

## SERELAREFA PROJECT

### This document

#### The Project “SERELAREFA”

The Project SERELAREFA – SEMillas REd LATina Recuperación Ecosistemas Fluviales y Acuáticos (Seeds of a Latin American network for the restoration of fluvial and aquatic ecosystems), funded by the UE programme FP7 IRSES-PEOPLE 2009, aims to improve the way water courses are managed by achieving benefits for both the environment and socio-economic activities. It fosters the adoption of River Restoration concept. Exchange missions, study trips, collection of experiences, setting up of case studies and publications are the main activities.

The Project started in September 2010 and lasts three years. Partners are:

- Italia - Centro Italiano per la Riquilificazione Fluviale –CIRF, coordinator ([www.cirf.org](http://www.cirf.org))
- España - Universidad Politécnica de Madrid-UPM
- Brasil - Universidade Federal do Rio de Janeiro-UFRJ
- México - Universidad de Guadalajara-UdG
- Chile - Dirección de Obras Hidráulicas –DOH
- Chile - Universidad de Concepción-UdeC

This document discusses a possible case study to be developed by the Universidade Federal do Rio de Janeiro-UFRJ, in the context of the SERELAREFA Project.

It deals with river Taquari, an interesting river within Mato Grosso region, Brazil.

The research leading to these results has received funding from the European Union Seventh Framework Programme (FP7-PEOPLE-2009-IRSES) under Grant Agreement n.247522



## BRIEF REPORT of FIELD SURVEY on TAQUARI RIVER

RIVER NAME : rio Taquari  
TITLE : field evidences and suggestions for further developments  
DATE : 11<sup>st</sup> December, 2012 (revised on July 28, 2013)  
LOCATION : Coxim, Mato Grosso do Sul, Brazil

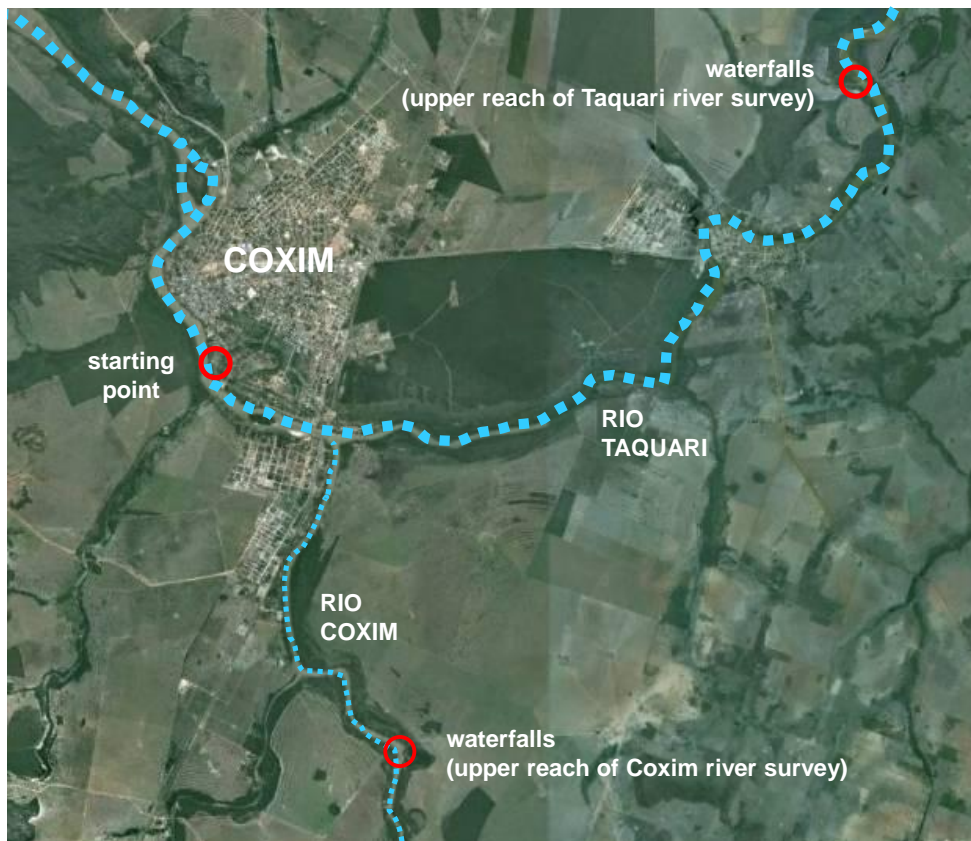
### BRAZILIAN TEAM

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### ITALIAN TEAM

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### MAPS AND KEY PICTURES





Navigation survey on Rio Taquari and Rio Coxim

## DESCRIPTION OF SITE VISIT

- We arrived at Coxim in the late morning and settle down at the Pousada Beira do Rio, which lies on the right shore of the Coxim river (a main tributary of the Taquari river);
- after lunch, around 3 pm, we went to the local Environmental Police post, located in Coxim on the right shore of the Taquari river, where the responsible official arranged the field visit with three motor boats and gave us basic instructions for safe and comfortable navigation;
- from there we first went upstream the Taquari river, passing below the two Coxim bridges (one of those -we were told- was submerged in 1985 by a significant flood and in any case both of them appear to be too low lying for such a river), until the confluence with Coxim river;
- then we navigate upstream Coxim river until the first small fall on the same river (geological discontinuity of the long profile), where we had a brief walk on the river shore;
- then we navigated downstream the Coxim river and entered again the Taquari river and navigated it upstream until the first jump we met (more upstream we were told that higher ones are present);
- eventually we came back downstream along the Taquary river, passed the police post and navigated around a large fluvial island in front of Coxim town. Nearby, we noticed an old – now practically abandoned- river branch which used to be the main one.

## Observations

The boat captains paid significant attention while driving the boats and had to use their long-time experience to avoid the frequent areas of very low depth where the boat out-board engine could have dragged the river bottom. We were told that the water always has a very thick turbidity (and even more during our visit because of the significant rains of previous days) and so it is absolutely impossible to have a perception of water depth unless from observation of the slight differences in the color of water and from the shape of surface ripples and current anomalies, so that experience plays a key role.

During the trip, we observed significant bank erosion in some reaches, particularly those with higher banks, not covered by vegetation (probably because of geotechnical instability) and sometimes even in the inner shore. No defenses were present, unless some loose, un-managed rip-rap protections in some short reaches of the most “densely” (although always scattered) inhabited areas.



Some random evidences of spot bank erosions (within the survey reaches)

We noticed that riparian vegetation was present along most of the surveyed stretch, but it presented clear signs of alteration and in most cases seemed to be quite young (possibly less than 5 years). We understood that what we were observing was indeed a large scale river restoration project being implemented in the past years, which consisted in fencing most of the riparian corridor, in agreement with local cattle risers and agricultural entrepreneurs, in order to preserve it from grazing a strip with a width of about 30 m at each side. Consequently, re-vegetation was the result of a natural process occurring just preventing the cattle to access the river shore.

Another interesting action concerns the regulation and control policy of the commercial and subsistence fishing in the river system: householders -we understood- are allowed to catch daily one pray each (or maximum 3 kg per family), while each commercial fisherman is assigned with 20 locations (marked with visible signs) where he can install a fishing tackle.

It is to be pointed out that on the Taquari and Coxim rivers a very special periodical natural phenomenon occurs (“piracema”), i.e. between October -November, large fish stocks use to swim upstream for spawning. We did not understand if in the last decades the phenomenon has seen a decrease or not; the suspect is that there is indeed a decline, in which case it is possibly associated with the riverbed morphological evolution taking place.

Although the general perception of the river (from inside) is that of a natural setting, it is to be noted that the anthropogenic presence and use of the river is significant: navigation and fishing and recreational access to the river occur perhaps every 50-100 m or so in most of the reaches visited. Also more than one sand dredging floating device has been notices.



Another interesting aspect is that just downstream of the geomorphic jumps (« quedas ») the river opens very large pools which seem to reach significant depths ; it is most probably the effect of dispersion of the excess of the kinetic energy accumulated locally in the jump. In one of such pools we saw some fish jumping.

Some old-dated (large wood vegetated) islands are present; a large one seems to occur , in particular, just upstream of the jump we reached on the Taquari river. It may rather consist of a temporary one created by a “recent” cut of meander (progressively abandoning the former course), but in any case it probably is the result of a geomorphic process occurred there in association with the jump caused by a hard rock outcrop (perhaps basalt or hard sandstone) which constitutes a « fixed point » in the longitudinal profile determining a reduction of slope and an associated sedimentation: with time, the bank sedimented there became vegetated and progressively transformed into an island ; or rather , as already said, during a flood event the river opened an alternative path becoming (this is just speculation; indeed, there are evidences of former meanders as recognizable from Google Earth images).



Confinement due to the presence of some rock formation (possibly sandstone) does occur in particular where an old bridge on the Taquari river had been destroyed and replaced recently by a higher one. There the river width is significantly reduced and the river has less chances to overflow.

## ACTIONS UNDERTAKEN, ONGOING AND FORESEEN

- It is evident that a quite large scale restoration has been already undertaken, as commented above
- We do not know much, at the moment, about the motivations and details of such actions; we also do not know much about which studies have been carried out previously, their results, and what are the actions planned for the future (we found for instance a recent paper on survey of river bed profile and sections through radar technology [http://www.scielo.br/scielo.php?script=sci\\_arttext&pid=S0102-261X2002000100006](http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0102-261X2002000100006))
- An additional effort of info gathering is required before the conclusions drawn in this report can be considered correct, so all considerations which follows only have a pronounced preliminary character.

## PROBLEMS AND OPPORTUNITIES OFFERED AS A CASE STUDY

- It seems that significant problems have affected the area, associated with a dis-balance of sediment input, to an extent that motivated studies and actions. If part of such problems (or possibly new ones) still exist, there is an interesting background to promote further action.
- Although we could not examine it yet in depth, we are aware that a significant capital of knowledge has been built by other subjects and in particular by the Universidad de Campo Grande which definitely constitutes an invaluable asset.
- The Universidad de Campo Grande, which already carried out studies on that river system, seems to be very much keen of further developing activities on the area and is the natural candidate to take a primary role in the scientific component of a possible future river restoration project. The seminar we had in Campo Grande, before the visit to rio Taquari, showed us the high level of competence reached by local researchers , practitioners and managers and the deep knowledge they have on the local problems.
- At the same time we believe that, taking advantage of the expertise in sedimentology of Geraldo Wilsons' team, together with a significant interaction with the CIRF group and its integrated approach to river management and restoration, could add an important value both on the scientific and management regards.
- The Campo Grande Municipality has gained a maturity in the management of riverine problems which guarantees a very appropriate and promising partnership at the institutional level. Other key institutional subjects can be involved which can add significant strength to a new initiative
- In particular, the Environmental Police, present on the area since long time, is very motivated and can be a very useful support on the field for instance to collect field data and carry out surveys and interviews, as well as to set up and maintain a monitoring scheme. They are quite trained in environmental education activities, an ability which is certainly key in any river restoration scheme.
- More in general, in Brazil the morphological modification of river stretches associated with hydropower schemes and profound change in land-use seem to need further applied research efforts in order to effectively support river management (see for instance the very interesting papers *Changes in a large regulated tropical river: The Paraná River downstream from the Porto Primavera Dam, Brazil* at<sup>1</sup>, or *The geomorphologic response of a large pristine*

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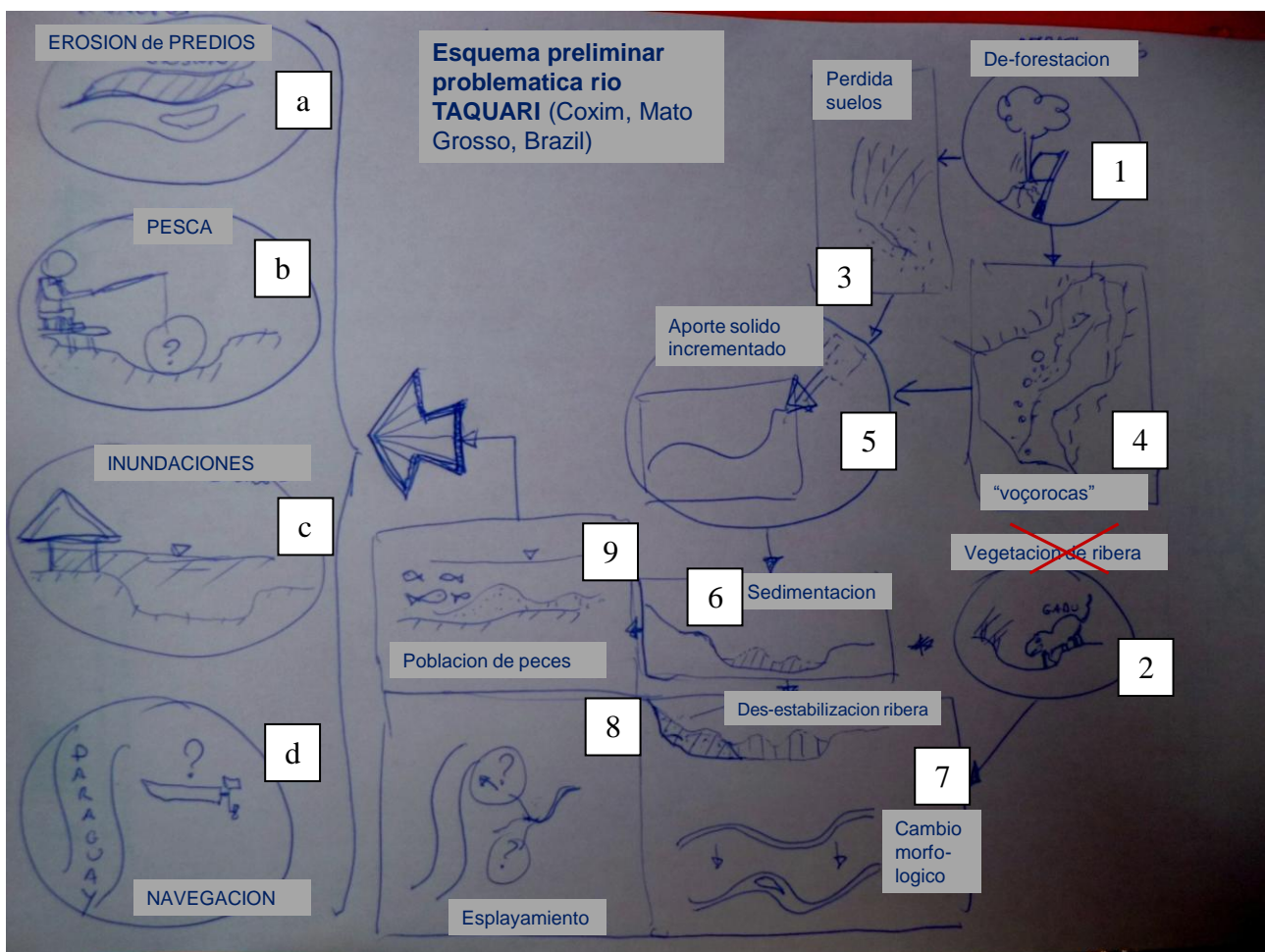
<sup>1</sup> <http://www.sciencedirect.com/science/article/pii/S0169555X09001226>

*alluvial river to tremendous deforestation in the South American tropics: The case of the Araguaia River at<sup>2</sup>*

- Our impression is that such changes do exist as well as a number of significant impact of different kind, from the erosion of land properties or sea shores, to the modification of aquifer elevation and associated water availability for supply and transformation of the riparian and floodplain vegetation; or the difficulties encountered by fluvial navigation or, last but not least, the increase in flood risk. Any study which faces such topic could be of great value to pave the way and in this sense the Taquari case study is particularly promising.

**PRELIMINARY THINKING IN THE RIVER RESTORATION SPIRIT**

A very qualitative, but attempting to be comprehensive, understanding of current system (at catchment and fluvial scale) and its problems is depicted in the figure below and commented; it presents an hypothesis of cause-effect relationship that, of course, has to be proven and eventually may result inadequate; it has just the purpose to show the type of integrated reasoning we would like to develop.



Conceptual cause-effect map drafted on the field, just to stimulate discussion (purely speculative).

<sup>2</sup> <http://www.sciencedirect.com/science/article/pii/S0169555X09001238>

Drivers (at catchment scale)

- livestock holding demands from the farmer category (at moment considered as the only or main driver)

Pressures (at catchment and river corridor scale)

- 1) deforestation (*desmatamiento*) in the upper watershed in the lat '70s and '80s (to gain exploitable land);
- 2) (partial) destruction of riparian vegetation (*mata ciliar*) while creating access to the river for cattle;

Status alterations (at catchment scale)

- 3) + 4) and 5) Increase of sediment input to river system because of increased soil erosion and triggering of extensive and sometimes giant gullies (*voçorocas*)
- + (hydrological cycle alteration (lower infiltration, higher runoff both in volume and discharge)
- + (diffused pollution increase & groundwater and surface water ecosystems contamination)

Status alterations (at river reach scale)

- 6) sedimentation processes increase along watercourse (creation of bars, sand sheets and possibly actual aggradation process)
- 7) (in some reaches and for limited extension) bank erosion with additional sediment input and river bed widening (and possibly anabranching or, in the long run, straightening to increase sediment carrying capacity)
- 8) the river nowadays almost does not reach its natural receptor, the Paraguay river, and splays through a number of channels, losing almost all of its waters (this configuration seems to have been exacerbated because of the above described cause-effect relationships)
- 9) ecosystem modification affecting fish population (amongst other species)

Impacts

The above factors induce a number of negative socio-economic impacts as follows:

- a) increase in land loss from agricultural and cattle rising land properties (*fazendas*)
- b) reduction of fishery outcome and worsening of ecosystem quality



- c) increase of flooding levels and frequency

(flooding at Coxim)

- d) increased difficulties for navigation , particularly to reach the rio Paraguay.

What we envisage is a project that further investigates the relationships of the kind depicted above leading to a scientifically based understanding of the complex behavior of the river system and particularly identifying what are current trends:

- Is aggradation really occurring? If yes, which is its trend?



- About the planform evolution of the river: how much/fast is it moving? Are there evidences of behavioral shift? Is it tending to anabranch or to straighten somewhere?
- Is the solid input still higher than that of reference conditions (i.e. unaltered river system)?
- What are the morphological (forms and processes) reference conditions (unaltered river setting) to be considered to evaluate fluvial alterations?
- Has flooding frequency and intensity really increased? If yes, which are the consequences?
- What about fisheries and navigation stakes; etc.?

According to the answers to such questions, it could be worthwhile to develop a more focused strategy of river restoration including actions of quite diversified type like vegetation management, soil conservation practices, urban setting adaptation, fishery management actions and so on, acting at different spatial and temporal scales. Significant attention should be paid in defining the most appropriate implementation strategy (stakeholders involvement, time frame, funding, etc...).

The next step, according to local partner interest, could be setting up a project proposal document (concept paper) and creating an appropriate partnership, while looking for the necessary funding.