Sustainable Flood Mitigation Strategies Pilot Study 1

Community flood mitigation activities

Community: Carre
District: Chonguene, near Xai Xai

Report EX 5129
Release 1.0
April 2005

HR Wallingford

Document Information

Project	Sustainable Flood Mitigation Strategies Pilot Study 1
Report title	Community flood mitigation activities: Carre
Client	DFID
Client Representative	
Project No.	MDS0542
Report No.	EX 5129
Doc. ref.	EX5129-Pilot study_1 Carre rel1-0.doc
Project Manager	Mr DM Ramsbottom
Project Sponsor	Mr DM Lumbroso

Document History

Date	Release	Prepared	Approved	Authorised	Notes
18/04/05	1.0	dmr	dml	dmr	

Prepared .....

Approved .....

Authorised .....

Summary

Sustainable Flood Mitigation Strategies
Pilot Study 1

Community flood mitigation activities

Community: Carre
District: Chonguene, near Xai Xai

Report EX 5129
April 2005

This report describes the development of a sustainable flood mitigation strategy for the village of Carre in the Limpopo basin in Mozambique. A sustainable flood mitigation strategy is a strategy that can be implemented and maintained by a community to reduce the impacts of flooding on the livelihoods of community members. The work was carried out under a DFID Knowledge and Research (KAR) project, in which information on sustainable flood mitigation strategies were collated in a 'Source Book' and then applied to three communities in Mozambique.

Carre lies on the lower Limpopo floodplain, and is very vulnerable to floods as it is about 8km from the edge of the floodplain. A series of meetings were held with the community to develop ideas for mitigating the impacts of floods. About 20 ideas were developed, some of which required external support to implement whereas others could be done by the community with external guidance.

Two of the most important mitigation measures, provision of drinking water during floods and pest-resistant seed, were implemented with external support and funding. This was done to help the community deal with some of the most pressing concerns, and stimulate the community to further improvement.

The implementation work was carried out in collaboration with the Eduardo Mondlane University, the Department of Health, the Department of Agriculture and the local District Administration.

Contents

Figures

1. Introduction

Sustainable Flood Mitigation Strategies are strategies that can be implemented by communities to reduce the impact of floods on their livelihoods. A strategy for an individual community consists of a number of measures. Examples of measures include strengthening of houses in flood risk areas, to reduce the risk that houses will be destroyed, and providing safe water supplies during flood emergencies, to reduce the risk of sickness.

A Knowledge and Research (KAR) project to identify Sustainable Flood Mitigation Strategies was completed in March 2005. The project includes:

- Development of a Source Book which contains information on sustainable flood mitigation strategies. This is intended for use by Government organisations and NGOs to assist communities to develop their own strategies using a participatory approach. The Source Book is provided in Portuguese and English.
- Posters that can be provided to communities as part of the process of developing their own strategies. These are currently in Portuguese. However the number of words on the posters is minimal to facilitate understanding by any community. Pamphlets have also been produced, that can be used by community leaders and others to explain the posters to communities. These are in black and white, and can also be used as teaching materials in schools.
- Pilot studies in three communities in Mozambique.

The project was undertaken by HR Wallingford Ltd (HRW), the project leader, and the Eduardo Mondlane University (UEM), with contributions from other flood specialists.

This document discusses types of activities that could be included in a strategy for Carre, one of three communities that have agreed to collaborate on the pilot studies. It is based on information obtained from meetings with the Community, particularly a full-day meeting to discuss flood issues in detail, on 30 September 2004. This meeting was attended by the Community leader and about 150 members of the community.

A summary of flood related issues at Carre is contained in **Section 2.**

The needs of the Community are assessed against the contents of the Source Book in **Section 3**, in order to identify measures that could be implemented in the Community.

A number of possible measures have been identified from this assessment, and these are listed in **Section 4**. Thus Section 4 contains initial suggestion of the types of activities that could be included in a strategy for Carre.

In order to begin a process of developing a flood mitigation strategy for Carre, it was decided to implement some of the measures with the help of Community members. These are described in **Section 5**.

The Community has taken over these measures, and it is hoped that they will provide an incentive to develop further measures, in collaboration with the local administration and NGOs.

This project ended in March 2005. For any future strategies to be successful, they should be identified by the community itself. The following approach is therefore recommended:

- Ensure that Committee established to look after the initial measures developed under this project continues to function. This requires follow-up, which could be provided by the local District Administration or NGOs that are active in the area.

- Other possible flood mitigation measures should be discussed in detail with the Community, possibly through the Committee.

- The Community should decide which measures to implement.

- The Community, the local District Administration, and other relevant organisations (for example, INGC, ARA and NGOs) should discuss and agree what support will be provided to the community, and by whom.

- Appropriate training should be provided to the local District Administration, other relevant organisations and the communities in the development and implementation of flood mitigation strategies and measures.

The greatest challenge facing the community at Carre is to take as much responsibility as possible for flood mitigation in order to minimise the impacts of flooding.

2. Impacts of flooding at Carre

The causes and impacts of flooding at Carre are summarised in this section. A more comprehensive report on this pilot study has been prepared by UEM.

2.1 LOCATION OF CARRE

Carre is located in Chonguene District, near Xai Xai. The approximate location of Carre is shown on Figure 2.1.

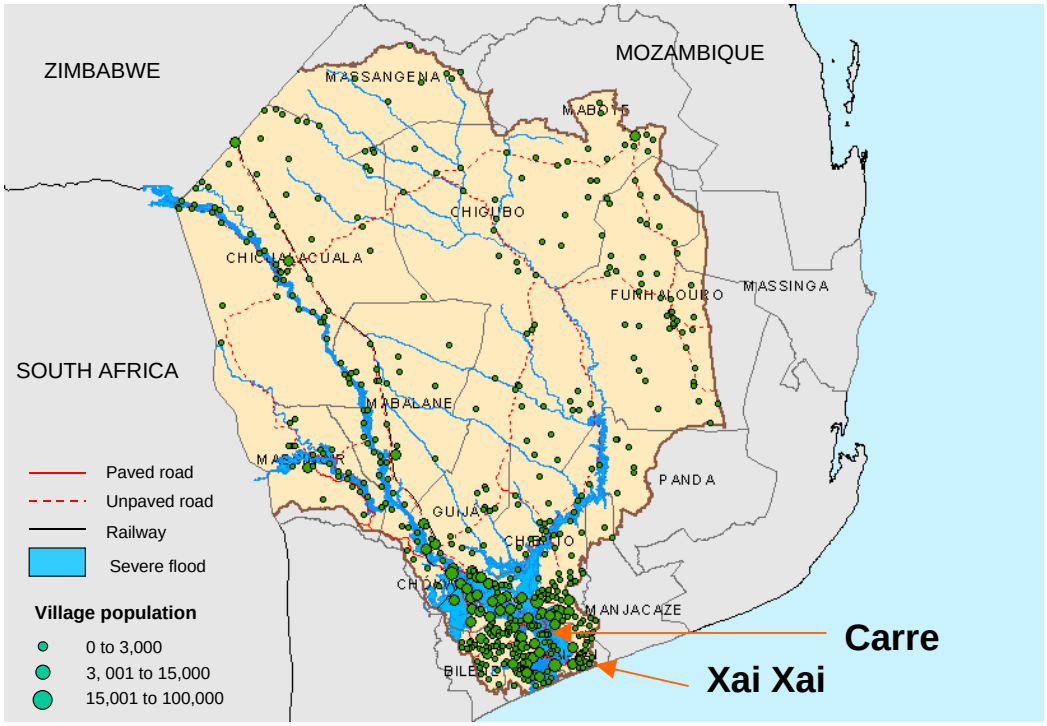

Figure 2.1 Limpopo floodplain showing location of Carre

The community is on the left bank of the Limpopo in the Limpopo floodplain, close to the river. Two views of the Limpopo in the vicinity of Carre are shown on Figure 2.2.

Figure 2.2 The Limpopo near Carre

The left bank floodplain is of the order of 10km wide, and therefore any evacuation requires travelling at least this distance. Figure 2.3 shows the floodplain with the valley side in the distance.

Figure 2.3 The Limpopo floodplain near Carre

There is a flood protection dike on the Limpopo, which passes adjacent to the community. It is about 2 to 3m high. It is isolated from the valley side in a big flood and is therefore a dangerous 'safe haven'. It was overtopped in the 2000 floods. The dike is shown on Figure 2.4.

Figure 2.4 The old flood protection dike, used for access to Carre during small floods

2.2 FEATURES

The floodplain is very flat. There are local undulations possibly caused by excavations for the dike. There is also the remains of an irrigation and drainage system, long since abandoned. There are few large trees. Figure 2.5 shows two view of the floodplain at Carre.

Figure 2.5 General views of the floodplain

The houses are constructed with wooden frames and jute walls, often with a covering of mud. There are no concrete or brick buildings. The houses are widely spaced, adjacent to cultivated areas. Typical houses are shown on Figure 2.6. Figure 2.7 shows part of the group of buildings at the centre of the community. Figure 2.8 shows a typical house in detail.

Figure 2.6 Typical houses

Figure 2.7 Houses in the centre of Carre

Figure 2.8 Detail of typical house

The population of the community is as follows: 542 families
2879 people

2.3 DESCRIPTION OF FLOODS AND IMPACTS

The land is flat and most of the area floods even in small events. There are however some slightly raised areas.

It is understood that flooding occurs every year. In small floods, crops are affected but not houses. Crops are normally planted in low areas to obtain the greatest amount of moisture in case of drought. There is therefore a balance between planting in low areas, and risking loss of crops due to flood, and planting in high areas and risking loss of crops due to lack of water.

The 2000 flood is understood to have overtopped the dike, and it must therefore have been about 3m or more deep. Thus the whole community was submerged.

Floods enter the area via gaps in the dike (initially via outfalls of old open drains where the sluices no longer close). The people would like the gaps in the dike closed. In 2000 the dike was breached, cutting off the access route to the valley side (the people do not walk across fields because of the danger of falling into deep water in low areas when the area is flooded).

It is understood that the Community repaired a 100m breach in the dike to restore access. This was a major undertaking, which indicates that the Community can do things when it has to. However it is not clear how much external help was provided. The dike repair was well constructed, suggesting external assistance.

The flood season was stated as September to March. The flood season is therefore long and it would not be possible to modify crop calendars to avoid the flood season, particularly as the rains occur in the same season.

Flood warning is provided by radio. Warnings distinguish between large and small floods, but now the people leave whenever they receive a warning following the 2000 flood. The people have no way of protecting their houses when they are away. It is understood that thieves take things.

The main crop is maize. Two crops are grown per year. Yields are low. Figure 2.9 shows a typical field, early in the growing season.

Figure 2.9 Typical field at Carre

Surplus food is stored after harvest but is eaten by rodents and other pests.

Food is short in flood periods because (a) crops are destroyed, (b) the amount of stored food is limited, and (c) stored flood is damaged by pests.

House materials are weak and houses are easily damaged in floods. Strengthening houses is difficult because there is a lack of suitable materials.

Most animals were killed in the 2000 flood and they do not have replacements. Thus they do not have animals for ploughing. The loss of animals was a major disaster for the Community.

People were moved to an evacuation area after the flood where there is a school. The children stay there but the adults have returned to the village to farm the land. Thus the parents and children are separated.

The people want a school in the village. The Government will not build one because of the flood risk. A school could provide a valuable safe haven during floods if designed for this purpose, although the Government may not wish to consider a school in the Community now that one has already been built in the evacuation area.

Water is obtained from the river. When a flood occur, the water is dirty. The Government has provided a well at the evacuation area. The villagers must pay Mt 10,000 per month for this, but the pump is often broken.

The people were affected by malaria and cholera during the floods. There was no mention of diahorrea. No medical assistance is provided according to the Community.

An important mitigation measure is to consider the scope for different economic activities to reduce vulnerability, although the scope at Carre is clearly limited. Current economic activities are:

- Agriculture
- Some fishing, but fish are small
- People seek work after floods to get money. There are however few jobs available on the high ground and normally very few people have paid work.

Consequently money is scarce. It was noted, for example, that there are no shops.

2.4 COMMUNITY CONCERNS ABOUT FLOODING

Particular issues raised by the Community related to flooding include:

- Frequent loss of crops.
- Can anything be done to improve crop yield?
- There is a lack of clean drinking water during a flood.
- There is often little spare food that could be stored. When food is stored, it is damaged by pests. Can storage of food be improved?
- There is a need for seeds and hoes after a flood. There is a risk that seeds and crops will be damaged by pests.
- The loss of animals during the 2000 flood has had a very serious impact on the Community. The animals have not been replaced.
- Can houses be raised? The Community said that they do not have materials, and ground raising would be a large undertaking.
- The issue of whether houses and valuables can be protected in a large flood was discussed.
- There is a need to clearly distinguish between large and small floods in flood warning messages. There is no need to evacuate in a small flood.
- The impression was given that little Government support is provided to the community during and after a flood. The Government has however provided a re-settlement area and a school. It appears to be Government policy to resettle people outside flood risk areas, but the people have no source of income in these areas. They therefore return to the floodplain in spite of the risk. Thus the issue of employment and livelihoods for people in re-settlement areas should be discussed between the Community and the District Administration.

3. Application of the Source Book to Carre

The main headings in the Source Book are listed in this section using bullet points. Each heading represents a measure or group of measures that could contribute to a sustainable flood mitigation strategy.

Under each heading, comment in given *in Italics* on whether the measure (or group of measures) would be applicable to the Community. Those measures which appear to be applicable are listed in Section 4.

Awareness raising

- Source Book suggestion: **Prepare flood maps (national or regional)**
  Response: Flood maps are already available from the Limpopo Atlas, which shows that the whole area floods.

- Source Book suggestion: **Provide support to Regional/Local Government** by disseminating the Source Book and other flood information, and providing training:
  Response: There is scope for raising awareness and working with Regional and Local Government to help with flood problems. However this cannot be done in the timescale of the project, and should be done by the organisation that provides long-term support to communities.

  This should be discussed with Regional/Local Government. A local NGO should be involved as they often have more capacity to work with communities.
  Suggested measure: See Section 4.4

- Source Book suggestion: **Provide flood information to communities**
  Response: The Community is aware of flood risk and warning arrangements. The crucial issue for local flood warning is to distinguish between large and small floods.

  More participatory work is needed on mitigation strategies. This takes time to develop.

  Awareness of flood issues could be raised by using the posters and cards in schools (eg flood marks and safe haven posters) although the Community is aware of the risk because of frequent flooding.
  Suggested measure: See Section 4.1

- Activities with community
  - Source Book suggestion: **Make flood map with community**
    Response: The whole area floods during large flood events. There was no mention of high ground apart from the dikes and the valley side. A flood map would therefore be of limited use in a large flood. The community has reasonable knowledge of which areas flood in a small flood.

  - Source Book suggestion: **Seasonal calendar**
    Response: The flood season is long. The Community says that it lasts half the year (September to March).

- Source Book suggestion: **Flood marks**
  Response: There are no permanent structures for locating flood marks. If the Community decides that it wants them, new concrete posts are suggested.
  Suggested measure: See Section 4.3

- Source Book suggestion: **Keep people aware in periods when there are no floods**
  Response: As flooding appears to be annual, awareness of flooding is high. However the Community must be kept aware of the risk to life in a large flood.

Flood Warning:

- Source Book suggestion: **National/regional flood warning system**
  Response: A flood warning system for the Limpopo exists

  - Data collection
    Response: There is no benefit in involving the Community in data collection for the Basin flood warning system as it is located near the downstream limit of the catchment

  - Prepare warning message including lead time and magnitude of flood, and all clear message.
    Response: It is understood that warning messages are provided that give an indication of timing and magnitude of the flood. Before 2000, warnings were not always believed particularly the magnitude of the 2000 flood. There is need to distinguish with confidence the difference between small and large (life threatening) floods.
    Suggested measure: See Section 4.2

- Source Book suggestion: **Local warning system**
  - Flood watch
    Response: The Community depends on flood warnings. The Community is aware of the locations where flooding starts, and could implement a flood watch. See also 'Trigger level' below. This would help to provide information about whether to evacuate, and when.
    Suggested measure: See Section 4.1

  - Gauges
    Response: No raingauge needed as source of flood is Limpopo.

  - Trigger level
    Response: This could be explored more. The Community moves to high ground when a warning is received. The memory of the 2000 flood is still fresh and affects behaviour. However the longer the houses are accessible and empty, the greater the risk of theft. It is therefore desirable that the Community has a system that allows the people to decide whether to move, and when.

- Source Book suggestion: **Dissemination of flood warnings**
  - Dissemination to communities
    Response: The Community receives messages by radio.

– Dissemination to remote areas
Response: People in remote locations receive messages by radio and sometimes from Community leaders

Prepare for floods

- Source Book suggestion: **Flood defence**
  – Main infrastructure
  Response: Large existing defence embankments exist but there is no evidence that they are maintained. Floodwater enters the defended areas, initially through drainage outfalls in the now disused drainage system and then through breaches in the embankments.

  – Local infrastructure
  Response: The only infrastructure is the flood dike referred to above. There may be scope to prevent frequent flooding by blocking drain outfalls and locally raising parts of the dike. This is seen as major work by the Community, requiring machines. In particular, machinery would be needed to compact the embankment.

  The community repaired a 100m section of dike that had breached, cutting of their access to Xai Xai. This suggests that such work is possible and should be discussed between the community and the District Administration. The repair was well constructed, suggesting that external assistance was provided.

  There is a danger that blocking drainage outfalls will affect land drainage in the area.
  Suggested measure: See Section 4.2

  – Drainage systems
  Response: None in the Community (there is an old abandoned system for the irrigation scheme).

  – Operation and Maintenance
  Response: None

  – Flood fighting
  Response: None. The river is huge and there is little that communities could achieve

  – Sandbags
  Response: The use of sandbags is unlikely to be effective because of the high depth of flooding that can occur. Sandbags could protect groups of houses for a limited depth of flooding, but the effort would be large and the warning is unlikely to provide sufficiently accurate depth information.

- Source Book suggestion: **Safe havens**
  Response: The dike provides a haven for small floods. A safe haven big enough for the 2000 flood would require a large a large amount of construction work and is beyond the capability of the Community. As the floodplain is so large, a safe

haven (or havens) would have to be big enough for people, animals, food, fodder and shelter.
A safe haven that is overtopped in a large flood is a potential disaster.

- Source Book suggestion: Prepare houses for floods
  - Strengthen houses
    Response: It would be possible to strengthen houses but materials are needed. This would reduce the amount of reconstruction work after a flood.
    Suggested measure: See Section 4.3

  - Flood proof houses
    Response: There is little scope for floodproofing the houses without rebuilding them. It would be more appropriate to rebuild them on raised ground.

  - Raise houses
    Response: This could be done by one or more of the following:
    - *Build houses on stilts, but materials would be needed*
    - *Build houses in a new location on higher ground, but there is little if any scope for this on the floodplain.*
    - *Build houses on areas that have been artificially raised, but this would require a lot of work.*

    Raising will reduce but not eliminate the risk of houses being flooded. It would probably not be practical to raise houses above the 2000 flood level.
    Suggested measure: See Section 4.3

  - Platforms inside or on roof
    Response: The houses are currently not strong enough to support internal or external platforms. Once again the question of flood level is of vital importance. Any strengthening of houses and provision of platforms must be linked to a reliable estimate of the 2000 flood level.

  - Relocate houses
    Response: The Government has provided a re-settlement area. Houses have been built using local materials and there is a concrete school. However there are few jobs and people have returned to the floodplain. This issue should be discussed between the community and the local District Administration.

    It may be possible to allow each family to have two houses, one on the floodplain and one in the re-settlement area.
    Suggested measure: See Section 4.1

- Source Book suggestion: **How to decide whether to stay or leave?**
  Response: Since the 2000 flood, the Community chooses to leave when a flood warning is received. The Community would prefer to stay but does not feel safe. Even the dike was overtopped in 2000.

  A key issue in this decision is the quality of the flood warning. If the size and timing of the flood were known with reasonable accuracy, the people would be a better position to decide whether to stay or evacuate.

- Source Book suggestion: **Evacuation site**
  Response: An evacuation site is available although it is about 10km away from the Community.

- Source Book suggestion: **Evacuation route**
  Response: There is an evacuation route along the dike but it is long, and muddy in wet weather. Evacuation is therefore a slow and hazardous process.

- Source Book suggestion: **Evacuation procedure**
  Response: The evacuation procedure was not discussed. However it appears to be a hazardous operation, particularly for vulnerable people.

- Source Book suggestion: **Evacuation shelter**
  – Facilities:
    Response: An evacuation area is available but the facilities are not known. It appears that the community provided their own food, water, etc in 2000.

  – Management
    Response: Not discussed

- Source Book suggestion: **Water supply for emergency** including water purification
  Response: Assistance could be given to improve water supplies during a flood. This includes:
  - *storage of water above flood level in small floods when people do not evacuate*
  - *collecting rainwater*
  - *water purification using chlorine or bleach. This should be administered by a competent person.*

  Suggested measure: See Section 4.3

  Ensure that the well in the re-settlement area is working
  Suggested measure: See Section 4.2

- Source Book suggestion: **Health precautions**
  Response: There are health problems during floods including malaria and cholera. The Red Cross produces flood kits that include some simple health measures. The Red Cross is not working in this area but there may be other NGOs who can assist. It may be possible to reduce health problems by simple techniques, but this requires more investigation.
  Suggested measure: See Section 4.2

- Source Book suggestion: **Care of vulnerable people**
  Response: The care of vulnerable people during a flood has not been discussed with the Community. This should be done as it will provide more insight into evacuation issues.

- Source Book suggestion: **Protect water and other services**
  Response: Water is taken from the river. There are no other services. An alternative water supply is available at the re-settlement area although it does not always work.

- Source Book suggestion: **Food supply for emergency**

Response: There may be scope to improve the storage of food. However there does not appear to be much spare food, and food storage is affected by a range of pests. Thus the key issues are:

- *Can yield be increased, to provide more food in flood periods? For example, are there any faster growing varieties? The growing season needs rainfall early in the crop cycle, and this occurs only one or two months before the main flood period.*
- *Can improvements be made to food storage and pest control?*

Suggested measure: See Section 4.2

- Source Book suggestion: **Other equipment needed** (fuel, cooking utensils, etc)
  Response: The needs for other equipment have not been discussed with the Community.

- Source Book suggestion: **Protect homes from looting/store for valuables**
  Response: It may be possible to build a platform in a tree for guards selected from the Community. However there are issues: platforms would be needed close to each group of houses; the guards may be powerless to prevent looting; and the guards would be at risk from the flood.
  Suggested measure: See Section 4.1

- Source Book suggestion: **Protect access and evacuation routes**
  Response: Damage to the main Community access route was repaired after the 2000 flood. It may be advisable to implement a programme of inspection and repair, particularly at the start and end of each flood season.
  Suggested measure: See Section 4.1

- Source Book suggestion: **Care for animals**
  Response: Practically all animals were killed in 2000. This has very severe consequences and the community has not recovered. In addition to the loss of meat and milk, animals are used to plough land. Thus there is a severe impact on agriculture.

  The process of re-building stocks requires money and ways of looking after animals during floods.
  Suggested measure: See Section 4.3

- Source Book suggestion: **Protect agriculture**
  Response: Discussed under 'Food supply for emergency', above. Agriculture can be afflicted by soil erosion, deposition of unwanted sands, and damage to bunds and other works. There appears to be little that can be done to prevent this kind of damage.

  It may be possible to save some crops by picking early fruit and grain that is nearly ripe. However it may not be possible to pick very much in the period between receiving the flood warning and evacuation. Any picked grain will require drying before it can be used.

- Source Book suggestion: **Protect fisheries**
  Response: There are no fisheries other than fish taken from the river.

- Source Book suggestion: **Store seeds and other essentials to aid recovery**

Response: There is often a shortage of seed and stored seed is destroyed by pests. A source of pest-resilient seed for new crops is needed.
Suggested measure: See Section 4.2

- Source Book suggestion: **Protect livelihoods**
  Response: The main livelihood activity is agriculture. There is a very small amount of paid work. The scope for reducing reliance on agriculture should be discussed with the District Administration with a view to identifying more paid work. Money is urgently needed after a flood to restore agriculture and help people during the period when they have no crops.
  Suggested measure: See Section 4.2

  The Community should consider if there is anything else they could do to secure their livelihoods when flooding occurs.
  Suggested measure: See Section 4.1

- Source Book suggestion: **Planning for initial community recovery**
  Response: Ideas for improving the ability of the Community to recover should be developed with the Community.
  Suggested measure: See Section 4.1

- Source Book suggestion: **Planning for floods**
  - Responsibilities
    Response: A meeting should be held between Community leaders and the District Administration to discuss responsibilities in a flood emergency. It is unlikely that the District Administration can assist during the flood, but it may be possible to agree some preparatory activities.
    Suggested measure: See Section 4.2

  - Community plan including dissemination of warning
    Response: A Community Plan should be developed within the Community using a participatory approach. This will require a change of thinking and behaviour, and should form part of a long-term strategy to mitigate the impacts of flooding. Suggestions are given in Section 4.

    The community should decide how to practice the plan. Full evacuation requires a long journey for all involved.
    Suggested measure: See Section 4.1

  - Equipment
    Response: This would be identified in the Community Plan referred to above.

  - Funding
    Response: The flood mitigation strategy will require some funding. It is recognised that the Government has already invested in re-settlement areas and may be reluctant to commit more of its limited funds. However it may be possible to interest an NGO(s) in providing assistance. A meeting should therefore be held with potential supporters and involve them in developing the strategy.
    Suggested measure: See Section 4.2

  - Flood without warning

Response: This is a very low risk scenario. It could be addressed by the implementation of a local flood watch.

- Source Book suggestion: **Development in flood risk areas**
  Response: This is not considered to be applicable at the present time. As more becomes known about flood risk areas, it may be possible for the Community to develop their own zoning method.

What to do when a flood occurs

Response: The following items should be considered as part of the Community plan. In particular, there should be liaison with the District Administration regarding the way in which shelters are operated, and what information is needed on flooding situations.

- *Implement plan*
- *Help vulnerable people*
- *Prepare and open shelters if required*
- *Prepare and undertake evacuation if required*
- *Flood fighting*
- *Use sandbags where suitable*
- *Emergency relief actions*
- *Provide information on local situation*

Further information on these activities is provided in the Source Book.

What to do after a flood occurs

Response: The following items should be considered as part of the Community plan. Further information on these items can be found in the Source Book.

- *Initial recovery actions*
- *Repair roads and bridges*
- *Restore water supply and other services*
- *Telecommunications*
- *Disease prevention*
- *Medical facilities*
- *Community health*

- *Reconstruct damaged communities*
  - *Train people*
  - *Re-build*
  - *Floodproof*
  - *New build*
- *Repair flood structures*

- *Livelihoods*
  - *Cash and in-kind*
  - *Avoid panic selling*
  - *Re-start agriculture*
  - *Restore other economic activity*

- *Review of flood*

The actual actions taken will depend on the impact of the particular flood and the condition of the community after the flood. External assistance will be essential for some of these items in most circumstances. The District Administration should discuss with INGC, ARA and NGOs how best to support flood affected communities.

4. Initial suggestions for flood mitigation activities

From the review of the Source Book in Section 3, the following items have been selected as measures that could be implemented at Carre to provide a flood mitigation strategy. However, any strategy must be decided by the Community, and therefore these items are initial suggestions only.

The Community Flood Mitigation Strategy should be developed within the Community using a participatory approach. This requires a change of thinking and behaviour, and should form part of a long-term strategy to mitigate the impacts of flooding.

The items are divided into the following groups:

- Things that can be done by the Community now.
- What can be done by the Community with help from external organisations including the District Administration, INGC, ARA and NGOs.
- What can be done if some funding were available.
- What long-term support can be provided to the Community

4.1 THINGS THAT CAN BE DONE BY THE COMMUNITY NOW.

The following items could be undertaken by the Community now, although facilitation would be needed to inform the Community about these issues and what they could do.

- Raise awareness of flood issues in schools using posters and cards. For example, the posters showing flood marks and safe havens could form the basis of school discussions.
- Implement a local flood watch on the river to assist with deciding whether to evacuate and when. This could also assist with other actions, for example deciding when to start storing water.
- Consider whether to allow each family to have two houses, one on the floodplain and one in the re-settlement area.
- Decide how to guard houses during floods. One possible method is to construct platforms in trees and provide boats for the guards. There are however dangers in a very large flood, and guards may not be able to prevent thieves taking things.
- Inspect and repair the evacuation route, particularly at the start and end of each flood season. External help may be needed if repairs are large.
- Consider if there is anything else the Community can do to secure the livelihoods of people when a flood warning is received, for example storing food at the resettlement area.
- Consider ways for improving the ability of the Community to recover after a flood.
- Prepare a Community plan and assemble the required equipment. The plan should be practised before each flood season. A plan might include:
  - Agreement on the content and dissemination of flood warning messages with the District Administration and the ARA, so that the Community can decide whether to evacuate.
  - An evacuation plan.

- Preparation of the evacuation site.
- A method for guarding houses during the evacuation period.

4.2 WHAT CAN BE DONE BY THE COMMUNITY WITH HELP FROM EXTERNAL ORGANISATIONS

- Review the accuracy and wording of flood warning messages with a view to providing the messages needed by the Community and minimising the need for evacuation. **Information about the size and timing of an approaching flood is particularly important when deciding whether to evacuate.**
- Prevent frequent flooding by blocking drain outfalls and locally raising parts of the dike. External assistance would be needed, preferably from the Government organisation responsible for flood defences. Blocking of drain outfalls could however cause drainage problems. Ideally the gates on the outfalls should be rehabilitated.
- Ensure that the well in the re-settlement area is working.
- Consider methods of reducing health problems in liaison with the Local Health Department and NGOs.
- Consider the scope to improve the production and storage of food. Key issues include pest control and ways of improving yields of dry season crops. The Government Department of Agriculture should be involved in this activity.
- Improve the storage of seed including prevention of damage by pests. **This is vital for rapid recovery of crop production.**
- Discuss with District Administration whether there is any scope for providing more paid jobs near the re-settlement areas, to reduce the dependence of the Community on agriculture.
- A meeting should be held between Community leaders, the District Administration and INGC to discuss responsibilities in a flood emergency.
- Discuss with District Administration, INGC and NGOs possible financial and other support for the flood mitigation strategy. This should include the way in which shelters are operated, and what information is needed by the District Administration on flooding situations.

4.3 WHAT CAN BE DONE IF SOME FUNDING WERE AVAILABLE

- Permanent structures for marking the heights of previous floods (flood marks). If the Community decides that it wants them, new concrete posts are suggested.
- Strengthen houses if the Community feels this is needed. Materials would be needed.
- Raise some houses using stilts or earth platforms. It may also be possible to move some houses to higher areas to reduce the work needed. This will require materials and external assistance.
- Improve water storage and purification during floods. **This is vital to reduce health problems during and after a flood.**
- There is a need to re-build animal stocks but this requires money. Methods for looking after animals during floods must also be developed.

4.4 WHAT LONG-TERM SUPPORT CAN BE PROVIDED TO THE COMMUNITY

- Raise awareness of Regional/Local Government of flood mitigation strategies. Ideally this should involve an organisation that would be able to provide long-term support to communities. This could involve a local NGO.
- More participatory work is needed with the community on mitigation strategies. This takes time to develop. Therefore there is a need to identify an organisation to work with the community. This organisation will require training in flood mitigation strategies.

5. Implementation of some flood mitigation measures

5.1 INTRODUCTION

From the list of flood mitigation measures listed in Section 4, it was decided to implement some measures that would involve the Community in construction activity. The reasons for this were:

- The Community would become engaged in the process.
- The Community would see some immediate benefits.
- There would be a permanent reminder of the flood mitigation programme.

The following measures were selected:

- Provision of a water purification system together with rainfall harvesting facilities.
- Provision of a rodent-proof seed store together with treatment of seed to prevent pest damage.

These were selected for the following reasons:

- They were considered to be important issues by the Community.
- They should provide a significant reduction in health problems experienced by the Community during and after a flood, and contribute to the restoration of livelihoods after a flood event.
- They could be provided within the project time-scale and budget.

It was recognised that it was not possible to provide facilities that would be resistant to the giant flood of 2000, and the measures provided were intended to be of use during normal floods when the Community was not evacuated.

The vital flood mitigation measure for extreme floods of the magnitude that occurred in 2000 is to provide enough warning time to permit safe evacuation of people and, if possible, animals.

These measures were important for all three communities covered by the pilot studies, and it was decided to provide the same facilities at all three communities.

5.2 COMMUNITY MEETINGS

Initial meetings were held with the Community to confirm that it was willing to take part in the project, and provide some initial information about the project to the Community. Figure 5.1 shows two views of the initial meetings with the community.

Figure 5.1 Initial meetings with the community

A full-day meeting took place in September 2004 to discuss flood issues and possible mitigation measures.

The houses in the Community are widely spaced, with each group of houses being surrounded by an area of crops. The centre of the Community is a considerable distance from many houses and this affected the number of people who attended. It is estimated that about 150 adults attended, representing roughly 10% of the adults in the Community.

The project team was represented by David Ramsbottom and Darren Lumbroso of HR Wallingford, together with staff members from Eduardo Mondlane University. The language of the meeting was Shangaan and therefore translation was required.

During the discussion of the flood mitigation measures, the project team went through the measures contained in the Source Book and asked the Community to comment on each measure in turn. Prior to the meeting, measures which were clearly not suitable based on the initial meetings were discarded in order to concentrate on the measures that could be effective.

The format of the meeting was as follows:

1. Welcome by the Community leader
2. Introduction by the District Administrator
3. Discussion of flood problems, led by the project team
4. Discussion of flood mitigation measures. This was the major part of the meeting.
5. Short presentation on the next steps.

Photographs of the meeting are shown on Figure 5.2.

Figure 5.2 Planning meeting with the community

Some of the issues discussed at the meeting are summarised in Section 2.3, and the main conclusions of the meeting are listed in Section 2.4. The response is summarised more formally in Section 3, which considers each topic listed in the Source Book in turn and the response.

The responses were then used to prepare the list of flood mitigation activities in Section 4, from which the need for safe water supplies during a flood and pest-resistant seed for post-flood recovery were identified as priorities.

5.3 IMPLEMENTATION OF FLOOD MITIGATION MEASURES

The chosen measures consisted of the following components:

- A 3000 litre water tank mounted on a concrete stand about 1m above ground level. The tank could either be filled using river water or by rainwater from the rainwater harvesting facility referred to below.
- A rainwater harvesting facility with a catchment area of 18m^2, constructed using tin sheets on a concrete and wood frame. The facility was connected to the water tank.
- Provision of water purification fluid in collaboration with the Ministry of Health and the NGO PSI. When the facilities were handed over, training was provided by PSI on how to safely purify water in the tank, and also how to purify water obtained from the river in the traditional way using containers of about 20 to 25 litres capacity.
- Provision of a seed store with devices to prevent entry by rodents, together with seed that has been treated to prevent damage by other pests. The seed was treated in collaboration with the Ministry of Agriculture. The seed store was located under the rainfall harvesting facility.

The construction of the measures is shown on Figures 5.3 (columns), 5.4 (frame), 5.5 (rainfall collection area) and 5.6 (seed store). The work was directed by a local contractor but labour was provided by the Community.

Figure 5.3 Construction of columns for rainfall harvesting facility

Figure 5.4 Construction of frame for rainfall harvesting facility

Figure 5.5 Construction of rainfall collection area for rainfall harvesting facility

Figure 5.6 Construction of seed store

The completed facilities are shown on Figures 5.7 (general view), and 5.8 (water tank).

Figure 5.7 Completed rainfall harvesting facility and seed store

Figure 5.8 Completed water tank

Some issues that arose when designing the system are listed below:

1. The water collection system can be used for both rainwater and river water. Rainwater does not need purification. However it will often be mixed with river water and, in addition, there may be sources of pollution in the tank that have settled out from previous stored water. It was decided to purify all river water added to the tank, and clean the tank regularly.
2. River water contains sediment and this will accumulate in the tank. Thus it is necessary to clean the tank and guidance was given on how frequently to do this.
3. The water purification fluid takes some time to mix with water in the tank or smaller containers. RPI advised that whenever it was used in small containers, there is a need to shake the water containers as people may not leave them long enough to achieve dilution.
4. Two small bottles of the water purification fluid are needed for 3000 litres. To avoid the necessity of trying to measure how much water there is in the tank, it was decided to make sure the tank is completely empty before being filled with river water. In this case two bottles would be needed. There was no need to add additional water purification fluid if rainwater entered the tank.
5. It was stressed that the tank is for emergency drinking water in times of flood (and drought, if they can be filled). The tanks are far too small to provide a regular water supply for a whole community.
6. The water purification fluid has been made nationally available in Mozambique.

5.4 HANDOVER OF THE FACILITIES TO THE COMMUNITY

The facilities were handed over to the Community on 9 February 2005. The handover is shown on Figure 5.9. The Committee appointed by the community to look after the facilities is shown in Figure 5.10.

Figure 5.9 Handover of the completed rainfall harvesting facility and seed store

Figure 5.10 Committee appointed to look after the facility

The Community was instructed on the use of the water purification fluid by members of PSI, and the need for water purification was beautifully demonstrated by the use of theatre, performed by a team from PSI. A scene from the production is shown on Figure 5.11.

Figure 5.11 Use of theatre to inform the community about water purification

PSI are primarily concerned with the reduction of waterborne disease, particularly cholera. This collaborative action between a flood mitigation team and a disease reduction team demonstrates how collaborative approaches could be adopted to address wider problems faced by communities, notably the impacts of drought, HIV Aids and malaria.

It was however recognised that only one issue should be addressed at a time, to avoid confusion. Thus, the handover on 9 February 2005 concentrated on water purification. The treatment of seeds to prevent damage by pests will be carried out after the crops have been harvested in late March 2005.