Government of Sudan- Ministry of Agriculture

Sudan Productive Capacity Recovery Programme
Model Projects

THE DEVELOPMENT OF IMPROVED MARKET CHAINS AND VALUE ADDITION FOR PRODUCTION SUPPORTED BY SPCRP IN RED SEA STATE (II)

The Processing & Marketing of Fish & Fish Products, Tomato, Okra, and Mesquite Pods into Fodder

The case of Red Sea State

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PROJECT: Market development for Fisheries in Red Sea State
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PREFACE

SPCRP-MP is spending considerable resources on stimulation activities and studies in order to identify and generate deal-flow of new commercial ideas and business opportunities in Red Sea State for income generation and livelihoods. This study is part of a series of case-studies on the development of improved market chains and value addition for production Supported by SPCRP-MP in four different states with different crop/livestock/fisheries perspectives. In particular, this study is made with the aim to identify potentials in Red Sea State for business improvements in tomato and okra production, and promote fish production and markets for new products and services in marine and maritime sector. Such an endeavor is expected to enhance the processes to commercialize these new business propositions for prosperous new jobs and opportunities in Red Sea state.

In particular, the study attempts to achieve three main objectives. First, identify and create financially feasible small scale processing enterprises for fish and fish products in Red Sea State on the basis of sustainable investments in artisanal (small-scale) fisheries and in accordance to reliable fishery management plans. Second, identify processing opportunities for fresh/dried tomato and okra products as an important part for market development, since both crops have a very short period of harvest often lead to a glut that cause sharp price reductions. Third, utilization of mesquite pods, which can be processed for animal feeding, thus reduce their harmful effect on the environment and crop agriculture.

Making use of previous experiences, the SPCRP project(s) will target the promotion and marketing of small scale fishery by Red Sea state as a means for sustainable development and in a context of a more comprehensive local development paradigm. Thus, the methodology follows a community driven development approach in project design. For this purpose, the main issue will be the determination of clear marketing strategies for Red Sea State under MP and MPP projects, particularly the fish and fish products along the coastline of Red Sea as well as processing of mesquite pods for animal feed and tomato and okra for human consumption[1].

To achieve the first objective a conceptual framework for marketing is need to help understanding the livelihood strategies, economic conditions and fishing practices of artisanal fishermen in the Red Sea State. Some model projects are developed and the financial analysis with regard to feasibility and profitability of processing of the identified products will be examined. The outcome of the study is expected to be the strengthening of the capacities of the small-scale fishermen and let them be able to make better plans; adopt good fish processing management and have adequate finance to maintain their fishery activities in a more economically sound way.

[1] However, lack of current data on tomato, okra and fish processing, inadequate statistics on prices and costs were principal factors in not meeting the specific measurement of some of the feasibility parameters.

The second expected output will be an identification of the external and the internal constraints and opportunities in relation to fishery, mesquite, tomato and okra production. The ultimate outcome will help setting a number of policies, institutional development initiatives, and investment programs in addition to raising quality measures to meet international standards, the standards that promote fish and fish products exports, local vegetables' markets that keep healthiness and safety a priority.

ACKNOWLEDGEMENTS

Thanks are extended for many people who supported the completion of this study in the way it looks and from whom we derived enormous magnitudes of assistance (Annex 1). First of all, author would like to thank the entire SPCRP-MP and CB staff members in Red Sea State (Port Sudan &Tokar) who availed all kinds of support and assistance to visit Agieg which constitute an important element in the fish story. Jan Hendricks receives our acknowledgment, and Mr. Omer Ali Osman, SPCRP National Coordinator, deserves special thanks for his overall support in providing logistics and also in mobilizing his staff in Tokar to organize meetings with Framers' Organizations, Women Associations and the officials of DTAS, Agieg and also in Port Sudan. Appreciations are extended to SPCRP staff in Port Sudan and Tokar who is instrumental in facilitating meetings and consultation with the Farmers Trade Union, Development Associations, and Fishermen association.

Particular thanks go to fervent promoter of this task, Mr. Geoff Griffith, SPCRP MP Coordinator in Khartoum and his assistant Mr. Saad Ali Babiker, my companion to Port Sudan, for time and energy invested in supporting every aspect of the study.

Last but not least, we would also like to thank any unmentioned individuals on the list of people interviewed attached in Annex for the time devoted to and the interest showed by responding to the study and for patiently enduring discussions, in some cases at night and during weekends. We hope that the findings and recommendations of this study will be of use to SPCRP and other stakeholders in their efforts to strengthen the livelihoods of fishermen, farmers (women and men, and children) in Red Sea State.

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LIST OF GLOSSARY, ACRONYMS AND CONVERSION FACTORS

ARP	Agricultural Revitalization programme (ARP)
CIPEC	Canadian Industry Program for Energy Conservation.
DTAS	Delta Tokar Agricultural Scheme
ERDP	Eastern Region Development Programme
EU (EC)	European Union (European Community)
FAO	Food and Agriculture Organization
ff	fresh fruit
FRC	Food Research Centre of Agricultural Research Corporation
FVTU	Fruits and vegetables Trade Union (of Red Sea State)
HACCP	Hazard Analysis and Critical Control Point
HBEs	Home Based Enterprises (HBEs)
IPA	Informative Product Advertising (IPA)
ISO	International Standards Organization
MT	Metric Ton
MoA	Ministry of Agriculture
NGOs	Non-Governmental Organizations
OXFAM	Global Non-Governmental Organizations
PPA	Persuasive Product Advertising (PPA)
SDG	Sudanese currency
SMEs	Small and Medium Enterprises
RSS	Red Sea State
SIFSIA N	Sudan Integrated Food Security Information for Action (North)
SPCRP	Sudan Productive Capacity Recovery Programme
SPCRP-MPP	Sudan Productive Capacity Recovery Programme, Model Project Programme
SSMO	Sudanese Standards and Metrology Organization (SSMO)
SSOP	Sanitation Standard Operating Procedure
SWOT	Strengths, Weaknesses, Opportunities and Threats
TQM	Total Quality Management
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNICEF	United Nations Children's Fund (UNICEF)
UNIDO	United Nations Industrial Development Organization
USAID	United States Agency for International Development

Currency Equivalents

Currency		Equivalent
US$ 1.00	=	SDG 2.9 official exchange rate
US$ 1.00	=	SDG 3.9 parallel market rate

One sack of millet = 94.35 kg.
One sack of sorghum feterita equals to 91.5 kg, mugud type 88 kg, and white sorghum varieties 94.35 kg.
All other coversions which are not national are mentioned either as footnote or described in the text where appropriate.

EXECUTIVE SUMMARY

The prime objective of this study is two-sided. The first is to conduct an initial fish processing, vegetables and mesquite assessment and analyses to identify critical gaps and constraints and propose mitigations and second is to assess the financial and economic feasibility of intended projects. For this purpose, the current status of the sectors are envisioned in terms of employment, production, local consumption and export and highlight on overt and latent economic opportunities is also emphasized through encouraging and strengthening backward and forward linkages in the fish industry, mesquite and vegetables processing.

The study recommends undertaking pilot project interventions in fish processing both filleting and wet salt fasiekh making through small processing units and excludes drying of fish as its financial returns are not profitable although technically feasible. Tomato processing by grading, sorting and packaging is most financially attractive followed by tomato pasting; however, tomato drying comes in the third place in terms of profitability to processors. Processing of mesquite pods is also financially profitable and need to be enrolled in the project intervention plan. The size and number of fish processing units needed for Red Sea need to be determined after consultation with specialists for implementation and erection of units that involve engineering and technical aspects.

The study offers a range of steps to take up opportunities concerning the three main enterprises, i.e. mesquite, vegetable (tomato, okra) and fish processing and addresses their respective challenges in development. In this respect, the prospective user of this study (SPCRP MP, state authorities or any business entrepreneur) can make his/her own attentiveness to broaden or narrow the scope of usage, gathers any information he/she considers necessary to make an informed decision on small business, be it fishing enterprise industry, vegetable or mesquite processing.

The study calls for reviewing the existing state policy and institutional frameworks that promote trade in fish and fish products and the extent to which existing fish marine department and other related institutions (marine research and statistics) and enact policies that provide the right basis for facilitating fisheries trade in Red Sea. Particular emphasis must be placed on coordination between the various initiatives (UNIDO, Banking institutions, Zakat Chamber and NGOs) in such processing facilities for a steady and viable industry establishment.

1. BACKGROUND INFORMATION AND CONTEXT OF ANALYSIS

1.1 About the Red Sea State

The Red Sea State falls between latitude 16º and 22º North and longitudes 35º and 37º east. Red Sea State (RSS) can be divided into three distinct physical areas: the coastal strip, the hilly area and the flat western plains. RSS total area is about 218,887 km^2 with a total population of about 728,000 persons, representing 2.9 % of Sudan's population (UNDP 2005:Babiker and Pantuliano 2006). Most of the coastal population is semi-nomadic[1] taking fishing as a major livelihood support as increasing desertification of the land made agriculture difficult and herding less profitable. The State is sub-divided into eight *mahallias* (localities or districts (see map on Annex 1.1): Port Sudan, Suakin, Gunub/Aulib, Sinkat, Hayya, Halaib and Tokar/Agig (Babiker and Pantuliano 2006). Over the years much of the rural population of Red Sea State has moved to the state capital, Port Sudan; where road infrastructure is substantially tangible. Other most important cities in the state are Sinkat, Sawakin, Tokar, Usaif and Mohmed Goal.

The topography of the state is diverse and the desert comprises almost one third of the total area. The coast extends over 740 km along with volcanic hills at 20-40 km distance from the sea shore. The Red Sea State experiences two types of rainfall, summer and winter rains where the former is considered more important to crop growing and pasture. Climate varies with diversity in rainfall in the range of 25-400 mm per annum. However, 60% of the state receives rainfall less than 100 mm per annum, mostly during the period of November and February. Temperature is usually in the range of 22-41 Cº with relative humidity of 52-71%.

The state's economy depends largely on trade activities through the main ports as well as the border trade between Sudan and both Egypt and Eritrea. The usual Saudi Arabia outlet and trade avenue cannot go unmentioned as smuggling to/from Saudi Arabia is also mutual but limited. Bilateral trade is usually limited to licensed traders.The state accommodates the largest Harbour for exports and imports (Port Sudan) including oil exports by Bashaier Harbour. Main institutions in the state are the Sudan Shipping Line, Sudan Railways, Sudanese Standardization and MetrologyOrganization (SSMO), and Port Sudan Airport. Important to come across is famous tourism by the Red Sea, particularly the areas of Arkawait and Arosa.

Agricultural land comprises only 2% (0.8 million fed.) of the state's land, while salty areas occupy 40% (18 million fed) and 58% (26.2 million fed) remain as a desert area. The current traditional and rain fed farming in the state does not exceed 17,000 feddan. Water resources in the state are estimated as 678 million cubic meters in addition to wells at a depth of 40-60 feet. Livestock depends largely on natural pastures, forage crops from outside the state in addition to agro-industrial residues.

[1] Urban people comprise about 38% of the population whereas the nomads constitute 51% in contrast to 11% as urban-rural dwellers.

However, irrigated farming in the Red Sea State is confined to seasonal tributaries along TokarDelta.

In Bija societies, women have traditionally played a subsidiary role in these societies where the women's role is regarded as motherhood and child-rearing while tribal leadership, land and livestock ownership are customarily reserved for men. At present rural women are employed in family agriculture (see agriculture in Agieg Annex 4.2 & 4.3), firewood gathering, cooking and even herding but this does not contribute much to their social or economic advancement (Abeywickrama 2009).

1.2Background on the fishing and fish products in Red Sea state

Sudan Red Sea coast extends for about 853 km and is naturally protected by barrier reefs that form lagoons and natural harbours and customary fish landing sites. The territorial waters of the country consist of 91,600 sq. km. of the Exclusive Economic Zone, inclusive of 22,300 sq. km. of shelf area. For this vast area, the sheltered waters and the areas of mangrove swamps contain a high level of bio-diversity. The annual fish potential or the sustainable yield for fish in the sheltered coastal zone is said to be at least 10,000 MT of various fish varieties[2].Despite the availability of adequate marine fish resources (hopefully to be used as raw material for processing) in Red Sea State; nevertheless, little information is available to make use of these potentials. Over and above, sea food is not a usual or main dish in the state, particularly the densely populated areas (Port Sudan and Suakin) for many reasons, part of it is cultural and others are due to poverty and economic reasons.

A recentstudy made by UNIDO on fishing (Abeywickrama 2009) concluded that, the cultural practices on artisanal fishing industry along the Red Sea coast are still at a primitive stagedespite the high potential the state has. However, most of the fish by Red Sea coastline is sold fresh and a small proportion is processed into wet-salted or dried form. Worth to note in this respect is that, smoked fish is not widely known in Sudan. In his report Abeywickrama (2009) went further to givean uncomfortable portrays of current fishing industry by the coastline of the Red Sea.While the total sustainable fish harvests available to Sudan from the Red Sea is estimated at around 30,000 MT of fin fish, the current production is no more than 1,500 MT per annum (Table 1.1) and fishing is mostly done with simple equipment.Fishermen show low levels of wide-fishing skills,poor finance and equipment that render them at the shallow waters of the lagoons within the barrier reefs.

To link the fishing industry, global wise, to Sudan's current situation, Zajc (2010) has mentioned important products of fish processing industry as:

[2]The FAO Fishery Country Profile, Feb. 2008, states that figures of fish catches are only rough estimates based on government permits issued and this was confirmed by the Department of Marine Fisheries (two state fisheries offices, one in Port Sudan and one in Suakin). Information in this context is cited by Abeywickrama (2009).

- Canned fish (small oil fish, large pelagic fish)
- Dried, salted, smoked and marinated fish
- Fish filets
- Frozen fish
- Crustaceans, shellfish, molluscs

However, new products in this industry include:

- Smoked and marinated bass fillets
- Smoked eel
- Marinated shrimp tails (becoming important in the processing industry)
- Pate and salads prepared from a wide number of species (Ibid 2010).

Of above mentioned types, information shown by the below table (Table 1.1) are the only available data, however, can give a general idea about the current fish types and their respective quantities by Red Sea State.

Table 1.1: Volumes of fish produced &exported (tons) to Arab Gulf and Eastern Asia 2001-2010

Season	Kokian fish or Trocus[1]	Fresh fish[2]	Sea cucumber[3]	Shrimps[4]	Sea bed fish[5]	Sardine fish[6]	Totals* in tons
	Quantity in tones						
	كوكيان	اسماك طازجة	عزيري	جمبري جرف	اسماك جرف قاع	اسماك ساردين	Total tons
2001	378	40	36.7	31	-	-	486
2002	376	70.2	44.9	3.9	358.9	-	854
2003	364	102.2	30.6	12.4	806.6	717	2033
2004	336	153.2	19	60.5	1404	1638	3611
2005	385	65.2	20.1	46.2	782	1466	2765
2006	301	37.2	9.75	-	-	-	348
2008	280	1.2	14.9	4.95	92.3	-	393
2008	319	0.5 dry)	17.7	53.3	622.6	-	1013
2009	56	5.2	-	17.95	319.2	335	733
2010	137.5		1.1	-		Non	139

Source: Department of Marine Fisheries. Ministry of Agriculture Red Sea State.

*Other types of fishes are exported minor as mother pearls 0ne tone in 2003, 14 tons in 2008 and 2.5 tons in 2010. Shark fish fins 0.4 tons in 2001, 0.18 ton in 2002 and 1.2 tons in 2008. Exports from shrimp farm were once in 2004 and then stopped. in 2011 only 551 tons of sea bed fish is exported till July

Worth to note in this connection is that *fish processing* does not always mean a complicated canning process, but also include filleted packaged fish, dry fish and wet salted fishas is the case with a cottage industry that can easily be taken up by fishery-men/women at the community level as we shall see in the upcoming sections. Many trials in fish processing were undertaken by NGOs in the Red Sea state. OXFAM have had strong presence in the area before they were expelled out by the Sudanese Government a year ago. UNIDO was(and still)have interest in developing fish marketing through the so-called landing sites.In this respect, UNIDO is active in supporting certain infrastructure developments as landing sites for fishermen at various places in Red Sea State[3].

Learning from past experience, the SPCRP project need togo beyond provision of seeds and tools to the community to establish a processing and marketing system thatserves the interest of both the fishermen and the consumers through provision of smooth market chains[4,5,6].This is why marketing strategies (of crops grown in Delta Tokar) for processed tomato and okra products and also processed mesquite pods as fodder for animal are examined in this study.

1.3Background on vegetables production in Delta Tokar

The Delta Tokar is the outwash fans of the Baraka River, on the coastal plain of the Red Sea some 150 km south/south-east of the Red Sea state capital Port Sudan. The Delta covers a gross area of about 406,000 feddan (170,520 ha) of which about 40% (160,000 feddan) has been irrigated in the past. The Delta is divided into three parts, the Western, Middle and Eastern Delta areas with the central area forming the main part of the irrigation scheme. The town of Tokar is located about 35 km from Shidin Rock, a local land mark on the Baraka River. Reliable population data for the Tokar Delta are not available but the Tokar Delta Corporation (TDAS) has a total of 5,724 landowners and 24,000 landless sharecroppers registered (Anderson 2008).

Mean daily temperatures in Delta Tokarrange from 19.9º C to 28.7º in February to 27.2º C to 41.5º C in August (Anderson 2008). As a result, no annual crop can be cultivated without irrigation. Wind is the dominant factor in the Tokar Delta affecting not only crop production but also land preparation. At the onset of the flood season in July, the *Haboob* wind blows from the south-east at a mean speed of 21.3 km/hr. and this last for almost three months until September (Ibid 2008).

Although the Delta Tokar Agricultural Scheme (DTAS) was developed for cotton, farmers mainly grow sorghum for which they can afford the inputs. Recently, vegetable production has been introduced due to the declining prices of cotton (Table

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[3]In 2006, the UNDP embarked on a project to support fishery activities in Halaib (Assal, 2008).
[4]*Market:* Any formal or informal structure (not necessarily a physical place) in which buyers and sellers exchange goods, labour, or services for cash or other goods. The word 'market' can simply mean the place in which goods or services are exchanged. However, markets are defined by forces of supply and demand, rather than geographical location e.g. 'imported cereals make up 40 per cent of the market'. Further definitions in relation to marketing are given in a spate section.
[5]Many studies referred to the fact that, the marketing system lays the root of the fishery problem in Red Sea state.
[6]*Market chain*: General term for a supply chain or a value chain: a sequence of market actors who buy and sell a product or item as it moves from initial producer to final consumer (Albu 2010).

1.2). The board of the Government-controlled Tokar Delta Agricultural Scheme (TDAS) made it compulsory[7] for farmers to plant 60% of their land area with cotton, 30% with sorghum or millet, and 10% with vegetables with the aim to maintain cotton production.

As our main concern in this study is on vegetables, particularly tomato and okra for processing, some highlights are shown in Table 1.2 to be used as indicators for the scope of production, sustainability and continuity of vegetables supply for the intended processing industry. Table 1.2 shows that only half of the land allotted for vegetables is used with an average of 5% compared to the total area dictated for vegetables which comprise 10% of total irrigated land. Many reasons can be attributedto this low land use pattern; among them stand the marketing problem.

Table 1.2: Annual irrigated and cultivated areas in Tokar Delta for the last 5 years

Season	Total annual area planted by category (Feddan)					Total area planted
	Irrigated	Cotton	Sorghum	Vegetable	Millet	
1997-1998	42,540	6,651	5,393	1,045	5,168	18,257
1998-1999	68,745	4,852	7,937	1,230	6,049	20,068
1999-2000	47,690	3,869	5,243	1,360	4,933	15,096
2000-2001	41,720	7,695	8,522	892	7,494	24,603
2001-2002	83,902	9,906	10,862	1,200	13,149	32,117
2002-2003	60,892	4,789	5,517	1,048	11,388	22,742
2003-2004	102,485	7,790	12,123	2,790	15,400	38,103
2004-2005	38,726	4,052	8,780	1,554	10,840	25,226
2005-2006	65,340	4,400	20,012	2,588	15,600	42,600
2006-2007	49,405	4,020	21,744	1,100	17,845	44,709
2007-2008	67,570	3,912	11,425	1,873	14,195	31,405
2008-2009	6,980		3,500	500	2,000	6,000
2009-2010	29,700	532	7,317	1,093	9,140	18,082
	75,197					40,688

Source: Delta Tokar Corporation, 2011

*Detailed data for the 2010-2011 is not readily available. However total area sown in season 2010-2011 is 40,688 feddan and flooded area is season is 75,197 feddan.

For instance, in season 2008-2009, showed the lowest level of land use as due to less area irrigated (7000 feddan). In that year, vegetables grown comprise 8%of the total planted area, a figure close the permitted level of vegetables grown.

Yield information on cotton, sorghum and millet over the time span from 1997-1998/2009-2010 (Fig. 1.1) showed drastic variation among crops and between years.Cotton showed an ever deteriorating crop in terms of yields in the last years compared to other crops. However, worth to note is that, while one kantar of cotton earns 620 SDG in Gezira it only earns 110 SDG in Tokar Delta.

[7]However, it has not been possible for TDAS to enforce thiswithout provision of good quality seeds and other inputs together with the appropriate ginning and marketing facilities.

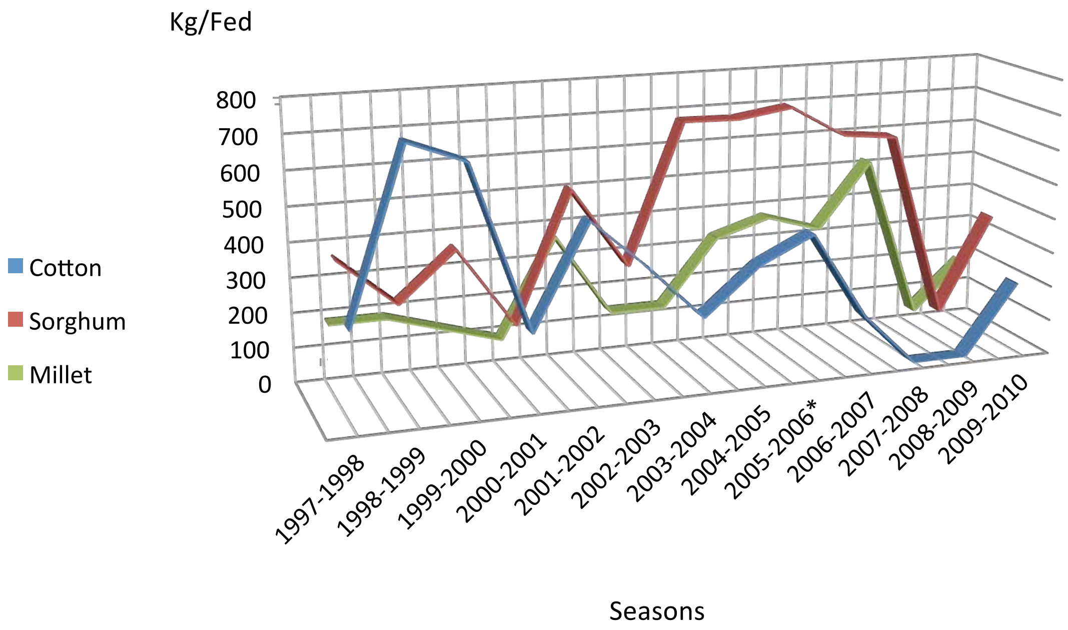

Fig. 1.1: Annual average yields* (Kg.)/feddan for three crops in seasons 1997/1998-2009/2010

*Cotton yield are indexed by multiplication by 100 to allow visibility and comparison with other crops. For real measurement of cotton yield divide by 100 to get yield in Kg. /feddan

1.4Background and economic importance of mesquite pods: can we make use out of it?

Mesquite grows widely in many places in Red Sea state, particularly Delta Tokar irrigated Scheme. The plant was first introduced to stabilise sand dunes but has taken over the Delta when farmers abandoned their land during the severe drought of the early 1980s and on the outbreak of the war with Eritrea in 1997. It has been estimated that around 60,000 feddan can no longer be cultivated because of mesquite infestation.

A recent report (Babiker, 2010) showed that mesquite has occupied 33% of the total Tokar Delta as a whole and 37% of the arable land area. The recent acceleration of mesquite is related to the customary land use laws[8] and the removal of the strict land clearance rules that existed under the original Tokar Corporation/Scheme. Migratory and resident livestock are prohibited from entering the Delta TokarAgricultural Scheme, but this has not been enforced and thus many new mesquite seeds are introduced through the dung of animals that feed on them (Anderson 2008).

Mesquite clearance is a farmers' first problem in Tokar Delta. Subsidizing mesquite clearance is not an effective option for its clearance, and control through better land management can be the feasible option.On the other hand, experience in Gash Delta has shown that sound land tenure arrangements coupled with improved supply of

[8] Anderson (2008) cited that, share-croppers do not receive any payments from landowners for clearing the land and then earn only 25% of income generated from their endeavours (and only 25% of 68% in the case of cotton).

irrigation water are sufficient for farmers to undertake mesquite clearance by themselves through group formation. It is proposed that state sponsored mesquite clearance only focus on the most infested areas and even then it is linked with follow up incentives to encourage the farmers to both participate in the clearing and then to maintain the land immediately after clearance (Ibid 2008). However, processing of the mesquite pods (which contain the seeds) into feed for animal might be a suitable option to eradicate the plant or at least reduce its dissemination and hence reduce its harmful effects to irrigated land. Throughout the remainder of this section we shall try to give utilization options through processing of the plant into useful material to both man and animal.

1.5 Justification of the SPCRP project themes

This very SPCRP-MP endeavour is to create an inductive environment for efficient marketing of processed fish and fish products that can allow small scale fishermen in Red Sea State to manage their local fish resources rationally and effectively.Second, the study is meant, in part, to promote an improved business oriented culture and attitudes in the Red Sea State. The SPCRP-MP endeavour goes, on the other hand, to explore the possibility of processing tomato and okra produce in Delta Tokarso as to generate more income to people and hence promote their local development and upraise the spirit of peace through equity.

Beginning with the end in mind, promotion of poverty reduction in Red Sea State is line with SPCRP-MP policy, with a more focus on improved production and marketing pro-poor interventions. The project will assist in reduction of povertyin Red Sea stateby increasingincome through value addition by processing of fish and also increase the area of vegetables under cultivation in Delta Tokar and Arba'at by processing of tomato and okra vegetables into marketable products. Both initiativeswill result in moreemployment opportunities and improved livelihoods in rural areas through the introduction of processing plants, the untapped resources that will ensure balanced development across all Red Sea localities;

The study is planned to investigate the market potential for selected products. The rational for this very SPCRP-MP model is to avail a conceptual marketing framework (which appears to be the missing element that lead to failure of many projects) to set a basis for constructing single or multi-product line(s)/unit(s)/(facility(s) for fishery and fishery products and also develop another model for processing of tomato either into dry form or tomato paste, and okra into dried or fresh forms as well as the utilization of mesquite pods as animal feed and even human food.

Current information shows lack of small-scalefish processing facilities across the entire state despite the abundance of fish in Red Sea state. Therefore, the study will investigate the economic feasibility and the market for processed fish products and other vegetable. Along with this thematic objective, there is also a need to investigate if fishermen are interested in producing and selling fresh or process their harvest if adequate transport and marketing infrastructure (cold stores, transport services, etc.) for this industry is undertaken.

1.6 Objectives, scope of work and research questions

a) Main and specific objectives of the study

i) The study is an attempt to provide added value to fish and fish products, tomato and mesquite pods in Red Sea State through processing into different forms. To achieve this study objective; an assessment of the potential markets, market chains and market linkage of the aforementioned products which can be profitably sold will be conducted. The study will also provide suggestions and predictions for future market development wherever possible. The study will identify and examine the essential stakeholders in the fish market (sellers, middlemen and potential buyers of products in different processed or unprocessed forms. The potential value addition to the producers should also be identified.

ii) Along with above objective, the study also aims at identifying the kinds of processing enterprises that are viable and profitable, the different types of machinery needed, possible suppliers and prices. Regarding vegetables, the study will provide suggestions as to the types of tomato being grown in relation to marketability with highlights to alternative varieties known to be preferred in the market(s). Packaging and transportation of processed products are also important elements that will be taken into account together with the costs of plant and related machinery.

iii) The study will seek means to promote the commercial fin fish processing industry in Red Sea (preferably in Port Sudan) for different market segments and shall search for alternative marketing channels that enable fishermen to obtain premium or at least fair prices for improving their livelihoods.

b) Coverage and scope of work

Four different coastal fishing regions were noted by Abeywickrama (2009) along the Red Sea coastline: (1) in the Port Sudan vicinity with landing at the *Sigala* market, (2) in the communities to the north of Port Sudan, (3) in the communities to the south of Port Sudan[9] and (4) in the extreme south around *Agieg*[10], *Agiettai* and *Adbana*. In the extreme south, the fishing communities are the poorest as they are far remote from Port Sudan the main market. Based on this information, the SPCRP project area will be along the coastal stretch from *Suakin* to *Agieg* where there are several fishing

[9] The fisheries resources are abundant in the waters just south of Port Sudan. The fishing communities here are located at Hoshiri, Kalanyaib, Suakin, Sheikh Saad, Sheikh Ibrahim, Ashad and Eiram.

[10] The *Agieg* community has few small boats (from SOFAT Company which was bankrupted by boat sales to artisanal fishermen). They are not full-time fishermen and also make a living making charcoal from mesquite trees.

communities[11]. The fisherman's union in *Suakin* has already expressed a strong interest in commercial fish drying so might be considered as a focal point for future marketing efforts. It has been observed that fishing communities are very poor and the major cause is fact that they are unable to find sustainable markets with a good rate of return.

c) *Research questionsand themes*

- What are the main characteristics of the fish value chain activities, and who are the main market participants in the market channels? Same question also holds for tomato and okra production in Delta Tokar Agricultural Scheme.
- What are the current market structures in fish markets and how participants conduct/behave in these markets?
- What is the typical marketing environment in the Red Sea fisheries and important trends?
- How could we set a better market position in Gulf and Asia markets and also inland?
- Why fish trade is not very growing compared to the abundant resource available?
- Would processing make purchasing of fish more convenient/inconvenient for the middle-class households[12] under current market prices.
- Is the retail price of fresh fish low/high in comparison with the price of fresh mutton meats, and
- Are fish supplies unlimited/limited to affect demand and how could we create new avenues/opportunity for alternative marketing channels.
- Would direct marketing of fish by the cooperatives, using refrigerated sales vans bypassing the existing market structures, feasible and possible or would it be conquered by the existing trading practices.
- Considering the sensitive issues of women in Bija societies, what will be the role of women in these types of businesses?
- What are the utmost strengths, weaknesses, opportunities and threats of the fishery industry in Red Sea State? And how can market opportunities for fish and fish products be improved? Same question also holds for tomato and okra production in Delta Tokar Agricultural Scheme.
- Etc.

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[11]The market is controlled by a cartel of 19 wholesale traders. Improvements to the structure of the fishing industry could rescue these communities from poverty and also provide better fish marketing services to consumers (Abeywickrama 2009).

[12]*Households:* A group of people, often family-related, each with different abilities and needs, who live together most of the time, contribute to a common economy, and share the food, essential resources, and other income generated by it (Albu 2010).

1.7 Organization of the study

The study falls in six main chapters. Chapter I give background information and context of analysis to the fishery, vegetables and mesquite processing to feed animals in Red Sea State. The chapter justifies the project themes and provide the objectives, scope of work and the rationale for making the study.

Chapter II overviews the methodology and approaches for the research and analysis, and gives precise definitions and concepts in relation to the study.A brief socio-economic exploration of small-scale fishermen in red sea state is given in Chapter II and also encompasses the vegetables and mesquite concerns. Chapter III explores in details the fish processing and conceptual requirements of the industry. The chapter overviewsfurther the seasonal factors affecting production and marketing of processed products and highlights on the opportunities, challenges and policy options.

Details on marketing and market analysis are given in Chapter IV; whereas elaboration and recommendations on the marketing mix for processed products are included in the same chapter. Chapter V outlines the projects organization and management togetherwith the financial feasibility. Conclusions, recommendations, policy implications and the way forward for the fish processing industry is given in chapter VI. References and annexes are cited where appropriate together with recommended readings and further research work to be accomplished.

2 METHODOLOGY, CONCEPTSAND APPROACHES FOR THE RESEARCH AND ANALYSIS

2.1 Research Approach

A comprehensive desk review of information and documents was started prior to commencement of the field work. Both quantitative and qualitative data on the current situation of small-scale fisheries, horticultural production and forest products in Red Sea state were assessed for different geographical locations along the Red Sea coastline from Port Sudan to Agieg. The primary data collection was based on interviews (focus group discussions) with key informants through community meetings with farmers, fishermen and women associations in different geographical areas (from Port Sudan, Tokar andAgieg) to reflect the diversity and integrity of targeted groups. The compiled data sets include production and marketing information to meet the study objective.

Although cultural obstacles hinder fish catching for women (but not marketing) nonetheless information was obtained since they have been involved in fish processing (salted and dried fishprocessing).The information obtained is found useful in reshaping the fish processing concept towards this stratum. Review and analysis is made for the information obtained from existing secondary sources including review of major current policy strategies.Additional information is also gathered through internet linkages to widen the scope of the subject coverage[13].For achieving the study objectives, we tend to make use of the secondary information already available by previous studies.

2.1.1 Current & on-going projects of the same objective(s)

Several aid projects were/areformerly/currently undertaken by international aid agencies, government agencies, NGOs and national development banks for the Red Sea fishing communities. The Zakat Chamber was assumed to provide 100 wooden boats to fishermen in the south-central coast area free of charge by the end of the year 2010 while beneficiaries are required to obtain their own outboard motors through a bank loan. Under the patronage of the Ministry of Social Affairs, the Farmers' Bank has initiated a one million SDG project to supply 100 fishing boats to register coastal fishermen of cooperatives or associations of a group of 4 fishermen per boat. Each boat cost 10,000 SDG at an interest rate (Murabaha) of 10% after a two month grace period with undated blank cheques as guarantees and mortgages of boats to the banks. The Zakat Chamber is also offering a scheme of 30 small vans to be utilised to create small

[13]While reviewing the fishing practices and production techniques adopted by small scale fishermen in Red Sea the author observed that, an integrated approach that focuses on the livelihoods of fisher households and communities is essential. This could be made by further studies by introducing a fishery industry concept at that level to address the problem. Such a wide based approach will require, above all, a comprehensive understanding of the Bijas' household livelihoods by identifying and analysing their various options, constraints, risk minimizing strategies, coping, survival or investment strategies as well as the effects on the households of larger natural environment factors (such as seasonality) and of the political economy context (Bonfiglioli and Hariri, 2004).

entrepreneurs with the help of the UNIDO to train and build capacity of entrepreneurs. UNIDO usually focus on small scale fish, vegetables and other BHEs enterprises for food processing. Famous of UNIDO projects currently underway is the erection of *landing sites* for fishermen to sell, maintain their boats, and purchase inputs as ice, nets, spare parts, etc.

2.1.2 Some of expected outcomes and outputs of the study

The main expected outcome is to provide a consistent, comprehensive document that will assist the SPCRP-MP management to understand, plan, and implement action plans and project intervention/projects through the small scale microfinance tools. Other outcomes that revolve around and move in same direction include but not limited to the following:

- ✓ Marketing analysis conducted, andmarket-driven diversification stimulated
- ✓ Major production centres along the red sea coast identified, andthe size of the market in fishery and related products[14]estimated.
- ✓ Different marketing channels taking product from the producer to the consumers identified.
- ✓ Current marketing arrangements in fish markets identified and analysed and mitigations for improvement proposed.
- ✓ Consumers' purchasing powers/habits of specified food products (fish, tomato, okra and mesquite pods for animal feed) assessed.
- ✓ Feasibility study of fish processing plantoutlined.
- ✓ Existing (and anticipated) fish marketing problems and constraints in processingidentified.
- ✓ Marketing strategy(ies) for processed fish and other vegetable products developed.
- ✓ Knowledge on market and market opportunities for fisherman and vegetables producers of Red Sea State disseminated.

The intention in this study is to go for community based processing equipment and possibly through the construction of small scale processing/collection centres that provide better incomes for the poor, in both fish and vegetables production. However, issues of fishery cooperatives vs. individual fisher households[15] will be highlighted. On fish, focus will be on small scale fishermen (artisanal) and less emphasis on big or large scale fishing by big boats (trawlers) or outboard motors with better fishing gears.

[14] However, the fish study will include suggestions for the export opportunities of fish products to the different States and external markets including the value added products (e.g. fish crisps, fish pickle.) but excludes ornamental fish.

[15]The well-off or wealthierhouseholds who have assets (boats and equipment) and hired labour is negligible). It is only small number of big companies (Ba Bood and Osama) who are characterized by having a number of assets and diversify their investments (including shrimps, fish harvesting, processing, and distribution). Our observation showed that, a negligible fraction of the fishers in the Red Sea belong to this type, while in Ageig it does not exist.

2.2 Definitions and Concepts

a) Definitions

The definitions given in this text are meant to facilitate understanding of marketing issues beforehand in a more precise way and also in the context of Red Sea state. Therefore, and unless otherwise stated differently, the following definitions will hold true for each particular term. As our concern in this study is the small scale fishery (artisanal fishery sub-sector), the author tried to avoid the generally broad marketing and big industry definitions that are not strategically meaningful -at this stage- in the situation of the Red Sea State. However, some of the definitions are seemingly broad, though useful to broaden the scope of handling the fish industry in future studies. Though, some of the definitions are not widely used in Sudan, but remain applicable and essential when needed, therefore; should be understood within the terms of reference specified in this study.

i) Food:is anyraw, cooked, or processed edible substance, ice, beverage, or ingredient used or intended for use or for sale in whole or in part for human consumption.

ii) Food Processing:describes the food (fish) intended for sale as human food and "processed" in a way that includes canning, extracting, fermenting, distilling, pickling, freezing, drying, smoking, grinding, cutting, mixing, coating, stuffing, packing or packaging.

iii) Food Processing Plant:isany place where food processing is conducted. "Food processing plant" does not include any establishment subject to the requirements of Retail Food Establishment.

iv) A cold store is any building or part of a building used for storage at temperatures controlled by refrigeration at -1WIC or lower (FAO, 1994).

v) Processed Fish:is fish that is processed or preserved for human consumption by means of smoking, curing, salting, drying, marinating, pickling, fermenting or related processes.

vi) Fishery products: the term includes a diversity of products of which stand the following: chitin, chitosan, shark fin and fin rays, fishmeal, fish body oil, shark liver oil, Fish maws and icing glass, fish skin leather. Pearl essence, Fish extract, shrimp extract, fish glue, fish fertilizer.

vii) Fish silage value added products fish sausage, fish soup powder fish wafer, fish cutlet, fish ball, fish fingers, and fish cake.

viii) A market system is 'a network of producers, suppliers, processors, traders, buyers, and consumers that are all involved in producing, exchanging, and consuming a particular item or service. The system includes various forms of infrastructure, input providers, and services (Albu 2010). This market operates within the context of rules and norms that shape this system's particular business environment.

ix) *Market structure*: In economics, market structure describes whether a market is essentially characterized by competition, or oligopoly, or monopoly. The degree of rivalry among buyers and sellers in a market – and hence its structure – is determined by relatively stable features such as the number and size distribution of market actors, the degree of differentiation between them, the availability of market information, and the nature of barriers to entry.

x) Oligopoly: A situation in which a small number of market actors controls all (or nearly all of) the market for a given type of product or service. This is a less extreme form of market power than monopoly. However, oligopolies can lead to monopoly like situations if those few traders collude to set prices, rather than competing against each other.

xi) *Cartel*: A group of enterprises or traders who attempt to limit competition and control prices or the supply of a good or service through mutual restraint on production or supply, or simply by colluding to fix prices. *See also* 'oligopoly' (I*bid* 2010).

xii) *Competitiveness*: This is a completely different concept from competition. It refers to the ability and performance of an individual enterprise (or an entire value chain) to out-sell and supply goods and/or services, compared with rivals in a given market (I*bid* 2010).

xiii) Fish product assembly and market linkage services: Any service that brings together or leads to the mobilisation and organisations of fishermen into more efficient units to better link up with buyers at the landing sites. Such service targets the mobilisation and strengthening of the fisher folk into strong organisations for collective actions in landing site development, management, and effective marketing linkages. It could include mobilisation, formation, and training of new fisher folks groups/associations; strengthening of existing groups; and backward and forward linkages of fisher folk groups to large buyers (USAID 2004).

xiv) Quality assurance services: Such services include all activities related to delivery of improved quality fish to the market. It includes training of fishermen on fishing methods and techniques that ensure quality fish; training on after-catch handling and hygiene; quality issues in processing and export; and technological issues particularly in boat design and structures for quality assurance, particularly with regard to ice preservation (Ibid 2004).

b) Concepts and Notions

Five different types of fishing are known worldwide and include artisanal, subsistence, industrial[16], recreational and experimental fishing (Gulaid 2004). The small-scale fisheries (SSFs), also called 'traditional' or 'artisanal' fisheries, are our

[16]In relation to this, a distinction between the two definitions the *artisanal processors* and the *industrial processors* (with different concepts) need to be highlighted as to avoid confusion by the reader. The artisanalprocessors include small-scale processors (SSPs) who are labour-intensive and well linked (backwards and forwards) to small boats. The processing is commonly in the form of filleting and freezing or chilling, smoking, frying and sun drying for preservation purposes given that fish is highly perishable. The industrial processors, on the other hand, provide the necessary storage, packaging, and labelling and expand the scope of the market both locally and internationally leading to growth and expansion of the sub-sector (for more information see USAID 2004).

main concern in this study. However, in this study, the term ‘artisanal fisheries’ is different from ‘subsistence fisheries’ where the former constitute a labour-intensive production system based on the harvest of fish products by small units of artisanal craftsmen (generally belonging to a same household, a same cluster of households or a same kin group) with or without the use of external hired workers (Bonfiglioli and Hariri, 2004).Subsistence fishing, on the other side, is entirely for private consumption carried out on individual basis fishing without the use of boats and does not contribute significantly to employment and income generation. In some texts, the terms subsistence fishing and artisanal fishing are used interchangeably.

As information on vegetables production is seemingly adequate as Delta Tokar Agricultural Scheme has long history in data records, highlights will be made on the socioeconomics of fishermen and their incomes in the next section.

2.3 Socio-economic exploration of small-scale fishermen in Red Sea State

2.3.1 The main characteristics of Small Scale Fisheries in Red Sea State

The population in Red Sea State is an interaction of multifarious socio-cultural factors of herding, cropping and fishing practices. The following points represent salient feature of fisheries along the coastline of Red Sea State:

- ✓ Poor fishermen with poor business management skills and weak group organizations/associations. Most of fishermen use hand driven small boats, simple equipment (with unsophisticated technology), small amount of capital and energy. For this reason, the small scale fishery men can only go for short fishing voyages/trips close to shore (a distance of about 5-7 nautical miles(not exceeding a week and usually of half-day or overnight) coming up with a relatively small amounts of production.

- ✓ Although fish is sold fresh in principal, common processing equipment on land sites include techniques for salting, drying and, and rarely use icing fish). This has resulted in low level of income and less capital for investment.

- ✓ There is monopolistic conduct (moving towards an oligopolistic behaviour where few dominate the market) in the fish business market (Sigalatraders, lorry drivers &transporters, etc.). Such conduct renders fishermen highly dependent on services provided by a number of cartel traders.
- ✓ The fishing practice is mostly seasonal (seasonality factor let most fishermen be in agricultural farming and/or herding).
- ✓ Sea fishing has both production and market risks as no marine insurance currently exists for small boats fishermen.
- ✓ Low level of technology usage due to illiteracy and there is a need for small institute to train fishermen as well as organization of fishermen into efficient association.

2.3.2 Fishing expeditions (voyages) and net annual income

No data is available on the number of fishermen in the Red Sea State. However, artisanal fishing and processing does not provide employment to a large number of people in the Red Sea State. Even though there is data lack regarding the employment generated by private companies, it has been estimated that a total of 2,000 to 3,000 people are employed in private fish export and processing operations with a range of between 5 and 200 employees per enterprise.

The Department of Marine & Fisheries Department has no adequate information on fishing sector as to the number of employees. Given this situation, it is rather difficult to assess total fish harvest which usually escapes official records. Little information is available on number of voyages per boat or per annum, estimations deem necessary therefore to fill in the apparent information gap. Information from previous studies (Abeywickrama 2009) showed an annual harvest per small artisanal fishery boat to approximately 8.2 MT per season, and if the number of working boats ranges between 150 and 200, an average annual harvest will range between 1230 to 1640 MT per year.

Taking an average price for average fish types as 6-12 SDG/kilogram we will arrive at a total volume of minimum sales of 7,380,000-14,760,000 SDG/annum and a maximum sales volume of 9,840,000-19,680,000 SDG/annum.The amount of sales and revenues can be increased by upgrading the market with value added products for the higher income segments of the market by developing filleted and packaged fish product for the supermarkets in Port Sudan and other towns in other states including Khartoum and abroad.

2.4 Main participants in fishing industry: their roles and functions

In this section only few highlights as to the socioeconomic of participants will be viewed and details as to their market behaviour, conduct and performance shall be presented when dealing with market analysis in upcoming chapters. The main institutions/associations which participate in the fishing industry shall also be reviewed as to their roles and functions in promoting the fish industry.

a) Fishermen and market participants

Various participants are involved in the fish industry along both the supply and demand chain/sides. The fishermen andthe suppliers of the fishing process (who avail credit to finance operations) represent the supply side in the fishing industry. Their role, as the name indicates, is to avail raw material to be supplied to local and export markets. Along the supply chain, the market side involves wholesaler, retailer, middlemen/brokers and distributors who can supply supermarkets, hotel agents and customary consumers with food. The chain extends to include the processing (fried grills *'Shawayat'*, dried, salted, filleted, etc.). Exports are usually made by company agents, through the classical international marketing system. Details on these issues shall come where appropriate in subsequent chapters.

b) Institutional roles of department of fisheries and marine resources in Red Sea State

Of the main roles of the Department of Fisheries and Marine Resources in Red Sea (DFMR, RSS) is to availing statistics, studies and documents concerning quantities, prices and other necessary information. As the department is concerned with all types of live marine resources in Red Sea, its mandate is to provide basic training in fish handling, technology provision to fishermen to improve fishing (deep and shallow waters' nets) and provision of training on methods of fish catching, fish processing and filleting, drying etc.

Despite the fact that, the Marine and Fishery Department of Ministry of Agriculture is underestimated, underscored and under-resourced, nevertheless, its close collaboration with security forces (Military Intelligence, marine security forces, etc.) for control of smuggling trade, particularly fish products continued. To strengthen the link between the institutions involved in fishery, there should be an active coordination body between the College of Marine Sciences, the Marine Fishery Department (MoA), the Marine Research Station and the Ministry of Environment and Tourism and others in order to promote the fish industry. Besides, the activation of Coast Monitoring and Control measures and laws remains equally important for fishermen for safety-first measures as life-jackets, compasses, shipping equipment for marine vessels, communication radios, etc.

The current status quo condition shows that, the marine and fisheries department is under-equipped to go for collecting and disseminating information on fish market supply, and for sure, cannot provide information on foreign or national/domestic and international markets. The department lacks computer facilities for information gathering, processing and analysis and thus is unable to provide fishermen/consumers with advice on seasonal trends, and regularly identify products that are in demand on domestic and foreign markets. The real challenge for Department of Marine Fisheries is the compilation of all its accessible data into a manageable information system, capable of satisfying both local information needs and also has regional access and global dimensions.

c) The Sudanese Standards and Metrology Organization (SSMO)

SSMO office in Port Sudan is concerned with the technical implementation of laws and regulations issued by SSMO in Khartoum. Their main duties in the fish/fishing sector include:

- Inspection of frozen fishes (microbial test, HACCP, etc.)
- Implementation of import and export specifications for frozen and smoked fish

- Gradual implementation of the technical specification of sea food on local market, which has been embarkedin early 2008[17].

Currently, there is no recipe for a standard specification for fish processing (factory specification and product specification including those for vegetable processing); however, the SSMO can readily develop such standards upon request when required. Until that time comes, they sometimes apply the Gulf specification, Arab or international specification to protect consumer from health hazards.The rules of procedures for SSMO include:

- Export contract(s),
- Form of the Central Bank for export purposes,
- Field and laboratory inspections of products,
- Commercial documents (as contract, hygiene and standards, etc.) to apply the specification to.

No doubt, the SSMO can play a leading role in designing the procedures for fish industry specifications and also vegetables as well as raising awareness on quality and hygienic measures and standards for sea foods in the entire country, including the Red Sea state.

d) Role of women and other development Associations

Through development organizations, women play a substantial role in fish processing in the Red Sea state, particularly fasiekh and kajek making.The pressure of life and role of NGOs have changed the mind-set of the Bija society towards a positive role for women in work (Annex 2.1-a, b). One can loudly say; women can now participate in all fishing activities, other than direct fishing, including vegetables processing when well trained. For instance, a sizable number of women participate in fish processing by traditional processing units in the area between the Airport and Trucks port near Port Sudan.Many women development associations are active in Suakin, Tokar and Port Sudan (Annex 2.1-a, b& Annex 2.2).

[17]There is a committee which composes of local authorities, Consumer Protection Association (active in making kasha campaigns) to inspect food as milk, meat, etc.

3 FISH PROCESSING AND CONCEPTUAL REQUIREMENTS

3.1 Preamble to fish processing

Fish are excellent water animal to rear where they can convert the feed into body tissue more efficiently than most farm animals, by transforming 70% of their feed into flesh (INCONSULT 2006).With such a highly perishable product, and the many constraints in the Red Sea state, fish processing will not at all be an easy business as it may face many challenges, suchas varying and uncertain fish supply and difficult working conditions including power and water availability situations. To succeed in this business, hopefully, much attention should be given to the 'tough' environment as Red Sea coastline when thinking to establish a small fish processing unit or small plant.

It sound obvious that government usually think of employment opportunities and income generation for fishermen/farmers, individual fish entrepreneurs usually think of how much money they will earn or lose if they get into such business?Many unsuccessful stories in fish processing plants were observed worldwide and some of them ended up losing money, effort and shutting down for inappropriate organization of the processing unit/plant or misconception and understanding of the many other reasons that can cause failure.

To avoid such silly faults, preliminary answers to basic questions as adequacy of fish supply (will there be enough fish for the plant to run and for how long?), the level of competition (will fishermen sell the fish to you or to other buyers?), and the market for sales of the processed products (where is the marketplace), all thesequestions need first be clarified before going deep into the processing unit/plant business. Even if answers to the aforementioned queries are clear, two more questions -typically in the case of Red Sea State-, which relate to the organization and labour management of the processing unit/plant, will probably be a puzzle.For this purpose, (Knapp and Reeve, 2008) envisioned management puzzle twice (can you get a good processing plant manager? and can you get good workers?)before erection of a processing facility/ unit/plant.

Even if management is to the perfection, failure may arise due to poor quality and spoiled fish (can you produce consistent good quality?) or poor transportation and storage media (can you get reliable transportation and refrigerated storage at a price you can afford?). Additional questions as described by Knapp and Reeve are left to annexes (Annex 3.1). The questions posed are also applicable to the case of processing of tomato and okra with some modifications.

The implementation approach followed in this study gives a result-based exercise which stresses on the need to establish a working model of small-scale fishery processing unit(s)/plant that solves the fishermen marketing problem by The Red Sea and along the fishery market chains rather than an identification of a multitude of small marketing initiatives lacking a coherent vision. Such a model will lead us gradually from subsistence-oriented to market-oriented fish industry that can further grow from semi-commercial to full commercialization of the fish sector in Red Sea State.

To make this industry successful a question posed is: Should SPCRP-MP go for cooperatives' support to establish a pilot plant/unit(s)by provision of capital equipment for small scale fishing and also provision of credits under present cooperatives' mal-organization (or new forms) or whether to go for support of capable business entrepreneurs for having viable SMEs. If answers are in favour of cooperative associations, we should know whether such seed money should be allocated equitably among members to run small processing enterprises or collectively with or without collaterals?

In both cases, the proposed SPCRP-MP fish processing plant (unit(s) or facilities) would act as a catalyst that will trigger changes that will benefit directly or indirectly the entire fishing industry in the Red Sea in a short period of time. The small scale fish processing plant could be established on an experimental basis by adopting clear methodologies and tools of a community-driven development programme, be it through cooperative association or on individuals basis, but and overall, should end up with empowerment of fishery-men, processors, increase the demand-driven responsiveness of the society, and give greater administrative autonomy and accountability to the fishermen community.

Conclusion: Value-adding is not necessarily profit-adding. In other words, you can earn a lot of money and be successful just by keeping your operations simple (Knapp 2008)

3.2 Theoretical overview of fish and vegetables processing

3.2.1 Theoretical overview of fish and vegetables processing

The seafood industry in developed countries as shown by Colic et al (200x) consists primarily of many small processing plants, with a number of larger plants located near industry and population centres. Till we reach that age, SPCRPis to remember that industries always be in clusters. Numerous types of seafood are processed, often at the same plant. Saltwater fish (tuna, sardines, pacific whiting, swordfish), molluscs (oysters, clams, scallops), crustaceans (crabs and lobster) and others such as shrimp, octopus etc. are often processed concurrently or seasonally.

The aim of this intensive theoretical overview of fish processing is to give background information so as to improve our understanding of the subject matter and help in informed decision as: from where to start, and where to go and how long will it take us to achieve it. As it is not possible to cover all theoretical aspects of fish processing in this study within the given time frame, focus is made on filleting of white and oily fish, the canning industry and the production of fish meal and oil,only from theoretical basis. Again, the extensive theoretical elaboration is meant to provide a wider picture of the industry in order to display to our business entrepreneurs various types of technologies available to help them decide which one to use on cost effectiveness basis. Thus, information presented in this respect will provide plentiful guidelines to be generated for other types of processing activities, hopefully during this SPCRP-MPterm.

Fig. 3.1 shows a series of processes involved in white fish processing (UNEP 2000).The pre-treatment of the fish involves the removal of ice, washing, grading according to size and de-heading, if this has not been done previously on the boat.Large fish may also be scaled before further processing.The next step in the process is filleting (Fig. 3.1), which is generally done by mechanical filleting machines[18]. The filleting section is generally separated from the pre-treatment area by a wall, to prevent workers and goods passing from the non-sterile pre-treatment area to the sterile filleting area. The filleting machines comprise pairs of mechanically operated knives which cut the fillets from the backbone and remove the collarbone. Some fish fillets may also be skinned at this stage(UNEP 2000).

In the trimming section, pin bones are removed and operators inspect the fillets, removing defects and any parts that are of inferior quality. Offcuts are collected and minced. Depending on the final product, the fillets may be cut into portions according to weight or divided into parts such as loin, tail and belly flap. As a final step before packaging, the fillets are inspected to ensure they meet product standard.

Fresh products are packaged in boxes with ice, the ice being separated from the products by a layer of plastic. Frozen products can be packed in a number of ways (Table 3.1). Fillets or pieces can be individually frozen and wrapped in plastic, but the most common method for them is to be packed as 6–11 kg blocks in waxed cartons. The blocks are typically frozen and then kept in cold storage[19].If the cold chains (cold storage facilities) are developed in Red Sea State, the variety of species, processes, methods of presentation and packaging available will be providing a wider scope for the preparation of numerous frozen fish products. These products, however, can be

[18]The fish processing entrepreneur (or SPCRP-MP management) can choose simpler plants which can do with simpler technologies but remain with the same idea.

[19]An FAO publication (FAO 1994) showed that freezing and cold storage is an efficient method of fish preservation but does not improve product quality. The final quality depends on the quality of the fish at the time of freezing as well as other factors during freezing, cold storage and distribution. The important requirement is that the fish should at all times be kept in a cool condition before freezing, about 0°C, and the use of ice or other methods of chilling is recommended.Freezing and frozen storage of fish can give a storage life of more than one year, if properly carried out. It has enabled fishing vessels to remain at sea for long periods, and allowed the stockpiling of fish during periods of good fishing and high catching rates as well as widened the market for fish products of high quality (Ibid, 1994).

separated into two main groups; products intended for direct consumption and products intended for further processing [20](Ibid 2000).

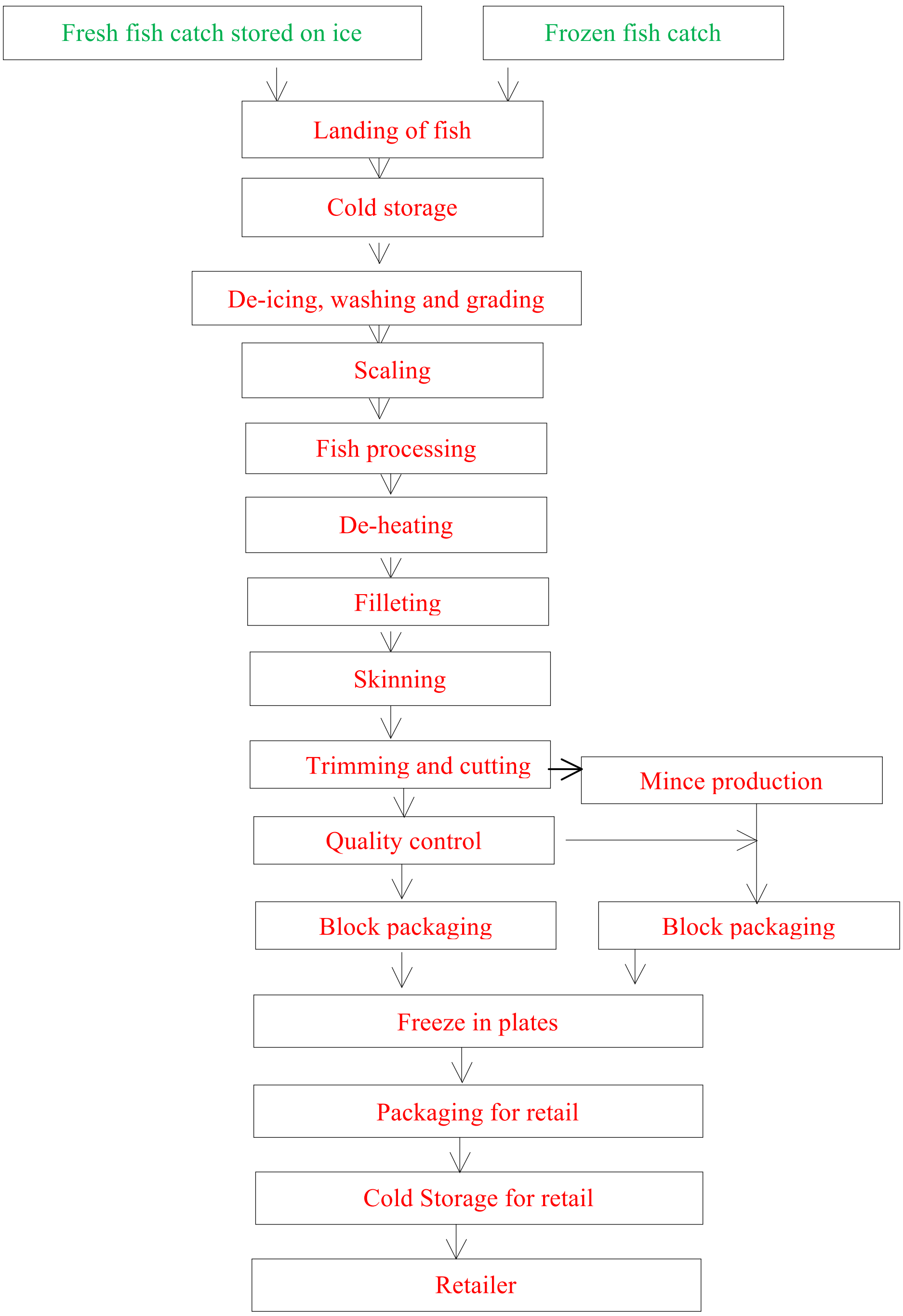


Fig. 3.1:Process flow diagram for the filleting of white fish(adapted from UNEP 2000).

Important in fish processing is the assessment of fish quality, by carefully investigating the many variables that have an impact on this protein source. Each species are to be

[20]The latter intended for further processing is usually produced for two purposes: a) frozen in bulk and thawed after storing, to be used as newly caught, unfrozen fish or b) frozen in bulk and after storage, further processed without thawing so that it may be presented as a retail pack (Ibid, 1994).

examined individually with respect to its environment, composition, harvesting and methods of handling.

Table 3.1: Packaging methods and applications

Packaging Method	Details	Process
Coated paper bags	Polythene-lined sacks	Hand
" "	Metalized Laminate	Hand / Mech.
Plastic film bags	Polythene - laminated (preferable) generally transparent-sometimes over printed- can be metalized or opaque	Hand
" "	Heat sealed	Hand/ Mech
" "	Film pulled tight by vacuum	Mech
" "	Vacuum-packed and suitable for boil-in-bag cooking	Mech
Shrink/stretch film	Shrink applied as sheet or tube. Shrunk by heating	Hand/ Mech
Cartons	Waxed or laminated board	Hand, Mech
Trays	Plastic Foil, Plain, Foam, and Overnable	
Boxes	Polystyrene foam	

Source: FAO, 1994

It must be understood that no single index of quality has been standardised (as far as SSMO is currently concerned) and that there are microbiological, chemical, biochemical and physical interactive changes that require testing. A number of different tests can be used for estimating the degree of spoilage in fish. FAO (1994) suggests tests that include total bacterial numbers, total volatile bases, TMA, total volatile reducing substances, indoor sensory analyses, refractive index of the eye fluid, electrical parameters of the fish flesh, volatile acids, volatile ammonia and total volatile nitrogen. All of these however, require considerable judgment, if they are to be interpreted correctly (Ibid, 1994).

The steps involved in the filleting of oily fish are summarised in Fig. 3.2.Oily fish species are characterised as those having oils distributed throughout the fillet and in the belly cavity round the gut. Fillets from these species may contain up to 30% oil. Oil content varies not only between species but also within species. Oily fish species are very rarely gutted or cleaned on board the fishing vessels, due to the high oil content and the consequent risks associated with oily surfaces (UNEP 2000). Keeping the skin of the fish intact also reduces oxidation of the oil and thus maintains flesh quality. Oily species can be filleted like white fish species, but they are also used for canning (Ibid, 1994).

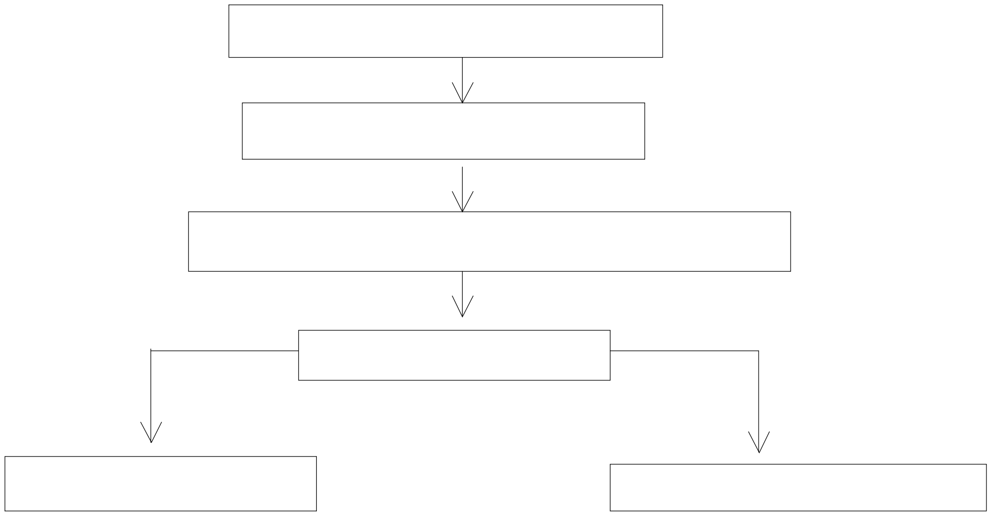


Fig. 3.2: Process flow diagram for the filleting of oily fish (herring) (borrowed from UNEP 2000)

The steps involved in fish caning are summarised in Fig. 3.3. In this process, all fish is degutted, skinned, can filled and precooked and sent to storage.

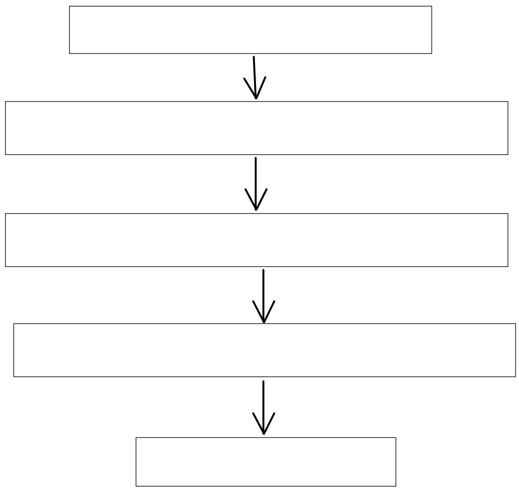


Fig. 3.3: Process flow diagram for caning process of fish (borrowed fromUNEP 2000)

The steps involved in fish meal in fish oil production,which seema bit complex, are summarised in Fig. 3.4.Despite the less use of fish meal as an input in relevant Sudanese industry, yet investment and market opportunities remain important to business entrepreneurs in this regard. Fish meal and fish oil are produced from fish that are caught specifically for this market, by-catch from fishing activities and solid waste from filleting and canning. Fish meal and fish oil products have a high nutritional value. Fish meal is used as feed for livestock and farmed fish, and the oil is used as an ingredient in paints and margarine(UNEP 2000).

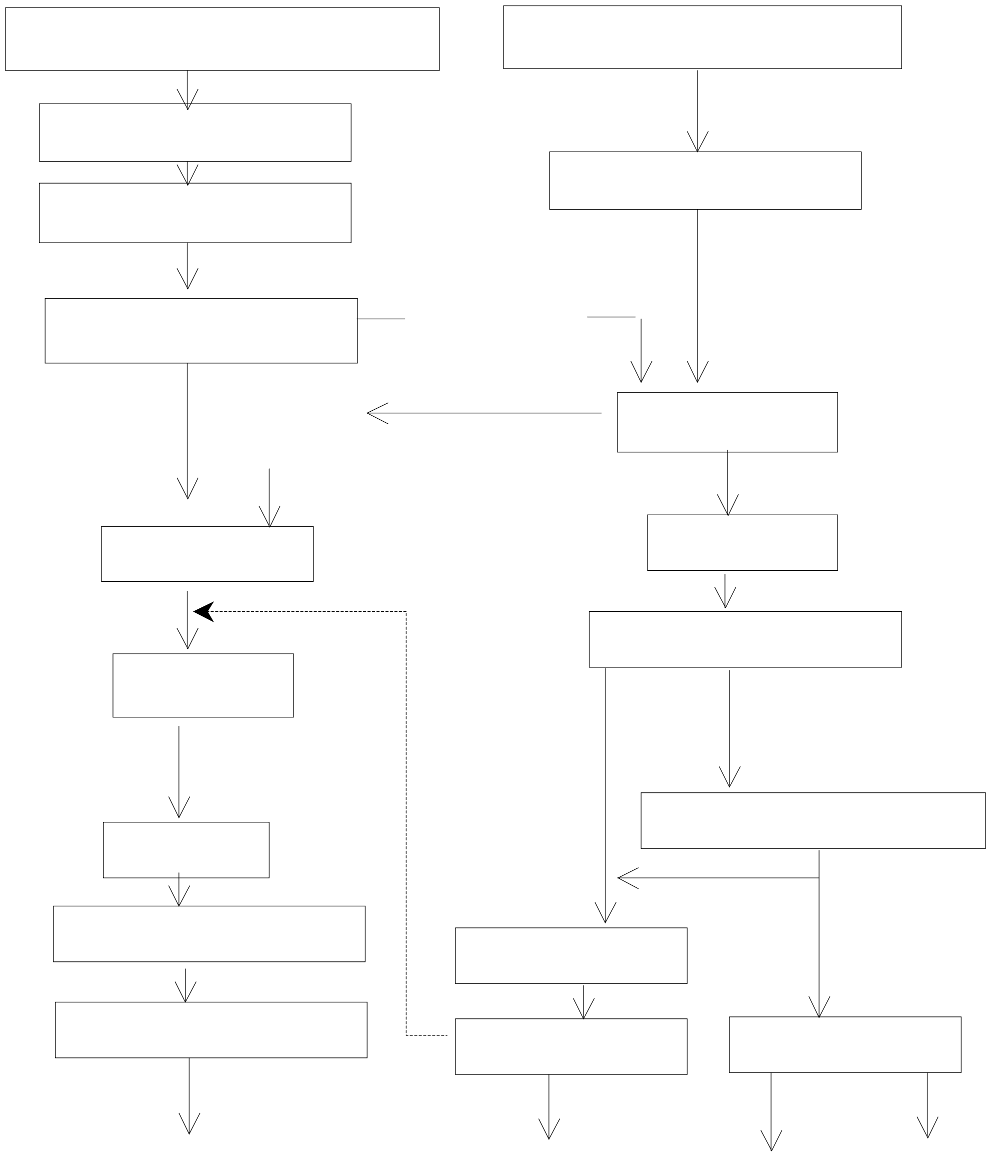


Fig. 3.4: Process flow diagram of fish meal and fish oil production (borrowed from(UNEP 2000)

Fish meal is derived from the dry components of the fish, and the oil from the oily component. Water, which makes up the rest of the fish matter, is evaporated during the process. Most fish meal and fish oil production processes are automated and continuous, and comprise several process lines, each with a certain processing capacity. Production rates vary considerably, according to the season and types of fish being processed.

From purchasing, through various stage of drying, salting to selling again, a generic salt-and-dry production process, is given by CIPEC (2005). This flow chart of stages and processes can be adaptable to Sudan's fishing industry (Fig. 3.5).

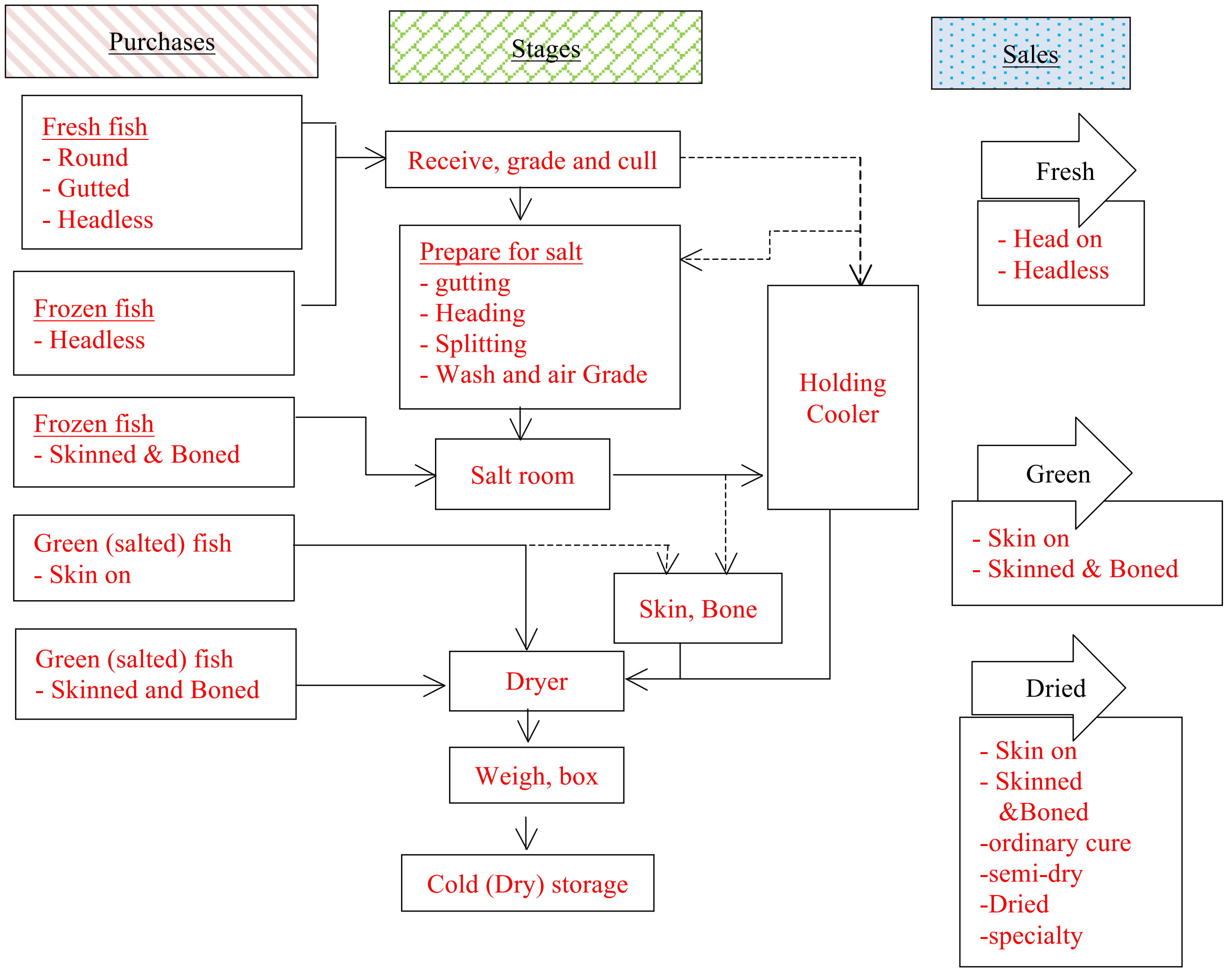


Fig. 3.5: Generic Salt-and-Dry Production Process (Adapted from CIPEC, (2005).

3.2.2 Theoretical overview of vegetables processing

Tomato and okra can be processed into different forms depending on the type of variety and the intended product use[21]. In all cases, we need to make a distinction between fresh tomato/okra markets and the industrial tomato/okra markets for they are totally different tackles. Moreover, producers usually expect high prices at fresh market produce than those offered by processors who convert them into new forms/products. In this context, processing into other products is only meaningful during glut seasons, where produce can only spoil if not sold.

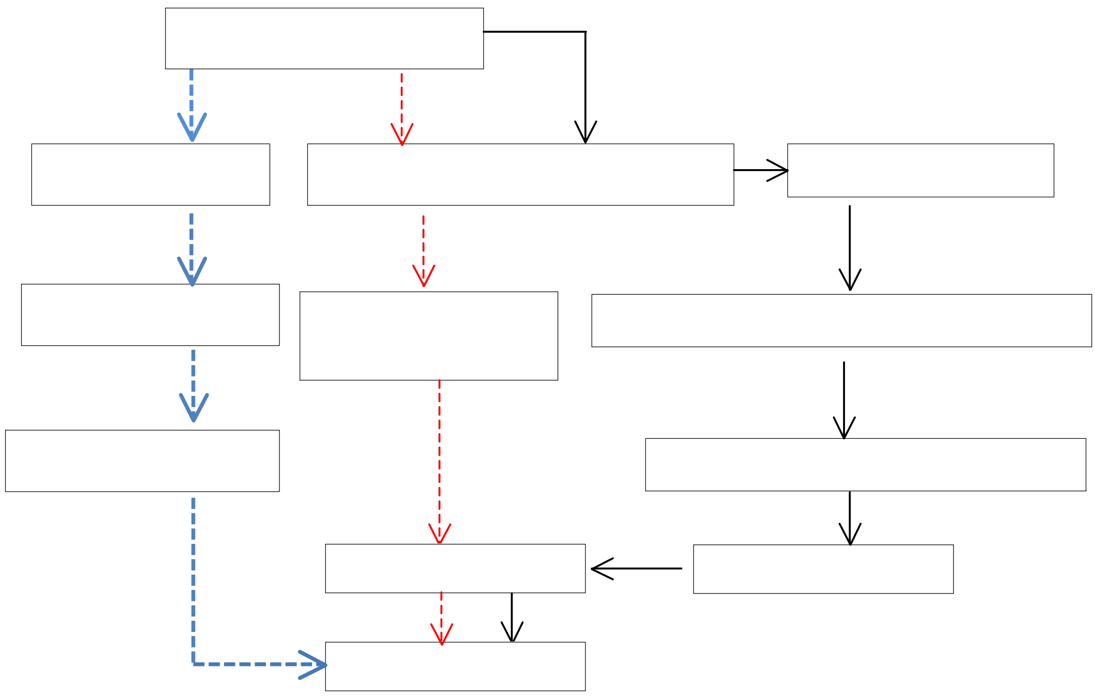
[21] For instance, tomato brix (concentration) varies according to intended use as tomato paste 30%-32%, tomato puree 12%-15% and fruit pulp 10%-26% (more information will be given in financial analysis tables)

a) tomato processing

Tomato is a rich source of vitamin A & C and is cultivated over vast area of land in the world.Tomatoes can be processedfresh bysorting, grading, and packing/packaging (Fig. 3.6). In many parts of the world, dehydrated tomatoes are often used as secondary ingredients by large multi-national firms (USAID 2008-b), therefore, are commonly produced in enclosed ovens that are heated by steam or fuel oil to ensure meeting the standards for quality characters as size, shape, consistency and microbiological content (Fig. 3.6). However, open air drying for this product is not acceptable for it does not meet these requirements (Ibid 2008-b). The possibility of producing sun dried tomatoes, using solar ovens, remain first option in glut seasons for the capital investments are relatively low-cost and also labour-intensive activity, which provide employment for many people in Tokar (Fig. 3.6).

Simple tomato pasting operations can also be made when conditions are favourable (Fig. 3.6). Important to consider is the Etabeet effects on products quality. Whether sun dried or oven dried, Etabeet winds during the dry season might contaminate sun dried products for it contain inorganic matter and microbiological contents.

Fig. 3.6:Three processes for tomato (fresh, dried and sauce/paste[22]).



Notes: Thick blue lines indicate simple processing operations ---->
Thin black lines shows transformation of tomato into a new product (tomato paste)
Thin dotted red lines shows drying operation ---->
*Glass jars are subjective to breakage

[22] If SPCRP intended to go for tomato pasting (with 30-32%, additional processes need to be involved as following: sorting/washing, scrubbing, chopping, thermo-breaking whether hot or cold, pulping, refining, evaporation/concentration, packaging, storing and then send to consumers.

Sun dried tomatoes may represent an option for value added processing of tomatoes[23] in Tokar when no winds *'Etabeet'*are prevailing. In sun shiny whether, dried tomato production is a relatively low-tech operation, despite the risk of biological contamination since the process is conducted in the open air. However, following a strictly good post-processing management (monitoring and testing) its safety and quality as a food product can be assured.

b) okra processing

Okra is a vegetable crop that belongs to the genus *Abelmoschu*s, family *Malvaceae* and requires almost two months for maturing. Okra is essential in human diet all over the country and the economic importance of okra in DeltaTokarcannot be bypassed. Okra contains carbohydrate, proteins and vitamin C in large quantities and the essential and nonessential amino acids that okra contains are comparable to that of soybean (Farinde et al 2007).

Fig. 3.7 shows the various: processes involved in okra, which may also be applicable to Jews mellow and chilli drying and processing. The dotted lines indicates linkages to these various processes, whether being manual, semi-mechanical, a combination of the two or using fully modern equipment. The tools used for processing fresh okra are knifes, graters, and mortar and pestle/grinding stone respectively (Ismail 2011).

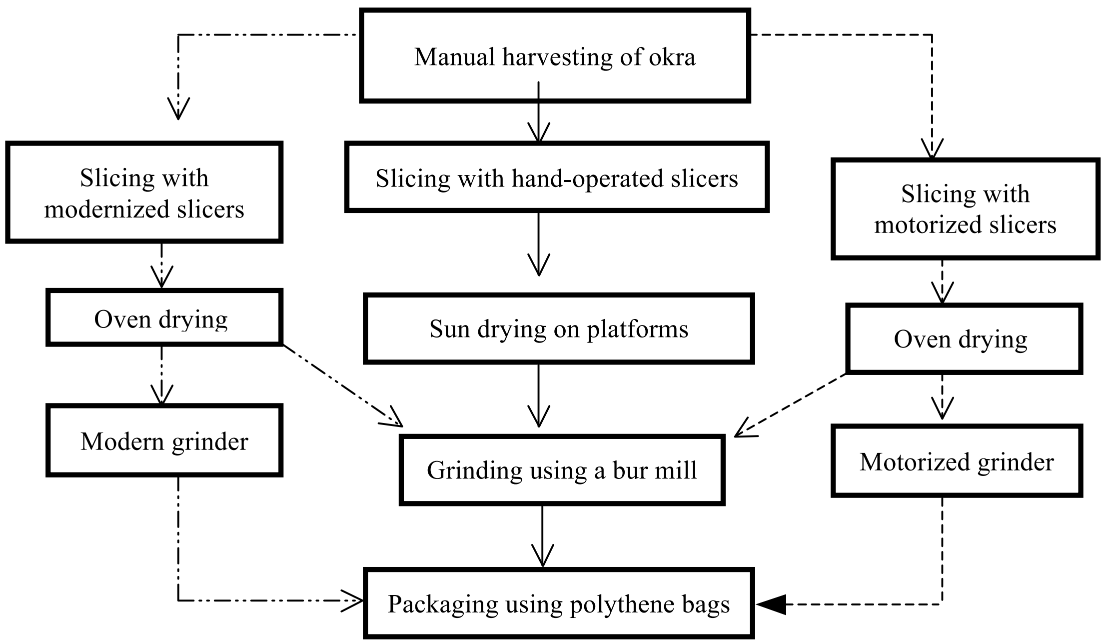


Fig. 3.7: processes involved in okra drying and processing

Similar to the Blue Nile study, mechanized processing can be introduced on small scale to medium size enterprises in Red Sea State (DTAS). *Hamadtu Engineering*

[23] An oven dehydrated tomato will have <5% moisture content, whereas sun dried tomatoes have between 15% and 18% moisture content. For ovens, the conversion is 20Kg of fresh tomatoes to make 1 Kg of dehydrated tomatoes(USAID 2008-b). Depending on the location, sun drying usually takes 3 days.

Company can design and produce intermediate technologies for processing okra upon specifications given by engineers.

Preservation of okra is an important step along the marketing chain where okra could be stored for future use or for immediate consumption. Some problems of spoilage will be encountered during production and could be overcome through proper preservation. Preservation can be done naturally by sun drying sliced okra for three days or with artificial drying facilities. Dried okra can be stored in baskets or bags. The dried okra is ground and cooked when needed for consumption. Grinding can be by crushing stone or any modern equipment (Fig. 3.7). The steps involved in processing okra (grinding after drying) can also be applies for Jews mellow and chilli pepper. Okra is basically used as food in different forms, dried and fresh okra which is usually sliced, grated, or crushed to make soup (Fig. 3.7). Both manual and semi-modern processing methods can be used for processing both fresh and dried okra (Fig. 3.7).

3.3 Seasonal factors affecting production and marketing of processed products

The food industry is becoming the most dynamic and innovative sector in the national and the global economy. The sector is vastly growing with the emergence of new food technology packages that open up both opportunities and threats to modern societies and economies in areas of foodstuffs and related technology (Ismail, 2008). Many factors are known to influence the production (supply) of vegetables in DTAS and shall be highlighted. The problems in fishery sector are not adequately addressed and little is known on factors influencing this industry. However, many seasonal factors are affecting fishing activities in various ways and at various degrees.

i) Specific factors affecting the processing of fish and fish products

It has been obvious that many institutional, legislative, societal, competitive, organizational, and management constraints are facing fishery sector, particularly in Red Sea State. Some of these factors relate to lack of information and statistics on the sector itself as a result of absence of a proper market information system, while others relate to inadequacy in fisheries management measures due to poor orientation of the policy, strategy and legal framework towards general objectives.

The fishery's sector main problem is the persistent marketing bottlenecks that restrict production to just meet fishermen needs and the already poor demand by people in the state. Lack experience on part of fishermen to maintain engine boats confined them to use hand boats. On the processing front, know-how and skilled labour for better enterprises management is some example. Lack of industrial infrastructure as fresh waters, electric power supply, etc., impedes the whole manufacturing/processing sector in the state. Marketing remains a potential bottleneck to fish production in the absence of marketing mix (product planning, promotion, cold storage, distribution, etc.). However, the UNIDO landing sites might solve the problem of scarcity of appropriate workshops and provide qualified technicians. For many fishermen in Agieg, days are spent to purchase spare parts and nets from Port Sudan thus curbing their fishing activities.

To develop new markets, fish must be processed in form to attract new customers ashandling fishery products lacks codes of practice and instructions by SSMO, thus reduces international demand which depends on the appropriateness of hygienic conditions of processing. This renders competition of small scale fishermen with large-scale commercial fisheries, almost inequitable. However, auction platforms, might be useful to maintain good prices for poor fishermen, however, this by far unreachable due to small quantities under cartel by suppliers/traders. Piloting in fishery industry might remove private sector reluctance to investment, if finance is adequately availed. However, unless fishermen associations improve their organizational structures, in the form of more stronger and competent fisheries cooperatives, the prospects of the sector will be uncertain.

On the supply side, thereis a persistent lack of sufficient capital to make investments in the fishery sector. Localities are weak in terms of planning and they rarely provide incentives to promote fish business**.** Storage for fish is lagging behindfor the lack of storage facilities as appropriate refrigerators to preserve or control the fish quality. The lack of ice, freezing and cold storage facilities limit the opportunities in the fishing businesses along the entire coast.Other than the capital city (Port Sudan), transportation network over the entire state is generally weak.

ii) Specific factors affecting the processing of tomato, okra and mesquite

Crop agriculture is not far from thegeneral deterioration in infrastructure necessary for processing and in many areas.However, the situation may even be aggravated by inadequate transport networks to producing areas, market and energy infrastructures in the state together with the very limited access to markets and lack of extension service in both crop and fishery production and market management (Annex 4.3).

Thespecific factors which may affect the processing of mesquite pods relate to lack of knowledge on part of herders on the utilizations of the pods as animal feed, fish meals and also for human consumption. Energy required for operatingmilling machinery, and the unclear demand for the produce might face the intended processing units.

4. THE MARKETING AND MARKET ANALYSIS

Production and marketing system are synonymous twins that mutually benefit each other and as such should be viewed identically and quite importantly. Beginning with the end in mind, SPCRP MP, UNIDO and Ministry of Agriculture (MoA) who are running commendable efforts to upgrade the fishing industry should lay much emphasis on the marketing issues which rendered previous projects to fail in improving fishermen livelihoods. To achieve this objective, innovative marketing concepts need be introduced and tested for fish/tomato/okra and mesquite processing plant(s) to ensure the viability of its marketing strategies and make adjustments accordingly. However, the modernisation of the fish industry by introducing better methods of harvesting, processing and introduction of quality standards would also increase sales and hence increase fishermen's income and simultaneously improve their living standards.

Information on the production system will be analysed through its different subsystems –fish catching and others along the supply chains–, vegetables production and mesquite pods collection where appropriate.

4.1.The fish market analysis

Little information[24] about the characteristics of the export market is available to local participants in the fish industry.Information is scattered and lacking,even about domestic market and there is no unique publication to use as a data source[25].

4.1.1. Fish products and consumption

Two types of fish is distinguished by the fishery department according to availability in sea waters: i) deep sea fish (as Najil) and usually found under stones and ii) the shallow waters fish (sand fish) as Bayad, sharks, Arabi, etc.). However, Najil is the most common type of fish and is of high preference in Port Sudan and also abroad. Fish exports to Saudi Arabic in 2009 were estimated to 150 ton, 70% of which was Najil. Worth to note is that, there are certain institutional conflicts between the federal authorities and the state level in giving license for fishing (Egyptians are given federal license to trolling fish) in Red Sea State. This agreement has resulted in unfair protection to local fishermen as well as the spread of its impact in polluting the sea[26].

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[24]Despite its importance, there is no adequate information on previous fish bans or market segmentation in Red Sea State.

[25]In conducting this study, information sources includedSPCRP-MP coordinators, wholesale traders from Port Sudan *Sigala* Market (*Sigala* indicates a fish landing platform), State Federation of Fishermen’s Cooperative Unions, stakeholders in Agieg and Port Sudan, Women Development Associations and other cooperatives and trade unions, middlemen and brokers, officials (marine and fishery department, and MoA and education), University informants.

[26]MohmedNour (national coordinator of SPCRP CBN, RSS) disclosed coordination between UNIDO and SPCRP in fishery development and fish management. There is a forum between Eastern Region Development Programme (ERDP), SPCRP and UNIDO) to develop the fishery sector. They agreed on

Domestic fish is seldom sold in supermarkets and the only type of processed (fillet) fish comes from Saudi Arabia and purchased by special consumers. For locally produced fish it needs to be processed in the proper way as clean fillets with no bones and nice steaks. Whole fish is only sold by *Sigala* market and almost none in supermarkets. Whole fish fried with oil is sold by peoples' restaurants known as grills *'shawayat'* in metropolitan/urban concentrations.

4.1.2. Supply and availability of raw material

As has been already mentioned, a market information service as one that regularly collects information on prices of fish and products supplied to a range of markets and disseminates this information to fishermen, wholesalers and traders does not exist.In brief, supply and market information is generally not adequate. Statistics available by the Marine Fisheries Department showed that,the amount of traditional fishing constitute about 600 tons/year (60-70% of supply) while commercial fishing 400-800 tons/year and is directed for export (30-40%). Seasonality of supply (governed by weather, wind, etc.) affects quantity produced.

Other than Port Sudan and northwards of it, our survey showed that, fish production in Trinkitat, Adonana, Agitai, and Agiegusually reach 100 kg, 80 kg, 300 kg, and 75 kg per day respectively. This amount reaches almost half a ton (500 kg/day) and faces difficult transport conditions to market outlets. Agieg area is the main supplier of fish during winter. Problems of transport and distribution can be solved by establishing ice factory in midway to either towns or production centres.

Table 4.1: A primary classification of fish according to processing characteristics* (RSS 2011)

Fresh and/or Filleted**	Najil (coral traut), Abu Jibaa, Hamour (Grouper)Bayad (jacks), Fareysi (rat snappers), Al Shaoor (emperor), Dirag , Asmoot, Bohar, Safen, Redishan
Dried	Hreed, kass, Handook, Arabi
Dry-salted	Arabi, Sherwee, Small sharks
Wet-salted (Fasiekh)	Arabi, Salmani, Shagool, Kass, Soltan Ibrahim
Oil fish	Sharks' liver(but catch is prohibited for environmental reasons
Fish meals	Shells, all fish wastes,

Source: Based on information from Marine and Fishery Department (RSS) ((2011)
*Processing is usually made when there is no market for fresh produce and fear of spoilage
**salmon fish is not available in Red sea as in lives in Mediterranean Sea

a) *Fish and fish products*

that: ERDP provides inputs, SPCRP looks at the institutional links and the UNIDO provides the landing sites (workshops for maintenance of boats, training, etc.)

Two points are important and worth to mention when dealing with processing of fish in Red Sea state. The first is the level of processing required in order to add value to the product and the second is marketing of these processed products. However, the current stand of fish and fish products marketing is generally poor as there is no branding, no quality control measures as to the required international standards and hence low volumes sales. With adequate quality control, hygiene standards and reasonable prices Sudan can export fish to big markets as Greece and Turkey as well as gulf area. Taking this in mind, authorities should not go away from high value products in order to develop the fish sector as we cannot compete with Moroccan sardines[27] which are cheaper nor could we compete with Vietnamese and Ecuadorians in other sea food for their less cost of production.

Investigation showed that fish supply [28] during the season amount to about 4-5 tons a day on normal days and may reach up to 7-8 tons when quantities exported to outside countries and Khartoum are included. Quantity demanded by Khartoum -usually ordered by four traders who cartels trade to Khartoum- is estimated as 1-1.5 ton/week. However, the amount traded in Sigala market goes to 2 tons/day and may reach 6 tons/day. It has been observed that, some Lebanese traders export about 3 tons/week. Worth to note is that, export trade is not well organized as licensing rights is debatable between federal and local governments.

b) Shrimps and other products

Shrimps are available nearby Khors and Mangroof trees adjacent to the sea to the north and south of Port Sudan (Eyrum, Guab, Trinkitat) as well as Agieg shore and quantities produced is humble. In Port Sudan, there are two shrimp farms, namely Ba' Bood and Osama Fishing Farms and statistics about their production is unreachable. These farms usually sell their produce for domestic market (Khartoum and Port Sudan). However, the quality standards of our shrimps seldom compete internationally for the fish meal input is expensive (which increases the production cost) compared to world market price. The shrimp's market in Port Sudan is mainly Koral, Bohain, Mysara and BalaceHotels; however, few quantities are sold in Khartoum Hotels.

Promising is the so called *zurumbak*'strombus' which brings more income than fish salting or drying. Breeding of *zurmbak* requires special care as to the production since the nails which are expensive are produced every fortnight. This brings a monthly income of approximately 800 SDG/month. For instance, fishermen in Agieg sell strombus "zurmbak" nails for 300 SDG/lb., and this is sold in Port Sudan for 400 SDG/lb.**,**despite the high cost of zurumbak nails, itsmeat is sold at 4 SDG/Kg**.** Every

[27]Notice that, sardines usually stay for about six months (after canning) to take its flavour and taste before it goes to the market. This adds storage costs to the industry, however, if we were able start this industry, we may not need to import sardines any more. Sardines are rich in Vitamin D which is important in controlling bone fragility.

[28]Information given by Abdel Rahman El Birawione of the major suppliers toSigala market. Igbal, a research scientist university of Juba) said that a study made by a Spanish company showed that, amount of Tuna in Port Sudan is not sufficient to establish a processing factory

fisherman can obtain half lb. of strombus "zurmbak" in a week reaching a net income150 SDG/week/fisherman. If Strombus "zurmbak"[29] meat is included in calculation (10 Kg*4 SDG/kilo) this may reach 40 SDG/kg, which gives 200 SDG/week, a reasonable sum equivalent to 30 SDG/day.

4.1.3. Fish markets, demand and market development

Globally, the consumer demand for processed fish and fish products is increasing. Despite the continued demand for fishery products in EU, Asia and the Middle-east (USAID 2008-a), Sudan contribution to these markets is negligible.

a) *Sigala fish market, structure and conduct*

Sigala market is one of the main markets in Red Sea State and has undertaken some improvement during the last three years in terms of services provided. Historically, the Sigala market was located just near the Harbour and was brought to this place in 2008 to stop pollution and waste disposal.

About 20-25 traders are reported to finance fishermen in Port Sudan in fishing business which comprise about 15-20 boats. Some traders finance fishermen owing a boat for 2000 SDG and the trip usually takes a week after which all costs are deducted and the trader purchases the amount harvested by fishermen for an agreed upon price. The trade volume of such a business is estimated as 70,000 SDG/week. Other than individual fishermen who depend on their own resources, the total sum of fish trade volume may reach up to 1.12 million SDGs for the entire season, which extends from May to August.

Currently, exploitation to fishermen is not as acute as before. For instance, profit margins of traders are found to be in the range of 15-20%[30] whereas profit margins of retailers to consumers are found to be 25-50%.

The market infrastructure in Sigala market is reasonable but not to the international standards. Use of small scale balance is found inconvenient, however, there is a big Balance (belongs to the market committee) which measures big quantities. Worth to note is that, the SSMO people are not actively involved in theSigala market, giving indication that tarde is mostly domestic since exports require specific standards to be issued by the SSMO.

In the Sigala market, ice boxes (refrigerators) are rented for 20 SDG/day and can accommodate up to 500 kg. of fish for a couple of days. Sometimes an ice box is rented for 50 SDG/week when supply to the market is low. However, these ice boxes are not matching with refrigerator's standards and the only ones matching with SSMO standards are used by exporters for export purposes. Hygienic measures are lacking in Sigala market and disposals are again thrown back to the sea.

[29]Strombus "zurmbak" breeds a new nail every 15 days
[30]For example if price by wholesaler is 15-20 SDG/Kg, the fisherman will receive 12 SDG/Kg for good quality fish (class I).

Market authorities usually charge annual fees for licences and market services.Licence fees vary between 247 SDG/year for a trader to 221 SDG/year for a fish *scaler* (cleaner). The cleaners/scalers (who never face risk as wholesalers or retailers) usually perform de-heading, degutting and cleaning for one SDG/kg and may earn up to 70-80 SDG/day. It has been observed that, some unlicensed workers used to pay 100 SDG/year to the licenced workers to share with them space in mustabain the market.Worth to note is that, the rent for a place to work is made on mustaba basis[31]. One mustaba –specified area for fish show– is rented for 1000 SDG/month excluding the annual licence fees. Over and above, market authorities take local taxes in the range of 15-20 piasters[32]/kg., depending on varieties.

b) The market chain of fish and fish products

The market chain for fish in a typical fish market (Sigala market) is rather simple (Fig. 4.1). There are traders (also called camps' suppliers) who finance fishermen (rent of trucks for transport, fuel, food and ice) to be deducted from sales later on (Fig. 4.1).The whole chain extends from fishermen to suppliers, wholesalers, and retailers. Brokers and middlemen perform all jobs, from retailing to reselling to informal retailers to consumers.

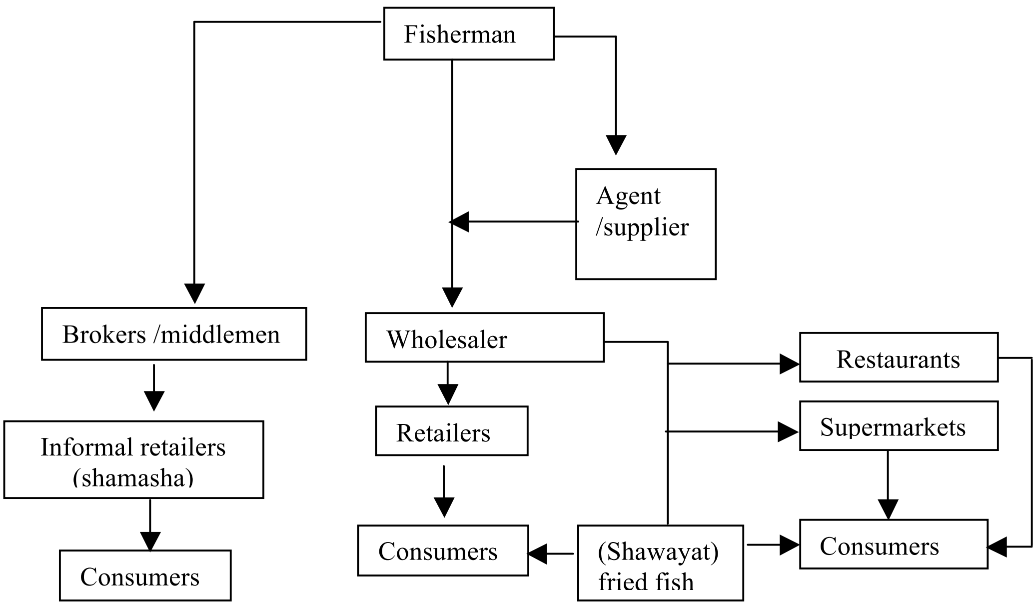

Fig. 4.1: Marketing chain of marine fish and fish products

The Sigala market can be said as competitive market, except on part of the supply chain. The number of middlemen and informal agents '*shamasha'* is so substantial to influence market price in one way or the other (Fig. 4.1). This is usually made by

[31]Mustaba is a specified place in the marketplace liscenced by authorities to traders to perform trading. Sigal market has 40 mustaba for sababa (middlemen) and 40 for *gashara*(scaler) or fish cleaner and is washed on daily basis, the pumps are out of work and washing is manual. There is Water Cycle Toilet, and path rooms and cafeteria in the market. Nafayat collects 1 SDG/mustaba every day. The disposalsare thrown to the sea (contamination and pollution)-SSMO is not there in this market.

[32]The local fee taken per kg is called Gibana. In 2010 it was7 pts/Kg and now reached 15 pts. /Kg in 2011.

increasing prices for consumers, who are not price conscious. However, profit margins in this market are usually in the range between 20-25%. The establishment of 6 cafeterias, removal of small shopping stores in Sigala escalates the prices

c) Market development,prices and consumer preference

To develop the fishery sector,focus is to be made on the demand site, local, national and international. Consumer preference, price andincome are utmost factors that affect demand. The most common type of fish preferred by people in Red Sea is Najil. Octopus is favoured by Chinese, Koreans working by Oil refinery stations in Port Sudan, but demand is not big.

Market development requires market infrastructure as cold stores, refrigerators, etc. However, cold stores are generally expensive.There is a need to play around with seasonality of supply to gain advantage in world markets.Domestically, food programmes for schools by UN agencies (WFPused to have School Feeding Programmeswith Department School Feeding of the Ministry of Education) were probable outlets for market development for fish and fish products including vegetables, but currently not working.

Prices of important fish (Red Sea State) are outlined in Table 4.2. Price of fish depend on the type, the grade quality and storability condition. Najil and Rishan are first class fish whose price is premium to fishermen. The Najil price starts at 8-9 SDG/Kg by wholesalers and may reach 25 SDG/Kg end of season. Rishan is also expensive fall in the range between 12-18 SDG/Kg for consumers.Arabi is second class fish that reaches 5-6 SDG/Kg from fishermen to wholesalers who sell at 8 SDG and reach consumer at 10-12 SDG/Kg. (Table 4.2).

Table 4.2: Wholesale, retail and consumer prices by fish class/type (SDG/Kg)

Type of fish	Fisherman to wholesaler	Wholesaler to Retailers/consumer	remarks
	Price SDG/Kg.	Price SDG/Kg.	Price SDG/Kg.
I class	8-9	12-15 17-20	May , June, November & December (Najil 15-25 for consumers, Rishan 12-18
II class	5-6	7-8 10-11	Arabi (4SDG/Kg.), sharks (5 SDG/Kg), and TuinaKusheri(7-8 SDG/Kg. begin of season and reach 10-12 end of season)
III class fish	4	6-12	Many species
Sources: Department of Marine Fisheries, RSS (2011). *Adjusted with information from Abdel Rahman El Birawi in Sigala market			

4.1.4. Fish trade, tariffs and Restrictions in Red Sea Region

Information on taxes, trade tariffs are not adequately available by marine and fishery department. However, it has been acknowledged that, potential trade barriers, and the 'Everything but Arms (EBA)' concessions by the EU to the Least Developed Countries (LDC) is still valid including fish products and therefore canned products as well. There is a common understanding that, the intra-regional fish trade between Sudan Egypt, Eritrea and SaudiArabia may not be a barrier at this stage. Restrictions and banswhen not meeting health and sanitary export requirements for exports might impede development of exports. The scape this circle, new partnership with competent exporters is desirable to develop the sector on the basis of international competitive-ness.

4.2.The vegetables market analysis

4.2.1. Demand, Supply and availability of raw material for processing

There is no recent data on to the demand of fresh or processed vegetables by Red Sea State. The demand is thus equated to supply (as a function of supply) and equilibrium prices are assumed for the respective quantities supplied. For this purpose, all quantities supplied to the market are assumed to be consumed or processed for later consumption.

a) *Tomato and okra in DTAS*

Delta Tokar, which is the main source of vegetables to the Red Sea State, is only 90 km from Suakin, 27 km from Trinkitat Harbour and 300 km from Gulf area. Vegetables are mainly grown in Tokar as well as Arba'at to the North of Port Sudan. DolabYey (near Suakin), which lies outside the DTAS, is famous in horticultural production; however, this area experiences severe shortage of water and suggestions to salvage crops by watering from Suakin. All crops are organic based (no pesticides or chemicals use[33]). Despite the potential delta Tokar has, marketing is one of the factors that hinder production of tomato and other vegetables, where there are times in which tomato is priceless and hence given to animals as fodder.

Worth to note is that, tomatoes grown by DTAS is mainly for fresh consumption in the first place; however, surpluses can be processed when there is no market for fresh produce. On the ground, Farmers Trade Union started in 1994 to link with Saedfactory for tomato processing into tomato paste in DTAS, but difficulty in transportation to Khartoum rendered the dream to fail. Some trials of exporting tomato to Saudi Arabic (7 tons)were also made in the nineties but this has also stopped. The main problem lies in transportation and access to markets in the right time and place. However, even if farmers' marketing problem is solves, and willingness to expand in vegetables by farmers is substantial, the DTAS will stand against expansion in vegetables beyond the

[33]Two things characterize Delta Tokar agriculture. First one is the organic agriculture as a result of high soil fertility. Second one is the balanced ecosystem which prevents harmful insects (predators) to survive mainly due to the 'Etabeet' winds which breaks the lifecycle of insects and thus prevents reproduction.

10% limit specified as from total area grown. Farmers claim that DTAS is not willing to change this policy for the revenues it used to get from cotton production as nothing else come to the DTAS from other crops. However, farmers cannot change the cropping pattern spontaneously as the land tenure structure is complex and the authorities can stop giving agricultural services. Despite this fact, cultivable land can, however, be expanded by expansion in areas occupied by mesquite.

Tomatoes grown in Delta Tokar are good varieties (strain B), which are tolerant to adverse conditions and have desirable characters for consumers. 50% of tomato production in the state is from Tokar (average production/feddan ranges between 2-4 tons/fed over several pickings which may extend between 5-7 pickings.Tomatoproduction might reach 30-45 tons/feddan in five successive pickings (7 feddan* 5 pickings* and each one is almost 6.5 tons) (Box 4.1).

Box 4.1: Summary of information taken from Farmers Trade Union, RSS
☒ @ total amount of tomato from delta Tokar to port Sudan market (above table @) is 30x55lorry*400 carton*10kg/1000= **6500 tons/year**   ☒ Quantity exported to Khartoum from Tokar from January to May can be estimated as average to 33 lorry *30day= 33*30*400*10 kg/1000= **3960 tons**   ☒ Okra is estimated as 50 lorry/season= 50*200sacks*20/1000= 200 tons   - Weighted average price for tomato=18.5 SDG/box   - One sack of okra =12-15 Kg   - One box of tomato =10kg, one carton of tomato=8-10 kg   - One lorry takes 350-400 tomato boxes, each box 10-15 kg.   - One lorry takes 150-200 sacks of okra of 15-20 kg. each

While area grown under tomato is 1000 feddan in 2011, tomato production is estimated as 4000-6000 tons with an average price of 30 SDG/10Kg box to one SDG/10Kg box (source: SPCRP-MP flyer No. 12 March 2011).

Table 4.3 shows the prices of tomato and okra during season 2010-2011, which wereextremely variable. However, prices should always be taken with care as there is no reliable statistics and figures are subjective to drastic variation across seasons and among production months.

Okra (ladies finger) is also grown from early November and harvested late May/June. Prices of okra fluctuate dramatically over months between 5 SDG/sack to 30 SDG/sack (Table 4.3). There is little or even negligible processing or drying for okra in Tokar and practice is on limited scale. However, there are other promising vegetable crops like egg plants, sweet pepper, and cucumbers. Information as their quantities and prices are left to annexes (Annex 4. 1). While one kantar of cotton earns 620 SDG in Gezira it earns 110 SDG in Tokar Delta.

Table 4.3: The prices and quantities of tomato and okra purchases

	Price SDG/unit	Quantity(lorry/day)

	Tomato			Okra	Tomato		Okra
Months	I	II	III	I	I	II@	I
January		40	60	65	2	3	2
February		30	30	45	7	12	5
March	80	25	25	25	10	13	4
April	60	5	5	10	18	13	6
May	20	2	2			6	3
June	30					6	
November				3-7			
December				5-30			

Sources: interviews with farmers and wholesalers
I, II, III shows different information sources
Prices of tomato per box (15 kg each)
Prices of okra per 20 kg sack
Quantities are in lorry terms/day. One lorry equals to box 300 of tomato (estimates)
One lorry equals to 200-250 sacks of okra (estimates)
@: vegetables and fruits suppliers Trade Union, Port Sudan market

For any small scale project to succeed, it is better to start with women groups or associations. The existing women groups/associations in Tokar require in the first place, a better organization. Second, clients/consumer preference is important for the processed products to be marketed. For small scale processing plant in Tokar, the following problems are to be considered:

- Problem of sizable fresh water availability for processing in Tokar. However, studies showed availability of underground water in Tokar, however; rehabilitation of Kremet power station (nearby Tokar) may contribute to solve water problem.
- Industry infrastructure as power, electricity and water (no electricity and power generation is only through diesel fuel).
- Poor road conditions, which are only accessible when no floods occur, are type of problems that hinder processing. Note that road is impassable during flood time which continues till September and growing season starts early October.

Table 4.4 shows that tomato and okra havethe highest production costs, 2920 SDG/feddan and 1240 SDG/feddan respectively followed by sorghum, millet and then cotton. Most tomato is of variety strain B and B2, and Aman hybrid.Worth to note is that, tomato seeds are generally expensive and productivity can be improved by organization of water efficiency use by digging wells for supplementary irrigation of vegetables. The supplementary irrigation[34] requires studies (and technologies) to determine water availability sites, hardness/saltiness, freshness, etc.

Table 4.4: Production costs of vegetables and other crops

[34]One may need to dig a well (30 meters deep) that cost 25-30 thousand SDG to ensure continuity of water supply.

Operation	Tomato	Okra	Cotton	Sorghum	Millet
	SDG/feddan				
Seeds	120	30			
Planting	75	75			
Reseeding	-	10			
Weeding	75	75			
Harvesting	500	500			
Boxes/sacks for packaging	150	50			
Well (water) preparation	400	-			
Irrigation fees	600	-			
Transport to the market	1000	500			
Total cost SDG/Feddan	**2920**	**1240**	**318**	**681**	**357**
Source: DTAS, 2011					

Horticultural crops face many problems. However, the American bollworm threatens all crops of the family malvacae, and serious losses were encountered by this heavy infestation of American bollworm last season (2010/2011.

Machinery to plough land is organized by DTAS. Worth to note is that, the Agricultural Revitalization programme (ARP) gave 30 tractors to DTAS and they plough a feddan for 25 SDG/fed. Farmers claim that, they are away from decision making circuits when it comes to projects with EU, EC or other donors.

4.2.2. Major markets for tomato and okra products

Port Sudan and Suakin are the two main markets for vegetables coming from Delta Tokar and distributed within the state. Other towns in the Red Sea state as Sinkat, Arkaweet, Haya are local markets for Tokar's vegetables in the stateDuring the glut seasons Kassal, Gedaref, Mediani and Khartoum absorb the market surpluses but at relatively low prices. Small portion of vegetables is sold for local consumption in Tokar town. However, small village around Tokar purchase their needs during market day which gathers people from different places. The biggest share of the marketing margins, as shall be viewed in details,goes to suppliers (wholesalers/distributors) who usually transport vegetables with their trucks.

4.3.Processing and marketing of mesquite pods as fodder

Available literature shows that, mesquite can be used as porridge, biscuits, medicine and animal fodder (fish and animal). Mesquite flowers twice a year, and occupies 180,000 feddan in Delta Tokar in addition to 100,000[35]feddan along the Khors and seasonal tributaries. A sizable mesquite tree can give up to 10-12 Kg. /year. A rough estimation of 200-600 tree/feddan was given by Hassan Abdel Nour (2010). And if 70% of area is occupied by tree density of 200/feddan and 30% is occupied by 600 trees/feddan then we can arrive at an approximate tree density of 320 per feddan.

[35]Estimations are given by Omer the SPCRP MP national director (2011).

Assuming a tree gives 10 Kg/annum, then total pods produced will be around 3.2 tons/feddan/year.

Mesquite can be a problem[36] and can also be part of solution to farmer's problem if change in concept from *eradication* to *management* is undertaken. Irrespective of this concept, mesquite is now a reality and people tend towards making charcoal from mesquite to earn a living (5-8 SDG/sack). Information showed that, currently people tend to substitute 12 sacks of charcoal with one sack of sorghum (1:12). However, replacement ratio by OXFAM in 2002 was 1:10. OXFAM experience (Box 4.2& Annex Box 4.2) with mesquite was towards using it with fish wastes as fish meal or animal fodder but no documented information on the recipe is readily available at this time for this ration formulation.

Box 4.2: OXFAM experience with mesquite (food for work)

- Machinery for mesquite processing cost 1750-7000 SDG (depends on size and whether hammer or stone)
- 8-10 HP diesel generator
- 2 labours for a miller,
- 2 for labours handling,
- One guard and a director.
- The machine works for 6 hrs a day (3 hrs morning, 3 hrs evening)
- The machine can process fifty sacks/ day. Each sack of 50 kg, averaging to 1500 kg.
  - Mesquite can be processed in small packages of 5-10 Kg. each
- The estimated production capacity as follows:
  - Mesquite pods produced from April to august (4 months), 25 days a month, 50 sacks a day, 10 machines gives (4*25*50*50*10)/1000= 2500 tons per production period
  - Inputs gasoline one jerkins (4 gallons)=30 SDG
  - Oils and lubricants
  - Water (2 barrels) = 8-10 SDG

DAL company has dairy farms which can use processed mesquite pods in Khartoum or export it to Gulf area where used as fodder for animals (camels[37]). In semi dry arid like RSS, mesquite can be good fodder for animals if known and produced commercially. Linking information from Tokar Delta Agricultural Scheme with this, SPCRP can lead an initiative to produce mesquite fodder in Delta Tokar.The product can be processed in four sites which can be chosen for processing and also as marketing outlets. Possible market avenues for mesquite include exportation as animal fodder. Although mesquite

[36]People observation by Mara'feet village showed that, existence of mesquite nearby wells, turn to fresh water into salty water.

[37]For more information see net web site Djibouti uses mesquite as feed for camels and also used as fodder for ruminants as well as fish catch in Egypt.

is not widely known as human food in Sudan, but global research information shows it can be introduced in biscuit cakes as famine food.

The processing of mesquite is not that complicated since it requires small capital, few labours (can be done by one family or household members) depending on the size of the enterprise itself. Marketing requires a concise marketing strategy since the product is not yet widely known as a commercial product.

4.4. The general situation analysis (SWOT)

Decisions on establishing fish processing enterprises are rather difficult to make particularly in areas which lack most of the necessary requirement as basic infrastructure like roads and power supply, etc. To help understanding the situation and facilitate decision, SWOT[38] analysis of the strengths, weaknesses, opportunities and threats facing such an industry is made and results are presented below (Table 4.5). The table can help SPCRP-MP to decide on ways and means to assist fishermen and vegetable growers taking this analysis into consideration.

4.4.1. Current Situation analysis of fish and vegetables in RSS

The analysis of current situation is summarized in Table 4.5. The table combines, the strengths, weaknesses, opportunities and threats facing establishment of any processing industry, be vegetables or fish industry[39]. Despite the great potentials RSS has in fish and vegetables, nevertheless, the weaknesses generally overweigh the strengths, unless genuine reforms and achievements are made in this front, the front of removing obstacles and exploring opportunities (Table 4.5).

The table is self-explanatory, and the institutional, administrative, organizational and legislative aspects/concerns are important flavours to consolidate the base of any marketing framework. This is why some of these issues were highlighted more than once in this report, for success depends on the integrity vision of the projects and the degree of involvement of the essential stakeholders concerned with such processing projects.

Table 4.5:SWOT analysis of fish processing in Red Sea State

Strengths	Weaknesses

[38]SWOT analysis is made as part of the situation analysis, which normally includes the analysis of external environmental forces that influence the market, and internal, non-marketing forces, such as financial and human resources that affect the marketing program.

[39] For the many similarities in conditions, strengths, weakness and opportunities are combined in one table. However, the reader is expected to be able to sort by type of industry, be it fish or vegetables.

- untapped and renewable marine resources - geographical location for development of fishery and aquaculture (gulf markets) - long coastline with large potential for fishing - possibility of increasing aquaculture production as shrimps, see cucumbers, and ornamental fish. - close to significant land locked countries/markets - no pollution of RSS coastline - low cost of labour - transport networks to domestic markets available	- low level of investment in fishery sector inefficient management of whole value chain - lack of financial institutions/banks, supporting fishermen. - small fishing boats confined to the shallow waters - the standard of the fishing is too low to provide sufficient TQM basis for export - no electric power and diesel fuel is hard to find in remote areas - poor road conditions to Agieg , difficult to pass during rainy season - lack of transport and storage facilities - local markets are not well developed - know how on fishing is lacking and cultural habits reluctant to fish meals - lack of education, extension and training - lack of advertisement, promotion of fish products - poor training and limited skills in handling. - No small fish processing firms
Opportunities	**Threats**
- domestic, national and regional markets are promising - labour intensive and low cost of investment - strengthened fishermenassociations - better cooperation and communicationbetween all stakeholders involved in sector development - improving logistics and infrastructure in ports Sudan, emergence of Sigala market can develop the auction system - existence of untapped marine and other aquaculture resources	- low quality standards for processing (microbial infection, poor qc, - low markets capacity - marine insurance and security problems and other related risks - trawlers coming in doing unrestricted fishing. - many difficulties in fish trade - (economic and legal conditions, etc.) - slow administration (difficult to - lack of knowledge on international requirements and specifications - uncontrolled use of marine resources (depletion) - EU fishing regulatory environment

4.4.2. Summary of main production and marketing constraints

The framework of this study is not only fish-processing-specific to red sea state, but also addresses some other vegetables (okra and tomato) and mesquite pods. Even this perspective is not adequately handled, due to severe lack of data, the specific characteristics of fisheries, such as fish trade, fisheries specific input requirements, including catch certification and fish trade documentation is not adequate. Moreover, some gaps also exist in relation to issues related to illegal, unreported and unregulated (IUU) fishing and sustainability of these resources**.**

4.4.3. Opportunities, challenges and policy options

Given these opportunities in both fishery and vegetables subsectors, SPCRP management can establish allies in both directions i) with big companies as DAL to start a commercialized or semi- commercialized processing industry in relation to fish, mesquite, tomato and okra processing. Mesquite can be processed for DAL poultry or dairy farms. ii) With women development associations/groups (better be organized first before articulation into sound projects/programmes) through adequate consumers' preference analysis.

Important to take into consideration is the challenge of availability of fresh water in most areas, when relative medium processing enterprises are thought of .To capture the emerging opportunities in fish trade, Red Sea authorities need to i) explore the domestic market (change culturally based eating habits which resist fish and poultry meat products, ii) substituting imports and re-exporting of products by meeting health and sanitary export requirements to open for new export opportunities (Tsamenyi and McIlgorm 2010).

From discussion with fishermen, there is evidence of oligopolistic behaviour by individual traders/suppliers although not as acute as in the past. Theoretically, such an oligopolistic structure (Omezzine et al 1996) permits individual buyers/traders to exercise some influence on price and to develop a procurement strategy by differentiated offers through location, size, and equipment of these processing facilities, services[40] rendered to fishermen, use of discounts, and premiums for different quality products.

4.5.The marketing mix for processed products

Designing a marketing strategy for each specific product requires a set of information that may not be available, for the reason that there are previous exercises in Red Sea state which one cannot follow within the given time frame of the assignment. As a matter of fact, each business enterprise needs a special marketing strategy that may differ from one enterprise to the other; nevertheless, we have tried to make a sensible marketing mix framework for the following food enterprises in the following order:

- Fish and fish products
- Okra, tomato processing
- Mesquite pods processing into fodder for fish and animal utilization.

4.5.1. Planning for multi-product plant(s)

In planning for a product, be it fish or vegetables, decisions about the package design, branding, trade mark, warranty, guaranty, product life cycle, and new product development are essential in this planning process. Of course, the product quality and constituent, which concern the food engineer, are equally important as hygiene and safety aspects. Details about each of these items are discussed where appropriate.

[40]The services provided include bait, ice, food for the crew, fuel, cash advances,etc.

Important to notice is, multiproduct line/units for fish processing can serve different purposes at a time or at different times. For instance, if the fish processing plant is located in Port Sudan or any place where mutton or beef meat is available, the processing plant can operate most of the year processing both fish and meat, and also provide customary processing services for area residents (army forces, hotels, restaurants, etc.).

a) Fish and fish products

For fish, planning of the product depends on the type of operations performed for each product. For instance, to enhance marketing strategies, policy option inproduct diversification would include but not limited tofilleted fish, dried fish, and/or canned fish, etc. Traders resort to dry fish when fish catch is much in excess of demand or if stocks of fish remain unsold for more than two days. The study tried to seek the feasibility of processing and market potential for high quality packaged dry fish to be sold either in grocery stores and supermarkets or to farmers in dry farming agriculture during rainy season in Gedaref, Blue Nile and Kordofan states provided that cheaper products are maintained. Such an avenue will create viable new business for the fisher communities in Red Sea State and ensure sustainability of supply if prices are competitive with dried fish from river lakes.

(i) Dried fish line

Two lines of dry processing concepts are available as described elsewhere. The first is to assist women in business (HBEs) by giving training in modern methods of dry fish preparation, simply by providing barrels for the salted-water (brine) to dip in gutted fish and drying houses where drying will be done through solar heat. The final finished product will be packaged in printed polythene bags with a trade logo. The second line is to use more sophisticated techniques of fish processing through a small processing unit/ plant.

(ii) Wet salted fish

Like dry fish, wet salted fish is usually made from fish on ice that remains unsold for more than two or three days. There is a potential market in Egypt but currently banned for mismatch with hygienic and health control measures.

(iii)Fish canning

Fish processing includes both the canning of fish for human consumption and the production of fish by-products such as meal and oil. Either a precooking method or a raw pack method can be used in canning. In the precooking method, the raw fish are cleaned and cooked before the canning step. In the raw pack method, the raw fish are cleaned and placed in cans before cooking. The precooking method is used typically for larger fish such as tuna, while the raw pack method is used for smaller fish such as sardines. At present time fish canning is not recommendable for the high costs and also hygienic and quality requirements.

(iv) Production of fish meal

Most of the fish wastes can be reused after being processed with techniques of drying and grinding as fish meal or agricultural fish fertiliser. The by-product manufacture segment of the fish industry uses canning or filleting wastes and fish that are not suitable for human consumption to produce fish meal and fish oil.

b) Tomato and okra products

Each particular variety of tomato requires particular product planning either for tomato paste or drying. Likewise, this applies for okra product planning. Product planning may come to a conclusion to sell fresh produce just by grading sorting and packaging. In addition, the product planner may recommend after chopping drying (or even freezing if technology is available) the vegetables, (cull vegetables). By processing and freezing these vegetables, we can hold the product during periods of oversupply and sell products during periods of undersupply and obtain a better price for these products. This gives an advantage over products sold in fresh market crops which do not have this luxury as they are dealing with perishable products making them "price takers."

The fresh market is also susceptible to periods of excess supply leaving producers with a surplus of fresh produce and depressed prices. The fresh market demands producers grade their products and only supply high quality produce resulting in a supply cull vegetables for which there is no ready-made markets (Christopher et al 2006).

The dried (also frozen fresh vegetable) market may offer an attractive opportunity to generate revenue from both culls and steady product this quality problem by allowing them to be highly selective in choosing produce for the fresh market and still maintain a market for cull products (Ibid 2006). However, packaging of vegetable productsas well as packing of frozen vegetables has grown substantially as a result of improved technology. The freezing option is not possible under Red sea State for lack of refrigerated stores and problems of power supply.

c) mesquite pods

There are no similar trials[41] for mesquite product in Sudan for human consumption to be tested for commercialization, and the only available information given by OXFAM was the processing for animal use, therefore, information is borrowed from international literature. A pilot plant has been designed and set up at the University of Piura for the processing of mesquite pods.The most remarkable equipment consisted of a washing and selection system for *mesquite (Prosopis)* pods; a drying system (tray dryer and pre-drying chamber); seed extraction equipment (a prototype algarroba mill,

[41]Reports on the composition and nutritive value of mesquite pods showed that they are a potential source of protein and energy, although pod composition varies with location. Mesquite pods have high palatability and nutritive value and, when crushed, have been eaten by cattle, sheep and goat without any adverse effects on their performance. Mesquite pods are rich in saccharose (20-25% of DM) and reduced sugar (10-20% of DM). They have a high content of calcium and phosphorus but the content varies depending upon season, soil type, year, etc.(Sawal et al 2004).

hammer mill and cyclone); an air separation system for seed obtention seed-roasting equipment; vibrating screen; a sugar extraction system; a centrifuge and concentration system for syrups, additionally, filtering and column(CTA 1999).[42]

As a matter of fact, SPCRP MP can broaden the scope of utilization, but focus should be made on developing a product for livestock utilization, packaged in 5-10 kg sack with a label and sufficient information on ingredients and expiry date.

4.5.2. Advertising and promotion plans

Like any other products, advertising and promotion plan would be a necessary item to increase sales and develop new markets for all products, such as fish, vegetables and mesquite pods.

There are various types of advertisements and promotion activities (hence budgets and costs) available for modern sales of fish, vegetables and even the newly expected mesquite powder for animal fodder. The processing unit/plant management needs to define what type/components of promotional mix are appropriate to promote these products. Both personal selling and non-personal selling promotional mix are suggested in order to create awareness of the newly developed fish productsand vegetables. However, the non-personal selling is extremely essential in this regard and includes advertising, sales promotion, and public relations. The manager should also decide on the promotional budget expenditure of the processing unit/plant. *Personal selling* on the other hand (done on a person-to-person basis) is effective at levels where people know each other and where direct face-to-face communication and hence promotion is achieved on daily basis.

The plant management can choose, whichever they like, between informative product advertising (IPA) and persuasive product advertising (PPA).If the manager decided to make an advertising campaign for his products, he can further decide where to go (mass media e.g. newspapers, television, radio, magazines and billboards). Similarly if the tendency is to go for *sales promotion plan,* where activities such as displays, shows and expositions, demonstrations will be some options, but probably add more costs. No doubt, the processing unit/plant needs to make good *public relations* with various publics like customers, organization's customers, suppliers, stockholders, employees, government, and the general public to increase his volume of sales.

4.5.3. System of distribution and the market institutions

There might not be a problem of transporting or distributing fish to markets or buyers in Port Sudan as the road network is excellent. However, poor road condition from Tokar to Agieg(also other towns) is the major obstacle to collection/distribution of fish

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[42]Other methods used shows a processing line consists of a shaker to clean seeds, a gas fired oven for drying and toasting, a extruder, a pin mill and ancillary bagging and storage facilities

from/to various parts in the state. This creates a challenge in supply of fresh and processed fish to consumers since domestic consumers generally prefer fresh products.

Distribution of fish using insulated trucks to markets is not common. A cold chain refrigerated truck/van can be a solution for distribution of the fish product. Currently, hired trucks are the most common mode of transporting fish to far markets. Instead of letting ice-vendors to transport ice to storage points, trucks can be equipped with ice-boxes so that they can do both transporting ice to the fishing sites for storage and also bring back fish from collection sites.

4.5.4. Pricing strategies

a) *Fish and vegetables purchase and sell methods:*

Two most common cost-oriented pricing procedures are available, namely the full-cost method, which uses all relevant variable costs in setting a product price, in addition it considers the fixed costs that cannot be directly attributed to the production of specific item being priced. The second type is the incremental –cost method, which overcomes the arbitrarily allocation of expenses (as in the full cost method. Therefore, it uses costs directly attributable to specific output in setting prices.

Most of the vegetable produce in Tokaris sold on the farm on per box/tin basis rather than per unit weight. The tomatoes are put into wooden boxes (approximately 12-15 Kg per box/carton) by specialized/hired labour. Pricing strategy depends on the type of purchase method, be it wholesaling or retailing.Additional processing costs (grading, sorting, and packing) can be added and reasonable mark-ups can be determined. Price differentiation strategy can be followed for each market and also for super markets and other consumption centres as hotels, hospitals and prisons, schools, army camps, NGOs, etc. In practice pricing, in most business, is based on the cost-plus approach (usually made as a % of the cost). This approach uses some basic cost figures/unit and adds a mark-up to cover unassigned costs and to provide a margin for profit.

b) *Marketing margins for wholesalers, retailers and other middlemen*

However, two main criteria should be taken into consideration when determining pricing and are: Retail and local sales and wholesale and mass purchases, which should be charged less than small quantities purchased by individual retailers.

4.6.Regulatory, institutional and legislative aspects

Regulatory, institutional and organizational frameworks are important in promoting fish and vegetables sector in Red Sea State. For instance, relevant regulatory and legal restraints regarding food products may arise if the food processing is not to the required standards made by the SSMO, that is, the hygienic and quality control measures. Besides, the packaging procedures for processing unit/plant in Red Sea is ought to be competitive with those of well-established industries in Khartoum (Saeed and Brair food industries, or even international standards if exports are anticipated. excessive taxes, duties, and customs on products as well as raw materials and inputs that can increase prices to an unaffordable and non-competitive level is another factor which can restrict the product(s) competition in markets.

A distinction between local government and federal government concern in fishing need to be settled for it acts as a real constraint to fishery development. In this case, a memorandum of understanding between the concerned government authorities and the owner of the processing unit/plant need to be made. The memo should include no control on prices by either side,respect of designed regulations for competitions in addition to the possibility of effective protection (exemption from taxes and the like) from state government after establishment of this small-scale processing enterprise for a reasonable grace period.

However, owners of processing units/plant should seek for information on relevant legal restrictions regarding food products in the state or at the federal level. Similarly, this should include information on packaging regulations and procedures and laws (some states prohibit plastic sacks). Information on duties, customs and taxes on food products and other raw materials and inputs should also be considered including government control or any other types of control that may exist in future. Further regulations on prices and any expected future regulations on competitions (such as possibility of effective protection from state authorities) after establishment on a relatively medium or large scale need be considered.

Cooperatives were supposed to provide all necessary facilities and equipment for fish production as well as cold storage, transport, etc. but their capacity and access to finance limit their scope and are really unable to market fisheries products for organization and institutional malfunctions. Therefore, cooperatives need to be organized, strengthened and institutionalized in a better way to achieve its objectives. This is because, cooperatives are generally weak and do not perform responsibilities as fishermen are/were not receiving loans or benefiting from health care services, marine insurance. Due to the poor organization, cooperatives are unable to contribute to purchasing fish equipment for the members at lower price and usually share in decision-making process which is usually undertaken by the Board of Directors away from the members.However, this may be attributed to the little interest in benefits and services provided by local cooperatives.

For DTAS farmers to have comparative advantage in national markets and compete in regional and international markets they need to organize themselves in associations whether producer's associations or farmers associations. Such organizations, when aware of their role can help in negotiations regarding the availability of raw materials necessary in the processing. Once these organizations are strong they can negotiate with regard to cropping pattern (increase area under vegetables to exceed the permitted 10% limit), inputs, labour affairs, technical matters concerning the industry such as packaging and labelling including regulations for the packing and grading of processed fruits and vegetables.

5. PROJECTS ORGANIZATION , FINANCIAL ANALYSIS AND MANAGEMENT

Following a comprehensive discussion on strategic options in fish and vegetable processing, SPCRP has set its way towards two main options at the present time to go for; either use simple lines/unitsfor dry processing, wet salting, and fish meal i.e. simple technology under the so called Home Based Enterprises (HBEs) or development associations, or develop Small to Medium Enterprises (SMEs) processing plants/industry[43] that require somewhat modern technology for processing. The first (HBEs) option is meant to assist women in business (HBEs) by giving training in modern methods of wet-salting or dry fish preparation, simply by providing equipment as barrels for the salted-water (brine) to dip in gutted fish and drying houses where drying will be done through solar heat. The final finished product will be packaged in printed polythene bags with a trade logo. Other forms of fish and vegetable processing will follow the same strategy, go simple.The project implementation[44]will make use of thepreviously discussed conceptual requirementsand model project(s) shall be phased out as follows:

First phase

- Assign a project coordinator, assistants to undertake the various project activities (production department, department of sales and marketing development,
- Procure/implement/monitor improved but simpleprocessing equipment/techniques.
- Train women associations on technology usage and more emphasis on hygienic and quality measures (may need more than two training packages)
- Establisha small fish filleting/packaging unit and test market sales with food distributor to supermarkets, door-to-door selling, wholesaling, retailing, etc.
- Establish dry fish processing unit, test market sales using food distributor (hospitals, prisons, supermarkets, etc.).
- Establisha wet salted fish making/marketing unit and start tracing the export avenues through local fish exporters.
- Develop a marketing mix strategy (product planning and development, promotion, advertising, pricing, and distribution, etc.)
- Initiate a micro-finance concept for financing this new women's development association business. The concept should be strict to make a revolving fund to ensure continuity and sustainability of the project on the basis of profitability, in case SPCRP project is terminated.
- All above steps are valid for other processing units in vegetables processing

Second phase

[43]The second line which uses more sophisticated techniques of fish processing through a processing plant is excluded as an option during workshop held in Khartoum 14th of August 2011. After having a theoretical background of all options, SPCRP management has decided to go for piloting using simple technology model projects. The remainder of this chapter, here-to-after, shall be confined to this choice.

[44]Business registration at the state authorities, approval/permits for HCCP (SSMO), municipality/District Council, preparation /approval of business plan, commissioning and installation of machinery, trial run and production.

- Expand units' operations on the basis of market success. In this phase, project director has to decide on the volumes of production for filleted/packaged fish, dry fish or wet-salted production based on actual sales records.
- Decide on new market products and search for new avenues
- Improve distribution strategy through directtruck sales of processed fish either throughsame women development associations, cooperatives, or private businessmen.
- Improve business management, marketing and sales (record keeping, data analysis, prices and profits computations)
- Decide on business expansion to SMEs either as association, cooperatives or joint-stock companies.
- All above steps are valid for other processing units in vegetables processing

Other strategic processing options that mix between HBEs and SMEs are also open when initial phases are successful, and in this case some requirements might change accordingly[45]. Some assumptions are made in computing the financial analysis, of the HBEs processing units. Sensitivity analysis is then made by taking upper and lower limits to cater for all extremes. Before doing the financial analysis, understanding the investment environment in Red Sea State is crucial for any viable business enterprise to start.

5.1.The investment environment in the Red Sea State

In principle, Bijas are reluctant to work in fishing and the fisheries business is considered as a low status job and even those in the business want to move out of it because of the low income from fishing. Historically, this may be related, in part, to the non-conducive investment environment[46] in fisheries' sector which has little to offer to itself to diversify and broaden the fishing business. Now there are some improvements in terms of fishing facilities such as roads, cold storage infrastructure, ice boxes, and relatively treated salt-waters compared to the situation in the last 10 years.

However, and despite the efforts made by the government to support the fishery sector, thegovernment policy is still lackingthe conceptual, organizational and institutional frameworks that can boost the sector to its intended objectives. On the positive side, the Farmers' Commercial Banks and Zakat Chambers,for instance, are involved in building boats for fishermen and the first batch reached 100 boats each cost 22,000 SDG. However, investigations showed that most of them are not working properly for they were badly designed and badly built.

[45]For instance, some issues need to be addressed more precisely upon determining the size of the business (unit/plant) and production volumes. Issues are: small fish cleaning and cutting line, packing lines to pack the fillets in Styrofoam trays, also salted and dried fish forms, shrink wrapper, a refrigerated room for storage of fish and products, and a refrigerated truck for distribution of the products. The plant may need, according to size fresh (tap) water. Most important is focuson hygienic, packaging and quality control measures if intended for export.

[46]E.g. Hadab is a famous fisherman in Haya is now investing in fish processing and canning in Swiss (Egypt).

On the vegetablesfrontline, the ERDP promised to givetwo processing plants for tomato processing into paste, and an Arab Emirates company requested DTAS authorities for 40,000 feddan of area under mesquite to be grown with vegetables,the Italian ambassador promised DTAS with a portable tomato paste factory in 2010 and all of them never showed up again. In general one can conclude that, the investment environment is progressing despite the tremendous obstacles that still stand before investment in both vegetables and fish production and marketing.

5.2.Processing units (plant) location and justification of capacity

Small processing units might not face the problem of location compared tosizable processing plants, which have to meet some specific requirements in relation to basement of equipment infrastructure, water, electric power, and skilled labour. Fish processing operations are generally located close to commercial fishing areas (Port Sudan, Suakin, Agieg, etc.); however, in some cases catches may be transported over long distances or even exported abroad for processing.

Most of the production centres in the state face the problem of fresh water availability, a main constraint for medium processing plants, which require large quantities of water to work. For instance, the fresh water availability (drinking water and for processing) is a serious problem in Agieg and relatively in Tokar although Tokar is relatively better than Agieg in this concern (annex 4.2). Despite the problem of sufficient fresh water availability in Suakin for bigger fish industries, nevertheless, it looks as a suitable site for SMEs fish processing for its central geographical location and access to consumption /distribution centres. If SPCRP starts with small processing units (women development associations and/or HBEs), fresh water problem might not be that acute.The following justification can be considered when determining the location of the processing plant(s) in future.

- Suakin is located near to the sea and have the bulk of fishermen along the coastline organized in a number of associations (authorities have a tendency to develop fish auction market in the area)
- Closeness to the sea facilitates getting rid of waste disposals and also has easy export.
- Existence of a water treatment station for purification of salt water as well as making use of the Guab terrace (on the mountainous area 32 km from Suakin) which can increase the fresh water table in the area. Although Suakin suffers from water availability of fresh water during summer, however, this problem might be solved when pipelines from Atbara River are installed in place.
- Undertaking of a new landing site (UNIDO) fully equipped with 27 ice making machines, maintenance workshop, and 4-6 refrigerator trucks can make use of fish wastes.
- Power (electricity) is available.
- Accessible all year round.

- There is no place adjacent the sea in Port Sudan. The nearest place is Kalanaib, which is 10 km to the south of Port Sudan, can be a site for salting, drying.

5.3. Financial analysis and project viability

A number of assumptions are made in conducting the financial analysisfor the intended business to bring theory closer to reality. Fishing is performed all the year round, nevertheless, May-August represents the typical season for fishing. Therefore, it is thought important to take into consideration that some fish processing activities/operations are very seasonal, where operations extend over fewer months per year (during the harvesting season) and the business should maintain sustainability even for such short periods. To extend the shelf life for products inputs/outputs and cold stores (ice-boxes, etc.) are essential to prevent fish rotten/spoilage and therefore essential in the analysis.

For vegetables, harvest usually starts late October and early November for okra and tomato off-shoots usually begin in January and continue till May. Overall, the information given in this section will provide the broad framework that summarizes the general fish/crop performance about costs and returns. However, all costs and returns need to be revised upon changes on prices and production costs of inputs and prices ofoutputs as well as any changes that occur in the size and capacity of the processing units/plant[47].

5.3.1. Fish processing unit(s)and profitability

The financial analysis is an important step in the establishment of a fish processing unit or plant. A brief summary on the steps involved in the financial analysis is given in this section and calculations are based on information collected in July 2011including information on prices of inputs and products. As usual, costs and cost items are categorized into fixed, variable and operating costs. As allfish products will be processed by the same processing unit(s),the overhead costs will be distributed among the existing products(assumed to be performed by one women development association or fishermen association to make use of existing assets and minimize overall costs) and any other products developed in the future. All costs, returns and net profits are shown in Table 5.1 to 5.3 and details of equipment and material needed are left to annex 5.1.

Average input price weretaken for fish products (Table 5.1) and similarlyfor sale prices. The assumption is that, a minimum price will give a better market position for the new business and product prices can be increasedgradually when market conditions improve.

[47] In RSS conditions, two main cost items might affect the processing industry and include the fuel for generators and the cost of labour (skilled and unskilled depending on the size of the processing unit(s).The analysis considers a simple model of a simple processing unit, therefore, might not be a big issue. Be it an issue, the organization and labour requirement should be thoroughly studied and this include information on skilled and unskilled labour requirements, the rate of payment and expected rises and other labour legislations matters and costs.

Table 5.1: Volumes of fish production and sales/year by the proposed unit

	Wet-salted fasiekh*	Dried fish (kajek)**	Filleted fish	Unit Subtotals
Purchases in Kg./day	120	40	200	360
Processing ratio	2:1	4:1	1:0.45	
Production Kg/day	60	10	90	160
Input Price/Kg (SDG)	5	3	8	16
Output Price/Kg (SDG)	15	4	20	39
Work days	200	100	200	500
Per day sales in one shift (SDG)	900	40	1800	2740
Per day sales in two shifts	1800	80	3600	5480
Annual sales one shift (SDG)	180000	4000	360000	544000
Annual sales two shifts (SDG)	360000	8000	720000	1088000
Annual costs one shift (SDG)	119224.4	39741.48	198707.4	357673.3
Annual costs two shifts (SDG)	238448.9	79482.95	397414.8	715346.6
Annualprofits one shift (SDG)	60775.57	-35741.5	161292.6	186326.7
Annual profits 2 shift (SDG)	121551.1	-71483	322585.2	372653.4

*Fasiekh fish is taken as Arabi, Salmani, Shagool, Kass, Soltan Ibrahim (Table 4.1)
** Dried fish is taken as Hreed, kass, Handook, Arabi, whereas dry-salted as Arabi, Sherwee, and small sharks. Worth to note sea dried fish is not recommended in dry farming areas for the high salt contents. Farmers prefer the fresh water kajek for quality and cheap price.

Worth to note is that, current market prices are 4 SDG/kg for dried fish, 15 SDG for wet salted (fasiekh) and more than 20 SDG/Kg for common filleted fish (Gushari&Najil). However, dried fish is not a common practice, nevertheless is incorporated in the model to show significance and model strength as sometimes women development association show interest in drying fish when the alternative is to leave fish to spoil thus incur additional costs.

Information presented in table 5.1 shows that, an average production unit can earn good annual returns in all fish processing business, except for fish drying where losses are certain under assumed sale prices. The reason for the disinterest of fishermen with fish drying is that, it requires four Kg to come up with one Kg. of dried fish with almost the same price as wet. The table also shows that, wet salting of fish earns next to fish filleting sold fresh which come first (Table 5.1).

While wet salting of fish earns 60,775 SDG/ annum fish filleting sold fresh which come first showing annual profits of 161,293 SDG. However, profits almost double when work is performed two shifts a day. Worth to note is that, under current situation, dried fish (kajek) will reduce the net business profits by almost 35,740 SDG a year if continued to be produced under persistent conditions (Table 5.1).

Profitability analysis was made for the entire business under four different scenarios with two options of one shift and two shifts of operation, and both results were found encouraging (Table 5.2). The association which undertakes production can increase its profits by increasing marketing sales by creating new market avenues through nonconventional market avenues as schools, army forces, Sudanese Sea Ports

Corporation, as well foreign corporations working on oils through developing a new way of deferred payment. When the business establishes a good market position, it may start to cross the border to other countries. However, quality standards, hygienic aspects should remain as first concern.

Table 5.2: Profitability analysis for the overall Fish Processing Model

	Cost SDG/year	
ITEM COSTS	One-shift/day	One-shift/day
Primary raw material	232000	464000
Industrial raw material	10748	21496
Labour requirement	50000	100000
Assets and construction	4120	8240
Machinery and equipment	4966	9932
Insurance (0.005)	15092	30184
Interest on capital (murabaha10%)	30183	60366
Total cost/year	333,527	667,054
Total returns/year	544,000	1,088,000
Net profit margins/year	210,473	420,946
Source: based on information obtained from various sources, 2011. *Contingency costs(8%) are omitted		

The model (Table 5.2 and 5.3, annex 5.1) assumed that labour requirement is from same society members and are paid. It further assumes that some of the fixed overhead costs like furniture and desk office tables, etc. will be borrowed from the association, therefore, considered costless as part of their contribution to the business. However, upon expansion, skilled and well trained expertise need to be recruited. Training would be vital in reducing overall costs and business management.

Under current assumptions of production and sales conditions (Annex 5.1), the processing units will be more feasible if two shifts per day are undertakenwhere annual profits may reach 421,000 SDG (Table 5.2). However, one shift can also make positive profits (319,000 SDG) if prices of sales improved by 20% (Table 5.3). Almost 639,000 SDG net profits can be earned when the processing plant works for two shifts accompanied by an increase in sale prices by 20%. In case there is a sharp decline by 20% in sales prices the plant will still continue to earn profits under the given assumptions (Table 5.3).

Table 5.3: fish net margins/year & sensitivity analysis at different scenarios

Scenarios	**SDG per**	
Sensitivity scenarios	One-shift/yr.	2-shifts/yr.
Net profit margins/year	210,473	420,946
10%-increase in sales	264873	529746
10%-decrease in sales	156073	312146
20%-increase in sales	319273	638546
20%-decrease in sales	101673	203346

Source: own computations based on field mission data, 2011.

An alternative line of production of strombus 'zurmbak' could be thought off to bring more income than fish drying. The study was not able to make empirical analysis for productions, and only sale prices were obtained. However, breeding of zurmbak requires special care as to its production since the nails which are expensive will grow every fortnight. This brings a monthly income of approximately 800 SDG/month. SPCRP may need to undertake further analysis.

5.3.2. Vegetable processing unit(s) and profitability

Both tomato and okra can be processed or dehydrated at varying degrees of moisture content, depending on the purpose of utilization and the method used. A number of assumptions are outlined in annexes 5.2(a-c) showing level of price inputs and output products. The profitability of each line of processing is illustrated in this section and details are left to annexes (annex 5.2(a-d).All equipment needed, raw material, labour required and their related costs are detailed in the aforementioned annexes (Annex 5.2, a-d).

For okra vegetable, two main options (other than conventional mortar and pestle)are also available for purchase of needed equipment for making dried okra, and other vegetables and are shown where appropriate. Domestic manufacturer (may be Hamadto/Kabashi manufacturing Company) can fabricate equipment[48] suitable for slicing, grinding and packaging of these intended products.

Important to understand is that, drying the fruit during the Etabeet winds is difficult, in all processes, as the dust is a problem for quality aspects. Producers,who attempt to dry what they harvest, whether laying the tomato/okra fruits out on mats (*birish*) outdoors during dry periods and bringing them indoors when it blows, may reduce the product quality and hence price. Drying tunnels might be costly for individuals but might be an option for a group of producers and/orcooperative associations. At this stage of analysis, solar drying equipment was used to supplement open air drying when needed.

a) processingand dehydration of tomato

Three options for tomato processing were dealt within this study while computing profitability. Like the example of fish processing, the costs and cost items of tomato and okra dehydration/drying/processingare categorized into fixed, variable and operating costs. The costs will be shared by the produced products and any other developed products that enter the processing unit in the future for the similarities in the production processes.

[48]The other option is to import the machinery needed from Indian manufacturer which might be relatively expensive compared to domestic ones. Since SPCRP directions are to go for cheaper and domestically produced equipment from companies located in Khartoum, details can be obtained from any of the well-known manufacturers for erection. Again, the engineering and technical part need be addressed and prepared by a food engineer and installed under his supervision (check Mudawi notes).

Before processing, a thorough understanding of conversion factorsis important for it determines quantities produced; the sales volumes, and their related prices and costs (Table 5.4). Under these assumptions, the analysis showed that, dehydrated tomatoes seem to present the least option while processing by sorting, grading and packaging into small boxes will remain potentially first option for the high market demand for fresh ones while tomato paste or sauce remain the second based on profitability (Table 5.4), which will also be governed by consumer demand and market preference (Fig. 3.6).

Table 5.4: dehydration ratios of some selected vegetables

Product or crop	Conversion ration minimum and maximum	
Tomatoes (oven dry)	20:1	6:1
Tomatoes (sun dry)	6:1	7:1
Tomatoes paste in % terms	30%	32%
Tomatoes pure in % terms	12%	15%
Tomatoes pulp in % terms	10%	26%
Okra	10:1	13:1
Jews mallow*	12:1	14:1
Chilli pepper*	5:1	6:1
Source: Journal of food science, FRC 1975: newly developed dehydrated products by Babker Bashir FRC Journal Vol 7, p 47-51 *Note: The focus in this study is on tomatoes and okra processing. Other vegetables can be processed using same equipment when required.		

Table 5.5-a;which summarizes the profitability analysis of fresh tomato processingshows a net profit of 150,000 SDG per one shift and this may even double if the unit went into two shift work. The investment loan required mount to 2,211,858SDG including raw material cost which constitute the biggest portion. Almost 95% of the processing costs are primary raw material costs, while processing and other costs share the 5% and labour cost shares only 3%. The model took into consideration 8% contingency costs for unseen during unit establishment;however, precise calculations of all costs may reduce this per cent to the minimum and hence increase revenues.

Table 5.5-a: Summary of profitability analysis of fresh tomato processing model

	One shift	**Two shifts**
reduced volume of sales/season (Kg)	675000	1350000
actual volume of sales at packaged price at 3.5 SDG	2362500	4725000
production season (days/year) working days	150	300
	Total cost/season	
Primary raw materials (per year basis)	1806939	3613879
Labour Requirement	63000	101010
Assets & Constructions	2213	4426
Equipment & machinery	2210	4420
TOTAL COSTS/SEASON	1874362	3723735

insurance .005 (includes risk + uncertainties)	110.5	221
contingency 8%	149949	297898.8
Capital interest Murabaha (10%)	187436.2	372373.5
NET-MARGINS/SEASON	150642	330772.2

*assumed 10% discards to be dry processed
Break-even is 3.6 SDG/kg in one shift work.

The sensitivity analysis for fresh tomato processing showed substantial increases in profits when sales increase by 10% and 20 % respectively mounting to 386,892SDG and 623,142 SDG correspondingly (Table 5.5-b). However, fresh tomato processing is sensitive to drastic changes in sale prices where losses (-85,608 SDG) by will be incurred if 10% drop in sales is realized (Table 5.5-b).

Table 5.5-b: Sensitivity analysis of fresh tomato processing

	SDG/season as per	
Scenarios	**One shift**	**Two shifts**
TOTAL COSTS/SEASON	1874362	3723735
NET-MARGINS/SEASON	150642	330772.2
10% increase in sales prices	386892	803272.2
10%decrease in sales prices	-85608	-141728
20% increase in sales prices	623142	1275772
20%decrease in sales prices	-321858	-614228

For dried tomato, net profits under given assumptions (Table 5.5-a &Annex 5.2-b) will reach 61,851 SDG per production season when working one shift a day and may double to 153,192 when production increases by two folds using two shifts a day (Table 5.6-a). Again the raw material costs of dried tomato processing constitute the major share in cost items (94%), and labour cost involved come next. Although the investment will not realize big profits as fresh fruit processing (packaging), nevertheless, a 10% increase in sales will triple the net profits to 180,000 SDG (Table 5.6-b).Drop in prices by 10% may bring losses as high as 57,000SDG per season. However, decrease in prices of sales by 20% will shut down the enterprises as losses may exceed 175,000 SDG per yr.

Table 5.6-a: summary of profitability analysis of dried tomato processing model

Particulars	One shift	Two shifts
reduced volume of prod./season Kg. (using conversion ratio (6:1))	118750	237500
actual volume of sales (SDG) at package price SDG10 /kg	1187500	2375000
production season (days/year)	150	300
	Total cost SDG/season	
Primary raw materials (per yr basis)	892275	1784550
Labour Requirement	57000	89010
Assets & Constructions	763	1526
Equipment & machinery	3742.5	7485

TOTAL COSTS/SEASON	953780.5	1882571
insurance .005 (includes risk + uncertainties)	187.125	374.25
contingency 8%	76302.44	150605.7
Capital interest Murabaha (10%)	95378.05	188257.1
NET-MARGINS/SEASON	61851.88	153192

*assumed 5% discards to be dry processed

Table 5.6-b: sensitivity analysis of dried tomato processing

Scenarios	SDG/season as per	
NET-MARGINS/SEASON	61851.88	153192
10% increase in sale prices	180601.9	390692
10%decrease in sales prices	-56898.1	-84308
20% increase in sales prices	299351.9	628192
20%decrease in sales prices	-175648	-321808

Among the three options available, the tomato paste processing represents the second option in terms of profitability and returns to processors/associations (Table 5.7-a, Table 5.7-b and Annex 5.2-c). The net profits earned in one shift will exceed 222,000 SDG and reach almost 482,000 SDG when two shifts are performed.

Table 5.7-a: summary of profitability analysis of tomato paste processing model

	One shift	Two shifts
reduced volume sales/season (kg)	237500	475000
actual volume of sales (SDG) at7.5/kg	1781250	3562500
production season (days/year)	150	300
Primary raw materials (per yr basis)	1243974	2487949
Labour Requirement	67800	105000
Assets & Constructions	2216	4432
Equipment & machinery	6430	12860
TOTAL COSTS/SEASON	1320420	2610241
insurance .005 (includes risk + uncertainties)	321.5	643
contingency 8%	105633.6	208819.2
Capital interest Murabaha (10%)	132042	261024.1
NET-MARGINS/SEASON	222832.5	481773.1

*assumed 5% discards

Important in this option is that,a decrease in sale prices by 10% will still bring profits by 44,707 SDG while drop in prices by 20% will accumulate losses to more than 133,000 SDG/season (Table 5.7-b& Annex 5.2-c). On the other hand, any increase in price of sales will result in tremendous profits reaching 401,000 and 580,000 SDG for 20% and 10% increase respectively.

Table 5.7-b: sensitivity analysis of tomato paste processing model

	SDG/season as per	
Scenarios	One shift	Two-shifts
NET-MARGINS/SEASON	222832.5	481773.1
10% increase in sale prices	400957.5	838023.1

10%decrease in sale prices	44707.55	125523.1
20% increase in sale prices	579082.5	1194273
20%decrease in sale prices	-133417	-230727

b) Processing and dehydration of okra

Okra can be processed into either dried form or grinded up to powder form commonly known by Sudanese as (*weika*). The model developed to grind okra into this form for suitability to store for longer time period and also save space in terms of bulkiness where ratio used will be 5:1. Table 5.8-a gives a summary of profitability analysis of okra processing unit and details of machinery, equipment and related costs are attached to annex 5.2-d.

The feasibility analysis for okra processing unit showed premium profits of 1,164,328SDG per season/year. The raw material (okra) constitutes almost 93% of total costs (excluding insurance and other unseen costs) (Table 5.8-a).

Table 5.8-a: summary of profitability analysis of okra processing model

	One shift	**Two-shifts**
reduced volume of prod./season (kg) using conversion ratio (5:1)	85500	171000
actual sales (SDG) at 25 SDG/Kg package	2137500	4275000
production season (work days/year)	180	360
	Total cost/season (in shifts)	
Primary raw materials (per yr basis) SDG/yr.	762813.2	1525626
Labour Requirement	57000	89010
Assets & Constructions	763	1526
Equipment & machinery	3977.5	7955
TOTAL COSTS/SEASON	824553.7	1624117
insurance .005 (includes risk + uncertainties)	198.875	397.75
contingency 8%	65964.3	129929.4
Capital interest Murabaha (10%)	82455.37	162411.7
NET-MARGINS/SEASON	1164328	2358144

For more information see annexes 5.2-d
Discards assumed 5%

With 20% increase in product prices, inputs being constant, the annual profits may reach 368,000 SDG. However, the processing unit can earn even with 20% drop in product prices (Table 5.8-b).

From the results presented in previous tables, it is clear that okra processing into *weika* (dried powder form) would represent a viable industry that can maintain adequate profits to processors if adequate market outlets are ensured. In practice, the drastic variation in price of outputs is uncontrollable, and this represents a threat to dried *weika* market. From this analysis, SPCRP,need to develop a good market network by organizing producer's associations to conduct promotional plans for their products and establish a position to compete with products coming from Gedaref dry farming area as well as Gezira irrigated areas.

Table 5.8-b: sensitivity analysis of okra processing model

	SDG/season as per	
Scenarios	One shift	Two-shifts
NET-MARGINS/SEASON	1164328	2358144
10% increase in sales	1378078	2785644
10%decrease in sales	950577.8	1930644
20% increase in sales	1591828	3213144
20%decrease in sales	736827.8	1503144

5.3.3. Mesquite processing unit(s) and profitability

As has been described in the text, a simple example of mesquite grinders business is undertaken to examine the profitability and sensitivity of investment if milled mesquite pods enterprise is established in areas of Tokar where the crop widely spreads. Table 5.9-a, and 5.9-b give some financial indicators to this business and details as machinery and equipment needed is shown by Annex 5.3.

Table 5.9-a: summary of profitability analysis of mesquite pods processing model

	One shift	**Two shifts**
Reduced volume of production Kg./season	256500	513000
Actual volume of sales (SDG) at 1.2 SDG/package	307800	615600
Production season (days/year)	180	360
Primary raw materials (SDG per yr.Basis)	208303.2	416606.4
Labour requirement	21800	36240
Assets &constructions	2125	4250
Equipment & machinery	775	1550
Total costs/season	233003.2	458646.4
Insurance .005 (includes risk + uncertainties)	38.75	77.5
Capital interest Murabaha (10%)	23300.32	45864.64
NET-MARGINS/SEASON	51457.73	111011.5

Assumed 5% discards

The net profits coming up from such a business will be 51,000 to 111,000 SDG depending on work load and the number of shifts performed. Many assumptions are made drawing from the experience of OXFAM. As mesquite is not a crop and availability of seed inputs requires search by children and Youngers within the scattered mesquite forest, it is expected that, many will enrol in such work. The investment cost is less than 250,000 SDG including the raw material cost which exceeds 81-89% of total costs (Table 5.9-a).

Table 5.9-b: sensitivity analysis of mesquite pods processing model

Scenarios	**SDG/season as per**	
	One shift	**Two-shifts**

NET-MARGINS/SEASON	51457.73	111011.5
10% increase in sales	82237.73	172571.5
10%decrease in sales	20677.73	49451.46
20% increase in sales	113017.7	234131.5
20%decrease in sales	-10102.3	-12108.5

In conclusion, mesquite milling is profitable even when sale prices drop by 10% of the given purchase prices (Table 5.9-a, and Annex 5.3). This is, by itself, an encouraging sign to go head in this business. Of course, the environmental and economic impacts to agriculture need special assessment but remain beyond the scope of this study.

5.4.Summary and conclusions on profitability of projects

- Information indicates that fishprocessing scenarios is feasible based on an average production unit and can earn good annual returns in all fish processing business, except for fish drying where losses are certain under the developed modelassumptions and given sale prices.Wet salting of fish earns next to fish filleting sold fresh which come first.
- Under current assumptions, the analysis showed that, dehydrated tomatoes seem to present the least option while processing by sorting, grading and packaging into small boxes will remain potentially the first option at this stage-for the high market demand for fresh ones while tomato paste or sauce remain the second choice based on profitability, which will also be governed by consumer demand and market preference.
- The feasibility analysis for okra processing unit showed premium profits of 1,164,328SDG per season/year.From the results presented in previous okra tables, it is clear that okra processing into *weika* (dried powder form) would represent a viable industry that can maintain adequate profits to processors if adequate market outlets are ensured.
- Mesquite milling is a profitable investment and net profits coming up from mesquite are substantial (51,000 to 111,000 SDG)per season.

In conclusion,any establishment of a multi-product fish processing unit in Red Sea statewould be beneficial to fishermen, processors and community at large. The vegetable processing lines for both okra and tomato require (although proofed to be economically feasible based on assumptions set forth) further verification as to the size and number of the units and the money available for implementation. The current estimated volume of locally produced vegetable raw material(both okra and tomato) exceed the volumes needed to start a viable business, however, additional units can be installed to fill in gaps for both tomato, okra and fish processing upon existence of new markets and fund availability.

5.5.Wastewater and waste management

As in most processing industries, seafood processing operations produce wastewater containing a substantial amount of contaminants in soluble, colloidal and particulate forms (Colic et al 200x). The degree of contamination depends on the process[49] which is determined by the type of flotation needed. It may be small (washing operations), mild (fish filleting), or heavy (boat storage tanks unloading, blood water from facilities storage tanks, stick water from fishmeal processing). To avoid such hazards, Red sea Authorities need to strengthen the institutions responsible for such measures even at the SMEs or HBEs level of investment.

Big fish industry requires much water, hence more waste, in terms water volumes. In many countries, the typical figures for fresh water consumption per tonne of fish intake are 5–11 m^3 for fish filleting, 15 m^3 for canning and 0.5 m^3 for fish meal and oil production. Fish meal and oil production also consumes about 20 m^3 of seawater per tonne of fish intake (COWI, 19xx). Since our industry will be relatively small, much water, hence less contamination, will exist if standards are to be met.

5.6.Limitations of the study and further research work

Lack of information and data-base for fish industry and also vegetables in Tokar made it hard to verify data sets for models built-up. Moreover, the responsible authorities keep inadequate information on fish, such difficulty in tracking time series data on retail prices of products and the like, as well as the variability in prices of input and outputs.

5.6.1. Limitations of the study

One of the limitations of this work is the short time period for the group interviews and the relatively small sample size for fishermen, producers and consumers, markets and market participants. However, the number of stakeholders could be increased in future studies in order to increase the level of precision in such business. Secondly, the methodology used –focus group discussion - is confined to a limited number of respondents within Port Sudan and Agieg and excluded other localities out of the scope of SPCRP interventions. However, the assumption made to fill in such information gap is that, the information of the situation in these uncovered localities is/was almost the same as in Port Sudan area if not even worse. Despite these limitations, the paramount information, which has been collected during interviews with government officials who knew more about the different localities, might cover the information gaps by other localities.

Thirdly, the time frame of the study (which extends for over four weeks) did not allow for wider market survey for the intended products, particularly the demand side, thus market surveys were limited to main stakeholders through focus group discussions. The psychological and economic factors hindering market development in fish sector

[49]Flotation is one of the most effective removal systems for suspensions that contain fats, oil and grease mixed with low density organic suspended solids.

were not covered as part of market survey. Potential market surveys for fasiekh, kajek fish and *weika* markets were not adequately met. However, some of the market information might be obtained during the implementation phases.

5.6.2. Market research and its role in fish promotion

Market research is extremely essential for any business development. Currently, little research is made on fishing and fish markets and even this meagre information talks about market structure and ignores largely the market conduct and behaviour. Before developing a market logo, potential fish products the units/plant will process and produce need be identified together with identification of potential customers/buyers for products been produced. We also need to make dialogue with potential customers to learn about their needs and expectations on these fish products (also vegetable and mesquite products) prior to commencement. This is to make sure that the produced products meet the needs and expectations of the potential customers.

We know that it is extremely difficult to estimate what potential customers would be willing to pay for these products since the products are not yet produced, however, we need to make our sales volume expectations by value judgment by comparing with similar products sold in the markets we hope to sell to. By analysing the strengths and weaknesses compared with the competitors one can decide as where to go through developing a marketing plan for selling the processed products. The fastest way to business failure, and hence to jail, is to make products and wait for someone to buy them from you.

6. OVERALL STUDY SUMMARY AND CONCLUSIONS

6.1. Summary and conclusions

Fresh tomato vegetables are the best choice for the premium prices and less costs involved. Dried okra in powder form also has the utmost profitable income compared to fresh or finger dried forms. Mesquite is economically feasible as fodder and utilization can be expanded to include human food. Fresh filleted fish seems the better option for SMEs fish processors, while Kajek (dried fish) is not economically feasible under current model assumptions. Wet-salted fish still a viable option, since practice keep costs to the minimum. Other conclusions are grouped to facilitate follow up and understanding.

Development of fisheries industry

- The available fish resourcesand the capacity of sector indicate a need for national policy intervention and organization of professional participants at the state and federal levels to create a national policy and corporation (organization) for monitoring and management of fishery resources. The mandate for the state fishery department should be strengthened for better data gathering and analysis.
- There is a need for national and state programmes for improving the fishery sector and adapting to market standards through modernization of fishing vessels, improve the quality requirements for handling of fish – both on-board vessels and in value chain towards market.
- The state authorities should continue on developing of fishing sites and fishing ports with modern landing facilities, services and infrastructure. Support should be given in the first place to professionals in fish business and development of marketing/distribution channels.
- For the fishing industry to evolve attention is to be given for establishment of well-organized fishing portswith 'landing sites' in Agieg locality and also other localities along the coastline which have potentials with significant yearly catches volumes. Such ports and landing sites (as we have seen in Suakin) will primarily provide landing capacity, relevant services needed by fishing vessels and quality treatment for the catch.

Fishermen concerns

- Most fishermen are highly dependent on informal sources of finance (some traders finance with fuel, ice, etc.) which are unreliable and highly expensive. Options to save money through formal bank accounts are costly and time-consuming for fishermen.

- The fishermen shouldorganize themselves in well-structured association both at locality and state level.

Hygienic measures and standards

- No other way than aligning the whole fishery sector to international standards, which may take some time but remain inevitable for competitiveness with other countries.

Fish trade

- Trade of fish and fish products is generally characterized by the export of small quantities of high-value species and import of low-value products as sardines. However, some high value filleted fish of good packaging is imported from Saudi Arabia.
- Despite the small quantities, fishery production in recent years has been mainly export-oriented to Saudi Arabia, gulf area and eastern Asia while local distribution

is even meagre. In terms of quantity, the most important is Najil fish while shrimps, shark fins and are most profitable in terms of catch value.

- There are no substantial fish exports to the world market. However, the few exports of processed fish are prepared elsewhere in the Sudan mainly from fresh water fish (fasiekh), collected in Port Sudan and then sent by road to Egypt where processed fish is in much demand. Moreover, there are good markets for dried fish both in the Sudan and international market, but fresh water ones is preferable to the sea ones.
- Domestically, there is no big market for sea fish compared to fresh water fish; however, we need to develop tourist market in Red Sea as part of developing the marine sector.

6.2. Strategies and the way ahead

For a real enhancement of fish sector development, genuine steps are to be made in order to rehabilitate and or develop the existing fishing sector. Addition of more motorized boats to the existing fleets; provision of sufficient fishing gear and accessories; improvement of fish handling and processing facilities and techniques; improvement of market outlets both internally and externally; promoting research activities and training of personnel are just few examples of the areas that need special care. However, any reforms to the sector will not be effective without upgrading existing legal frameworks and formulating other relevant legislatives regulations to monitor the whole fish industry.

On the other hand, price and production costs are key factor in determining market potential; however, the retail price of sea fish does not give an indication to competition or overweighing the river fish in most parts of Sudan. However, further sector and product quality evaluations will be needed to determine market requirements. Sector and market studies will be needed to provide more in depth details about market requirements, tastes, etc. after a determination of products which can compete on price. For Khartoum market, five factor: the price, quality, consistent and regular supplies, packaging, labelling are important for market entering and positioning in contrast to river fish which seems dominating most of the country in terms of preference.

6.2.1. How to come about strategic option in Red Sea state

Before throwing nets to the sea to catch fish, two strategic questions need to be verified and the answer to those questions needs to be thoroughly articulated into the SCRP[50] model project concepts. The first question relates the size of business intended to be

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[50]SPCRP national counterpart advocates that, the government gave fishermen production means (boats, nets, etc.) but fish farming is still traditional (classic) and recommends adoption of new modern techniques and technologies to develop the sector. There are potential fishing sites in Agieg and Trinkitat to the North east of Tokar and Hidob to the South of Tokar. inHidob, there are terraces (small earth dams) used as water catchment areas.

pursued in the Red Sea State. Answer to this question will determine the scope of business investment strategy as for instance, to lead development through small scale processing (SMEs) either by fishermen associations or private entrepreneurs or just through support of the Home Based Enterprisers (HBEs) by providing simple home based technologies for drying and salting.

In the absence of strategic planning[51] for the fish sector, Sudan cannot compete (under current situation) with Brazil, India, Vietnam, Ecuador who are 25 years or more in this business. Second, Sudanese should bridge the gap of poor experience that leaves them behind the fish market race in order to meet international standards (both quality and price) and measurements. To come about this requirement, this needs to develop a written plan on how to clean the processing units/enterprises and maintain them in a sanitary manner (SSOP> Sanitation Standard Operating Procedure) and conduct training for women development associations, fishermen, processors, and market agents on how to properly write and then follow SSOP as part of HACCP conduct. For every processing unit, we need to have a written HACCP (Hazard Analysis and Critical Control Point system) plan that details how the food safety of the products will be managed for each product form processed in the facility together with a disposals certificate from the local governing authority (SSMO in Port Sudan).

Under current situation, the strategy should consider that, the fish industry should first start small and then grow big to enjoy economies of scale/size over time and through gradual enrolment into the fish business. Therefore, the study strategically recommends the adoption of small scale processing businessthat goes for labour intensive rather than capital intensive means at this stage. However, the cage –culture which is well developed in Japan can be one of the means to develop the high value addition marine/fish products.

The study concluded that, at this stage of SPCRP project, there is no need for complex industry, rather, simple equipment is needed for processing (de-heading, degutting, and scalingو packing, icing or chilling) for local and export markets. However, the accreditation specifications for international markets is currently not met, nevertheless, competition can be in gulf area for similar standards and specifications. Along the same line of thinking, the study recommends diversification strategy for marketable products (zurmbak is one example), particularly the high value adding sp. (shrimps, octopus, fin fish and stacosa, and the sea cucumber fish (3000 $ for one dried ton.

[51] The problem with investment in the fishery sector in the Red Sea State is the absence of well-structured strategy due to absence of information and feasibility studies, a strategy that can describe what we can do and what we cannot do at this stage. This connotation is very important to be understood by policy maker, for some people want to make short-cuts to realize profits and jump over facts into a nowhere of dreams. Lack of knowledge in this concern, allowed dangerous people who have no background on fisheriesto emerge with dangerous ideas talking about investing huge amount of money (more than 5.2 million US $) to produce 10,000 tons of fish and about 3000 tons of shrimp a year, which resources currently does not exist.

To promote sea fish in Khartoum, market chain need be developed to ensure continuity of supply. However, the challenge is how to add value to the whole fish sellingpractices currently prevailing**.** The following points need to be thought of:

- Lead a promotion campaign to develop fish market (increase consumption), food security, have contacts with ministry of health, extension people to influence consumer preference and taste towards sea foods.
- Develop a market strategy to cover following potential market avenues
  - Hospitals and prison[52]s
  - Schools
  - Marine harbour workers
  - Army camps
  - Foreign companies
  - Cooperatives
- Develop market survey and assessment for
  - Courts, and grills in public yards
  - Supermarket[53]s
  - Wholesale markets
  - Retail markets
  - Niche markets (Friday and Saturday moving markets)

6.2.2. Strategies and options for export market

For a steady development of the fish sector, the first task is to identify prospective national entrepreneurs or companies interested in developing the sector. These firms can make close partnership and business relations with fishing communities. Other options will be to identify suitable foreign partners to participate in fisheries investment on a commercial basis (joint- venture agreements). However, certification system for export and accreditation are essential in international markets.

For instance, two options are to be followed in order to compete in gulf market.The first is cost minimization strategy that looks in marketing, distribution, financial, managing aspects, etc. and the second is a differentiation strategy that looks at the competitive/comparative advantage based on a specific demand as recognized by the Gulf market or by a sufficient part of midetranian market (Greece and Turkey, Lebanon as sea cucumbers). Such a strategy permits local export companies to avoid direct competition through prices by making the product not competitive with those of

[52] In Port Sudan prison about 495 long term sentenced prisoners. No fish is given to prisoners. However, tomato is give only during the season when it is cheap.

[53]The current purchases in supermarkets for local sea fish are small. For instance, 10 Kg of local fish can stay for 2-3 weeks to be sold in a supermarket. People prefer to purchase fresh fish directly from the Sigala market. Frozen fish is preferred by specific strata.. Worth to note is that, some people prefer the Saudi haamor or fillih for the good quality of filleting and packaging.

other companies/countries. Worth to note is that information in this study are indicative and a detailed analysis must be done for each product to verify these options specially in shark fins, sea cucumbers, and other sea foods.

For some products, a differentiation strategy is the only way to enter the fish market, as there is little room for newcomers on a highly competitive market (Vietnam, Brazil, etc.In differentiation on species for the fish market, care should be taken since Bija communities do not easily change their habits in terms of species and presentation of fish (whole versus filleted, fresh versus frozen). However, if the Najil is of high demand, in-depth work on this species might help to determine if with proper promotion, Najil could become “special” on national markets other than Port Sudan market.

Packaging and labelling is very important for processed products. Local or private labels could be an option for some species however, authorities should look for partnership with a renowned company (as Saudi Filleh) which has a strong brand and which is already well known in Sudanese supermarkets.

<u>For vegetables like tomato and okra same strategic framework applied in this context.</u> Overall, and to move ahead, competent authorities, legal frameworks that develop the legal aspects in fishing and vegetables production to export markets (SSMO to apply the TQM, HCCP and ISO standards) to have accreditation for export through known accreditation organizations.

6.3.Recommendation of the study

(a) *General recommendations*

In redesigning the fisheries policy, the Red Sea authorities should focus its endeavours towards achieving the following main objectives:

i) Restructuring and strengthening of the entire fishing sector in the state including the introduction of appropriate fishing fleet, upgrading the existing fish farming practices and adoption of small scale fish processing industry for value addition. In this connection, focus should be on professional fishermen.
ii) The development of aquaculture other than known fish (strombus) in order to explore and utilize the marine biological diversity to the appropriate capacity with the highest environmental and quality standards.
iii) Encourage the processing and quality handling of fish and fish products in order to improve value for the fish catches and also fish products.
iv) Regulating (through restricting other's malpractices in our territories) through fair fish trade mechanisms (e.g. roller agreements with Egyptians and Yemenis) to ensure the long-term sustainable management of our fishing resources in accordance with fishing possibilities taking into consideration the increasing competitiveness of other main fish harvesters.

v) Instituting an 'organization' with board of directories to promote the production, processing and marketing of marine fish and fish products.
vi) Developing infrastructure and logistical support of the fisheries in Agieg, Suakin and Port Sudan (cold stores, landing sites, docks, ship berth, transport, etc.)
vii) Strengthening organized fishermen associations and by offering training and capacity building programmes to improve the management of fishing.

(b) Specific recommendations

- Based on the results of this study, we recommend establishmentof small scale business enterprises in fish, vegetable and mesquite taking into consideration all organizational and institutional aspects
- Assign project manager for the three SPCRP MP areas.
- Design a market logo for each specific commodity, is the main role of the person responsible for marketing section.
- Conduct a detailed market training module on market costs, returns and profits computation as well as strategies setting and market mix development.

Organizational and Institutional aspects

- SPCRPin collaboration with MoA and other institutions should set different initiatives to strengthen and/or rebuild the technical and managerial capacities of essential stakeholders/shareholders as a prerequisite for sustainable development of the fishery industry. This could be done through training in basic business management and the improvement of the organisational structures of existing cooperatives and market institutions.
- The study calls for coordination and integration of the fragmented efforts in fishery sector to a more close partnerships and strategic alliances with a variety of on-going and/or future projects/programmes in a more broader perspectives that embraces not only fishery production but also marketing and fishery-related management issues as capacity building and upgrading of market institutions and the like.
- A review of existing policies and institutional structures, at the state and federal levels to promote trade in fish and fish products, including trade facilitation, trade-related financing and trade preferences;

Production issues

- To improve competitiveness of our fish products we need to adjust production to the domestic and export market needs through designing a strategy for market development (Bija are reluctant to fish and sea food). Adding higher value to the existing aquaculture products can possibly be through diversification of production by including marketable species (farming of shrimps, sea cucumber) in addition to improvement in management practices and reduction of production costs.

- In the light of new political, administrative, and economic contexts in RSS, there is an urgent need to redefine the fundamental role of fisheries cooperatives in the state. Cooperatives should increasingly focus on conducting business operations in a dynamic, flexible and assertive way, adopt a 'business unit' operating model, become an integral part of the private sector (with independent, business-oriented and self-reliant procedures and mechanisms), and leave to other actors more specific roles and functions. Their leadership needs to be prepared and trained for more specific economic functions. A number of reforms should contribute to remove a number of barriers and constraints that at present block cooperatives from entering and competing in the market economy*(Yemen study)*

Credits and microfinance

- Encourage microfinance institutions to support or avail microfinance and credit schemes for vegetables growers as well as the artisanal fishermen (working capital to purchase storage refrigerators, boats, engines, fishing tackle, fuel, etc.).
- Develop an initiative for microfinance of small to medium enterprises

Control measures, standards and Safety,

- Develop a guide to the application of cleaner production to the fish processing industry such as fish fillets, canned fish, fish meal and fish oil at small scale fish processing plants with the purpose of raising awareness of the environmental impacts of fish processing and highlight approaches that industry can take to avoid or minimise these impacts.

Federal and state relations

- There are some State-Federal power imbalances (rule of governance) that need to be settled prior to commencement of any project, particularly the fish sector

General recommendations for improvement

- Capacity building for non-professional to make them professional
- Training through farm schools and HEBs in Port Sudan, Tokar and Suakin
- Outstanding candidates to be trained (on international standard) in similar countries as Uganda and Kenya

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Annexes

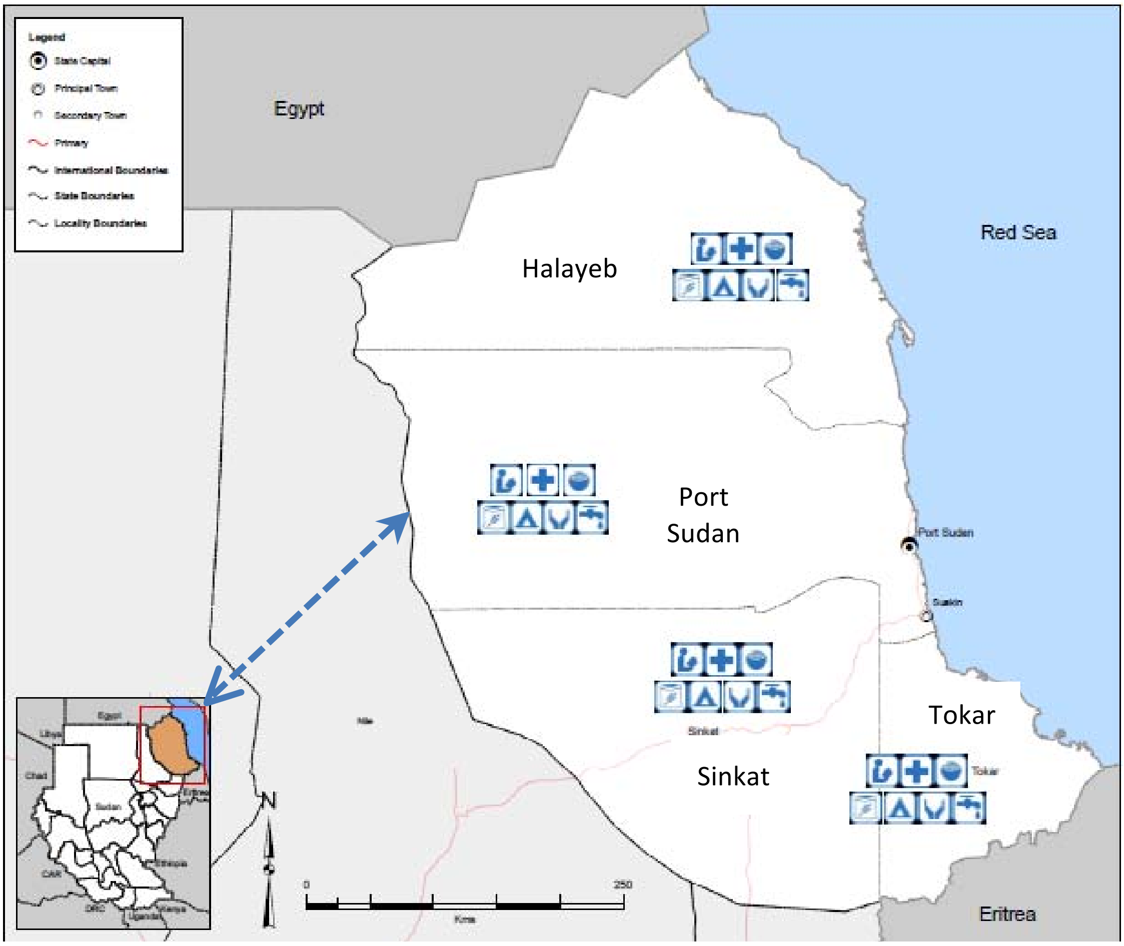
Annex 1: People met and institutions visited In Red Sea State July 2011

Name	Occupation and address	Remarks
Jan Hendricks	Technical Advisor 183-492014-15	SPCRP-MP coordination-red Sea State
Omer Ali Osman	SPCRP-MP National Director 0915011336	Deputy director of Delta Tokar Agricultural Scheme
IsamEldinAbdrahimSorkaty	D-General 0912537654	State Ministry of Agricultural Animal

		Resources and Irrigation
MohmedNur	SPCRP-CB-N National Director 0912538531	State Ministry of Agricultural Animal Resources and Irrigation
SaeedJumaFadul	Director, Department of Marine Fisheries of theMoAARI 0911385622	State Ministry of Agricultural Animal Resources and Irrigation
HamadOjan	Deputy director. Department of Marine Fisheries of the MoAARI 0918221799	State Ministry of Agricultural Animal Resources and Irrigation
MamdouhAbdella Osman	Shrimps specialist. Department of Marine Fisheries of the MoAARI 0918178159	State Ministry of Agricultural Animal Resources and Irrigation
John G. Baton	Senior fisheries advisor 0916999703 +249-311 834997-98	Modernization of small fisheries Red Sea State
Hassan Eisa A.	D-G of Delta Tokar Agricultural Scheme (DTAS)	
El TahirHashim Osman	Director of Agricultural Operations, DTAS	Tokar town
ObsharOkshtayer	Undersecretary of OmHail Society for Development	Tokar town 0913877406
OhajAbdellah Ahmed	Undersecretary of Abu Hadil for Women, Child and Society Development	Tokar town 0913203299
Aisha Medani	Member, Abu Hadil for Women, Child and Society Development	Tokar
Manal Ado	Member, Abu Hadil for Women, Child and Society Development	Tokar
Bakashkabiry Mahmoud	Head of Farmers' Union of Delta Tokar Agricultural Scheme (DTAS)	Tokar town 0918059186/ 0911477766
El Amin JailaniAbuFatma	Member of Farmers' Union of Delta Tokar Agricultural Scheme (DTAS)	Tokar town 0910528093
Abdel Hamid El Shaiekh	Treasurer of Farmers' Union of Delta Tokar Agricultural Scheme (DTAS)	Tokar town 0901189680
Ali Salehmahmoud	Fisherman, farmer and leader	Agieg village
Al Amin Moh. Malik	teacher, farmer and leader	Agieg village
Adam HimmetKhair	Fisherman, farmer	Agieg village
Mohmed Ahmed Osman	Fisherman, farmer and leader	Agieg village
Osman Ahmed Osman	Fisherman, farmer	Agieg village
Adam MohmedAbasher	Fisherman, farmer	Agieg village
MohmedSalihYassin	farmer	Agieg village
Adam Moh. Nur Adam	Fisherman, farmer , teacher	Agieg village
MosaMohmedMosa	Fisherman, farmer	Agieg village
Hamid MohmedElamin	Mrkt specialist (B. Nile and Red Sea)	0912507078
Abdel RahmanMoh. El Birawi	Wholesaler in Sigala market and supplier	0912188214
IgbalSead Ahmed	Research scientists	University of Juba
Mustafa Abdellah	MahaliaOfiicer	Sigala Market 0910681225
AfafHamid Nur	Gender specialist consultant UNIDO (0918341937)	UNIDO- Port Sudan
Vet.AmalMohmed Ahmed	Inspection Department SSMO, port Sudan	SSMO, Port Sudan 0912258234
ZakariaMohmedSulimanSaleh	Director of SSMO, port Sudan office	SSMO
Omer AdrobAlawiaOkair	Director of informal education - School nutrition programme	Ministry of education, RSS 0912638724
Adam ElDuma Adam	colonel Police officer	Port Sudan Prison
MohmedsaedSaleh	Head of vegetables and fruits supply union, RSS	Port Sudan RSS, 0911177626
SalehMohmedIdris	member of vegetables and fruits supply	Port Sudan 0912757445

	union, RSS	
IdrisMohmed Ibrahim Elamin	Member of vegetables and fruits supply union, RSS	Port Sudan
El Tha 'air Hassan MohmedSaleh	UNIDO consultant and national coordinator of the modernization of small scale fisheries project & lecturer in Red Sea University	UNIDO, RSS) 0912431939
*Interviews were made on focus discussions, July 2011.		

Annex 1.1. Red Sea Map by Locality (borrowed fromSUDAN - Red Sea State Who Does What & Where, April 2010 **(OCHA)**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Secondary Town
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State Boundaries
Locality Boundaries
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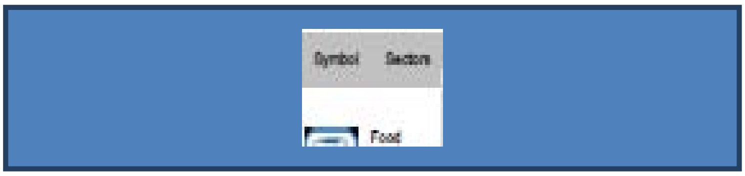
Symbol
Sectors
Food

Annex Box 2.1-a: About Om Hail Association for Development
- Established in 1998 - Its services cover four main sectors; namely agriculture, waters, health and education. - The geographical coverage extends to five main areas the Sahel coast, the middle, Khor Baraka and Upper Khor Baraka, and Langaed area. - *Fishing*: along the coastal line up to Ageig. - Four associations are formed with 80 members excluding Ageig . - Fishermen have boats and ice boxes for fish chilling - *Agriculture:* In Irem area. Millet, water melons, okra and tomato are common vegetables grown. - In Khor Baraka: Horticultural crops are grown by individuals and associations which comprise a total of 23 farms. - Most crops grown are tomato, okra, sweet pepper and shamamgalia - Participated with OXFAM in in provision of many services including mesquite milling.

Annex Box 2.1-b: About Abu Hadya for Women, Children and Community Development
• Established in 2009 as a branch of a primary association in Port Sudan and they rent a house for the daily operations • Targets women, children and community development • Members 683 women, 135 men • Provides training in food processing (marmalades, drying of okra and tomato, Abray&Rugag, soft drinks, and other works as sewing. • Due to high humidity drying of vegetables require improved techniques • Training activities performed in 2010, about 127 women participants (in processing and marketing) • Training activities performed in 2011, 140 women participants (in processing and marketing) • in 2011, 40 men participants were trained in marketing • FAO has established the micro finance project and there are 4 subgroups for micro-finance, each ring consists of 10 members (mostly women). • Also there are 10 farmers ' schools which total to 100 members (10*10) • Training course were made for 105 participants in improved ovens (canon) • More training for the women groups is needed

Annex 2.2: Summary of related UNIDO (Women Development Association) activities in Red Sea State

UNIDO focus on small scale fish, vegetables and other BHEs enterprises. They face marketing problems of their products

- Women find sewing and other non-food activities more marketable and profitable than fish and other food drying. Their mark-ups are usually 10% profit
- Membership of women development association (WDA), reach 182.
- they process Fasiekh 30 kg/day about 0.2 tons/week and 0.75 tons a month
- there is another Women Development association (called Khanssa) focus on fishery.
- There are no market avenues and demand is little for fish products, for the processing is extremely traditional, no packing machine and no quality and safety standards
- No proper packing, poor handling and promotion
- Packing of half Kilo is sellable than large packaging
- Strombus "zurmbak" (Duffra) is profitable than processing other fish products
- The Women's Development Associations purchase fish to process under the so called (*friends of fishery*) initiative.
- Training on feasibility and marketing is required particularly, training on net making
- Profit margins range between 20-25% of costs
- During off season, the WDA has no funds and they take loans from traders
- The cooperative law is not matching with the fishery sector and requires special update to include the fishery sector

Annex 3.1: Five Steps in Planning a Small-scale Fish Plant(Adapted from Knapp and Reeve (2008))

1. Define your goals.
Goals. Why do you want to start a fish plant?
Financial objective. How much money do you need to make?
2. Do a reality check.
Challenges. Do you understand the challenges you will face?
Strategy. Do you have a strategy to overcome these challenges?
3. Research things you can't control.
Markets. What products do markets want? What prices will they pay?
Fish resources. What species in what volumes are caught in your area?
Competition. Who is your competition in buying fish?
Transportation. What transportation is available for shipping fish?
Land. What locations are available for a plant?
Utilities. What utilities are available?
4. Plan things you can control.
Fish. How much fish will you buy?
Products. What kind of products will you produce?
Buildings. What kind of buildings will you use?
Equipment. What kind of equipment will you use?
Manager. Who will manage the operation?
Workers. Where will you find workers?
Season. How long a season will you operate?
5. Analyze if your plan works financially.
Capital. Who will put up how much money to start the plant?
Grants. What grants can you get?
Loans. How much money will you borrow and need to pay back?
Costs: How much money will you spend?
Revenues. How much money will you earn from sales?
Profit or Loss. How much money will you make or lose?
Cash flow. Will you have money when you need it?

Annex 4.1: The prices and quantities of tomato and okra purchases

	Prices SDG	Quantities (lorry/day)

	Egg plant	Sweet pepper	Egg plant	Sweet pepper
January	15	45	1	
February	10	30	2	
March	5	30	3	3
April	5	37	6	3
May	5	55	3	3
June				

Sources: interviews with stakeholders
There is no distinct measurement for a sack or box and figures are given as a range of estimates
Prices of tomato per box (10-12 kg)
Prices of okra per 20 kg sack
Quantities are in lorry terms/day. One lorry equals to box of tomato (estimates)
One lorry equals to sacks of okra (estimates)

Annex 4.2: Summary of interviews and focus discussion in Agieg

Agieg area extends from RasGasar to Agieg and they form 3 associations each of 100 fishermen. The total number of fishermen amount to about 300 equally divided between Agieg, Adobana, and Agitai. Only one-third of the total numbers (about 90 fishermen) are currently at work while the rest moved out of business for the following reasons:

Lack of marketing infrastructure as refrigerators, ice boxes, etc.

Long distance to market

No finance

Number of boats in Ageig approximate to 30. There are 100 fishermen in Agieg but only 30 are now doing fishing and the others desert the job (jobless)

Fishing community of Agieg do not do dry process for fish for the price of the dried fish is almost equal to the fresh (1 kg fresh = 0.25 kg dried). To overcome their marketing problem, they demand two big boats to transport the harvest of the three associations along the coast and bring ice and other inputs from Port Sudan. The boats should be equipped with big engine with diesel (no benzene). Moreover, the community of Agieg and neighbouring villages demand fishing equipment (nets, refrigerators, spare parts, threads, maintenance, etc.) as well as small ice factory and training of labour to maintain their boats.

Worth to notice is that, the water desalting station in Agieg, although it is new, is not working for it requires a well to avail water.

In Agieg, fishermen sell STROMBUS "ZURMBAK" nails for 300 SDG/lb. and this is sold in Port Sudan for 400 SDG/lb**.** despite the high cost of zurmban nails, itsmeat is sold at 4 SDG/Kg**.** Every fisherman can obtain half lb of STROMBUS "ZURMBAK" in a week reaching a net income150 SDG/week/fisherman. If Strombus "zurmbak"[54] meat is included in calculation (10 Kg*4 SDG/kilo) this may reach 40 SDG/kg, which gives 200 SDG/week, a reasonable sum equivalent to 30 SDG/day.

Unlike expected, Nagil fish is not common in Agieg and fishermen sell it at price of 2 SDG/Kg, however, Kushaeri is the common type of fish in Agieg. While fishermen price of Nagil fish in Port Sudan reach 4 SDG/Kg), traders sell at 6-10 SDG/Kg in Port Sudan.

Annex Box 4.3: Costs and returns from Agieg to {Port Sudan (marketing

[54]Strombus "zurmbak" breeds a new nail every 15 days

takes a week)

If price is 4 SDGper kilo
- One lorry of 600 Kg to Port Sudan = 1000-1200 SDG/trip
- Refrigerator rent =100 SDG/trip
- 35 ice strip =5X35= 175 SDG
- Fish cost 2X600= 1200 SDG
- Total cost 175+1200=1200 SDG= 2700 SDG
- Total returns 600x4 =2400
- Loss 300 SDG (sometimes)
If price is 9 SDG per kilo
- Returns =9X600= 5400 SDG
- Profits 2700 SDG/week

However, fishermen increase their revenues by catching Strombus "zurmbak" can be most profitable in cages rather than ad hoc culture. New techniques and laws and regulations need be enacted to organize its fishing (as in Eritrea).

Agriculture in Agieg

Besides fishing, community of Ageig perform limited agriculture outside the delta area. Two projects in Agieg known Makban (A) and is of 500 Feddan and owned by farmers, and Makban Project (B) for poor farmers livelihoods and is of 500 Feddan area distributed among 250 farmers each own 2 feddan. It has been observed that, mesquite covered Makban Project (B) almost entirely (about 500 feddan) and now people only cultivate on Makban (A).

Makban projects were used to be irrigated by flood irrigation, bur since the establishment of Tay terrace (small dams), they depend on rain water. In this year, only 250 feddan were cultivated by tomato, okra, cucumber and watermelons. The quantity of tomato produced in Makban is generally small and is only used for local household consumption i.e. no surpluses for market. Total quantity produced of okra mostly goes to Port Sudan, Tokar and Grora[55]. Worth to note is that, In Eideb, (7 km from Agieg), there is a well (dunki) which can irrigate the 500 feddan in Agieg. Authorities have already made a feasibility study and there is already a tractor and land rover for this project but all not running now. Despite the existence of small agriculture in Agieg, people think focus should be made on the sea and little to agriculture, specially, mesquite. 7 milling sites are proposed to be located in Agieg and/or Durrheb, Adubana, Agitai, Grora, Ayterba, and Andal.

Annex 5.1: Details of the fish processing model

[55] 250 feddan *7 pickings/month*3 months season and each picking is one lorry i.e. 1*10*3=30 lorry

	Wet-salted fasiekh*	Dried fish (kajek)**	Filleted fish	Unit Subtotals	
Purchases in Kg./day	120	40	200	360	
Processing ratio	2:1	4:1	1:0.45		
Production Kg/day	60	10	90	160	
Input Price/Kg (SDG)	5	3	8	16	
Output Price/Kg (SDG)	15	4	20	39	
Work days	200	100	200	500	
Per day sales in one shift (SDG)	900	40	1800	2740	
Per day sales in two shifts	1800	80	3600	5480	
Annual sales one shift (SDG)	180000	4000	360000	544000	
Annual sales two shifts (SDG)	360000	8000	720000	1088000	
Annual costs one shift (SDG)	119224	39741	198707	357673	
Annual costs two shifts (SDG)	238449	79483	397415	715347	
profits one shift (SDG)	60776	-35741	161293	186327	
profits 2 shift (SDG)	121551	-71483	322585	372653	
Volume of production and sales/day				Sales SDG	Sales SDG
	Kg/day	Price SDG/kg	work days	One shift	Two shifts
wet-salted fasiekh(2:1)	60	15	200	180000	360000
dried salted kajek(4:1)	10	4	100	4000	8000
filleted(1:0.45)	90	20	200	360000	720000
fish meals from disposals	160	1	200	32000	64000
subtotals				576000	1152000
Fish (raw materials)					
	working days	PriceSDG/kg (b)	Quantity	Total cost/yr (1 shift)	Total cost/yr(2 shifts)
Primary raw materials (per day basis)			Kg		
wet-salted fasiekh(2:1)	200	5	60	60000	120000
dried salted kajek(4:1)	200	3	20	12000	24000
filleted(1:0.45)	200	8	100	160000	320000
fish meal product (as half of fish)	200	0.1	90	1800	3600
Sub Total			180	232000	464000
industrial raw materials					
waters	200	5	2	2000	4000
ice	200	2.5	5	2500	5000
polyethene for packaging	200	0.1	80	1600	3200
rolls for labelling and stickers	200	0.1	80	1600	3200
jerkins for fasiekh	200	5	4	4000	8000
species and additives	200	8	2	3200	6400
gasoline gallons/day	200	2.5	0.66	330	660
lubricants	200	0.6	0.15	18	36

Sub-totals				10748	21496
Labour Requirement					
	months	SDG/mo	No.	Cost/ yr(1 shift)	Cost/yr 2 shifts
labour1 permanent labourers	12	500	1	6000	12000
labour2 administrative labourers	12	750	1	9000	18000
Causal labours	7	500	10	35000	70000
Sub-totals				50000	100000
Assets & Constructions		SDG	quant	Value SDG	Value SDG
land squ.m		10	400	80	160
processing room 130 squ.m		650	100	1300	2600
administrative building (m)		650	50	650	1300
Room for cold storage		1200	60	1440	2880
room for input-product storage (m)		650	50	650	1300
Subtotals				4120	8240
Equipment, machinery and cars	No.	Unit cost SDG	No. or set	Value SDG	Value SDG
	2 Solar dryers, capacity of each 30 Kg/day	12000	2	2400	4800
	16 Plastic barel for washing of fish	50	16	80	160
	6 Jute sheets for dripping water from fishes	50	6	30	60
water tank		5000	1	500	1000
	8 big plastic basins	120	8	96	192
	1 grinders (motorized) for fish meals	3500	1	350	700
Sealing and packing devices		950	1	95	190
Balance for measurement		600	1	60	120
Electric Generator (15 KW)		5000	1	500	1000
cutting boards & tables		700	1	70	140
hand gloves		10	20	20	40
knives& saws		150	1	15	30
appliances& electric connections		1500	1	150	300
ice boxes		500	5	250	500
1 Freezer of 250 litres capacity		2300	1	230	460
	Balance(s) for weight measurement	400	3	120	240
subtotal				4966	9932
FIXED COST ITEMS (TOTALS)					
VARIABLE C)ST ITEMS (TOTALS)					
total costs				301834	603668
insurance .005 (includes risk + uncertainties)				1509.17	3018.34
contingency8%				24146.72	48293.44
Capital interest murabaha (10%)				30183.4	60366.8
Total loan required (SD)				357673.29	715346.6

Annex 5.2-a: Details of profitability analysis of fresh tomato processing model

				One shift	Two shifts
reduced volume of sales/season (Kg)				675000	1350000
actual volume of sales SDG at packaged price at 3.5 SDG				2362500	4725000
production season (days/year) working days				150	300
	No. (a)	PriceSDG/ unit	Quantity .Kg	Total cost/season	Total cost/yr
Primary raw materials (per yr basis)					
Qu.tomato strain B/season		1.8	750000	1350000	2700000
waters for washing(cubic meters)		10	7500	7500	15000
one Kg plastic sack (perforated)		0.5	750000	375000	750000
Paper for tomato ripening (every week)	one ballet	40	21	840	1680
wooden box/plastic thread sacks		0.75	67500	50625	101250
fuel (gasoline gallons/day)		8.5	10	22950	45900
lubricants		0.6	0.15	24.3	48.6
Sub-totals				1806939	3613879
Labour Requirement					
		SDG/mo	No.	Cost/ yr(1 shift)	Cost/yr 2 shifts
Manger	12	750	1	9000	11250
Accountant	12	500	1	6000	7200
labour1 permanent labourers	12	600	1	7200	14400
labour2 administrative labourers	12	650	1	7800	9360
Store keeper	12	450	1	5400	6480
Guards	12	300	1	3600	4320
Causal labours	6	500	8	24000	48000
Sub-totals				63000	101010
Assets & Constructions		SDG	quant	Value SDG	Value SDG
land squ.m		1	500	10	20
processing room 130 squ.m		650	100	1300	2600
administrative building (m)		650	50	650	1300
Cold store		1200	60	1440	2880
Warehouses for ff (m)		650	50	650	1300
W.C & sanitary facilities		500	12	120	240
kitchen & meal room		400	12	96	192
Wells, 8 meter deep (one unit with accessories)		500	8	160	320
Subtotals				2213	4426
Equipment & machinery	No.	Unit cost			
		Price/Unit	No.	Value SDG	Value SDG
Washing units for fruits washing		2000	1	200	400
Grading & sorting machine		2500	1	250	500
Small-hand driven wagon		100	4	40	80
sealing and wrapping devices		900	set	90	180
furniture		1500	set	300	600
Electric Generator (15 KW)		5000	1	500	1000
electric connections		1500	1	150	300

Balance(s) for weight measurement		1100	3	330	660
Sunk pumper for well		3500	1	350	700
subtotal				2210	4420
TOTAL COSTS/SEASON				1874362	3723735
insurance .005 (includes risk + uncertainties)				110.5	221
contingency 8%				149949	297898.8
Capital interest Murabaha (10%)				187436.2	372373.5
NET-MARGINS/SEASON				150642	330772.2

Annex 5.2-b: Details of profitability analysis of dried tomato processing model

				One shift	Two shifts
reduced volume of prod Kg./season (using conversion ratio (6:1)				118750	237500
actual volume of sales (SDG) at package price SDG10 /kg				1187500	2375000
production season (days/year)				150	300
	No. (a)	Price SDG/unit	Quantity. Kg.	Total cost/ton/season (1 shift)	Total cost/yr(2 shifts)
Primary raw materials (per yr basis)					
Qu. tomato strain B/(kg) season		1.1	750000	825000	1650000
waters for washing(cubic meters)		10	7500	7500	15000
one Kg plastic sack (perforated)		0.5	118750	59375	118750
Paper for tomato ripening (every 3 days)	one ballet	40	10	400	800
Sub-totals				892275	1784550
Labour Requirement					
		SDG/mo	No.	Cost/ yr(1 shift)	Cost/yr 2 shifts
Manger	12	750	1	9000	11250
Accountant	12	500	1	6000	7200
labour1 permanent labourers	12	600	1	7200	14400
labour2 administrative labourers	12	650	1	7800	9360
Store keeper	12	450	1	5400	6480
Guards	12	300	1	3600	4320
Causal labours	6	500	6	18000	36000
Sub-totals				57000	89010
Assets & Constructions		SDG	quant	Value SDG	Value SDG
land squ.m		1	500	10	20
administrative building (m)		650	50	650	1300
Warehouses for ff (m)		650	50	650	1300
W.C & sanitary facilities		500	12	120	240
kitchen & meal room		400	12	96	192
Subtotals				763	1526
Equipment & machinery	No.	Unit cost			
		Price/Unit	No.	Value SDG	Value SDG
Washing units for fruits washing		2000	1	200	400
Small-hand driven wagon		100	4	40	80
Solar dryers, capacity of each 30 Kg/day		12000	2	2400	4800
sealing and wrapping devices		900	set	90	180
furniture		1500	set	300	600
electric connections		1500	1	150	300
Balance(s) for weight measurement		750	3	225	450
plastic sheets for sun drying		50	15	250	500
plastic basins		35	10	87.5	175
subtotal				3742.5	7485
TOTAL COSTS/SEASON				953780.5	1882571
insurance .005 (includes risk + uncertainties)				187.125	374.25
contingency 8%				76302.44	150605.7

Capital interest Murabaha (10%)		95378.05	188257.1
NET-MARGINS/SEASON		61851.88	153192

*assumed 5% discards to be dry processed

Annex 5.2-c: Details of profitability analysis of tomato paste processing model

				One shift	Two shifts
reduced volume sales/season (kg)				237500	475000
actual volume of sales (SDG) at 7.5/kg				1781250	3562500
production season (days/year)				150	300
	No. (a)	Price SDG/unit	Quantity. Kg.	Total cost/season by shifts	
Primary raw materials (per yr basis)					
Qu. (kg)tomato strain B/season		1.3	750000	975000	1950000
waters for washing(cubic meters)		10	7500	7500	15000
one Kg glass jar		0.9	225000	202500	405000
stickers and labels	one ballet	0.01	225000	2250	4500
wooden box/cartons		1	33750	33750	67500
fuel (gasoline gallons/day)		8.5	10	22950	45900
lubricants		0.6	0.15	24.3	48.6
Sub-totals				1243974	2487949
Labour Requirement					
		SDG/mo	No.	Cost/ yr(1 shift)	Cost/yr 2 shifts
Manger	12	1000	1	12000	15000
Accountant	12	750	1	9000	10800
labour1 permanent labourers	12	600	1	7200	14400
labour2 administrative labourers	12	550	1	6600	7920
Store keeper	12	500	1	6000	7200
Guards	12	450	1	5400	6480
Causal labours	6	600	6	21600	43200
Sub-totals				67800	105000
Assets & Constructions		SDG	quant	Value SDG	Value SDG
land squ.m		1	800	16	32
processing room 130 squ.m		650	100	1300	2600
administrative building (m)		650	50	650	1300
Cold store		1200	60	1440	2880
Warehouses for ff (m)		650	50	650	1300
W.C & sanitary facilities		500	12	120	240
kitchen & meal room		400	12	96	192
Wells, 8 meter deep (one unit with accessories)		500	8	160	320
Subtotals				2216	4432
Equipment & machinery	No.	Unit cost			
		Price/Unit	No.	Value SDG	Value SDG
Washing units for fruits washing		2000	1	200	400
Vacuum cooker (thermo oil), capacity 300 Kg juice		16000	1	1600	3200
pulper		9000	1	900	1800
Pasteurization equipment + stainless steel basin		6000	1	600	1200

Stainless steel tank for packaging, capacity 500 liter	6000	1	600	1200
Tomato blanching kettle	3000	1	300	600
Pasteurization pump	4000	1	800	1600
Electric Generator (15 KW)	5000	1	500	1000
electric connections	1500	1	150	300
Balance(s) for weight measurement	1100	3	330	660
Sunk pumper for well	3500	1	350	700
Well accessories +pump + pipelines	1000	1	100	200
subtotal			6430	12860
TOTAL COSTS/SEASON			1320420	2610241
insurance .005 (includes risk + uncertainties)			321.5	643
contingency 8%			105633.6	208819.2
Capital interest Murabaha (10%)			132042	261024.1
NET-MARGINS/SEASON			222832.5	481773.1

*assumed 5% discards

Annex 5.2-d: Details of profitability analysis of okra processing model

				One shift	**Two-shifts**
reduced volume of prod./season (kg) Using conversion ratio (5:1)				85500	171000
actual volume of sales (SDG) at 25 SDG/Kg package				2137500	4275000
production season (work days/year)			180	180	360
	No. (a)	Price SDG/unit	Quantity Kg.	Total cost/ton/season (1 shift)	Total cost/yr(2 shifts)
Primary raw materials (per yr basis)					
Qu. Of okra/season		1.5	450000	675000	1350000
waters for washing fruits(cubic meters)		10	9000	9000	18000
one Kg plastic sack (perforated)		0.5	85500	42750	85500
labels		0.01	5000	50	100
fuel (gasoline gallons/day)		8.5	20	35700	71400
oil & gallons/day		2.5	0.66	297	594
lubricants		0.6	0.15	16.2	32.4
Sub-totals				762813.2	1525626
Labour Requirement					
		SDG/mo	No.	Cost/ yr(1 shift)	Cost/yr 2 shifts
Manger	12	750	1	9000	11250
Accountant	12	500	1	6000	7200
labour1 permanent labourers	12	600	1	7200	14400
labour2 administrative labourers	12	650	1	7800	9360
Store keeper	12	450	1	5400	6480
Guards	12	300	1	3600	4320
Causal labours	6	500	6	18000	36000
Sub-totals				57000	89010
Assets & Constructions		SDG	quant	Value SDG	Value SDG
land squ.m		1	500	10	20
administrative building (m)		650	50	650	1300
Warehouses for ff (m)		650	50	650	1300
W.C & sanitary facilities		500	12	120	240
kitchen & meal room		400	12	96	192
Subtotals				763	1526
Equipment & machinery	No.	Unit cost			
		Price/Unit	No.	Value SDG	Value SDG
Washing units for fruits washing		2000	1	200	400
Small-hand driven wagon		100	4	40	80
Solar dryers, capacity of each 30 Kg/day		12000	2	2400	4800
sealing and wrapping devices		900	1	90	180
grinder-motorized		1750	2	700	1400
electric connections		750	1	75	150
Balance(s) for weight measurement		450	3	135	270

plastic sheets for sun drying	50	15	250	500
plastic basins	35	10	87.5	175
subtotal			3977.5	7955
TOTAL COSTS/SEASON			824553.7	1624117
insurance .005 (includes risk + uncertainties)			198.875	397.75
contingency 8%			65964.3	129929.4
Capital interest murabaha (10%)			82455.37	162411.7
NET-MARGINS/SEASON			1164328	2358144

Assumed 5% discards

Annex 5.3: Details of profitability analysis of okra processing model

reduced volume of production Kg./season				256500	513000
actual volume of sales (SDG) at 1.2 SDG/package				307800	615600
				One shift	Two shifts
production season (days/year)			180	180	360
	No. (a)	Price SDG/unit	Quantity in Kg.	Total cost/season (in shifts)	
Primary raw materials (per yr basis)					
Qu. mesquite/season		0.25	270000	67500	135000
10 Kg plastic sack with labels		0.5	256500	128250	256500
fuel (gasoline gallons/day)		8.5	8	12240	24480
oil & gallons/day		2.5	0.66	297	594
lubricants		0.6	0.15	16.2	32.4
Sub-totals				208303.2	416606.4
Labour Requirement					
		SDG/mo	No.	Cost/ yr(1 shift)	Cost/yr 2 shifts
labour1 for milling	7	600	3	12600	25200
manger & Store keeper	7	800	1	5600	6720
Guards	12	300	1	3600	4320
Sub-totals				21800	36240
Assets & Constructions		SDG	quant	Value SDG	Value SDG
rent		300	12	3600	7200
store		650	50	650	1300
Subtotals				2125	4250
Equipment & machinery	No.	Unit cost			
		Price/Unit	No.	Value SDG	Value SDG
Machinery for mesquite processing cos		1750	2	350	700
Small-hand driven wagon		100	4	40	80
disel generator 8-10 HP		1750	1	350	700
Balance(s) for weight measurement		350	1	35	70
subtotal				775	1550
TOTAL COSTS/SEASON				233003.2	458646.4
insurance .005 (includes risk + uncertainties)				38.75	77.5
contingency 8%				0	0
Capital interest murabaha (10%)				23300.32	45864.64
NET-MARGINS/SEASON				51457.73	111011.5
10% increase insales				82237.73	172571.5
10%decrease in sales				20677.73	49451.46
20% increase in sales				113017.7	234131.5
20%decrease in sales				-10102.3	-12108.5

Assumed 5% discards