RESSOURCE
PROJECT
SWM Sahelian Wetlands Site

Sudan
The socio-economic importance of wetlands in the Khor Abu Habil alluvial fan for agriculture, livestock, hunting and fishing
Internal Consultancy Report

Prepared by:
Dr. Hassan Abdelnabi Allajabu and Dr. Mubarak Ali Ibrahim

Date: April 2021

RESSOURCE PROJECT

Millions of people depend on the major Sahelian wetlands to meet their food and financial needs. These ecosystems are home to a multitude of waterbirds – migratory and resident – and provide essential livelihoods and services to local communities.

However, climate change, water and agricultural developments, and the intensive exploitation of the natural resources are contributing to the degradation and disappearance of the wetlands. The resulting dramatic changes in habitats have a major impact on the waterbird populations in the Sahel, and the impacts of hunting have yet to be assessed. These populations have already declined by 40 percent between 1960 and 2000. If the waterbirds were to disappear from this region, many rural communities would be deprived of an important source of protein.

Restoring and preserving the wetlands is a way to ensure the sustainability of the use of the services and the resources that they provide, in particular waterbirds, for the many rural populations that depend on them. In five countries in the Sahel and the Nile Valley (Chad, Egypt, Mali, Senegal and Sudan), the RESSOURCE Project "*Strengthening expertise in sub-Saharan Africa on birds and their rational use for communities and their environment*", in collaboration with the national authorities and local communities, aims to:
- preserve the ecosystems of major Sahelian wetlands;
- improve knowledge on waterbird populations and on harvesting by hunting;
- develop innovative solutions for the sustainable management and exploitation of wetlands and waterbird populations.

DISCLAIMER

About Authors

Dr. Hassan Abdelnabi Allajabu
Associate Professor of Agric. Extension
& Rural Development
College of Animal Production
Sudan University of Science and
Technology
SUDAN

Dr. Mubarak Ali Ibrahim
Assistant Professor of Natural
Resources and environmental Studies
Ministry of Animal Resources &
Fisheries & Wildlife.
Wild Research Centre
SUDAN

ACKNOWLEDGEMENT

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ACCRONYMS

CAHWs	Community Animal Health Workers
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FFEM	French Facility for Global Environnent (Fonds Français pour l'Environnement Mondial)
HHs	Households
IFAD	International Fund for Agricultural Development
KII	Key Informant Interview
MOPER	Ministry of Production and Economic Resources
NKS	North Kordufan State
RESSOURCE	Renforcement d'Expertise au Sud du Sahara sur les Oiseaux et leur Utilisation Rationnelle en faveur des Communautés et de leur Environnement. (in English: Strengthening expertise in sub-Saharan Africa on birds and their rational use for communities and their environment).
SDG	Sudanese Pound (Currency, 1 USD ≈ 406 SDG)
SWMP	Sustainable Wildlife Management Programme / Programme de Gestion Durable de la Faune Sauvage
UoK	University of Kordufan
USD	United States Dollar
WCGA	Wildlife Conservation General Administration (of Sudan)
WNS	White Nile State

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EXECUTIVE SUMMARY

The present study was designed to evaluate the socio-economic importance of the wetlands of the Khor Abu Habil alluvial fan for agriculture, livestock, hunting and fishing purposes. It was conducted in 72 villages representing the area of Khor Abu Habil. Four respondents and one village Sheikh from each village were selected to represent the four activities under study. A questionnaire was designed to collect the primary data, while the secondary data were obtained from the relevant sources by filling out a form of annotated bibliography. The study findings revealed that the inhabitants depend mainly on Khor Abu Habil as a source of livelihood spending 62% of their work time in activities related to Khor Abu Habil alluvial fan. In addition, the study revealed that the average total income gained from the different activities under study is relatively high, *i.e.*, the highest annual households (HHs) income obtained from the fishing activities was around SDG 1,524,062 (around 3,700 USD), followed by livestock breeding earning SDG 1,446,361 (around 3,500 USD), whereas farming and bird-hunting activities scored the third and fourth levels respectively. The study reported the presence of a large number of Mayas (seasonal water ponds) used for the four activities under study, *i.e.*, 316 mayas were used for livestock breeding, 312 for bird hunting, 272 for farming and 223 for fishing.

The HHs members participation rates in the four activities differ from one activity to another, the highest rate recorded was among the farmers' HHs members with 58.2% participation; the second highest rate was among the livestock herders' HHs with 22.5% participation; the third and fourth highest rates were among the fishermen and hunters' HHs with 8.8% and 2.1% participation respectively. The study findings indicated that the vast majority of Khor Abu Habil inhabitants including the livestock herders are settled in their villages for most of the year. The vast majority of Khor Abu Habil inhabitants produce their own food for self-subsistence.

The study indicated nine species of waterbirds as the most hunted species in Khor Abu Habil area namely: White-faced Whistling Duck, Fulvous Whistling Duck, Knob-billed (Comb) Duck, Garganey, White Stork, Northern Shoveler, Sacred Ibis, Glossy Ibis and Ruff. The average number of individual waterbird harvested each year from all the nine species is about 54.8 birds. 98% of hunters reported that they hunted the birds from mayas while 1.7% & 0.3% from Nile River and uphill forest respectively. 2.4 is the average number of hunting months reported during the year. 1.3 days per week is the average number of days during which the hunters eat the hunted birds. 8.6% of hunters community, mainly youth participated in the hunting activities. All hunters respondents confirmed performing other livelihoods activities besides hunting, *e.g.*, 94.8% of them were engaged in farming; 10% of hunted birds were sold for income sources as well as for home consumption, while 90% of birds were hunted for entertainment, leisure and hobby.

The study noticed the scarcity of large wild mammals in Khor Abu Habil areas. They would have disappeared many years ago due to frequent drought years.

The study proposed the following recommendations:
1. Conduct further studies on hydrological aspects, impact of climate change on biodiversity & ecosystems structure of Kho Abu Habil.
2. Assess the impact of the four project activities *(Agriculture, Livestock, Hunting and Fishing)* on household food security.
3. Recommend Khor Abu Habil area to be designated under the Ramsar convention as an internationally important wetland area for promoting the conservation and sustainable use of wetlands' resources.

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RESUME EXECUTIF

La présente étude a été conduite en vue d'évaluer l'importance socio-économique des zones humides du delta intérieur du Khor Abu Habil au Soudan pour les secteurs de l'agriculture, l'élevage, la chasse et la pêche. Elle a été menée dans 72 villages représentatifs la zone du Khor Abu Habil. Quatre répondants et un Sheikh de village ont été sélectionnés dans chaque village pour caractériser les quatre activités étudiées. Un questionnaire a été conçu pour recueillir les données primaires, tandis que les données secondaires ont été obtenues à partir des sources pertinentes en remplissant un formulaire de bibliographie annotée.

Les résultats de l'étude ont révélé que les habitants dépendent fortement du Khor Abu Habil pour leurs sources de revenus, y consacrant 62% de leur temps de travail. En outre, l'étude a révélé que le revenu total moyen obtenu à partir des différentes activités étudiées est relativement élevé. Le revenu annuel par ménage le plus élevé obtenu à partir des activités de pêche était d'environ SDG 1.524.062 (environ 3.700 USD), suivi par l'élevage de bétail gagnant SDG 1.446.361 (environ 3.500 USD), tandis que les activités agricoles et de chasse aux oiseaux arrivent en troisième et quatrième position respectivement. L'étude rapporte l'existence d'un grand nombre de mayas (plans d'eau saisonniers) utilisées pour les quatre activités étudiées : 316 mayas étaient utilisées pour l'élevage, 312 pour la chasse aux oiseaux, 272 pour l'agriculture et 223 pour la pêche.

Les taux de participation des membres des ménages aux quatre activités diffèrent d'une activité à l'autre, le taux le plus élevé a été enregistré parmi les membres des ménages d'agriculteurs avec 58,2% de participation ; le deuxième taux le plus élevé a été enregistré parmi les membres des ménages d'éleveurs avec 22,5% de participation ; les troisième et quatrième taux les plus élevés ont été enregistrés parmi les membres des ménages de pêcheurs et de chasseurs avec 8,8% et 2,1% de participation respectivement. Les résultats de l'étude indiquent que la grande majorité des habitants de Khor Abu Habil, y compris les éleveurs de bétail, sont installés dans leurs villages pendant la majeure partie de l'année.

La grande majorité des habitants de Khor Abu Habil produisent leur propre nourriture et sont autosubsistants.

L'étude a indiqué neuf espèces d'oiseaux d'eau comme étant les espèces les plus fréquemment prélevées dans la zone de Khor Abu Habil, à savoir : Le dendrocygne veuf, le dendrocygne fauve, le canard à bosse, la sarcelle d'été, la cigogne blanche, le canard souchet, l'ibis sacré, l'ibis falcinelle et le combattant varié. Le nombre moyen d'oiseaux d'eau prélevés chaque année pour l'ensemble des neuf espèces est d'environ 54,8 oiseaux. 98 % des chasseurs déclarent chasser les oiseaux dans les mayas, tandis que 1,7 % et 0,3 % d'entre eux chassent respectivement sur les rives du Nil ou dans les collines. 2,4 est le nombre moyen de mois de chasse déclarés au cours de l'année. 1,3 jour par semaine est le nombre moyen de jours pendant lesquels les chasseurs mangent les oiseaux chassés. 8,6 % de la communauté des chasseurs, principalement des jeunes, ont participé aux activités de chasse. Tous les chasseurs interrogés ont confirmé qu'ils pratiquaient d'autres activités de subsistance que la chasse, par exemple, 94,8 % d'entre eux étaient engagés dans l'agriculture ; 10 % des oiseaux chassés étaient vendus comme source de revenus ainsi que pour la consommation domestique, tandis que 90 % des oiseaux étaient chassés pour le divertissement, en loisir ou hobby.

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L'étude rapporté également la rareté des grands mammifères sauvages dans la zone du Khor Abu Habil. Ils auraient disparu il y a de nombreuses années, en raison des années de sécheresse successives.

L'étude a proposé les recommandations suivantes :

1. Mener des études supplémentaires sur les aspects hydrologiques, l'impact du changement climatique sur la biodiversité et la structure des écosystèmes de Kho Abu Habil.

2. Évaluer l'impact des quatre activités étudiées (agriculture, élevage, chasse et pêche) sur la sécurité alimentaire des ménages.

3. Recommander que la région de Khor Abu Habil soit désignée au titre de la convention de Ramsar comme une zone humide d'importance internationale pour promouvoir la conservation et l'utilisation durable des ressources naturelles des zones humides.

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I   INTRODUCTION

The Khor Abu Habil is one of the longest intermittent stream in Sudan. It originates from the central part of the Nuba Mountains. The weathered zone of the basement rocks and the Wadi fill sediments are the principal water bearing formation for Khor Abu Habil. The river runs through three states, South Kordofan, North Kordofan and White Nile States, and pours some years into White Nile River at AL-Tabarat village (South Um-Jar town). In South Kordofan State, Khor Abu Habil runs fast in deep level and does not make Mayas "It's intermittent water gathering places (water ponds) which the Khor's water catches and stays for a period of time, (may be prolonged or shortened), in some areas stays until the Khor flows back, these water uses for the four activities under studied ", while in North Kordofan & White Nile States it runs slowly and spreads over a wide area for long distance and makes Mayas of big size that last for long time before they dry up and evaporate.

Khor Abu Habil in North Kordofan State is located between Al-Rahad and Wad Ashana towns (between latitudes 12° 15' and 12° 30' North and 29° 45' to 31° 45' East) (IFAD 2005). While in White Nile State, the river flows northward between 12° 15' and 13° 00' North and 30° 30' and 31° 15' East.

Khor Abu Habil is flooded every year between July and October crossing a distance of 150 km with a total discharge of 140 million cubic meters per year. It has a wide alluvial Delta with heavy clay deposits (Ahmed *et al*. 2016). Khor Abu Habil covers an area of 26,792 km² (Mohammed 2010). See

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Annex 4: Map of the Khor Abu Habil area.

Heavy clay soil is the dominant soil type at the bed and flood plain of Khor Abu Habil. Rains fall from June to October with average intensity between 500 mm near the source at Dilling town to 400 mm downstream near Tandelti (Ibrahim, 2010). The Khor Abu Habil population density is relatively high with about 63.8 persons per km² compared to average density of 15.9 persons for the country and 13.6 persons for North Kordofan and 8.9 persons for South Kordofan (IFAD, Sudan Office, 2005 & www.worldmeter.info, 2021).

II   OBJECTIVES AND PURPOSE OF THE STUDY

The main objective of the study is to evaluate the socio-economic importance of the wetlands of the Khor Abu Habil alluvial fan for Agriculture, Livestock, Hunting and Fishing. The specific objectives are:

1. To estimate the total annual income gained from these activities.
2. To estimate the number of inhabitants engaged in the activities under study.
3. To identify the benefits gained from the activities investigated.
4. To determine the number and usage of "Mayas" (water ponds).
5. To determine the challenges facing the inhabitants during engaging in the above activities.
6. To evaluate the presence of large wild mammals at present and in the past.
7. To create a value chain analysis for the studied activities.

III   THE STUDY METHODOLOGY

III.1   Study population

The study population is a subset of the target population from which the sample is actually selected (Bickman & Rog, 1998). This study targeted the residents around Khor Abu Habil whose livelihoods are dependent to some extend on the Khor Abu Habil natural resources.

The fieldwork was conducted between 5 February to 19 March 2021 with 55 working days (37 days for field survey and data revision & 18 days for data analysis and reporting) during which the filling of questionnaires was completed through conducting face-to-face interviews to collect the primary data. The study area was divided into squares (10X10 km^2), the total number of squares is 70, and hence the study area is 7,000 km^2. In each square one village is selected to represent the specific square (see map attached in annexes).

The consultants selected a village Sheikh as a Key Informant and a field guide for all (70) villages to help in identifying and guiding the team to reach the sampled villages and to facilitate dialogue during face-to-face interviews, especially with hunters.

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III.2   Sampling and sample size

Firstly: The purposive sampling method was adopted to select the 70 villages, been the villages in close proximity to "mayas" or Khor Abu Habil (see map Annex 5).

Secondly: In each selected village, Stratified sampling was applied in selection of the targeted respondents, whereby, the targeted populations were divided into four strata in each village based on the type of the activity, e.g., migratory waterbird hunting, fishing, agriculture and livestock raising. According to proposal design, 70 respondents' representatives are proposed to be selected for each study activity, whereas on the ground, no targeted numbers were identified for fishing and hunting activities, because some villages are without fishing or hunting activities in place. (See Table 1).

Table 1: The Number of respondents planned vs. actual

Respondents	planned	actual	%	Remarks
Fishermen	70	54	77%	Activity not found in some villages
Birds hunters	70	58	83%	Activity not in some villages
Farmers	70	72	103%	2 more villages have been selected
Livestock breeders	70	72	103%	2 more villages have been selected
Sheikh's villages	70	72	103%	
Total	**350**	**328**	**94%**	
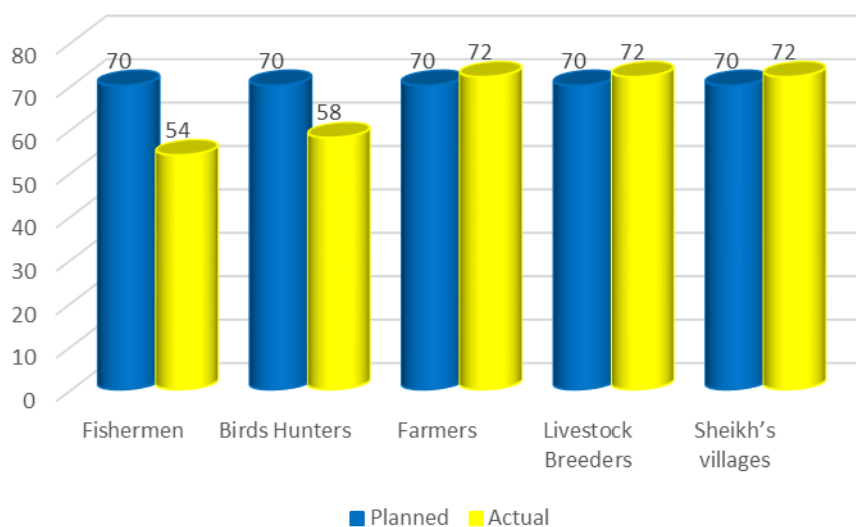
Figure 1: Number of respondents (actual & planned)

III.3   Primary data collection tools

1. **Questionnaire:** a questionnaire was designed and reviewed in consultation between the RESSOURCE Project supervisors and the two national consultants to ensure meeting the survey areas, objectives and other requirements. The questionnaire contained a set of questions for activities under study and other socio-economic aspects related to these

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activities. The filled out questionnaires were revised for their correctness and completeness.

2. **Key Informant Interviews (KII):** to adopt this tool, an information checklist was prepared, and addressed to a group of 70 village's Sheikh. The main aim of the KII is to gain general information about the village regarding the number of inhabitants, hunters, fishermen and livestock breeders, also to inform them about the survey objectives and importance, and urge them to cooperate with the project join team (*RESSOURCE Project staff + WCGA*) that would visit them to collect the necessary information in line with Ramsar Convention guidelines on wetlands.

3. **Observation:** is a data collection and verification tool. In this survey observation tool was used in a very limited scale, particularly to observe and document the studied activities of hunting, fishing, livestock raising and farming around the Mayas (see annexes).

III.4   Secondary data collection tools

The secondary data was obtained from the following relevant sources:

1. Ministry of Agriculture in White Nile state (pastures, animal production, Agricultural extension and rain-fed agricultural departments).
2. Ministry of Agriculture in North Kordofan State (Agricultural administration in Al-Rahad locality).
3. University of Kordofan.
4. Khor Abu Habil Agricultural Schemes (El-Seemeh town N.K.S).

III.5   Data analysis

III.5.1   Quantitative Data

The quantitative data were collected through the questionnaire, the completed forms were revised at the end of each working day to ensure that they are correctly filled and accomplished. The data were then tabulated and analyzed using excel application. The analyzed data were displayed in simple frequency distributions, means and graphs.

III.5.2   Qualitative analysis

These includes the following:

1. **Sociological and cognitive analysis**. Descriptive analysis was conducted for the sociocultural characteristics of the respondents, to better understand their perceptions and influences on studied activities.
   Socio-economic variables includes: age, household size, HHs members participation, length of stay in the village, annual income, income sources, estimation of work time, production average, areas, etc.
   Cognitive variables includes: knowledge about number of village inhabitants, fishermen, hunters, farmers and livestock breeders, presence of wild large mammals, problems identified and knowledge about Mayas economic value, nature of studied activities, the roles of actors in the production system, etc.

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2. **Value chain analysis**: "a value chain is a model that describes the full range of activities needed to create a product" (investopedia.com, 2021), the model describes the different stages of each studied activities, e.g., marketing, selling price, selling amount, consumption rate, trade rate, production purposes, etc. by identifying the key players and estimating the quantities being harvested.

III.6   Data and information quality control

To ensure the quality of the data and information, the following procedures were followed:
1. Questionnaire was pretested, to test the level of understanding and good response to the questions.
2. Samples of the filled questionnaires were revised at the end of the day and the remarks were discussed.
3. Using KII to collect general information from a group of five people comprised of village Sheikh and four respondents as representatives of the four studied activities to ensure answers to the crosscheck questions.

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IV   RESULTS DISCUSSION

IV.1   Farming Activities

IV.1.1   Farmers' socio-economic characteristics

Agriculture is considered as the main occupation in Khor Abu Habil area, based on this survey the total number of farmers in the selected village is 46,225 persons, about 10% of them (about 4,570 farmers) cultivate their crops within or around the natural Mayas. As shown in Table 2 the farmers spend 68.1% of working time during the year in land cultivation. the farmer's average household members is relatively high composing of 8.5 individuals; on other side, this large household members have a significant roles in overall agribusiness and farming practices as shown in Table 2, i.e., 84.7% of HHs member are participants in the agriculture activities. The farmer's average age is about 54.6 years that indicates having a wealth of experiences in farming practices. The estimated agricultural average annual income is 1,308,680 SDG considered relatively high in comparison to the Sudanese family average income.

As we know, the human civilization began with cultivation practices that is because the agriculture is related to human stability and settlement and provision of different necessary services. For these reasons, Table 2 showed that 87.5% of the farmers interviewed reported that they remain the whole year in the villages attending their farms compared to 66.5% of animal breeders living in the same villages (Table 7). More than half of respondent farmers (58.3%) as shown in Table 2 stated that either they cultivated crops close or around the flooded Mayas. Due to natural resources diversification in Khor Abu Habil area, 93.1% of the respondent farmers (Table 2) reported that they perform alternative occupations besides farming. The table shows that about two-thirds (67.2%) of farmers who have other occupations practice livestock herding, 16.4% work as traders predominately in crops or livestock products, 13.4% work as agricultural farm labor in irrigated schemes, e.g., Gazira and White Nile agriculture schemes, while 3% reported that during off-season they travel to South Kordofan State (SKS) and Northern State (NS) to work in traditional gold mining and return home at the beginning of the rainy season to practice farming. In the study sample observed in Khor Abu Habil area, the family is an economic and a productive unit contributing to the economic development of the society. As shown in Table 2, 57.2% of households farmers, i.e., 350 out of 612 HHs members have participated in agriculture. The table shows that all family members were involved in agricultural workforce including wives, boys and girls; however, as indicated in the table, the wives and other female members have a great roles in assisting their husbands as farm labor, beside cultivating their own home gardens locally known as called "Jubraka" to grow leafy vegetable, Okra, tomatoes, eggplant and other early maturing staple food crops such a maize, sorghum, millet for both household consumption and sale.

Agriculture has great benefits to human beings; it creates working opportunities for more than 60% of developing countries populations. As shown in Table 2, 61.1% of the respondent farmers reported that they benefited from agriculture as a source of family income, food supply and fodder for their animals. The inhabitants in Khor Abu Habil are dependent on own farm products to meet their food requirements. The farmers usually stockpile some sorghum stocks for consumption throughout the year especially during the lean period. Regarding the perishable crops such as tomatoes and okra, the famers have adopted many techniques for vegetable processing to preserve and consume during the off-season. As illustrated in Table 2, a common denominator for the agricultural benefits shows that the farmers are in whole dependent on

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agricultural as a principal source of family income. Regarding the benefits of fodder provision, there are two scenarios, firstly, all the farmers in Khor Abu Habil areas keep the crop residue, i.e., fodder as by-products stored on the rooms roofs for animal feeding. Secondly, some respondents farmers reported that they cultivated Roselle (*Hibiscus sabdariffa*) as fodder crops.

The traditional agriculture prevails all over Khor Abu Habil areas, relying on manual labors that requires large number of farm workforce. As reported in Table 2, 81.9% of the respondent farmers stated that they hire additional agricultural labor to work on their farm; the table shows a total number of 806 employees participated in farming activities at a ratio of 14 employees working for each farmer.

Table 2: the 72 Farmers' socio-economic characteristics

Average age = 54.6 Years			Total annual income average = 1,308,680		
Total number of farmers = 46,225			Total number of farmers cultivating in or aside to natural Mayaas = 4,570		
Average % of cultivating in total yearly work time = 68.1%			Average of HHs members = 8.5 % of HHs members participating = 58.2%		
% of HHs members participated in agriculture = 57.2%			Total number of agricultural employees = 806		
Category	**#**	**%**	**Category**	**#**	**%**
Staying whole the year in the village (N=72)			**Practicing another occupations besides farming (N=72)**		
Yes	63	87.5%	Yes	67	93.1%
No	9	12.5%	No	5	6.9%
Farmers cultivating in or aside flooded Mayaas every year (N=72)			**Occupations type (N=67)[*1]**		
Yes	42	58.3	Worker	9	13.4%
No	30	41.7%	Traditional gold mining	2	3%
			Livestock breeders	45	67.2%
			Traders	11	16.4%
The participation of HH members in farming activities (N=72)			**Households member categories participated in farming activities (N= 61)[*2]**		
Participated	61	84.7%	Wife + Boy (s) + Children	9	14.8%
Not participated	11	15.3%	Wife + Boy (s)	25	41%
			Boys + children	6	9.9
			Wife + Children	3	4.9%
			Boys	9	14.7%
			Wife	9	14.7%
Benefits from the farming (N=72)			**Getting employees for the farming activities (N=72)**		
Income + Food supply	26	36.1%	Yes	59	81.9%
Income + Food supply + Fodder	44	61.1%	No	13	18.1%
Income + Food supply + hobby satisfaction	2	2.8%	Total No. of employees = 806		
			Workers average per farmer = 14		

IV.1.2   *The cultivated crops in Khor Abu Habil areas*

As reported in Figure 2, the total cereal crops cultivated by the 72 farmers in the selected villages of the study area is 4,361.6 feddans (1 feddan = 1.038 acre = 0.42 ha). More than half of the area was cultivated with sorghum that constituted the main staple food crop. 31.7% of the areas were cultivated with sesame scoring second in ranking and 6.9% of the area cultivated with groundnut scoring third in ranking. Vegetable crops cultivated areas obtained the fourth ranking while Roselle crop scored the fifth position as the smallest area cultivated.

The following are the detailed information about the main cultivated crops in Khor Abu Habil areas:

1. **Sorghum**: Sorghum is the staple food crop for Khor Abu Habil inhabitants; the crop is cultivated for both self-subsistence and trading as cash crop, with 28.9% of the production being kept for household consumption and 72.1% for selling (see Table 3). The total sorghum cultivated area during 2020/2021 rainy season was 2,457.5 feddan with a total production of 668.9 metric ton and an average productivity of 0.27 ton per feddan. The respondent famers reported that they rely on three irrigation water sources for sorghum: (*i*) rain-fed water source that irrigates 98% of the total sorghum cultivated area; (*ii*) "Mayas" water source using flood irrigation through planting sorghum in the wetted areas of Mayas after water retires. Mayas irrigate 1.8% of the total sorghum cultivated areas; and (*iii*) Nile River irrigation technique is applied for farmers residing along the banks of the While Nile. The Nile irrigates 0.2% of the total sorghum cultivated areas. Regarding productivity per unit area, River Nile cultivation was the highest productivity obtained amounting to 1.6 ton per feddan, followed by Mayas cultivation in the second position and the rain-fed sector as the lowest production obtained.

2. **Sesame crop**: In Khor Abu Habil areas Sesame is cultivated as cash crop with 94.8% of the total production being traded whereas 5.2% was kept for household consumption (see Table 3). The total sesame cultivated areas during 2020/2021 rainy season was 1,428.1 feddans with a total production of 322.3 metric tons and with an average productivity of 0.23 ton per feddan.

3. **Groundnut** (Peanut) is the main cash crop in the study area. A total area of 310.9 feddans was cultivated during 2020/2021 rainy season with a total production of 143.9 metric tons; 93% of production was sold in the local market and 7% was kept for household consumption.

4. **Roselle** (karkade): North Kordofan State, in which Khor Abu Habil is located, is considered as one of the most important areas for Roselle cultivation. The crop is similarly grown in White Nile State zone. Often, Roselle is intercropped with Sorghum and Sesame, i.e., "cultivation of two or more crops simultaneously on the same area". The total area of Roselle cultivated during 2020/2021 season was 69.1 feddans with a total production of 7.6 tons and with 1.1 ton average productivity per feddan. Some of the respondent farmers reported that Roselle is usually cultivated for own consumption. Table 3 showed that 32.9% of total the production was consumed and 67.1% was sold; fewer farmers reported that Roselle was cultivated as fodder crop.

5. **Vegetable crops**: Due to soil fertility and water availability, Khor Abu Habil area is considered as one of the most important and vital areas for vegetable production, it supplies the big-city markets in the country with fresh and quality vegetables. For instance, the tomatoes named "Allah Kareem" a village located at Khor Abu Habil plains in NKS are famous for its quality and well-known throughout Sudan. The Figure 3

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indicates that 62.2% of total vegetable cultivated area was grown under watermelon, 17.7% grown under okra, 14.2% under cucumber and 2.4% grown under tomatoes. The Figure 3 also indicates a small area was cultivated with Onion, Arugula, Chili Pepper, Sweet Potatoes and eggplant. The total production of vegetable crops during 2020/2021 season was estimated to be around 564.2 tons. New vegetables varieties have been recently introduced to Khor Abu Habil areas such as chickpea and Dill with production intensity as shown in Table 4. The irrigation sources for vegetable irrigation differ from one crop to another, however, the same above sources for field crop irrigation are applicable to vegetable irrigation but with combinations, i.e., 67.5% of okra areas depend on rain-fed irrigation while 32.5% of the area relies on "Mayas" water sources, 78% of tomatoes areas are cultivated on Mayas (Table 4), 91% of onion areas are cultivated along the River Nile bank and irrigated from the river (Table 4). The vegetable crops of Arugula, Chili Pepper, Dill, Sweet Potato and eggplant are cultivated around "Mayas". On the other hand, 85% of Watermelon areas are cultivated as rain-fed crop relying on rainwater. A total number of 272 "Mayas" are found in the study area which are predominantly used for vegetable cultivation; however some "Mayas" are permanently flooded throughout the year while large numbers of them are swamped for a short period of time depending on size and the amount of water collected in each "Mayas". As indicated above, the agricultural average production in the study area is relatively low due to many reasons from the farmers' viewpoints (Table 5).

The farmers have ranked the agricultural problems encountered in the following order:
1. The first problem is the agricultural pests and birds destruction to sorghum and millet crops; watermelons and cucumber bugs and warms are present as well. Domestic animal (mainly cows & goats) destruction of vegetable farms was another serious challenge observed by the study team compelling some villagers to sleep in their fields to safeguard their crops against animal attack.
2. The second problem priority is the seasonal flooding of Khor Abu Habil. 13.9% of the respondents indicated the frequent seasonal flooding of the river covering large areas and causing damages to a vast area grown with agricultural crops.
3. The third problem is the rising prices of agricultural inputs and the low production per unit area.
4. The fourth problem is the inadequate agriculture extension services in the area. For instance, the head of the agricultural extension department in the State Ministry of Agriculture in White Nile State stated they are lacking the sufficient budget to implement the extension activities that resulted in poor extension services disseminated to the farmers, affecting crop production.

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Table 3: Cereal crops (Source: Field Survey, 2021)

% Purpose of production		Irrigation source	Areas in feddan	Total production (kg)	Production average (ton/feddan)	No. of mayaa	% of area from the total areas
Self-sub.	Trading						
Sorghum							
28.9%	72.1%	Rain-fed	2,406.2 (98%)	626,535	0.26	0	**(54.5%)**
		Floods (mayaa)	45.5 (1.8%)	33,150	0.72	45	
		White River Nile	5.8 (0.2%)	9,200	1.58	0	
Total			**2,457.5**	**668,885**	**0.27**	**45**	
Sesame							
5.2%	94.8%	Rain-fed	1,428.1	322,275	0.23	0	(31.7%)
Peanut							
7%	93%	Rain-fed	310.9	143,102	0.45		(6.9%)
Roselle (Hibiscus)							
32.9%	67.1%	Rain-fed	69.05	7,588.5	0.11		(1.5%)
Total			**4,265.6**				

Table 4: Vegetable crops (Source: Field Survey, 2021)

% Purpose of production		Irrigation source	Areas in feddans	Total production (kg)	Production average (ton/feddan)	No. of mayaa	% of area from the total areas
Self-sub.	Trading						
Okra							
32.95%	67.05%	Rains	30.5 (67.5%)	19,830	0.7		5.4%
		Floods (mayaa)	14.8 (32.5%)	17,150	1.2	63	
		Floods (Nile)	0	0	00		
Total			**45.2**	**36,980**	**0.8**		
Cucumber							
27.7%	72.3%	Rains	23.3 (64.4%)	11,250	0.48		
		Floods (mayaa)	12.9 (35.6%)	7,080	0.54	82	
		Floods (Nile)	0	0	0		
Total			**36.2**	**18,330**	**0.51**		
Tomato							
12.21%	87.79%	Rains	0.5 (8.3%)	500	1.00		
		Floods (mayaa)	4.7 (78%)	11,490	2.4	18	

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		Floods (Nile)	0.8 (13.7%)	5,600	7.00	
Total			**6**	**17,590**	**2.9**	
Onion						
4.8%	95.2%	Floods (mayaa)	0.2 (9%)	400	0.5	
		Floods (Nile)	2.05 (91%)	8,350	4.07	2
Total			**2.25**	**8,750**	**4.57**	
Arugula						
20%	80%	Floods (mayaa)	0.09	45	0.5	3
Chili pepper						
50%	50%	Floods (mayaa)	0.3	200	0.7	2
Dill						
1%	99%	Floods (Nile)	0.2	40		
Sweet potato						
6%	94%	Floods (mayaa)	2.3	2,450	1.06	2
Chickpea						
52.6%	47.4%	Floods (mayaa)	1.15	215	0.18	7
Eggplant						
13.5%	86.5%	Floods (mayaa)	2.4	7,000	2.91	3
Watermelon						
7.4%	92.6%	Rains	134.4 (85%)	390,850	2.8	
		Floods (mayaa)	19.3 (13%)	61,770	3.2	87
		Floods (Nile)	5 (2%)	20,000	4.00	
Total			**158.7**	**472,620**	**2.9**	
			254.8	**564,220**		**272**

Table 5: Challenges facing farmers (Source: Field Survey, 2021)

Categories	Frequency	%
Pest	32	44.4%
Floods	10	13.9%
Animal attacking farming	7	9.7%
Low production	7	9.7%
High prices of agricultural inputs	7	9.7%
Lack of extension services	4	5.6%
Weeds	4	5.6%
Lack of fuels	1	1.4
Total	**72**	**100%**

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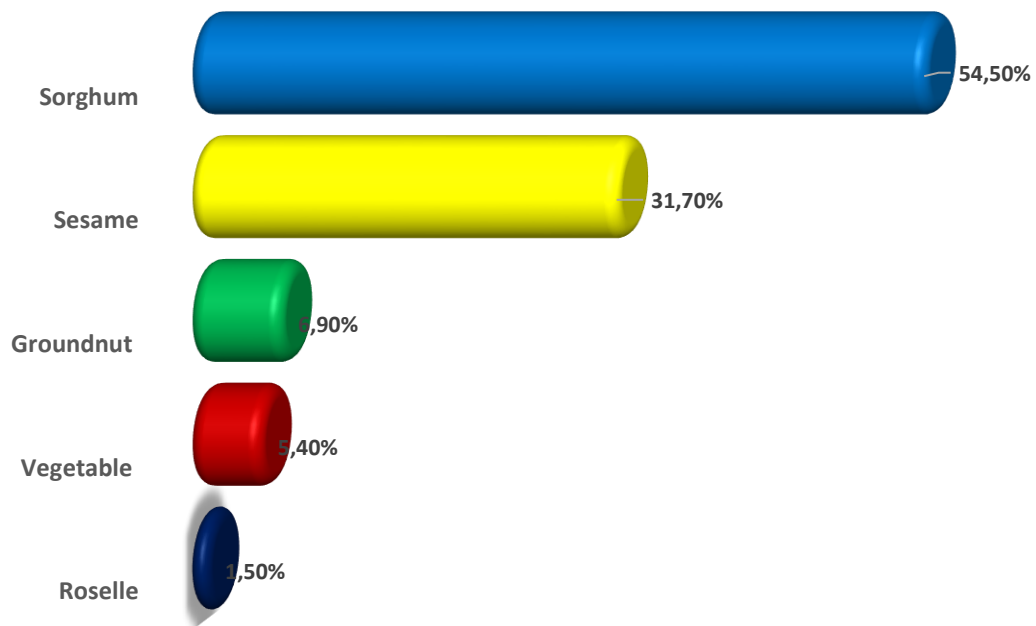*Figure 2: Crops Cultivated in the Khor Abu Habil area*
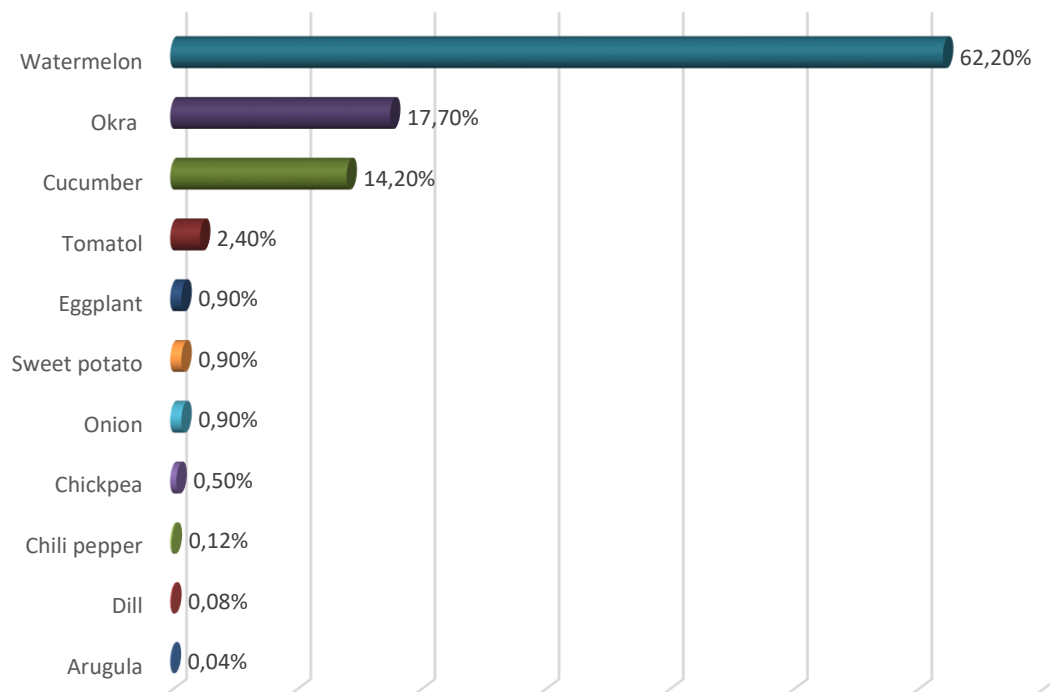
Figure 3: Vegetables cultivated in study area

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IV.2   The livestock raising in Khor Abu Habil area

The livestock-raising ranking is the second major activity in the Khor Abu Habil area following farming. There are wide areas of natural pastures spread all over the area. As shown in Tables 6 & 7 the interviewed sedentary livestock breeders possessing around 7,245 heads of livestock, 51% of them are sheep, 25% cows and 20% goats. Table (6) shows 84% of the respondent breeders have cows, 91.7% have goats, 83% have sheep, 98.6% have donkeys and only 2.8% are camels' owners.

The livestock raising purpose is for self-subsistence and trading as illustrated in Table 6. In Khor Abu Habil cows are raised for dairy, own-consumption and trade (Table 6). 30.4% is the average-selling rate for cows, i.e., usually male calves between 6 months and two years are sold gaining an average financial return of SDG 56,147 for each head. The dominant species of goats in the area are the Nubian & Desert species characterized with poor milk production, hence these goats are raised mainly for meat. Goats slaughtering is common in the area as part of their culture of generosity and hospitality; goats are slaughtered for relatives visiting their family members and for guests coming to the area or passing-by on their way to other destinations. Also, the study showed that goats are raised for trading at an average selling rate of 30.4% with an average financial return of SDG 7,598 for each goats breeder in the study area considered to be lower compared to cows selling rate (see Table 6). On the hand, sheep raising is mainly practiced as a profitable investment with an average selling rate of 45.5% of the total number possessed and gaining an average financial return of SDG 12,233 for each sheep breeder. The dominant sheep species in the area are the "Hammary" species usually raised in the sandy soil zones and the Garaj species raised in the clay soil areas. Donkeys are raised as means of transportation and carrying goods, crop harvest and water. As shown in Table 6, 69.2% of the livestock owners for the five species (cows, goats, sheep, camel and donkeys) raise their livestock for self-subsistence and trading combined, whereas 30.8% of the owners raise them solely for self-subsistence. The average selling rate for all livestock species is SDG 24,922 (Table 6). About 39.6% is the average amount sold collectively per year for the all five animal species from the total number of livestock owned by respondents (Table 6).

As shown in Table 7, 61% of work time during the year is spent on animal husbandry practices (raising practices). The average of breeders household number is 9 persons; however only 22.5% of the total livestock owners households members, i.e., *153 out of 667 HHs members* are engaged in livestock raising which is far lower than the number of participants in the agriculture sector. Based on Table 7 all the HHs members including wives, daughters and boys participated in the livestock raising activities, however, due to harshness and severity of the livestock raising practices, females usually participated in a lower ratio compared to males and boys, contrary to the agriculture businesses in which females participation is higher compared to males.

As stated in Table 7 the breeders' average age is about 52 years compared to 54 years for farmers due to livestock raising been a rough and tough profession that requires younger ages and fitness. The estimated livestock raising total annual income per HHs is around SDG 1,446,361, which is higher compared to SDG 1,308,680 income gained from the agriculture sector.

As shown in Table 7, 76.4% of livestock respondents confirmed that the Mayas are not always flooded every year forcing them to move with their animals to other locations searching for water and pastures. Table 7 shows that one-third (33%) of the livestock owners move to other locations within WNS (Kennana and Asalaaia), another one-third (34.5%) depends on other water sources

inside their villages, e.g., wells and Hafirs, 11% depend on White Nile River source, while a minority group (3.5%) continue traveling to near States in South and North Kordofan looking for water. As indicated in Table (6), 86.9% of the respondents stated that the majority are sedentary and 10.8% are semi-nomadic with men and young people travelling leaving behind the rest of the family members to cultivate the field, e.g., wives, girls and boys. Only 2.3% represents a small number of pastoral nomads.

Table 7 shows that 100% of the livestock breeders practice other occupations beside livestock raising, i.e., 95.8% of them work as farmers "*agro-pastoralists*", 2.8% work on livestock bi-products trading and 1.4% work as traditional gold miners. Table 7 showed that the respondents reported they have benefited significantly from the livestock products as income source, food supply, means of transportation and farm manure.

Table 7 shows two-thirds (65.3%) of the respondents hired workers to assist them in animal husbandry, i.e., 94 employees were hired to work in livestock sector compared to 806 workers in the farming sector with 1.3 worker for each breeder in comparison to 14 workers employed by each famer.

Regarding the presence of large wild mammals, 95.8% of the respondents reported no wild mammals are existing in the study area while 4.2% confirmed that some wild mammals are present mainly hyena. However, most of the available wild animals are close to the border within the Republic of South Sudan. 56.9% of the livestock raisers stated that last time they had seen a deer (Gazelle) was during 1950s, 1960s and 1970s.

The livestock raising in Khor Abu Habil areas faces many challenges; Table 8 shows the respondents response for ranking the livestock sector challenges encountered in the following priority order:
1. Inadequate natural pasture, due to the expansion of the cultivated areas into areas predominately preserved for natural pasture, which has forced the pastoralists (breeders) to travel for long distances searching for pastures.
2. The outbreak of animal diseases and pests leading to high rate of mortality. The herders stated that their animals suffer much from different types of diseases including Anthrax, PPR "peste des petits ruminants", Foot and Mouth Disease "FMD", Sheep pox, etc.
3. Insufficient water sources for animals especially during summer season pushing the herders to migrate with their animals searching for water.
4. High prices of veterinary medicines and insufficient veterinary services in the area including the limited number of trained Community Animal Health Workers (CAHWs) as stated by 4.2% of the respondents.

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Table 6: Livestock in Khor Abu Habil Area (N=72 villages) (Source: Field Survey, 2021)

Livestock type	Total Herd size	Owners No.	Breeding purpose		No. of Mayaas (Grazing or Drinking)	Breeding manner			Amount sold/ year	Total amount of selling price (SDGs)
			Self-sub + Trading	Self-subsistence		Sedentary	Nomadic	Semi-nomadic		
Cows	1,808 (25%)	61 (84%)	59 (96.7%)	2 (3.3%)	268	45 (73.7%)	2 (3.3%)	14 (23%)	550 (30.4%)	3,425,000 (56,147 / owner)
Goats	1,497 (20 %)	66 (91.7%)	62 (93.9%)	4 (6.1%)	297	63 (95.5%)	2 (3%)	1 (1.5%)	637 (42.6%)	501,500 (7,598 / owner)
Sheep	3,696 (51%)	60 (83%)	58 (96.7%)	2 (2.3%)	288	46 (76.7%)	1 (1.6%)	13 (21.7%)	1,683 (45.5%)	734,000 (12,233/ owner
Camel	17 (0.2%)	2 (2.8%)	1 (50%)	1 (50%)	4	1 (50%)	1 (50%)	0	0	0
Donkey	227 (3.8%)	71 (98.6%)	0	71 (100%)	316	71 (100%)	0	0	0	0
Total (or average)	**7,245**	**260**	**69.2%**	**30.8%**		**86.9%**	**2.3%**	**10.8%**	**2,870 (average 39.6%)**	**4,660,500 (average 24,922)**

Table 7: Livestock breeders' socio-economic characteristics (Source: Field Survey, 2021)

Average age = 52 Years			Total annual income average = 1,446,361 SDGs		
Total number of sedentary livestock breeders = 19,167			Total number of nomadic livestock breeders coming to the maya/village each year = 2,531		
% of cattle breeding in total yearly work time = 61%			Average of HHs members = 9 % of HHs members participating = 22.5%		
% of HHs members participated in livestock breeding activities = 22.5%			Total number of livestock breeder employees = 94		
Category	**#**	**%**	**Category**	**#**	**%**
Staying whole the year in the village (N=72)			**Practicing another occupations besides livestock breeding (N=72)**		
Yes	48	66.5%	Yes	72	100%
No	24	33.5%	No	0	00
Taking animals to Nile River (N=72)			**Occupations type (N=67)**[*1]		
Yes	29	40.3%	Farming	95.8%	
No	43	59.75	Traditional gold mining	1.4%	
			Livestock trading	2.8%	
The participation of HH members in livestock breeding activities (N=72)			**Households member categories participated in breeding activities (N= 63)**[*2]		
Participated	60	83.3%	Wife + daughter	5	7.9%
Not participated	12	16.7%	Wife & son (s)	13	20.6%
			Wife & son(s) & daughter(s)	1	1.6%
			Son (s)	34	54%
			Wife	3	4.8%
			Son (s) & daughter (s)	4	6.3%
			Daughter (s)	3	4.8%

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Benefits from livestock breeding (N=72)			Getting employees for the livestock breeding activities (N=72)		
Income + food supply	1	1.4%	Yes	47	65.3%
Income + food supply + transportation	60	83.3%	No	25	34.7%
Income + food supply + transportation + farm manure	11	15.3%	Total No. of employees = 94 Workers average per farmer = 1.3		
The flooded of Mayaas every year (N = 72)			**Location visited by breeders when Mayaas not flooded (N = 55)**		
Yes	17	23.6%	Nile River	6	11%
No	55	76.4%	South Kordufan State	2	3.5%
Presence of wild large mammals at time being (N = 72)			North Kordufan State	2	3.5%
Yes	3	4.2%	White Nile State	18	33%
No	69	95.8%	Near villages	8	14.5%
The presence of wild large mammals beforetime (N = 72)			Inside village	19	34.5%
Yes	41	56.9%			
No	31	43.15			

Table 8: Ranking the livestock problems priorities according to breeder's viewpoints (Source: Field Survey, 2021)

Categories	Frequency	%
Lack of pasture	34	47.2%
Diseases & pests out break	23	32%
Lack of water	8	11.1%
high prices of veterinary medicines	4	5.5%
Lack of extension and veterinary services	3	4.2%
Conflicts between breeders & farmers	2	2.8%
Low production	1	1.4%
Total	**72**	**100%**

IV.3   Fishing Activities

IV.3.1   Fishers' socio-economic characteristics

The big-size Mayas in Khor Abu Habil contain large numbers of fish during the wet season that remain throughout the season. The famous Mayas with fish exist in the villages of Asalaya, Mohoyum, Karmal and Shirkela. The most important fish species include "garmut" (*Clarias laser*), "gurgur" (*Ynodontus spp*), "Um-kouro" (*Protopterus aethiopicus*) and "bolti" (*Tilapia niloticus*).

Fishing is not considered as the main livelihood in Khor Abu Habil area, nevertheless it falls in the third category after agriculture and livestock raising. Table 9 shows the total number of fishermen in the sampled villages is 1,575 spending 69% of total annual working days on fishing. The average fishermen household member is about 8 individuals, although it constitutes a high percentage of family membership, only 34% of them participate in the fishing activity. The fishermen average age is around 42 years. The study found that 44.4% is the total annual household income obtained from fishing amounting to SDG 1,524,062 per year. This is higher amount compared to the other targeted socio-economic sectors in the study area namely, agriculture, livestock-raising and hunting. The study also showed that not many local residents

are practicing fishing in the area; most fishermen are outsiders coming from other villages and nearly town.

Table 9 shows that only 5.7% of the total fishermen are fishing experts while 94.3% of them work in other sectors and practice Ad hoc fishing. Out of the total number, 86% practices farming, 2% are livestock herders and the remaining 6% are traders and unemployed such as students. About (70.4%) of respondents remain through the whole year in the village.

The results showed 33.3% of the HHs members participated in the fishing activity with boys constituting the large number. As mentioned above most of the local communities in Khor Abu Habil are not professional fishermen, they do not need to hire fishing workers, instead they fish themselves, only 18.5% of respondents admitted that they hired a total number of 84 fishing workers during the past year.

IV.3.2 *Fishing in Khor Abu Habil*

Table 9 shows that total annual weight of fish caught by respondents in Khor Abu Habil area is 275.9 tons. Average number of fish harvested out of all fish species is 11,337 fish. From the results of the study the most fish species caught during the year was 'Garmout', i.e., 2,531 fish caught followed by 'Bolti' in the second place with 2,327 fish caught while 'Um-korou' and 'Gargour' species were ranked third and forth with average number of 927 and 643 fish caught respectively (Table 10).

The detailed information about the annual caught species in Khor Abu Habil Area is as follows:
1. **Bolti**: locally named as 'farsha' is the second abundant fish species in Khor Abu Habil Area. Table (10) showed that Bolti is caught for household consumption together with trade or for consumption and leisure activity as a hobby; 56% of the caught fish was sold and 44% was kept for consumption. The total weight of fish caught was 116.4 ton with an average weight of 2,327 kg.
2. **Garmout**: locally named as 'balbout' is the most common fish species caught by respondents all over Khor Abu Habil area; the fish is found in all targeted villages with medium size compared with other species, however, large sizes reaching 4 kg are found when they stay longer in the Mayas. Table 10 shows 64.2% of respondents caught 'Garmout' species for home consumption beside trade while 35.8% of respondents reported they caught the fish for consumption as well as for entertainment as a hobby. The total weight of fish caught was 134.2 ton with a total average weight of 2.531 kg.
3. **Um-korou**: constitutes the largest species caught recently by fishermen in Khor Abu Habil area. The fish was found widely all over the study area with an average weight of 6 kg per a fish. However, the fish is not consumed widely by the inhabitants compared to other fish species. Similar to other species,'Um-korou' is caught for home consumption including trade or for consumption and entertainment as a hobby (Table 10). 66.7% of the fish was sold widely in the market and 33.3% kept for consumption. The total weight of fish caught was 16.7 ton with a total average weight of 927 kg. Table 10 shows 71.4% of respondents caught the Gargour species for home consumption and trade, while 28.6% of respondents reported they caught the fish for consumption as well as for entertainment and hobby. The total weight of fish caught was 5.7 ton with an average weight of 643 kg.

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Table 9: Fishermen's socio-economic characteristics (Source: Field Survey, 2021)

Average age = **42.3** Years			Average total annual income average = **1,524,062** SDGs		
Total number of fishermen in selected villages = 1575			Average number of fishing months in year = 3.5 Months		
% of fishing in total yearly work time = 69%			Average of HHs members = 7.7 % of HHs members participating in fishing = 8.8%		
% of HHs members participated in fishing activity = 8.8%			Total number of fishing employees = 84		
Total No. of Mayas using for fishing = 223			% of average yearly income provided from fishing = 44.4%		
Average number of fish harvested for all species = 11,337 fishes			Average weight of fish caught (all species) (in kg) = 0.7 kg		
Fish total annual production in tons = 275.9			Average number of days per a week that fishermen eat the fish they caught = 1.7		
Category	**#**	**%**	**Category**	**#**	**%**
Staying whole the year in the village (N=54)			**Practicing another occupations besides fishing (N=54)**		
Yes	38	70.4%	Yes	51	94.4%
No	16	29.6%	No	3	5.6%
Capturing wild birds in the fishing traps			**Occupations type (N=50)**		
Yes	21	39.6%	Farmers	43	86%
No	32	61.4%	Livestock breeding	1	2%
			Student	3	6%
			Traders	3	6%
The participation of HH members in fishing activities (N=54)			**Households member categories participated in fishing (N= 18)**		
Participated	18	33.3%	Boys	18	100%
No participated	36	66.7%			
Benefits from fishing activities (N=53)			**Getting employees for the fishing activities (N=54)**		
Income + food supply	34	64.2%	Yes	10	18.5%
Food supply + hobby	19	35.8%	No	44	81.5%
The flooded of fishing Mayaas every year (N = 53)					
Yes	40	75.5%			
No	13	24.5%			

Table 10: Fishing in Khor Abu Habil Area (Source: Field Survey, 2021)

Fish type	No. of fisherman	Fishing purpose		Fishing place			Amount caught in ton	% of fishing sale	Average amount in kg	Average selling price (SDG/kg)
		Self-co + trade	Self. Co. + Hobby	Mayaa	Nile	Maya+ Nile				
Bolty	50 (69.4%)	33 (66%)	17 (34%)	46 (92%)	1 (2%)	3 (6%)	116.4	56%	2,327	195
Garmout	53 (73.6%)	34 (64.2%)	19 (35.8%)	49 (92.5%)	1 (1.9%)	3 (5.6%)	134.2	56.2%	2,531	168.5
Gargour	7 (9.7%)	5 (71.4%)	2 (28.6%)	4 (57.1%)	1 (14.3%)	2 (28.6%)	5.7	67.9%	643	138.6
Um Korou	18 (25%)	12 (66.7%)	6 (33.3%)	18 (100%)	0 00	0 00	16.7	58%	927	196
Total (or average)	**128**	**65.6%**	**34.4%**	**117 (91.4%)**	**3 (2.3%)**	**8 (6.3%)**	**273**	**59.7%**	**1,607**	**174.5**

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IV.4   Waterbird hunting in Khor Abu Habil

IV.4.1   Hunter's Socio-economic characteristics

The waterbirds hunting in Khor Abu Habil area is not the main activity for the local inhabitants, it ranks as fourth activity in this study when compared to other four sectors (in terms of hunters number, activity work time and total yearly income provided from it). The total number of hunters in the selected villages was 586. Table 11 shows that the hunting time is 29% from the total annual working time, while the Average number of hunting months is 2.4. The bird hunting average household members is about 8.6 individuals; however, only 2.1% of the members participated in the hunting activity. The hunters' average age is around 48 years, which reflects a fact that all hunters are well acquainted and experienced with birds hunting activity using fire-gun/rifle or local traditional traps. The total average annual income of hunting is SDG 551,103 constituting 4% of the total annual income for waterbird hunting households. Table 11 shows 1.3 days are the average number of days per week the hunters eat the birds they hunt. Also, 77.6% of the hunters remain the whole year in the village while 22.4% leave the village to look for other sources of income in other places. The results showed 8.6% of HHs members (boys only) participated in hunting activities. However, all respondents confirm having other livelihoods activities besides hunting such as 94.8% of them are engaged in farming 3.4% work as drivers and 1.7% as tailors. 82.8% of respondents said that the hunting Mayas always remained flooded, while 17.2% are in disagreement. The overall average of waterbirds hunting purposes is that 10% of hunted birds are sold for income sources as well as for household food security (self-consumption), while 90% of birds are hunted for entertainment, leisure and hobby.

As shown in Table 12, 98% of hunters reported that they hunted the birds from mayas while 1.7% & 0.3% from Nile River and uphill forest respectively. The study showed (Table 11) no evidence is supporting the existence of large mammals in the study area. Only 9% of respondents said that there are some wild large mammals such Gazelle and Hyena existing in the area while 91% disagree with this statement. However, 96.4% of the respondents confirm the presence of various types of large wildlife mammals in the past when the habitat was most conducive and favorable.

IV.4.2   Waterbird hunting in Khor Abu Habil area

There were many waterbird species hunted in Khor Abu Habil area by local inhabitants for income as well as food consumption and hobby. The study provided good information on water birds hunted species and their annual harvested amount of individual species, also it reflects the Occurrence of illegal hunting carried out by hunters coming from other areas. Sometimes they legally hunt but without supervision and follow-up by the concerned authority, resulting in large amounts of birds being hunted, including prohibited species.

The detailed information about the annual waterbird species hunted in Khor Abu Habil area is as follows:

1. **White-Faced Whistling-Duck (*Dendrocygna viduata*)**: Table 12 shows about 9.1% of respondents hunted this species for own-consumption and trade, while 90.9% of them hunted for own-consumption and hobby. The average number of this species harvest yearly is 76.2, compared to 76.4% of hunters engaged in hunting this bird. The study provides valuable information about the hunting sites. 98.2% of hunters stated they hunted from flooded Mayas, while 1.8% hunted from River Nile. Almost all the hunted

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birds (99.8%) from Mayas. The average selling price for the White-Faced Whistling Duck was SDG 257; about 5% of White-Faced Whistling Duck is sold in the markets, while the remain amount was consumed by hunters. More than 81% of hunters hunted these birds by gun/rifle while 18.2% of them use traditional bird traps.

2. **Fulvous Whistling-Duck (*Dendrocygna bicolor*)**: Table 12 shows about 9.3% of the respondents hunted Fulvous Duck for own-consumption and trade, while 90.7% hunted the bird for own-consumption and hobby. The average number of this species harvested yearly is 75, compared to 59.7% of hunters engaged in hunting this bird. Similarly, the study provides wealthy information indicating 100% of hunting practices take place in the flooded Mayas. The average selling price for this species is SDG 300 and 4% of the hunted Fulvous Whistling Ducks are sold in the local markets, while the remain amount was consumed by the hunters. 82.7% of hunters hunted these birds by gun/rifle and 17.3% use traditional bird traps.

3. **Comb (Knob-Billed) Duck (*Sarkidiornis melanotos*)**: Table 12 shows about 10.2% of the respondents hunted this species for own-consumption and trade, while 89.8% of the respondents hunted for own-consumption and hobby combined. The average number of this species harvested yearly is 32 birds, compared to 68.1% of hunters engaged in hunting this bird. The study provides substantial information about the birds hunting places indicating 100% of hunting practices take place in the flooded Mayas while only 2% of hunting occurs in the Nile. The average selling price for this species was SDG 2550 and 5.5% of the hunted Comb (Knob-Billed) Ducks is sold in the local markets, while the remaining amount was consumed by the hunters. 84% of hunters hunted these birds by gun/rifle while 16% use traditional bird traps.

4. **Garganey (*Spatula querquedula*)**: Table 12 shows about 11.6% of the respondents hunted this species for own-consumption and trade, while 88.4% of respondents hunted for own-consumption as well as for hobby. The average number of this species harvested yearly is 79 birds compared to 59.7% of hunters engaged in hunting this bird. The study provides substantial information about the hunting locations. Likewise, the study provides wealthy information indicating 100% of hunting practices take place in the flooded Mayas. The average selling price for this species was SDG 255 and 6.3% of the hunted Garganey is sold in the local markets, while the remain amount was consumed by the hunters. 79% of hunters hunted these birds by gun/rifle, while 21% use traditional bird traps.

5. **White Stork (*Ciconia ciconia*)**: Table 12 shows about 13.5% of respondents hunted this species for own-consumption and trade, while 86.5% of respondents hunted for own-consumption and hobby. The average number of this species harvested yearly is 33 birds, compared to 72% of hunters being engaged in hunting this bird. The study provides valuable information about the bird hunting sites. In addition, the study indicates 98% of hunting practices occur when 96.2% of Mayas are flooded with 1.9% of hunting taking place in downhill forests. The average selling price for this species was SDG 290 and 7.9% of the hunted Garganey been sold in the local markets, while the remain amount was consumed by the hunters. 83% of hunters hunted these birds by gun/rifle, while 17% are using traditional bird traps.

6. **Northern Shoveler (*Spatula clypeata*)**: Table 12 shows about 7.7% of respondents hunted this species for own-consumption and trade while 92.3% of respondents hunted for own-consumption and hobby combined. The average number of this species harvested yearly is 31 birds, compared to 58% of hunters being engaged in hunting this bird. The study provides valuable information about the bird hunting sites.

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In addition, the study indicates 97% of hunting practices occur when 97.6% of Mayas are flooded with 2.4% of hunting taking place in the Nile. The average selling price for this species was SDG 300 and 5% of the hunted Northern Shoveler is sold in the local markets, while the remain amount was consumed by the hunters. 81.7% of hunters hunted these birds by gun/rifle, while 17% are using traditional bird traps.

7. **Sacred Ibis (*Threskiornis aethiopicus*)**: as shown in Table 12 about 10.5% of respondents hunted this species for self-consumption and trade, while the others 89.5% hunted it for self-consumption and hobby. The average number of this species harvested yearly is 24 birds, compared to 52% of hunters being engaged in hunting this bird. Again this study provides valuable information about the hunting site in the mayas is 97.4% in flooded mayas, 99.5% hunted were harvested from Mayaa and (2.6%) in the Nile. The average selling price for this species was 288 SDG. The average of Sacred Ibis sold is 5.3%, while the remain amount was consumed by the hunters. Most of hunters hunted these birds by gun/rifle, about 82.7% and about 17.3% using traditional traps.

8. **Glossy Ibis (*Plegadis falcinellus*)**: Table 12 shows about 7.3% of respondents hunted this species for own-consumption and trade, while the others (92.7%) hunted for own-consumption and hobby. The average number of this species harvested yearly is 31 birds, compared to (57%) of hunters being engaged in hunting this bird. The study provides valuable information about the bird hunting sites. In addition, the study indicates 100% of hunting practices occur when 97.6% of mayas are flooded with 2.4% of hunting taking place in the Nile. The average selling price for this species was SDG 250 and 4% of the hunted Glossy Ibis is sold in the local markets, while the remain amount was consumed by hunters. 80% of hunters hunted these birds by gun/rifle, while 20% are using traditional bird traps.

9. **Ruff (*Calidris pugnax*)**: Table 12 shows about 11% of the respondents hunted this species for own-consumption and trade, while 89% hunted for own-consumption as well as hobby. The average number of this species harvested yearly is 112 birds, compared to (62.5%) of hunters being engaged in hunting this bird. The study provides useful information about the hunting grounds with 62.5% of hunters hunting for this bird. In addition, the study indicates 100% of hunting practices occur when 97.8% of mayas are flooded with 2.24% of hunting is taking place in the Nile. The average selling price for this species was SDG 245 with 5.5% of hunted Ruff is sold in the local markets, while the remain amount was consumed by hunters. 82.5% of hunters hunted these birds by gun/rifle, while 17.5% are using traditional bird traps. For those which caught by traps specially white stork was sold alive. The nine species which mentioned above were the most hunted birds in all selected villages in Khour Abu habil area. Al so the study provide good information about waterbirds regarding their average selling price, ratio sold on market/auto-consumption as illustrates that in the Figures 4 – 5 - 6:

Table 11: Hunter's socio-economic characteristics (Source: Field Survey, 2021)

Average age = **48** Years			Total annual income average = **551,103** SDGs		
Total number of hunters in selected villages = 586			Average number of hunting months in year = 2.4 Months		
% of hunting in total yearly work time = 29%			Average of HHs members = 8.6 % of HHs members participating in hunting = 2.1%		
% of HHs members participated in waterbird hunting activities = 2.1%			Total number of mayas used for hunting = 312		
Average % of total annual income provided from hunting in mayas = 4%			Average number of days per a week that hunters eat the birds they hunted = 1.3		
Category	**#**	**%**	**Category**	**#**	**%**
Staying whole the year in the village (N=58)			**Households member categories participated in hunting (N= 5)*2**		
Yes	45	77.6%	Boys	5	100%
No	13	22.4%			
The flooded of hunting Mayaas (N = 58)			**Occupations type (N=58)**		
Yes	48	82.8%	Farmers	55	94.8%
No	10	17.8%	driver	2	3.4%
			Tailor	1	1.7%
The participation of HH members in waterbird hunting (N=55)			**The presence of large mammals (N = 58)**		
Participated	5	8.6%	Yes	5	8.6%
No participated	53	91.4%	No	53	91.4%
Benefits from livestock breeding (N=58)			**Getting employees for the waterbird hunting (N=58)**		
Income + food supply	5	8.6%	Yes	0	00
Food supply + hobby	53	91.4%	No	58	100%
Hunting in the Nile River (N = 55)			**The presence of wild large mammals beforetime (N = 58)**		
Yes	3	5.2%	Yes	54	93.1%
No	55	94.8%	No	4	6.9%

Table 12: Waterbird hunting in Khor Abu Habil area

Birds species	No. of hunters having taken this species	Hunting purpose		Average No. of individual waterbird yearly harvested /hunter	Hunting place			Average % hunted from mayas	Average % of water-bird sale	Average selling price (SDG/bird)	% shot by gun	% trapped
		Self-con + trade	Self. Co. + Hobby		Flooded Mayas	uphill forest	Nile					
White-faced W. Duck	55 (76.4%)	5 (9.1%)	50 (90.9%)	76.2	54 (98.2%)	0	1 (1.8%)	99.8%	5%	257	81.8%	18.2%
Fulvous W. Duck	43 (59.7%)	4 (9.3%)	39 (90.7%)	75	43 (100%)	0	0	100%	4%	300	82.7%	17.3%
Comb (Kn-B) Duck	49 (68.1%)	5 (10.2%)	44 (89.8%)	32	48 (98%)	0	1 (2%)	100%	5.5%	255	84%	16%
Garganey	43 (59.7%)	5 (11.6%)	38 (88.4%)	79	43 (100%)	0	0	100%	6.3%	255	79%	21%
White Stork	52 (72%)	7 (13.5%)	45 (86.5%)	33	50 (96.2%)	1 (1.9%	1 (1.9%)	98%	7.9%	290	83%	17%
Northern Shoveller	42 (58%)	3 (7.7%)	39 (92.3%)	31	41 (97.6%)	0	1 (2.4%)	97%	5%	300	81.7%	18.3%
Sacred Ibis	38 (52%)	4 (10.5%)	34 (89.5%)	24	37 (97.4%)	0	1 (2.6%)	99.5%	5.3%	288	82.7%	17.3%
Glossy Ibis	41 (57%)	3 (7.3%)	38 (92.7%)	31	40 (97.6%)	0	1 (2.4%)	100%	4%	250	80%	20%
Ruff	45 (62.5%)	5 (11%)	40 (89%)	112	44 (97.8%)	0	1 (2.2%)	100%	5.5%	245	82.5%	17.5%
Total (or on Average)	**408 (63%)**	**41 (10%)**	**367 (90%)**	**493.2 (54.8)**	**400 (98%)**	**1 (0.3%)**	**7 (1.7%)**	**99.4%**	**5.4%**	**271**	**82%**	**18%**
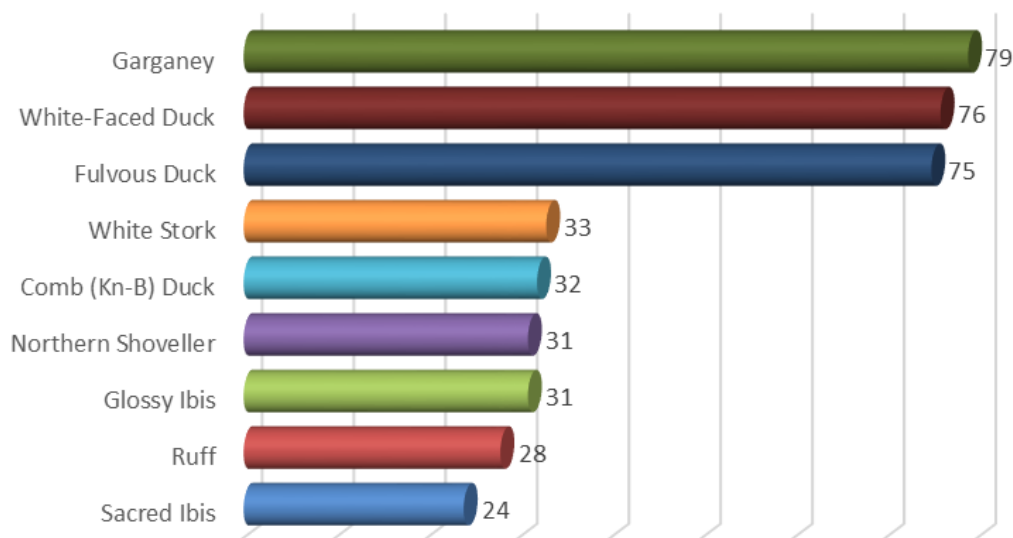
Figure 4: Average No. of individual waterbird harvested per year per hunter
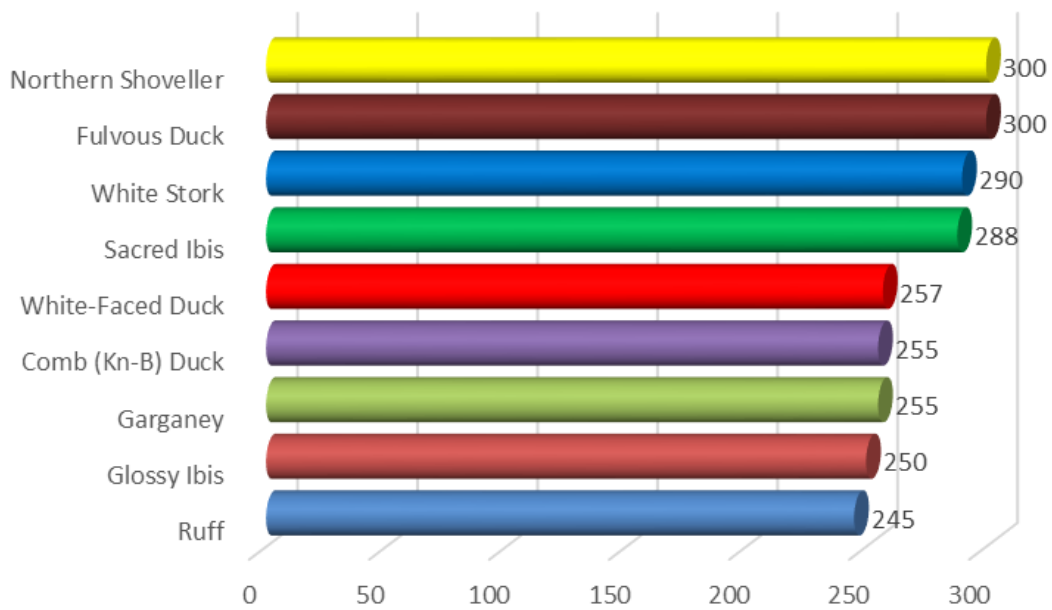
Figure 5: Average selling price by bird species (SDG)
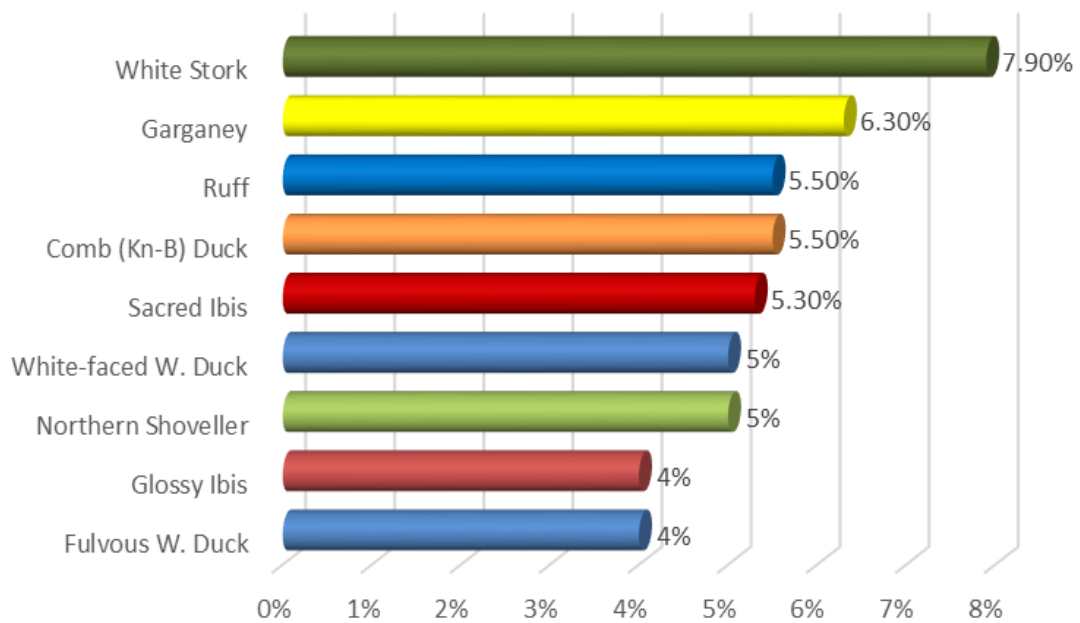
Figure 6: Average % of waterbird quantity sold per year by species

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IV.5 Comparisons between the four studied activities

IV.5.1 The rate of HHs member participation in the four studied activities

The study has found that the respondents' HHs have significant roles in the production processes of the 4 activities under study, but the participation rates differs from activity to another, i.e. high in farming and lower in the other three activities). As reported in Figure 4, the highest participation rated was among the farmers' HHs members with 57.2% participation. The second highest rate was for breeder's HHs with 22.5% participation. The third and fourth highest rates were for fishermen and hunters' HHs with 8.8% & 2.1% participation respectively.
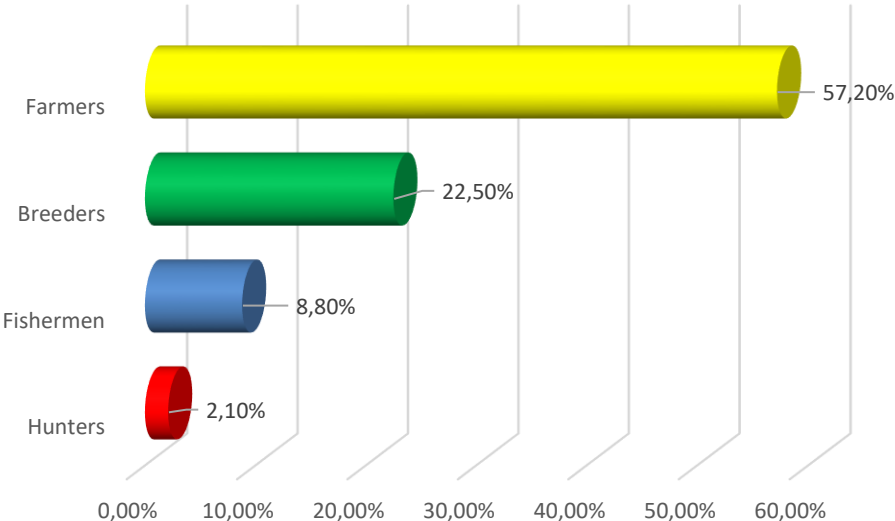
Figure 7: % of respondent's HHs members participation in studies activities

IV.5.2 Average annual income distribution according to the activity

The four studied activities generate different annual income. The Figure 8 shows that the fishing activity has scored the highest average annual total income followed by livestock breeding, whereas farming was in the third ranking and hunting scored the fourth ranking.
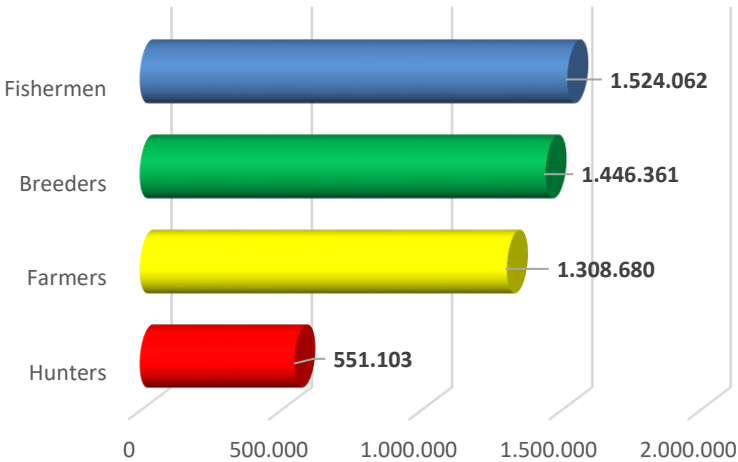
Figure 8: Average annual income per HHS for the four activities studied

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IV.5.3 Uses of Mayas

The study has found that the four studied activities depended either completely or partially on the mayas. The livestock breeding scored the highest dependence on 316 mayas in the study area due to every animal life is dependent on water. The birds hunting scored the 2nd level relying on 312 mayas in the study area since the waterbird hunting is related to water availability. The farming activity scored the third ranking due partial dependence of the farming system on water from Mayas. The fishing scored the fourth and the lowermost position since not all fish are found in Mayas water sources i.e. some small or shallow mayas don not have fish, whereas the other three activities under study can be practicing in all mayas even in these small or shallow one.
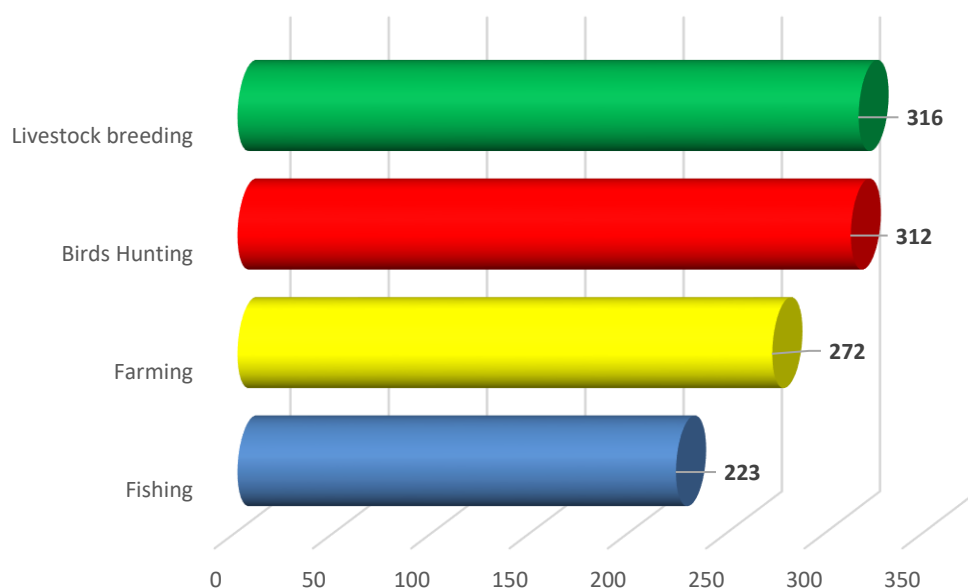
Figure 9: Number of Mayas based on its uses

V   CONCLUSIONS

1. The respondents spent 62% of their timework in activities related to Khor Abu Habil alluvial fan.
2. A vast majority of the respondents cultivates land and raise livestock, whereas 82% & 77% of the respondents practice in waterbirds hunting and fishing respectively.
3. The household members in Khor Abu Habil areas constitute an economic and productive units participating in all production processes, particularly in land cultivation.
4. The average total annual income gained from the studied activities (with exceptions of hunting, traditional gold mining, trading and car driving and other some activities mentioned by respondents) relatively high.
5. The vast majority (90%) of waterbirds hunters are hobbyists.
6. A great number of mayas are used for livelihood activities.
7. The vast majority of Khor Abu Habil inhabitants are settled in their villages for most of the year including livestock herders.
8. The agriculture and livestock raising are the main sources of income in Khor Abu Habil areas, followed by fishing to some extent, and waterbird hunting to an even lesser extent.

9. The vast majority of Khor Abu Habil inhabitants produce their own food and are self-sufficient.
10. Lack or scarcity of large wild mammals in Khor Abu Habil areas at present since they have disappeared many years ago due to frequent droughts as reported by Ahmed (2016). However, they could be present in very limited areas bordering the Republic of South Sudan.

VI   RECOMMENDATIONS

1. We highly recommended to designate the Khor Abu Habil area as an internationally important wetland under the Ramsar convention.
2. Suggestions for further studies related to (*i*) The impact of climate change on biodiversity & ecosystems structure in Khor Abu Habil area; (*ii*) Improvement the fish production in each individual maya; (*iii*) Hydrological studies, with the aim to increase water holding capacity of the mayas, and hence their seasonal lifetime.
3. Raising awareness of the local inhabitants is a must in order to protect natural resources especially birds and fish.
4. In some places, there is a crucial need to construct small-scale dams for water harvesting, but great care should be taken to make hydrological as well as environmental impact studies/assessment before.
5. Sustainable hunting management and hunting permits delivery in White Nile State should be put in place, organized and reinforced.
6. Specific areas must be identified and designated for waterbird hunting instead of widespread hunting.
7. Fishery resources must be put under the Federal Fishery Department jurisdiction to improve annual fish production in both quantity and quality.

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VIII ANNEXES

VIII.1 Annex 1: images

Photo 1: A young boy fishing in a flooded mayaa

Photo 2: Filling questionnaire during face-to-face interviews

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Photo 3: Camels drinking water in a flooded mayaa

Photo 4: A fishing boat in a flooded mayaa

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Photo 5: Installation of a bird trap

Photo 6: A White Stork trapped

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Photo 7: A wide tomato-cultivated area in Khor Abu Habil plains

Photo 8: Harvesting tomatoes

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Photo 9: Tomatoes harvest

Photo 10: Tomato drying process

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Photo 11: Harvested sorghum in the Khor Abu Habil plains

Photo 12: a joint orientation meeting between village's Sheikh (Omadas), Tendelti Local Governor, WCGA representative, RESSOURCE project staff (OFB) and the 2 national consultants

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VIII.2 Annex 2: Village's Sheikh Names

#	Sheikh name	Village	Phone	Remarks
1	Awad Mohammed	Alla Kreem	0915658409	
2	Abdellah Ismaeal	Hasab Alla	0911722541	
3	Ahamed Mohammed Zyeen	Rahad Elsheikh	0918699517	
4	Saued Adam	Al awama	-	Sheikh's son
5	El sadig Mohammed	Um - Wood	0903197030	
6	Modawi Hamad	Um Suar	0968632899	
7	Abdel gadier Mohammed	Um Saeed	0967885592	
8	Ayead Mohammed	Al-Radeef Al-Ahamada	0912977392	
9	El tyeb Ibrahim	Al Seelia / Rehaana	0900444122	
10	Khadir El towm	Abu-Hamara El-Fadnia	0917021898	
11	Al mobsher Al shysh Al bashair	Al-Shaareeqa	0916944008	
12	Ahmed Bashair Sharf el dyeen	Karkaj	0969466055	
13	Abdellah El naier Dyab	Um Jup	0911480321	
14	Ahmed Mohammed El teib	Al-eleeqa El-sheikh	910274735	
15	Abdellah Mohammed Abdellah	Um-bahatoot	0904305260	
16	Al sadig Mohammed Abdel rahman	Keteer Bala	0915063716	Local-leader
17	Mohammed El shykh Mohammed	Al-Rawada	0915463133	Local leader
18	Abdel rahman Aeid El haj	Al-Shawaf	0960198977	
19	Hassan Abdel aal	Al-eeleqa Badareen	0913816631	
20	Mohammed El bashair	Al-Thora	0917112410	
21	El Dashi El emam	Um-Boosa	0964676519	Sheikh's son
22	Abdel aal baleala Abdellah	Um-Aqareeb Shamal	0912584910	
23	Bakheit yousf Suliaman	Kapoos	0913349666	
24	Ismaiel Dafallah Osman	Wafara	0966249722	
25	Mohammed Suliaman	Saleema Al-aqeeb	0968315166	
26	Abdel bagi Abdel alaim	Dabat Alqaraa	0964049412	
27	Abdel gadeir El abead	Boobnees Alkholoof	0962423493	
28	Mohammed Awadel allah	Kereej	0918960630	Sheikh's son
29	Mohamed Abas Ahmed	Um-Kooeka Almahata	0915499236	Local leader
30	Msoud Hassan	Sekrenja	0915251425	
31	Abdel hafeez bulal El bashair	Beer Al-Keeter	0906577550	
32	Ahmed Mohammed Fedel syd	Um-Booesa	0909866154	Sheikh's son
33	Farah Dafallah Abdelallah	Abu-Rookoba	0914686885	
34	Ahmed Mohammed Ali	Tooeal	0967356088	Sheikh's brother
35	Mousa Salh Mousa	Abu Ambaj	0968183914	
36	Abaker Ahmed	Qooz Alaaq	0966766251	Sheikh's son
37	Abdel rahman Mohammed	Ekeebish	0917040434	
38	Sadig Noor eldeen Ismaeil	Bataran	0964118421	
39	Ahmed El zain Khameas	Aramal	0917595160	
40	Salim Mohammed Abdellah	Al-Teeben	0911055315	
41	Ali Abdel aal Yahya	Jadeed	0910363186	

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42	Ahmed Ali Ismaeil	Karkaoy Shamal	0964231967	
43	Hassan Aysa Abdel karaim	Um-Qoodor	090298335	
44	Abdellah mohammed Abdellah	Al-lShaqaa	0908081264	
45	Ali El zain	Aziza Janoub	0963697734	
46	Mohammed Mohammed Zain	Konooz	0963502739	Sheikh's son
47	Mohammed Ahmed Dwa elneam	Al-Seeleq	0904973835	Sheikh's son
48	El tayb Yasean El shaikh	Um-Adaa Algarbia	0913375949	Sheikh's son
49	Mohammed Ball	Al-Weesaa	0916858758	
50	Ali Hamed Hamad	Al-Qalaa	0914120880	
51	Abdel gawi Mohammed	Toolohi	0969294239	
52	Abdel rahman Numan Rahama	Qardood El-kheel	0967105102	
53	Sadig Ismaeal Shareaf	Treeter	0915705075	
54	Mohammed Ahmed Omer	Helat Elshiekh Adam	0915035973	Local leader
55	Al tyeib Mohammed Towm	Um ookaz	0912220950	
56	Al noor Omer Ahmed	Um Maqaareen	0910924112	
57	Al noor Mohammed Yagoub	Uma Gookhaeem	0967666819	
58	Al deye Ali Gad elsyd	Bashaeer Shareq	0915524615	
59	Al teib Bashair Gaber Hago	Um Kooeka Alqardood	0900555729	
60	Abead Mohammed Abead	Al Shawafa	0914264516	
61	Ahmed Mohammed Ahmed	Al-eqeela	0913895298	
62	Umda Al Mutasim	Sheerkela	0910046287	Omda
63	Al doad Mohammed Ali	Malaqa	0913698431	
64	Makei Gomaa Makei	Al-Reeshead	0968852878	
65	Hamad Hassan Abdellah	Abu-Kamdala	0917727019	
66	Yasir Abdellah Ali	Koohol	0918596918	Omda
67	Mohammed Hassan Yahya	Al-adaia	0912809307	
68	Orno El shykh Osman	Al-Hejeerat	0908185229	
69	Ahmed El shazli Kream allah	Koo Namosa	0915248130	
70	Abdel allh Hafeiz Abdel rahman	Al-daqaq	0906828816	
71	Abdel Rahaman Musa	Al-rahad (Weehda)	01002109313	
72	Bashair abdel moamen Mohammed	Hafeer Altomat	0919416873	

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VIII.3 Annex 3: The villages name and coordinates

#	Village name	Coordinates	State / locality
1	Alla Kreem	X GPS = 13 02. 150	White Nile State
		Y GPS = 31 56. 464	(Tandality locality)
2	Hasab Alla	X GPS = 13 01. 136	White Nile State
		Y GPS = 31 55. 110	(Tandality locality)
3	Rahad Elsheikh	X GPS = 13 11. 656	White Nile State
		Y GPS = 32 04. 218	(Tandality locality)
4	Al awama	X GPS = 13 11. 005	White Nile State
		Y GPS = 32 07. 029	(Tandality locality)
5	Um - Wood	X GPS = 13 13. 175	White Nile State
		Y GPS = 32 08. 895	(Tandality locality)
6	Um Suar	X GPS = 13 17.073	White Nile State
		Y GPS = 32 11.112	(Goli locality)
7	Um Saeed	X GPS = 13 19. 726	White Nile State
		Y GPS = 32 11. 537	(Goli locality)
8	Al-Radeef Al-Ahamada	X GPS = 13 21. 083	White Nile State
		Y GPS = 32 15. 027	(Goli locality)
9	Al Seelia / Rehaana	X GPS = 13 17. 813	White Nile State
		Y GPS = 32 13. 885	(Goli locality)
10	Abu-Hamara El-Fadnia	X GPS = 13 14. 443	White Nile State
		Y GPS = 32 15. 677	(Goli locality)
11	Al-Shaareeqa	X GPS = 13 15. 026	White Nile State
		Y GPS = 32 18. 943	(Goli locality)
12	Karkaj	X GPS = 13 19. 088	White Nile State
		Y GPS = 32 19. 053	(Goli locality)
13	Um Jup	X GPS = 13 22. 771	White Nile State
		Y GPS = 32 17. 615	(Goli locality)
14	Al-eleeqa El-sheikh	X GPS = 13 30. 762	White Nile State
		Y GPS = 32 19. 735	(Goli locality)
15	Um-bahatoot	X GPS = 13 31. 342	White Nile State
		Y GPS = 32 24. 895	(Goli locality)
16	Keteer Bala	X GPS = 13 45. 232	White Nile State
		Y GPS = 32 25. 505	(Ad Duwaym locality)
17	Al-Rawada	X GPS = 13 38. 352	White Nile State
		Y GPS = 32 22. 023	(Goli locality)
18	Al-Shawaf	X GPS = 13 21. 462	White Nile State
		Y GPS = 32 32. 354	(Goli locality)
19	Al-eeleqa Badareen	X GPS = 13 19. 462	White Nile State
		Y GPS = 32 30. 050	(Goli locality)
20	Al-Thora	X GPS = 13 21. 613	White Nile State
		Y GPS = 32 26. 036	(Goli locality)
21	Um-Boosa	X GPS = 13 16. 491	White Nile State
		Y GPS = 32 24. 101	(Goli locality)
22	Um-Aqareeb Shamal	X GPS = 13 12. 126	White Nile State
		Y GPS = 32 20. 985	(Goli locality)
23	Kapoos	X GPS = 13 01. 937	White Nile State
		Y GPS = 32 00. 779	(Tandality locality)
24	Wafara	X GPS = 13 06. 021	White Nile State
		Y GPS = 32 01. 263	(Tandality locality)
25	Saleema Al-aqeeb	X GPS = 13 00. 940	White Nile State
		Y GPS = 32 04. 576	(Tandality locality)
26	Dabat Alqaraa	X GPS = 13 08. 101	White Nile State
		Y GPS = 32 06. 433	(Tandality locality)
		X GPS = 13 05. 491	White Nile State

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27	Boobnees Alkholoof	Y GPS = 32 09. 965	(Tandality locality)
28	Kereej	X GPS = 13 05. 652	White Nile State
		Y GPS = 32 15. 780	(Goli locality)
29	Um-Kooeka Almahata	X GPS = 13 00. 360	White Nile State
		Y GPS = 32 16. 585	(Tandality locality)
30	Sekrenja	X GPS = 13 07. 333	White Nile State
		Y GPS = 32 20. 695	(Goli locality)
31	Beer Al-Keeter	X GPS = 13 01. 722	White Nile State
		Y GPS = 32 22. 146	(Goli locality)
32	Um-Booesa	X GPS = 13 06. 282	White Nile State
		Y GPS = 32 27. 905	(Goli locality)
33	Abu-Rookoba	X GPS = 12 55. 090	White Nile State
		Y GPS = 31 59. 362	(Tandality locality)
34	Tooeal	X GPS = 12 49. 021	White Nile State
		Y GPS = 31 57. 142	(Tandality locality)
35	Abu Ambaj	X GPS = 12 43. 258	White Nile State
		Y GPS = 31 56. 981	(Tandality locality)
36	Qooz Alaaq	X GPS = 12 47. 221	White Nile State
		Y GPS = 32 05. 881	(Tandality locality)
37	Ekeebish	X GPS = 12 55. 616	White Nile State
		Y GPS = 32 06. 110	(Tandality locality)
38	Bataran	X GPS = 12 55. 791	White Nile State
		Y GPS = 32 03. 027	(Tandality locality)
39	Aramal	X GPS = 12 57. 519	White Nile State
		Y GPS = 32 11. 722	(Tandality locality)
40	Al-Teeben	X GPS = 12 54. 580	White Nile State
		Y GPS = 32 09. 420	(Tandality locality)
41	Jadeed	X GPS = 12 56. 258	White Nile State
		Y GPS = 32 14. 143	(Tandality locality)
42	Karkaoy Shamal	X GPS = 12 51. 711	White Nile State
		Y GPS = 32 12. 432	(Tandality locality)
43	Um-Qoodor	X GPS = 12 49. 929	White Nile State
		Y GPS = 32 19. 281	(Tandality locality)
44	Al-Shaqaa	X GPS = 12 58. 712	White Nile State
		Y GPS = 32 21. 307	(Goli locality)
45	Aziza Janoub	X GPS = 12 57. 114	White Nile State
		Y GPS = 32 25. 604	(Al salam locality)
46	Konooz	X GPS = 12 50. 953	White Nile State
		Y GPS = 32 23. 934	(Al salam locality)
47	Al-Seeleq	X GPS = 12 52. 226	White Nile State
		Y GPS = 32 30. 527	(Al salam locality)
48	Um-Adaa Algarbia	X GPS = 12 59. 626	White Nile State
		Y GPS = 32 32. 381	(Al salam locality)
49	Al-Weesaa	X GPS = 13 02. 854	White Nile State
		Y GPS = 32 30. 573	(Goli locality)
50	Al-Qalaa	X GPS = 12 58. 620	White Nile State
		Y GPS = 32 37. 529	(Al salam locality)
51	Toolohi	X GPS = 12 53. 086	White Nile State
		Y GPS = 32 35. 338	(Al salam locality)
52	Qardood El-kheel	X GPS = 13 03. 657	White Nile State
		Y GPS = 32 41. 051	(Al salam locality)
53	Treeter	X GPS = 13 06. 899	White Nile State
		Y GPS = 32 32. 402	(Goli locality
54	Helat Elshiekh Adam	X GPS = 13 07. 624	White Nile State
		Y GPS = 32 36. 551	(Kosti locality)
		X GPS = 13 13. 185	White Nile State

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55	Um ookaz	Y GPS = 32 34. 415	(Goli locality
56	Um Maqaareen	X GPS = 12 59. 149	White Nile State
		Y GPS = 31 49. 742	(Tandality locality)
57	Uma Gookhaeem	X GPS = 12 50. 337	White Nile State
		Y GPS = 31 45. 622	(Tandality locality)
58	Bashaeer Shareq	X GPS = 12 51. 638	White Nile State
		Y GPS = 31 49. 973	(Tandality locality)
59	Um Kooeka Alqardood	X GPS = 12 48. 642	White Nile State
		Y GPS = 31 51. 504	(Tandality locality)
60	Al Shawafa	X GPS = 12 53. 565	North Kourdofan State
		Y GPS = 31 40. 487	(Um Ruwaba locality)
61	Al-eqeela	X GPS = 12 53. 662	North Kourdofan State
		Y GPS = 31 34. 350	(Um Ruwaba locality)
62	Sheerkela	X GPS = 12 48. 012	North Kourdofan State
		Y GPS = 31 24. 768	(Um Ruwaba locality)
63	Malaqa	X GPS = 12 47. 277	North Kourdofan State
		Y GPS = 31 17. 877	(Um Ruwaba locality)
64	Al-Reeshead	X GPS = 12 46. 949	North Kourdofan State
		Y GPS = 31 15. 306	(Um Ruwaba locality)
65	Abu-Kamdala	X GPS = 12 48. 759	North Kourdofan State
		Y GPS = 31 12. 172	(Um Ruwaba locality)
66	Koohol	X GPS = 12 46. 476	North Kourdofan State
		Y GPS = 31 07. 713	(Um Ruwaba locality)
67	Al-adaia	X GPS = 12 41. 129	North Kourdofan State
		Y GPS = 31 00. 142	(Um Ruwaba locality)
68	Al-Hejeerat	X GPS = 12 39. 475	North Kourdofan State
		Y GPS = 30 51. 541	(Al Rahad locality)
69	Koo Namosa	X GPS = 12 51. 429	North Kourdofan State
		Y GPS = 31 05. 488	(Al Rahad locality)
70	Al-daqaq	X GPS = 12 43. 402	North Kourdofan State
		Y GPS = 30 47. 353	(Al Rahad locality)
71	Al-rahad (Weehda)	X GPS = 12 43. 792	North Kourdofan State
		Y GPS = 30 39. 287	(Al Rahad locality)
72	Hafeer Altomat	X GPS = 12 36. 635	North Kourdofan State
		Y GPS = 30 39. 848	(Al Rahad locality)

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VIII.4   Annex 4: Map of the Khor Abu Habil area

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VIII.5   Annex 5: Sample grid

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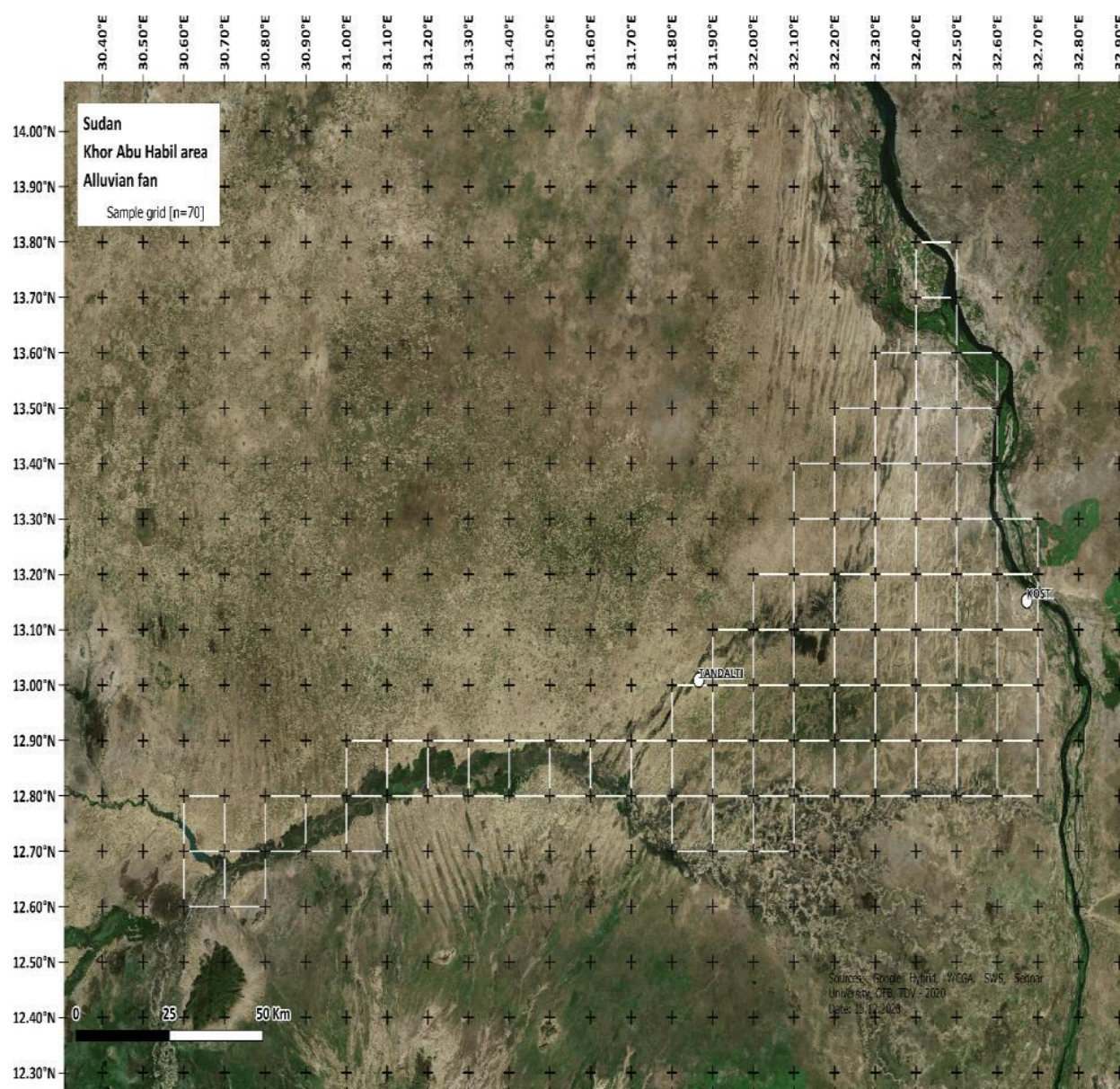
VIII.6 Annex 6: Mayaa's locations

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