PD-ABT-424

Consultancy Report #2
RECAP Project

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Purpose: The purpose of this consultancy was to provide engineering expertise to Chemonics, USAID, and the GRM as specified in the proposal for the task order under Chemonics' contract agreement with USAID for the Madagascar Rural Roads Infrastructure and Systems Rehabilitation Task Order.

Summary of activities undertaken. Basically the site visits and tasks were divided in four parts as follows:

1) Visit and review of RIP-4 road, railway rehabilitation activities on the FCE line and proposed port of Manakara repair and reconstruction works. **(This part of the assignment was done in coordination with Mr. Ken Rikard, Value Engineer)**
2) Similiarly, prepare a work plan to visit and review other sites of interest to include the Vavatenia road segment and the river crossing at Ambolifaho.
3) The Ambalavao-Miarinarvio road, and finally,
4) The RN-4- Bekobay road mainly for information on box culvert bridges and applicable lessons learned from that segment of rehabilitated roads. See detailed workplan/schedule of visits attached as an annex to this report.

The most significant findings/results of these efforts and recommended actions include:

- As reported in Ken Ricard's report, which we both agree on, is the engineering assessment on the four major bridge structures on Route RIP-4. I will not repeat what Ken has described but will elaborate a little on the possible course of action and some suggestions based on talks with the TP Engineer in Tana, (Mr. Gabriel Rabenarivo) and later the Regional Engineer in Fianarantsoa, (Mr. Evariste Andriamamonjy) who is responsible for the bridges and roads in that region. As a result of our talks on the situation of the four bridges in question, Mr. Andriamamonjy agreed that only his department can and should take full responsibility for the safety of those bridges. He assured me that he will undertake a detailed evaluation of the bridges by their (GOM) certified engineers and send in a report within a month on the status of the bridges and what can be done to either strengthen them or replace them, and the estimated costs to do so. What is obvious at this stage is that replacing those 4 bridges will cost approximately $1,326,000 (a total of 156 LM @ $8,500/LM) using Bailey type bridges. A detailed discussion on this follows.
- While the bridges situation will take some time to resolve, it is recommended that work proceed on the RIP-4 by starting with detailed survey work (which I believe started) leading to a "Schema D'Itineraire" (or line diagram survey) which would enable quantity and accurate cost

estimates to be determined. Based on this study and estimates, the amount of work for year one can be planned. It is recommended that work commence on two sections of the roadway starting at Tolongoina (near Manampatrana), as access to site will be by train rather than by road. One contractor will start repair works going north and the other south. In this way valuable time will not be lost while tackling the bridge problem, nor would the public be encouraged to use the bridges under consideration. It is also concluded that the RIP-4 is an integral part of the transportation system for that zone, together with FCE railway and the port of Manakara and therefore merits rehabilitation to maximize the utility of the system. It would therefore not make sense to invest in the railway and ignore the roads and port that are parts of the transportation system.

- The most significant repairs needed for the port of Manakara would be to repair the warehouse roofing, approximately 1,000 square meters, the support pillars of the main loading dock, and the support columns of the equipment shed. Estimated costs for these three repair works would cost about $150,000. (see photos # 1, 2, & 3.)
- On the Vavatenia road, we met a representative of FID who informed us that the FID will undertake the rehabilitation of the entire road, with the exception of the river crossing at approximately 17 kms from Vavatenia on the Saranindona river. We talked to Mr. Hubert Nicolas Randriamanainjasa, Deputy Mayor of Ambodefaho, which is a village located at the end of the road segment, about 5 kms beyond the river. Mr. Randriamanainjasa accompanied us to the river and provided useful information regarding that road segment. We measured the width of the river, which is 45.8 meters (and not 70 meters which is the info. we got before visiting the site). A simple submersible bridge on piles, similar to the one built on the Ikongo river, seems to be a practical solution here and would cost about $190,000 or less depending on the river bed soil conditions. The shallow river, at normal flow (approx. 1 meter deep, and a sandy river bed would require a less elaborate foundation than the Ikongo bridge. Fewer piles and of a lesser depth would be needed and could be handled by a Malagasy rather that a foreign firm, all contributing to lowering the overall cost for this bridge. This bridge will not be considered heavy or dangerous to the public due to the shallowness of the river and the stable sandy river bed. If the bridge is built to about half a meter above its normal operating level, it would be unoperational during floods and so will be closed to the public. It must also be noted that working with the FID, who will finance the rest of the road will add value in terms of better donor coordination and leveraging of USAID investment.
- The Ambalavao road is a 38.6 km segment branching off from a previous CAP road near Ambalavao and heading south east to a village called Miarinarivo. The first 5 kms is in a relatively good condition but gets progressively worse thereafter. There is a large, 71 m long concrete bridge at the first 3.5 kms along the road, which is in good condition. There are

about 18 other timber bridges ranging from 4 meters to 12 meters long, plus 4 large timber bridges with spans of 17.5 meters, 24, 40 and 21 meter lengths respectively. All the timber bridges mentioned above are in very poor and dangerous condition and would need to be replaced or majors repairs undertaken. In addition, several sections of the road will need grading, drainage works, etc. The full rehabilitation of this road may be too costly and beyond the RECAP budget. I believe that the most effective and productive use of funds on this road, if the project thinks that other criteria are met and the road deserves attention and investment, is to upgrade it from its present condition of a 15km/hr road to a 30 km/hr road by investing on the 22 timber bridges and upgrading the most critical sections of the roads. (on the return journey, and without stops, it took us two and a half hours to cover the full 38.6 kms.) This would include constructing dips instead of culverts in most sections. A detailed survey would be needed to estimate the costs of doing the critical sections and repair or replacement of the bridges. I would recommend a detailed survey be done this year and based on that study and available funds, plan for possible intervention. There isn't enough of data to do any accurate costs estimates on this road at present. A guesstimate would be in the region of $580,000 for the bridges alone.

- Inspection of the Bekobay road revealed several important lessons. The most significant one was regarding the box culverts for river crossings. They appear to be more effective than radiers. Although their costs are marginally higher than radiers, they are much cheaper than conventional bridges and stay and function well. Several concrete radiers were completely covered with earth and have become ineffective. See photos attached. Another important consideration was that this road was impacted by heavy rains due to the cyclones and may merit some repair work, considering the earlier CAP/USAID investment on that road. Also, while the road user associations have and continue to make concerted efforts towards routine maintenance, they remain handicapped when excessive rains or cyclone damage occurs, nor are they equipped to handle periodic maintenance.

Discussion:

1. RIP-4 road, railway rehabilitation activities on the FCE line, and proposed port of Manakara repair and reconstruction works:

On the RIP-4, the 4 identified bridges that need to be addressed have been described in Ken's report. This would take a large chunk of the budget if ReCap funds are used to repair or replace them. As these are heavy structures, they need to be studied carefully and by certified heavy bridge engineers. The sole authority in Madagascar for these works is the TP department and they must be involved and take responsibility for those

structures. As mentioned in the summary of findings above, the regional Engineer in Fianarantsoa has promised to do a detailed study and present these to the RECAP office within a month. The project should follow up with the TP on this issue. There are several options available to address this issue. One is wait for the TP engineers report and review its costs. If costs are reasonable and within the budget for repairs, then I would propose that RECAP goes out to tender on the basis of the TP Engineer's design criteria and specifications. The TP engineers will then have to take full responsibility for the supervision and acceptance of the bridge works. Payment will be made on the basis of the GOM certification and acceptance of the bridge repair works. The contractor should also provide a ten-year guarantee (assurance decenale).

Another option would be to go out to tender based on a design-build/repair basis where the contractor will inspect the sites, design and provide firm offers (and costs) to rehabilitate the bridges. Design load should be specified as 16 tons. This should costs less than replacing the bridges, and it must be made clear in the tender documents that the contractor will have certified bridge engineers design and supervise the works. The contractor will then take full responsibility for the safety and liability and will provide the ten-year guarantee as required by law. The problem here is that they may be few contractors capable or interested in taking that responsibility in Madagascar. They may instead opt for new construction and totally new bridges but by that time we will at least know what the firm costs are and be in a position to compare them with costs of concrete submersible bridges. The exercise will enable ReCAP to determine best value and a course of action.

The third and best option is to have another donor finance the bridges. I understand the ADB is interested in providing funds to purchase materials for Bailey bridges. If they have the funds and can execute in a timely manner, well and good. There will then be sufficient funds for RIP-4 and the other tertiary roads. However, I have doubts about ADB or the WB moving in a timely manner and maybe RECAP should consider doing a couple of the bridges (the less costly ones) so the project could move with the first years planned work. In this case it may be wise to consider two bridges, the 33.6m bridge at PK 46 and the 17m bridge at PK 46.4, both in Tolongina. This way the road repair works could proceed both north and south from Manampatrana, right down to Ikongo in the south and up to about 40 kms from Ifanadiana in the north. The balance can be completed in year two when the bridges at PK 10.244 and PK 40.200 are addressed. For both these river crossings I would suggest concrete submersible bridges as done previously in Ikongo. The two concrete submersible bridges will cost about $357,000 assuming local firms are capable and there will not be any major foundation problems. At the 17 m crossing there is evidence of solid rock base and piles may not be needed. In the case of the 33.6m bridge a detailed survey of the site is needed to see if an access ramp for a submersible bridge is feasible or not. If not, than replacement by a Bailey bridge may be more economical if RECAP could purchase the Bailey bridge components and have the TP in Finiar assemble and install it. A cost comparison of the two options will be helpful.

A brief visit was done on a segment of road from the Farahony Bridge leading to the railway station of Sahasinaka. We visited only about half a km as a culvert was totally

washed out but was told that this road only needed a bridge here and would provide a short cut to the Sahasinaka station. The point where the road was cut seemed an ideal place for a box culvert type of bridge and would cost about $40,000 for that structure alone. A survey of that road would be needed to verify that claim. There is too little information to comment further on that road from our visit.

With regard to the FCE railroad, Ken covered our thinking and I have nothing more to add.

As far as the Manakara port is concerned, it's apparent that the minimum repair works should be done with the understanding that the GOM will move to-wards privatization of the facility. The most important item at the present time appears to be the stabilization of the wharf. It is also apparent that the pillars that support the wharf have collapsed more due to the impact of the docking vessels (side kick) rather than any vertical loading. The fact that it is still standing when several pillars have collapsed indicates that the platform at that section has redistributed its load on the remaining load bearing pillars. Those broken pillars should be repaired or replaced. This was discuss in details with Vero and the team. After repairs are done, the front piers must be protected by providing sufficient rubber tires. This type of damage could have been prevented if timely action was taken to cushion the wharf from the impact of docking and parked vessels. Similar repairs to the columns of the equipment shed should be done.

Finally, it appears that not much can be done about the corrugated roofing sheets besides replacing the ones that were damaged by the wind. Some overhang rafters will also have to be replaced or repaired. In all it is estimated that less than 1,000 square meters of corrugated sheets will need to be replaced. As mentioned in the summary, the total costs for all these repairs should be in the region of $150,000. Dredging of the seabed and other heavy rehabilitation work should be left to the private sector to do after privatization.

2) The Vavatenia road segment and the river crossing at Ambolifaho:

As mentioned in the summary above, useful information on this road was provided by Ms. Marie Setilahy, a FID representative working on road, and Mr. Hubert Nicolas Randriamanainjasa, Deputy Mayor of Ambodefaho, who accompanied us on the visit to the river. At least three trucks per day used to pass by that road during harvest time but that has stopped due to the deterioration of the road. Moreover, harvest is almost throughout the year because they produce various crops. For example, Coffee in January, Rice in March, Pepper in April, Cloves in October, and Bananas and fruits throughout the year. There used to be a radier for the river crossing but that was destroyed about 15 years ago and since that time river crossing was by boat or foot. We also noted that the school was on the other side of the river and school children were transported by pirogues. (See photos #) We also noticed villagers carrying bananas any other produce by foot from the villages to the market in Vavatenia. On our way back we were stuck behind a truck for a couple of hours as workers tried digging the truck out of the mud.

The truck had gone only 7 kms to a village and was returning with produce when it got stuck.

The first 5 kms of the road is in a fairly good state due to work by the FID but impassable even with a four-wheel drive vehicle for the rest of the 12 kms to the river. The road then continues another 5 kms after the river to the village of Ambodefaho. The FID has determined that this road is the life line for the people in that zone and have allocated funds to rehabilitate the full 22 kms but do not have sufficient funds to do the river crossing.

The river is 45.8 meters wide and remains shallow (less than 1 meter deep) even during the rainy season. According to the villagers, the flash floods that occur during the rainy season raises the river by about 7-8 meters but it then subsides within a day to its normal level. Because it is shallow, it does not lend itself to a ferry crossing which would have been the cheapest solution. A radier or submersible bridge would be suitable. However, I would recommend a simple submersible bridge for the following reasons:
1. Children need to cross the river each day and a radier means they would need to cross by boat or get wet.
2. There was a radier before and it failed because it is difficult to maintain or repair a radier, and,
3. Because a submersible bridge would be marginally more expensive than a radier but would render more value in the long run. Given the stable sandy soil a simple submersible bridge seems ideal for this river and would be less complicated than the one built in Ikongo where the pile foundations costs more than the bridge itself. I would therefore recommend that this bridge, which would cost about $190,000 or less depending on soil studies, be given priority.

3) The Ambalavao-Miarinarvio road:
A detailed survey, "Schema D'Itineraire" should be done to determine what the road and bridges will cost and where economies can be made to suit available funds. The bridges on this road should be mainly of timber as the material is readily available in that area and the local villagers are used to repairing them. As mentioned in the summary of findings, the number of bridges, (culverts not counted) needed for these 38.6 kms makes this an expensive road to rehabilitate to the usual standard of a 40 km/hr rural road. Therefore, after the study is done, only the critical sections could be improved. A "couche de roulement" could be avoided in many sections but drainage, grading and erosion control should be given emphasis. There are several places where rice fields on either side of the road cause drainage problems. In this case embankment fill may be needed with culverts or dips to allow water to flow freely. The estimate on the bridges alone which was mentioned as $580,000 was based on information provided by the TP Regional Engineer in Fianarantsoa. (Note estimated costs quoted was to replace the timber bridges and not to repair them as most of those bridges were considered beyond repair).

4) The RN-4- Bekobay road:

This road was visited mainly for information on box culvert bridges and applicable lessons learned from that segment of rehabilitated roads. Mr. Bruno Rasolofonomenjanahary accompanied me on the inspection of the road and on the following day we met with the President of the road users association, Mr Bendray.

There are several important lessons/observations to be made on that 46 kms road which previously had a history of problems. The first is that the main river crossing structures introduced there, the box culvert concept, withstood the cyclone related floods and performed well. Some of the radiers on the other hand did not. Some were completely covered with mud and as such became ineffective. Secondly, the erosion control measures taken did help in many respects but in some the over emphasis on vetiver was not justified. The natural grass on the sides of the road did just as well. In some places vetiver had the opposite effect from what it was intended to do. It blocked the downstream part of the culverts causing erosion on the sides of the culverts. The lesson here is to use the grass that grows well near the road, which is less costly as it is readily available, and use vetiver where there are steep embankments. Photos to illustrate these will be presented to the team.

Although most of this road seems to be in fairly good condition, it is evident that the road was hit again by the cyclone related floods and some sections have eroded and other washed out. According to the President of the road users association, 250 Million FMG was spent last year to maintain the road (of which about 200 M fig was obtained from the Gum's road maintenance budget) and this year they have a budget of only 60 M. As some sections need more than maintenance due to the cyclone related damage, they will not be in a position to do an adequate job on the road. Moreover, it appears that the road is also due for some periodic maintenance as well. Given the high prior investment by USAID/CAP on this road, I would recommend ReCAP consider adding some funds for critical repair works on this road as well. There are no structures to be built, just earthworks and drains and a sum of about $50,000 to $100,000 would go a long way to extend the life of this road over the next few years and protect the high investment already made in that area.

Based on these findings and discussion a preliminary budget is offered for the team to review. This will be updated/refined after the site survey has been completed.