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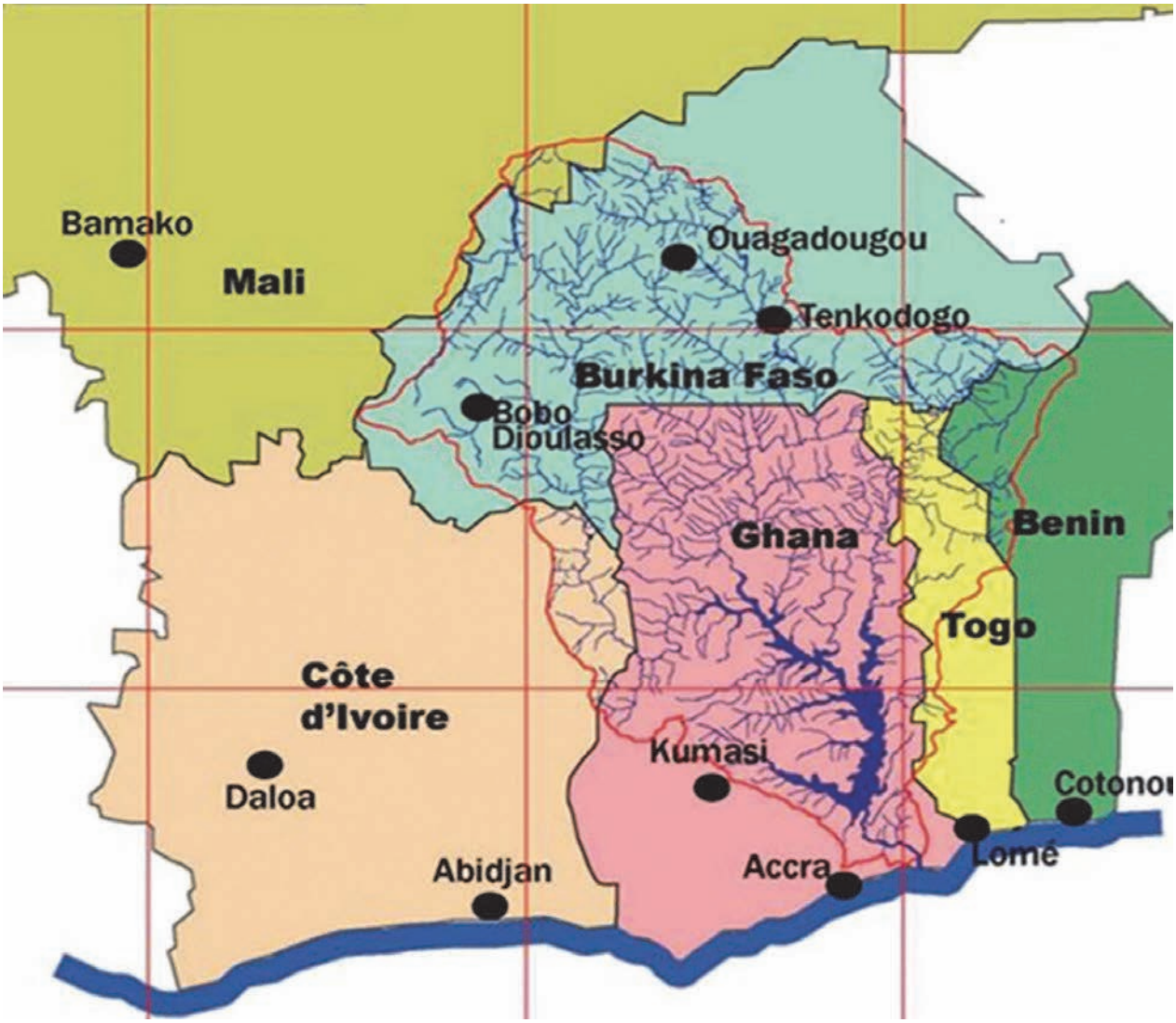
# STRENGTHENING THE PERFORMANCE OF POST-HARVEST SYSTEMS AND REGIONAL TRADE IN SMALL-SCALE FISHERIES – CASE STUDY OF POST-HARVEST LOSS REDUCTION IN THE VOLTA BASIN RIPARIAN COUNTRIES



# STRENGTHENING THE PERFORMANCE OF POST-HARVEST SYSTEMS AND REGIONAL TRADE IN SMALL-SCALE FISHERIES – CASE STUDY OF POST-HARVEST LOSS REDUCTION IN THE VOLTA BASIN RIPARIAN COUNTRIES

**Yvette Diei-Ouadi**
Fishery Officer
Products, Trade and Marketing Branch, Fisheries and Aquaculture Policy and Economics Division
Food and Agriculture Organization of the United Nations
Rome, Italy

**Boris Komivi Sodoke**
Consultant
Products, Trade and Marketing Branch, Fisheries and Aquaculture Policy and Economics Division
Food and Agriculture Organization of the United Nations
Rome, Italy

**Yacouba Ouedraogo**
Sociologist
Fisheries and Aquaculture General Directorate
Ouagadougou, Burkina Faso

**Frieda Adjoa Oduro**
Senior Fisheries Officer
Ministry of Fisheries and Agriculture development, Fisheries Commission
Accra, Ghana

**Kissem Bokobosso**
Fisheries Officer
Ministry of Agriculture, Livestock and Marine Resources
Lomé, Togo

**Illia Rosenthal**
Consultant
Products, Trade and Marketing Branch, Fisheries and Aquaculture Policy and Economics Division
Food and Agriculture Organization of the United Nations
Rome, Italy

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
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## PREPARATION OF THIS DOCUMENT

This document contains the report of the situational analysis of post-harvest systems in the Volta Basin riparian countries, and presents proposals for interventions aimed to strengthen their efficiency, competitiveness and sustainability.

This report summarizes the main activities implemented under the NEPAD–FAO Fish Programme (Support to the Implementation of the Strategy for Fisheries and Aquaculture in Africa-NFFP), focusing particularly on how its Output B4 "Mechanisms established for improving the performance of the fisheries and aquaculture post-harvest chain and regional trade" has been achieved. This first phase of the programme was carried out in the Volta Basin, which served as a pilot beneficiary area, to inform similar interventions in other shared waterbodies.

These activities stem from a sustained collaborative effort to ensure the buy-in of fisheries institutions, authorities and value chain representatives of the six riparian countries (Benin, Burkina Faso, Côte d'Ivoire, Ghana, Mali and Togo). The involvement of the Volta Basin Authority in the two final workshops is a clear indication of their level of ownership, which is essential to implementing the African Union Policy Framework and Reform Strategy for Fisheries and Aquaculture in Africa in the context of Lake Volta.

A training of trainers was held in March 2013 in Lomé, Togo, followed by the practical implementation by national assessment teams of the methodology established through the Post-Harvest Losses Assessment Regional Programme, implemented from 2006 to late 2008, and detailed in FAO Fisheries and Aquaculture Technical Paper No. 559. The teams innovated in using an inclusive approach, which took into account technical/technological and infrastructure issues as well as gender, policy, regulations, impact of climate change dimensions and matters linked to consumers. The collected data were processed and informed the identification of sustainable loss-reduction solutions and key elements for a common strategy to support the performance of post-harvest fisheries and aquaculture systems.

Following the debriefing workshop held in February 2014 in Ouagadougou, Burkina Faso (Agenda in Appendix 5), during which results were presented, an international consultant was hired to prepare a comprehensive report documenting the whole process leading to these results. The preliminary draft was submitted on May 2014 and thoroughly reviewed by several experts from beneficiary countries at the concluding stakeholder workshop, which took place on 13 and 14 May 2015 in Grand-Bassam, Côte d'Ivoire before the final English and French versions were edited and published by FAO.

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## ABSTRACT

The New Partnership for African Development (NEPAD) noted, in its 2013 Annual Review on the International Partnership for African Fisheries Governance and Trade (PAF), that the majority of fisheries are poorly managed in Africa. NEPAD and FAO aim to strengthen Africa's capacity to implement programmes and responsive reforms in fisheries governance and trade in order to increase post-harvest benefits and to improve the livelihoods of fisheries actors and the contribution of fish products to food and nutrition security through good fisheries resources management. All of these factors justify Result 4 of Component B of the NEPAD-FAO Fish Programme (NFFP) "Support to the implementation of the strategy for fisheries and aquaculture in Africa (GCP/RAF/463/MUL)". This programme is a collaborative effort between the NEPAD Planning and Coordinating Agency (NPCA) and FAO, funded for the first three years by the Swedish Agency for International Development Cooperation (SIDA) for an amount equal to USD5.5 million.

Activities consisted in first taking stock of the existing situation through a review of available secondary-source information and gathering data during an ad hoc visit to a few sites in the Volta Basin's three riparian countries with the largest areas and production volume: Burkina Faso, Ghana and Togo. The results of this process were presented at a subregional workshop in Lomé in March 2013 to the main stakeholders in the public and private sectors. The aims were in order to strengthen the stakeholders' understanding of the sustainable value chain approach in addressing issues linked to losses and improve their ability to use loss assessment tools and identify solutions for the primary factors of these losses, while fully integrating gender and climate change dimensions. This workshop was then followed by pilot practical case studies in five beneficiary countries (Burkina Faso, Côte d'Ivoire, Ghana, Mali and Togo) to allow participants to familiarize themselves with the post-harvest loss assessment (PHLA) methodology. These were followed by a wider-scale exercise in Burkina Faso, Ghana and Togo, and the completed field studies allowed a deepening of the analysis through PHLAs and understanding of cross-border trade dynamics in the three countries.

Highlights of these studies presented at a subregional workshop showed that losses amounted to 27 percent of total catches, with levels ranging from 13.5 to 45.5 percent depending on the country. Quality losses are predominant, followed by losses due to market forces, while physical losses are minimal. The causes are multifactorial, with 65 percent linked to the lack of improved technology, infrastructure and good manufacturing practices, and the other 35 percent due to the actors' social and cultural dimensions of vulnerability, and the lack of responsible governance, regulations and their enforcement. This study is the first to establish clearly the cycle of poverty and vulnerability (of humans and resources) directly perpetuated within the post-harvest losses context. It emphasizes the importance of involving, in every PHLA context, all stakeholders in the entire process, from identifying existing elements to selecting priority areas of action. This process has highlighted the elements of a strategy aimed at sustainable and competitive post-harvest chains and the need to mainstream all dimensions, including gender, in post-harvest losses and cross-border trade analyses and in loss reduction interventions.

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FAO would also like to thank the Volta Basin Authority for adhering to the spirit of the work carried out and all those who, through their objective comments and recommendations, have led to consolidating this source of information.

## ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| AFPF & RS | African Fisheries and Aquaculture Policy Framework and Reform Strategy |
| BC | Basin Commission |
| CLP | critical loss point |
| CNFTPA | National Training Centre for Fish and Aquaculture Technicians - Centre National de Formation des Techniciens des Pêches et de l'Aquaculture (Senegal) |
| Code | FAO Code of Conduct for Responsible Fisheries |
| EASA-IO | Eastern-Southern Africa and Indian Ocean Region |
| EFLAM | exploratory loss assessment method |
| EIFP | Economic Interest Fishery Perimeter |
| FAO | Food and Agriculture Organization of the United Nations |
| FTT-Thiaroye | FAO-Thiaroye processing Technique |
| EFLAM/IFLAM | exploratory/informal fish loss assessment methodology |
| FAPHC&RT | Fisheries and Aquaculture Post-Harvest Chain and Regional Trade |
| GDP | gross domestic product |
| GWG | Governance Working Group |
| IUU | illegal, unreported and unregulated (fishing) |
| LT | load tracking |
| MDG | Millennium Development Goal |
| NEPAD | New Partnership for African Development |
| NFFP | NEPAD–FAO Fish Programme |
| NGO | non-governmental organization |
| NICFC | National Inland Canoe Fishermen Council |
| NPCA | NEPAD Planning and Coordinating Agency |
| PAF | Partnership for African Fisheries |
| PHL | post-harvest loss |
| PHLA | post-harvest loss assessment |
| PRA | Participatory Rapid Appraisal |
| QLAM | questionnaire loss assessment method |
| REC | regional economic community |
| RFB | regional fishery body |
| SIDA | Swedish International Development Cooperation Agency |
| SmartFish | An EU funding programme for the Eastern-Southern Africa and Indian Ocean Region |
| SWOT | strengths, weaknesses, opportunities and threats (analysis) |
| TWG | Trade Working Group |
| VBA | Volta Basin Authority |

USD2.04 = XOF1 000
USD1 = GHS3.62

## EXECUTIVE SUMMARY

World per capita apparent fish consumption increased from an average of 9.9 kg in the 1960s to 19.2 kg in 2012. In Africa, the estimated contribution of the fisheries sector to national and agriculture gross domestic product (GDP) exceeded USD24 billion, i.e. 1.26 percent of the continent's GDP and 6 percent of its agriculture GDP (excluding processing). One-third (2.7 million tonnes) of total harvest fisheries production in Africa comes from inland waters. However, the New Partnership for African Development (NEPAD) noted, in its 2013 Annual Review on the International Partnership for African Fisheries Governance and Trade (PAF), that the majority of Africa's fisheries are poorly managed. To improve food security and livelihoods through proper management of fish resources, NEPAD and FAO aim to strengthen Africa's capacity to consider, determine and implement programmes and responsive reforms in fisheries governance and trade through the PAF programme as well as issues regarding raising post-harvest benefits. Increasing post-harvest benefits through fish loss control would improve the livelihoods of fisheries actors and boost food and nutrition security. Cost-effective loss reduction would improve income, contributing to poverty eradication and improved food security.

These factors illustrate why the activities detailed in this report form part of the NEPAD–FAO Fish Programme (NFFP) "Support to the implementation of the strategy for fisheries and aquaculture in Africa (GCP/RAF/463/MUL)", a programme designed as a multidonor programme, with a budget of USD5.5 million funded for the first three years by the Swedish Agency for International Development Cooperation (SIDA).

The results of this programme include strengthening the capacity of the main stakeholders in the fisheries public and private sectors of the Volta Basin riparian countries to better understand the issues linked to post-harvest losses (PHLs) and to strengthen their ability to pass on the acquired knowledge in a cascade fashion to propose and implement sustainable solutions for reducing losses by adopting an inclusive approach. This has been achieved through a holistic approach that integrates technical/technological and infrastructure aspects with dimensions linked to gender, policies, regulations, the impact of climate change and matters linked to consumers. This approach by the NFFP was the first of its kind for post-harvest loss assessments (PHLAs) since initial validation of the methodologies in 2008.

Activities consisted in first taking stock of the existing situation through a review of available secondary-source information providing an overview of the fisheries sector, the importance of fishing in the Volta Basin, and more specifically the place given to PHL issues in existing sectoral and policy documents. This stocktaking was completed with information gathered during a visit to sites in the Volta Basin in the three riparian countries with the largest areas and production volume (Burkina Faso, Ghana and Togo) in order to better understand the daily reality of fishing operations and downstream activities. The results were presented at a subregional workshop in Lomé in March 2013. The workshop aimed to strengthen the capacity of 15 participants – representatives of fisheries administrations and fisheries actors – in their understanding of the sustainable value chain approach in addressing issues linked to losses (types, causes and generic impacts, interconnections, etc.), and to improve their ability to use loss assessment tools and identify solutions, while fully integrating social, gender and climate change dimensions. It also aimed to guide participants in their selection of representative sites and of a value chain that would be studied in depth through PHLAs and the analysis of cross-border trade dynamics in the three countries. The tilapia fishery was selected for thorough assessment given its predominance in the overall study locations.

Prior to the in-depth PHLAs, the workshop was followed by pilot practical case studies in five beneficiary countries (Burkina Faso, Côte d'Ivoire, Ghana, Mali and Togo) to allow participants to familiarize themselves with the PHLA methodology, test the questionnaires and possibly amend them. Based on lessons learned, the wider-scale exercise then took place in Burkina Faso, Ghana and Togo, allowing a deepening of the analysis through PHLAs and the understanding of cross-border trade dynamics in these countries.

Highlights of these studies were presented at a workshop in Ouagadougou, which took place from 18 to 20 February 2014. The workshop also determined the elements of a strategy for sustainable and competitive post-harvest chains. A workshop on mainstreaming gender issues in the analysis of PHL data and cross-border trade then took place in Cotonou, Benin, in March 2014 before the official closing of NFFP Phase 1 on 30 March 2014. This report presents the whole process leading to the formulation of that strategy, which was validated at a stakeholders' consultation workshop held in May 2015 in Grand-Bassam, Côte d'Ivoire.

Generally, PHLs refer to fish discarded/removed from the supply chain or sold at low prices owing to deterioration in quality or market dynamics. This means that, first, fish operators (fishers, processors, fishmongers/traders, etc.) lose potential revenue, and, second, consumers have access to less fish or low-quality fish and fishery products. This may result in negative impacts on food security.

The analysis of the data from Burkina Faso, Ghana and Togo indicates PHLs averaging 27 percent but with a range of 13.5–45.5 percent, thus marking significant differences between countries and within fishing operations. Quality losses represent the largest share (17 percent of production, i.e. more than 60 percent of the share of total PHLs) and outweigh physical losses (physical removal of fish from the supply chain), confirming the findings of other studies. The annual value and volume of the products affected in the study sites range, respectively, from USD605 000 to USD700 000, and from 1 100 to 1 400 tonnes. The losses due to market forces that apparently may not be a loss of fish as food rank second after quality losses, a fact justifying why it is essential to consider seriously their significant contribution to eroding actors' revenue. In some cases, these losses are more important than quality losses, resulting in a considerable shortfall for the actors affected and, thus, a negative impact on poverty reduction efforts.

The critical loss stages vary by location, but in general one can consider the five most important ones: before capture; during sourcing (when fishmongers and processors purchase the catch); smoking (or drying); storage; and transport to markets for certain types of operators or marketing stages for others.

The subregional workshop has shown that there are more similarities between Volta Basin countries than specificities with regard to the causes of losses. These are multifactorial, with 65 percent linked to the lack of improved technology, infrastructure and good manufacturing practices, and the other 35 percent due to the actors' social and cultural dimensions of vulnerability, and the lack of responsible governance, regulations and their enforcement. Thus, these case studies strongly establish how gender and sociocultural aspects and adaptation strategies to climate change or to the effects of exogenous factors play a significant role in the occurrence of losses.

The issue of prohibited fishing gear, at the heart of governance concerns, is also raised in terms of subregional cooperation on harmonizing standards and effectively enforcing regulations. This also highlights that previously identified barriers to regional trade only partially contribute to the inefficient performance of post-harvest systems. To these issues, one can add the sustainability of other natural resources, including excessive use of wood in smoking operations. With inefficient processing devices, the end product is either of poor quality or removed from the supply chain, and therefore not consumed. The effect of deforestation is of great concern not only to Sahelian countries such as Burkina Faso and Mali but also to others. These inefficient systems weigh on operating costs, particularly where the wood is purchased. In other cases, they increase the drudgery of actors, including women, who need to fetch the wood from farther away owing to its increasing scarcity.

The study shows that the fragility/vulnerability of fish stocks is worsening because of coping strategies to offset losses, which consist of irresponsible fishing or post-harvest practices. It thus reinforces the argument that post-harvest management contributes to responsible natural resources management, including fisheries.

Loss-reduction interventions will thus focus on losses prioritized in terms of their magnitude and impact, drawing on "minimal losses" cases. Country proposals emphasize the need for integrated measures that fully incorporate the multidimensional nature of the losses identified. Comprehensive

information is needed on some of the data, especially regarding cost–benefit analysis, with, at times, load tracking (e.g. probable loss in nutritional attributes).

Regarding smoked tilapia, the technical, economic, social and environmental feasibility of reducing losses has been studied with the introduction of improved smoking technology. It should combine an attractive return on investment for vulnerable actors with the following characteristics: efficiency; producing quality products with a good return; alleviating the workload, especially when combining smoking with home/community responsibilities; and generating less environmental impact. On this basis, the NFFP sponsored the development of training materials to disseminate the FTT-Thiaroye smokehouse technique. In addition to ensuring a responsible and equitable supply, marketing of products generated will be supported by actions at the policy or institutional level. These could be, depending on the context: appropriate interventions to prevent artificial gluts driven by acts of "highway robbery" and other armed robbers/thieves; strengthening security conditions; more efficient infrastructure; responsible market management, including the relationship between fishing seasons and frequency of market fairs; incentives; and organizational empowerment of actors.

This study is the first to establish clearly the cycle of poverty and vulnerability directly perpetuated within the PHL context. The strategy informed by this study should be promoted in the Volta Basin riparian countries and in other regions or shared waterbodies to inspire similar subsequent initiatives in small-scale fisheries. An eventual follow-up undertaking should anchor this as an opportunity for cross-fertilization on the process, the tools developed and the use of human resources for other development programmes.

This programme emphasizes the importance of involving, in every PHL reduction context, all stakeholders in the entire process. It is also essential to cover all the dimensions of the cause of PHLs, and assess the infrastructure, services, social conditions, environment, the priorities of stakeholders, including the most vulnerable – all of these being embedded in the sustainable value chain approach.

# 1. RELEVANCE AND OBJECTIVES OF POST-HARVEST LOSS REDUCTION ACTIVITIES WITHIN THE FRAMEWORK OF THE RESULT B4 OF THE NEPAD–FAO FISH PROGRAMME (NFFP)

## Relevance

Global fish production has grown steadily in the last five decades, with food fish supply increasing at an average annual rate of 3.2 percent, outpacing world population growth at 1.6 percent. World per capita apparent fish consumption increased from an average of 9.9 kg in the 1960s to 19.2 kg in 2012. This impressive development has been driven by a combination of population growth, rising incomes and urbanization, and facilitated by the strong expansion of fish production and more efficient distribution channels. In 2012, total world fisheries and aquaculture production reached 158 million tonnes (FAO, 2014).

The fisheries sector generates a variety of benefits including nutrition and food security, livelihoods, employment, foreign currency from exports, and conservation and biodiversity value that are of global significance. Fish and fishery products are among the most-traded food commodities worldwide, with trade volumes and values reaching new highs in 2011 and expected to carry on rising with developing countries continuing to account for the bulk of world exports (FAO, 2012). In 2011, a study entitled "The value of African fisheries" (carried out in the framework of the NEPAD–FAO Fish Programme [NFFP] funded by the Swedish International Development Cooperation Agency [SIDA]) estimated the contribution of the fisheries sector (including fishing, processing, licensing of local fleets, and aquaculture) to national and agriculture gross domestic products (GDP) and employment generation at more than USD24 billion, 1.26 percent of the GDP of all African countries and 6 percent of agriculture GDP, excluding processing (which comes under "manufacture of food products"). One-third (2.7 million tonnes) of total harvest fisheries production in Africa comes from inland waters. Aquaculture is still being developed in Africa and is mostly concentrated in a few countries, but it already produces 1.5 million tonnes of fish, with an estimated value of almost USD3 billion per year (FAO, 2014). However, in its 2013 Annual Review on the International Partnership for African Fisheries Governance and Trade (PAF), the New Partnership for African Development (NEPAD) noted that the majority of fisheries are poorly managed in Africa (NEPAD, 2013).

Early work conducted by the PAF Governance Working Group (GWG) conservatively estimated losses arising from the contribution of the fisheries sector to economic growth to at least USD2 billion per year. More recent data have enabled the PAF GWG to improve this calculation, and losses are now estimated at roughly USD10 billion per annum. However, the GWG believes that this more recent figure most probably remains an underestimate owing to the inappropriate computational method used to calculate the magnitude of mismanagement of African fish resources. As fisheries management systems improve in the coming years and resource wealth begins to be generated on a sustainable basis, it may be possible to lower estimated losses (NEPAD, 2013).

The mismanagement of African fish resources not only means that potential growth benefits are not realized but that other benefits are also threatened for the more than ten million Africans who depend upon fish and fisheries for their livelihoods, and the 30 percent of the population who rely on these resources for their nutrition and food security (NEPAD, 2005). In the future, this situation may also be further affected by climate change as the distribution of species, biodiversity and biomass are likely to change – especially in fisheries where safe biological limits have already been reached or exceeded (NEPAD, 2013).

In order to improve food security and livelihoods in the continent through proper management of African fish resources, NEPAD aims to strengthen Africa's capacity to consider, determine and implement responsive reforms in fisheries governance and trade through the PAF programme. In 2013, the Trade Working Group (TWG) published studies and implementation plans on "Updated data on cross-border and international trade", "Identification of obstacles, (time and cost increase, trade governance, code of practices, hampering smooth imports and exports of fish, especially intra-regional

trade)", and "Loss reduction and value addition for better market access for fish and fisheries products", which are essential components of the PAF programme.

Securing post-harvest benefits through fish loss control has long been a concern of development practitioners committed to improving the livelihoods of fishers, processors and traders and the contribution of fish products to food security. Cost-effective loss reduction would improve income, contributing to poverty eradication and improved food security. The FAO Code of Conduct for Responsible Fisheries (the Code) recognizes the important problem of fish losses under Article 11.1 Responsible fish utilization (FAO, 1998), which places an emphasis on loss reduction:

- Subarticle 11.1.5. States should give due consideration to the economic and social role of the post-harvest fisheries sector when formulating national policies for the sustainable development and utilisation of fishery resources.
- Subarticle 11.1.6. States and relevant organisations should sponsor research in fish technology and quality assurance and support projects to improve post-harvest handling of fish, taking into account the economic, social, environmental and nutritional impact of such projects.
- Subarticle 11.1.7. States, noting the existence of different production methods, should through cooperation and by facilitating the development and transfer of appropriate technologies, ensure that processing, transporting and storage methods are environmentally sound.
- Subarticle 11.1.8. States should encourage those involved in fish processing, distribution and marketing to:
  a) reduce post-harvest losses and waste;
  b) improve the use of by-catch to the extent that this is consistent with responsible fisheries management practices; and
  c) use the resources, especially water and energy, in particular wood, in an environmentally sound manner.

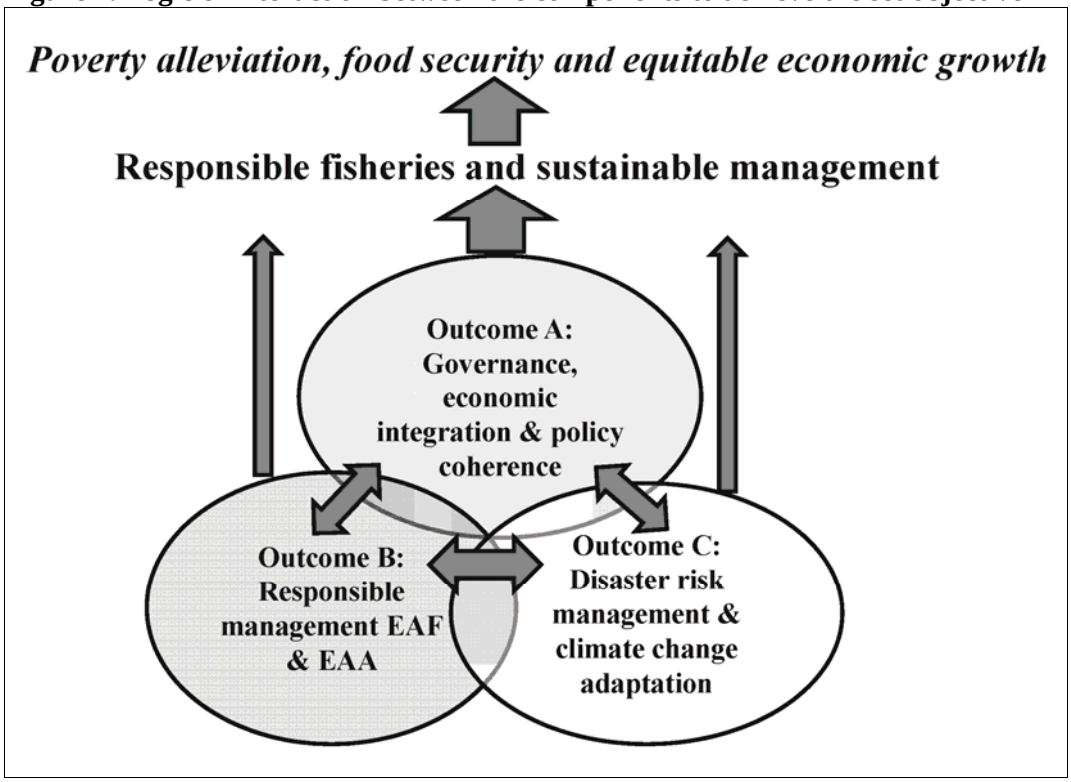
The most obvious way to increase fish supply, even without increased landings, is to reduce losses of what is currently caught. Yet, a rational use of already scarce development resources, along with planning and implementation of effective loss reduction strategies, require that losses be thoroughly assessed and due attention be given to reducing those that are significant (Akande and Diei-Ouadi, 2010).

Post-harvest losses (PHLs) pose not only a threat to food security but also to the livelihoods of the value chain actors involved and to natural resources sustainability. Because of their structural limitations, small-scale fisheries are the most affected. Addressing the multifaceted dimensions of PHLs compounded by the dispersed nature in small-scale operations requires a holistic approach, which entails first understanding their contextual occurrence to then set baselines including priority losses, and establish milestones to gauge progress in loss reduction efforts.

All of these factors thus illustrate why the activities detailed in this report have been included in result 4 of component B of the NEPAD–FAO Fish Programme (NFFP) "Support to the implementation of the strategy for fisheries and aquaculture in Africa (GCP/RAF/463/MUL)". This programme is a collaborative effort between the NEPAD Planning and Coordinating Agency (NPCA) and FAO that was originally designed as a multidonor programme with a budget of USD5.5 million funded for the first three years by SIDA.

The NFFP has supported regional capacity building in governance and the development of approaches, tools, methods, information and knowledge with a view to informing policy-making. It has also aimed to support regional efforts to achieve the Millennium Development Goals (MDGs) through the improvement and responsible management and development of fisheries and aquaculture. It comprised three components that are interconnected (Figure 1).

**Figure 1. Logic of interaction between the components to achieve the set objective**

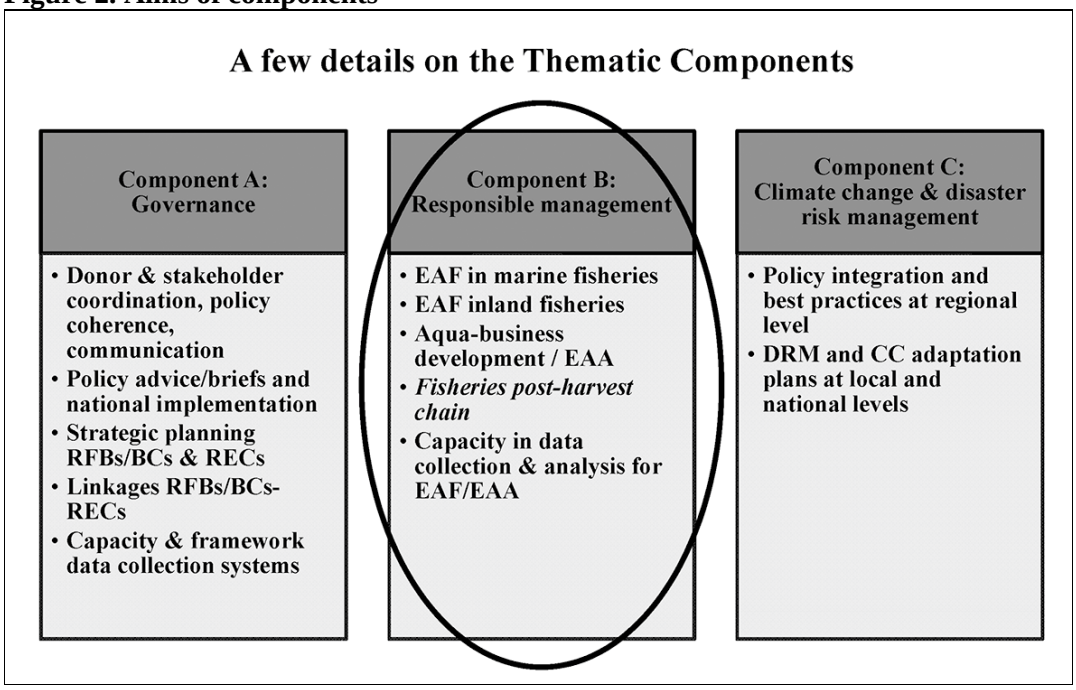



*Source:* NEPAD-FAO Fish programme document.

As shown in Figure 2, Component A aims to promote policy development by working with the NPCA as well as with regional fishery bodies (RFBs), the basin commissions (BCs) and the regional economic communities (RECs). Component B, which includes the output that is the main subject of this report, and Component C are of a technical nature and complement the areas of intervention of the Partnership for African Fisheries (PAF).

The achievement of result B4 is the fruit of a collaborative effort between fisheries institutions providing logistical support and the teams of fish loss assessors, while NFFP provides capacity building and support to all the activities in the field. This work has been consistent with Section 4.4, on "Responsible and equitable fish trade and marketing" of the African Fisheries and Aquaculture Policy Framework and Reform Strategy (AFPF & RS), and other chapters regarding small-scale fisheries development, sustainable resource use, gender issues, strengthening resilience and reducing vulnerabilities. It aimed to obtain the buy-in of both high-level officials and representatives of fishers, processors and traders during the assessment process, from the desk review to the field data collection and sharing. In addition, the involvement of the Volta Basin Authority (VBA) in the debriefing workshop held in February 2014 in Ouagadougou, Burkina Faso, during which results were presented and the elements of a common strategy were developed, and in the concluding stakeholder workshop (13–14 May 2015 in Grand-Bassam, Côte d'Ivoire), where this report was reviewed along with the draft strategy "Strategy for sustainable reduction of post-harvest losses and improved regional trade in fishery and aquaculture products of the Volta basin", is a clear indication of their level of ownership, which is essential to implement the AFPF & RS in the context of the Volta Basin.

**Figure 2. Aims of components**




*Source:* NEPAD-FAO Fish programme document.

### *Choice of the Volta Basin*

The Volta River Basin is the ninth-largest basin in sub-Saharan Africa, covering an estimated area of 400 000 $km^2$. Several major rivers drain the Volta Basin: the Mouhoun (Black Volta), the Nakambé (White Volta) with the Nazinon (Red Volta) as its tributary, the Oti and the Lower Volta. The Oti River begins in the Atakora hills of Benin at an altitude of about 600 m and flows through Togo and Ghana. In 1998, according to Opoku-Ankomah, the mean annual flows of the Mouhoun, Nakambé, and Oti Rivers were 7 673 × $10^6$, 9 565 × $10^6$, and 11 215 × $10^6$ $m^3$, respectively. The Oti River, which comprises only about 18 percent of the total catchment area, contributes 30–40 percent of the annual flow of the Volta River system. This situation is due to the steep topography and the relatively high rainfall in the Oti sub-basin. The Volta Basin is spread over six West African countries (43 percent in Burkina Faso, 42 percent in Ghana, and the remaining 15 percent in Togo, Benin, Côte d'Ivoire and Mali).

Lake Volta is the largest artificial lake in Africa (8 700 $km^2$). It contributes 90 percent of the total inland fishery production in Ghana and provides livelihoods to some 300 000 fisherfolk, including about 80 000 fishers and some 20 000 fish processors/traders (Asare and Osei Bonsu, 1993).

Fish is an important part of the diet and the culture of the region. While part of the catch is consumed fresh, another part is processed in diverse ways – salted, dried, fermented and smoked – and traded within and between countries of the region. Such trade continues to be important today, taking place largely at an informal level (ICSF, 2002).

Given all of these elements and three additional main reasons, the Volta Basin was chosen as the beneficiary area of this implementation pilot phase of the Output B4, which focuses on improving the performance of the post-harvest value chain and regional trade. These three main reasons are:

- The potential synergy with other NFFP components: activities of these components were initially envisaged in this area, but unpredictable changes in the calendars during implementation prevented these from taking place.

- The status of a shared inland waterbody where small-scale fishing predominates suggesting a potential for capturing multiple country drivers and diverse dimensions in appraising PHLs and fish trade.
- The Volta Basin is one of the poorest areas of Africa, thus making issues of food and nutrition security a priority. In addition, as any watershed, the environment, particularly the ecosystem of the Volta River, suggests that climate change and variability may have an impact, therefore exacerbating the level of vulnerability. It is important to understand how coping strategies such as migration and various other strategies may be linked to post-harvest losses (PHLs).

Post-harvest losses are defined as a decrease in the quantity or quality of food (physical or quantitative loss; quality loss), but a greater attention is also given to the loss in the monetary value of fish. This may not necessarily be a result of loss of fish as food, but as a result of a decrease in value irrespective of quality. At times, losses caused by market forces trigger controversy. Although they do not constitute a food loss *per se*, events along the supply chain can cause them, resulting in changes in quality attributes or physical losses over time (as emphasized in Akande and Diei-Ouadi, 2010). Other irrefutable reasons call for due attention to market-force losses if poverty eradication and food security for all are to be achieved:

- Income loss for fish operators fits within the poverty dimension, given that drastic downward price moves have an impact on their livelihoods.
- While a supply glut can be beneficial for a customer/consumer who can take advantage of a subsequently reduced price, it can be counterproductive when the situation evolves over time into a lean supply, accompanied by skyrocketing prices. A fair and efficient scenario would be to have stable prices or very limited fluctuations with evenly (geographically) distributed products throughout the year. This appears to be a "win–win" situation for all (producer and consumer).
- A glut in one location while scarcity prevails in another one could result in cheap and abundant food with a likelihood of wastage for customers in the oversupplied location, while other consumers within the same country will need to spend more resources to satisfy their dietary needs and food preferences.

The impact on smallholders' incomes and consumers' spending to satisfy their minimum intakes can be put into a wider perspective, as done by the World Bank (2014). The whole issue should therefore consider holistically the competitiveness of small-scale operators and the access of all people, at all times, to sufficient fish as food.

The meagre information available on PHLs is sparse and unreliable. It was therefore important to generate objective data to identify feasible solutions for strengthening the performance of actors along the value chain and for minimizing losses. However, it is overambitious to tackle all sources of losses simultaneously. Therefore, it is necessary to use an approach that considers the entire supply chain and allows both the issues to be ranked and their feasibility to be assessed, in order to then implement possible actions that make rational use of available resources. Given the contextual nature of the losses, the most significant ones identified (at critical points or hotspots) through a systematic evaluation can thus be considered for interventions that aim to have the most impact. The implementation logic of the outcome B4 is based entirely on an inclusive approach that takes into account technical, technological and infrastructure issues together with gender, policy, regulations, impact of climate change dimensions and matters linked to consumers. The resulting information should objectively inform policy, strategies and interventions, and contribute to defining indicators and mechanisms to measure effectiveness.

**Objectives of component B4**

The key objectives of the NFFP on post-harvest loss assessment (PHLA) within the Volta Basin have been to identify inefficiencies in the post-harvest chains and develop elements for an informed strategy for sustainable reduction of PHLs and greater regional trade in fishery products. This led to:

- developing the capacity of fisheries officers and fishers in assessing and designing cost-effective interventions to curb these losses sustainably;
- building a sound understanding of fish losses and their intricate dimensions;
- drawing lessons from the activities and designing relevant loss-reduction intervention elements.

## 2. CONTEXT

### Status and importance of fisheries in the Volta Basin

Estimates of Lake Volta's fishery potential range from 40 000 to 271 000 tonnes, and there is no consensus as to what the most accurate figures may be within this broad range, (Béné and Russell, 2007). However, fisheries-related activities provide a substantial contribution to Volta Basin households' livelihoods, and are the primary income-generating activity for most families in the area, contributing more than 70 percent of revenue on average. This figure reflects the fact that fishing is a major activity for communities along the shores of the basin. Fishing is mostly done by men, and processing chiefly by women. People living around the Volta River Basin are as follows:

**Table 1. Population distribution in the Volta Basin**

| | ***Year 2008*** | | | | | ***Year 2025*** |
|---|---|---|---|---|---|---|
| | **National population** | **Basin population** | | | | |
| | **Total (thousands)** | **Total (thousands)** | **Basin as % of country** | **Rural (thousands)** | **Rural as % of total basin** | **Projection (thousands)** |
| Benin | 8 290 | 590 | 7.12 | 378 | 64 | 820 |
| Burkina Faso | 15 850 | 11 227 | 70.8 | 7 186 | 77 | 15 997 |
| Côte d'Ivoire | 18 400 | 497 | 2.70 | 318 | 77 | 718 |
| Ghana | 23 383 | 8 570 | 36.6 | 5 484 | 84 | 11 696 |
| Mali | 14 517 | 880 | 6.06 | 563 | 88 | 1 260 |
| Togo | 5 870 | 2 154 | 36.7 | 1 378 | 70 | 3 385 |
| Total | 86 310 | 23 918 | 27.7 | 15 307 | – | 33 876 |

*Source:* UNEP-GEF Volta Project, 2012.

#### *Benin*

The area of the Volta River Basin in Benin is 17 098km$^2$, corresponding to 4.10 percent of the basin (Asante, 2006), with the Oti River being referred to locally as the Pendjari River. Tributaries include the Koumongou, Kéran, Kara, Mô, Kpanlé, Wawa, Ménou and Danyi Rivers. Owing to regularization by the Kompienga Dam in Burkina Faso, the Oti River flows constantly with an annual average flux of 100–300 m$^3$/s, which can exceed 500 m$^3$/s (Béné, 2007).

Fisheries activities in the Volta Basin in Benin have not been studied adequately. However, fish production is seen as an important para-agricultural activity in the basin. Although fish are abundant in the Oti River in Benin, fisheries activities in this country are limited compared with those in Ghana and Burkina Faso.

#### *Burkina Faso*

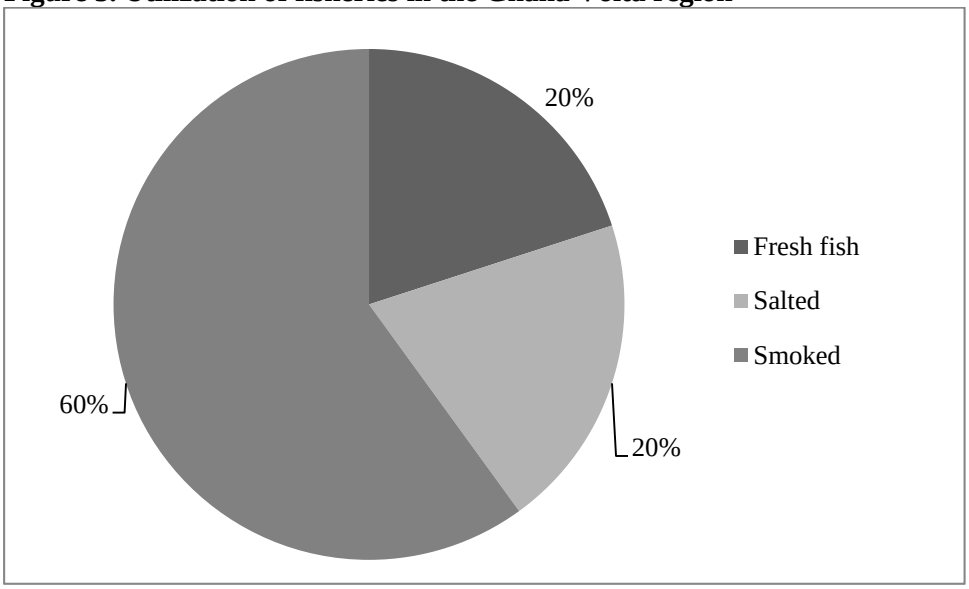
In Burkina Faso, fisheries are still very informal, lacking structure, and thus are marginalized at the macroeconomic level. Fishing occurs on a local scale in rural areas. However, fishery resources constitute an important complementary source of proteins, employment and cash-income for a large number of households (Béné, 2007). The fisheries potential of the Burkinabe Volta Basin has been estimated at about 3 750 tonnes per year. The Bagré and Kompienga reservoirs generate the majority of these catches, but the country is also endowed with a very large number of small-scale reservoirs that could be used for fisheries.

#### *Ghana*

In Ghana, Lake Volta is the main inland fisheries source. Several practitioners and researchers have pointed out that the production of other waterbodies (rivers, swamps, lagoons, ponds and other reservoirs) is largely underestimated and underexploited. Seasonal fishers operate in these smaller

waterbodies but they have a relatively low productivity, even though fishing is one of the major activities in their livelihoods strategy. According to the 2013 study by de Graaf, G. & Garibaldi, L, the Lake Volta fisheries in Ghana contribute about 18 percent to national fish landings (78 000 tonnes) and employ about 100 000 people. Fishing is done solely by men, and processing by women. Utilization includes smoked fish (60 percent), salted fish (20 percent) and fresh fish (20 percent) (Figure 3).

**Figure 3. Utilization of fisheries in the Ghana Volta region**



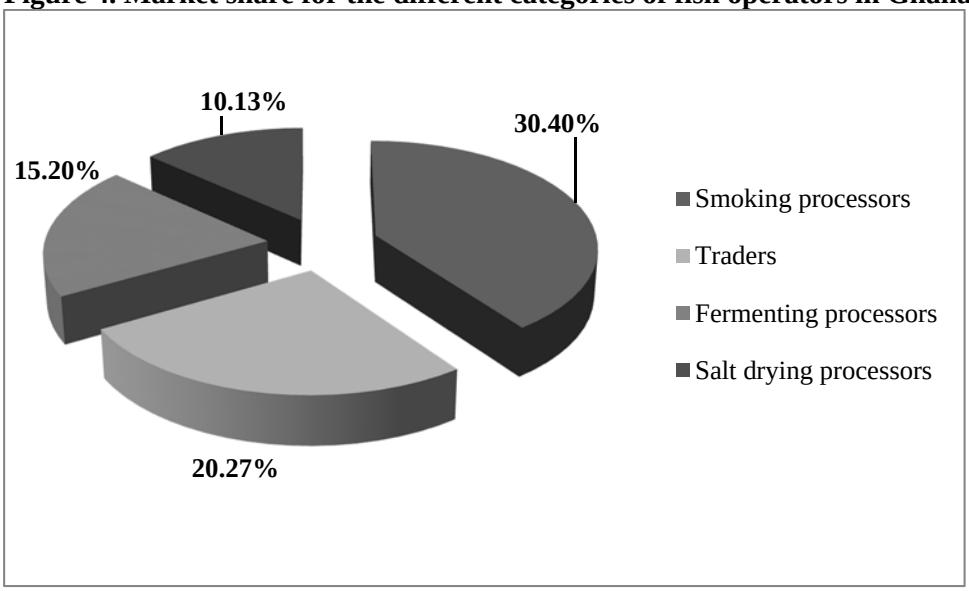

Fishing on the lake is a year-round activity. However, individual fishing methods and targeted species vary greatly during the year. The major fishing season is June–September (the rainy season) when fishers set gillnets in the offshore areas. The lean season occurs between November and April/May (the dry season), when the lake is receding and fishers set gillnets in the inshore areas. These gillnets, along with cast nests, lines and traps, were the principal fishing gear types previously used (Bazigos, 1970; Coppola and Agadzi, 1976). More recently, other gear types have been introduced, including drive-in gear (wangara), bamboo-pipe fishing, nifa nifa (surrounding nets combined with pot traps), acadja (fish aggregating devices made of tree branches and bushes), and beach seines (adranyi) (Braimah, 1989, 1991). Fishers set and operate these different gear types using canoes. In 1998, the 24 000 canoes on the lake were largely non-motorized plank canoes (95 percent) and were operated on average by three men (Braimah, 2000).

Most fishing villages do not have their own markets and depend on a few larger lakeside towns for the marketing of their catch. As a consequence, a large number of fishing communities channel their products through market towns outside their administrative boundaries. While a few markets are accessible by paved roads (Asuogyaman, Jasikan and Kpando markets), most roads in rural areas are unpaved, and in the wet season their conditions make fish trading very difficult.

Processing methods comprise smoking, salting, sun-drying and fermentation. Fishers' wives and relatives, who predominantly do the processing, sell the processed fish on a weekly basis at a local market and give the sales revenues to their husbands.

Figure 4 shows the percentage market share of different categories of Volta Basin fish operators in Ghana.

**Figure 4. Market share for the different categories of fish operators in Ghana**




***Côte d'Ivoire***

In Côte d'Ivoire, the contribution of fisheries to the national economy and food security, in terms of intake of protein, vitamins and other valuable nutrients, is important. However, this contribution is not optimized because of inefficiencies along the supply chain, including PHLs. The contribution of the Volta Basin is minimal.

***Mali***

Prior to the construction of the dam on the Mouhoun River in Burkina Faso, fishing in Mali was done using rudimentary equipment and the activity did not provide a significant source of income. However, when the waters rose, several villages moved to the edge of the river, and fishing became a more important activity. This originally subsistence activity has now grown into a commercial industry.

***Togo***

In Togo, the hydrographic network of the Volta Basin consists mainly of the Oti River and its tributaries. The Oti (340 km long) or Pendjari sub-basin rises 600 m above sea level in Atakora in the north of Benin (where it is called Pendjari). It runs through Togo, covering a distance of 167 km and goes into Ghana at its northeastern border with Togo. Its tributaries are the Koumongou, Keran, Kara, Mô, Kpanlé, Wawa, Menou and Danyi. The Volta Basin covers all five of Togo's economic regions from south to north. The total area coverage of the Volta Basin in Togo is 26 700 $km^2$, representing about 47.3 percent of the area of the national territory (UNEP-GEF Volta Project, 2008). Although the basin has a multitude of rivers, fishing remains a secondary activity for the people living around them. However, fisheries contribute to the national economy, and the sector provides food, livelihoods and income, both directly and indirectly.

Smoking is the major form of processing (90 percent of catches are smoked), followed by drying, especially for anchovies (National fishing policy document for Togo, 1996). Smoking is done using traditional round or chorkor-clay, cement or cut-barrel kilns. Except in central Katanga (fishing port), fish smoking is performed in the immediate vicinity of processors' dwellings. Smoking is carried out for 3–4 hours, with mangrove wood and coconut husks being used as energy sources. Drying of fish, especially small pelagics, takes place in the open sun. Fish are placed on fine screens or racks or on the floor at the beach. Drying-curing is a technique often used to process some demersal species. The aforementioned three types of losses were observed.

Assessment activities in the subregion prior to the NFFP

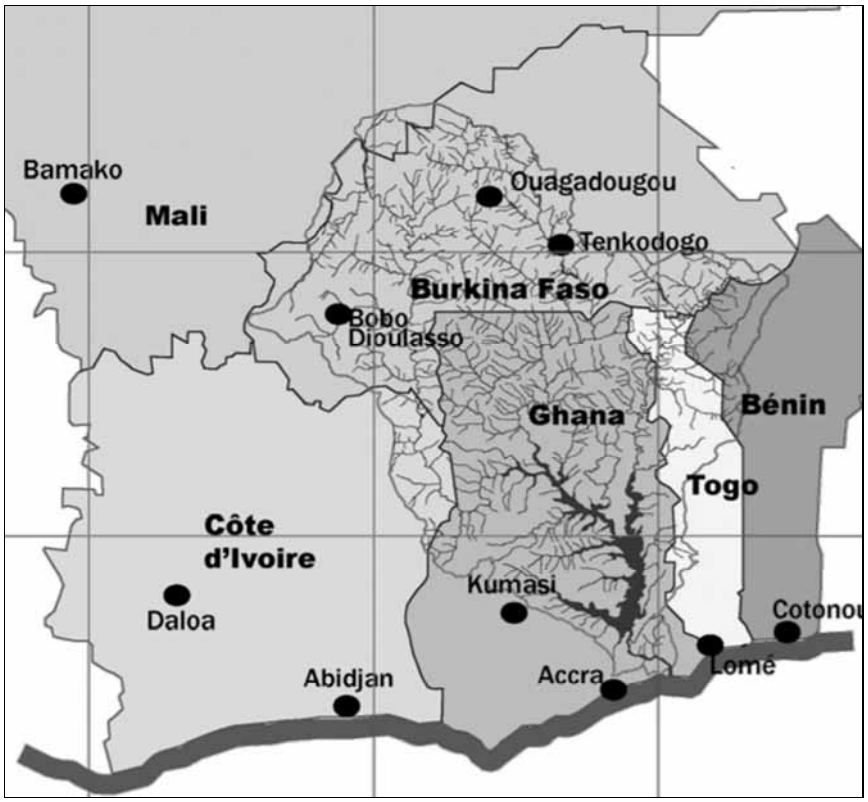
Between 2006 and 2008, under an FAO initiative, assessments were undertaken in five sub- Saharan countries, Ghana, Kenya, Mali, Uganda, and the United Republic of Tanzania (Akande and Diei-Ouadi, 2010) as part of the validation process of the PHLA methods and capacity building. This led to the publication of a manual for extension workers (Diei-Ouadi and Mgawe, 2011). The work of the NFFP in the Volta Basin has centred on applying these validated loss assessment methods to take stock of mainstreaming important gender considerations, climate changes and any other eventual vulnerability factor in order to then identify the key drivers of losses that affect trade within the riparian countries.

## 3. PHASE 1 – BASELINE STUDY

### General issues from the review of secondary sources of information

The Volta Basin covers about 400 000 km$^2$. This basin is shared between six riparian countries: Benin, Burkina Faso, Côte d'Ivoire, Ghana, Mali and Togo (Figure 5). Burkina Faso and Ghana share almost equally 85 percent of the total area of the waterbody, and the other countries have smaller portions in terms of area and in fish production. However, the Volta Basin covers about half of the area of Togo.

**Figure 5. Map showing the geographic distribution of the Volta Basin between the six riparian countries**




*Source:* Lemoalle, J. & de Condappa, D. 2009. Water Atlas of the Volta Basin. Colombo, Challenge Program for Water and Food, and Marseilles, Institut de Recherche pour le Développement. 96 pp.

Numerous (informal) exchanges of fishery products take place between different countries, but are difficult to quantify, as they are rarely documented. The information triangulated from various sources, including from PHLAs, has enabled a map of the flow of these exchanges to be sketched (see section Opportunities starting on p. 41).

Based on this knowledge and the data in Table 2, further analysis then focused on three countries, namely, Burkina Faso, Ghana and Togo, to generate representative information on the Volta Basin.

**Table 2. Volta Basin – domestic fish production in the riparian countries**

| | Benin | Burkina Faso | Côte d'Ivoire | Ghana | Mali | Togo |
|---|---|---|---|---|---|---|
| Sources | ONASA (National Bureau for the Support of Food Security) | Fishery Resources General Directorate, 2012 | WAEMU Survey on inland and lagoon fisheries | Fisheries Commission 2013 annual report | Annual report, National Directorate of Fisheries, 2013 | Activities report, Directorate of Fisheries and Aquaculture 2013; PHLA report, Togo |
| | (tonnes) | | | | | |
| Total national production | 41 949 | N.C. | 50 000 | 436 000 | N.C. | 20 000 |
| Continental production | 31 500 | 20 000 | 44 758 | 95 000 | 99 552 | 5 000 |
| Volta Basin production | N.C. | 17 000 | 716 | 82 000 | 9 000 | 2 400 |

N.C.: not communicated.

**Importance of inland fisheries and the Volta Basin and analysis of the level of priority in policy documents**

Inland fisheries, and particularly the Volta Basin area, are a crucial source of fishery resources in riparian countries. As shown in Table 2, the Volta Basin is the sole provider for Burkina Faso (85 percent of domestic production) and a significant source for Ghana (18-19 percent of national fish landings and 90-95 percent of inland fish production). More detailed figures can be found in the table in Appendix 1, and these confirm how the Volta Basin contributes to national food security and actors' livelihoods in macroeconomic terms.

However, in many cases, this position is either not taken into account or is only poorly considered in terms of priority given to inland fisheries, including the Volta Basin fishery. This is exacerbated in coastal countries, such as Ghana and Togo. It is reflected in the lack of visibility of these issues in documents dealing with the sectoral development and is translated in the absence of socio-economic infrastructure and management processes for these inland waterbodies. The findings from the field observations corroborate this observation. Moreover, relevant fisheries policy information is timid in fully recognizing the true importance of inland fisheries. The different available instruments communicated for each of the study countries are summarized below.

In Burkina Faso:

- The 2011–2025 National Strategy for Sustainable Development of Fisheries and Aquaculture is the umbrella for interventions in the areas of fisheries and aquaculture.
- An action plan for 2011–15 provides a framework for its implementation, and its main objective is to sustainably increase fish production.

In Ghana, the sectoral development policy focuses on four main areas:

- Fisheries management, water resources conservation and protection of their natural environment,
- Promoting value-addition in the fisheries sector and improving livelihoods in fishing communities,
- Sustainably developing aquaculture.
- Improving the service provision to the sector by the Ministry of Fisheries and other support institutions.

In Togo, the four documents of interest are:

- The Strategy for Accelerated Growth and Employment Promotion 2013–2017.
- The Revival Strategy for Agricultural Production.
- The National Agricultural Investment and Food Security Programme, a sectoral policy document on fisheries and aquaculture,
- The National Strategy for Aquaculture Development, with the overall objective "to make aquaculture a significant contributor to improving the coverage of national needs in fishery products, the economic growth of the country and poverty reduction".

**Regulations and institutions involved in the management of post-harvest issues**

The analysis of the information on the three countries shows that reducing PHLs is addressed from various angles. However, it is not specifically referred to in most sectoral documents – they focus mainly on improving productivity in fisheries – or the mandates of the institutions responsible for fisheries development do not specifically reflect this aspect. For example, extensive reference is made to proper handling and processing practices, which contribute to better control of PHLs. As loss reduction is not presented as a priority that integrates the entire value chain, and a systematic approach that can integrate the critical points (hotspots) seems non-existent, piecemeal interventions still prevail. Their effectiveness has yet to be demonstrated, given the persistent PHL. The instruments that are in force, as well as the mandated institutions in the various countries, are presented in Table 3.

In all three countries, the competent authority is the ministry in charge of fisheries through mandated central and decentralized directorates. Other institutions include research centres, non-governmental organizations (NGOs) and professional organizations. It should be noted that in general there is no autonomous institution specifically dedicated to inland fisheries.

**Table 3. Regulations and institutions involved in the management of post-harvest issues**

| Burkina Faso | Ghana | Togo |
|---|---|---|
| Joint Order No. 00044/MAHRH/MECV/ MRA/MS/MCPEA/MATD laying down hygiene measures and handling, transport and storage conditions for fishery products in Burkina Faso. Standards that regulate the conditions of fish processing exist. The same applies to marketing, there is a decree on trade organization that defines 4 types of fish traders: fishmongers: M1 (4-wheel vehicle), M2 (2-wheeled vehicle); retail – processor; importers; exporters | Law 625 (2002) on fisheries, fisheries regulations (LI 1968) national fisheries policy and aquaculture in Ghana (2008) | Law No. 98–012 of 11 June 1998 regulating fishing<br>Decree 2001-067/PR laying down sanitary rules for the production and placing on the market of fishery products |
| MRAH (Ministry of Animal and Fisheries Resources)<br><br>The General Directorate of Fisheries and Aquaculture Environment and Sustainable Development Regional Directorates | ▸ MOFAD (Ministry of Fisheries and Aquaculture Development) -FC,<br>▸ Research (CSIR-FRI) Food Research Institute (FRI), within the Council for Scientific and Industrial Research (CSIR).<br>▸ Universities (UCC, LEGON and KNUST)<br>▸ National Fisheries Association of Ghana<br>▸ Ghana Canoe Fishermen Council<br>▸ Ghana Inland Canoe Fishermen Council<br>▸ NGOs (HEN MPOANO, DAA, etc.)<br>▸ Ministry of Fisheries and Aquaculture Development<br>▸ Fisheries Commission<br>▸ Landing Beach Committees<br>▸ Chief fishers and their elders etc. | ▸ MAEP (Ministry of Agriculture, Livestock and Fisheries)<br>▸ Centrally managed by the Directorate of Fisheries and Aquaculture (DPA) + the Livestock Directorate (DE) through the Division of Sanitary Control of fisheries and livestock sectors<br>▸ At regional and prefectural levels, the relay is provided by the Regional and Prefectural Agriculture, Livestock and Fisheries Directorates (DRAEP)<br>▸ Research Centre: l'ICAT, l'ITRA, DPPSE.<br>Other institutions:<br>▸ Environment Directorate, the Navy, Department of Maritime Affairs<br>NGOs<br>▸ Les Amis de la Terre<br>▸ CERAD- international<br>▸ APPA<br>▸ GRAIL NT, AGAIB<br>Professional organizations<br>▸ UNICOOPEMA<br>▸ UGEFETRAPO<br>▸ UGCPC<br>▸ UGCPD |

## Preliminary observation of sites

### *Selecting the sites*

In order to have an overview of the status of PHLs and prepare for the selection of a specific value chain to then conduct an in-depth study, two riparian communities were visited in each country. These fairly representative sites, given their respective shares of production and the number of actors involved, have also been the epicentres of the PHLA in-depth study; detailed characteristics justifying their choices are described in the following section. They are:

- In Burkina Faso: one fishery camp in Kompienga and one other in Bagré.
- In Ghana: Yeji and Dzemeni.
- In Togo: Pansieri and Mango camps. Two aquaculture units in Touaga and Kangounou were also visited.

### *Tools used to gather data*

The assessors mainly used an observation checklist that was devised by the programme team that may be found in Appendix 4.

### *Information from the preliminary observation of sites*

*Actors*

The work is distributed according to gender. Fishing is the responsibility of men, and fish trading and processing are mainly carried out by women. The active age group is between 25 and 49 years (both men and women). Many are organized in associations. However, as can be seen in Table 4, these are undermined by problems of leadership, generational conflicts, corruption and non-compliance with regulations, and thus require strengthening of their organizational capacity.

*Prevailing fishing and aquaculture operations at the sites*

In most cases and in accordance with common practice in small-scale fisheries, dugout canoes are the means of transport. Motorboats are also used in Ghana. In all three countries, gear included set gillnets, drifting gillnets, beach/shore seines, hawks nets, pots, line and bait, traps, bamboo sticks, etc. In Burkina Faso, non-regulatory fine mesh nets are used to catch juvenile fish.

At most sites, the net is set hours/days prior to the harvest and pulled out hours/days later, depending on the means of transport. This contributes to early spoilage and, consequently, to quality loss in the finished product. Once the fish is on board, handling does not follow prescribed hygiene rules (the fish is not immediately preserved and adequately stored) and thus it is exposed to physical, chemical and/or microbiological contamination. Storage in ice or in insulated containers is virtually non-existent.

Aquaculture is more developed in Ghana (in ponds and cages by specialized small-scale industries) than in Togo (in ponds and dams). No reliable information is available on the aquaculture sites surveyed in Burkina Faso, probably because this activity is still at the embryonic stage compared with the two other countries. However, the 2008 FAO Fisheries and Aquaculture country profile highlighted the ongoing development in the country of four systems or production techniques: aquaculture in ponds, pens, cages and fish restocking.

The predominant genus is *Chrysichthys* (catfish), followed by *Cichlidae* (tilapia). In Ghana, aquaculture is practised in ponds in Kumasi and the surrounding area and in cages in the Akosombo enclave. Fish, especially fresh tilapia, are sold at farmgate to wholesalers (especially women). The two main aquaculture farms are Tropo Farms and West Africa Fish Limited. They produce ice on site for preservation.

Tilapia predominates over catfish in the two types of production throughout the basin. One of the decisive factors in favour of choosing the capture tilapia value chain to evaluate PHLs in the Volta Basin was that farmed fish were reported to have minor losses. This is due to easy planning (compared with the unpredictable nature of capture fisheries/fish) and the fact that it may be relatively easier to manage farmed fish supply to meet customer demand (size, volume, etc.).

**Table 4. Sociocultural characteristics of the actors, by country**

| Country | Sociocultural characteristics of the actors |
|---|---|
| **Burkina Faso** | Harvest and post-harvest activities in the Kompienga and Bagré fisheries are ranked according to gender. Men do the fishing while women essentially carry out processing activities. As for age groups, young teenagers are assigned roles respectively to work as assistant fishers (boys) or assistant processors (girls) with older members of the community.<br>Actors are organized in groups and unions (departmental, provincial and regional). Fishmongers also concurrently ensure fish transport to access areas.<br>On the Kompienga site at the time of the survey, their number was estimated at 400 fishermen with 53 percent from Burkina Faso and 47 percent foreigners. About 200 women were working as processors. |
| **Ghana** | Traditionally, fishermen along the lake are headed by a chief fisherman, who watches over their activities. The chief fisherman is often in the city. At village level, there are deputy chief head fishermen. Chief fishermen are indigenous to the region, while a deputy chief may be a foreigner who has come to the area to fish. The elections of chief fishermen and counsellors are regulated by various rules and traditional norms. Beyond the traditional system, fishermen from Yeji and Dzemeni belong to the National Inland Canoe Fishermen Council (NICFC).<br>A queen mother is in charge of issues regarding women living in the city; therefore, she does not handle only fishmongers' and processors' issues. To fill this gap, women who work in rural/waterside settings have formed their own associations for their well-being. In Yeji, the large 30-year-old Yeji Cooperative Fish Processors and Marketing Society brings together every category of fish processor and trader. A market queen mother is elected by the women of the market and is in charge of resolving all the conflicts between groups of women in the market. Women pay her by gifting her with a specific fish quality from each of the traders. In Dzemeni, there are two associations, the Lolongo Fish Processors Association, which is 10 years, old and the older Akpenamawu. |
| **Togo** | The surveyed population consists of fishermen, processors/traders and aquaculture farmers.<br>Togolese constitute 67.1 percent of fishing communities; the other members are from Burkina Faso, Ghana, Mali, Niger and Nigeria.<br>The fishermen population surveyed is young and 62.9% are illiterate. Each household consists of 10 people on average.<br>94% of women surveyed are Togolese and mostly processors/traders. 68% of these women are illiterate.<br>Fish farmers are all Togolese and 48.9% are women. |

*Fish supply operations*

*Activities of landing, pretreatment, packing, packaging, storage, transport*

Most of the sites visited in the three countries do not have piers. Pretreatment of fish is carried out in unsanitary conditions within the household, using inadequate equipment, with non-potable water (from the river or lake). Packaging and/or processing are done with inappropriate containers exposing

products to physical shocks during transport, dust contamination from the air, sunlight when it is very hot, and water and moisture during the rainy season. All these weak points contribute to increasing the risk of quality loss for fresh or processed fish. Table 5 summarizes the situation in each country.

**Table 5. Summary of post-harvest activities by country**

| | Burkina Faso | Ghana | Togo |
|---|---|---|---|
| **Landing** | Sorting: Wholesalers select large specimens, and women processors collect the rest.<br>At landing, wholesalers collect and store their fish in makeshift insulated containers. | In Dzemeni, the landing takes place in unhygienic conditions, in the open air and on the beach.<br>Assembling in aluminium pans. | The landing takes place on non-equipped sites.<br>Collected fish are stored in raffia baskets, jute bags, metal drums or basins without any ice.<br>Transport to where the fish are sold is done on foot, by bicycle, motorcycle or taxi depending on the distance. |
| **Pretreatment** | No pretreatment on the pier or at the weighing centre.<br>Fishmongers store fish directly in an insulated container. Processors carry out the pretreatment (trimming, rinsing, draining) at the processing site. | Pretreatment prior to processing is done within the household.<br>The main operations are: scaling, draining and cutting into pieces.<br>The size of the pieces depends on the target market.<br>Rinsing is done with untreated water from the shore. | Fresh fish sold is not pretreated.<br>If it is pretreated, the water used is not potable. |
| **Processing** | | | |
| **Packaging / conditioning processed fish** | Either in bulk or piled up in boxes, basins, leaky baskets and often inappropriate material. | Packaged in 3 main types of baskets weighing 41, 57 or 64 kg. | In baskets previously lined with paper (smoked fish), in basins, jute bags, barrels (fried fish) and raffia baskets. |
| **Storage of processed fish** | There are no dedicated storage places for processed fish at fishing sites. The processed goods are generally immediately sold and do not have to be stored for sale at a later time. | Smoked fish is stored in locales or ovens and stacked as high as possible. Stocks are then put together for sale on the next weekly market fair. | Smoked fish are kept on kilns and more or less protected with metal sheets. They are also kept in often poorly protected basins or baskets and stored in homes.<br>Fried fish are stored in homes in the same conditions as smoked fish. |
| **Transport** | Processed fish wholesalers stow fish in boxes they convey to urban centres by public transportation vehicles. | No specific vehicle assigned to transporting fish. | Processed products are transported on foot, by bicycle, motorcycle, bush taxi or truck.<br>Transport time depends on the distance between the camp and the place of sale. |

*Processing: smoking, drying, salting, fermentation*

In the three countries, smoking is the main activity at processing sites, followed by drying. These are carried out with simple methods (smoking with traditional ovens and drying in the sun). Other techniques include frying, salting, drying and fermentation. The study showed that the sites in the

three countries shared common features: lack of improved processing equipment (except in Ghana where unused Chorkor kilns do exist but are decrepit as they are too far away from dwellings), or infrastructure in a dilapidated or degraded state with no observance of hygiene rules. Moreover, fishmongers/traders and processors have limited knowledge of processing techniques. All this leads to poor-quality and non-competitive products on the market. Drying can be used as a fish preservation method mainly for home consumption. However, most often, it is used as a mitigation method in times of bumper harvest to prevent fish spoilage; in this case, the fish is also salted.

Loss estimates have been reported with a range from 0.1 to 35 percent, depending on the country and the preservation or processing method. Fish processing is performed in the immediate vicinity of processors' dwellings with the same equipment that is also used to prepare family meals (such as knives, containers and cutting boards). Certain factors contribute to these losses. For example, Ghanaian processors working in Burkina Faso are reluctant to use salt to preserve fish. To avoid post-processing weight loss, they do not leave the fish to dry long enough. Consequently, smoked or dried fish is often infested with worms and various insects within a few days after processing. Moreover, in the sites surveyed in Ghana, it was found that Chorkor ovens (which have a greater capacity to save fuel, improve product quality and provide less exposure to the heat and smoke) were practically not used despite being widely disseminated in these communities a few years ago. Processors, accustomed to their inefficient traditional ovens, which are round or rectangular, made of clay or mud, are reluctant to take ownership of these improved ovens. Beneficiaries questioned the conditions under which they were introduced and have therefore left them in disuse, while continuing to incur losses linked to outdated techniques.

Plate 1 illustrates traditional processing activities in Ghana.

Given the lack of mastery of the PHLA methodologies by the assessors at the time of the survey (in fact, except for Ghana, loss assessment teams had not yet been trained in these assessment methods), the collected data on losses were considered sufficiently indicative to inspire an in-depth PHLA, following the training of the Lomé workshop. Therefore, this information is briefly presented in Part 2 so that they may be compared with those obtained after the training.

**Plate 1. Traditional processing activities in Ghana**

(a) Smoking.

(b) Frying.

(c) Dilapidated and abandoned improved Chorkor ovens at the Yeji community's processing centre.

(d) Quality of dried products.

*Courtesy of:* National PHLA team, Ghana.

*Marketing*

The information collected in the three countries shows that fresh fish sales transactions generally take place at sites devoid of piers and infrastructure for adequate preservation. Clients, almost all women, consist of processors, small local resellers and wholesalers from urban centres and neighbouring countries. This demonstrates that there is a regional flow of fisheries products. However, the share of each market category (local, national, regional) was not documented as the value chain actors were not able to give precise quantities. Specific information regarding each site is detailed here below:

In Burkina Faso, fresh fish from the Kompienga and Bagré fisheries is sold to local populations, wholesalers with four-wheel vehicles coming from remote areas and fishmongers with two-wheeled vehicles from the surrounding communities. The bulk of catches (72.3 percent) is sold at the fishing sites, with 24.6 percent sold in the village or at the local market, and 3.1 percent in other markets. The main outlets are the major cities, including Bobo-Dioulasso and Ouagadougou. An unrecorded portion of fresh fish from Kompienga is exported to markets in Benin, Niger and Togo. Processed fish from the Kompienga and Bagré fisheries is sold to local populations, dealers from neighbouring localities and wholesalers from afar. An undocumented part of processed fish from Kompienga is sent to Benin and Nigeria. Almost all the salted fish processed in the Bagré fishery is sent to Ghana.

In Ghana, processed fish from inland fisheries is found at a number of markets, mainly in large urban cities. Some is sold in local markets. Other processed fish such as tilapia, particularly when smoked and salted, is sent for sale abroad.

Aquaculture fish is only traded on the local market, mainly in urban centres, traditional markets, restaurants, bars or hotels. Most fish is sold fresh, whole or cut, chilled or not. Smoked catfish appears to be sold at a higher price than when fresh because it is a delicacy enjoyed in Ashanti and other regions.

In Togo, fresh fish sales transactions take place at landing sites, in fishers' dwellings or in a public place in the open. Fresh fish is sold in heaps, basins or by conventional kilograms. Products are sold to traders from Burkina Faso (once or twice a month), traders (wholesalers) coming from Dapaong, in the north of Togo (two to three times per week), households and women processors from the camps.

**Conclusions on this preliminary phase**

After the PHLA training in Lomé, all the information from the review of secondary sources and preliminary observation of some communities in the Volta Basin was discussed and used to select sites for an extended investigation in a wider geographic area.

It was important to strengthen the capacity of representatives of fisheries administrations and fisheries actors in order to improve their understanding of the issues linked to losses (types, causes and generic impacts, interconnections, etc.), and their ability to use loss assessment tools and identify solutions for the primary factors of these losses, while formally integrating gender and climate change dimensions. This approach by the NFFP was the first of its kind for PHLAs since the methodologies were first validated in 2008.

In this context, it was decided to bring together key actors in a subregional workshop on the collection and use of data on post-harvest fish losses that would then inform sustainable loss-reducing interventions.

# 4. PHASE 2 – CAPACITY DEVELOPMENT OF ASSESSORS AND STAKEHOLDERS IN ASSESSING POST-HARVEST FISH LOSSES AND PILOT PHLAS

## Introduction

The five-day subregional Training Workshop in Data Collection and Use for Fish Post-Harvest Losses to Inform Sustainable Reduction Interventions was held from 10 to 15 March 2013 in Lomé, Togo. The workshop was a platform to build capacity in methods used to evaluate the performance of fishery-product supply chains and share the stocktaking results on the existing situation in three countries of the Volta Basin.

The workshop preparatory phase consisted in designing questionnaires that included actors' coping strategies and the regional trade dimension as essential elements in the gathering of data.

The workshop helped to consolidate the understanding of interwoven factors and multiple implications of PHLs, which constitute the basic knowledge required to design sustainable and realistic loss-reduction interventions. As a reminder, the output B4 has led to the adoption of a holistic approach that takes the entire supply chain into account while fully integrating issues such as gender, vulnerability and stakeholder groups' resilience in the analysis of significant losses and marketing of products caught and processed in the Volta Basin. Focusing on priority issues that emerged from this exercise will ensure better impact while using development resources efficiently.

Upon returning to their country, these trained participants are expected to lead the process by starting from analysing secondary data sources all the way up to assessing losses in the field. This should then allow them to identify loss-reduction interventions, prepare a cost–benefit analysis, implement and monitor projects, and evaluate their effectiveness. The workshop's main objective was to ensure that these actors become true drivers of cascade knowledge transfer with the tools they have acquired.

## Organization and conduct of training sessions

The workshop was attended by 17 participants from the 6 riparian countries, including fisheries officers experienced in artisanal fisheries, especially in terms of post-harvest, and representatives of fish workers organizations (see Appendix 2 for the agenda and Appendix 3 for the list of participants). Four experts from FAO headquarters, the Subregional Emergency Office for Eastern and Central Africa, the "Strategic Response Programme on HIV/AIDS for fishing communities in Africa" and the "SmartFish Program for Eastern-Southern Africa and Indian Ocean Region" also attended the workshop. The computer and data digitization management specialist and the fisheries expert of the SmartFish programme specifically contributed by sharing experiences in introducing mobile phones in the PHLA in the area where the programme was being implemented.

The objective was to understand how similar tests may be conducted in the Volta Basin, while taking into account all of the needs of the NFFP, which considered the disaggregation of all the information by gender, age groups, the relationship between climate variability and PHLs, actors' coping strategies and the regional trade dimension as essential elements in the gathering of data.

The efficient organization and excellent coverage from both public and private media that characterized the workshop were achieved mainly thanks to the good cooperative spirit of the FAO Togo Representation.

In accordance with the agenda (Appendix 2), the workshop proceeded in various sessions including:

1. Plenary presentations and group work, especially on case studies extracted from previous loss-assessment activities. The Madagascar Crab and Lake Victoria Sardine case studies were reviewed. These are actual examples documented during SmartFish and PHLA training as part of the FAO regional methodology validation programme. They encompass the fundamental concepts in PHLs.

2. Reviewing and amending the assessment questionnaires previously developed by the technical unit (FIPM) with contributions mainly regarding "gender" issues, by the HIV/AIDS programme coordinator.
3. Visits to strengthen the knowledge acquired during plenary sessions and test the questionnaires by implementing them in a fishing community while conducting a variety of activities. These practical sessions took place at the Katanga fish processing centre, on the outskirts of Lomé, through intensive interactions with fish operators.

   One of the main lessons learned during this field visit was the trap in which the investigators found themselves owing to the non-observance of the basic principles of the participatory rapid appraisal (PRA) method. This technique is essential in the exploratory/informal fish loss assessment methodology (EFLAM/IFLAM) and enables better understanding of rural communities' issues in an inclusive manner. It does so by taking into account the concerns of the most vulnerable (those at the bottom of the scale in terms of financial power or production capacity), while analysing their relationships with those who are relatively better-off. Oversights by the groups of participants in applying the PRA method led to them identifying wrong critical loss points and causes. Using these data would have resulted in designing ineffective interventions, as they would have been unsuitable for minimizing losses on this site of more than 300 individuals (see Box 1).

**BOX 1**

**Katanga snapshot case, Togo**

Katanga is a processing centre with about 400 processors, all women except for one man. The available information indicates that smoking has a prime position compared with frying and drying. According to the group interview, all operators participating agreed that "smoking" incurs more losses than drying, fermenting and frying and that losses affect more people in this category of activity (automatically given priority). However, the group aligned itself on a single critical loss point (CLP), namely the storage of smoked products, which was indeed exclusively identified by the most vocal interviewees.

Subsequently, interviews with key informants (small groups of 3–5 people in the same age group) were carried out and helped in thoroughly analysing the main flow diagram of the smoked fish value chain, as illustrated here below. The diagram shows several points of significant losses along the chain. In fact, storing products concerned a tiny minority of site operators, those with high volumes and supplying cross-border markets. They have enough capital to store the fish for longer than a month and up to three months, to then sell it when prices are at their peak during the offseason. This is the case of the only male processor and a few women.

Otherwise, most female processors supply markets overnight and their critical points are, above all:

1. purchasing/supply of raw materials;
2. transporting the product from the landing to the processing site (standby/scarce means of transport);
3. packing and packaging smoked fish;
4. transport to market (physical damage/fragmentation);
5. incidentally, smoking (fish occasionally burned owing to lack of attention) and/or storage.

The male processor also identified packaging and transportation as additional critical points during the key informants interview, coming to three CLPs instead of the sole one (storage) he mentioned during the group meeting. He also has a strong workforce that handles all the different steps from the purchase of raw materials to packaging, thus experiencing only negligible losses in each of these steps, unlike the female processors.

**BOX 1 (continued)**

**What caused this turnaround?**

In fact, the data from the large group interview were biased from the start, given that the process prevented discrete or small operators from contributing, as they often feel embarrassed because of their poverty and are too intimidated to speak in public. Indeed, in spite of efforts by the facilitator and some group members experienced in community-based approaches to ensure that the silent group of women sitting on one side of the meeting be directly asked questions on the issues, the meeting continued. This resulted in building on the responses mainly from two to three individuals, including the one male fish processor (with a large production capacity, and therefore a flow diagram that differs slightly from the majority of these women) and two or three very active women, who also have large production volumes.

One may imagine the implications an intervention to reduce losses based solely on this general group meeting could have had. For example, priority for assisting in providing adequate processed fish storage facilities in this community could have been recommended, when this measure would actually only benefit half a dozen individuals and would address non-significant losses, which are moreover incurred by people whose "economic" power is already more than adequate. The lesson learned was the need for an effective triangulation and for creating conditions to capture the views of all, including the majority of those that are the most vulnerable. Limiting the approach to this level of data often results in misleading and unaddressed aspirations and needs of this social group. Be it in decision-making, designing interventions or their exposure to potential innovations, the deep-rooted resignation and discretion of these actors with a low social status are an obstacle that must be overcome to enable efficient post-harvest systems and equitable development.

| | |
|---|---|
| From 4:00 to 5:00 | • Household chores |
| 6:00 | • Arrival at landing |
| From 7:00 to 10:00 | • Buying and transportation (from landing to processing site) |
| From 10:30 to 14:30 | • Unloading<br>• Pretreatment<br>• Arranging fish on racks<br>• Draining<br>• Cooking |
| From 15: to 4:00 the next day | • Smoking<br>• Cooling<br>• Packaging, packing, storage |
| More or less once a week | • Transport to market<br>• Sale |

4. The baseline studies conducted in three countries were presented and gave rise to fruitful exchanges. Field PHLAs were also planned, starting with a pilot study taking place in a site close to the team leader's workplace, to be followed by a full study in the Volta Basin once the project's technical division approves the pilot study report.
5. The first version of the video on the design, construction and use of the FAO-Thiaroye Processing Technique was screened and a discussion followed to obtain feedback on how to improve this teaching tool, which will be widely disseminated.
6. Formulating recommendations to strengthen the PHLA process.

A combination of improvement tools such as brainstorming, cause-and-effect analysis, gap analysis and strengths, weaknesses, opportunities and threats (SWOT) analysis were employed in order to identify the critical strategic issues to be addressed by the development agenda. Participants, with the help of these improvement tools, first established the cascade of cause–effect relationships (from the highest level to the lowest level of constraints, problems and bottlenecks that limit the competitiveness of post-harvest fisheries and aquaculture chains and cross-border trade within the subregion). They then identified the gaps and internal and external factors within the current situation by using a SWOT analysis, and then benchmarked it against an improved situation (the targeted improvements). Barriers to improvement will be removed by a series of activities and outcomes. The expected end result would consist in implemented new efficiencies, identified economic incentives and, notably, the enhanced competitiveness of the Fisheries and Aquaculture Post-Harvest Chain and Regional Trade (FAPHC&RT) of the Volta Basin. These analyses were done in the context of a regional outlook of enhanced sustainable productivity, value addition and competitiveness of the FAPHC&RT of the Volta basin, and they were conducted in a highly participatory and consultative process involving key fisheries stakeholders.

For the PHLA field studies, participants were recommended to use the EFLAM/IFLAM and the questionnaire loss assessment method (QLAM) as methodologies as they are useful in obtaining a quantitative and qualitative understanding of the post-harvest fish losses by supplementing them with essential additional parameters for the NFFP. These include the disaggregation of all the information by gender, age groups, the relationship between climate variability and PHLs, actors' coping strategies and the regional trade dimension.

**Key lessons and recommendations**

***Main points***

This workshop provided participants with skills and a better understanding of the concepts of PHLs, the main practical steps for assessing these losses, things to do and not to do, and potential pitfalls to be avoided when collecting primary data to then generate reliable information. The progress in capacity building is highlighted through the assessment of the level before and after the workshop, as well as the overall assessment of training expectations. Participants actively contributed to the discussion and made valuable suggestions, which helped finalize the questionnaire to configure mobile phones.

The active involvement of participants and the Katanga experience have helped to generate significantly improved questionnaires that, for the first time, mainstream issues of diverse kinds into PHLAs. Participants are also to be credited for their substantive contribution to develop a harmonized form common to both projects (NFFP and SmartFish) to periodically collect data on losses.

- Based on the plan agreed upon during this workshop, each of the six countries should undertake the pilot PHLA on a site near the PHLA's team leader's workplace so that the team may better familiarize themselves with the evaluation methodologies tools.
- Participants were quite curious and interested in using mobile phones for data collection. They saw this as an opportunity to modernize the collection of statistical data. The phone kit given to each national team would be used in the field and lessons would be shared for a suitable decision on this tool.
- Based on the data from the baseline study, three to four sites per country and the tilapia value chain were selected for the PHLAs in the Volta Basin.
- Participants made very interesting and constructive suggestions and comments after viewing the draft of the promotional video on the FAO-Thiaroye Processing Technique. These were taken into account before presenting the video at another workshop in May 2013 in Abidjan, Côte d'Ivoire, after which a final version of this teaching tool funded by the NFFP will be made available for the target audience.

***Workshop recommendations***

The following recommendations emerged during the workshop:

- To facilitate the fieldwork, the FAO FIPM technical officer was asked to develop, as a guide, a note on the step-by-step approach, starting from the collection of secondary data, the preparation and the fieldwork up to sharing results with the relevant value chain stakeholders, policy-makers and private investors. This document was sent to the teams in all of the countries before the start of the pilot PHLAs. It should be completed over time with the learning from evaluations in different contexts, including the work in the Volta Basin with the objective to make it a reference document in addition to Diei-Ouadi and Mgawe, 2010..
- National workshops organized to share information from the Volta Basin studies and increase their ownership by stakeholders should be inclusive and involve the participation of representatives of all stakeholders including the private sector, the fisheries administration and other public institutions and donors. They will all take place before a subregional workshop is organized.
- The use of other information technology and communication tools such as tablets to facilitate data entry (keyboard) should be explored. The possible use of the Internet for interviews through Skype, video, etc. has also been suggested to allow investigators to conduct interviews through questionnaires without having to go to the field in terms of validation with the questionnaire loss assessment method (QLAM).

***Follow-up activities – Choosing the sites for the pilot PHLAs***

This small initiative is part of the capacity-building framework. Its ultimate goal, as agreed during the workshop in Lomé, is to familiarize PHLA teams with the acquired tools before embarking on a large-scale PHLA in the Volta Basin.

The following sites to conduct the pilot PHLA are in the vicinity of the team leaders' workplace. It should be noted that at this stage Mali has self-funded its own pilot study and selected some Volta Basin sites. Table 6 summarizes information on fisheries, operators and methodologies.

**Table 6. Pilot PHLAs in Volta Basin countries**

| Country | Sites and fisheries investigated | Operators participating in the PHLA | Fish species | PHLA method used | Method/tools |
|---|---|---|---|---|---|
| **Burkina Faso** | Tanghin (Ouagadougou) market with supply from sites of the Volta | Half a dozen fishmongers 25-49 years old<br>Twenty resellers 25-49 years old | Tilapia | IFLAM Based on PRA method principles | **Methodology**<br>1. Direct on-site observation<br>2. Semi-structured interview with selected operator groups<br>3. Semi-structured interview with key informants<br>**Tools**<br>1. Assessment checklists (observation, group interview, interviews with key informants)<br>2. Mobile phone to digitize data<br>3. Vehicles to go to the sites |
| **Côte d'Ivoire** | Landing site of Abobodoumé (Abidjan) | 77 fishmongers<br>23 smoked-fish processors | Bream, sole, grouper, captain, bream, triggerfish, sea bream, skate, bar, snook, arangue, monkfish, flying fish, bonito | | |
| **Ghana** | Ahwiam, fishing village in Dangme, West District, Greater Accra Region | 65 smoked fish processors (50 also practice drying)<br>12 fryers | Tuna, mackerel, flying gurnard, barracudas | | |
| **Mali** | Baye in the Sourou, Volta Basin, and Konna in the Mopti circle in the Niger Delta | 65 processors (smoking, drying)<br>35 fishmongers for fresh fish | Clarias, Tilapia | | |
| **Togo** | Lomé fishing port | 25 fishmongers | Tilapia | | |

**Overview of the major issues raised by the pilot PHLAs**

The information collected and analysed was useful to share, given its variety and comprehensiveness in featuring non-technical or technological aspects.

***Basic infrastructure at the sites***

Weak or almost non-existent infrastructure (water, electricity, jetty, fish market) is common in all five countries. In addition, the road network is in poor condition, and the means of transport are inadequate.

***Social characteristics***

Findings at all sites in the five countries show:

- A very high illiteracy rate among operators whatever their fisheries activities.
- A rather weak organizational level (group dynamics); even if groups may be organized in associations, individualism prevails in the daily conduct of operations.
- The division of tasks is the same in the different countries and sites: men carry out mostly fishing (95 percent), and post-harvest activities (fish marketing and processing) are predominantly under the responsibility of women. In some cases, non-nationals are present, especially in processing activities (Côte d'Ivoire, Togo).

***Marketing of the products***

Fresh and/or processed products are sold on local markets in the surrounding communities and also sent to major cities. However, it is difficult to estimate the volumes involved in trade, as traders have little documentation or do not record data. Very little cross-border trade to other countries in the subregion is reported.

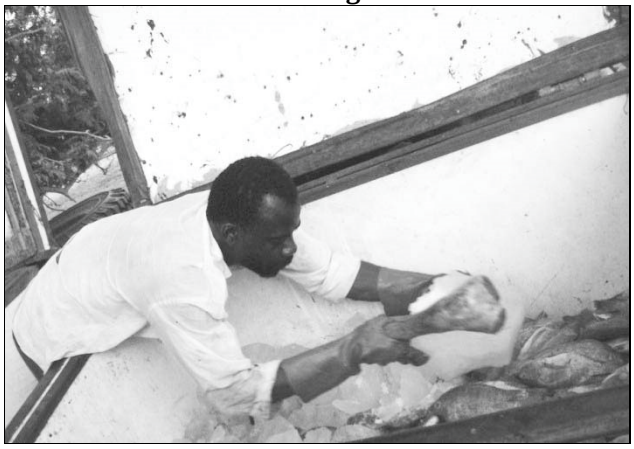
***Overview of the data on losses (PHLs)***

The loss results analysis for the five countries (see loss matrices by country in Appendix 6) highlights three types of losses (quality, physical, market forces) that affect the different categories of operators surveyed (fishmongers and processors). However, their importance varies from one site to another and generates varying degrees of impact in terms of food security and livelihoods. The most frequently identified losses at the sites and in the countries are quality losses for fresh as much as for processed products. They are related to the lack of ice, processing and storage infrastructure, as well as fishers, fishmongers and processors having limited knowledge in good hygiene practices. Losses due to market forces are caused by, for the most part, a lack of market information and by supplies exceeding demand in times of bumper harvest.

In addition to these common causes of losses, some quite specific losses were revealed by this pilot assessment and should be highlighted:

1. To limit spending (avoid costs relating to several supply trips), in some countries, fishmongers rely on maximum vehicle load by extending the collection period (20–30 days collection time during the lean season). This happens while the fish are kept in makeshift insulated boxes with an amount of ice that is not commensurable with this long duration and the volume of fish (Plate 2).

**Plate 2. A collector breaking chunks of ice in a container of "fresh" fish**



*Courtesy of:* Y. Ouedraogo, Burkina Faso, PHLA team.

2. Such handling and storage practices (long collection time, long-term storage with little ice) cannot be without consequence on the final nutritional quality of stored products. It would be useful to conduct a study to assess the effect or potential impact of these practices in terms of nutrients and other valuable compounds in fish and fish products.
3. In some sites and countries, fishers use prohibited or unregulated fishing gear (gillnet, surface, beach seine, etc.) to capture small or juvenile species, or they haul their nets in after an unusually long net laying period. This means that they recover fish that have begun to deteriorate and/or are too small when they lift the net and, therefore, the fish sold to fishmongers may be of poor marketable and fair quality. This illustrates the close link between illegal, unreported and unregulated (IUU) fishing and the occurrence of PHLs specifically in terms of quality. Moreover, this issue raises considerations regarding fish stock depletion, habitat destruction, unfair competition for honest fishers, and the impact on livelihoods in riparian communities owing to the low return from this fish.
4. Competition with imported tilapia and other fish species such as sea carp was highlighted in one of the national reports. This competition extends throughout the year and is especially exacerbated in times of bumper harvest or festive periods (Christian Lent, baptism, confirmation, end-of-year celebrations) because they coincide with high landing volumes while imports do not decrease or are not adjusted according to the level of supply in line with demand at these times of the year. This requires consistent planning and better regulation by fisheries and post-harvest authorities. Depending on the time of year, a suitable scheme could be envisaged:

    - During high fishing / oversupply periods: avoid oversupply of the market that could harm national/local production by implementing appropriate measures to regulate imports.
    - During the lean period: allow complementarity by providing a framework that permits imported frozen fish on the market, given that some small-scale operators (fresh resellers, processors) use it as raw material and it has been confirmed as an important coping strategy.

    In addition, a complex situation is emerging as local consumers are changing their dietary habits. It appears to be somewhat related to the fact that imported products are competitive, resulting in increased sales of imported sea carp and tilapia. It was reported in Burkina Faso that the share of local tilapia consumption is 20 percent but is tending to lose market share, as consumers increasingly prefer imported products. However, an in-depth analysis of this information is needed.

5. Small operators diversify their activities, including small businesses, in order to cope with economic losses along the fish supply chain.
6. Recovery or the hope to compensate for these losses in future operations implies a tendency for fishers to increase their fishing effort as an adaptation strategy.

# 5. PHASE 3 – FULL PHLAS IN THREE COUNTRIES WHERE THE VOLTA BASIN PLAYS A MAJOR ROLE IN TERMS OF INLAND FISHERIES: BURKINA FASO, GHANA AND TOGO

## Significance of the assessment

### *Objectives of the PHLA in the three countries*

These PHLAs conducted to obtain an overview of the losses phenomena had three objectives:

- Expand all stakeholders' level of understanding regarding PHLs by strengthening their capacity and sharing information from the field. This should ensure more awareness and wide ownership of the interventions stemming from the PHLA and thus more sustainable results.
- Identify the different types of losses (physical, quality, market forces) and their magnitude, with a particular focus on the most significant ones incurred by the tilapia value-chain actors – fish mainly in smoked form – and their main causes and impacts.
- Provide sustainable mitigation solutions and the main components of a potential strategy, which encompasses food security, livelihoods of vulnerable communities and natural resources sustainability aspects.

### *Assessment methods used*

The EFLAM/IFLAM based on the accelerated method of PRA and the QLAM were used in all three countries and to cover a variety of parameters. Some load tracking was conducted on specific issues, such as to evaluate the efficiency of fish smoking process by quantifying the fuel wood/fish ratio. Akande and Diei-Ouadi (2010) provided examples of how IFLAM has been used and the data it can generate. More information on QLAM can be found in Ward and Jeffries (2000) and Diei-Ouadi and Mgawe (2011).

The observations, group meetings, key informants and QLAM checklists used during the assessment are those that were finalized after the workshop in Lomé and the pilot PHLA by five of the six countries. Originally, mobile phones were to be used as a tool for collecting all the data, but using them proved problematic from the onset of the investigation on site for almost all the teams in the three countries. This led them to use only paper questionnaires. However, mobile phones were used to establish GPS positions and map out infrastructure at the sites.

### *Selected sites and selection criteria*

As stated above, the investigation focused on tilapia, as its prevalence was the primary criterion when choosing the survey sites. However, in Ghana, given the changes in species distribution that relegate tilapia to second or sometimes third place (at some sites) in the Volta Basin, the survey was conducted on multiple species. Table 7 summarizes the sites along with the selection criteria. In Burkina Faso, the PHLA was conducted in four sites located in the three regions with relatively higher fishing activities (the Hauts Bassins, the loop region of the Black Volta, and the Eastern Region) that contribute 60 percent to total domestic fish production and cover 70 percent of the Burkinabe Volta Basin's production. The study focused on the supply chain of fresh fish in Tounga (Kompienga fishery, Eastern Region), Bama (fishery in the Kou valley, Hauts Bassins) and Gouran (fishery in the Sourou Valley, loop region Mouhoun). The smoked fish PHLA was carried out at the site of Di (fishery in the Sourou Valley, Mouhoun region).

**Table 7. Sites and selection criteria**

| Country | Sites chosen | Selection criteria |
|---|---|---|
| Burkina Faso | Bama (Kou Valley fishery, Hauts Bassins region)<br>Di (Sourou Valley fishery, Boucle du Mouhoun region)<br>Gouran (Sourou Valley fishery, Boucle du Mouhoun region)<br>Tounga (Kompienga fishery, Eastern region) | • Volume of landings, including tilapia<br>• Accessibility<br>• Importance of the fishing site at local level (number of operators, intensity of activities)<br>• Organizations present |
| Ghana | Buipe (Northern region)<br>Dzemeni (Volta Region)<br>Tapa Abotoase<br>Yeji (Brong Ahafo Region) | Contribution of landings in domestic inland fisheries production<br>The diversity of post-harvest actors and fishing activities<br>Number of actors involved in processing and marketing<br>Volume of processed fish<br>Anticipated level of actor cooperation<br>How accessible the communities are and housing availability for assessors |
| Togo | Donga<br>Koumongou-kan<br>Nadougbal<br>Pansiéri | Volume of landings, including tilapia<br>Diversity of fish operators (fishers, processors, traders, etc.)<br>Proportion of full-time versus part-time operators<br>Structuring infrastructure (baseline study) |

The importance or potential of the fisheries, as shown in Table 7, is one of the key criteria for the selected sites. The data review of secondary information sources was cross-checked with the data collected *in situ*. This has resulted in Table 8, which demonstrates the relevance of the different choices.

Table 8 shows that, except in Burkina Faso, the PHLA teams failed to interview some of the important operators, that is the fishers, who had originally been included in the list of interviewees, and, therefore, their supply conditions could not be correctly studied. Had this been done, it would have allowed for a comprehensive value-chain assessment and provided more accurate information on upstream losses to then better understand the possible phenomenon of cumulative losses.

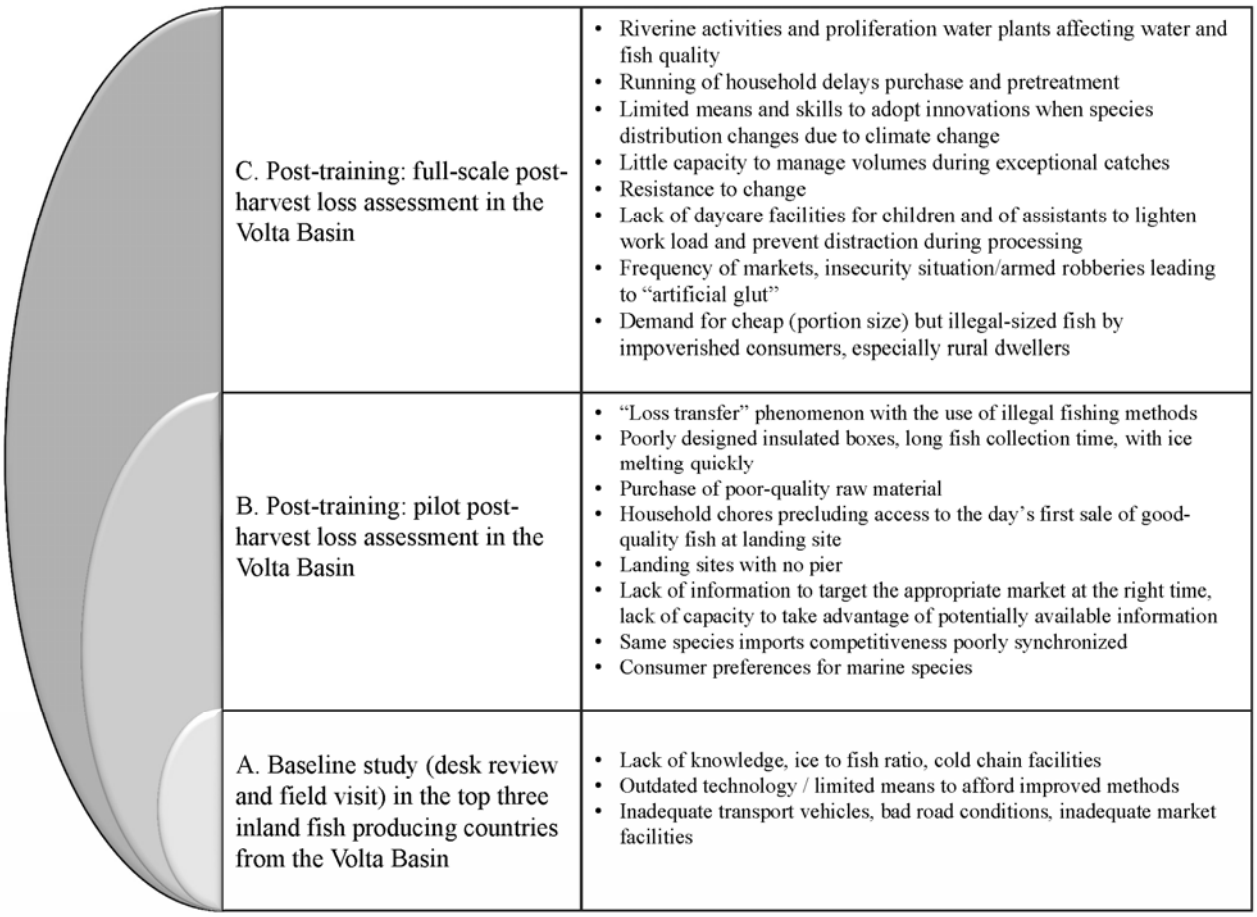
**Table 8. Selected sites – production, and actors surveyed**

| Country | Production by site (tonnes) | Total/year production per site (tonne) | Production share of these sites in relation to the total production of the Volta Basin in each country | Actors surveyed |
|---|---|---|---|---|
| Burkina Faso | Bama site 2 299<br>Di site 4 811<br>Gouran site 4 930<br>Tounga site 2 217 | 12 000<br>Tilapia dominates the production | 70% | Fishers and fishmongers at all sites and particularly Tounga<br>Fresh-fish retailers in Bama and Gouran<br>Fried-fish processor from Tounga operating in Bama and Gouran<br>Smoked-tilapia processor in Di |
| Ghana | Buipe 11 400<br>Dzemeni 23 750<br>Tapa Abotoase 14 250<br>Yeji 28 500 | 65 000<br>Of which 21 000 is tilapia (32%) | 80% | Fresh-fish retailers in Dzemeni and Yeji<br>Smoked-fish processors at all 4 sites<br>Drying/salting processor at 3 sites (not Tapa Abotoase)<br>Fermentation processor at Tapa Abotoase<br>Salted/dried fish retailers in Buipe<br>Smoked-fish retailers in Tapa Abotoase |
| Togo | Donga 495<br>Koumongou-Kan 960<br>Nadougbal 183<br>Pansiéri 1 470 | 2 234<br>of which 487 is tilapia (21%) | 93 % | Smoked-fish processors |

**Results and analysis of the information collected at the different sites**

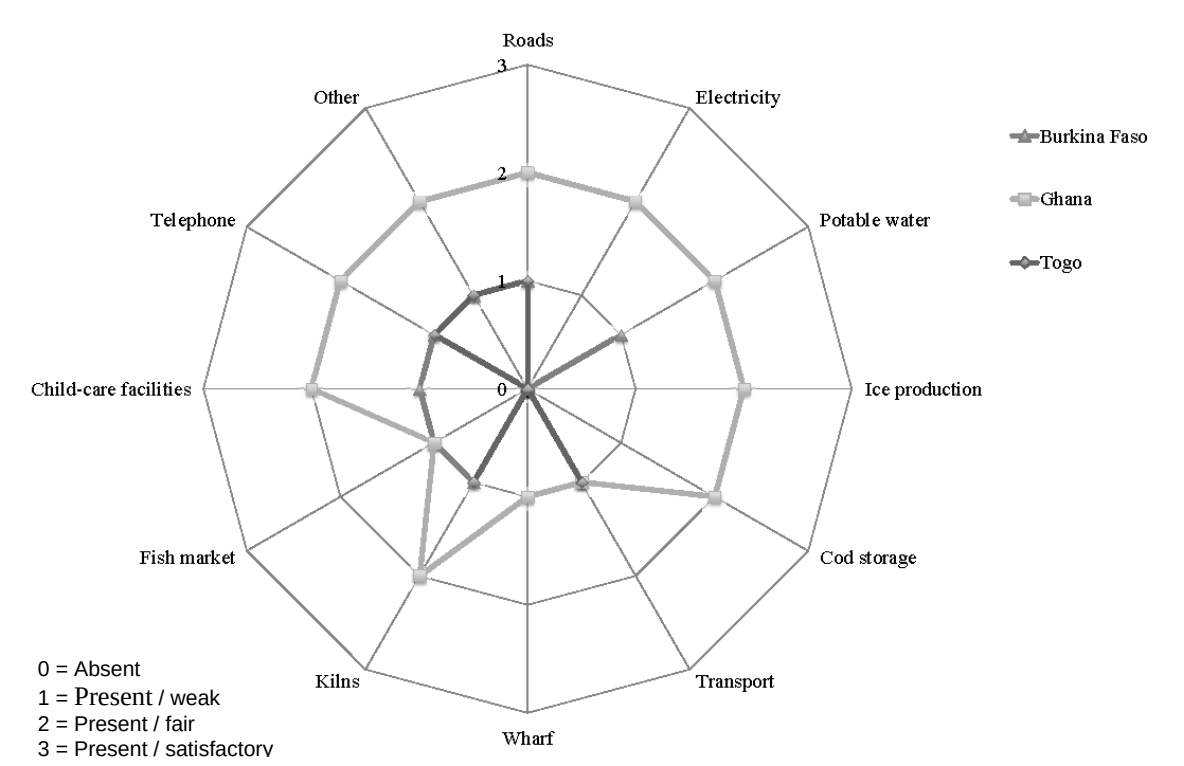
It is important to point out how the information has been reinforced at this stage of the assessment process regarding the performance of post-harvest systems and regional fish trade. This follows the training and familiarization exercises with the pilot studies and the network set up to allow all the participants of the six riparian countries to share their views. Figure 6 shows the volume and type of prominent information of all the stages.

**Figure 6. Information collected at different stages of the study in relation to the causes of the losses in the Volta Basin riparian countries**



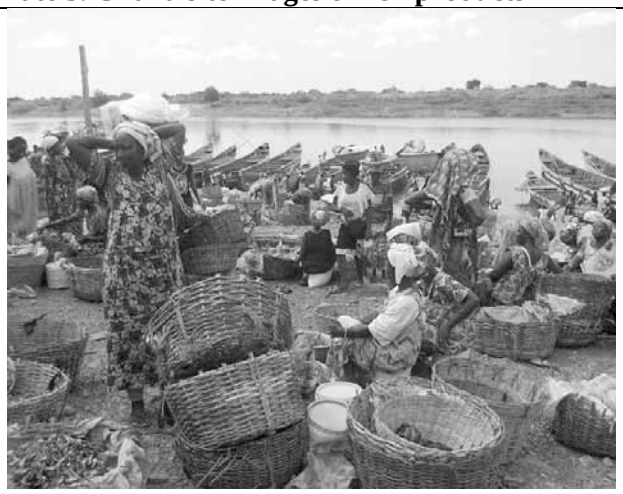
***Infrastructure and equipment***

**Figure 7. Main infrastructure and services available at sites**




This comparative schematic representation in Figure 7 shows that, except in Ghana, the infrastructure and equipment are in a state that is below the required minimum. In addition, the PHLA team in this country conducted most of its studies in peri-urban sites or major collection centres for products coming from nearby or distant fishing villages, whose infrastructure and services development is very different to that of primary production sites. The shortage of these means is probably more acute at production sites, which are also poorly accessible by road. This is also reflected when observing the different levels of losses between Ghana and the two other countries. Plate 3 illustrates one aspect of these sites in Ghana.

**Plate 3. Ghana site images of fish products**

| | |
|---|---|
|  |  |
| Products from fishing villages being landed at the Buipe site. | Open-air sale of processed fish. |

*Courtesy of:* National PHLA team, Ghana.

The findings of these studies show that all practices that would minimize PHLs, e.g. transport of fresh fish with a cold chain from the canoe to the fishmonger's stall, the implementation of good hygiene and processing practices, easy access to markets, nursery, kindergarten or even at times school services, are almost non-existent. Specific facilities such as children's day-care centres and nursery schools are also crucial for women. They make it easier for them to access good-quality raw material and allow them to perform pretreatment and processing activities in all tranquillity, without the dual task encompassing taking care of their children simultaneously with other household activities, resulting in losses. It is important to note that, at most study sites, smoking is carried out in the immediate vicinity of processors' dwellings. Moreover, children's day-care centres would allow for increased mobility, thus more possibilities to target alternative markets when the one at the site is saturated or the variability in demand from buyers requires this action.

The absence or weakness of the telephone network (especially mobile) also has significant implications that include: (i) losses related to accessing and using market information, including lost online sales opportunities; and (ii) the possibility to perform commercial transactions and secure fish sale income without having to carry cash, which exposes the various actors along the value chain to possible attacks by robbers or highway bandits.

The fish processing equipment (smoking, drying, fermentation, frying) in the three countries is made up of the most rudimentary tools. In Ghana, the country of origin of the Chorkor kilns, improved kilns do exist but are abandoned or not widely used. Plate 4 illustrates this fact with an example of a modern structure housing unused improved stoves on the Buipe site, whereas, less than one kilometre away, smoking on inefficient kilns is pervasive. This highlights how important it is to conduct a thorough analysis of beneficiaries' social conditions and priorities during the design so as to build infrastructure that encompasses these different dimensions, as well as the need to involve stakeholders during the whole technical support process.

**Plate 4. Unused and used kilns**

| | |
|---|---|
|  |  |
| Processing complex with unused Chorkor kilns. | Smoking on a less efficient and run-down kiln. |

*Courtesy of:* National PHLA team, Ghana.

### *Actors' social characteristics*

Tables 9–11 summarize the information gathered regarding actors' social characteristics by type of activity according to the country and organizational status/level at the various sites.

**Table 9. Burkina Faso – actors' social characteristics**

| Activities | Total people involved | Women (%) | Foreigners (%) | Organized in association | Illiterate (%) | Actors by age category (%) | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | 15–24 | 25–49 | > 50 |
| Fishing and landing | 320 | 0 | 0 except in Tounga (26.7) | All the fishermen are organized in associations except in Gouran, where only 10% of them are grouped together | 98 | 12 | 69.45 | 18.55 |
| Fresh fish sale | 36 | 100% for 3 sites 20% for Tounga | 0 | Yes | 80 | 10.8 | 64.5 | 24.7 |
| Processing (smoking, frying) + selling processed products | 181 | 100 | 0 | Yes | 98 | 9.6 | 74.4 | 16 |
| Smoking in Di | 125 | | 0 | Yes | 97 | 23 | 62 | 15 |
| Fishmongers from Ouagadougou coming to Di | About 10 | 100% | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. |

N.A.: not applicable.

**Table 10. Ghana – actors' social characteristics**

| Activities | Total people involved | Women (%) | Foreigners (%) | Organized in association | Actors by age category (%) | | |
|---|---|---|---|---|---|---|---|
| | | | | | 15–24 | 25–49 | > 50 |
| Fresh fish selling in Yeji and Dzemeni | 167 | 100 | N.A. | Buipe 1 fishmonger group with 150 members | 21 | 102 | 44 |
| Smoking on the 4 sites | 186 | 100 | N.A. | Yeji, 3 smoking processors groups totalling 150 people | 16 | 124 | 46 |
| Drying/salting in 3 sites | 103 | 100 | N.A. | | 7 | 81 | 15 |
| Fermentation in Tapa Abotoase | 28 | 100 | N.A. | Dzemeni, 1 fishmonger and processor group totalling 200 members | 3 | 20 | 5 |
| Fresh fish and drying/salting in Buipe | 120 | 100 | N.A. | | 8 | 92 | 20 |
| Smoking/ selling in Tapa Abotoase | 70 | 100 | N.A. | Tapa Abotoase, 4 smoking processors groups | 5 | 53 | 12 |

N.A.: not applicable.

**Table 11. Togo– actors' social characteristics**

| Activities | Total people involved | Women (%) | Foreigners (%) | Organized in association | Illiterate (%) | Actors by age category (%) | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | 15–24 | 25–49 | > 50 |
| Smoking | 55 | 100 | 82 | None | 84 | 11 | 69 | 20 |

*Note:* In Togo, the PHLA was only conducted with the smoked-fish processors.

The following observations were made at all the sites of the three countries:

- The very high rate of illiteracy among fishing and post-harvest actors. Illiteracy is generally considered as a potential risk factor for PHLs, given how important it is in terms of knowledge and skills. However, this study did not draw any significant difference between literate and illiterate groups; thus, illiteracy cannot be explicitly linked to contributing to PHLs.
- Setting up associations: In most cases, groups are already established and, thus, there is a certain level of organizational development. However, group dynamics are quite weak. Given the lack of group spirit, individualism prevails and internal conflicts are common. A well-known consequence of this state of things is that processors in the same group may be in stiff competition, by not agreeing on a minimum set price. Not taking into account operating costs when artificially setting different prices may lead to an increase, which reduces their product's competitiveness *vis-à-vis* fishery products from elsewhere. The technical assistance aimed at reducing PHLs relies heavily on efficient groups to be truly effective because they allow for economies of scale, sharing of experiences together, and strengthening the bargaining power and defending the interests of the various members regarding the supply of quality products and market access. In fact, surveys show that these groups were created on a non-sustainable basis because, when the process was implemented, emphasis was put on accessing microcredit or equipment goods rather than on a spirit of cooperation. This gave rise to spontaneous groups whose mandate is not well defined with subscribers that lose interest as soon as funding, goods or services are received and redistributed rather than associations that would emerge from members' needs in a larger sense.
- The 25–49 age range group predominates in all types of activity. The age factor has been identified in certain types of losses and in different contexts. For example, in Burkina Faso, losses were greater for fishers over 49 and were related to the type of fishing gear (gillnets) that they mostly use. This makes them more susceptible to losses than younger fishers who have the physical strength to use cast nets. Because they are more reluctant to accept change and innovation, women processors of the same age group (49+) were also unanimously found in all the riparian countries as being likely to experience more losses than their younger compeers. However, it was not possible to establish the correlation between losses and age; hence, it remains subjective.
- The division of tasks in countries and sites: almost all fishing (95 percent) is undertaken by men, and post-harvest activities (fish marketing and processing) are undertaken by women. Some men (wholesalers) are involved in selling fresh fish in Burkina Faso.
- With a few exceptions, nationals are the ones carrying out fishing and processing activities in Burkina Faso and Ghana. In Togo, smoked fish processors are mainly foreigners from neighbouring countries.

***General information on fishery and/or post-harvest operations***

The tables in Appendix 7 provide detailed information on the tools used by each type of actor in each of the three countries and the species affected by the different practices. They indicate the high potential of these sites, but confirm inadequate fishing, pretreatment, packing, packaging, storage and marketing practices. The flow chart in Figures 6–8 depict how certain smoking practices are carried out. It was developed with the actors' active involvement and summarizes the inputs compiled from several different countries, which also take into account gender perspectives and some of the vulnerability aspects.

**Figure 8. Flow diagram for fish smokers**

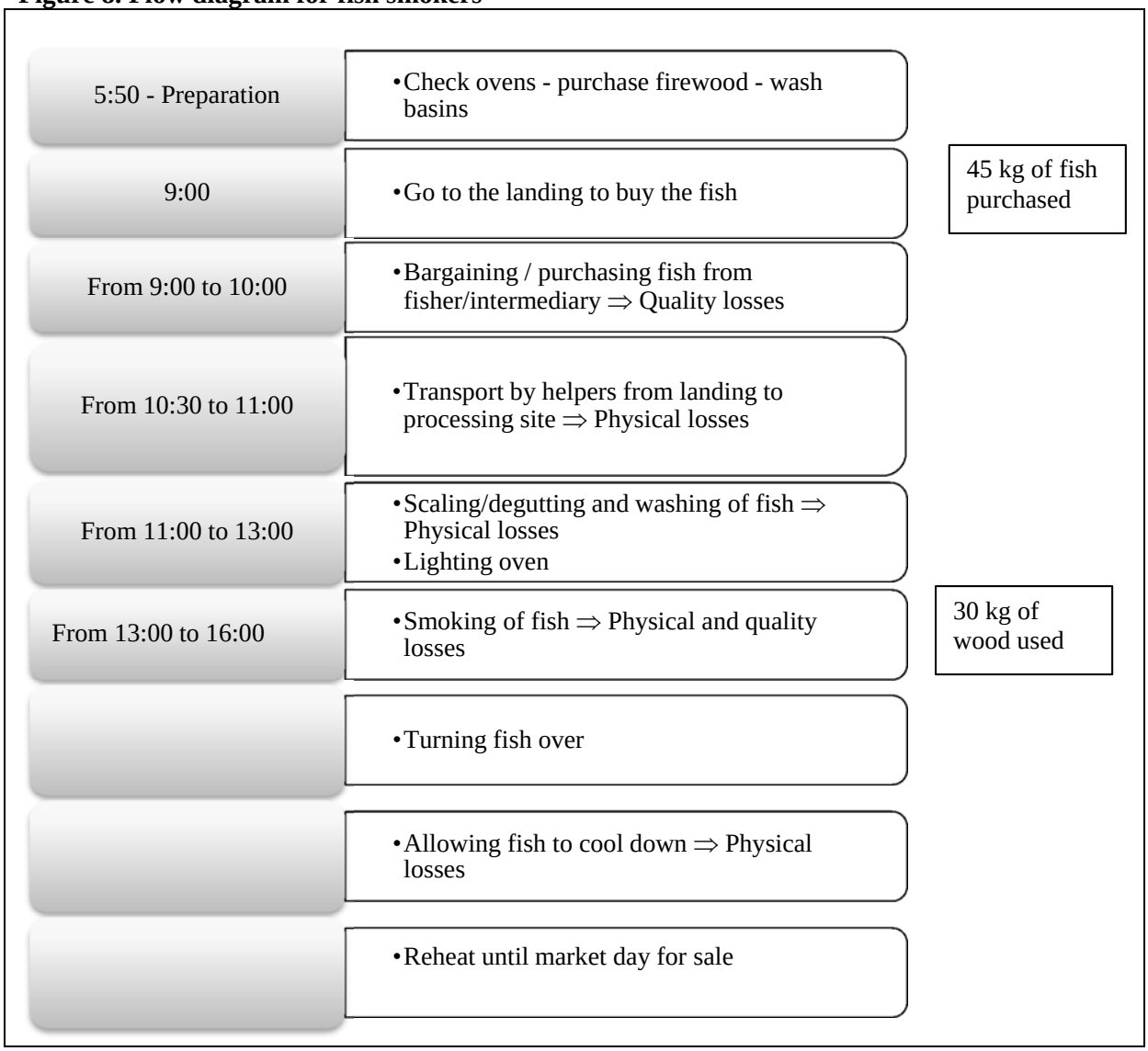


**Figure 9. Flow diagram for salted/dried-fish traders**

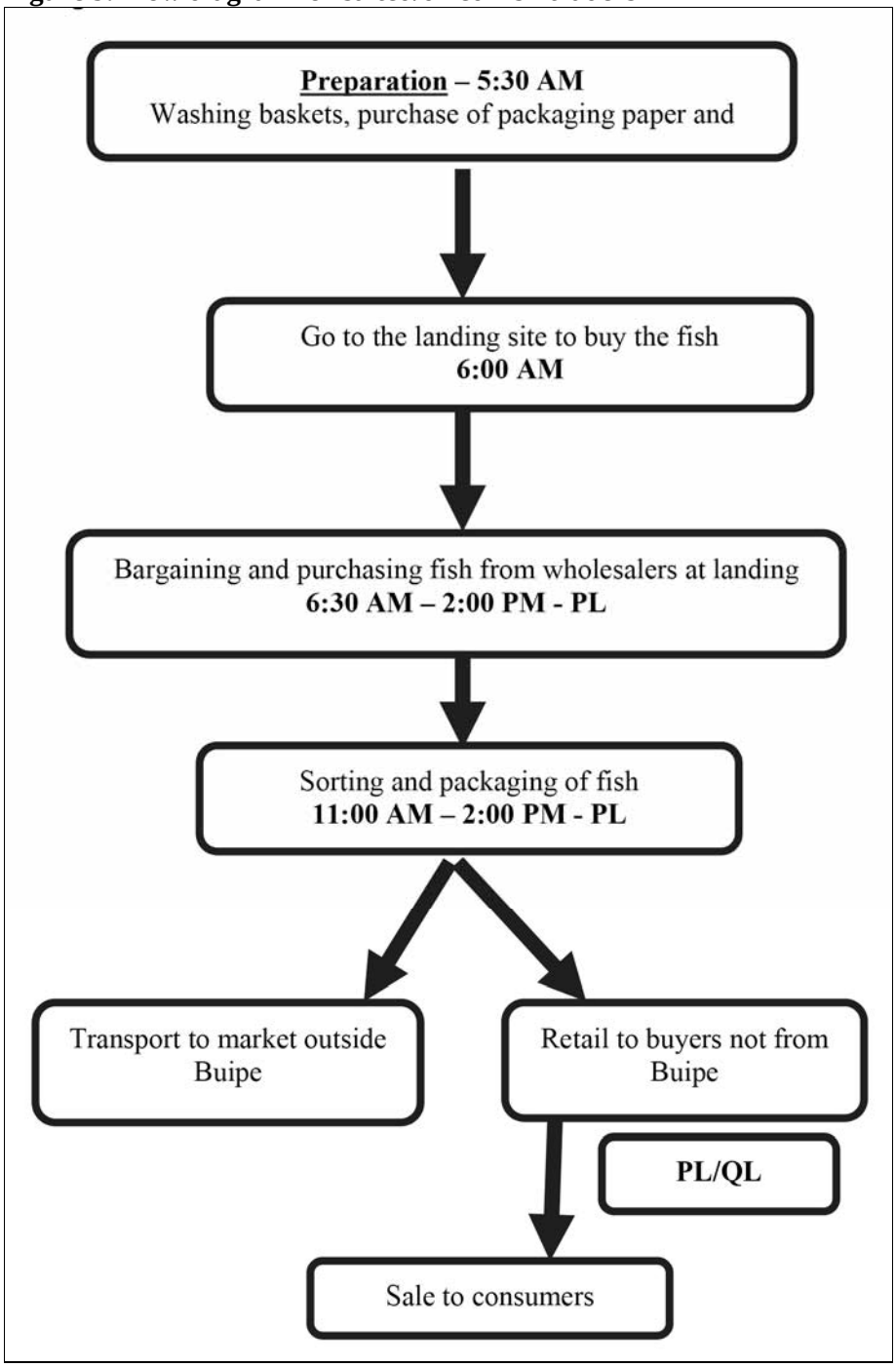
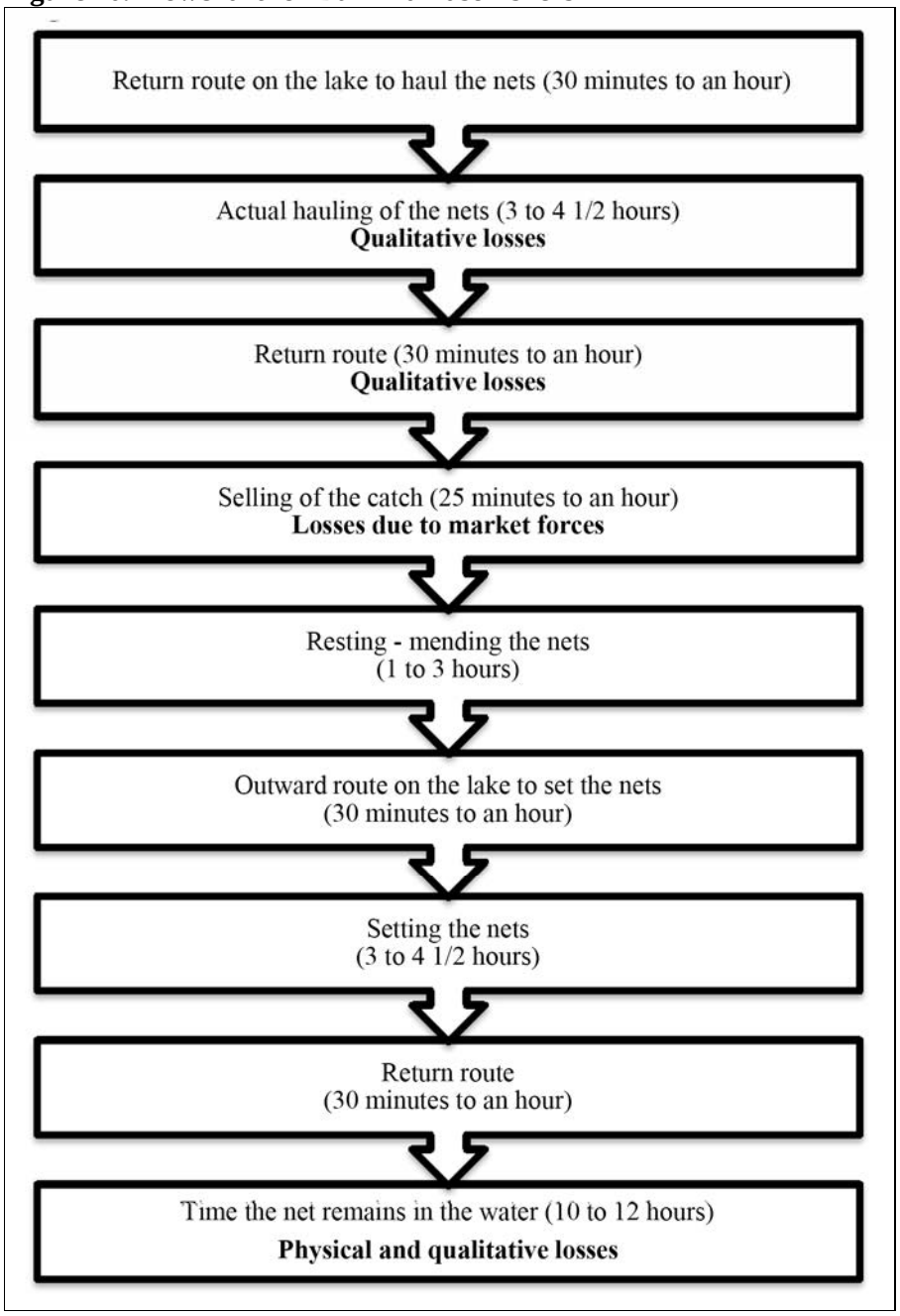


**Figure 10. Flowchart for Burkina Faso fishers**




The flow charts in Figures 8–10 and Box 3 show where losses occur along the chain, the causes of losses specific to women, and tasks per working day.

**BOX 3**

**Tasks of women who are both housewives and fish processors**

**Detailed tasks for a housewife and fish smoking processor**

- Wakes up at 4:30. Goes to morning religious gathering. Back at 5:40 and starts early preparation.
- Household tasks and breakfast can be done by older children and assistants.
- Between 11:00 am and 1:00 pm, assistants prepare and serve lunch.
- Preparing and serving dinner.
- Cleaning of utensils and performing other household chores
- As the market day is once a week, the fish is stored until that day.

**Detailed tasks for a housewife and fish drying processor**

- Wakes up at 4:00 for prayers until 5:15.
- The woman processor and the children deal with household chores and breakfast from 5:30 to 9:00.
- The dried-fish processor usually goes to the lake with basins by herself.
- If, by chance, the landing has not taken place in her absence, she waits for fishermen on the canoes to bring the fish. If necessary, the processor can do other activities while the assistant waits and informs her when the fish arrives. Most of the time, fish comes from a wholesaler and other times from different wholesalers.
- Fish can be kept for 24 hours before being transported to the market.

## Marketing of fishery products in each of the three countries

### *Choice of markets*

Depending on sites/countries or their position along the value chain, actors either stay at the local market and wait for customers (individual consumers, individual wholesalers, semi-wholesalers or wholesalers) that may come from other places, or go to meet them to target national and cross-border markets. It was not possible to identify formal outlets such as the private sector (hotels, restaurants, etc.) or collective food services in public institutions. A successful value chain could ensure the features that would satisfy the most important criteria for these markets, which are the products' food safety and freshness along with regular supply, and thus provide the different actors with a regular source of income. This implies that these actors should have the appropriate capacity to honour this kind of partnership. Factors determining the choice of an identified market at these sites are:

- The price: A remunerative price is essential and constitutes a legitimate criterion prioritized by the actors.
- The demand in terms of product type: Although no formal or systematic collection or management of commercial information has been set up, some actors learn about an outlet, often through word-of-mouth.
- Geographic location: Markets located near production sites and processing are the most popular. This is of great importance, especially for women, who are usually very limited in terms of travel, especially when they have very young children and substantial household chores. The fact that sociocultural constraints (e.g. partner opposed to the desire of the woman to travel to a distant market to sell her products) noted in certain communities in Africa could not be specifically identified in this study of the Volta Basin does not mean that they may not constitute one of the conditions in choosing these markets. This causal link is worth studying in more detail to substantiate the degree of importance of this issue in the Volta Basin.
- Familiarity with the market.

***Opportunities***

As presented in Table 12, fishers generally sell products on the production site and probably so do many fresh-fish retail fishmongers, while processed fish are sold outside of the processing site.

Most processors do not sell on the production site but either in nearby markets or to buyers coming from neighbouring or remote communities. Some are engaged in both forms of trade.

**Table 12. Fishery operators – business opportunities, shares and conditions**

| Country | Type of fishery operator | Business opportunities, shares and access conditions (including physical access by operators, pricing, and means of payment) | | |
|---|---|---|---|---|
| Burkina Faso | | Pricing is done according to weight (kg) on scales in Tounga.<br>At the other sites, pricing is done on the fish's average weightMeans of payment: cash and credit.<br>However, in some cases, the fish is handed over based on family ties: the fisherman gives some of his catch (because not popular, not of premium quality, or early spoilage) to his wife so that she may process it (smoking, drying or fermenting). | | |
| | | **Local market** | **Domestic market** | **Regional/international market** |
| | **All actors** | | | Difficult to quantify because the channel is informal.<br>The Gouran and Bama sites are affected by the trade with Mali.<br>The Tounga site, located on the Kompienga fishery, borders with Togo and Benin.<br>Exchanges of fresh tilapia fish by wholesalers close to the Togo (Dapaong) and Benin (Tanguiéta) borders. |
| | **Fishermen** | 100% sold at landings | – | |
| | **Fresh-fish fishmongers** | – | Work in Tounga with vehicles equipped to collect and transport fish. Sold in Ouagadougou. | |
| | **Smoked-fish processors** | 1–5% | 80–90%<br>Through sales to smoked-fish retailers from urban centres and other local collectors. | |
| | **Smoked-fish retailers** | 0% | 100%<br>Purchase from smoked fish-processors in Di by retailers from Ouagadougou, Dédougou Koudougou, Bobo Dioulasso. | |
| | **Fried-fish processors** | 1–5% | 80–90%<br>Packaged in parcels and conveyed by taxi to markets in Bobo Dioulasso, Koudougou Tugan. | |

| | | | | |
|---|---|---|---|---|
| **Ghana** | | In Buipe: wholesalers/retailers from Kumasi, Techiman, Dormaa, Berekum, Sunyani, Krachi, Yendi and Makango buy fresh fish, or Buipe resellers directly sell in Kumasi, Accra and other cities.<br>In Dzemeni: resellers from Buipe, Jaketi, Tsita, Kpevi, Atoklopo, Tongor and Gbogbonikope sell fresh fish. The customers are wholesalers/retailers that come from Accra, Koforidua and Suhum.<br>Pricing is done either according to weight (kg) on scales, or using basins with different volumes, basket or burlap bags, depending on the operator and the type of buyers. Means of payment: cash and credit. | | |
| | | **Local market** | **Domestic market** | **Regional/international market** |
| | **Fishmongers** | 20% | 80% | Minimal, difficult to quantify because informal. |
| | **Smoked-fish processors** | 30% | 70% | Minimal, difficult to quantify because informal. |
| | **Salting/drying operators** | 10% | 90% | Minimal. |
| | **Fermented-fish processors** | 15% | 85% | Minimal. |
| **Togo** | | Sales are done in kg and basins, depending on the type of fish and the season. Means of payment: cash and credit. | | |
| | | **Local market** | **Domestic market** | **Regional/international market** |
| | Fishermen (fresh fish supply) | Market share: 83% | Market share: 7% | Market share: 10% |
| | Processors (smoked fish) | Market share: 7% | Market share: 18% | Market share: 75% |

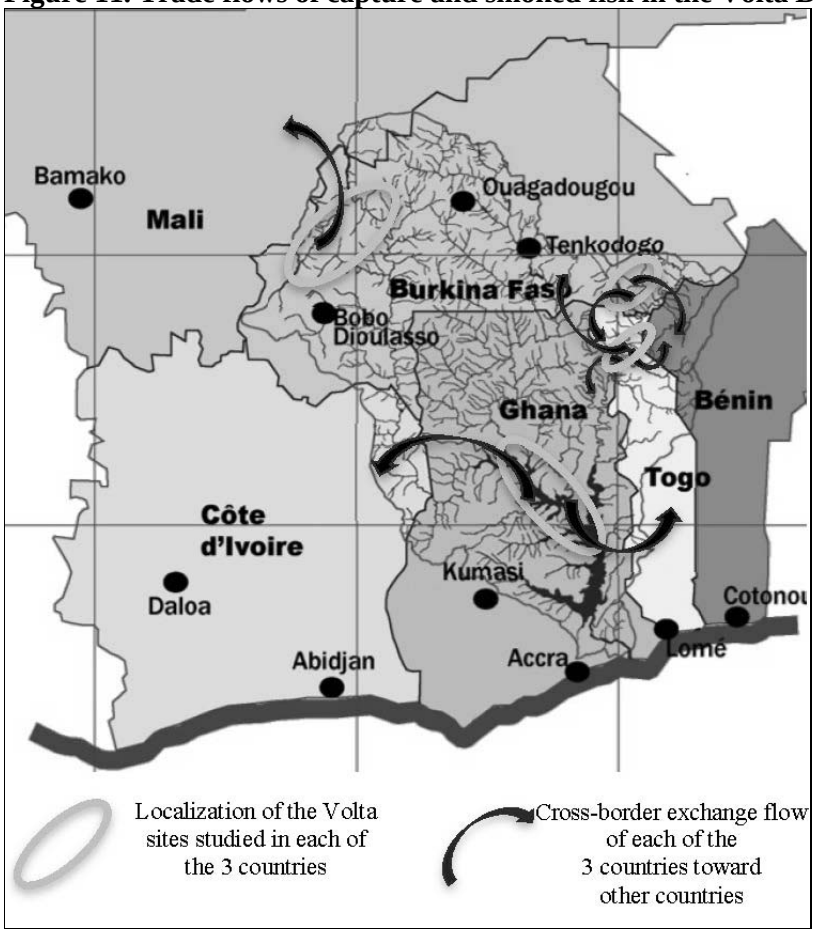
Although they had been included in the questionnaires, the different distances could not be estimated, thus making it difficult to ascertain the predominant direction of movement/travel, i.e. fishmongers/vendors from production areas towards marketing centres/customers or vice versa. However, the implication is that one type of actor has to travel. Whether this is from production sites to markets or customers from market localities to production sites, the possibility of losses owing to insecurity on roads, particularly because of armed robberies / road blockers was pointed out at the sites in Ghana.

The first part of the report indicates that cross-border trade occurs in all sites at different levels of importance, but it is not documented. Data on direct exchanges seem to be sporadic; some channels are more complex, with a product transported from one site to a domestic market and later being found on the other side of the border. Consequently, the share of the market for certain products or sites could actually be higher than reported. Figure 11 gives a map showing the trade flows of fresh and smoked fish in the Volta Basin identified by the programme. As an example, here are the details of the national and cross-border trade for Togo:

- National market: Smoked products are brought by wholesalers from Mango, Dapaong, Mandouri, Guérin-Kouka, Takpemba; they then sell them in their home town.
- Subregional market: Burkina fishmongers take fresh products to Togo with refrigerated trucks.
- Smoked fish products are taken to Simou (Benin) by smoked-fish processors from Donga and Pansieri and resellers from Simou. They are sold in Tchereponi in Ghana by smoked-fish processors from Nadougbal and resellers from Tchereponi.
- In Donga, smoked-fish processors sell on site, in Mandouri and in Benin in Simou.
- In Pansiéri, women from Dapaong and Benin come to buy on-site and sell most of it in Benin in Simou.
- In Koumongou Kan, sales take place on-site; women wholesalers come from Mango to purchase the fish while smoked fish processors rarely travel to sell on the Mango and Gando markets.

- In Nadougbal, sales to wholesalers are done on-site, in Guérin-Kouka, in Takpemba and in Ghana in Tchereponi.

**Figure 11. Trade flows of capture and smoked fish in the Volta Basin**




The smoked-fish value chain also includes cross-border markets and exports to other parts of the world, including the European Union (Member Organization). As recorded in Diei-Ouadi and Mantey, 2005, this popular market has drastically shrunk in recent decades. Small-scale units have not been able to meet the sanitary requirements set by the European Union (Member Organization) and other international markets and, therefore, have been forced to focus on the less-demanding domestic or regional markets. For example, the niche market called the "abrokyi market" in Ghana at the beginning of the 1990s counted more than a dozen units that were all later suspended. The situation was similar in the other traditionally exporting Volta Basin riparian countries. However, some were then upgraded, but to date, fewer than five units have been approved in Ghana, one in Togo and another two or three in Côte d'Ivoire for these markets. These units have adopted technical and sanitary engineering and integrated the FTT-Thiaroye kilns in their processing methods, especially for smoking.

# 6. SPECIFIC INFORMATION ON POST-HARVEST LOSSES

**Summary of main findings**

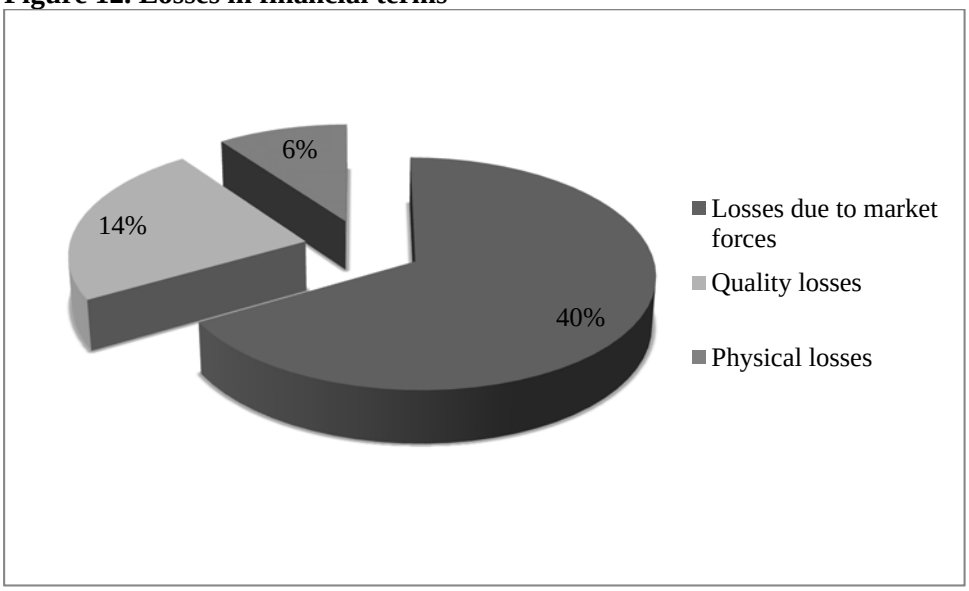
Of the fisheries studied, farmed tilapia was found to incur the lowest losses because of its comparative advantages over wild harvests in terms of easy planning (compared with the unpredictable nature of capture fisheries/fish) and the fact that it may be relatively easier to manage farmed fish supply to meet customer demand (size, volume, etc.). Three types of losses have been identified in the supply chain of fresh wild tilapia that are of importance according to the NFFP study conducted in 2013. It showed that quality losses and those due to market forces are significant while physical losses (fish removed from the supply chain) are generally very low.

***Burkina Faso***

Causes of losses in Burkina Faso are essentially: the inadequate cold chain, poor handling practices, the long-term fish collection time, inefficient smoking techniques, and ill-timed and mismanaged imports of tilapia during the local peak fishing season. The major losses incurred by dealers of fresh fish are due to inadequate preservation prior to marketing, given the lack of sufficient icing or proper storage conditions (fish is improperly stowed in makeshift, poorly insulated containers).

On average, the various losses are 60 percent of the total tonnage sold by wholesalers. Out of these 60 percent, losses due to market forces represent 40 percent, quality losses 14 percent and physical losses 6 percent, as shown in Figure 12.

**Figure 12. Losses in financial terms**




This results in fishmongers losing between XOF1 760 000 and XOF1 725 000 per year, or 23 percent of expected annual sales. The monetary impact of physical losses and those due to market forces represent 6 and 5 percent, respectively, of the turnover of wholesalers. Quality losses drain wholesalers' financial gains by 12 percent. Losses due to market forces are more important in terms of tonnage but the financial impact is less compared with quality losses.

For fishers, qualitative losses occur predominantly during the setting of gillnet gear, which is used on every site and during transport of fish ashore. The main causes of quality losses for fishers are poor water quality, capturing small-sized tilapia (constituting the average weight of catches), and unavailability of storage devices on board. Adverse weather conditions, especially in March, April and May, also amplify the level of losses during this period.

Water pollution, leading to poor water quality, and the use of prohibited fishing gear and methods of fishing are telling examples of how regulations and proper fisheries governance are not enforced. Poor water quality in October and November is the cause of 35 percent of the annual quality losses incurred by fishers in Tounga.

In Gouran, 94 percent of respondents believe that the use of non-regulatory nets with small mesh is responsible for the abundance of small tilapia in fishers' catches. This practice is responsible for 73 percent of quality losses at the Gouran and Di sites, where these types of nets are mostly used, and fishers in Tounga, Gouran and Di are most affected by these losses. The PHLA found that, in Tounga, these losses represent 24.4 percent of annual production about USD61 million/year and correspond to 86 percent of the total value of losses incurred by fishermen, whose livelihoods are heavily affected as women have little involvement in post-harvest activities. Annual quality losses of landings at the Gouran, Di and Bama sites are 24.2, 22.1 and 13.2 percent, respectively.

In Bama, the use of cast nets instead of gillnets partially explains the relatively low occurrence of quality losses. Most of the fishers affected by quality losses are more than 50 years old, as they do not have enough physical strength to deploy cast nets that generate fewer losses than gillnets.

Losses due to market forces are significant in Gouran and Di where small tilapia production is between 73 and 80 percent. Losses due to market forces in Gouran and Di represent 24.9 percent (USD9.5 million) and 25.4 percent (USD11.5 million) of annual production, respectively.

In Gouran and Di, retailers recorded qualitative losses and losses due to market forces from the fish bought locally from wholesalers. In terms of consignments, quality losses average 8 percent and losses due to market forces can reach 72 percent. Quality losses are more recurrent throughout the year. For an annual supply of 3 600 kg per dealer, physical losses are estimated at 288 kg, and 2 592 kg are sold under the impact of market forces. The annual monetary value of losses varies between XOF864 000 and XOF882 000 for each retailer, which represents 14 percent of turnover. Losses due to market forces have a monetary impact of 10 percent on turnover and 4 percent may be attributed to quality losses.

Losses due to market forces may be attributed to low competitiveness of locally produced tilapia over imported ones. In Kompienga, this is exacerbated by fishers increasing their prices because of incidental and operating expenses, and competition between different groups of fishmongers. The amount associated with losses incurred by fishmongers due to market forces is estimated at 25 percent of annual traded fish.

Qualitative losses are the most important for smoked fish processors and wholesalers. For smokers in Di, these are due to the low quality (freshness conditions, size) of raw materials and inefficient smoking techniques. As a result, qualitative losses are estimated at 12 220 kg of smoked fish, or 17 percent of annual production and valued at XOF10.3 million, or 11.4 percent of the annual smoked fish turnover.

***Ghana***

The PHLA found that this, coupled with usually poor handling and processing operations, resulted in losses at the four study sites (Buipe, Yeji, Dzemeni and Tapa Abotoase) that can be traced back to fishing locations where the products originated and where losses are considered to be higher.

Significant losses due to market forces occur at different stages by value chain actors, fish smokers, salt dryers and traders, respectively, amounting to up to 20 percent. The threat of armed robbers along major roads and highways has slowed down the pace of trading activities in all the markets visited, which has led to "artificial glut" with subsequent high records of losses due to market forces. The markets observed are also in dire need of renovation given their rundown state. Quality losses and physical losses make up 5 and 4 percent of total fish supply, respectively. According to the report, markets follow a schedule with a frequency of one to a maximum of two times per week, hence

lacking flexibility because they are not set up according to fishing seasons or the expected volume of products. This contributes to quality losses and, at times, physical losses and is not conducive for regular fresh fish sales from fishing centres. Inadequate storage capacity and conditions have also been identified as factors influencing the level of losses. Women are incurring losses because they are distracted while processing fish as they have to combine this with running of household/child-care tasks; they have less access to the best-quality raw material, because of delays at home while the first auction or sale is taking place. The study focused on four categories of fish operators – traders, smokers, salt dryers and fermenters – at the four study sites.

Different types of losses that occur for each category of operator at the study sites are summarized below. Generally, losses due to market forces were the highest of total losses (74 percent) followed by physical ones (14 percent) while quality losses were minimal (12 percent), as shown in Figure 13. The contribution of losses in percentage terms is presented in Figure 15 and 16 for each category of operator at the study sites. Traders recorded the highest losses due to market forces (53 percent) followed by smokers (15 percent). Traders had the highest physical losses (10 percent) as opposed to smokers with 3 percent. This comparative analysis shows that smokers had higher physical losses (3 percent) and quality losses (3 percent) than salt dryers, who had one percent physical losses but no quality loss due to the nature of the product.

**Figure 13. Total percentages of losses for all study sites**

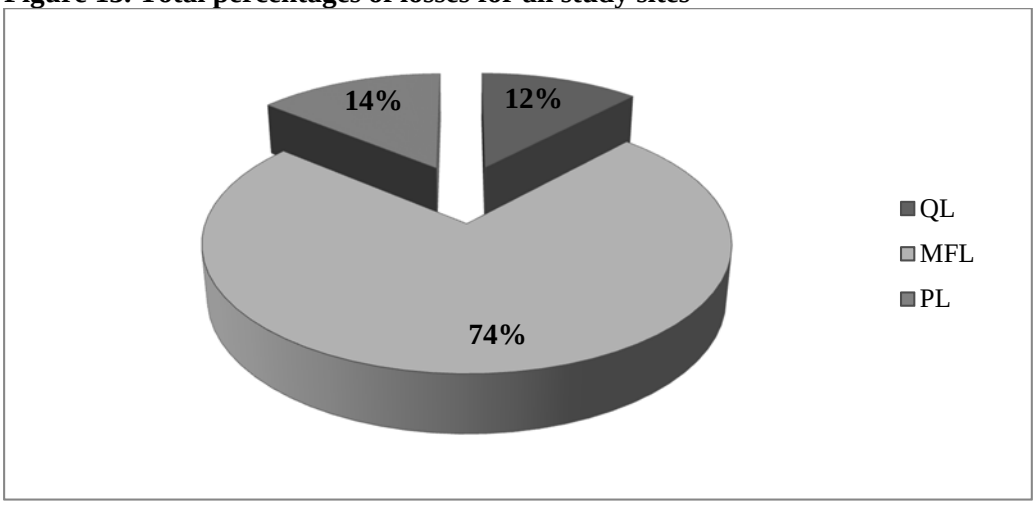



**Figure 14. Comparative percentage of losses for each study site**

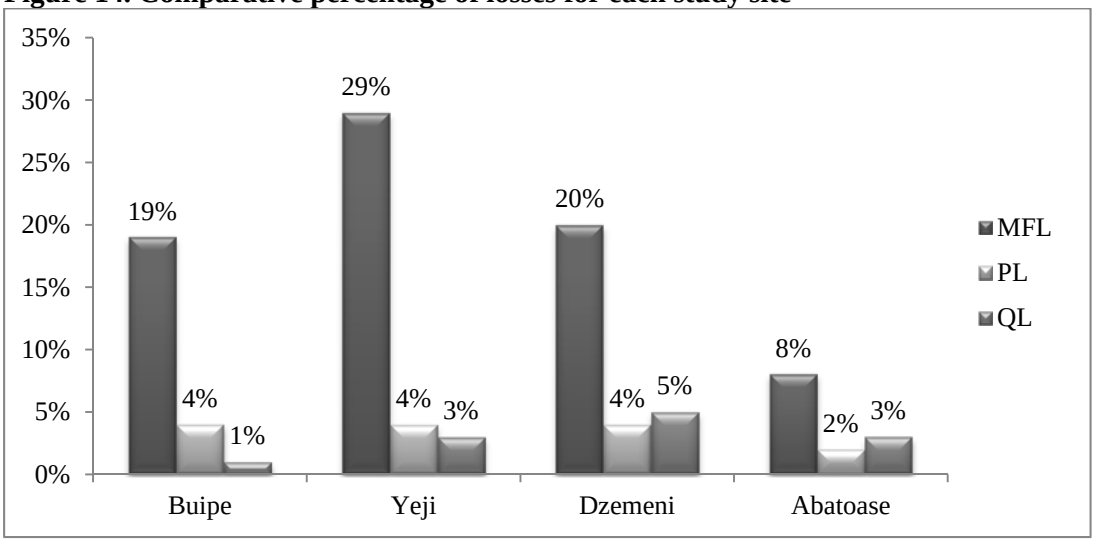


**Figure 15. Total percentages of losses for each category of operators**

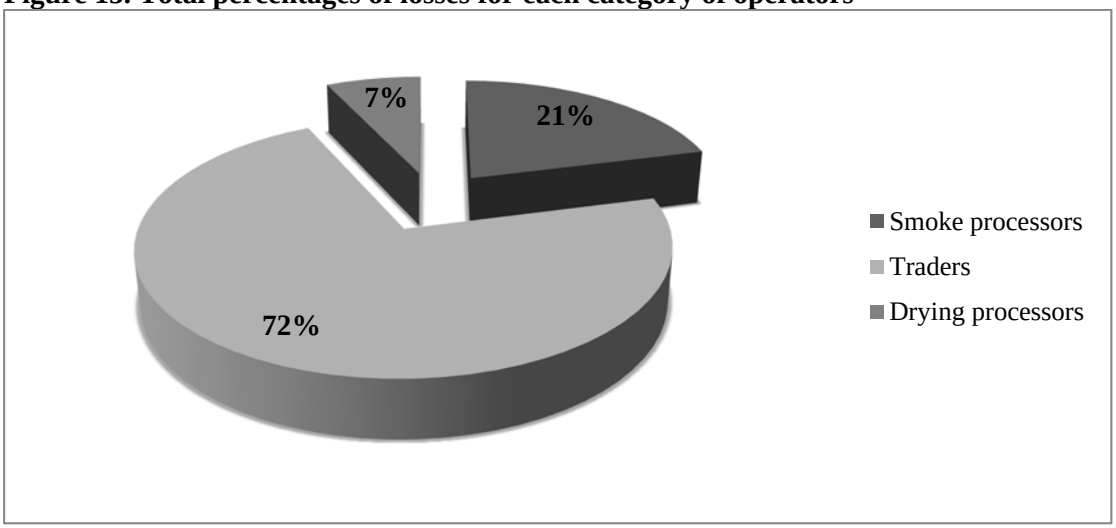
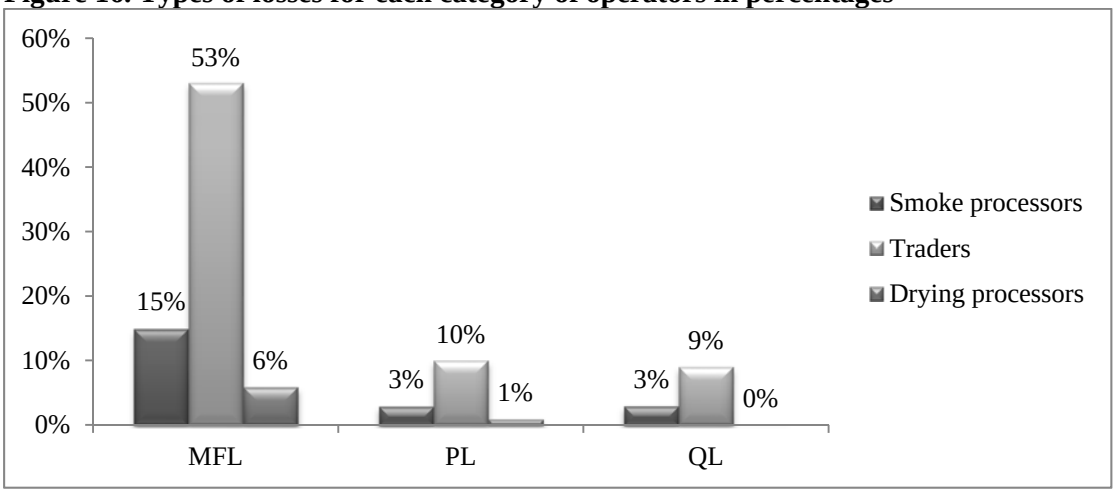



**Figure 16. Types of losses for each category of operators in percentages**




In Dzemeni, the quality losses (4 percent) were higher than the physical losses (3 percent). Smokers incurred the highest quality losses; In Tapoa-Abotoase, quality losses (3 percent) were also higher than physical losses (2 percent); fermenters only faced losses due to market forces (7.4 percent).

In general, the level and probably also the nature of the losses reported on the Ghana side of the basin are lower than those of other countries. The main reason cited was that in this particular case the study looked in most instances at the markets where products are sold rather than the original fishing sites where handling and processing occur, and where losses would be higher (e.g. the losses would be higher at the camps and the villages where operations that supply markets are held, as usually a sorting stage takes place before the products are brought to the market).

***Côte d'Ivoire***

The result of the pilot study carried out by NFFP in 2013 in the Abobodoume processing centre, located in a suburb of Abidjan, showed that critical losses occurred at the handling stage of fresh fish and the storage of processed fish. The losses are due to microbial growth and survival because of the inability to maintain the cold chain. For dried products, the losses are also due to rancidity and attack by insects. Quality losses make up to one-third of the average annual amount of fish purchased primarily during the good season and were identified as the major loss. Losses linked to market forces are significant because of missed market opportunities (supply and demand, lack of market

information and lack of infrastructure). Products rejected by fishmongers are sold directly by fishermen to women processors who ferment and smoke them. This processing compensates for the physical loss. The average annual financial loss as a result of quality losses is about XOF47 997 000 per fishmonger. The causes identified by the study are inadequate infrastructure (non-equipped landing sites), lack of equipment (cold rooms and ice plants) and lack of potable water.

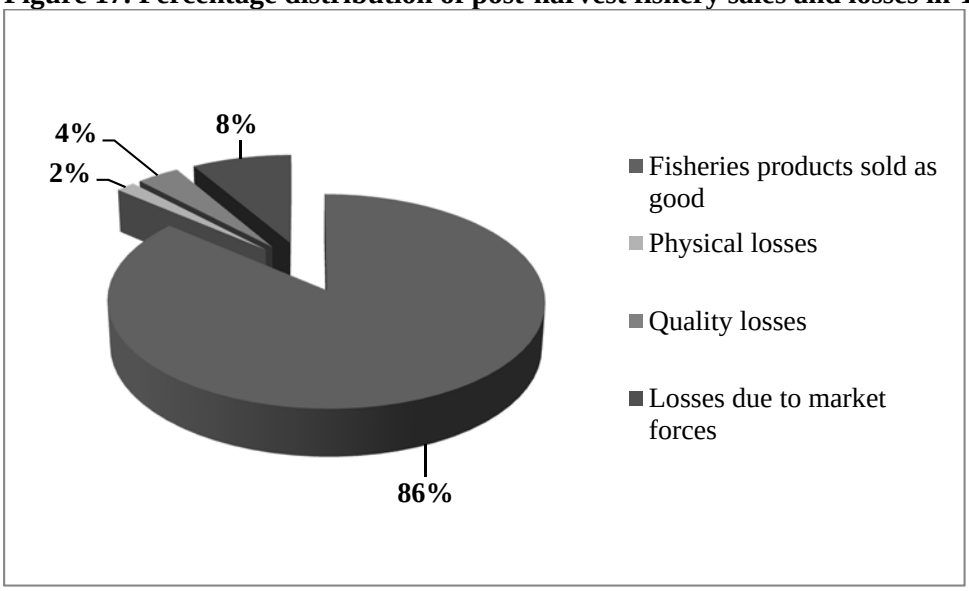
***Mali***

Quality losses, market forces losses and physical losses were recorded for fresh fish and smoked fish during the NFFP study in 2013. The average quality and physical losses are 10.87 and 1.28 percent respectively. Fresh fish losses on the Konna site constitute 6.4 percent of overall catches. Identified causes of losses are generally: vehicles breaking down, lack of ice, poor handling and weak management capacity during peak periods, poor preservation and storage conditions. They also include products prices being reduced for fear of poor sales owing to the lack of infrastructure and equipment, weak knowledge of good hygiene practices (GHP) and good manufacturing practices (GMP), inadequate processing capability, robbery attacks and use of inappropriate fishing gear or set nets.

***Togo***

The NFFP 2013 study sites comprised a total of 61 013 kg in production; out of these, 86.25 percent (52 625 kg) were sold in good quality, while losses due to market forces accounted for 8.46 percent (5 162 kg), quality losses for 3.65 percent (2 226 kg) and physical losses for 1.64 percent (1 000 kg), as summarized in Figure 17.

**Figure 17. Percentage distribution of post-harvest fishery sales and losses in Togo**

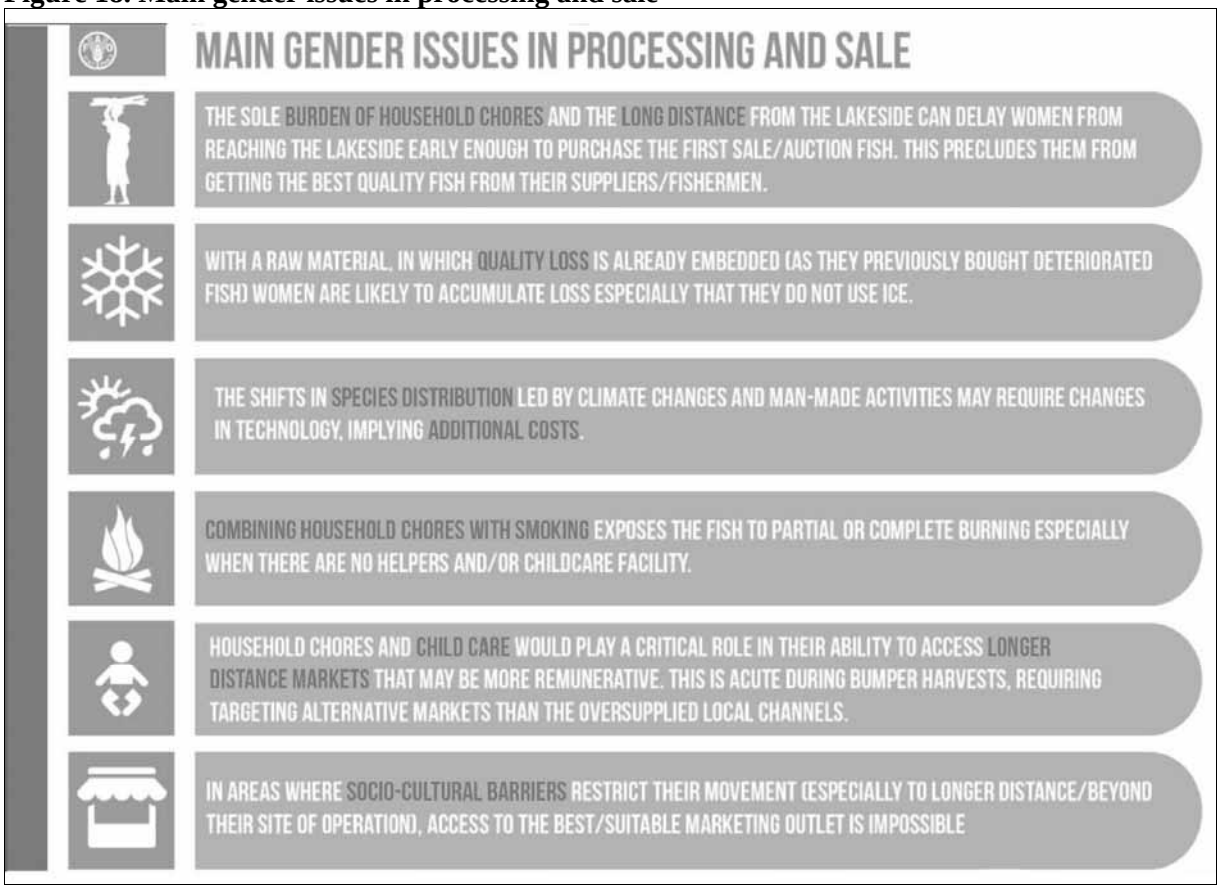



At the fishing stage, the main causes of losses include inadequate or dormant fishing gillnets, longlines and beach seine that bring in about 7 percent of total fish production. Losses during the peak harvest season were also due to poor storage facilities and the poor availability of ice to adequately preserve fresh catches. Losses due to improper processing for smoking and frying equipment also contributed to about 7 percent losses of total catches during peak harvest season. Poor packaging and poor infrastructure facilities such as poor road conditions, poor communication technology and inadequate market information, singly or collectively, contribute to quality losses, physical losses and losses due to market forces in Togo.

***Specific gender issues in fish handling, processing and trade***

The countries studies showed that post-harvest operations conducted by women and members of vulnerable groups are hampered by a number of factors, and lead to a significant difference between men and women as well as marginalized and well-off value chain actors. Figure 18 illustrates these dimensions in terms of quality, quantity and/or being due to market forces.

**Figure 18. Main gender issues in processing and sale**




*Courtesy of:* S. McDonough, FAO Regional Office for Africa.

As men are involved in fishing, the predominant issues linked to downstream operations regard mainly women more and include:

- Having low purchasing and bargaining power makes them vulnerable to their suppliers.
- When they cannot accompany porters carrying their fish, they are the ones who sometimes lose some of the product owing to theft.
- They bear the entire burden regarding fuelwood acquisition for smoking, especially access to the best-quality wood from their suppliers. The inefficiency of their smoking systems further weakens their position as these require a larger quantity of fuelwood, thus having implications for operating costs and the level of drudgery, especially when they personally have to go to collect wood.
- Combining household chores with smoking exposes the fish to partial or complete burning, especially when women cannot rely on assistants. Having to concurrently manage time between household chores, pretreatment and processing of fish means that housewives face a situation incommensurate with that of a male processor or a woman living alone, independently of their level of knowledge or control of smoking techniques. This is also one of the reasons for predominantly placing processing “units” in the immediate vicinity of processors’ dwellings, thus involuntarily subjecting the entire household to health and sometimes death risks.

- They are the only ones to incur losses owing to predation by animals when draining fish or cooling it on the ground, given their lack of means to invest in raised racks and storage facilities.
- They are the only ones to bear the brunt of the loss transfer phenomenon, intensified by their state of vulnerability and the fact that fishermen adopt irresponsible adaptation strategies.
- They are more affected by the phenomenon of armed robbery, prevalent on main roads and highways (Ghana case).
- Household chores and child care play a critical role in their ability to access longer-distance markets that may be more profitable. This is amplified during bumper harvests, which require targeting different markets from the oversupplied local ones.

***Assessment of cross-border trade***

Trade within the riparian countries has been informal with little documentation or no data recording the types of products, the volume of trade or the issues linked to hassles by authorities. Pittaluga *et al*. (2003) estimated that 30 percent of fish caught is sold by local fish traders (female intermediaries): 15 percent by the young and small-scale fish traders at the beach, and another 15 percent is sold by the wives of fishers directly to fish traders distant from markets. Wholesale fish traders purchase about 40 percent.

A large proportion of the fish is sold wholesale. Wholesale traders travel to fishing villages to purchase processed fish and return to the lakeside market within the next 2–3 days with the fish to prepare its transport to urban centres. At times, multiple intermediaries may be involved in handling the fish before it reaches markets.

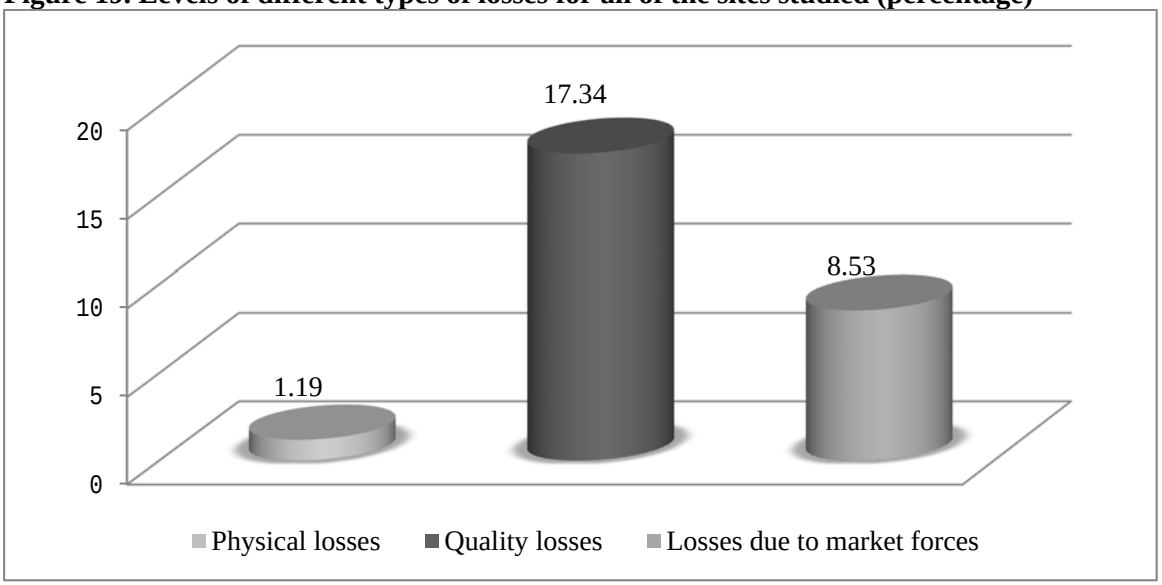
The volume of fish bought by the distant fish traders (not the local female intermediaries who can grant credit and other services) is a function of two dominant variables: financial and social assets. Successful experienced traders can benefit from the trust they have acquired during their long relationships with the fishers. This facilitates their purchases on credit, which is then paid on subsequent visits. In addition, some wholesale fish traders own a number of small trawl and gillnet fishing vessels and hire these to fishers to work for them, and take over the control of fish caught by these fishers.

**Characteristics emerging from the full PHLAs**

***Magnitude of losses***

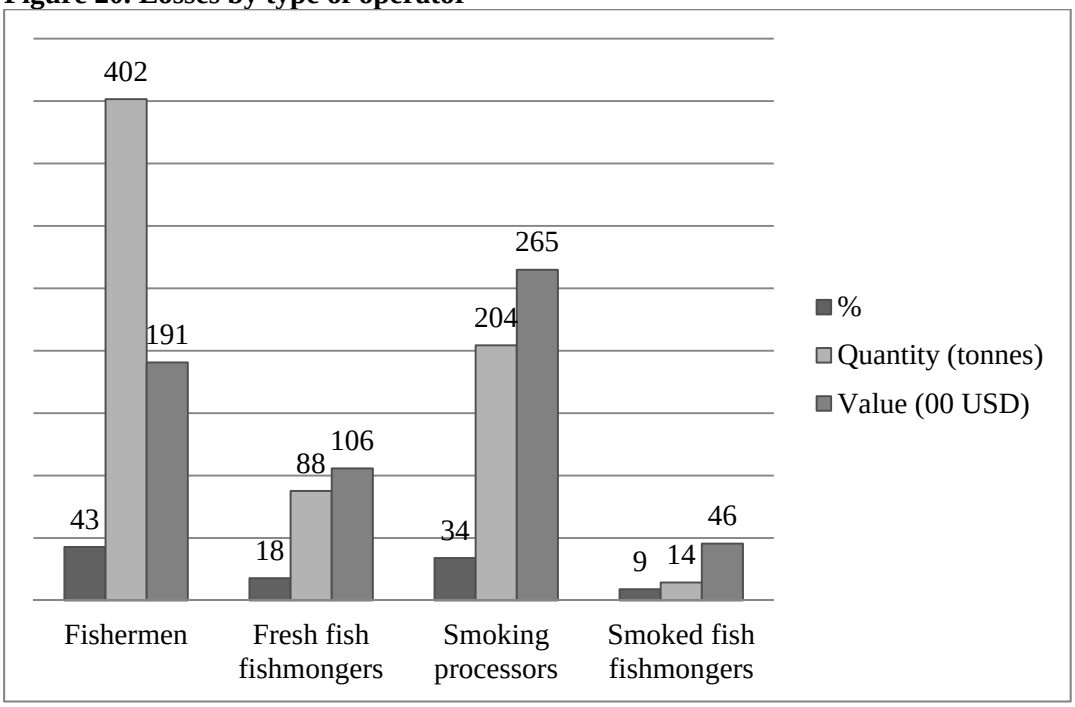
Data from summary loss matrices (Appendix 6) helps to understand the differences between sites, the types of products and various variability factors. As shown in Figure 19, total cumulative losses over a year of production average 27 percent, with levels ranging from 13.5 percent to 45.5 percent depending on the country. This corresponds to 1 145 tonnes for the study sites.

**Figure 19. Levels of different types of losses for all of the sites studied (percentage)**




These average figures mask significant discrepancies that exist between stakeholder groups and between sites. Smoked-fish processors and fishermen incur the largest losses, of 34 and 43 percent, respectively, while fishmongers, whether they sell fresh or processed products (smoked, dried, fermented, etc.) are less affected. Figure 20 presents the comparison between smoked and fresh fish operators.

**Figure 20. Losses by type of operator**




Losses are generally lower in Ghana because of the status of the selected sites (mostly collection/marketing centres) and also a slightly better level of infrastructure development than in the other two countries. Sorting of products is carried out before transportation from villages to the collection centres, leading to better-quality batches that are relatively less prone to physical and quality losses compared with those in production villages. The data analysis shows that losses in Ghana are apparently caused more by market forces than any other type.

With 45.7 percent of total losses (due solely to fish smoking), Togo ranks first in terms of percentage of landings of study sites. In Burkina Faso, the significant losses incurred by fishermen and fresh-fish fishmongers should also be highlighted; they vary between 41 and 43 percent of cumulative losses (physical, quality and market forces).

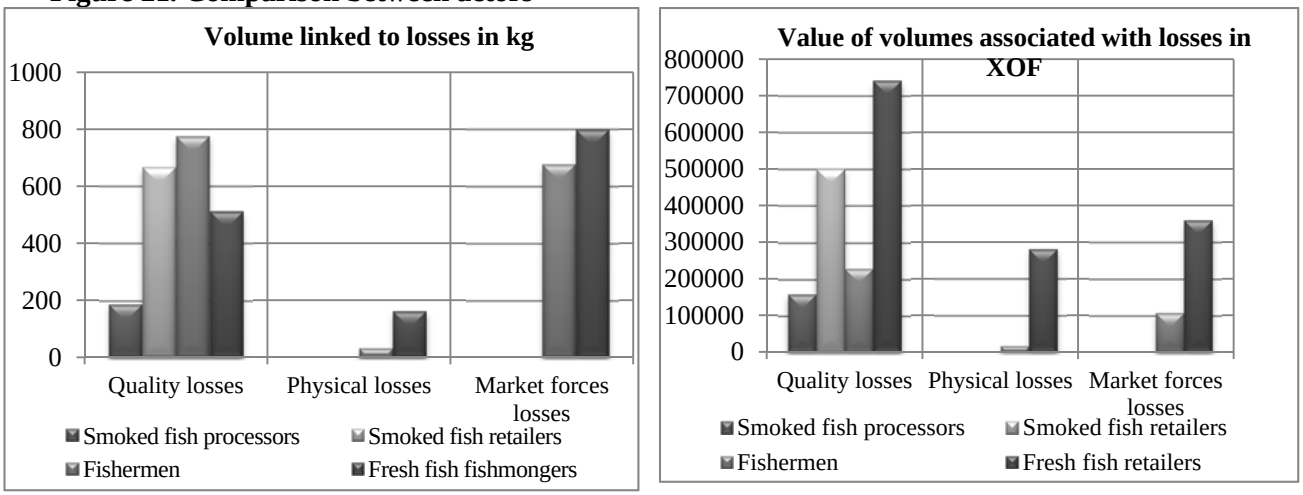
This assessment confirms that quality losses, representing 64 percent of share, outweigh the other two types of losses, as already reported in other studies (FAO Technical Paper No. 550[1]; Save Food Kenya case study[2]). Table 13 also shows that they are directly followed by losses due to market forces.

**Table 13. Extent of losses by type of operator for the sites studied**

| | Physical losses | | | Quality losses | | | Losses due to market forces | | | Total losses | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | % | Tonnes (wet weight) | Value (USD) | % | Tonnes (wet weight) | Value (USD) | % | Tonnes (wet weight) | Value (USD) | % | Tonnes (wet weight) | Value (USD) |
| Fishermen (Burkina Faso) | 0.7 | 6.5 | 6 172 | 23 | 2.5 | 126 341 | 19.2 | 180 | 64 305 | 42.9 | 401.5 | 190 646 |
| Fresh-fish fishmongers (Burkina Faso & Ghana) | 1.26 | 6.24 | 38 680 | 2.91 | 14.35 | 31 961 | 13.7 | 67.08 | 35 160 | 17.87 | 87.67 | 105 801 |
| Smoking processors (Togo, Burkina Faso & Ghana) | 1.65 | 9.93 | 39 712 | 21.6 | 129.86 | 180 581 | 10.74 | 64.58 | 44 587 | 33.99 | 204.37 | 264 880 |
| Smoked-fish fishmongers (Burkina Faso & Ghana) | 0.4 | 0.65 | 9 805 | 5.37 | 8.65 | 17 835 | 3.19 | 5.14 | 17 887 | 8.96 | 14.44 | 45 527 |
| All operators | 1.19 | 44.48 | 94 369 | 17.34 | 643.88 | 356 718 | 8.53 | 456.24 | 161 939 | 27 | 1 145 | 606 854 |

Losses due to market forces, which may not count at first glance as a food loss but could eventually lead to it, and as shown above, have a direct impact on the actors' income, far outweighing physical losses. In some cases, as for fresh-fish fishmongers and in terms of landing volumes for fishermen, losses due to market forces are more important than damage to product quality. The comparative graphs in Figure 21 illustrate the PHLA findings for Burkina Faso.

**Figure 21. Comparison between actors**




[1] Op. cit., note 1.

[2] FAO. 2014. *Food loss assessments: causes and solutions, case studies in small-scale agriculture and fisheries subsectors, Kenya.* Global Initiative on Food Loss and Waste Reduction – Save Food. Rome. 86 pp. (also available at www.fao.org/fileadmin/user_upload/save-food/PDF/Kenya_Food_Loss_Studies.pdf).

Physical losses range from negligible (for fried- or smoked-fish processors, resellers in Burkina Faso and fermenting processors in Ghana) to a maximum of 5 percent for other groups of operators, namely those involved in primary production (0.7 percent), smoking in the three countries (1.72 percent), salting and drying in Ghana (1.75 percent), and fresh and processed fish marketing (3.12 and 1.1 percent, respectively).

***Causes of losses***

As compiled in Table 14, losses are caused by multiple factors commonly highlighted in interventions and stem from technical, technological and/or infrastructure deficiencies, weaknesses in knowledge and skills and other less well-known causes. The information analysis shows that the causes are generally known, but their level of importance or the critical step (steps) to which they are associated depends on the context and the specific supply chain or type of activity. Table 14 present data for the three countries on three different types of operators.

**Table 14. Causes of losses at critical stages of post-harvest fish operations**

| Operator | The five most-important critical loss stages | Main causes of losses |
|---|---|---|
| Fisherman | Fishing | **Water contaminated by:**<br>Fertilizers/pesticides from agricultural activities on the banks<br>The proliferation of aquatic grasses forming floating islands, decaying at times and causing death in fish<br>**Fishing technique:**<br>Time the net remains in the water causing spoilage to occur and destruction and also attack on the net by carnivorous fish<br>Fishing with prohibited gear including chemicals/dynamite, small-mesh nets capturing immature fish more susceptible to spoilage |
| | On board | **On board handling**:<br>Inadequate practices and fish stowage<br>Preservation with little or no use of ice / inefficient cold chain |
| | Landing and auction selling | Inadequate infrastructure and landing equipment<br>Preservation with little or no use of ice / break in or absence of cold chain<br>Lack of storage / limited storage capacity to allow for spreading sales over time during peak fishing season, which results into fish being sold off<br>Periods of peak fishing coinciding with seasonal farm work with less demand causing sell-off to carry out agricultural activities<br>Competition with uncontrolled tilapia imports, especially during peak fishing seasons |
| Smoked-fish processors | Supply/purchase | Raw material already in the process of spoilage when purchased or default not visible a priori (as for fish caught with chemicals or dynamite)<br>Purchase of small-sized fish<br>No use of ice<br>Slow purchase operations |
| | Transport to the processing site | Piled-up / stacked product<br>Product exposed to ambient temperature<br>Tardiness due to lack of support/assistants |
| | Draining (before smoking) and cooling on racks after smoking | Attack by predators, various contaminations<br>Start of spoilage due to longer waiting on racks in times of glut/saturation |
| | Smoking | Established conservatism within certain social groups with pretreatment and smoking practices that promote quality loss<br>Improper technique, with: |

| Operator | The five most-important critical loss stages | Main causes of losses |
|---|---|---|
| | | (i) difficult fire control leading to the calcination of the product<br>(ii) incomplete smoking facilitating subsequent spoilage<br>(iii) at times, charring of an entire batch<br>Distraction by simultaneous household activities resulting in excessive smoking, sometimes possible burning of an entire batch<br>Fragmentation and various damage in fish from low-quality raw material |
| | Packing/packaging | Rough handling and use of inappropriate materials (such as baskets, jute bags) leading to breakage, magnified in products from low-quality raw material |
| | Storage | Conditions conducive to infestation by insects, mould growth, etc.<br>Lack of warehouses designed for storing these products /storage in homes<br>Stacking containers causing fragmentation of products |
| Fishmonger (fresh or smoked) | Supply/purchase | Low-quality product or undersized fish<br>Unusually long collection period<br>Fraudulent practices or lack of knowledge of good practices in stock management by processors or retailers that offer for sale a mixture of products that have different quality grades or whose weight has been overvalued owing to deliberate spraying of water<br>Theft of products during price negotiation/bargaining |
| | Storage | High stowage density of product (size of product stacks) leading to lower layers being crushed, increased with long collection period/storage<br>Unsuitable container (weakly insulated and too deep)<br>Insufficient storage ice quantity<br>Abnormal long collection/storage period<br>Limited storage capacity |
| | Transport | Inadequate transport means (i.e. unsuitable vehicles for transporting this type of product, or vehicle breakdowns, or canoe sinking extending the length of or interrupting transport) and impassable roads<br>Inadequate storage and handling of consignments causing product fragmentation<br>Theft of product during transport<br>Unsafe conditions / highway bandits constraining movement between markets and production sites, thus leading to an artificial saturation of products |
| | Distribution/ marketing | Limited storage capacity during high fishing season for allowing sales to be spread over time, resulting in fish being sold off<br>Artificial or real saturation (limited preservation capacity during peak fishing period)<br>Competition with ill-timed/uncontrolled imported fish during major fishing seasons<br>Non-compliance of the cold chain<br>Unsuitable marketing arrangements: inadequate physical infrastructure for markets or non-conducive market frequency so that they may be in line with landing trends<br>Amplified undersized fish processing practices, with the increasing demand from poor communities<br>Absence of alternative markets / focus on traditional market which is at times, oversupplied |

On average, all the countries report that 65 percent of the losses are related to the limitations listed in Table 14 and are closely linked to knowledge and know-how, technology and infrastructure.

This group of causes of loss is indeed evident in the case of:

- the net left for a long time in the water;
- the inadequate cold chain;
- the supply of lower-quality raw material;
- abnormal stowage, handling or collection times (see snapshot case 1 [Box 4);
- an inefficient method of smoking;
- no or weak protection of the product during draining or cooling;
- inadequate conditioning/packaging;
- inadequate storage facilities;
- transport conditions detrimental to the quality and/or physical integrity of the product;
- placing product in a market where it is exposed to any source of contamination or spoilage owing to the lack of technical and sanitary engineering.

This is also partly due to the lack of capacity in terms of managing market information (first of all in terms of availability and then of know-how to take advantage of it). This forces operators (fishermen, fresh- or processed-fish fishmongers) to limit themselves to their traditional market, despite its saturation level in these products (see snapshot case 4 [Box 7]). The ability to collect and use market information to meet the requirements is also linked to the financial and technical resources that allow access to a market that may provide an easy outlet and better profits.

**BOX 4**

**Snapshot Case 1: Losses in quality due to long fish collection periods by fishmongers (Kompienga site, Burkina Faso)**

The study of fishmongers shows three main types of operations: collection/supply, preservation (icing the fish) in containers, and transport to major market centres. The supply and, more particularly, the storage in containers are critical steps that entail a high risk of incurring losses. Indeed, in order to minimize transport costs to urban markets and thus maximize profits, operators equipped with large containers attempt to gather a maximum load of fish. This step may extend over a period ranging from 14 days to three weeks depending on the season. This long collection period brings about the risk of affecting the product's chemical, microbiological and nutritional quality, because icing is not properly applied, the moderately insulated container is very deep, so causing the stacked lower layers (fish collected in the first few days) to be compressed, thus promoting nutrient leaching because of the ice melting. Moreover on arrival, the "first-in first-out" rule is not applied because sales begin with the last fish stacked (the first accessible layers being the upper ones). The estimated physical and quality losses are thus, respectively, 5 and 15 percent, amounting to a minimum of 600 kg per collection trip.

**Analysis and recommendation**

Icing and especially reducing the collection time (maximum seven days) are essential measures to reduce these losses significantly. However, these measures require a comprehensive consideration of the chain that takes into account costs and benefits to encourage operators to make up loads with containers only half or two-thirds full, or smaller ones, thus generating a maximum of higher-quality products. In-depth load tracking with different scenarios is therefore needed to provide these objective evidence elements, including a study of the nutrient profile variation and other valuable compounds in fish and fish products.

This first group of causes seems to affect all value chains (fresh, smoked, dried, etc.) or types of actors in each country, and the quantified data show that fishermen and fishmongers are less exposed than processors. Its significance is well evidenced in Togo, for example, where out of the top five causes, aspects related to technology and infrastructure have been brought to the fore for more than 80 percent of smoking processors' losses. Countries unanimously consider the smoking process as critical. Even in Ghana, use of inefficient equipment is reported while the Chorkor, a known improved kiln, was originally developed in this country (see above). This causes quality and, to a lesser extent, physical

losses and a negative impact on the natural resources, particularly in terms of fuelwood waste. Snapshot case 2 (Box 5) depicts some of the issues related to the smoking process at the study sites.

**BOX 5**

**Snapshot Case 2: Losses due to the use of inefficient smoking systems**

Direct observation of smoking in the different sites shows the widespread use of inefficient systems. Inefficient barrel or metal drum kilns, handled mud kilns with large fireplaces or poorly designed Chorkor kilns are used. The illustrations below are from Burkina Faso, Ghana and Togo but are fairly representative of devices encountered across all the Volta Basin riparian countries.

Traditional fish smoking with a Dafing kiln in Burkina Faso (PHLA, 2013).
*Courtesy of:* Y Ouedraogo.

Traditional fish smoking at one of the sites studied in Ghana (PHLA 2013)
*Courtesy of:* National PHLA team.

Complete or partial charring of fish owing to these inefficient devices results either in its physical removal from the food chain or an inferior quality. Data that are connected with obsolete smoking kilns show that they are the leading cause for physical losses and the second cause for quality losses incurred by smoking processors in all three countries. If complete losses are rare, they are devastating when they occur, as a whole batch may be affected by fire (kiln materials or fat burning, etc.).

| **Estimate for quantity of inputs used** | |
|---|---|
| Raw material | Maximum production: Ten 70 kg baskets of fresh fish per day |
| | Minimum production: Five 70 kg baskets of fresh fish per day |
| Smoked products | The end product can be evaluated to roughly one-third of the raw material in terms of weight |
| Fuel | For one 70 kg basket of fish, processors use in total: |
| | - XOF2 500 (USD5.10) of wood (80 kg) |
| | - XOF1 000 (USD2.04) of coconut husks and wood shavings, equivalent to about 8 kg of husks and 5 kg of shavings |
| | Resulting in a total fuel ratio of 1.32 (wood/fish 1.14 + 0.18 for the husks and shavings) |

As per the table here above, when considering the volume of fish involved, this results in a significant loss of revenue.

**BOX 5 (continued)**

Higher operating costs should also be taken into account as more wood is used than with improved kilns such as the Chorkor kiln. If this wood is not purchased but fetched, the processor's workload is increased, as a larger quantity of fuel needs to be collected. In both cases, the wood/fish ratio has worrying consequences on natural-resource sustainability. During the load tracking of the smoking process, this ratio was assessed at 2: 1 in Burkina Faso, 1.35:1 in Ghana and 1.5:1 in Togo, and thus at least two to three times higher than for improved stoves, so clearing timber resources, which are a rare commodity in Burkina Faso, a Sahelian country, and far from abundant in the other two countries.

**Analysis and recommendation**

Reducing these losses and waste calls for the use of improved kilns, namely the Chorkor, the Cinderblock or the brand new FTT-Thiaroye system. However, full ownership and successful change will depend on the approach used in any intervention. In locations where improved kiln types have been introduced through community centres, they have not been used. Smoking processors prefer their traditional system that allows them to carry out this activity in the immediate vicinity of their dwellings, despite the loss conditions and even if it generates smoke and heat, thus representing a health problem for them and their families. As with any beneficiary ownership process, it is fundamental to conduct a sociocultural analysis and take into account stakeholders' interests and priorities when providing technical and awareness-raising support.

The first group of causes of loss (i.e. related to the knowledge and skills, technologies and other infrastructures) is well documented and enriched with information, as it has been carefully examined in relevant connected questions. Solutions have focused on improving technology, infrastructure and practices. However, this study of the Volta Basin has also highlighted the fact that the importance of the second group, that is social and cultural dimensions of vulnerability, responsible governance, regulations and their application, should be seriously taken into account, in order not to risk minimizing the sustainability of interventions by neglecting key opportunities. Indeed, these dimensions represent 35 percent of losses. Although Table 15, a comparison table of operators in Burkina Faso, reflects the prominence of factors other than technology, skills and infrastructure, it also highlights policy and/or regulations and their enforcement, for example.

Indeed, an in-depth analysis of the case studies, some of which are illustrated in the following paragraphs, highlights the importance of this second group of causes, whose 35 percent share of losses raises important questions that may be rarely or not always perceived. These factors emerge from aspects discussed previously and bring about risks to natural resources management and the sustainability of fishing activities, including:

- Unwillingness to adopt innovations, prevailing especially among operators older than 49, even when they are aware of the technology and it is already used in their immediate environment.
- Gender-specific questions: Even if they have the will or the financial means, women have little opportunity to be able to always access the fish of the highest quality in the first hours of auction/sale, given that they are responsible for household chores. The same applies to some of the losses incurred during processing, particularly in terms of incomplete or excessive smoking or calcination of the product during this process. Managing this disadvantage to reduce the level of losses is therefore a priority in the context of lightening chores and enabling capacity development. When considering assistants as a possible solution, the consequences on potential post-harvest benefits need to be examined as this represents additional production costs. When looking for ways to resolve the issues around childcare, it would be appropriate to contemplate social, health and education facilities such as nurseries, kindergartens and schools.
- (i) Weakness in managing the public land perimeter regarding polluting plants or riparian human activities, such as lack of control over pesticide use in Economic Interest Fishery Perimeters (EIFPs) in Burkina Faso; or (ii) the lack of concrete actions to enforce regulations on the mesh size of fishing nets or prohibited physical or chemical fishing methods. The issue of illegal fishing, including the use of dynamite or chemicals, already discussed in previous studies, including

coastal fishing in Ghana (Akande and Diei-Ouadi, 2010), is a major concern in the Volta Basin. Data collected to date indicate that these illegal methods (reported to affect 73 to 80 percent of tilapia production in two of the four sites studied in Burkina Faso) are a coping strategy for fishermen and usually respond to a need to compensate for losses due to inefficiencies. However, this study also shows that this is associated with the need to meet the strong demand from rural and poor communities that cannot afford legal-size fish (> 300 g), as the price of a portion size (a whole fish) is too high for them. This is especially true for fishing small tilapia (< 160 g) used in frying operations in Burkina Faso (see snapshot case 3 [Box 6]). In addition to environmental implications, potential economic losses consist in a loss of revenue per kilogram of XOF661 (USD1.35), which is the price differential with a legal size tilapia, which would have been reached with fishermen being patient for a few more months, rising from XOF390 (USD0.8) to XOF1 050 (USD2.15).

- Fishermen who practice fishing with dynamite or chemicals rarely incur any consequence for breaking the rules, but instead women processors are the ones who mostly suffer losses. They may indeed find themselves with a product that has a flaky texture, with a dark colour and that crumbles easily after smoking, because it is very difficult for them to distinguish, simply by looking, a fish caught illegally from one captured legally. At best, a batch of such quality is sold at a greatly reduced price. At worst, although rarely, the competent authority will seize it and this will therefore result in a physical loss. In any case, the act perpetuated by one actor along the chain is at the expense of another who incurs the losses, hence the term “transfer of loss”; this is a serious concern in most countries.
- A non-conducive security environment for commercial transactions in production sites (see snapshot case 4 [Box 7]).

**Table 15. Dimensions of losses in Burkina Faso**

| Significant losses / operators | Knowledge and technical skills | Infrastructures and services | Policy/legislation and enforcement/ governance | Access to information and markets | Access to financial services |
|---|---|---|---|---|---|
| Quality losses incurred by fishermen | ++ | + | +++ | + | + |
| Losses due to market forces incurred by fishermen | | ++ | + | + | |
| Quality losses incurred by fresh-fish fishmongers | + | ++ | + | + | + |
| Losses due to market forces incurred by fresh-fish fishmongers | | | + | + | |
| Physical losses incurred by fresh-fish fishmongers | + | ++ | + | | |
| Quality losses incurred by fresh-fish / smoked-fish processors | ++ | | ++ | + | |
| Quality losses incurred by smoked-fish fishmongers | | + | | | + |

**BOX 6**

**Snapshot Case 3: quality losses owing to the use of small-mesh nets**

In Burkina Faso, regulation prohibits fishing in public waters using gear (gillnet, cast net, trap made with fabric or mesh) with a mesh size of less than 35 mm side to side.

At the Bama, Gouran and Di sites, the most commonly used sizes of fishing net meshes are, respectively, 22, 27 and 15 mm. This leads to small fish being caught that are prone to deterioration and alteration from physical shocks. The quality loss due to the size affects about 73–80 percent of the tilapia production in the Gouran and Di sites.

The different sizes of Tilapia on sale at one of the study sites in Burkina Faso.
*Courtesy of:* Y Ouedraogo.

Practices that cause quality losses linked to tilapia size also have a potentially strong negative impact on the environment and the sustainability of aquatic resources. They are maintained by the socio-economic context of the target market. This study shows that the rural population, with limited financial resources, cannot afford to buy legal-size tilapia given its price that, moreover, is rising, given the increasing scarcity of natural resources. These poor fishing practices, which were revealed in Burkina Faso, have been linked to the lack of harmonized regulations between that country and Mali regarding standards for authorized gear. As the waterbody is easily accessible to all and not effectively controlled, illicit practices on one side are also found on the other side of the shore.

**Analysis and recommendation**

This illustrates the strong link between illegal, unreported and unregulated (IUU) fishing and the occurrence of post-harvest losses (PHLs), and specifically quality losses. Moreover, this raises not only environmental considerations (depletion of fish stocks, habitat destruction), unfair competition *vis-à-vis* honest fishermen but also the actors' vulnerability (poverty) and its impact on PHL occurrence. Subregional cooperation, especially between Mali (Sourou Valley) and Burkina Faso, was identified as important during the workshop where results were presented, as fishermen on both sides of the border seem to practise this kind of fishing.

Although the main cause of quality loss associated with small tilapia fishing turns out to be insufficient enforcement of regulations, reduction interventions should not be limited to raising awareness on changes in practices along with increased regulations and their enforcement. They also need to consider the social dimension (consumers with limited resources), thus making support measures essential. National fisheries governance and subregional cooperation on the harmonization of standards to curb illegal fishing are at stake.

**BOX 7**

**Snapshot Case 4: Losses related to artificial glut because of robberies incurred on roads by fishmongers travelling to market sites in Ghana to buy fish**

At the sites visited, one of the root causes of losses due to market forces is product saturation resulting from lack of sales, even during the lean period. Indeed at the study sites, women (processors, fresh-fish fishmongers and resellers) complained that they were forced to practise cheap prices as customers, mostly fishmongers coming from distribution markets, were deserting their markets. Owing to various factors (physical movement limited by family status, conservatism, low initiative to target other markets, etc.), travelling to sell products in distant markets tends to be the exception for these operators. They therefore supply primarily their traditional market, the one next to the fishing area. These market fairs follow a schedule established for generations with a frequency of one to a maximum of three times per week, hence lacking flexibility because they are not set up according to fishing seasons or the expected volume of products. The buyers (fresh- and smoked-fish fishmongers) come to these fairs to buy and then go to sell in major market centres.

Until recent years, transactions were carried out smoothly, and they would have easily continued were it not for recurrent attacks or robberies, especially on roads leading to major cities and the capital (highway to Tamale going through the Buipe site; traders operating on this site come from major cities such as Accra, Kumasi, etc.). This has resulted in a drastic reduction in the number of clients, because they either have had a similar experience or heard of victims of this phenomenon. This climate of insecurity that poses a risk to their lives, to losing the money they carry, and to a lesser extent, their products, justifies the fears underlying this downturn. The direct consequence is the growth of a systematic, albeit artificial, trend during fairs to have excessive supplies of products, but which are in reality artificial. Reduced fish price occurs regardless of product quality, valued at GHS65 000 (USD18 000), because there are fewer customers / less demand while the volume of supply is at times stationary. Indeed, armed robberies are second on the list of the five major causes of market force losses in the Ghana part of the Volta Basin, and Ghana is relatively better equipped in terms of infrastructure and services than Burkina Faso and Togo. In Buipe, about 80 percent of the respondents during the study asserted that the fact that long-distance fish traders do not feel safe on the highway is the main deterring factor for them to travel to the market of the basin production sites. This seriously affects the livelihoods of fishing communities.

**Analysis and recommendation**

This issue deserves special attention at both the institutional and political levels when identifying measures for reducing losses. The hopes and demands of the different actors can be summarized in a strengthening of security measures, and a stronger commitment and involvement of the police to address these losses due to market forces, which represent a daunting obstacle. It is also important to recommend and encourage commercial transactions by electronic transfer. These solutions are increasingly adopted, especially with payments using mobile phones. In Ghana, e-commerce is a reality in agriculture; its extension to other sectors, along with a good geographical coverage should be considered in conjunction with appropriate sanctions for a safer environment, to enable an effective reduction of such losses.

- The role played by massive mismanaged and uncontrolled imports of fish products (Box 8), and the complexity of the competition context between artisanal fisheries actors, bringing the need for intervention at policy level to the forefront.

**BOX 8**

**Snapshot Case 5: Losses due to market forces incurred by operators resulting from ill-timed fish imports (Burkina Faso)**

Imports were reported to be of concern owing to their significant impact on smallholders' competitiveness. Imported frozen fish plays a crucial role in bridging the demand–supply gap and also allows small-scale fishermen to maintain their activities during the lean fishing season because it is used as a raw material. Cold-storage facilities owners and importers pay import taxes based on volume and, thus, directly contribute to the national economy by providing income for the national treasury. However, fish imports can be detrimental to the development of the local fishing industry, particularly the small-scale one, if they are not synchronized with national and subregional fishing flows.

In Ouagadougou, the Tanghin market is an important market for fresh fish; every two to three weeks, it receives fish from the Volta Basin (i.e. Kompienga). Tanghin traders and women fishmongers largely experience losses – 40 and 72 percent, respectively – due to market forces when imports coincide with seasonal domestic bumper harvest. This leads to an estimated loss of XOF137 000 (USD280) in annual results for poor market traders. Because cold-storage facilities owners are generally more organized, they can easily agree to a minimum price among themselves, thus weakening considerably the position of small-scale fishermen, as this drastically downgrades the value of their products.

These inadequately planned imports have a considerable effect in terms of losses, but it is worth mentioning that the local tilapia from Kompienga also remains non-competitive because fishermen's prices escalate given the competition between different groups of fishmongers. The lack of group dynamics and competition between operators of the same group prevents members from agreeing on a realistic price to propose and leads to artificial pricing with the risk of a downward sale resulting in losses.

**Analysis and recommendation**

Fisheries and aquaculture authorities should address the key problem linked to losses arising from inequitable competitive imported tilapia *vis-à-vis* that of artisanal fishermen through coherent planning and regulation. This requires good visibility and reliable information on yearly trends in domestic production (season by season) and fishery products trade in order to identify appropriate periods and import volumes that can meet domestic demand without creating a saturation that may be harmful for artisanal fisheries actors. Based on the currently available information, this could be to apportion the volume needed to fill the demand gap between national high fishing seasons and lean periods, for example.

Moreover, additional information collected on the lack of organization and stakeholder dialogue between small-scale actors, leading to the price of local fish escalating, should also be further examined in order to devise an inclusive solution.

- Other unlawful compensation or loss prevention strategies (Box 9).

**BOX 9**

**Snapshot Case 6: Physical and quality losses due to fraudulent practices**

Practices carried out by certain groups of actors, knowingly or because of a lack of awareness of good manufacturing practices, are generating losses for operators downstream in the value chain or negatively affecting the end consumer.

**Burkina Faso**

Illegal and fraudulent marketing practices by smoked-fish processors / retailers entail spraying water intentionally on fish batches just before selling them to fishmongers to increase the weight of the product. The unit of measure being the conventional kilogram, fishmongers end up paying for a fictional weight of fish. They later realize that they were cheated when these products were placed on the market when parcels arrive at the point of sale having diminished in weight during transport because part of the water has evaporated.

Based on the assessments made on purchases in urban markets that represent the end of the value chain, where smoked fish are sold to consumers, the amount associated with losses from fraudulent sales practices, caused by processing vendors, amounts to 1 188 kg/year for fishmongers, that is 11 percent of the quantities purchased.

For smoked tilapia purchases of 108 tonnes/year, the actual amount purchased is estimated at 96 tonnes/year owing to fraudulent practices. Knowing that the average selling price of smoked tilapia is XOF2 030/kg (USD4.15/kg) in the capital city, it may be deduced that the value of the quantities associated with losses due to fraudulent practices amounts to XOF24 150/year (USD49.32/year) per fishmonger. This is a huge loss of revenue for them.

Beyond the dimension of financial losses, adding water to smoked products results in quality losses. In fact, this increases the moisture content of these products and leads to the development of maggots and mould and, thus, predisposes the fish to rapid spoilage.

**Togo**

To avoid incurring losses on smoked products of questionable quality or to compensate for losses, operators hide them in a batch of good-quality products, mixing them unobtrusively as a coping strategy. This practice mostly occurs before placing the products on the market and, thus, customers who are not vigilant or are ill-informed may face unwanted harmful effects.

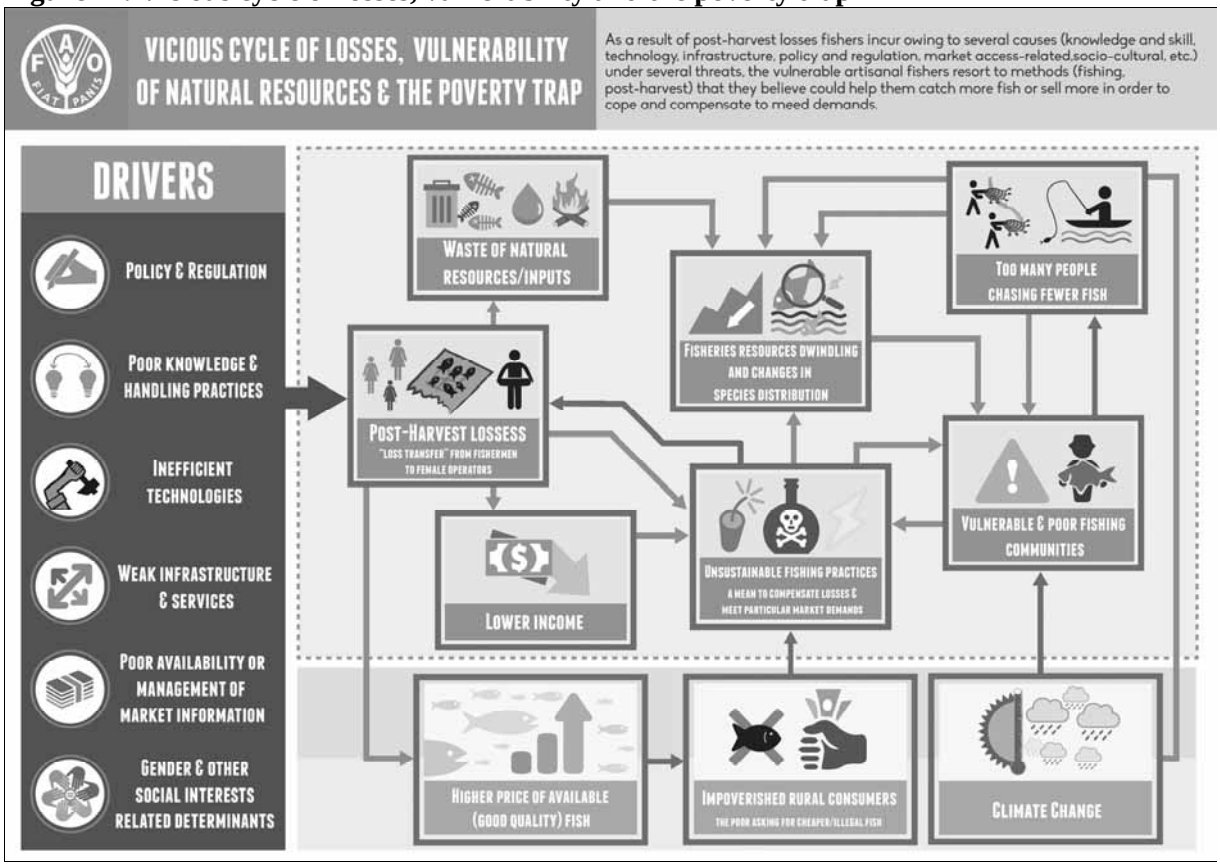
**Analysis and recommendation**

These fraudulent practices do not constitute an actual loss of fish in most cases, such as for fishmongers in Burkina Faso. In Togo, they nevertheless amount to a certain amount of loss of good-quality fish for customers.

Awareness sessions or training on good practices would help to curb these bad practices. They should include meetings and consultations between smoked-fish processors and smoked-fish fishmongers associations under the mediation of the competent authority and NGOs for a viable solution.

Figure 22 presents a schematic representation of the majority of the issues discussed here above and provides a summary of the information from the reports on the causes and effects in all of the countries.

**Figure 21. Vicious cycle of losses, vulnerability and the poverty trap**




*Courtesy of:* S. McDonough, FAO Regional Office for Africa.

To cope with PHLs due to several causes (lack of knowledge, skills, technology and infrastructure, policies and regulations, market access, socio-cultural context, etc.) and to compensate for them, small-scale fishermen resort to fishing and post-harvest methods they believe can help them catch or sell more fish. This occurs while climate change has led to declining catches (changes in the type, amount and distribution of species in the Volta Basin). Variability in rainfall has led to lower water levels resulting in low fish catches because fish species have decreased in quantity and quality. It is also well known that in this subregion, as in most African countries, the influx of fishers into the fisheries sector is greater than the exit of them from it. These unsustainable practices are also caused by the growing demand for cheap fish by the poorest segments of the population, aggravating the reluctance to limit the flow. In addition to gear with illegal mesh sizes (to catch many juvenile fish), in some cases, devices such as lights are first used to aggregate the fish to then kill them with dynamite or carbide (an easier way to catch fish). This allows fishermen to catch large batches, something they cannot do by only circling the fish with an aggregation device.

Fish caught this way are of poor quality and sell at a lower price. When regulations are actually enforced, the fish is seized and destroyed by the competent authority, resulting in lower revenue for communities. Their attempt to retrieve or make up the loss in revenue in the next fishing trips perpetuates these illegal practices. As described in snapshot case 3, fish processors are often the most affected by what may be called the phenomenon of “transfer of loss”.

When a woman processor who has experienced this unpleasant surprise has a choice, she will change her supply source. Those who can afford it finance a fisherman to supply them with good-quality raw materials. However, this partnership sometimes ends up with the sponsored fisherman departing for another landing site, thus causing serious inconvenience to the unlucky “financier”. In a country such as Ghana that has more than 1 300 fishing villages / landing sites along Lake Volta, finding a fisherman can be very difficult.

Fishermen are forced to use irresponsible practices adapted to their state of vulnerability or poverty level. As resources diminish, migration and the influx and exit of fishermen complicate the situation. Any decision by the authorities to stop or discourage the entry of new fishermen poses a real dilemma for which a sustainable solution should be commensurate with the complexity of the situation in terms of employment and/or eradication of poverty.

***Impacts of losses***

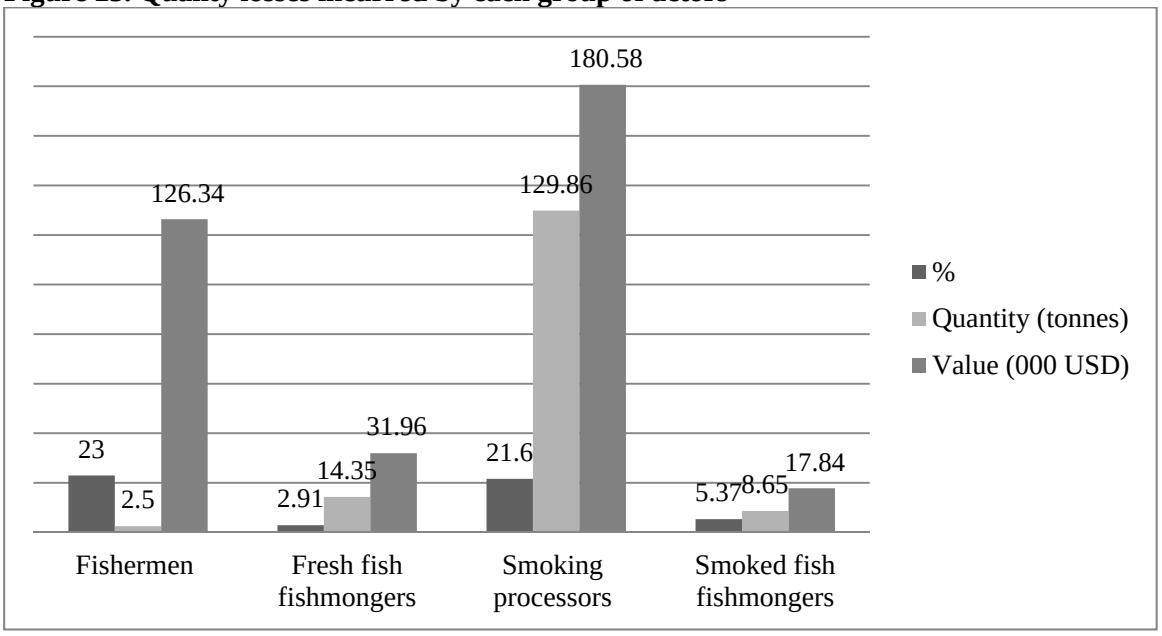
The analysis of the information reveals a real or potential impact on three levels: first as regards food security; then on the income level of the actors along the value chain; and finally on the environment, including the sustainability of natural resources.

*Food and nutrition security*

Physical removal from the food chain results in a physical loss and contributes to reducing the supply availability. It averages out to 1.2 percent or 45 tonnes at all study sites. Extrapolated to the total Volta Basin production, which is about 101 800 tonnes, the amount of fish that appears not to reach consumers is 1 220 tonnes.

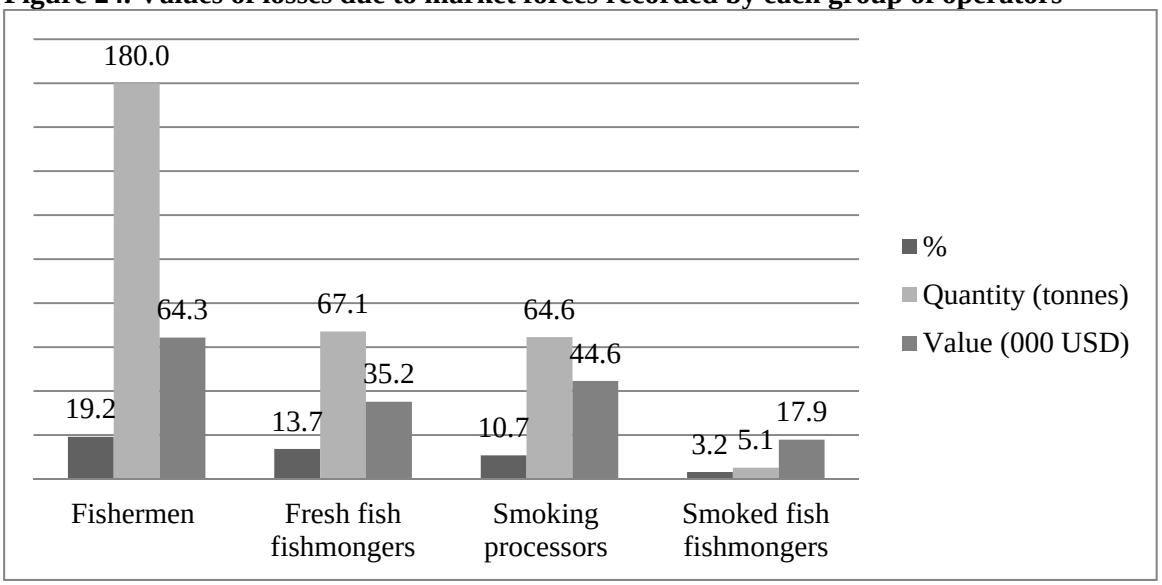
The above estimate indicates that physical losses are apparently low, which reflects misleading statements such as “in artisanal fisheries, all fish is used and there is no loss.” It underestimates the extent of nutritional value loss of fish for consumption and does not take into account its safety state. Therefore, 64 348 tonnes should be added to this quantity, corresponding to 17.34 percent of defective-quality fish that directly affects food security. Figure 23 provides an overview of losses linked to the main operators assessed in the study.

**Figure 23. Quality losses incurred by each group of actors**




As explained above, even if the first impact of losses due to market forces is in relation to operators’ income and does not appear to lead to food losses, these losses may evolve in quality and physical losses, as a result of various factors. This is the light under which one should consider the total of 456 tonnes of fish affected by losses due to market forces (Figure 24) and realize that this can be magnified, thus becoming a real threat to stability of food supply.

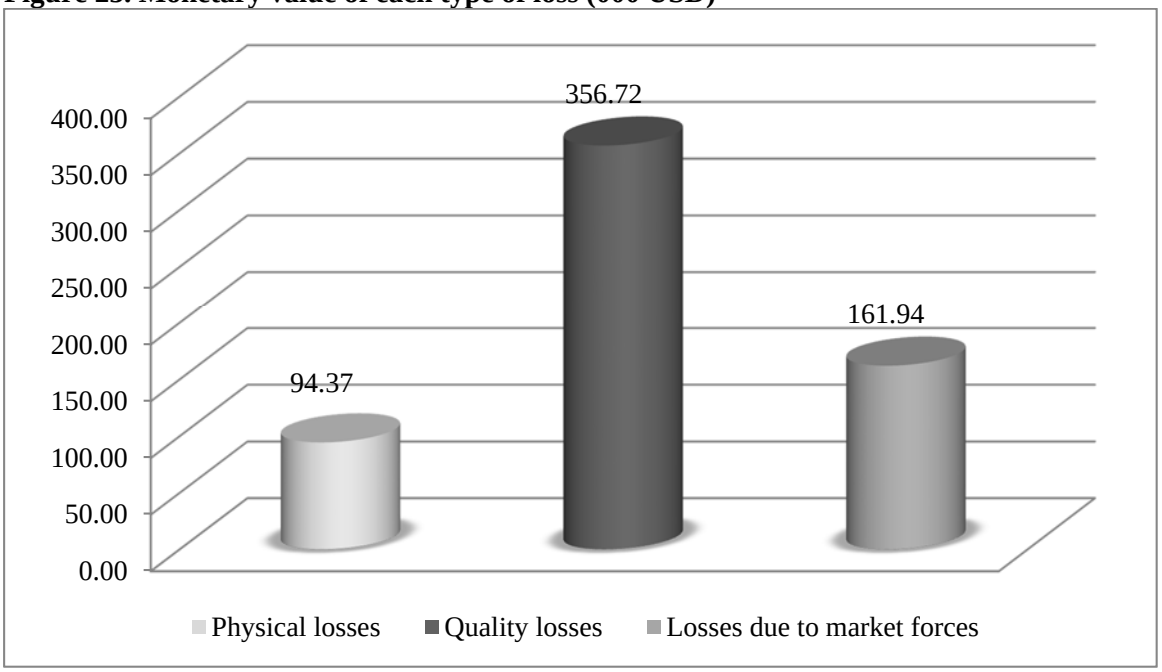
**Figure 24. Values of losses due to market forces recorded by each group of operators**




*Impact on post-harvest benefits for actors in the value chain*

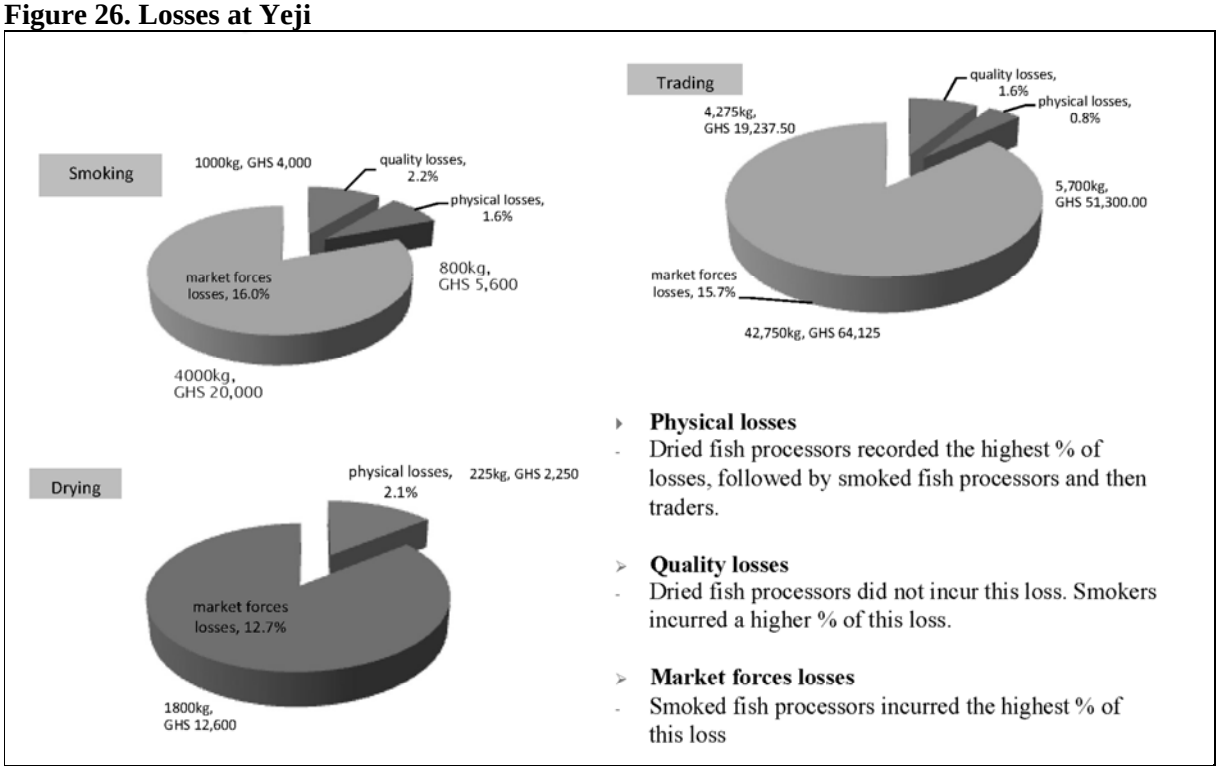
The above figures also show the loss in revenue for fisheries actors induced by each of the three types of losses. In monetary terms for the sites studied, these losses rank second and therefore constitute an important factor in eroding livelihoods. Figure 24 compiles data from the sites.

**Figure 25. Monetary value of each type of loss (000 USD)**




Losses due to market forces are more important than quality losses in certain cases or for certain operators, such as in Burkina Faso for fresh fishmongers and in Ghana on all the sites for almost most operators, e.g. Yeji (Figure 26).

**Figure 26. Losses at Yeji**




Production costs, which increase (depending on inputs such as fuelwood) and are in part the result of inefficient processing systems, also affect the livelihoods of operators. A wood/fish ratio, that is double or triple what it could be with an efficient, system means that the processor spends at least twice as much to obtain her product. To be competitive, this smoked fish would need to fetch a price similar to the product, most probably of greater quantity and quality, of a processor using an appropriate system that consumes half of the fuel required.

Table 16 summarizes information on fuel use for smoking. The ratio for improved kilns is in the range of 1:3 to 1:2.

*Impact on environmental/natural resources*

The relatively low level of fish physically lost along the chain (1.2 percent – equivalent to 45 tonnes in the survey sites) suggests that the overall risk that discarded fish significantly contributes to greenhouse gases emissions is relatively low and thus hardly affects environmental sustainability. However, attention should be given to the potential impact on the sustainability of natural resources from: (i) illegal and harmful fishing methods (discussed above); and (ii) widespread fuel (wood) wastage owing to ineffective smoking systems. Extrapolations on a large scale have been made with the data in Table 16 to give an overview of energy waste in all three countries. Estimates are presented in Table 17.

The major threat to the environment resulting from these activities is related to smoking systems. It has been measured and documented at these sites. Further investigation needs to be conducted regarding illegal fishing gear.

**Table 16. Fuel use for smoking**

| Country | Fuel | Characteristics | Ratio (wood consumption in kg for 1 kg of fish) |
|---|---|---|---|
| Burkina Faso | Wood (species not specified) | Price: XOF20/kg (USD0.04/kg)<br>Consumption: 2 kg of wood for 1 kg fresh tilapia with a water loss rate of 67% | 2:1 |
| Ghana | In Buipe (*Terminalia avicennioides*, called Tuitui) and Dzemeni (sheanut butter tree [*Vitellaria paradoxa*], called Yokuti) | Consumption: 2 kg of wood for 1.2–1.5 kg of fish | 1.35:1 |
| Togo | Wood (species not specified) | For 60 kg of fresh, smoking processors use<br>- 75 kg of wood for small fish<br>- 96 kg of wood amounting to between XOF1 000–1 500 (USD2.04–3.06) for large fish<br>This produces 18–20 kg of smoked fish | 1.25:1 for small species<br>1.60:1 for large species |

**Table 17. Estimated energy waste**

| Variables | Measures |
|---|---|
| **Mean ratio at the smoking sites of the three countries** | **1.5:1** |
| **Estimated ratio for smoking with improved kilns** | **0.5:1** |
| Total quantity per year of fresh fish used for smoking at the smoking sites of the three countries (tonnes) | 770 |
| **Equivalent in wood/year consumption art the smoking sites of the three countries (tonnes)** | 1 155 |
| **Equivalent in wood/year consumption at the smoking sites of the three countries if the smoking was done with improved kilns (tonnes)** | **385** |
| **Wasted wood for smoking at the smoking sites of the three countries per year (tonnes)** | **770** |
| Average price of wood/kg according to the information in the PHLA reports (USD) | 0.036 |
| **Cost of wasted wood at the smoking sites of the three countries per year (USD)** | **27 720** |

# 7. RANKING AND SOLUTIONS TO REDUCE LOSSES

For decades, efforts in the fight against post-harvest fisheries losses have focused on improving technologies and practices. Only recently has the need for a paradigm shift been recognized. This calls for integrating a broader approach that focuses on the effectiveness of the entire supply system resulting from a better understanding of the types, the magnitude and the contextual occurrence of these losses. As shown in this publication, the Volta Basin assessment was conducted by following this approach with multidimensional models of identified losses. In this framework, criteria based on evidence were identified, which were used to map losses while distinguishing the minimum ones from those that take priority in order to inform sustainable loss-reduction interventions.

The criteria that can guide loss prioritization are:

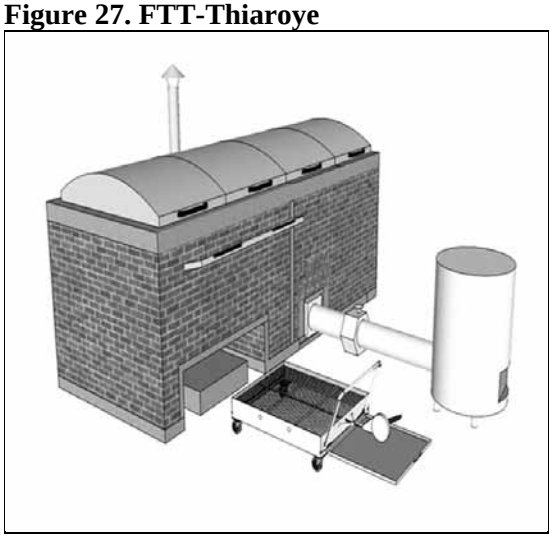
- the indicative magnitude of losses;
- the impact of losses on livelihoods and food security;
- the number of people affected by losses;
- the level of vulnerability or poverty of those affected by losses;
- the frequency and seasonality of losses;
- the trend of losses over time.

The choice of priority losses in all three countries is based on their extent, the number of people affected and the impact of losses on livelihoods and/or food security. It appears from the analysis of the PHLA results that, in all three countries, those of priority are quality losses and then losses due to market forces. However, the type of operator should be differentiated in this ranking; and for that, the country context or study site must be taken into account. Following the prioritization of losses, each country has developed a proposal for a loss reduction intervention in the sites surveyed (see Appendix 8 summary tables by country).

These draft proposals give a first source of information and guidance for loss-reduction interventions in the three countries. This information is also documented in a report on the strategy on sustainable loss reduction and strengthening regional trade, with details on specific activities to reduce gender inequalities. It also indicates stakeholder responsibilities when implementing the strategy, and challenges and opportunities in countries in terms of partnership. The effective and inclusive implementation of the proposals should ultimately address sustainability, competitiveness and gender equity in fisheries and aquaculture.

As the smoked tilapia value chain was one of the assessment's priorities, the NFFP programme has considered losses related to this processing with a view to not only optimizing operators' revenues, but also reducing the health risks they face with inefficient systems and protecting the environment. This is the reason for which it supported the development of training materials and pilot interventions (as in Togo) centred on the FAO-Thiaroye processing Technique (FTT-Thiaroye) developed by the National Training Centre for Fish and Aquaculture Technicians (Senegal) (CNFTPA), in partnership with FAO. This technique consists of a new system that combines the strengths of the most improved (Chorkor, Banda) kilns at this date with additional features giving them more assets to meet food safety standards. Assistance initiatives dealing with smoking or drying and storage of fish products as well as the country team proposals in Appendix 8 will certainly consider this technique. Figure 26 presents a schematic representation of the FTT-Thiaroye being disseminated in various initiatives.

**Figure 27. FTT-Thiaroye**



*Courtesy of:* O. Ndiaye.

## 8. CONCLUSION AND WAY FORWARD

The Volta Basin case study follows a step-by-step process, from a situational analysis for the selection of the key fishing locations to capacity development and loss assessment for sustainable reduction and improved trade interventions. This process has proved effective in collecting a large amount of information on the tilapia value chain, a major fishery, and also in some specific species that became predominant as a result of climate-change-led shifting of species distribution. The continuous collection of more quantitative and qualitative data during the whole assessment has shown that this process may be ideal in similar data-poor situations where human resources capacities are not conducive to thoroughly understanding value-chain dynamics and identifying performance criteria for future PHLs and regional trade enhancement.

The overall PHL level of 27 percent, of which quality losses make up the largest part (17 percent), does corroborate past studies in that this type of loss predominates over fish physically removed from the supply chain. However, it masks significant discrepancies among countries and within fisheries operations. Market force losses that apparently may not be a loss of fish as food but that do affect operators' livelihoods are important aspects that need to be examined more closely in subsequent case studies.

Discrepancies are notably reflected in the differences in volume and value. The analysis of the drivers (direct or indirect) of these losses and the case studies shows that dimensions of PHLs are intricate, multifaceted and context-specific. This explains in large part the differing shares of 65 percent versus 35 percent between the technical, technology and infrastructure drivers and the policy, socio-economic drivers and climate-change-led factors. All these strengthen the rationale for assessing PHLs in particular fisheries, locations or value chains in order to capture their significance and design tailored interventions that will make the most impact in terms of loss reduction.

This study is the first to establish clearly the cycle of poverty and vulnerability (of humans and resources) directly perpetuated within the PHLs context. It complements the Lake Victoria case studies (Akande and Diei-Ouadi, 2010) and demonstrates that more remains to be learned from PHL developments.

Given the time lapse between the processing of the data and the reporting of the loss-reduction interventions presented herein, the actual implementation phase would benefit greatly from a preliminary fine tuning. This would entail evaluating whether any action has been taken in the meantime and how these interventions may be complemented, if they are still valid. The strategy informed by these studies should be promoted not only in the Volta Basin riparian countries but also in other regions or shared waterbodies to inspire similar subsequent initiatives in small-scale fisheries. The potential follow-up of these activities should anchor this as an opportunity for cross-fertilization on the process, the tools developed and the use of human resources for other development programmes such as the forthcoming Lake Chad Basin assistance.

## 9. LESSONS LEARNED AND RECOMMENDATIONS FOR REPLICATING THIS PROCESS IN OTHER SHARED WATERBODIES OR REGIONS

When designing and implementing a similar programme in another geographical area, the first step should consist of the process of identifying existing elements, either in terms of specialists or secondary information in the fisheries sector.

Stakeholders should decide by mutual agreement the priority areas to be surveyed in order to assess the importance and impact of PHLs in the chosen geographical area, knowing that they may differ significantly from another river basin.

In order to cover all the necessary dimensions to fully understand the causes of PHLs, the heads of assessments should develop a framework to gather data, detailing not only the technical, technological and marketing aspects but also social characteristics and dynamics with a particular focus on roles and relations between men and women, generations and the most vulnerable populations. When collecting data, investigators should also identify beneficiaries' priorities so as to integrate them in their analysis of the existing situation, which will include at least three components: existing infrastructure and services; social conditions; and priorities of stakeholders, including the most vulnerable, throughout the post-harvest chain.

It will then be possible to integrate this information into the design and project implementation in order to ensure that beneficiaries buy into the activities offered by the programme and make it sustainable, as they will be involved in the whole process of capacity development and technical assistance and also build infrastructure that will be perceived as a real improvement suited to the reality of their daily lives.

To make any PHL reduction intervention sustainable, environmental preservation aspects should be an integral part of the activities to be implemented.

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**APPENDIX 1**

**Summary table on the importance of inland fisheries and the Volta Basin (contribution in macroeconomic terms to the livelihoods of actors and national food security) in the three countries surveyed during the PHLA**

| Country | Importance of fisheries and inland fisheries | Importance of the Volta and production | Main fishing sites in the Volta | Volta species |
|---|---|---|---|---|
| **Burkina Faso** | – Equivalent to **200 000 ha** of water surface<br>– Domestic **production** was estimated by the General Census of Agriculture II (GCA) in **2008** at **10 049.7** tonnes<br>– Domestic production in **2013**: **20 300** tonnes<br>– Accounted for **0.31% of GDP in 2003 and 0.41% in 2008**<br>– In **2008**, fishing generated **XOF7 407 450 000 (USD15 129 805) in revenue for fishers XOF3 billion (USD6 127 535) for processors XOF2.9 billion (USD5 923 285) of gross margin for fish traders and more than XOF46 million (USD94 000) to the state budget and local authorities.**<br>– The 2008 RGA identified **41 366 direct actors** with:<br>• 32 699 fishers (14% women)<br>• 2 983 processors (82% women)<br>• 3 375 fishmongers (54% women)<br>• 2 309 smoked-fish traders (66% women) | – The Volta Basin contains all of Burkina's fish perimeters of economic interest and comprises the maximum total production. The Volta Basin is the largest fish supplier in Burkina Faso (85.80% MARH, 2012), with 17 400 tonnes<br>– It represents:<br>• 78.2% of the country's reservoirs<br>• 80% of professional fishers<br>• 39.7% of the production is processed by small-scale industries (smoking and drying) | Lake Kompienga, Sourou Valley, Lake Bagré, Lake Ziga, Kou Valley, Lake Bam, Lake Toécé | – Cichlidae<br>– Centropomidae<br>– Mochokidae<br>– Characidae |

| Country | Importance of fisheries and inland fisheries | Importance of the Volta and production | Main fishing sites in the Volta | Volta species |
|---|---|---|---|---|
| **Ghana** | – Sector's contribution to national GDP is 1.6% (2012)<br>– Almost 2.5 million people employed in the sector<br>– Total national production is about 495 000 tonnes (Fisheries Commission annual report for 2013) with 70–80% of marine origin (400 000 tonnes), mainly artisanal, and the rest of almost inland production (also mostly artisanal) | – Inland fisheries contribute about 19% of national fish landings (82 000 tonnes)<br>– 95% of this production comes from Lake Volta. Fishing on the lake is only artisanal<br>– Employs almost 100 000 people<br>– Fishing is done only by men, and processing is done by women<br>– Share of different types of products<br>• Smoked – 60%<br>• Salted – 20%<br>• Fresh – 20% | In the 230 fishing villages scattered along Lake Volta in Ghana, almost all the inhabitants make their living directly or indirectly from lake fishing.<br><br>Sites:<br>– Yeji,<br>– Kwamekrom,<br>– Tapa-Abotoase,<br>– Dzemeni,<br>– Torkorroano, Dambai Brumben,<br>– Ekye Amanfrom,<br>– Nyuinyui nos. 1 & 2, Akatengand<br>– Akokoma Sisi | More than 100 species. The main ones are:<br>– Tilapias<br>– Chrysichthys<br>– Synodontis<br>– Mormyrids<br>– Heterotis<br>– Clarias<br>– Schilbeide<br>– Odaxothrissamento<br>– Bagrus<br>– Citharinus |

| Country | Importance of fisheries and inland fisheries | Importance of the Volta and production | Main fishing sites in the Volta | Volta species |
|---|---|---|---|---|
| **Togo** | − Monetary value: XOF5 billion (USD10 212 560) annual production, and XOF10 billion (USD20 425 120) annual value added, equivalent to 4% of GDP (FAO, 2008)<br>− Artisanal fisheries production: 24 000 tonnes. 19 300 tonnes are produced by artisanal fisheries<br>− Employs 22 000 people:<br>• 10 000 fishers,<br>• 12 000 fishmongers, processors/traders<br>– Production of inland fisheries: 5 000 tonnes, or 17–20% of the national capture fisheries production | − From 2002 to 2006, the Volta Basin contributed about 38% to Togo's GDP. (UNEP-GEF Volta Project, 2008)<br>− Fish production in the Togolese portion of the basin is estimated to be at least between 1 200 tonnes (FAO, 2007) and 2400 tonnes (PHLA, 2013).<br>− Contribution in national landings: 23%<br>− Contribution to employment:<br>− Fishers: 950 or 9.5%<br>− Processors/traders: 400 or 3.3%<br>− Product shares:<br>• Fresh: 17%<br>• Processed: 83% | Donga, Pansiéri, Wogou, Gnangou, Tiwoli, Kpantali, Kpardagou, Barwaga, Koumongou Kan, Mango, Gnangbandi, Djagouri, Nakpiegou, Tantchalangou, Saguidjoaga, Kara, Nadougbal, Djassakou, Sikou, Tounga, Nandouta, Kloukpong, Kpitab | In the Togolese part of the Volta Basin, 119 species (FAO, 2010) have been listed. The main species caught in inland waters are *Tilapia* spp. |

**APPENDIX 2**

**Training Workshop in Data Collection and Use for Fish Post-Harvest Losses to Inform Sustainable Reduction Interventions, 10 to 15 March 2013, Lomé, Togo**

**Programme**

| | |
|---|---|
| **Sunday 10 March 2013** | |
| Arrival of participants and transport to the hotel | |
| **Day 1 – Monday 11 March** | |
| 08.00 | Registration, Learning needs and evaluation of entry level knowledge |
| 09.00 | Opening |
| 09.30 | General information, getting to know each other (FAO, National organizer, participants) |
| 09.45 | Group picture |
| **09.50** | **Coffee/Tea Break** |
| 10.20 | Introduction to the training course, the learning process |
| 10.35 | NFF project overview and Output B4 presentation |
| 11.00 | The problematic, types and causes of post-harvest losses and rationale for the systematic assessment |
| 11.45 | Discussion |
| 12.00 | Group work 1: Types and causes of post-harvest losses |
| **12.45** | **Lunch Break** |
| 14.00 | Presentation of group work 1 |
| 15.00 | Introduction to PHFLA methods |
| **15.30** | **Coffee/Tea Break** |
| 15.45 | Introduction to PHFLA methods and the mobile phone approach Cont'd |
| 16.15 | The review and use of the secondary data for planning field loss assessment |
| 16.45 | PHFLA tool 1: the site visit/observation |
| 17.30 | Preparation for site visit/assignments of tasks |
| 17.45 | Recap of Day 1 and closing |

| | |
|---|---|
| **Day 2 –Tuesday 12 March** | |
| 08.30 | Technical visit to a fisheries site/market for observation, familiarization with mobile phone |
| **12.30** | **Lunch Break** |
| 14.00 | Reflection/evaluation of the site visit |
| **15.30** | **Coffee/Tea Break** |
| 16.00 | PHFLA tools 2 and 3: the group meeting and Key informant interviews (KII) |
| 17.30 | Preparation for Technical visit for Group meetings and KII /assignments of tasks |
| 17.45 | Recap of Day 2 and closing |
| **Day 3 –Wednesday 13 March** | |
| 08.30 | Technical visit for Group meetings and KII |
| **12.30** | **Lunch Break** |
| 14.00 | Reflection/evaluation of the group meeting and KII |
| **15.30** | **Coffee/Tea Break** |
| 16.00 | Reflection/evaluation of the group meeting and KII-Cont'd |
| 17.00 | Reporting the participatory survey information: Content of a concept note |
| 17.45 | Recap of Day 3 and closing |
| **Day 4 – Thursday 14 March** | |
| 08.30 | Introduction to QLAM and LT |
| **10.30** | **Coffee/Tea Break** |
| 11.00 | QLAM and LT Group exercise-Simulation on mobile |
| **12.30** | **Lunch Break** |
| 14.00 | Use of PHFLA data: Location/country loss mapping and Setting of loss reduction interventions |
| **15.30** | **Coffee/ Tea Break** |
| 16.00 | Video on an improved technique for reducing critical losses in small-scale fisheries |
| 17.30 | Recap and Closing of Day 4 |
| **Day 5 – Friday 15 March** | |
| 08.00 | Country presentations |
| **10.30** | **Coffee/ Tea Break** |
| 11.00 | Budgeting & planning, preparation for surveys |
| 12.00 | Post-learning training evaluation |
| **12.30** | **Lunch Break** |
| 14.30 | Vote of thanks and certificates |
| 15.00 | Closing ceremony |

**List of participants**

| Name | Organization | Country | Contact / e-mail |
|---|---|---|---|
| **ADABADZI Patience** | Secretary Yeji Fish Processing | **Ghana** | +233 207185480<br>patienceadabadzi@yahoo.com |
| **ALI Domtani** | Fisheries and Aquaculture Director | **Togo** | +228 90006011<br>domtania@yahoo.fr |
| **NII ARYEE Emmanuel** | | **Ghana** | +233 208370147<br>osubibibio@yahoo.com |
| **BADO KABORE Julienne** | General Director of Fisheries Resources | **Burkina Faso** | +226 70070961/76644329<br>juliennebado@yahoo.fr |
| **BOKOBOSSO Kissem** | MAEP/DPA | **Togo** | +228 90128759/22213470<br>bkissem@yahoo.fr |
| **DIALLO Ousmane** | National Directorate of Fisheries | **Mali** | +223 66791965<br>ousmanediallodnp@yahoo.fr |
| **DIEI-OUADI Yvette** | Fishery Industry Officer (FAO RAF + HQ) | | +39 06570 53251<br>yvette.dieiouadi@fao.org |
| **DION Somplehi Micheline** | Vice President FENACOPE.CI | **Côte d'Ivoire** | +225 6011602<br>avepff@yahoo.fr |
| **DJANKLA MODJOSSO Tanah** | MAEP/DE | **Togo** | +228 90091416<br>modjotanah@yahoo.fr |
| **GBETOGO HOUNGUE David** | | **Benin** | +229 97772445/95240770<br>gbetohohoungue@hotmail.fr |
| **KANGETHE Jackson** | Regional GIS/IT Officer (FAO RAF + HQ) | **Kenya** | +254 736700101<br>jackson.kangethe@fao.org |
| **KOUADIO N'Gandi Jean-Serge** | MIRAH/DAP | **Côte d'Ivoire** | +225 07250628<br>ngandi.serge@gmail.com |
| **KOUDOUVOR Kokou** | Lomé Fishing Harbour | **Togo** | +228 90066813/99578116<br>pierrekoudouvor@yahoo.fr |
| **MAIGA Fatimata** | National Directorate of Fisheries | **Mali** | +223 76461387<br>fatimatamaiga@gmail.com |
| **ODURO Frieda Adjoa** | District Fisheries Officer | **Ghana** | +223 277766589<br>friedaoduro@yahoo.com |

| Name | Organization | Country | Contact / e-mail |
|---|---|---|---|
| **OUEDRAOGO Yacouba** | Fisheries and Aquaculture General Directorate | **Burkina Faso** | +226 78663230<br>yackouedrago@yahoo.fr |
| **SANOU Emmanuel** | Union of Fisheries of Burkina | **Burkina Faso** | +226 76603823<br>emmanuel-sanou@yahoo.fr |
| **SIGNA David** | Fisheries Officer (FAO RAF/SmartFish project) | | +230 2512851<br>david.signe@fao.org |
| **TABE Gnandi** | FAO TOGO | **Togo** | +228 90272969/99643070<br>gnandi.tabe@fao.org |
| **WONGLA Kinhébgédé Kennely Serge** | | **Benin** | +229 689550<br>ken8fr@hotmail.com |
| **HOLVOET Katrien** | Coordinator of the Fish HIV/AIDS Programme | **FAO/Benin** | katrien.holvoet@fao.org |

**APPENDIX 3**

**Observation checklist**

| Observation | YES | NO | Comment and/or indication |
|---|---|---|---|
| **1. Infrastructure and services** | | | |
| • Landing site and facilities such as jetties, roads, markets, processing sites and plants, storage facilities, water supplies, electricity, ice supply and cold storage facilities, transport, | | | |
| **2. Conditions** | | | |
| • Hygiene and sanitation conditions | | | |
| • Physical status of the site (flood prone? Aeration? Size?) | | | |
| • Presence of animals and pests | | | |
| • Personal hygiene of key stakeholders | | | |
| • Temperature control or not of fresh fish | | | |
| **3. Activities** | | | |
| • Different types of fish and fishery products | | | |
| • Fishing gears and equipment | | | |
| • Times and duration in the landing and offloading of fresh fish | | | |
| • Times and duration of post landing activities | | | |
| • Fresh fish handling and packaging | | | |
| • Use of fish boxes or insulated hold | | | |
| • Risks of fish being contaminated with gears oil and fuel | | | |
| • Risks of fish being contaminated with bacteria, chemicals, dirt etc | | | |
| • Handling, packaging and storage of processed fish materials/equipment | | | |
| • Use or presence of any chemicals | | | |
| • Washing of equipment, personal, cleaning of fish and use of potable water | | | |
| • Transport methods | | | |
| • Processing methods and equipment | | | |
| • Packaging methods and techniques | | | |
| • Storage facilities for fresh and processed products | | | |
| **4. Losses** | | | |
| • Examples of losses – physical, quality, market | | | |
| • Things people are doing to avoid losses | | | |

| Observation | YES | NO | Comment and/or indication |
|---|---|---|---|
| **5. Units of measurement** | | | |
| • Examples of local units used for measuring, trading, storing, transporting fresh and processed fish and equivalence in conventional Kg | | | |

**APPENDIX 4**

**Workshop on Improving the Performance of the Fisheries Post-Harvest Chains and Regional Trade in countries bordering the Volta Basin, 18 to 20 February 2014, Ouagadougou, Burkina Faso**

**Agenda**

| | |
|---|---|
| **Monday 17 February 2014** | |
| Arrival of participants and transport to the hotel | |
| **Day 1 – Tuesday 18 February** | |
| 08.00 | Registration |
| 09.30 | Opening ceremony |
| 10.00 | Designation of the meeting officers |
| 10.10 | Group picture |
| 10.20 | **Coffee/ Tea Break** |
| 10.45 | General information, getting to know each other, process of the workshop /**FAO, national organizer, participants** |
| 11.00 | NEPAD-FAO Fish Programme (NFFP) development process perspective within centered on B4 : « Mechanisms established for improving the performance of the fisheries and aquaculture postharvest chain and regional trade»- **Gunilla Greig/Yvette Diei-Ouadi / FAO** |
| 11.30 | The joint initiative FAO - Volta Basin Authority: "The Volta Tilapia Project "**Charles Biney / VBA** |
| 11.50 | Overview of the major issues raised by the pilot post-harvest fish loss assessments in 5 riparian countries of the Volta Basin - **Boris Sodoke/FAO** |
| 12.15 | Discussion and debate |
| **12.45** | **Lunch Break** |
| 14.00 | Outcomes of PHLA in Burkina Faso part of Volta Basin **/ PHLA national team** |
| 14.30 | Discussion and debate |
| 15.00 | Outcomes of PHLA in Ghana part of Volta Basin **/ PHLA national team** |
| **15.30** | **Coffee/ Tea Break** |
| 15.45 | Discussion and debate |
| 16.15 | Outcomes of PHLA in Togo part of Volta Basin **/ PHLA national team** |
| 16.45 | Discussion and debate |
| 17.15 | Video of an example of good practice for sustainability of interventions in post-harvest losses: Drying fish in Lake Tanganyika fishery in Burundi / FAO / **FAO** |
| 17.45 | Recap of Day 1 and closing |

| | |
|---|---|
| **Day 2 – Wednesday 19 February** | |
| 08.30 | Preparation for group work, Session 1 - Presentation of specific and common determinants of post-harvest fish losses and trade barriers identified at the policy level and operational |
| 09.00 | Group work, Session 1 |
| **10.30** | **Coffee/ Tea Break** |
| 10.50 | Presentation of group work and discussion |
| 11.50 | Video on an improved technique for reducing critical losses in small-scale fisheries / FTT Thiaroye: Part 1 / **FAO** |
| **12.30** | **Lunch Break** |
| 14.00 | Preparation for group work, Session 2 - Consensual elements of a strategy for sustainable reduction of losses and strengthening of regional trade - Roles and responsibilities of stakeholders, Partnership, challenges and opportunities for implementing an eventual strategy |
| 14.30 | Group work , Session 2 |
| **15.30** | **Coffee/ Tea Break** |
| 15.50 | Group work -Cont'd |
| 16.20 | Presentation of group work and discussion |
| 17.45 | Recap of Day 2 and closing |
| **Day 3 – Thursday 20 February** | |
| 08.00 | Visit of a fishery site (fish market, landing site etc.) / **National focal point** |
| 12.00 | Video on an improved technique for reducing critical losses in small-scale: fisheries / FTT Thiaroye : Part 2: Use and maintenance / **FAO** |
| 12.30 | Workshop evaluation and recommendations |
| 13.00 | Vote of thanks |
| 13.15 | Closing ceremony and certificates |
| **13.45** | **Lunch Break** |
| ------- | Departure of participants and transport to the airport |

**List of participants**

| NAME | COUNTRY OF ORIGIN | INSTITUTION | Email |
|---|---|---|---|
| SEDZRO, Kossi Maxoe (Mr) | TOGO | | ksedzro69@hotmail.com |
| BOKOBOSSO, Kissem (Ms) | TOGO | MAEP-DPA / Chef d'équipe EPAC-Togo (Evaluation perte-après capture réalisé dans la Volta) | bkissem@yahoo.fr |
| DJANKLA MODJOSSO, Tanah (Ms) | TOGO | MAEP-DE | modjotanah@yahoo.fr |
| KOUDOUVOR, Kokou (Mr) | TOGO | | pierrekoudouvor@yahoo.fr |
| DIALLO, Ousmane (Mr) | MALI | Direction Nationale des Pêche | ousmanediallodnp@yahoo.fr |
| MAIGA, Fatimata (Ms) | MALI | Direction Nationale de la Pêche | fatimatamaiga@gmail.com |
| TOURE, Alhassane Abou Sidi (Mr) | MALI | Directeur National de la Pêche<br>Tel.: 0022366780566 | retoudysan@yahoo.fr |
| DION, Somplehi Micheline (Ms) | COTE D'IVOIRE | Présidente Association des vendeuses de poissons frais et fumés d'Abobo-doumé (AVEPFFA)<br>01 BP 542 Abidjan 01 | avepffa@yahoo.fr |
| DIOMANDE, Labla Jérémie (Dr) | COTE D'IVOIRE | Directeur de la Formation, de la Vulgarisation et de la Valorisation des Produits | dtvp06@yahoo.fr; labladiomande@hotmail.com |
| KOUADIO N'Gandi Jean-Serge (Mr) | COTE D'IVOIRE | Chef de service Etudes, Statiques et Documentation à la Direction de l'Aquaculture et des Pêches MIRAH-DAP | ngandi.serge@gmail.com |
| ARYEE Emmanuel (Mr) | GHANA | | osubibibio@yahoo.com |
| ODURO, Frieda Adjoa (Ms) | GHANA | District Fisheries Officer | friedaoduro@yahoo.com |
| HOLVOET, Katrien (Ms) | FAO/Benin | Coordinatrice du Programme Peche et VIH-SIDA | katrien.holvoet@fao.org |
| GNITASSOUN, Dénagnon Luc (Mr) | BENIN | | |
| BADO KABORE, Julienne (Ms) | Burkina Faso | Direction générale des Ressources Halieutiques | juliennebado@yahoo.fr |
| OUEDRAOGO, Yacouba (Mr) | Burkina Faso | Direction générale de la Pêche et Aquaculture<br>Halieute/Sociologue<br>Ouagadougou<br>Tél: +226 78 66 32 30<br>+226 70 03 07 30 | yackouedrago@yahoo.fr |
| SANOU, Emmanuel (Mr) | Burkina Faso | | emmanuel-sanou@yahoo.fr |
| COULIBALY, N. Désiré (Mr) | Burkina Faso | DG Peche | dnessan@yahoo.fr |

| NAME | COUNTRY OF ORIGIN | INSTITUTION | Email |
|---|---|---|---|
| BINEY, Charles A. (Dr) | Burkina Faso | Ag. Executive Director<br>Volta Basin Authority<br>Ouagadougou<br>Tel. Office: +226 50376067<br>Tel. Cell: +226 76137478 | cbiney@gmail.com;<br>c.biney@abv-volta.org |
| TAMINI, Josué (Mr) | Burkina Faso | | |
| DIALLO, Hamma (Mr) | Burkina Faso | | |
| KABORE, née Zabsonré Colette (Ms) | Burkina Faso | | |
| OUATTARA, Do Chrisphophe (Mr) | Burkina Faso | | |
| DIEI-OUADI, Yvette (Mrs) | FAO/Rome | | yvette.dieiouadi@fao.org |
| SODOKE, Boris Komivi (Mr) | FAO/Rome | | komivi.sodoke@fao.org |
| GREIG, Gunilla (Mr) | FAO/RAF | | gunilla.greig@fao.org |
| AKANDE, Gbola Rasaaq (Mr) | Consultant<br>NIGERIA | | akandegra@yahoo.com |
| NA-ANDI Mamane Tahir (Mr) | Expert Pêche<br>Commission du Bassin du Lac Tchad | B.P. 727 N'Djamena<br>République du Tchad<br>Tél: +235 63 97 32 94<br>Tél: +235 92 20 11 34<br>Email: mtnandi3@yahoo.com | mtnandi3@yahoo.com |

**APPENDIX 5**

**Summary matrices by site, operator and country of physical losses, quality losses, and losses due to market forces**

**Table A5.1. Summary matrix of physical losses for the different sites, operators and countries**

| Countries | Actors | Main stages of occurrence of losses | Causes of losses | Frequency and seasonality | Trends during recent years | Perception of losses and coping strategies |
|---|---|---|---|---|---|---|
| **Burkina Faso** | Fishermen | Laying of nets | Attack and destruction of the nets by carnivorous fish | Rarely when gillnets are used | Stable | Affects their revenues |
| | Fishmonger in Tounga | Minimal losses | | | | |
| | Resellers/ (smoking, frying) processors in Bama, Gouran | Minimal losses | | | | |
| | Fresh-fish fishmongers / frying processors from Tounga | Minimal losses | | | | |
| | Smoking processors from Di | Minimal losses | | | | |
| | Smoked-fish fishmongers | Minimal losses | | | | |

| Countries | Actors | Main stages of occurrence of losses | Causes of losses | Frequency and seasonality | Trends during recent years | Perception of losses and coping strategies |
|---|---|---|---|---|---|---|
| **Ghana** | Fresh-fish fishmongers in Yeji and Dzemeni | During the selling, sorting and packaging | Theft by armed robbers and by transport helpers | Frequency<br>5 times/month | On the increase | Strategy: vigilance and choice of trusted transporters to reduce losses |
| | Smoking on 4 sites | During the smoking, cooling/storage | Calcination, predators, theft | Frequency<br>5 times/month | On the increase | N.A. |
| | Drying/salting on 3 sites | During drying and storage | Predators and insect infestation, theft | Frequency<br>5 times/month<br>Seasonality high season and robbery season | On the increase | N.A. |
| | Fermentation at Tapa Abotoase | Minimal losses | | | | |
| | Salted/dried-fish fishmongers at Buipe | Transport to the market | Insecurity/robberies | Frequency<br>5 times/month<br>Seasonality high season and robbery season | On the increase | Perception: lack of assistance/ support from authorities to limit/stop robberies |
| | Smoked-fish fishmongers at Tapa Abotoase | Transport to the market | Insecurity/robberies | Frequency<br>5 times/month<br>Seasonality high season and robbery season | On the increase | Perception: lack of assistance/support from authorities to limit/stop robberies |
| **Togo** | Smoking processors | Sorting before pretreatment<br>Draining before smoking, cooling after smoking<br>Smoking *per se* | Purchase of inadequate quality raw material<br>Predators (dogs)<br>Thefts<br>Calcination during smoking | N.A. | N.A. | N.A. |

*Note:* N.A.: not applicable.

**Table A5.2. Summary matrix of quality losses for the different sites, operators and countries**

| Country | Actors | Stage at which losses occur | Causes of losses | Frequency and seasonality | Trends | Perception of losses and coping strategies |
|---|---|---|---|---|---|---|
| **Burkina Faso** | Fishermen | Capture (laying of the net, while net is in the water, deployment)<br><br>Handling and on board transport | Long staying time of the net in the water, lifting the net<br>Use of small-mesh net catching small fish that spoil more easily<br>Chemical contamination of water by fertilizers and toxic crop contamination by decaying plants<br>Inadequate cold storage infrastructure on board | + during high water period (water quality)<br>During yearly hot periods | Usually stable but the use of small-mesh nets is on the increase | Perception<br>Linked to high waters.<br><br>Coping strategy: using cast nets and diversifying activities (agriculture) |
| | Fishmongers | Sorting, handling, collecting, storage stages | Fish quality at time of purchase<br>Too long collecting period (fish kept for a very long time in a container with very little ice)<br>Inadequate / makeshift container,<br>Unhygienic landing site | Quite frequent, almost always | No improvement (stable or on the increase) | Perception:<br>Affects their revenues<br>Reduces local fresh fish availability |
| | Resellers/ processors | Minimal losses: sold when fresh – unsold or lower quality products are processed (fried or smoked) or consumed by the household | | | | |
| | Fresh-fish fishmongers / frying processors from Tounga | Buy fresh fish from the market | Insufficient ice/fish ratio<br>Small size fish that spoil easily<br>Inadequate freshness at time of purchase<br>Poorly stored/transported | Quite frequent, almost always | No improvement (stable or on the increase) | N.A. |
| | Smoking processor from Di | Supply<br>Storage<br>Processing | Fish that is not fresh<br>Small-sized fish that spoil easily<br>No cold-storage infrastructure<br>Inadequate smoking methods and techniques | Always | Stable | Perception: changing meshes of the nets<br>Training fishermen sorting at landing<br>Coping strategy: processed into livestock meal |
| | Smoked-fish fishmonger from Di | Conditioning<br>Vehicle loading<br>Transport | Bad roads, poor smoked-product quality, inadequate loading of merchandise in the vehicles and overloading | Quite frequent | Stable | Perception:<br>Affects their revenues<br>Coping strategy: Selective buying (large tilapia) |

| Country | Actors | Stage at which losses occur | Causes of losses | Frequency and seasonality | Trends | Perception of losses and coping strategies |
|---|---|---|---|---|---|---|
| **Ghana** | Fresh-fish fishmongers at Yeji and Dzemeni | Capture and crossing<br>Fishmongering, pretreatment<br>Transport to market | Inadequate freshness at time of purchase<br>Poor handling<br>Inadequate transport conditions | Frequency 1.5–2 times/ month | On the increase | Same as for physical losses |
| | Smoking at the 4 sites | Capture and crossing<br>Purchase from fishermen<br>Handling, conditioning and transport for smoking<br>Smoking | Inadequate freshness at time of purchase<br>Long-distance transport brings about spoilage because the product has not been smoked properly<br>Inadequate smoking (calcination + high level of humidity) | Frequency 1.5–2 times/ month<br>Seasonality: High fishing season | On the increase | |
| | Drying/ salting at 3 sites | Minimal losses | N.A. | N.A. | N.A. | N.A. |
| | Fermentation at Tapa Abotoase | Minimal losses | N.A. | N.A. | N.A. | N.A. |
| | Salted/dried-fish fishmongers at Buipe | Minimal losses | N.A. | N.A. | N.A. | N.A. |
| | Smoked-fish fishmongers at Tapa Abotoase | Conditioning and transporting of smoked fish for sale | Spoilage/decaying because of high humidity level and bad roads; fraudulent practices by sellers (water addition) breakage | | On the increase | Perception: Authorities must repair road network |
| **Togo** | Smoking processors | Fresh fish purchasing<br>Transport/handling of fresh fish<br>Storing fresh fish<br>Smoking<br>Transport to market | Inadequate raw material quality<br>Stacking of fish for storage<br>Limited storage capacity and inadequate storage methods<br>Controlling the fire, overloaded racks, fish not turned over properly<br>Fish calcination<br>Breakage of fish because of overpiling | Higher frequency when the Harmattan is blowing for causes due to calcination | N.A. | Use of salt for conservation<br><br>Smoking by fishermen before selling |

*Note:* N.A.: not applicable.

**Table A5.3. Summary matrix of losses due to market forces for the different sites, operators and countries**

| Country | Actors | Stage at which losses occur | Causes of losses | Frequency and seasonality | Trends | Perception of losses and coping strategies |
|---|---|---|---|---|---|---|
| **Burkina Faso** | Fishermen | Landing | Supply greater than demand during high fishing season (October–November)<br>Sell-off to accomplish agricultural activities as the high season coincides with the seasonal farm work | High fishing season<br><br>Seasonal farm work | Stable | Perception: Affects their revenues<br><br>Coping strategies:<br>Sell-off (price decrease to sell quickly)<br>Number of fishing days reduced |
| | Fishmongers | Selling in Ouagadougou | Fishmongers overbid the purchase price of tilapia among themselves<br>They also face competition from imported tilapia | All year round | N.C. | N.C. |
| | Resellers/processors in Bama and Gouran | At the market for frying processors in Bama | Supply greater than demand during high fishing season | High fishing season | Stable | N.C. |
| | Fresh-fish fishmongers / frying processors from Tounga | Minimal losses | N.A. | N.A. | N.A. | N.A. |
| | Smoking processors from Di | Minimal losses | N.A. | N.A. | N.A. | N.A. |
| | Smoked-fish fishmonger in Di | N.C. | N.C. | N.C. | N.C. | N.C. |

| Country | Actors | Stage at which losses occur | Causes of losses | Frequency and seasonality | Trends | Perception of losses and coping strategies |
|---|---|---|---|---|---|---|
| **Ghana** | Fresh-fish fishmongers in Yeji and Dzemeni | At the market<br><br>During transport to market | High season = oversupply<br>Weak purchasing power<br>Lack of market and information on the market | N.C. | N.C. | Perception of losses:<br>Markets are being deserted because fewer traders are coming from large cities owing to high incidence of armed robbery<br>Low purchasing power due to economic hardship<br>Poor institutional support<br>Coping strategies:<br>Income source/activities diversification (cattle breeding, sale of bushmeat, petty trade)<br>Changing supply source<br>Temporary change to other safer and more lucrative processing (from smoking to drying / salting) |
| | Smoking at 4 sites | At the market<br><br>During transport to market | High season = oversupply<br>Weak purchasing power<br>Lack of market and information on the market | N.C. | N.C. | |
| | Drying/salting at 3 sites | | | N.C. | N.C. | |
| | Fermentation at Tapa Abotoase | | | N.C. | N.C. | |
| | Salted/dried-fish fishmongers at Buipe | | | N.C. | N.C. | |
| | Smoked-fish fishmongers at Tapa Abotoase | | | N.C. | N.C. | |
| **Togo** | Smoking processors | When sold | Abundance of fresh fish leads to smoking a large quantity of fish; quantity of smoked fish on market higher than demand, causing price to drop to sell products | Back-to-school periods, fasting periods, Ramadan, Tabaski or holiday season | | Coping strategy: Sell-off |

*Note:* N.A.: not applicable; N.C.: not communicated.

**Minimal losses**

A few examples of minimal losses were observed in the three countries.

Actors have their own initiatives to minimize losses, namely:

- In Burkina Faso, on one site, the alternate use of gillnets and castnets partially explains the relatively low quantities associated with quality losses.
- In Ghana, the use of salt plays a role in long-term storage of salted/dried fish and prevents quality losses.
- In Togo, to diminish fresh fish losses, women use salt if the landing is quite a distance from the processing site. When the fishing location is far away from the processing sites, fishermen try to smoke the fish themselves on the fishing grounds before selling to smoked fish traders; this fish is put back on fire by smoking processors after purchase.

**APPENDIX 6**

**Tools used by each type of operator, by country and relevant fish species**

***Burkina Faso***

| Industry sector of the actors interviewed | Method/technique | Relevant fish species | Product quantity (fished or processed) (tonnes/year) |
|---|---|---|---|
| **Fishing at** all 4 sites | Dugouts, gillnets, cast nets | *Tilapia*, *Clarias*, *Gymnarchus*, *Heterotis*, *Bagrus* | 933 |
| **Fishmongering** (Tounga site) | Long collection time; conservation (icing of the fish in the containers), loading onto vehicles | *Tilapia*, *Clarias*, *Gymnarchus*, *Heterotis*, *Bagrus* | 28 |
| **Frying** by a frying processor in Tounga + Bama | Important frying, excessive reuse of frying oil | Unspecified species | 24 |
| **Sale of fresh/smoked fish** on site (Bama, Gouran et Di) | At local open-air market (no roofing) | Unspecified species | N.C. |
| **Smoking** (Di sites) | Traditional Dafing smoking kiln | *Tilapia*, *Clarias* | 73 |
| **Smoked fish fishmongers from** Ouagadougou who come to Di | Weighed on scales, packed in baskets and transported by taxi to Ouagadougou | *Tilapia*, *Clarias* | 96 |

*Note:* N.C.: not communicated.

***Ghana***

| Industry sector of the actors interviewed | Method/technique | Relevant fish species | Product quantity (fished or processed) (tonnes/year) |
|---|---|---|---|
| **Fresh fishmongering** at Dzemeni et Yeji | Negotiating price, buying, sorting and classifying, transported to markets in pans with very little ice | Unspecified species/ multispecies | 465 |
| **Smoking** at the 4 sites | Banda et Chorkor kilns | | 172 |
| **Drying/salting** at 3 sites | Sun-dried | | 60 |
| **Fermentation** at Tapa Abotoase | Traditional technique: pretreatment, salting in tanks, airtight seals | | 25 |
| **Salted/dried fishmongers at** Buipe | Buying from the processors and selling in the town markets | | 120 |
| **Smoked fishmongers** at Tapa Abotoase | Buying from the processors and selling in the town markets | | 65 |

***Togo***

| Industry sector of the actors interviewed | Method/technique | Relevant fish species | Product quantity (fished or processed) (tonnes/year) |
|---|---|---|---|
| **Smoking** | Traditional smoking kilns made out of mud/clay, barrels or old basins, netting and sheet metal | *Gariepinus, Labeo* spp., *Chrysichtys auratus, Tilapia* spp., *Lates niloticus*, spp., *Hemichromis* spp., and *Synodontis* spp. | Donga 98<br>Pansiéri 172<br>Koumongou Kan 24<br>Nadougbal 61<br>Total: 356 |

**APPENDIX 7**

**Country proposals**

**Table A7.1. Proposals for priority loss reduction interventions for the sites in Burkina Faso**

| Priority losses | Who will need to take action | What the appropriate actions are | Inputs and estimated annual cost |
|---|---|---|---|
| Quality losses faced by fishermen from the Tounga site owing to water quality degradation | Government | Inform riparian populations and build awareness on measures regulating using the banks of Lake Kompienga for agricultural activities | Information / awareness-building sessions in the lake's riparian villages: XOF500 000 (USD1 020) |
| | | Set up a surveillance system of the protection area around the lake involving the local community organizations | Monitoring rounds for the protection area around the lake: XOF1 500 000 (USD3 065) |
| | | Enforce regulations on bank protection | |
| | | Review the fishing closed period | Meeting of the management committee to share the results of the PHLA and decision-making: XOF3 000 000 (USD6 130) |
| | | Perform tilapia microbiological and biochemical analyses to determine the impact of different pollutants on the quality of the fish | Laboratory expertise (sample and analyses): XOF3 000 000 (USD6 130) |
| | | Monitor water quality with periodic analyses | Laboratory expertise (sample and analyses): XOF5 000 000 (USD10 215) |
| | Agencies/ donors, NGOs, VBA | Disseminate information on losses to operators and other users of the lake | Feedback meeting: XOF1 500 000 (USD3 065) |
| | Village development committees | Monitor the setting up of farms and vegetable crops in cooperation with extension workers | Field visits: XOF500 000 (USD1 020) |
| | | Raise members' awareness on the role of the protection area around the lake | Awareness-raising meeting with the support of technical services: XOF1 000 000 (USD2 045) |

| Priority losses | Who will need to take action | What the appropriate actions are | Inputs and estimated annual cost |
|---|---|---|---|
| Quality losses incurred by fresh-fish fishmongers because of the lengthy collection and the absence of ice near the Kompienga fishery | Government | Develop adequate landing areas | Construction /rehabilitation: XOF6 000 000 (USD12 255) |
| | | Restore functioning fish purchasing centres (landing wharfs) | Monitor visits to the landing wharfs: XOF500 000 (USD1 020) |
| | Fishermen/fishmonger groups | Build members' awareness to sell the fish on the landing wharves | |
| | | Report buying/selling of fish away from the landing wharfs | |
| | Agencies/ donors, NGOs, VBA | Financial support to the Government for the development of the value chain | Installation of ice plants XOF20 000 000 (USD40 850) |
| Quality losses incurred by fishermen, smoking processors at the Gouran and Di sites because of the use of small-mesh gear | Government | Take measures to regulate fishing on the Sourou | |
| | Government / agencies, donors, NGOs, VBA | Train fishing communities on the sustainable management of fish resources | Training sessions: XOF3 000 000 (USD6 130) |
| | | Build awareness / inform consumers on risks linked to juvenile tilapia catching. | Radio shows<br>Radio spots<br>Information / awareness-building sessions<br>XOF5 000 000 (USD10 215) |
| | | Assist private entrepreneurship in the aquaculture production of small tilapias | Establish aquaculture infrastructure<br>Train entrepreneurs<br>Aquaculture inputs<br>XOF10 000 000 (USD20 425) |
| | Agencies/ donors, NGOs, VBA | Accompany and facilitate negotiations with Malian authorities to draft regulations that ensure an economically viable and sustainable fish production in the Sourou | Meetings between the technical committee GIRE/Sourou Mali – Burkina Faso: XOF5 000 000 (USD10 215) |
| | | Set up and implement a joint participatory monitoring system for fishing operations | Training sessions, equipment for monitoring units: XOF3 000 000 (USD6 130) |
| | | Develop and implement a joint development plan (Mali –Burkina Faso) for the Sourou fishery | Studies, validation: XOF10 000 000 (USD20 425) |
| | Fishermen and women processor group union | Build members' awareness to use legal mesh-size nets | Information / awareness-building sessions: XOF1 000 000 (USD2 045) |
| | Government/ fishermen | Monitor fishing operations | Rounds of the monitoring brigade: XOF1 500 000 (USD3 065) |
| | Agencies/donors, NGOs | | Debriefing meeting: XOF3 000 000 USD6 130) |

| Priority losses | Who will need to take action | What the appropriate actions are | Inputs and estimated annual cost |
|---|---|---|---|
| Quality losses incurred by fishermen at the Tounga site owing to the use of small-mesh gear | Government | Strengthen the capacity of deployment and mobility of the technical team responsible for the management of the lake | Motorcycles and maintenance: XOF6 000 000 (USD12 255) |
| | | Organize the control of fishing operations | Control rounds with motorcycles and motorboats: XOF2 500 000 (USD5 105) |
| | | Inform migrant fishermen and build their capacity | Information sessions: XOF1 000 000 (USD2 045) |
| | | Rigorously enforce sanctions for perpetrators and accomplices of IUU fishing | |
| | | Present the results of the PHLA to the actors in Tounga | Debriefing meeting: XOF1 000 000 (USD2 045) |
| Quality losses incurred by fishermen and smoking processors in Di and Gouran and frying processors in Tounga because of the absence of ice | Agencies/ donors, NGOs | Set up and train a management committee for the ice plant (being installed by the Government) | Training for members of the committee and a technical team: XOF3 000 000 (USD6 130) |
| Quality losses incurred by smoked-fish fishmongers because of fraudulent sale practices | Agencies/ donors, NGOs | Support the organizing of a consultative meetings between processors and fishmongers of smoked fish | Consultative meetings: XOF1 500 000 (USD3 065) |
| Quality losses incurred by smoked-fish fishmongers at the Di and Gouran sites and smoked-fish fishmongers because of poor smoking techniques | Agencies/ donors, NGOs | Retrain smoking processors on hygiene, smoking fish and the quality of fishery products | Training session: XOF3 000 000 (USD6 130) |
| | | Improve the performance of the Dafing smoking kiln | Bring innovation to the Dafing smoking kiln in terms of reducing wood consumption, work drudgery, smoking time and the quality of smoked fish<br><br>XOF2 000 000 (USD4 085) |
| | | Disseminate quality standards for fish products | Information / awareness-building sessions: XOF2 000 000 (USD4 085) |

| Priority losses | Who will need to take action | What the appropriate actions are | Inputs and estimated annual cost |
|---|---|---|---|
| Quality losses incurred by fishermen in the Bama site owing to the use of small-mesh gear | Government | Raise the level of the dam's spillway of the lake to restore the fishing area | For the record |
| | Government/ Agencies/ donors, NGOs | Set up a consultation framework to manage fishing involving the two fishermen groups, fish resellers, technical services and the authorities in Bama | Consultative meetings: XOF1 500 000 (USD3 065) |
| | Government/ agencies/ donors, NGOs | Support and facilitate the negotiation of common rules for fisheries management | Consultative meetings<br>Validation meeting on the common rules: XOF2 000 000 (USD4 085) |
| | Government | Monitor the implementation of the management rules | Monitoring and evaluation missions: XOF1 000 000 (USD2 045) |
| | Government/ agencies/ donors, NGOs | Establish, equip and train a committee of participatory monitoring of the lake | Purchasing of navigation, protective and training equipment: XOF3 000 000 (USD6 130) |
| | Agencies/ donors, NGOs | Disseminate results to fisheries actors | Debriefing meeting: XOF1 000 000 (USD2 045) |
| **Total** | | | **XOF114 500 000 (USD233 870)** |

**Table A7.2. Proposals for priority loss reduction interventions for the sites in Ghana**

| Priority losses | Responsibility | Reduction interventions | Costs/revenues |
|---|---|---|---|
| Quality losses due to fish breakage | Fisheries Commission | Awareness building at the processing sites in production villages | Petrol, per diem<br>GHS1 810 (USD500) |
| | | Training of processors in fish handling – good practices | Training materials, resource persons, petrol, per diem<br>GHS3 620 (USD1 000) |
| | Fisheries Commission/ agencies/donors | Supply processing equipment, including good storage facilities in villages and Buipe | GHS181 000 (USD50 000) |
| | Fisheries Commission/ maritime authority/naval | Train vessel operators on how to handle fish during transport to markets | GHS18 100 (USD5 000) |
| Losses due to market forces because of the poor state of the market infrastructure | District assembly agencies/donors | Renovate the Buipe | GHS289 600 (USD80 000) |
| Losses due to market forces because of the risk of armed robberies | Police administration | Road police patrol | Petrol – GHS10 860 (USD3 000) |
| | | Implementation of e-commerce centre | GHS36 200 (USD10 000) |
| Losses due to market forces because of lack of market information | Fisheries Commission/ agencies/donors | | |
| Physical losses due to levies and taxes | Supreme chief / district assembly | Meeting between actor representatives and market authorities | Coffee break<br>GHS724 (USD200) |
| Physical losses due to fish calcination | Fisheries Commission | Retrain women smoking processors on good practices regarding fish smoking | Demonstration materials, petrol, per diem<br>GHS5 430 000 (USD1 500) |
| Physical losses due to fish being eaten by animals | Fisheries Commission/ agencies/donors | Fencing off the processing zone | GHS18 100 (USD5 000) |
| **Total** | | | **GHS565 444 (USD156 200)** |

**Table A7.3. Proposals for priority loss reduction interventions for the sites in Togo**

| Priority losses | Who will need to take action | What the appropriate actions are | Inputs and estimated annual cost |
|---|---|---|---|
| Quality losses | Government and technical and financial partners | Train smoking processors in good practices for processing and storing smoked products, hygiene and simplified accounting | This activity is being carried out by the Support to the Agricultural Sector Project (PASA) |
| | | Organize fishery actors in socioprofessional groups | This activity has been taken on board and will be programmed and implemented by the Technical Advisory and Support Institute |
| | | Support for the construction of improved kilns on Koumongou-Kan and Pansiéri sites (24 kilns) | Building of 3 large warehouses XOF5 000 000 (USD10 215), warehouse to protect the smoking kilns XOF20 000 000 (USD40 860) + building of 24 banda smoking kilns XOF300 000 (USD580)/smoking kiln XOF7 200 000 (USD13 950) |
| | | Support installation of solar panels for the freezers | Solar panels: XOF20 000 000 (USD40 860) |
| | | Support installation of ice plant in Pansiéri | Purchase of 5 freezers XOF2 500 000 each (USD5 125) |
| | | Support for drinking-water supply (all sites) | Drilling XOF6 000 000 (USD12 255) |
| | | Support for the acquisition of insulated containers (220 containers) | Purchase of containers XOF2 200 000 (USD4 500) |
| 2. Losses due to market forces | Government and technical and financial partners, NGOs | Organize experience sharing trips | XOF8 000 000 (USD15 500) |
| | The Fisheries Directorate and other State structures | Educate fishermen on the laws and regulations | For the record – already financed |
| | National consultant | Monitoring and evaluation of activities implemented | XOF10 000 000 (USD19 350) |
| **Total** | | | **XOF69 000 000 (USD145 945)** |

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