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REPORTS AND DOCUMENTS

Framework for environmental management in assistance programmes

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Section 1: Assistance programmes and environmental management

ICRC Assistance Programmes aim to preserve or restore acceptable living conditions for people affected by armed conflict and other situations of violence. These victims can be highly vulnerable and are in most contexts highly dependant on their local environment for their livelihoods, health and security. As such, human health, livelihood and survival are intertwined with environmental concerns. Environmental concerns are thus directly relevant to ICRC assistance activities and must be part of them.

As a leading humanitarian organisation, the ICRC has a key role to play in issuing a clear message that allows for consideration of environmental issues that affect the victims of armed conflict while ensuring that the victims themselves remain central to ICRC Assistance Programmes.

This document aims to define environmental issues in the context of ICRC's operations. It also aims to provide useful and practical guidance to Assistance delegates and national staff on two levels:

- how to understand the relationship between Assistance activities and the environment upon which victims of armed conflicts depend; how to consider the potential positive or negative impacts of Assistance activities, without in any way compromising the rapidity and effectiveness of ICRC action;

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- how to continue to develop an environmentally alert mindset and to enable environmental issues to be systematically integrated into the balance of factors that need to be considered to produce an efficient, effective and rapid ICRC response.

This framework for environmental management in Assistance Programmes is a first step towards formalizing an ICRC approach to environmental issues related to the victims of armed conflict and other situations of violence. The framework fits into the broader environmental concern of the institution as a whole. It encourages field operations to systematically assess, identify and understand the potential environmental impacts and implications of their activities and to take reasonable and feasible initiatives to reduce these impacts and enhance the efficiency, appropriateness and quality of Assistance Programmes.

1.1 Understanding environmental issues

This section explores some key questions regarding environmental issues from its definition to its linkage with humanitarian work.

A. Definitions

There are many different definitions and interpretations of the environment and environment-related terms. It is important to define a few terms related to the environment considered within the context of armed conflict and other situations of violence.

Environment: The definition of the environment in the context of ICRC activities focuses on human beings and their relationships with all the elements, natural or man-made, that directly or indirectly affect their living conditions. These include physical elements such as air, water, soil, natural resources, flora, fauna, but also consider socio-economic factors, beliefs, practices, political positions, law and policies that affect the livelihood.

Environmental impact: The direct and indirect effects of a project or ICRC presence on human beings (including social impact), fauna and flora, soil, water, air, climate and the landscape, the interaction of these factors, and on material assets and the cultural heritage.[1]

Environmental impact assessment: The identification, description and assessment of environmental impacts, together with project alternatives and mitigation measures.

Environmental mitigation measures: Environmental mitigation measures encompass all the measures undertaken to reduce the negative environmental

1 Adapted from European Union, Council Directive of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment (85/337/EEC), Article 3.

impacts of a project. These measures can include the modification or elimination of some activities, the choice of alternatives or the implementation of compensation measures.

Environmental management plan: Process made of specific activities, built into the project to ensure the identification and implementation of environmental mitigation (and enhancement) measures. It can contain baseline data, analysis of the impacts, residual impacts, monitoring and reporting processes.

These definitions place the human being at the centre of all interactions between biological, inanimate and human factors. It includes available and accessible resources and their mode of exploitation, available assets, and existing relationships with other persons and groups.

The term climate change is frequently mentioned in parallel to the term environment. It is widely mentioned as one of the factors that could contribute to future conflicts and exacerbate existing ones. It is however important to note that climate change is only one of several causes to the degradation of the environment. Bad governance, corruption or deficiency in private and public sources, population growth and density, and competition over resources are and will remain key contributing factors.

B. Classification of environmental issues

Four different types of environmental issues are frequently mentioned within the scope of humanitarian work:

1) Environmental issues that fuel tension

These issues refer to competition over resources such as natural resources (water, farming land, grazing land, forest, mines, wildlife) and other strategic assets (communication routes, cities, etc).

It is the responsibility of national and international policy-makers to lay the foundations of comprehensive environmental management. The scope of most of these issues goes beyond the ICRC mandate and expertise but a good comprehension of the environmental issues fuelling the conflict can enable ICRC to avoid exacerbating these dynamics.

2) Environmental issues created by conflicts

These can be **direct impacts** affecting populations, perpetrated by armed forces. They include amongst others:

– destruction of water supply and irrigation systems;
– destruction of shelter and other civil infrastructures;
– disruption of health services and health related problems including death;
– weapon and chemical contamination;
– surface water and aquifer contamination;
– impacts on fauna and flora.

These impacts are of interest to the ICRC as they directly relate to its mandate. They have to be assessed and understood in order to design appropriate assistance programmes to assist the populations affected by them.

– These can also be **indirect impacts perpetrated by the victims of armed conflict themselves**, related to their displacement or the constraints caused by adaptation to a situation of conflict such as high population densities. They may include:
– deforestation (firewood collection, charcoal production),
– spread of diseases,
– surface and subsurface pollution,
– over-exploitation of water,
– over-fishing,
– over-grazing,
– desertification.

As above, these issues must be assessed and understood in order to design appropriate assistance programmes to assist the displaced and host populations.

This framework provides insight into direct and indirect environmental issues caused by conflicts and highlights the importance of including these concerns into the design of assistance programmes.

3) Environmental issues created by humanitarian presence

Humanitarian agencies themselves can contribute to the overall degradation of the local environment as a consequence of their presence and activities. This includes:

– water and soil contamination from the poor disposal of waste;
– air pollution (exhaust fumes);
– fluctuation of price and availability of local products and services (including lodging);
– exacerbation of indirect issues listed above in contexts where the presence of humanitarian organisations encourages an increase in population density.

These issues are important and sensitive considerations, but are not covered in this document.

4) Environmental issues related to assistance programmes

Assistance Programmes aim to address the needs of populations affected by conflicts. By their very definition, they both depend on and affect the environment of these populations. How they affect the environment will depend on a careful assessment of all aspects of the situation at the beginning of ICRC's intervention, and a balance between immediate needs and longer-term consideration of the impacts on the local populations. If, for various reasons, the environmental issues surrounding the activity are not properly assessed or managed, it can potentially have a detrimental impact on the local environment and the beneficiary populations that the activities are designed to assist.

These impacts and interactions are complex and can include:

– overuse of farming land (fertility loss, deforestation, soil erosion);
– overgrazing / overfishing;
– overuse or pollution of water resources;
– pollution due to waste disposal (for example medical waste);
– loss of biodiversity or introduction of invasive species;
– detrimental effects on social or economical mechanisms.

Examples of environmental issues to consider during the design of a project, potential positive and negative impacts, suggestions to mitigate them and key points to consider as part of an overall assessment to find the most appropriate solution form part of Section 2, 3 and 4.

1.2 Rationale for the integration of environmental considerations into assistance programmes

According to the Assistance Policy paper,[2] the following principles guide all Assistance activities. This section explores how these principles relate to environmental considerations.

A. Taking the affected group and its needs into account

"The ICRC seeks to work in close proximity to the affected group. The organization must take account of the local value systems and the group's specific vulnerabilities and perception of its needs".[3]

The affected population will be best aware of its interactions with the local environment and consequences of any negative impact upon it. In cases of population displacement for example, the host community must be consulted to identify their main concerns relating to existing environmental issues and potential future environmental issues related to the displaced population.

→ **Consult with victims of armed conflict, either displaced or host populations**

B. Effective humanitarian assistance of high quality

"ICRC programmes must be planned, implemented and monitored in accordance with the highest professional standards. If the ICRC is to preserve its capacity to provide high quality and effective assistance, it must analyse and develop

2 ICRC, *ICRC Assistance Policy*, adopted by the Assembly of the International Committee of the Red Cross on 29 April 2004, Public Version, in *International Review of the Red Cross*, Vol. 86, No. 855, September 2004, pp. 677–693.
3 *Ibid.*, General Principle 3.1., p. 680.

professional standards in conjunction with academic institutions and other relevant bodies".[4]

This includes being aware of current issues and legislation related to the environment, natural resources and land management in the countries where ICRC is present and consulting with the appropriate authorities.

→ **Know and understand existing legislation and consult with relevant authorities**

C. Ethical norms

"When providing assistance, the ICRC must respect certain ethical standards, namely the applicable principles of the Movement, the principle of do no harm, and the principles set out in the relevant codes of conduct. The best interests of those suffering the consequences of armed conflict and other violent situations must always guide the ICRC's activities".[5]

The Red Cross/Red Crescent Code of Conduct, Principle 8, clearly states that "[w]e will pay particular attention to environmental concerns in the design and management of relief programmes. We will also endeavour to minimise the negative impact of humanitarian assistance …".[6] As members of the movement, ICRC has a moral responsibility to set an example and ensure that it does everything possible and feasible, within the limits of each situation, to integrate key environmental issues into its programmes and activities.

→ **Integrate environmental concerns in the design and implementation of Assistance Programmes**

D. Responsibilities within the Movement

"As a component of the Movement, the ICRC must discharge its responsibilities in compliance with the Seville Agreement and the Statutes of the Movement currently in force. During armed conflict or internal disturbances and in their direct aftermath, the ICRC has a dual responsibility: its responsibility as a humanitarian organization for carrying out the specific activities arising from its mandate and its responsibility for coordinating the international action taken by any components of the Movement involved in an operation or wishing to contribute to it. The ICRC must provide effective coordination and information in relation to both types of responsibility".[7]

4 *Ibid.*, General Principle 3.2., p. 680.
5 *Ibid.*, General Principle 3.3., p. 681.
6 *Code of Conduct for the International Red Cross and Red Crescent Movement and NGOs in Disaster Relief*, Principle 8, available at: http://www.ifrc.org/publicat/conduct/index.asp?navid=09_08 (last visited 30 September 2010).
7 *ICRC Assistance Policy*, above note 2, General Principle 3.4., p. 681.

Communication and collaboration with National Red Cross societies is an opportunity to advocate for more respect for the local environment where needed and to build capacity in this field, where and when appropriate. National societies can also provide valuable information on local environmental issues and national legislation. It is also an opportunity for the ICRC to ensure that the impact of joint activities on the local environment is managed by all members of the Movement.

→ **Promote environmental advocacy and capacity building with National Societies**

E. Partnerships with other humanitarian actors

"The ICRC must take particular care to associate with humanitarian actors whose working methods and policies are compatible with its own principles and work".[8]

Other humanitarian partners may share similar environmental concerns and be able to exchange useful additional information and advice.

→ **Exchange environmental information with other actors and share our environmental concerns**

1.3 Assistance strategies: Overall analysis of the situation and needs

"The ICRC conducts an overall analysis of each situation in which it is involved (security and economic, political, social, environmental and cultural aspects) in order to identify the problems and needs of the affected groups in terms of resources and services and their relationship with the various actors involved. … This analysis, regularly updated at the local, regional and international levels, enables the ICRC to draw up, adapt or alter its operational strategies. Finally, the ICRC analyses each situation and assesses risks in relation to expected impact. This is the basis on which the organization determines its own course … ".[9]

The ICRC adapts its response to the situation and consideration of environmental issues should be no exception to this rule:

Acute Crisis:

- In acute emergencies, the first priority is to address the immediate needs of the victims of armed conflict and ICRC seeks to maintain a rapid response operational capacity. Some environmental damage may be unavoidable due to time constraints and urgency of the situation. However, the implementation of mitigation measures should be considered as soon as feasible. Assistance delegates should be able to clearly justify their decisions and demonstrate the reasons behind them in an assessment report.

8 *Ibid.*, General Principle 3.5., p. 681.
9 *Ibid.*, Strategy 4.1., p. 681.

Pre-Crisis:

- ICRC supports existing systems or mobilises other entities to do so to prevent a disaster in humanitarian terms. Delegates should ensure that the delegation is aware of existing environmental issues at a local and national level, existing legislation and the relationships between populations and the environment.

Chronic Crisis:

- ICRC focuses on finding sustainable solutions to the problems it encounters, by handing over, and building capacities of authorities. Environmental issues and environmental management are key to finding sustainable solutions. Where national legislation does not exist or is not implemented, ICRC can use its experience to highlight the environmental issues that it encounters and build capacity where appropriate.

Post-Crisis:

- In contexts where it has a residual responsibility, the ICRC continues its activities and shoulders its responsibilities.

Consideration of environmental factors should not affect the above response patterns but should become a systematic, documented, and integral part of them.

1.4 Role of assistance programmes in addressing environmental issues

Humanitarian organisations as a whole cannot address environmental issues in a country without appropriate national environmental and natural resource management legislation and policies. However, there are measures that can be taken to enhance ICRC assistance response, to adhere to the "do no harm" principle and to reduce potential additional negative impacts on already vulnerable populations. A sound coordination done in consultation with local and national authorities, the affected populations as well as other national and international humanitarian agencies is essential.

Knowledge of the local environment, national environmental legislation and collaboration with local communities are essential. In many cases, national environmental legislation may exist and must be respected even if they are not respected locally by the local population.

Environmentally sound solutions are often logical, practical and feasible. It is not always necessary to be an environmental expert to find solutions that have the added benefit of being environmentally sustainable. It requires design and implementation of activities with an understanding of their environmental impact and active efforts to minimise these impacts wherever practical and feasible. A wide variety of activities can be developed expressly to contribute to improve the local environment while enhancing the situation of the local population. There is no sustainability of projects without a sustainable environment.

As a leading humanitarian organisation, the ICRC has a key role to play in issuing a clear message that allows for consideration of environmental issues that

affect the victims of armed conflict while ensuring that the victims themselves remain central to ICRC Assistance Programmes.

Section 2: Water and habitat and environmental management[10]

Water and Habitat programmes are designed to ensure access to safe water and to a healthy living environment. The ultimate aim is to help reduce the rates of mortality and morbidity and the suffering caused by the disruption of the water supply system, the lack of sanitation or damage to the habitat.

In a situation of acute crisis:

- ICRC ensures access to water and safe environmental sanitation conditions and helps basic health care facilities by means of emergency action and support for existing facilities.

In situations of emerging, chronic and post-crisis:

- ICRC's priority is to support and strengthen existing structures through specific programmes that meet the needs of the population in a viable, sustainable manner.

Water and Habitat field of activities are:

- supply, storage and distribution of drinking water;
- environmental sanitation and waste management;
- energy supply for key installations such as hospitals, water treatment plants and water distribution networks and appropriate technologies for cooking and heating;
- construction and reconstruction, including health structures and temporary shelter; rehabilitation of existing structures when destroyed;
- technical advice to administration department on ICRC premises interventions.

10 For key references from other agencies for environmental considerations in Water and Habitat activities see, T.H. Thomas and D.B. Martinson, *Roofwater Harvesting: A Handbook for Practitioners*, IRC International Water and Sanitation Centre, Technical Paper Series, No. 49, Delft, The Netherlands, 2007; Norwegian Refugee Council (NRC)/The Camp Management Project (CMP), *The Camp Management Toolkit*, 2008, Chapter 6: Environment; Office for the Coordination of Humanitarian Affairs (OCHA) / United Nations Environment Programme (UNEP), *Humanitarian Action and the Environment*, Leaflet; UNEP / Swiss Resource Centre and Consultancies for Development (SKAT), *After the Tsunami: Sustainable building guidelines for South-East Asia*, 2007; United Nations High Commissioner for Refugees (UNHCR), Environmental Guidelines, Geneva, 2005; UNHCR, *Refugee Operations and Environmental Management: Selected Lessons Learnt*, Geneva, 2001; UNHCR, *Refugee Operations and Environmental Management: Key Principles for Decision Making*, Geneva, 1998; UNHCR, *Cooking Options in Refugee Situations: A Handbook of Experiences in Energy Conservation and Alternative Fuels*, Geneva, 2002; U.S. Agency for International Development (USAID), *Environmental Guidelines for Small Scale Activities in Africa*, March 2009, Part II, Chapter 3: Construction; Chapter 5: Energy Sources for Development, Chapter 15: Solid Waste and Chapter 16: Water Supply and Sanitation, all chapters available at: http://www.encapafrica.org/egssaa.htm (last visited 20 July 2010).

The above activities can take place in both urban and rural settings and in detention places.

2.1 Environmental challenges of water and habitat activities

Current Water and Habitat assistance activities do not only take the environment into account, but in many cases propose solutions that respect or enhance it in order to achieve their purpose of reducing the rates of mortality and morbidity of victims of armed conflict. In many instances, these activities are inherently environmentally friendly.

When supporting an urban water treatment and distribution authority, for example, the project will include rationalisation of the use of existing resources taking into account their yearly fluctuations in order to ensure an adequate and continuous supply to affected populations.

Participatory approaches in hygiene promotion and sanitation activities enhance local awareness and understanding of the interactions between the local environment and the health of the affected population; and encourage communities themselves to manage their local environment in a way that is beneficial to them.

However, Water and Habitat programmes can also on occasion have a negative impact on the environment. Provision of additional equipment to a community or a water distribution body can change water consumption habits that were well-adapted to local conditions. Extensive construction programmes can contribute to localised depletion of resources, such as excessive wood consumption for brick-making, and the disposal of waste generated from construction programmes can be hazardous to local communities. Spring catchments, if not properly assessed can dry up streams and have a detrimental impact on crops and fisheries.

The Water and Habitat delegate must take these positive and negative factors into account when designing and evaluating programmes; combine them with the local context and come up with a solution that meets the needs of the affected population.

Some environmental challenges and considerations faced by Water and Habitat delegates when designing and implementing Water and Habitat activities are detailed in Section 2.3. It is not an exhaustive list of potential impacts and mitigation measures for all Water and Habitat activities, but can be useful to address key issues.

2.2 Case studies

The following two Water and Habitat case studies highlight the variety of environmental considerations that might arise during projects.

A. Biogas in prisons, Nepal

During the armed conflict between Maoist rebels and government forces, many people were detained in relation to the conflict.

Since 2004, the ICRC Nepali delegation supported detention authorities to ensure that detainees held in civilian jails had access to improved infrastructure by providing technical expertise and assistance. To date, the WatHab department has carried out rehabilitation and improvement works in 21 jails in Nepal.

Nepali jails generate several different types of waste with poor waste treatment systems available. This has the potential to create health problems both inside the prison and for the surrounding population.

The consumption of traditional fuels such as wood and kerosene as energy sources are also problematic. The excessive use of wood contributes to local deforestation and environmental degradation. Wood used in inappropriate stoves and in the kitchen causes significant indoor air pollution, raising health risks such as acute respiratory infections and conjunctivitis. These diseases are among the top ten for medical consultation. Kerosene is subject to the increase of fuel prices and puts additional pressure on the daily allowance of the detainees.

Biogas systems are already well known in Nepal with over 1 million people served by biogas. Local knowledge and experts are available.

ICRC decided to install biogas systems in three district jails. These systems were completed in May 2008. Three additional biogas systems are planned.

A combination of factors led to the Wathab department choosing biogas systems as a solution:

- available local knowledge;
- reduce health risks by reducing use of wood in kitchens;
- reduce pressure on detainee daily allowance by reducing need to purchase traditional fuels;
- reduce environmental impact on surrounding areas and local livelihoods by reducing need to purchase wood.

The objective of the installation of the biogas plants were to:

- improve the waste water treatment and consequently reduce health risks for detainees and surrounding population;
- provide renewable energy sources to reduce dependency on traditional fuels such as wood, kerosene and reduce health risks by improving prison kitchen environments;
- use biogas slurry as fertiliser;
- promote construction of biogas plants at an institutional level.

ICRC used a local expert partner to install the three biogas systems in the three jails of a total population of approximately 484 detainees.

After installation of the biogas systems, ICRC contracted an international expert to evaluate their performance, cost-effectiveness and user acceptance of these systems. The study aimed to draw lessons learnt and recommendations. The methodology included site visits, sampling and interviews.

The conclusions of the study highlight that, where and when appropriate, environmentally friendly technologies can be effective and contribute to an

improved response from ICRC. Documented monitoring, evaluation and implementation of any ensuing recommendations will help ICRC to provide feedback and lessons learned from such projects.

B. Wells in Mali

ICRC has been working in Mali since 1991. A WatHab programme with the Belgian Red Cross began in 1996. The objective of the programme was to provide access to clean water to Health Centre users in Bougrem. The objectives were then widened to include provision of clean water to returnees following the end of the rebellion as well as to nomads who has to adapt their lifestyles and remain sedentary for part of the year.

A mission took place in 1997 to evaluate the WatHab programme objective and technical choices; to prioritise next steps; to support field programmes and to harmonise actions between the Belgian Red Cross, ICRC field delegation and ICRC head office in Geneva.

Providing water to semi-nomadic populations particularly in grazing areas, where water is essential to survival of populations and their livestock presents several logistical constraints, particularly difficulties finding workers to dig the wells due to:

- low population numbers;
- communities unused to participating in such manual work;
- populations are frequently on the move, following grazing land exploitation patterns so not necessarily present at all times.

In fact, consultation with nomadic populations revealed that grazing land and surrounding areas often do not have wells. This is out of choice to avoid overgrazing. They only move to these particular lands during the rainy season. The lack of water means that no one is able to stay year-round. Construction of water points and increasing access to water in these areas may in fact create additional tension between communities.

This example highlights the fact that populations adapt to their surrounding environment and that an effective ICRC response must consult with communities to accustom itself with local habits and consider this in the design of an appropriate solution.

2.3 Examples of potential impacts and mitigation measures for Water and Habitat activities

Note: It is the responsibility of the projects designers and implementers to strive to reduce the environmental impact of their activities. These activities, impacts and measures cannot be expected to cover each and every possible situation. Their users are expected use their common sense, environmental awareness, technical knowledge and creativity.

Water and sanitation[11]

Activity/Technology	Potential impact	Mitigation measures P&D: Planning and design, C: Construction, O&M: Operation and maintenance.
General		
Site selection (D&P)	Damage sensitive ecosystems or endangered species (P&D)	Survey for, and avoid, wetlands, estuaries or other ecologically sensitive sites in the project area. Identify nearby areas that contain endangered species and get professional assessment of species' sensitivity to construction at site (P&D).
Construction of buildings and structures (C)	Damage sensitive ecosystems or endangered species (C). Cause erosion (C) and sedimentation	Follow guideline on Construction in this manual (P&D) (C). Train and monitor workers on best practices in construction of buildings and structures (P&D) (C). Gather data on soil type, slope and topography to determine the potential for significant erosion (P&D). Use silt screens, straw bales or similar erosion control measures (C). Avoid damaging vegetation (C). Revegetate areas damaged during construction. Do not remove erosion control measures until revegetation is complete (C). Use proper bedding materials for pipes (P&D) (C).
Soakways and drains	Cause erosion (O&M). Alter the natural flow of rainwater runoff (O&M). Create pools of stagnant water (O&M).	Use riprap (cobbled stone), gravel or concrete as needed to prevent erosion of (D&P) drainage structures (C). Monitor and keep drains and soakways clear (O&M).

11 USAID, above note 10, Chapter 16, Table 3: Impacts and mitigation measures for specific water and sanitation activities and technologies, pp. 15–19.

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Activity/Technology	Potential impact	Mitigation measures P&D: Planning and design, C: Construction, O&M: Operation and maintenance.
Water Supply Improvements		
Hand-dug wells, seasonal ponds, improved springs, ground-level catchment and similar structures	Contaminate water with human pathogens (O&M). Contaminate water with animal manure (O&M). Create pools of stagnant water (O&M). Exhaust water supply (not applicable to improved springs or hand-dug wells) (O&M).	Include focus on proper use and maintenance of the improvement as part of behaviour change and education program (P&D). Construct spigot or similar system that prevents people from touching impounded water with their hands or mouths (P&D) (C). Use fencing or equivalent that will keep live stock from grazing uphill or up gradient of the water supply improvement (P&D) (C). Do not allow animals to drink directly from the water source (O&M). Monitor drains and soakways and keep them clear of debris (see entry on soakways and drains above for more detail) (O&M). Monitor and repair leaks from cracked containment structures, broken pipes, faulty valves and similar structures (O&M). Put in place a system for regulating use, such as a local warden or appropriate pricing (P&D). Give the community training in operating the improvement (P&D) (O&M). Monitor water levels in wells or impoundment structures to detect overdrawing (M&O).
Wells	Provide water contaminated with nutrients and bacteria from animal waste (O&M). Create pools of stagnant water (O&M). Change groundwater flow (O&M). Create saltwater intrusions (O&M). Deplete	Don't let animals graze or be watered up-gradient from wellhead (P&D) (O&M). Monitor and repair leaks from cracked containment structures, broken pipes, faulty valves and similar structures (O&M). On islands and coastal areas, keep withdrawals within safe yield limits to avoid overdrawing, possible salt water intrusion and contamination of the well (P&D).

Activity/Technology	Potential impact	Mitigation measures P&D: Planning and design, C: Construction, O&M: Operation and maintenance.
	aquifer (groundwater) (O&M). Cause land subsidence (impact from many wells) (O&M).	Put in place a system for regulating use, such as a local warden or appropriate pricing (P&D). Include a focus on proper use and maintenance of the improvement as part of the behaviour change and education program (O&M). Monitor water levels (O&M).
Standpipes	Create pools of stagnant water (O&M). (This problem can be more severe when water table is high, clay soils are present, or population/tap density is high).	Ensure that spilled water and rainwater drain to a soakway or equivalent structure and do not accumulate and create stagnant standing water (C). Monitor and repair leaks from cracked containment structures, broken pipes, faulty valves and similar structures.
Treatment systems		
Pit latrine	Increase transmission of vector-borne diseases (O). Contaminate groundwater supply with pathogens (O). Contaminate water supplies, damage water quality and/or transmit disease at other locations if waste is not properly handled and treated during or after servicing (O). Cause injury to people or animals.	Devote adequate attention to identifying and addressing social barriers to using latrine (P&D). Use the ventilated improved pit latrine design that traps insect vectors (P&D). Evaluate depth to water table, including seasonal fluctuations and groundwater hydrology. The size and composition of the unsaturated zone determine the residence time of effluent from the latrine, which is the key factor in removal and elimination of pathogens. Pit latrines should not be installed where the water table is shallow or where the composition of the overlying deposits make groundwater or an aquifer vulnerable to contamination (P&D).

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Activity/Technology	Potential impact	Mitigation measures P&D: Planning and design, C: Construction, O&M: Operation and maintenance.
		Ensure that a reliable system for safely emptying latrines and transporting the collected material off-site for treatment is used. This should include use of a small pit-emptying machine such as the vacutug that relies on an engine-driven vacuum pump. The vacutug was tested for UNCHS in low-income areas of Nairobi, Kenya, and was found to give workers much greater protection from disease than conventional methods. See Wegelin-Schuringa, *Small Pit-Emptying Machine: An Appropriate Solution in Nairobi Slum*, for more details) (O&M). Ensure that collected material is adequately treated and not directly applied to fields or otherwise disposed of improperly (O&M). Properly decommission pit latrines. Do not leave pits open. Fill in unused capacity with rocks or soil.
Composting toilets	Increase transmission of vector-borne diseases (O). Contaminate groundwater supply with pathogens (O). Cause disease transmission to field workers and consumers of agricultural products (O).	Maintain humidity of composting material above 60% and supplement excreta with generous quantities of carboniferous material (dry leaves, straw, etc.). The pile should then remain aerobic, odour-free and insect-free (O&M). Construct sealed vaults to hold composting material if using fixed-batch systems. If using movable-batch systems check removable containers for leaks before installing (O&M). Test samples from active chamber and mature chamber after fallow period for *Ascaris* eggs and faecal coliforms (O&M). Allow sufficient residence time in mature chamber. This may vary from 6 months in warm climates to 18 months in cooler climates (O&M).

Activity/Technology	Potential impact	Mitigation measures P&D: Planning and design, C: Construction, O&M: Operation and maintenance.
		Ensure that the systems will be properly operated and maintained so that the soil amendment taken out after the treatment period is truly sanitized (O&M).
Dry toilets	Increase transmission of vector-borne diseases (O). Cause disease transmission to field workers and consumers of agricultural products (O).	Maintain humidity of composting material below 20% and supplement excreta with alkaline material (ashes or lime). The pile should then remain both odour free and insect free (O&M). Generous applications of ashes will help ensure that pathogens are destroyed. pH is the most important factor for sterilization (O&M). Construct sealed vaults to hold dehydrating and curing material (C). Ensure that the systems will be properly operated and maintained so that the soil amendment taken out after the treatment period is truly sanitized (O&M). Test samples from active chamber and mature chamber after fallow period for *Ascaris* eggs and faecal coliforms to assess level of sterilization (O&M). Allow sufficient residence time in mature chamber. This may vary from 6 months in warm climates to 18 months in cooler climates (O&M).
Septic tanks	Contaminate groundwater supply with pathogens (O&M). Contaminate surface water supplies with nutrients, biological oxygen demand	Evaluate depth to the water table, including seasonal fluctuations and groundwater hydrology. If water table is too high, line the tank with clay, plastic sheeting or some other impermeable material to prevent leakage (P&D) (C). Avoid direct discharge of effluent to waterways if possible.

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Activity/Technology	Potential impact	Mitigation measures P&D: Planning and design, C: Construction, O&M: Operation and maintenance.
	(BOD), suspended solids (SS) and pathogens. (Septic tank effluent generally contains relatively high concentrations of pathogens, BOD, and SS) (O&M). Contaminate water supplies, damage water quality and/or transmit disease at other locations if waste is not properly handled and treated during or after servicing (O&M).	Direct discharge to waterways with sufficient volume and flow to assimilate the waste may be acceptable. It is better to add a secondary treatment, such as passing effluent through an anaerobic filter, followed by discharge to an absorption field, or better yet, a constructed wetland (P&D). Ensure that a reliable system for safely removing sludge and transporting the collected material off-site for treatment is available. This should include use of a mechanized (probably vacuum-based) removal system (P&D) (O&M). Ensure that collected sludge is adequately treated and not directly applied to fields or otherwise improperly disposed of (See Sludge management below) (M&O).
Upflow anaerobic Filters	Damage ecosystems and degrade surface water quality. Sludge has high concentrations of nutrients, BOD, and solids (O&M). Cause disease transmission to field workers and consumers of agricultural products (Sludge may still contain pathogens) (O&M)	Treat sludge before secondary use (see Sludge management below). Do not allow disposal in or near water bodies (O&M). Provide workers servicing, transporting, and otherwise exposed to sludge with appropriate protective clothing including, at a minimum, rubber gloves. Train workers to wash hands and faces frequently with soap and warm water and make both available. (See Wastewater and sludge use in agriculture and aquaculture below) (O&M).
Settled and simplified sewers	Damage ecosystems and degrade surface water quality (O&M). Transmit diseases to field workers and consumers of agricultural products (O&M)	Ensure that collected sewage will be treated, e.g., in a wastewater stabilization pond, and not simply discharged to a river or stream or used directly in agriculture or aquaculture. This is especially important for simplified sewerage, since there is no interceptor tank (P&D) (O&M).

Activity/Technology	Potential impact	Mitigation measures P&D: Planning and design, C: Construction, O&M: Operation and maintenance.
Biogas reactors	Damage ecosystems and degrade surface water quality (O&M). Transmit diseases to field workers and consumers of agricultural products (O&M).	Do not allow disposal of digested slurry in or near water bodies (O&M). Follow WHO or other national or international guidelines for use of sludge in wastewater in agriculture and aquaculture (see Sludge and wastewater reuse below (M&O) (D&P).
Stabilization ponds (anaerobic, facultative, aerobic)	Damage ecosystems and degrade surface water quality (O&M). Transmit diseases to field workers and consumers of agricultural products (O&M).	Avoid discharging single (facultative) pond systems directly into receiving waters. If this is unavoidable, construct hydrography-controlled release lagoons that discharge effluent only when stream conditions are adequate. Install secondary treatment such as a constructed wetland, if possible (P&D) (C) (O&M). Use two-, three- or five-pond systems if possible (anaerobic, facultative,maturation)) (P&D). Allow only restricted uses for agriculture and aquaculture of effluent from all but five-pond systems (O&M).
Reed bed filter	Contaminate groundwater or surface water (O&M).	Evaluate depth to the water table, including seasonal fluctuations and groundwater hydrology. If water table is too high, line tank with clay, plastic sheeting or some other impermeable material to prevent leakage (P&D) (C).
Free water surface wetland. Floating aquatic macropytes	Provide breeding ground for disease vectors (O&M). Introduce invasive non-native species (O&M).	Use plant and animal species that are native to the region. Avoid introducing water hyacinth, water milfoil, or salvinia, which have proven extremely invasive outside of their natural range (P&D). If using water hyacinth, maintain dissolved oxygen at 1.0 mg/L, frequently harvest and thin plants and/or add mosquitofish (*Gambusia affinis*) to the wetland or use other plant species such

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Activity/Technology	Potential impact	Mitigation measures P&D: Planning and design, C: Construction, O&M: Operation and maintenance.
		as duckweed, water lettuce (*Pistia stratiotes*), water milfoil, or salvinia (*Salvinia spp.*) (M&O).
Rapid infiltration	Contaminate groundwater or surface water (O&M).	Use only where soil textures are sandy to loam (P&D). Use only where groundwater is >3 ft. below surface (P&D).
Sludge management	Damage ecosystems and degrade surface water quality (O&M). Cause disease in handlers and processors (O&M).	If possible, choose treatment technologies that do not generate sludge, such as wastewater stabilization ponds (P&D). Compost sludge, then use as soil amendment for agriculture (O&M). Provide workers with appropriate protective clothing, including rubber gloves, boots, long-sleeved shirts and pants. Train workers to wash hands and faces frequently with soap and warm water and make both available (O&M).
Wastewater use in agriculture and aquaculture	Cause disease in field workers and consumers of agricultural products (O&M).	WHO guidelines recommend (1) treat to reduce pathogen concentrations, (2) restrict use to crops that will be cooked, (3) use application methods that reduce contact with edible crops, and (4) minimize the exposure of workers, crop handlers, field workers and consumers to waste (P&D) (O&M). Wastewater used in aquaculture should have <103 faecal coliforms per 100 ml to minimize risk to public health. (*See Guidelines for the safe use of wastewater and excreta in agriculture and aquaculture: Measures for Public Health Protection*, 1989, WHO, Geneva (P&D) (O&M) http://www.who.int/environmental_information/Information_resources/documenpdf.wastreus/ts

Irrigation[12]

Type of problem	Potential impact	Mitigation measures P&D: Planning and design, C: Construction, O&M: Operation and maintenance.
Soil problems	Waterlogged soil	Use good irrigation management, matching water demand and supply by location. Provide drainage and line canals in highly permeable areas to prevent leaks. Redesign irrigation infrastructure to reduce waste; use sprinkler or drip irrigation systems instead of gravity-flow systems. Encourage farmers to value water resources by establishing a system of water user fees tied to consumption.
	Salt buildup on irrigated land	Design system to allowing leaching with excess water. Alternate irrigation methods and schedules. Install and maintain subsurface drainage system. Adjust crop patterns (fallow times, crop selections, etc.) to prevent further salt buildup. Incorporate soil additives. Add gypsum to either the irrigation water or the soil before irrigating. Plant salt-tolerant catch crops such as *Sesbania*.
	Crops wilting or dying	Monitor soil chemistry. Identify indicator plant species. Consult soil scientists. Apply soil nutrients, conditioners and chemicals where feasible.

12 Adapted from USAID, above note 10, Chapter 1, Table 4: Mitigation and Monitoring Table for Irrigation Impacts, pp. 33–35.

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Type of problem	Potential impact	Mitigation measures P&D: Planning and design, C: Construction, O&M: Operation and maintenance.
Water problems	Crops not growing over entire irrigated field	Maintain irrigation canals. Clear weeds. Line canals against leaks. Encourage farmers to value water resources by establishing a system of water user fees tied to consumption.
	Dry wells for drinking water and irrigation	Reduce off-take or pumping to allow natural aquifer recharge. Encourage farmers to value water resources by establishing a system of water user fees tied to consumption.
	Salt water in wells for drinking water and irrigation	Reduce groundwater pumping to allow natural freshwater to recharge the aquifer, in order to lower salt concentration in the aquifer.
	Water quality problems for downstream users	Treat irrigation drainage water before release.
	Reduced water quantity for downstream users, waterways and wetlands; intermittent streams run dry.	Reassess water available for irrigation; may need to irrigate a smaller area. Use pipes instead of open canals to prevent water loss from evaporation. Promote local and regional watershed management. If available, consider using treated wastewater for irrigation, leaving freshwater resources for other users.
Health problems	Increased incidence of water-related diseases	Periodically flush slow or stagnant waterways with water from dams to remove snails (which cause schistosomiasis). Note that this is effective only for a few hundred meters from where the water is released. Clear clogged irrigation canals. Control mosquitoes, snails and blackfly along reservoirs by periodically

Type of problem	Potential impact	Mitigation measures P&D: Planning and design, C: Construction, O&M: Operation and maintenance.
		fluctuating water levels, making shorelines steeper, and removing weeds. Periodically drain waterlogged fields to prevent mosquitoes. Train women in health issues.
Social problems	Increased inequity	Design and manage system to improve access by 'tail-enders' (users whose fields are farthest from the water source). Establish and enforce a volume-based water fee. Improve system management, including maintenance of main canals.
	Hinterland effect	Ensure adequate social and other infrastructure to meet needs of immigrants.
Water transport and storage problems	Weeds growing in reservoirs, irrigation canals, and drains Poor water quality downstream from a dam	
Ecosystem problems	Damage to downstream ecosystems from reduced water quantity and quality	

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Construction related activities[13]

Activity/Technology	Potential impact	Mitigation measures SS: Site Selection, P&D: Planning and design, C: Construction, O&M: Operation and maintenance
Site Selection (SS)		
Site occupied or used by local residents.	Displace untenured residents or reduce farmers' or pastoralists' lands.	Find alternative location (SS). If that is not possible: Provide equivalent land and/or accommodations or fair monetary compensation, provided these are accepted voluntarily and without coercion (SS).
Dwellings located close by.	Facility and/or construction disturbs neighbors, creating noise and dust.	Build as far as practical from neighbors (SS). Concentrate noisiest types of work into as short a period as possible, and during least disruptive times of the day. Take measures to keep dust to a minimum (P&D)(C). Screen facility with trees or fencing to control noise (P&D). Wet ground if water is abundant and/or leave natural cover intact as long as possible (C).
Site has historic, cultural, or social importance.	Offend local population; damage local social fabric.	Find alternative site (SS).
Site would require road improvement or new road construction (Also consult "Rural Roads" section of the ENCAP Africa Guidelines).	Cause one or more of a set of adverse environmental impacts typical of roads, including erosion, changing water tables, or providing access for illegal land clearing, logging or poaching.	Find alternative site. Evaluate "minimum tool" alternatives (e.g. consider whether a foot or bicycle path might suffice (SS) (O&M). Follow guidance on design, construction, and operation and maintenance described in "Rural Roads" and resources listed there.

13 Adapted from USAID, above note 10, Chapter 3, Table 1: Environmental Mitigation and Monitoring Issues for Construction-Related Aspects of Development Projects, pp. 8–17.

Activity/Technology	Potential impact	Mitigation measures SS: Site Selection, P&D: Planning and design, C: Construction, O&M: Operation and maintenance
Site contains habitat for important ecosystems, animals or plants.	Destroy or harm plants or animals of ecological, cultural, and/or economic importance.	Find alternative location (SS). If that is not possible: • limit access to the site, • design any infrastructure (if unavoidable) to create least impact (P&D), • minimize disturbance of native flora during construction (P&D) (C), • remove, without destroying, large plants and ground cover where possible (C), • replant recovered plants and other flora from local ecosystem after construction (C).
Site has important scenic, archeological or cultural/ historical features.	Destroy or harm these sites.	Find alternative location (SS). If that is not possible: • limit access to site, • design any infrastructure (if unavoidable) to create least impact (P&D), • minimize disturbance of site during construction (P&D) (C), • remove important artifacts where possible (C), • provide worker incentives for discovery and safe removal of archeological or paleontological material. (SS) (C).
Site is wetland or abuts body of water	Destroy or harm valuable and sensitive ecosystems and organisms.	Find alternative site. Wetlands and *riparian* ecosystems (those sited next to a body of water) are extremely sensitive. Wetlands provide important environmental services such as water storage, bird and animal habitat,

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Activity/Technology	Potential impact	Mitigation measures SS: Site Selection, P&D: Planning and design, C: Construction, O&M: Operation and maintenance
		flood control, and filtering toxins and nutrients from runoff (SS). If no alternative is available: • set back any infrastructure as far as possible from the water body/wetland and minimize the amount of wetland destroyed by infrastructure footprint or construction (SS) (P&D), • revegetate as soon as possible (C), • *if facility will include sanitation facility, find alternative site* (SS).
Site is steeply sloped	Cause erosion and damage to terrestrial and aquatic ecosystems during construction or use.	Find alternative site (SS). If that is not possible: • design facility and apply construction practices that minimize risk, e.g., use hay bales to control erosion during construction. Pay particular attention to potential erosion and redirection of water flows during design and construction (SS) (P&D) (C), • revegetate as soon as possible (C), • maintain design features (O&M).
Area is heavily wooded	Degrade forest, contributing to flooding potential.	Find alternative location if area is old growth or relatively undergraded forest (SS). If that is not possible: • design so as to minimize clearing or disturbance (P&D),

Activity/Technology	Potential impact	Mitigation measures SS: Site Selection, P&D: Planning and design, C: Construction, O&M: Operation and maintenance
		• avoid destroying rare or unique species. Consult with local populations about current use of forest and preferences for preservation (SS) (P&D) (C).
Site prone to flooding	Be destroyed and/or subject workers or inhabitants to risk of injury or death. Cause environmental damage from accidental release of toxic, infectious or otherwise harmful material during flooding. Contaminate drinking water.	Find alternative site or design infrastructure so it is raised above flood plain, if possible (SS): • design infrastructure to minimize risk, e.g., design with proper grading and drainage (P&D) • maintain design features such as drainage structures (O&M), • avoid constructing sanitation or other facilities that will use and store harmful materials at flood-prone sites (SS). If that is not possible: • design storage area so that hazardous materials are above ground and/or in waterproof containers with locking lids that are kept closed. Ensure that facility operators follow these practices (P&D)(O&M), • chose dry sanitation options or closed disposal systems, instead of wet ones such as septic tanks or detention ponds (P&D).
Area and/site prone to landslides	Be destroyed and/or expose workers or inhabitants to risk of injury or death. Cause environmental damage from accidental release of toxic,	Find alternative site on stable ground (SS). If that is not possible: • design infrastructure to minimize risk, e.g., plant trees all around facility ((P&D),

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Activity/Technology	Potential impact	Mitigation measures SS: Site Selection, P&D: Planning and design, C: Construction, O&M: Operation and maintenance
	infectious or otherwise harmful material. Contaminate water supplies.	• maintain protective design features (O&M), • avoid constructing sanitation or other facilities that will use and store hazardous or biohazardous materials at landslide-prone sites (SS). If that is not possible: • design storage area so that hazardous materials are stored in durable leak- proof containers with locking lids, and that these are kept closed (P&D)(O&M), • chose dry sanitation options or closed disposal systems, instead of wet ones such as septic tanks or detention ponds (P&D).
Planning and design		
Area experiences heavy rainfall, earthquakes	Be destroyed and/or expose workers or inhabitants to risk of injury or death. Cause environmental damage and/or contaminate water supplies via accidental release of toxic, infectious or otherwise harmful material.	Design infrastructure to minimize risk, e.g., in earthquake-prone areas, build structures with wood frames instead of concrete or brick (P&D). Maintain protective design features (e.g., drainage structures and vegetation on slopes). (O&M) Use material appropriate to the climate (e. g., stucco instead of adobe in areas with heavy rainfall) (P&D) (C). Design storage area so that hazardous materials are above the ground and/or in waterproof containers. Ensure that facility operators follow these practices (P&D)(O&M). Chose dry sanitation options or closed disposal systems, instead of wet ones such as septic tanks or detention ponds (P&D).

Activity/Technology	Potential impact	Mitigation measures SS: Site Selection, P&D: Planning and design, C: Construction, O&M: Operation and maintenance
Facility will generate solid waste (Also consult the "Management of Solid Waste from Residential, Commercial and Industrial Facilities" section of the ENCAP Africa *Guidelines*).	Spread disease. Contaminate drinking water (ground and surface). Degrade aquatic ecosystems. Generate greenhouse gases.	Include space and features for source separation of recyclables and organic waste. Consider including space and/or constructing a compost bin or worm box if facility will produce organic waste (P&D) (C) (O&M).
Facility will generate cooling waters, soaking waters, or water containing suspended organic mater, mercury, lead, soaps, etc. (Also consult the "Activities with Micro and Small Enterprises (MSEs)" section of the ENCAP Africa *Guidelines*).	Expose workers or local population to toxic, carcinogenic and teratogenic materials. Contaminate drinking water (ground and surface). Damage local ecosystems, animals or plants.	Incorporate cleaner production technologies into design, operation and maintenance as described in the "Activities with Micro and Small Enterprises (MSEs)" section of these *Guidelines* and resources listed there (SS) (P&D) (C) (O&M). Design with elements for storage, treatment and discharge of wastewater (P&D) (O&M).
Indirect effects on local populations.	Damage or destroy natural resources. Increase in-migration. Damage local social and cultural integrity. Facilitate spread of disease to both people and animals.	Research indirect effects that may be associated with the particular type of facility being built and evaluate other possible impacts of this type. If the project falls into one of the sectors covered in the *Guidelines*, the relevant sector briefing and the resources listed therein are starting points for this research (SS) (P&D) (C) (O&M).

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Activity/Technology	Potential impact	Mitigation measures SS: Site Selection, P&D: Planning and design, C: Construction, O&M: Operation and maintenance
Cumulative effects of one development project over time or many small developments built within a short time period.	Cause excessive extraction of building materials, multiply impacts associated with logging undergraded forest, quarrying and obtaining sand, gravel and fill ("borrowing"). (See below for more detail)	Develop logging, quarrying and borrowing plans that take into account cumulative effects and include reclamation plans (P&D). Monitor adherence to plans and impacts of extraction practices. Modify as necessary (C) (O&M).
Construction		
Construction crews and camps	Damage local habitat, compact soil and create erosion via building and occupation of construction camps. Contaminate surface water and spread disease via solid waste and feces generated by camps. Spread communicable diseases including malaria, tuberculosis, and HIV/AIDS via construction crews who come from outside the region. Introduce alcohol or other socially destructive substances via construction crews. Deplete local fauna and flora (especially game and fuelwood) via poaching and collection by construction crews.	Explore off-site accommodation for crew (P&D) (C). Keep camp size to a minimum. Require that crew preserve as much vegetation as possible, e.g., by creating defined footpaths (P&D) (C). Provide temporary sanitation on site, e.g., pit latrine (assuming the water table is low enough, with soil and geology of appropriate composition) (P&D) (C). Use local or regional labor, if possible. Screen potential crew members for HIV/AIDS and tuberculosis. Provide education and strict guidelines regarding contact with local residents, and enforce guidelines (P&D) (C). Set guidelines prohibiting poaching and collection of plants/wood with meaningful consequences for violation such as termination of employment. Provide adequate quantities of food and cooking fuel; both should be of good quality (C).

Activity/Technology	Potential impact	Mitigation measures SS: Site Selection, P&D: Planning and design, C: Construction, O&M: Operation and maintenance
Use of heavy equipment	Cause erosion due to machinery tracks, damage to roads, stream banks, etc. Compact soil, changing surface and groundwater flows and damaging future use for agriculture. Contaminate ground or surface water when machinery repairs result in spills or dumping of hydraulic oil, motor oil or other harmful mechanical fluids.	Minimize use of heavy machinery (P&D) (C). Set protocols for vehicle maintenance such as requiring that repairs and fueling occur elsewhere or over impervious surface such as plastic sheeting. Prevent dumping of hazardous materials. Burn waste materials that are not reusable/readily recyclable, do not contain heavy metals and are flammable (P&D) (C).
Use of hazardous materials	Contaminate ground or surface water when hazardous construction materials are spilled or dumped. Put workers at risk from exposure to hazardous materials.	Prevent dumping of hazardous materials. Burn waste materials that are not reusable/readily recyclable, do not contain heavy metals and are flammable (P&D) (C). Investigate and use less toxic alternative products (P&D) (C).
Demolition of existing structures	Bother or endanger neighbors via noise, dust, and debris from demolition. Contaminate soil, groundwater or surface water from demolition waste containing residual amounts of toxic materials (e.g., leaded paint).	Recover all reusable material (this may be standard practice in many developing countries) (P&D) (C). Determine whether toxic materials are present. If possible, dispose of waste in lined landfill. Otherwise, explore options for reuse in areas where potential for contamination of surface and groundwater are small (e.g., consider the feasibility of use as roadbed material, if non-hazardous.). (See the "Management of Solid Waste from Residential, Commercial and Industrial Facilities"

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Activity/Technology	Potential impact	Mitigation measures SS: Site Selection, P&D: Planning and design, C: Construction, O&M: Operation and maintenance section of the Guidelines and references listed there for a more information) (P&D) (C).
Site clearing and/or leveling	Damage or destroy sensitive terrestrial ecosystems in the course of site clearing/preparation. Produce areas of bare soil which cause erosion, siltation, changes in natural water flow, and/or damage to aquatic ecosystems.	Design infrastructure so that it will create least impact (P&D). Minimize disturbance of native flora during construction (P&D) (C). Remove, without destroying, large plants and ground cover where possible (P&D) (C). Use erosion control measures such as hay bales (C). Replant recovered plants and local flora as soon as possible (C).
Excavation	Cause erosion, siltation, changes in natural water flow, and/or damage to aquatic ecosystems when excavated soil is piled inappropriately. Expose inhabitants and crew to risk of falls and injuries in excavation pits. Deprive down-gradient populations and ecosystems of water if higher regions of aquifer are blocked.	Cover pile with plastic sheeting, prevent runoff with hay bales, or similar measures (P&D) (C). Place fence around excavation (P&D) (C). Investigate alternatives allowing shallower or no excavation (P&D).
Filling		

Activity/Technology	Potential impact	Mitigation measures SS: Site Selection, P&D: Planning and design, C: Construction, O&M: Operation and maintenance
	Block water courses when fill is inappropriately placed. Destroy valuable ecosystems when fill is inappropriately placed. Result in land subsidence or landslides later if fill is inappropriately placed, causing injuries or damage.	Do not fill the flow-line of a watershed. Be aware that in arid areas, occasional rains may create strong water flows in channels. A culvert may not supply adequate capacity for rare high volume events such as flash floods. (SS) (P&D). Design so that filling will not be necessary. Transplant as much vegetation and groundcover as possible (SS) (P&D) (C). Use good engineering practices (e.g., do not use soil alone. First lay a bed of rock and gravel) (P&D) (C).
Road improvement/new road construction (Consult the "Rural Roads" section of the ENCAP Africa *Guidelines* and resources listed there)	Erosion and changes to water quality and natural water flows via poor road construction practices and maintenance. Provide access for clearing agricultural land, logging, poaching, mining, settlement or other development that destroys natural resources and/or harms local populations. Lead to the spread of human or livestock disease.	Find alternative site. Evaluate whether an alternative mode of transport would suffice (e.g., rail, water, or footpath). (SS) (P&D). Adhere to specifications for road design and maintenance that keep water off road surfaces (P&D) (C) (O&M). Follow best practices for design, construction, and operation and maintenance described in the "Rural Roads" section of the ENCAP Africa Guidelines and resources listed there. These include practices such as developing quarry and borrow pit plans, following the contour line, using camber and turnout drains, training operations and maintenance personnel, etc. (SS)(P&D) (C) (O&M).
Source of building materials	Damage aquatic ecosystems through erosion and siltation.	Identify the most environmentally sound source of materials within budget (P&D).

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Activity/Technology	Potential impact	Mitigation measures SS: Site Selection, P&D: Planning and design, C: Construction, O&M: Operation and maintenance
	Harm terrestrial ecosystems via harvesting of timber or other natural products. Spread vector-borne diseases when stagnant water accumulates in active or abandoned quarries or borrow pits and breeds insect vectors. Alter river/stream courses through sand and gravel extraction. Alter their ecosystems or pollute them.	Develop logging, quarrying and borrowing plans that take into account cumulative effects (P&D). Monitor adherence to plans and impacts of extraction practices. Modify as necessary (C) (O&M). Fill in quarries and pits before abandoning (C). Control runoff into pit (C). Ensure lawfulness of extraction from rivers (P&D). Avoid working with machines in the water (C).
Decommissioning		
Hazardous abandoned structures	Buildings with collapsing roofs and walls, open latrines or septic systems, accumulation of rubble.	Remove or bury all abandoned construction materials and rubble. Fill in and close all latrines and septic systems.
Eroded soils in the vicinity of abandoned infrastructure	Gulleying and siltation. Damage to aesthetics.	Restore the site through replanting, reseeding and use of soil erosion control measures (hay bales, etc.).

Shelter[14]

Activity/Technology	Potential impact	Mitigation measures P&D: Planning and design, C: Construction, O&M: Operation and maintenance
Site and design	Change in land use pattern.	Ensure that present land use at the proposed project site is not critical and that the present activities can be carried out on nearby land before the site is selected.
	Destruction of important ecological, archeological or historical areas.	Before the site is selected, verify that biodiversity, conservation of endangered or endemic species or critical ecosystems will not be adversely affected. Likewise, verify that no important archeological, historical or cultural sites will be adversely affected by the project. An alternative site should be used if the area is identified as critical.
	Contamination of soil and water from sewage and solid waste.	Site human waste and solid waste disposal systems to avoid surface and groundwater contamination, taking soil characteristics and historical groundwater and surface water conditions into account. Install adequate and appropriate sewage and solid waste disposal systems (e.g., use aboveground composting latrines in areas with high water tables).
	Risk to residents due to possible natural dangers.	Ensure that proposed project site is not located in areas: • subject to fires, • subject to flooding, • with slopes over 20%, • below areas likely to undergo significant deforestation or land clearing.

14 Adapted from USAID, above note 10, Chapter 9, pp. 12–14.

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Activity/Technology	Potential impact	Mitigation measures P&D: Planning and design, C: Construction, O&M: Operation and maintenance
		If the site is in an area subject to these natural dangers, an alternate site should be used. If no appropriate alternative can be found, mitigation measures must be taken to minimize risk in areas where it is unavoidable (e.g., construct firebreaks, stabilize slopes, construct drainage, elevate housing units on pilings, etc).
	Risks to residents due to human activity near site.	Before the site is selected: • ensure that the project will not be located within the area of influence (normally 1 km) of pollution and hazardous waste sources, including factories, mines, military bases, etc. • insure that the project is not downwind of a contamination source. • if groundwater is to be used for drinking, test it for chemical and microbial contamination if there is any reason to doubt its purity. • identify and eliminate sources of noise pollution. • use alternate site if risk to residents is high.
	Excessive use and pressure on existing facilities such as schools and health centers	Include the expansion or construction of any necessary infrastructure in the layout and design of the project, if needed.
	Deforestation in order to implement project	If forest is dense or forms part of a critical habitat, an alternative site must be found. A forested area equal in size to one and a half to two times the area deforested must be established and maintained. The location and

Activity/Technology	Potential impact	Mitigation measures P&D: Planning and design, C: Construction, O&M: Operation and maintenance
		ultimate use of this protected area will be established in coordination with local municipal authorities. For each tree cut in a sparsely forested area, plant 20 new trees. This should be done no later than 6 months after the residents have moved in.
	Excessive use of fuelwood as an energy source.	Encourage use of alternative energy sources such as gas, electricity and solar where appropriate. If fuelwood is the dominant energy source, include the planting of fuelwood plots using local species in the project layout and design. Require all residents who cook with fuelwood to use improved stoves.
	Houses inappropriate for local climate; occupant comfort inadequate.	Ensure that the design, construction materials, and siting of windows and doors takes local climatic conditions in cool and hot seasons and seasonal variation in precipitation and winds into account. Use local materials if possible.
	Ventilation inadequate.	Design houses to ensure adequate ventilation for the potential heating and cooking sources to be used within the home. Take advantage of wind direction in design.
	Inadequate attention to type and location of solid waste disposal.	Prepare and implement a *Solid Waste Disposal Management Plan* prior to resident occupancy. Include technology and funding for system maintenance and disposal, effects on groundwater, wind direction, etc. in the plan.
	Health hazards due to lack of sanitation facilities (water,	Sanitation facilities *must* be included in the project design. Ensure that all sanitation facilities are installed and running before the occupants move in.

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Activity/Technology	Potential impact	Mitigation measures P&D: Planning and design, C: Construction, O&M: Operation and maintenance
	sewage and solid waste disposal).	
	Unsafe potable water supplies.	Ensure siting of supply systems and choice of supply technologies to minimize health hazards. Conduct seasonal testing of water quality, particularly for coliform bacteria and arsenic. Assess long-term and seasonal shifts in water quantity and quality.
	Hazard due to inadequate earthquake resistance or inappropriate materials.	Understand local risks of earthquake, floods and winds. Ensure that construction meets appropriate standards. Use locally available materials. Follow, or exceed, official design criteria.
	Social impacts within and around the project site.	A social analysis of the beneficiaries and the communities around the proposed site must be conducted implemented before the project is designed. If the site's location generates too much social conflict, an alternative site must be selected. Community development programs must be implemented in each community before or during the construction process.
	Lack of compliance with mitigation measures.	Collect signed binding agreements from the collaborating organizations and contractors before the project begins. Each NGO or partner must have an environmental management plan to ensure compliance with the mitigation measures. Have an independent evaluation of the plan conducted annually.

Activity/Technology	Potential impact	Mitigation measures P&D: Planning and design, C: Construction, O&M: Operation and maintenance
Habitation	Improper use of environmental and sanitary resources by householders.	If applicable, the responsible NGOs and partners must provide environmental and sanitary training for all residents before they move in. Training should address all of the following: • environmental education for children, • care of domestic animals, • reforestation of green areas, • proper use and maintenance of latrines, • social interactions in housing projects, • proper use and conservation of water, • construction and use of improved stoves, • fuelwood plot management.
	Lack of compliance with mitigation measures.	Collect signed binding agreements between the collaborating organizations and contractors before the project begins. Each responsible NGO or other partner must have an environmental management plan to ensure compliance with the mitigation measures. Have an independent evaluation of the plan conducted annually.

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Section 3: Economic security and environmental management[15]

The Economic Security Unit held a seminar in Nairobi from September 29th to October 3rd 2008 on the topic of "Agro Programmes and the Environment". Its objective was to raise awareness of environmental issues and include these issues, where possible, into its agricultural and other interventions. A report on the outcome of this seminar has been written and was made available in February 2009.[16] The feedback from this seminar forms an important and integral part of this framework.

The main purpose of economic security programmes is to preserve or restore the ability of households affected by armed conflict to meet their essential needs.

Acute crisis:

- ICRC provides the relief (food and essential household items) needed to sustain life and resume production, mainly through the distribution of agricultural equipment and supplies.

Emerging crisis, chronic crisis and post-crisis:

- ICRC's priority is to support and bolster the means of production through programmes tailored to the local economy. These programmes mainly concern: reviving agriculture, livestock health and management, and microeconomic initiatives.

Economic security main field of activities are:

- distribution of food rations;
- distribution of essential household items;
- distribution of seed, farming tools, fertilizer and fishing tackle;
- rehabilitation of agriculture and irrigation;
- livestock management;
- revival of small trades and handicrafts.

The above activities can be in both urban and rural settings and in detention facilities.

15 For key references see ICRC, *Regional Livestock Study in the Greater Horn of Africa*, ICRC, 2005; Norwegian Refugee Council, above note 10; UNHCR, *Environmental Guidelines*, above note 10; UNHCR *Refugee Operations* …, above note 10; UNHCR, *Forest Management in Refugee Situations – A Handbook of Sound Practices*, UNHCR/The World Conservation Union (IUCN), Geneva, 2005; USAID, above note 10, Chapter 1: Agriculture and Irrigation; Chapter 7: Forestry: Reforestation, Natural Forest Management, and Agroforestry; and Chapter 11: Livestock.

16 See ICRC, *The Environment & Agro Programmes: Analysis and Recommendations*, Agro Workshop, Nairobi, 29 September to 3 October 2008.

3.1 Environmental challenges of economic security activities

Agricultural assistance activities for example, not only take the environment into account, but propose solutions to enhance it, in order to achieve their purpose of preserving or restoring the ability of households to meet their essential needs.

Improved seed multiplication programmes or the distribution of drought tolerant varieties enable greater production on less land. Irrigation programmes rationalise the use of water; and seed distributions reduce household dependency on unsustainable livelihoods such as charcoal production.

However, agro-programmes can also have negative impacts on the environment: irrigation programmes can accelerate soil salinisation process, large-scale seed distributions may reduce the local crop biodiversity, amongst others.

The Economic Security delegate must consider these positive and negative factors when designing and evaluating programmes, combine them with the local context and come up with a solution that meets the needs of the victims of armed conflict.

The environmental challenges and considerations faced by Economic Security delegates when designing and implementing main agro and agro-economic activities are detailed in Section 3.3. This is not an exhaustive list of potential impacts and mitigation measures for all Economic Security activities, but can be useful to address key issues.

3.2 Case studies

The following two case studies present two very different examples where the Economic Security Unit has dealt with environmental factors in its response.

They highlight the fact that the environment is indeed an integral part of all operations; that there is no unique solution to a particular problem and that the efficiency of a solution depends on the context and many other factors.

A. Cassava and conflict in Democratic Republic of Congo

This particular case study highlights how conflicts and the ensuing population movement can serve to propagate environmental problems that were originally specific to one area, to much larger areas.

Since 1993, conflicts in the Democratic Republic of Congo, Rwanda and Burundi have resulted in more than five million deaths and have generated hundreds of thousands of refugees and internally displaced people.

When people are displaced following conflict, their fields are abandoned or sometimes looted. They become overgrown with weeds, and crops die out. When villagers come back, the harvest is often very poor and they remain impoverished.

When displaced, people often take food and animals with them including cassava stems which can then be replanted. Cassava is particularly well adapted to times of crisis as stems can be replanted, fields demands relatively low

maintenance, the roots are energy-rich and leaves are protein rich. Cassava often represents people's only means of survival as well as a way back into fragile economic livelihoods.

However, the cassava plant traditionally used in eastern DRC was susceptible to the mosaic virus, which can decimate entire crops. The ongoing displacement and return of populations in this area has caused a spread of the disease and widely affected cassava crops.

ICRC provided a new mosaic-resistant type of cassava plant to local associations to plant in communal fields. Cassava leaves and roots were harvested as food, and 70% of the stems redistributed or sold within the respective associations, while the remaining 30% were returned to ICRC for distribution to other farmers associations in the area.

ICRC provided initial stems of the mosaic-resistant cassava plants as well as training and planting materials. The project was run with partners such as Research Institutes, national Red Cross societies and the Ministry of Agriculture. ICRC has been able to handover several such projects, entirely to individual associations where this activity has continued to sustain itself.

This project has had the following results:

1) significant improvement of economic security of association members though healthy and resistant cassava stem sales;
2) setting up a lucrative system (without need for further ICRC support) which encourages associations to continue to produce cassava plants and stems;
3) availability of healthy cassava plant stems to a large population over vast zones allowing each household to either start over or enhance their cassava production;
4) setting up a quality production system thanks to partnerships with research institutes and national organisations.

B. Pastoralists and livelihoods in the Horn of Africa

Emergencies in the Horn of Africa are related to natural, economic, political or social causes; livestock owners are vulnerable to all these factors.

The horn of Africa currently accounts for the ICRC's greatest operations in the world and half the region's population relies on animals to a significant extent for its survival. This region faces increasingly harsh climatic conditions. Where conflict in the past has often aimed at expanding the attacker's own herds and, thus, his power and influence, it is today aggravated by climatic parameters.

Competition over natural resources is widespread. The human population of sub-Saharan Africa is growing faster than the capacity of the livestock sector to support it and tensions are likely to escalate. However, conflict over natural resources is just one of the causes of conflict and many other causes have also been identified.

The ICRC Livestock study in the Greater Horn of Africa was conducted in 2005 order to contribute to ICRC's understanding of the circumstances and

current challenges faced by a significant proportion of the population in one of its major operational areas.

The main aims of the study were:

1) to provide a comprehensive picture of the current livestock / pastoralist situation and any anticipated future developments and a working basis / reference for the next five years.
2) to design and submit regional livestock assistance guidelines and a proposed course of action for the ICRC at both regional and country level.

The study provides background information, past interventions, lessons learned and proposes a course of action with specific recommendations for livestock interventions in each country. By undertaking a regional approach, considering environmental issues amongst others, and incorporating cross-border issues, this addresses ICRC's attempts to harmonise its approach to observed needs; to improve regional coherence and to reduce potential double standards in its response mechanisms in the Horn of Africa.

3.3 Examples of potential impacts and mitigation measures for economic security activities

The following table lists some succinct suggestions for mitigating potential negative impacts of agro-economic and agro activities. This is not intended to list all possible impacts and mitigation measure, rather to highlight some examples. These tables were compiled at the Nairobi Agro Workshop by Economic Security Coordinators.[17]

Note: It is the responsibility of the projects designers and implementers to strive to reduce the environmental impact of their activities. These examples, impacts and measures cannot be expected to cover each and every possible situation. Their users are expected use their common sense, environmental awareness, technical knowledge and creativity.

17 See ICRC, above note 16, pp. 12–21. The examples in the table below were compiled at the Nairobi Agro Workshop by Economic Security Coordinators and complemented by USAID, above note 10.

Agronomy and agro-economics

Activity/Technology	Potential impact	Mitigation measures
Seed distribution	Overuse of land.	Study of usual land use, introduce high yield varieties.
	Decreased soil fertility.	Rotation with legumes, fertilizer application.
	Reduction of pasture land.	Introduce varieties providing crop residue for fodder.
	Change of animal management, fencing necessary.	Discuss field protection with local population and authorities, provide shrub seeds for living fence.
	Deforestation.	Introduce intercropping and timber plantations.
	Imbalance between agro and livestock.	Develop integrated and sustainable approach after socioeconomic assessment.
Seed multiplication / production		
Fishing kit distribution	Unnatural increase in fishing activities.	Baseline assessment to estimate previous numbers and ongoing monitoring. Support alternative income generating activities.
	Decline of fish population due to overfishing.	Follow national legislation, if existing. Independently assess fishing capacity of the area. Use appropriate fishing nets.
Fish farming	Introduction of 1 species, introduction of predatory species with impact on local species.	Consult and acquire full knowledge of local and proposed species.
Chicken Programmes	Biodiversity risk.	Limit importation. Preference for local species. Interbreeding with local species.
	Introduction of new diseases.	Follow national policy. Consult with local veterinarians.

Activity/Technology	Potential impact	Mitigation measures
		Identify local and introduced species vulnerability to diseases.
	Health risk from chicken wastes.	Appropriate waste management training.
Land clearing	Land tenure issues.	Consult with authorities and local leaders. Design and follow-up programme with land committees.
	Erosion.	Encourage sound agricultural practices such as earth mounds, natural fences, mulching, where appropriate.

Livestock activities

Activity/Technology	Potential impact	Mitigation measures
Animal vaccination	Pollution due to used materials.	Promote safe disposal / recycling.
	Overgrazing due to large gathering of animals.	Mobile vaccination / decentralised vaccination / use traditional gathering points.
	Overgrazing due to higher survival rates.	More mobility, improve offtake, alternative livelihoods.
	Disease mutation.	Surveillance.
Training of community animal health workers	Waste and poor drug disposal.	Focus on waste and drug disposal training to enhance the benefits of training.
Restocking	Overgrazing or resource competition.	Consult communities and use traditional grazing points.
	Spread of diseases	Monitor new cases and parasites.
Parasite control programmes	Contamination of water points.	Avoid water points and ensure careful application by trained people.

Activity/Technology	Potential impact	Mitigation measures
	Shifted concentration of parasites. Overgrazing.	Test first and treat accordingly. Mobile or decentralised treatment points / use traditional gathering points.

Section 4: Health and environmental management[18]

The health needs of people in armed conflict or other situations of violence are met according to defined minimum packages of health services/care. Curative and preventative health actions remain at the heart of our projects. Saving lives and alleviating suffering is the central objective of health assistance.

Emerging and acute crisis:

- the ICRC provides support for pre-hospital care (first aid and medical evacuation), basic health care and emergency hospital care (treatment of war wounded and other essential surgery), when access to medical facilities and the provision of health care are at risk.

Chronic crisis and post-crisis:

- the ICRC may consider providing support for a broader range of primary health care activities than those cited above. It may also take steps to strengthen other hospital services such as paediatrics, obstetrics and gynaecology (O&G), internal medicine and hospital management.

Main health activities are:

- first Aid;
- primary health care;
- emergency hospital care (war and essential surgery, paediatrics, O&G, internal medicine, hospital management);
- physical rehabilitation services;
- health in detention.

18 Health Care Without Harm (HCWH), *Environmentally Responsible Management of Health Care Waste with a Focus on Immunisation Waste*, Washington, 2002; A. Prüss, E. Giroult and P. Rushbrook (eds), *Safe management of wastes from health-care activities*, World Health Organization (WHO), Geneva, 1999; WHO, *Suggested Guiding Principles and Practices for the Sound Management of Hazardous Hospital Waste*, New Delhi: Regional Office for South-East Asia, WHO, 2000; WHO, *Guidelines for Safe Disposal of Unwanted Pharmaceuticals in and after Emergencies – Interagency Guidelines*, 1999; USAID, above note 10, Chapter 8 Healthcare Waste: Generation, Handling, Treatment and Disposal; Oliver Morgan, Morris Tidball-Binz and Dana von Alphen (eds), *Management of Dead Bodies after Disasters: A Field Manual for First Responders*, Pan American Health Organization/WHO/ICRC/International Federation of Red Cross and Red Crescent Societies, Washington D.C., 2009.

4.1 Environmental challenges of health activities

Human health is directly related to environmental conditions. The deterioration of the health of conflict-affected populations is linked to the deterioration of their local environment. ICRC health activities as listed above, more often provide support to existing medical facilities, and as such, do not generally directly consider environmental issues in the design of their activities.

Some primary health care activities, however, promote awareness of the link between local environmental conditions and health. The success of anti-malaria campaigns, for example, directly depends on community understanding and management of environmental conditions.

Health activities can also have direct negative impacts on the environment. Disposal of healthcare waste is of particular concern in countries where healthcare waste legislation does not exist or is not implemented, or where local practices may cause localised pollution to air, watercourses, aquifers or soils, thus further affecting the health of local populations.

The Health delegate must consider these factors when designing and evaluating programmes, particularly in the strengthening of hospital management, combine them with the local context and come up with a solution that meets the needs of the victims of armed conflict without, as far as possible, causing additional harm to the environment.

The environmental challenges and considerations faced by Health delegates when designing and implementing their main activities are detailed in the annexes of this document. This is not an exhaustive list, nor does it attempt to provide detailed healthcare waste management guidance. This would be best covered in a separate, specific document.

4.2 Case studies

The following case studies aim to highlight examples of how Health delegates in different situations have sought to deal with healthcare waste issues.

A. Lopiding Hospital waste management, Kenya

Lopiding was an independent ICRC hospital for conflict-wounded from South Sudan. It began to operate in 1987. The principal activity was war surgery and included services such as an orthopaedic workshop, physiotherapy, x-ray, pharmacy, laboratory, laundry, kitchen, maintenance and administration. In 2001 the ICRC commissioned the Institute of Occupational Health Sciences to conduct a waste management evaluation. In this case, the ICRC recognised that external expertise was required to identify the best possible solution.

The independent evaluation covered medical waste management from the creation of waste to its disposal. It made specific recommendations for improvements in several areas: waste minimization, separation and identification,

handling, collection, transport and storage, treatment, final disposal, assignment of responsibilities and workers training and safety. The recommendations were implemented.

The main objectives of the evaluation were to:

1) observe and describe current health-care waste management from the creation of the waste to their final disposal, including collection, transport, intermediate storage and treatment;
2) analyse the risks generated by the actual health care waste management to the general population and ICRC employees;
3) to provide recommendations for future improvements.

After the evaluation, observation and interviewing of key staff, local authorities and other local health centres; a final report was produced covering the following topics:

1) types and quantities of waste;
2) containers and labelling;
3) collection, transport and storage;
4) pre-treatment;
5) final disposal;
6) waste water treatment;
7) health and safety practices;
8) responsibilities and training;
9) legislation, regulation and policies.

Although it was concluded that waste management in Lopiding did not result in extreme hazardous situations for either the surrounding population or hospital staff; several recommendations for future improvement were issued on the different stages as listed above.

After the peace agreement in 2006, ICRC withdrew from Lopiding hospital and handed it over to the Kenyan Health Ministry.

Although these recommendations may have been followed, there is no documented evidence of any follow-up or implementation. This is something that should be considered in any future assessment or evaluation initiatives.

B. Physical rehabilitation – prosthesis recycling

ICRC has commissioned a study to find an improved design process for its polypropylene trans-tibial prosthesis in Cambodia. The study takes into account economic and technical constraints but also considers user needs and environmental impact of the product.

A Life-Cycle Assessment was used to evaluate the environmental effects of the production, use and recycling phases of the prosthesis. This will enable ICRC to decide which aspects of the different stages of the product life may need to be improved from an environmental perspective.

This project resulted from a cooperation agreement between a PhD student at the Norwegian University of Science and Technology and the ICRC Physical Rehabilitation Programme Health Unit and is still ongoing.

The researcher was asked to investigate the current polypropylene technology used by ICRC in Cambodia and to suggest further development of the current prosthesis for children to produce and user-test a prototype of the suggested solution.

A large majority of current ICRC supported projects are already recycling polypropylene scraps in crutches handles, however, there are no formalised schemes for ensuring recycling of the materials used in the production of prosthetic appliances and it is unknown how each ICRC supported centre is currently managing its material waste.

This study is currently investigating the following trends:

– current levels of collection / disposal and re-use of different components;
– existing efforts to find new ways of recycling or reusing materials from returned or used prosthesis.

The results of the study to date have indicated a general lack of awareness of possibilities of recycling or reuse and of proper disposal methods in physical rehabilitation centres in Cambodia.

This study will contribute to the overall effort of improving final product cost-efficiency, user satisfaction and well-being, and as such contributing to the improvement of the quality of ICRC assistance to victims of conflict in Cambodia.

4.3 Types of health waste arising and main impacts

As there is much in-depth guidance on disposal of healthcare waste, this section will not detail the impacts or mitigation areas. It is beyond the scope of this framework to provide specific healthcare waste disposal guidance. It defines the types of waste that can arise, types of disposal, main possible impacts and outline the minimum elements of a waste management plan.

Note: It is the responsibility of the projects designers and implementers to strive to reduce the environmental impact of their activities. These examples cannot be expected to cover each and every possible situation. Their users are expected use their common sense, environmental awareness, technical knowledge and creativity.

Main impacts of healthcare waste[19]

- Disease transmission, through infectious waste, sharps, and contaminated water.
- Chemical and toxic threats, through chemical and pharmaceutical exposure.

19 Adapted from USAID, above note 10, Chapter 8: Healthcare Waste: Generation, Handling, Treatment and Disposal.

Waste disposal method	Type of waste	Advantages	Disadvantages
Open air burning	Not effective for pathological waste. Not good for most pharmaceutical or chemical waste.	Disinfects reasonably well, destroying 99% of microorganisms. 80–90% burning efficiency.	Burning may be incomplete and residues still infectious. More hazardous to staff involved. Greater risk of scavenging by waste-pickers or of transfer of pathogens by vectors including insects. Sharps in ashes will still pose physical hazard.
Drum or brick incinerator	Infectious waste. Sharps waste. Pathological waste.	Disinfects reasonably well, destroying 99% of microorganisms. 80–90% burning efficiency.	Emits black smoke, fly ash, acid gases, and some toxins. May produce odours. Sharps in ashes will still pose physical hazard. Not good for most pharmaceutical or chemical waste.
Incineration	Infectious waste. Sharps waste. Pathological waste.	Disinfects effectively. Reduces waste volume by ~80%; burning efficiency of 90–95%. Low investment and operating costs.	Emits pollutants such as fly ash, acid gases, and some toxins. May produce odours (can be limited by not burning

Waste disposal method	Type of waste	Advantages	Disadvantages
			PVC plastics). Sharps in ashes will still pose physical hazard. Not good for most pharmaceutical or chemical waste.
Encapsulation	Sharps waste. Small amounts of chemical. and pharmaceutical waste.	Simple and safe. Low cost.	Not effective for non-sharps infectious waste.
Safe burial	Infectious waste. Sharps waste. Small amounts of chemical and pharmaceutical waste.	Provides some of human health and environmental protection by making waste inaccessible. Organic materials will eventually biodegrade.	Soil can become polluted if permeable. Difficult to prevent scavenging.