Consider the education systems in the rural areas in White Nile State through participation of local people, in particular vulnerable areas to increase resilience of present food production systems and to support climate change adaptation, mitigation and technology development, transfer and dissemination.
- Considerable participation of local people in the planning process is important. Much greater attention should be paid to the attitudes, aspirations, perceptions, and socio-economic priorities of rural households.

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Reference

- Alary, V., Corniaux, C. and Gautier, D. (2011), "Livestock's Contribution to Poverty Alleviation: How to Measure It?", *World Development*, Vol. 39.2011, 9, p. 1638-1648
- Elzaki, R.M., Ahmed S. E.H.A., Elbushra, A.A., (2010), *Impact of Livestock Biodiversity in Poverty Reduction and Welfare Change in Rural Sudan*, Social Science Research Network/ Social Science Electronic Publishing, Inc
- Elzak, R.M., Elbushra, A.A., Ahmed, S.E.H. and Mubarak, A.M. (2011), "The role of livestock production on food security in Sudan: Rural White Nile State". *Online Journal of Animal and Feed Research*, Vol. 1(6), pp. 439-443
- FAO (1991), Animal Production and Health Paper; Application of biotechnology to nutrition of animals in developing countries, Agriculture and consumer protection: <http://www.fao.org/DOCREP/004/T0423E/T0423E00.HTM>; Job number T0423, ISSN, 0254-6019, 1991
- FAO (1999), Tropical Livestock Units (TLUs), <http://www.fao.org/ag/againfo/programmes/en/lead/toolbox/Mixed1/TLU.htm>

- FAO (2011), Analysis of 2010 State Level Baseline Household Survey; Food Security Technical Secretariat / Ministry of Agriculture (FSTS) FAO- Sudan Integrated Food Security Information for Action (SIFSIA), www.fao.org/sudanfoodsecurity/en
- FAO/WFP (2009/2010), Assessment mission report, Crop production and food security assessment for the northern states of the Sudan, report has been prepared by Ian Robinson with material and information from FAO-SIFSIA-N, FAO-ERCU SUDAN, Planning and Agricultural Economics Administration, MoAF-Khartoum, MoAs in the 15 northern states of Sudan, WFPVAM Khartoum and nutrition summaries from UNICEF-Sudan. Other original data and field summaries from Assessment Mission team leaders, and original market, and RFE/ NDVI analyses prepared by FAO-SIFSIA-N and FAO-ERCU. February 07, 2010.
- MAR (2008), Animal Census, Ministry of Animal Resources, Khartoum, Sudan
- Moll, H.A.J. (2005), "Costs and benefits of livestock systems and the role of market and nonmarket relationships" *Agricultural Economics*, Vol. 32(2), pp. 181-193
- Moll, H.A.J., Staal, S. and Ibrahim, M.N.M. (2007), "Smallholder dairy production and markets: A comparison of production systems in Zambia, Kenya and Sri Lanka", *Agricultural Systems*, Vol. 94(2), pp. 593-603
- MAFAWI (2010), Ministry of Agriculture, Forestry, Animal Wealth and Irrigation, Kosti, White Nile State, Sudan. Baseline Survey on livestock and fishery production, White Nile State of Sudan
- MAFAWI (2012), Ministry of Agriculture, Forestry, Animal Wealth and Irrigation, Kosti, White Nile State, Sudan. Annual Report
- Musa, L.-A.; Ahmed, M.K. A.; Peters, K J.; Zumbach, B. and Gubartalla K E. A. (2005), The reproductive and milk performance merit of Butana cattle in Sudan. Humboldt-Universität zu Berlin, Institute of Animal Sciences, Department of Animal Breeding in the Tropics and Subtropics, Germany
- NBHS (2009), Sudan National Baseline Household Survey, North Sudan - Tabulation Report. Sudan Central Bureau of Statistics, Kosti department, White Nile state, Khartoum, Sudan
- Pica-Ciamarra, U., Tasciotti, L., Otte, J. and Zezza, (2011), A. FAO-ESA Working Paper No. 11-17, 2011, Livestock assets, livestock income and rural households' Cross-country evidence from household surveys. (www.fao.org/economic/esa)
- Sansoucy, R., M. A. Jabbar, S. Ehui and H. Fitzhugh (1995), Keynote paper: The contribution of livestock to food security and sustainable development, in: *Livestock Development Strategies for Low Income Countries*, FAO/ILRI, Rome/Nairobi
- Tarig, M., Gibreel (2002), "The Impact of Commercialization on Household Food Crops Production in Western Sudan Dryland Agriculture", *Thesis* Submitted to the School of Graduate Studies of Addis Ababa University in Partial Fulfillment of the Requirements for the Degree of Master of Science in economics.

Appendix

Abbreviations:

Busen	Private Business
CBS	Central Bureau of Statistics
CV	Coefficient of Variation
EA	Enumeration area
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
GE	Government Employee
HHs	Households
SDG	Sudanese Gineih (Pound)
STDEV	Standard Deviation
MAFAWI	Ministry of Agriculture, Forestry, Animal Wealth & Irrigation
MAR	Ministry of Animal Resources
MR	Maximum Range
Mu	Mean
NBHS	National Baseline Household Survey
WFP	World Food Programme
PDS	Primary Data Source
TLUs	Tropical Livestock Units
Obs	Observations

Currency Equivalents:

Currency unit	=	Sudanese Gineih (SDG)
U\$ 1.00	=	SDG 4.45
SDG 1.00	=	U\$ 0.22

Weights and Measures:

1 kilogram (kg)	=	2.204 pounds (lb)
1000 kg	=	1 metric tonne (t)
1 kilometer (km)	=	0.62 miles (mi)
1 meter (m)	=	1.09 yards (yd)
1 square meter (m ²)	=	10.76 square feet (ft ²)
1 acre (ac)	=	0.405 ha
1 hectare (ha)	=	2.47 acres
1 feddan (fd)	=	0.42 ha = 1.03 acre