THE VALORISATION AND DEVELOPMENT OF VALLEY BOTTOMS IN WEST AFRICA

A NEW APPROACH TO PRE-DEVELOPMENT DIAGNOSTIC METHODS FOR VALLEY BOTTOM PROJECTS
REPORT OF THE REGIONAL COSTEA/CILSS OUAGADOUGOU WORKSHOP / 14 -15 MARCH 2023

Writers:
Jean-Louis Fusillier

Contributors:
Amandine Adamczewski,
Thomas Hertzog, Georges Serpantie

With the support of
AFD AGENCE FRANÇAISE DE DEVELOPPEMENT

Ordered by
AFEID

COSTEA
ENSEMBLE POUR RELEVER LES DÉFIS DE L'AGRICULTURE IRRIGUÉE

THE VALORISATION AND DEVELOPMENT OF VALLEY BOTTOMS IN WEST AFRICA

ACRONYMS AND ABBREVIATIONS

ANEVE	Agence Nationale des Evaluations Environnementales (National Agency for Environmental Assessments)
CILSS	Permanent Inter-State Committee for Drought Control in the Sahel
CIRAD	Centre de Coopération Internationale en Recherche pour le Développement (French Agricultural Research Centre for International Development)
COSTEA	Comité Scientifique et Technique de l'Eau Agricole (Scientific and Technical Committee for Agricultural Water)
ESIA	Environmental and Social Impact Assessment
ESIS	Environmental and Social Impact Statement
ESMP	Environmental and Social Management Plan
FAO	Food and Agriculture Organization
GIS	Geographic information system
IER	Institut d'Economie Rurale (Rural Economics Institute of Mali)
INERA	Institut de l'Environnement et de Recherches Agricoles (Environment and Agricultural Research Institute of Burkina Faso)
IRD	Institut de Recherche pour le Développement (French public research institution)
P	Precipitation
PET/ETM	Potential evapotranspiration / maximum evapotranspiration
PARIIS	Projet d'Appui Régional à l'Initiative pour l'Irrigation au Sahel (Sahel Irrigation Initiative Support Project)
ToR	Terms of Reference

INTRODUCTION: FRAMEWORK OF THE COSTEA-PARIIS WORKSHOP ON PRE-DEVELOPMENT DIAGNOSTIC METHODS

This report presents the proposals for changes to pre-development diagnostic methods discussed at the regional feedback and exchange workshop on the results of COSTEA's 'Development of Valley Bottoms' structuring action, carried out in partnership with PARIIS. This workshop, held on 14 and 15 March 2023 in Ouagadougou, was attended by 27 participants from the regional coordination of PARIIS, project ownership bodies of the three countries, Burkina Faso, Mali and Niger, research institutions, COSTEA's Permanent Technical Secretariat and the consortium of experts brought together by COSTEA.

The report was drafted by J. L. Fusillier, A. Adamczewski (CIRAD), G. Serpantié (IRD) and Thomas Hertzog (INSUCO) after the compilation of the results of the workshop.

This structuring action (SA) on valley bottoms was initiated following a previous workshop co-organised by COSTEA and CILSS in 2019, which drew up a situational overview of the agricultural development of valley bottoms and the effects of development projects throughout the West African region. The workshop confirmed that valley bottoms have a productive potential that should be harnessed and that investments in this area are still of great interest. However, the results of projects carried out over the last few decades have also fallen short of expectations, with the unresolved problem of the low sustainability of structures and facilities and insufficient crop performances. In terms of rice cultivation, the flagship crop of development policies in Sudanese and Guinean zones, the projects have generally contributed to expanding the areas without managing to achieve sustainable intensification. The project design phase, with its pre-development diagnosis, has been shown to be a cause of these development failures. The methods generally used, which are compartmentalised by discipline and incomplete, have proven to be poorly suited to anticipating the potential impacts of development options on all components of the surrounding area: agricultural, social and environmental. The methodological recommendations made by the Valley Bottom Research and Development Consortium in the 1990s and 2000s have had little effect. And some environmental and social issues have now taken on far greater importance due to climate change, demographic pressure on land, the impoverishment of certain rural classes, as well as demands for greater gender equality.

In response to this need for a new methodology, this COSTEA action therefore set out to design and test complementary approaches for pre-development diagnosis. These methods were applied to six cases of valley bottoms being developed by PARIIS, in Burkina Faso, Mali and Niger[1]. The results were presented and discussed at the above-mentioned workshop.

The first part of the regional workshop was devoted to the lessons learned from these case studies: what contribution did they make to clarifying the issues at stake for the site and its development project? How have these studies contributed, in some cases, to revising the development option initially selected? In the second part, the proposed methods were reviewed[2], the principles on which they are based were presented, then their feasibility was debated in the light of the projects' conditions of intervention, resources and constraints, as underlined by PARIIS.

The structure of the report will follow the workshop sequence, with:

- the three principles guiding a renewed approach to pre-development diagnoses: participation, integration and the search for sustainability;
- the five proposed methods to be implemented, which were presented and then discussed in terms of their relevance and feasibility. These proposals are summarised below[3]:
  (i) Add a spatial and interdisciplinary overview of the context;
  (ii) Integrate an environmental baseline study into the project design phase;
  (iii) Focus the hydrological analysis on agronomy and the management of structures;
  (iv) Complete the socio-economic baseline study with a socio-land diagnosis;
  (v) Add an 'agri-environmental' or 'sustainable agronomy' baseline study.

Finally, we propose an organisational framework and discuss the allocation of resources to development project studies.

1. PRINCIPLES PROPOSED FOR A RENEWED APPROACH

PARIIS bases its hydro-agricultural development intervention strategy on the concept of 'irrigation solutions', which comprises four components: (i) organisational, for the planning of the intervention and the delegation of the management of the development; (ii) technical, for the design of the structures; (iii) financial, to contribute to the investment, maintenance and the supply of agricultural inputs; and (iv) cognitive, with the strengthening of the project operators' skills. The PARIIS approach involves building these 'irrigation solutions' together with the beneficiaries.

If it is to be successful, this approach to co-building solutions requires adherence to a number of principles: (i) the effective participation of the beneficiaries; (ii) taking account of the multiple technical, economic, social and even environmental dimensions of the development by mobilising a range of disciplines for diagnoses that are also co-built; (iii) a degree of sustainability of the development by ensuring its integration into society and the local ecosystem.

1. Diagnostic des ressources, de la mise en valeur et des options d'aménagement des bas-fonds [Diagnosis of the resources, exploitation and development options of valley bottoms]. Country reports: Burkina Faso, Mali, Niger. Site reports: Nambé, Tialla (Burkina Faso), Doumba, Senou (Mali), Founkoye, Tadiss (Niger). COSTEA, December 2022.

2. Revue des méthodes de conception des projets d'aménagement bas-fonds du PARIIS et propositions d'approches complémentaires pour l'aide à la conception [Review of the design methods for PARIIS valley bottom development projects and proposals for complementary design assistance approaches]. COSTEA, February 2023.

3. The details of the methodological proposals are developed in the COSTEA valley bottoms SA report of February 2023.

The implementation of these principles could certainly come up against difficulties linked to: the conditions of the project cycle; the technical cultures of the consultancy firms, geared towards rural engineering, and; operational constraints. But it is already necessary to examine what these principles can contribute, and see how they can be implemented in pre-development study methods.

1.1. The active participation of the beneficiaries in the joint construction of local 'irrigation solutions'

The principle of participation is now recognised as an essential condition for the success of development projects, going beyond a passive type of participation based on information and awareness-raising. PARIIS has already embarked on a number of actions in this direction, including: identifying potential sites for intervention through surveys involving local actors to discuss criteria of viability; analysing beneficiaries' objectives and expectations in the socio-economic baseline study of the detailed preliminary design; asking beneficiaries to contribute their labour for the construction of the structures, and; setting up a 'Complaints Committee' to adjust the approach during the development works.

However, the objective of participation appears to be hampered by several factors that need to be corrected. Firstly, it is in contradiction with another project objective, which is to accelerate execution by standardising the models of structures that are disseminated on a large scale. For example, only one model is applied in Burkina Faso (reinforced contour bunds) and Mali (micro-dams) out of the five models or 'irrigation solutions' identified for valley bottoms. This pre-determination of the structure limits the possibilities of adapting to producers' expectations and sometimes increases the complexity of the development in order to deal with sites that are not well suited to the model (in particular due to the varying sizes of catchment areas). Furthermore, participation also comes up against the usual practises and time constraints of the experts in charge of the diagnoses. Little use is made of local knowledge on the environment and its exploitation limitations. Gathering this knowledge requires additional survey resources, not limited to sociologists alone, but extended to technical experts in hydrology, soil science and agronomy or agro-ecology, where available. Finally, the participation of beneficiaries in carrying out the works is generally limited to material handling tasks, and local artisans are rarely involved, whereas they could acquire maintenance skills. This question of passing on masonry skills has often been raised by valley bottom development programmes, for example through the training of assistant masons by the company awarded the contract, but it has never been standardised or imposed.

Moving towards the beneficiaries' active participation would therefore involve: opening up the development options for each site by capitalising on the range of models of structures identified by PARIIS; taking greater account of the knowledge of the various valley bottom users (not only farmers and not only men) on the constraints and opportunities for developing their environment, and; integrating local artisanal masons in skilled labour tasks.

Active participation would also mean implementing consultation and facilitation tools over the long term, in other words, thinking of participation as a process over the course of the project. In this approach, each meeting or encounter is part of an overall trajectory, the ultimate aim of which is to facilitate the beneficiaries' ownership of the action by encouraging collective reflection and synergies within a territory.
Although participation is often stated as a principle, it remains difficult to put into practice. Making participation concrete would mean translating it into methods, tools and operational stages (shared diagnosis, participatory mapping, village assembly, focus groups, feedback, etc.), implemented by irrigation solution operators and project teams.

1.2. An interdisciplinary integrated approach for a more comprehensive diagnosis of the issues at stake in the project and of the development options

Conventional pre-development diagnoses lack an overall understanding of the current site, the issues at stake (the valley bottom's current multiple functions, the expectations of the various valley bottom users, agronomic and environmental diagnoses) and the likely systemic consequences of various development scenarios. Indeed, everything is interconnected: the organisation of local society (land tenure system, economic system, governance), the valley bottom ecosystem and the current system of activities. After development, the transformation will affect each of these elements that are linked by firmly established logics, customary hierarchies, etc. There will be winners and losers, and the target population will be confronted with the gap between the new development and their expectations.

It would therefore seem that the added value of a reform of the study approaches should focus on three areas: (i) adding new themes to fill the many gaps (e.g. no agronomy, environmental baseline produced afterwards, hydrology not sufficiently integrated in the agricultural management of water, the current land tenure system and its post-project reform scarcely addressed, etc.); (ii) strengthening the participation of local stakeholders and their support to make the most of local knowledge and take current logics into account; (iii) integrating three disciplinary viewpoints through interface themes: agricultural management of water, agro-economics, agri-environment, knowledge and expectations, and cross-functional workshops with the beneficiaries and their support.

1.3. Aiming for the social, economic and ecological sustainability of the developments

Until now, sustainability has not been explicitly given as an objective for these developments, which remain focused on increasing agricultural production in the name of national food sovereignty or local food security. Only compensation measures (social and environmental safeguards) are proposed, giving the impression that the adverse social and environmental impacts of any project are a matter of financial compensation or reforestation elsewhere. And yet technical failures, environmental degradation and past conflicts linked to previous developments have made local actors themselves aware of the risks and of sustainability. Some damage cannot be compensated for because it cannot be assessed. Previous developments have been accompanied by severe degradation of the environment through erosion and deforestation and by forms of social injustice, and local people feel that they have not been listened to enough, and would like new projects to start by managing these problems.

Thinking about sustainability from an early stage (site identification, detailed preliminary design) rather than afterwards, will make it possible to equalise three objectives of human, economic and environmental progress, without reducing the valley bottom to its purely productive dimension. Firstly, it is necessary to get back to the basics of development, which is not merely economic expansion but also human gain (improving living conditions, building capacity, empowerment, independence and equity), in a spirit of adaptation to the environment (and so without a standardised vision). To implement the objective of sustainability, it is up to the project (and its funding agency) to accept to reconcile the project's economic ambitions with its social and environmental ambitions (which may sometimes mean reducing the economic ambition in the short term), and to reason in terms of 'areas of the environment sustainably managed without conflict' and not just 'area of rice that can be sown in the scope of the development'.

The environment involves long-term commitment, and therefore also has an economic value, which has several components: 'intrinsic' (the right of species to exist in their environment), 'use' (the material and immaterial value accorded to it by its many users) and 'non-use' (the potential future uses arising from its preservation and the ecosystem services resulting from good conservation). The social dimension involves listening to and effectively taking account of society, its expectations and the demands of its most vulnerable or dominated members (such as women and young people), while respecting local social structures.

2. PROPOSALS OF COMPLEMENTARY METHODS

2.1 Spatial and interdisciplinary approach to the site and its context

Justification and issues at stake

While the detailed preliminary designs most often begin with general data (tables containing general information on the site and its context), there are no maps to help understand how the proposed sites fit into the territories. In order to better adapt the development to its context, and to initiate an approach that is as integrated and participatory as possible from the outset of the study, a first step would be to sufficiently contextualise the development: not only the zone earmarked for development, but also its immediate or more distant environment (geographical location in relation to the final markets, livestock movement routes, etc.), in as interdisciplinary a way as possible. The advantage of such a spatial or multi-scalar geographical approach is that it allows themes to be aggregated then integrated, taking into account both physical and human processes at different scales (valley bottom, village territory, municipality, small region). At the local level, this pre-analysis of the context is also an opportunity to engage an initial participatory approach.

Objectives of a spatial analysis of the context

The spatial analysis of the context is one of the interfacing and cross-disciplinary themes. It therefore contributes to the integration of disciplinary viewpoints, to the cohesion of the team of experts, and facilitates interaction with local actors (maps, tools for debates and visits). In practical terms, it helps inform the project and the experts, and to raise awareness among local stakeholders of:

- the presence of water resources on the site, upstream or downstream, the risks associated with the upstream (size of the catchment area, degradations, presence of dams) and the downstream (areas with slow drainage, pollution issues, sources of irrigation water). This is an initial exploration of the seasonality of pre-existing water regimes and water developments (dams, reservoirs, wells, etc.).
- the geographical contexts, the major (economic) opportunities and constraints of interlocking territories (valley bottom, village territory, municipality, small region if necessary), types of market, settlement dynamics, pressure on land, relations with towns and other development centres, etc;
- local society, current dynamics: settlement structure, lifestyles, growth value chains, local social structures (authorities, land tenure structure, labour associations, formal associations, inequalities, privatisation phenomena);
- a preliminary exploration (accompanied transects) of the resources and uses of the land by 'landscape unit', which is more detailed and integrative than the soils alone; extending the analyses to the margins of the area under consideration, upstream (catchment area) and downstream, and over time (past, future); having a soil map beforehand would be an advantage.
- the ecological constraints and opportunities: the place left to 'nature' and biodiversity in the landscape, diversity of uses, zones to be restored, ecotourism, pollution, potential for carbon sequestration, etc. launching hypotheses and points to be explored further. This makes it possible to anticipate areas for diagnosis (value chains, areas that will be disrupted, local expectations given the context, risks, areas and developments to be preserved or restored) and to co-define them.
- The main development trends (diachronic approach based on local information and the comparison of images from different dates).

Methods and tools

Complete information and indicator tables at two levels: village territory and municipality

Tools: bibliography, communal databases, communal development plans, regional databases that can be used for a cluster of projects.

Preliminary spatial analysis before the first field trip
Schematic mapping at several scales: catchment area (by hydrology); small region if necessary, village territory, developed area, evolutionary trends (by comparing images taken twenty years apart).
Tools: Google Earth, Q.GIS, national GIS databases, possibly previous aerial photographs (provided by the environmental study).

Participatory field study

- Joint pre-diagnosis mission, 1 day per site (dry season);
- Joint in-depth diagnosis mission, 1 day per site (wet season);
- Further investigation, data acquisition, and analysis in the three fields (agri-environment, hydro-hydraulics, socio-economics) and at their three respective interfaces;
- Meetings of experts to discuss the expert reports.

Tools: field transect sheets, seasonal participatory mapping of the water, soils and their uses on pre-established maps, focus group guides.

Practical aspects
The only additional work compared to the 'General' section of the current ToR is the mapping approach and the creation of a mini-GIS, since each thematic specialist is expected to propose a spatial diagnosis. A geomatician or one of the thematic specialists could format the spatial diagnoses of the other thematic specialists. This additional competence could therefore have an additional cost. To reduce it, it would be preferable for one of the thematic specialists to have GIS skills and use free software such as Q GIS (as in the case of the COSTEA Burkina team, which had access to such skills through two INERA experts and one IRD expert). A map was also produced by an INSUCO expert. In Mali, the IER also had this type of expertise.

Results

Presentation of a diagnosis in the form of commented maps on a nested scale, acting as hypotheses for the following stages.

Example of Burkina Faso: Nambé
The multiscale interpretation of Google Earth imagery revealed the following key features:

- a peri-urban region with a strong dynamic of 'rurban' social transformation and artificialisation (roads, suburbs, privatised real estate, dams);
- the large size of the catchment area (400 km^2), which is partly urbanised;
- the importance of cash market gardening: 'interstitial' rice-growing areas, so rice is probably 'not the priority' (late harvests, etc.);
- the importance of pre-existing hydraulic developments (the 'bouli' reservoir, piping)
- the last humid savannahs with perennial grasses, with women mowing for the urban livestock of Ouagadougou;
- the importance of sedimentary inputs from the northern tributary and water pollution issues in the downstream Narbagre lake.

Example of Mali: Doumba

- We analysed the land use on Google Earth satellite images and positioned development scenarios;
- Strong pressure on the land could be observed, and the valley bottom is heavily occupied by orchards; the first issues identified are the loss of economic assets (orchards, buildings) and natural assets (woodlands on riverbanks);
- The risk of flooding of these assets varies depending on the development scenario (one or two micro-dams).

Example of Niger: Founkoye
The satellite rasters available in Google Earth were used prior to the field missions in order to gain an initial overview of the development issues on the particularly extensive site of Founkoye. This interdisciplinary spatial analysis was shared between all the national experts so that: (i) the maps produced would cover the dimensions that are essential for understanding the site, and (ii) everyone could identify a priori the areas with the greatest issues at stake according to the dimensions to be analysed, i.e. the areas of particular interest during the field visits.
On the regional scale, the analysis showed the characteristics of dispersed settlement and polarisation by the city of Tahoua, and the environmental issues (difference in shrub density from upstream to downstream in the valley and areas of erosion and wind deposits in the valley and on the plateaus).
On the local scale, the analysis showed the spatial issues in terms of agricultural development and land pressure, by categorising the land uses: market gardens, orchards, rain-fed fields and pastures.
At the micro-local level, the aim was more to shed light on issues related to certain specific areas in the direct vicinity of the planned future weirs.

Debate and recommendations of the workshop

Questions put to the participants
The questions to be discussed were as follows: What is the relevance and importance of a synthetic and integrated overview of the resources and uses of the valley bottom and their implications for development using mapping approaches? What are the strengths and weaknesses? Which sources should be used? Which tools should be privileged? How should local communities and actors be involved?

Arguments in favour, strengths

- An overview of the context exists in the preliminary study - 'General information on the site', but it lacks maps and their synthetic interpretation.
- Need for a global overview of the area and its issues at stake;
- The integration of issues at different scales from the project area;
- The interest of a diachronic view over twenty years or so;
- The interest of a global, holistic, multi-layered view;
- There is a certain mapping tradition in some consultancy firms, which is an asset;

- Local actors can participate or interact on the maps (sharing the communal development plan and communal documents, village assembly, participatory transects of the landscape units, participatory mapping, actors' opinions).

Points of attention, constraints

- A question was asked about the imprecision of the initial intervention zone: Response: the mapping could be progressive;
- The term 'regional' needs to be clearly defined: area extended to the catchment area and the territory to which the valley bottom belongs? municipality? small region? Response: the area extended to the catchment area and cities if nearby;
- How much would the expertise cost and what is the risk of lower profitability for valley bottom projects, whose development cost must remain low? Response: need to rebalance costs between the themes and between study phases (integrate ESIA activities and resources into the detailed preliminary design).
- How efficient is the analysis?
- This risks extending the duration of the studies;
- Lack of skills in GIS tools in some consultancy firms;
- Availability of data in some countries.

Still to be specified

- The number of themes that can be integrated;
- The approach should differ according to the type of development (new build or rehabilitation);
- Carried out at what stage in the process? Response: preliminary design-detailed preliminary design stage.

Recommendation of the workshop

The spatial approach is relevant and important, but it will be necessary to assess the time and cost involved in applying it to each site.

2.2 Pre-development environmental diagnosis

Justification and issues at stake

Reference to environmental sustainability is not explicit in valley bottom projects, given the stated priority objective of extending production areas and of intensification or 'optimisation'. With the exception of the case studied in Niger, where an environmental specialist was recruited from the detailed preliminary design stage, the environment is not yet sufficiently integrated in baseline studies making it possible to identify and evaluate a 'without development' scenario and to design 'with development' scenarios with a clear objective of environmental sustainability.

Furthermore, little use is made of local environmental objectives and knowledge. There are no plans to restore any environmental damage caused by previous similar developments or to protect areas that are still semi-natural (riparian forests, ponds, copses, isolated trees), or for programmes to prevent damage caused by the development or disruption of infrastructures.

Instead, the environment is considered retrospectively, as part of an approach known as 'environmental and social safeguarding'. The principle is to compensate for the impacts resulting from the development, both on society (loss of rights, displacement, new water and health risks, etc.) and on the environment (reforestation to compensate for loss of tree cover). However, the framework of sustainability, an international consensus expressed since the 1992 Earth Summit, and generally adopted by national policies, would require a different approach. This issue calls for balancing the concern for economic development with social objectives (equity and social inclusion) and environmental objectives (restoration in the event of previous degradation, avoiding new degradation, reducing it). Providing compensation for them is no more than a makeshift solution, and should be the exception.

An environmental baseline (situational overview of ecosystems) is included in the Environmental and Social Impact Statement (ESIS) for the PARIIS projects. However, as it comes after the detailed preliminary design (except in the case of Niger), it is not integrated into the basic findings that would enable the design of the development to be adapted to take account of the objective of environmental sustainability. For example, the profound degradation of the Tialla soils (a network of wide, deep gullies) after two phases of contour bund development, is only mentioned in the ESIS, and is therefore not taken into account by the project for the rehabilitation of the dyke network, which only seeks to avoid the areas degraded by the previous development, at the risk of reproducing the same type of impact on areas that have not yet been degraded. In addition, this very sunken drainage network places the new contour bund project outside the usual feasibility standards.

Avoidance is a priority principle in environmental management; it is therefore necessary to be well aware of the environmental issues before any project, to try to avoid damaging the environment in the first place, or at least to reduce a foreseeable impact in advance.

The ESIS has other drawbacks besides its late timing.

The impact study of the ESIS examines ex-ante the foreseeable impact of a project that has already been defined, but whose design has not taken the environment into account. Compensating for impacts should only be an ultimate and exceptional solution, whereas it becomes systematic with the ESISs. The very principle of 'compensation' is questionable due to the lack of any real ecological equivalence (for example, the destruction of century-old trees of species adapted to wetlands is claimed to be compensated for by planting exotic shrubs in dry areas, which will not provide the same type of ecological or societal services). In addition, according to many accounts, the ESISs (which are primarily used by environmental agencies, such as ANEVE in Burkina Faso, to validate projects) are nowhere to be found, and the Environmental and Social Management Plans (ESMPs) are scarcely followed. Since the compensations are inadequate in nature and in practice, the 'avoid degradation, reduce degradation' rules should be more clearly stated in the initial scoping of the project.

Another shortcoming of the ESIS environmental baseline is that it reflects a situational overview at the time of observation, rather than a trajectory (the notion of baseline = trend), because it fails to address the genesis of the observed state by seeking information on an earlier state. However, sustainability involves taking a long-term view. Even if the area to be developed underwent no further degradation due to the development, the risk of degradation would lie in the future extension areas, which are too small to be subject to the obligation of an ESIS study. We therefore need a global vision of the valley bottom and of its past (before the first development), and a forecast of its future with sufficient vision (medium term) and beyond the area to be developed, to anticipate possible future degradations linked to future extensions, with a view to the zoning of a 'project area', including the irrigated part.

The ESIS also focuses on establishing levels of risk, all issues taken together (including the transmission of HIV-AIDS by the staff of the construction companies, the most significant risk considered on several sites studied), which tends to dilute the ecological issue (risk of erosion overlooked).

Proposal for an early environmental baseline

The proposal made through the COSTEA study is therefore to integrate the environmental baseline into the detailed preliminary design (early baseline), to improve it by taking time into account, and to draw out, in a participatory manner, environmental sustainability or ecological restoration objectives in the project itself, with a view to reconciling the production ambitions with the environmental objectives. The case of Niger, where an environmental study is integrated into the detailed preliminary design, is an example to be followed in this respect.

The environmental baseline differs from the agri-environmental study (proposal 5), which is primarily agronomic, with a strong focus on sustainability. In the former, the starting point is the environment: the valley bottom is considered as an ecosystem transformed by human activities, and the aim is to characterise the biodiversity dynamics (ecosystems, adapted species in decline, extinct species), the forms of artificialisation and persistent naturalness, and the symptoms of degradation compared with a previous state (pollution, erosion, drying up of wetlands, loss of perennial plant cover, loss of soil fertility, loss of ecosystem services, etc.). In the second approach, the starting point is people and their activities: their practices in the use of natural resources, their cultivation practices, their restoration and conservation activities, their impacts, their footprints and their perceptions. These two approaches are therefore highly complementary and mutually supportive, and many environmental surveys could be pooled with the agronomy section, provided that the environmentalist can work at the same time as the agronomist.

Investigation tools

The following investigation tools can sometimes be pooled with other expertise components:

- Google Earth photo-interpretation maps (see proposal 1, Spatial approach to the context);
- Landscape unit recognition sheets: resources, uses, cropping systems, semi-natural ecosystems, livestock and wildlife (see proposal 1);
- Focus group interview guides (see proposal 5, Agri-environment).

The following tools are specific to the environmental study:

- Aerial photo archives from a 'pre-development' period (1950s);
- Survey guide on the local appreciation of ecosystem services (intended for a few agricultural, pastoral, fishing, etc. specialists);
- Participatory observation sheet on fallow land as a source of fertility, fodder and pests;
- Surveys on practices that have impacts and possible alternatives, including questions about the environment and training received.

Mapping of ecosystems with a view to zoning

The zone of investigation for the development project must be larger than the irrigated zone (or zone of influence of the dykes). The conversion of natural or pseudo-natural wetland ecosystems into agro-ecosystems should be traced from the past to the present (1950s aerial photos, Google Earth, eyewitness accounts), if possible.
The current ecosystems in the target area should be classified:

- refuges of biodiversity: sacred sites, ponds, segments of riparian forest in good condition, isolated trees and copses, savannahs, fallow land, preserved areas in the vicinity that will be impacted by possible future extensions (risk linked to developments that would not satisfy all of the claimants);
- the different types of agro-ecosystem:
- diversified forms of small-scale farming (mounds of associated crops, extensive grazing and haying, fishing, useful trees in crops, temporary fallow farming practices),
- permanent and intensive forms of agriculture that retain dense tree cover or are part of an agro-ecological transition (agro-forestry, organic market gardening, etc.),
- permanent and intensive agriculture, with a conventional format and sparse tree cover.

Interface with agronomy: land resources, fertility, other natural resources

- As a reminder, carried out by the agronomist (proposal 5)

Interface with agronomy: production and collection uses and practices (=provisioning ecosystem services)

- As a reminder, carried out by the agronomist (proposal 5)

Inventory of ecosystem services (other than provisioning)

According to the definition of the Millenium Ecosystem Assessment (2005), ecosystem services are benefits derived from ecosystems for human well-being, of which we are not always aware. They include support services (habitats, pedogenesis), regulatory services (hydrology, pest predation, fertility, climate, pollination, etc.) and cultural services (or cultural importance). But there are also 'disservices' (the disadvantages of certain predatory or competitive species in agro-ecosystems, negative local values). We need to be more aware of the services provided in the past and in the present, and of what could change with the development.

The inventory of ecosystem services can benefit from a dual perspective:

- A scientific or expert point of view ('regulatory', 'support, 'cultural importance' services)
- The people's point of view (symbolic relationships, perceived benefits for humans, for women, for domestic animals, for the climate, associated values, cultural importance, etc.) through surveys.

These two points of view are highly complementary and mutually enriching.

For example, for an expert, an isolated tree (wooded area) represents carbon sequestration, a wood resource, fodder, is conducive to infiltration and fertility, is a habitat for insects and birds, and entails certain risks (damage to dykes and pavements or roads); for the populations, it provides shade, fruit, medicines, attracts rain, fertilises and reduces wind, but is an obstacle to certain light-demanding crops.

An example developed in the deliverable 2 report to illustrate an expert's point of view, is the deterioration of anti-erosion regulation services in the valley bottom ecosystem following the multiple developments in Tialla; these services have been preserved in the adjacent lowlands.

Participatory approach to the environmental objectives and issues of a development (agro-socio-environmental interface)

Concern for the environment is not always a reflex in societies that are increasingly 'individualised' and have short-term concerns. A participatory approach is also a place for sharing preoccupations. As with the other thematics, the participation of local actors and regional authorities is necessary not only to benefit from their expertise (fauna, flora, key areas) but also to debate certain questions and decide on priorities (focus groups, surveys, interdisciplinary debate).

For example, should valley bottoms continue to play a partial multifunctional role when the project's objective from the outset was rice production? Should valley bottoms continue to provide regional services? (Nambé, for example, provides fodder for the women of Ouagadougou). Should certain environmental assets (soil, biodiversity) be restored or preserved (as in the case of erosion at Tialla)?

There also needs to be a debate on the proposed facilities and their own sustainability (maintenance, rapid repairs in the event of devastating floods, sizing of the structures, maintenance organisation, areas to be preserved or restored, how to 'green' cropping or usage systems (focus groups and interdisciplinary debates) with a view to sustainability (for example, how to reduce the harmfulness of pesticides). In particular, we need to take advantage of local skills (knowledge of plants, nursery growers, farmers trained in agroforestry) or nearby skills (agro-ecological sections of federations of market gardening or rice cooperatives).

Following this 'co-construction', an impact reduction or avoidance programme should be included in the design of the development project, and not just in the 'post-development' ESMP programme in the form of 'compensation'. This environmental component of the detailed preliminary design could take various forms, such as the zoning of the valley bottom (within the boundaries of a project zone extended to the periphery of the irrigated zone), identifying and preserving certain ecosystems and forms of small-scale traditional farming of environmental interest, certain multifunctional resources (pastures, ponds, isolated trees) or sacred places, certain areas providing regulatory ecosystem services (riparian forests); an ecological engineering programme to restore degraded areas; a more ecological cultivation model; an infrastructure maintenance and repair programme assisted by a predefined entity (with a view to reducing the risk of subsequent gullying); a programme to monitor implementation with a view to making any necessary corrections; a programme to raise awareness of the environmental and health risks of pesticides and excessive fertiliser doses, and to provide training on more ecological practices and links with quality product value chains.

It will still be necessary to carry out the ESIS impact study once the development and exploitation scenarios have been 'integrated', i.e. once they have already sought, in advance, to reduce their environmental impact.

Debate and recommendations of the workshop

The question to be debated concerned the feasibility of an environmental baseline integrated into the detailed preliminary design, since a baseline and an impact study are already implemented in the ESIS, albeit independently.

Debate on the weaknesses of the ESISs

Some of the information contained in the ESISs is not relevant;
Environmental issues are not sufficiently taken into account at the development design stage, as the detailed preliminary design and ESIS studies are disconnected.

Debate on relevance

It is therefore relevant to propose that the environmental baseline of the ESIS be included in the detailed preliminary design, in order to design a project that integrates environmental impact avoidance and reduction measures.

Fears

Some fear higher costs if an environmentalist is included in the detailed preliminary design team.

Funding agency procedures and national regulations may require the environmental baseline study to be carried out at the later date.

Proposed reorganisation of the studies, with a view to not recruiting another environmentalist

The recommended sequence of work is as follows:

- 1st: Environmental diagnosis prior to the design of the development (baseline), leading to the definition of the environmental issues with the local populations and partners;
- 2nd: Taking account of the environmental issues in the design of the developments;

- 3rd: Proposal of a low-impact development project;
- 4th: Study of the residual environmental impacts and risks, based on the final project (ESIS);
- 5th: Mitigation measures for the residual environmental impacts and risks (ESIS).

2.3 Focusing the hydrological analysis on agronomy and the management of structures

Justification and issues at stake

The current valley bottom development strategy is based on the application of a single model of a partial water control structure, predefined at national level on the basis of the experience of rural engineering departments. The advantage of this is that it provides a technical reference framework and standard costs, making it possible to speed up the project design and implementation phases for dissemination to a large number of sites. The hydrological baseline study is thus limited to providing the data needed to size the structure and specify it to the site. It currently focuses on: (i) the 10-year flood to calculate the structure's resistance and (ii) the average annual input of the catchment area in the case of micro-dams, sometimes supplemented by a summary water balance of the reservoir to assess the filling and availability of the resource for uses.

However, the hydrology should help specify the objectives of the development, help dimension the exploitation, and discuss management scenarios. What gaps need to be filled between the water requirements of crops (and other uses) and rainfall or groundwater supplies? What is the facility's capacity to contribute to this? What risks might the structure represent? Hydrology mobilises climatic data (rainfall, evapotranspiration) which should be used, beyond the calculation of the design flood, to assess the water risks for crops: pockets of drought but also submersion by floods at the beginning of the cycle for rice, waterlogging of soils in the middle of the cycle, access to the water table for the end of cycles and off-season crops, and the possibilities of slowing down its drawdown to extend the growing season.

Two new approaches are therefore proposed: (i) an agri-climatic analysis for winter crops (mainly rice); (ii) for water storage schemes (controllable micro-dams or retention dams), an assessment of the potential impacts of the structure and its management on the exploitation of resources.

Agro-climatic analysis approach

This analysis aims to: (i) characterise the area's climate and its implications in terms of meeting crop water requirements, (ii) identify an optimum crop cycle (length of cycle and sowing date) under rainfed conditions (for rice) and (iii) assess the risks of pockets of drought during the cycle and the prospects for mitigation through the development.

On the one hand, it is based on 10-day climate data on rainfall (over a long series of around twenty years, making it possible to identify any trends linked in particular to climate change) and evapotranspiration (average over the last three years), as well as crop data for crop coefficients (Kc). On the other hand, it is based on users' knowledge of the water regime in the valley bottom (run-off, flooding, groundwater dynamics, zone differentiation) and of cropping cycle positioning practices (sowing and harvesting dates).

The proposed stages of analysis are as follows:

- Frequency study of annual rainfall to assess inter-annual variability and characteristic rainfall patterns (median, driest and wettest year over a five-year period, driest and wettest year over a 10-year period), and identify the existence of any long-term trends.
- 10-day P-PET (precipitation-potential evapotranspiration) climate balance to characterise the pre-wet, wet and post-wet periods, during which the crop cycles will be set. Frequency analysis of 10-day P data to assess the risk of pockets of drought during these periods (P value in the driest year over a five-year period compared with PET/2 in the crop emergence phase, or PET in the vegetation development phase).
- Water constraints for rice growing and implications for the timing of the rice cycle. The aim is to compare rainfall contributions during the various phenological phases with the crop's water requirements at maximum evapotranspiration (ETM), for two or three options of sowing dates and cycle lengths. An inter-annual analysis should be carried out to determine the frequency with which these rainfall contributions exceed the requirements. Favourable sowing decades can then be determined, i.e. those in which rainfall is likely to meet the water requirements at least 8 years out of 10. The optimum cycle length can then be identified by examining the coverage of the rice ETM by rainfall for each decade. The at-risk decades where P< ETM with a frequency higher than 1 year out of 5 (threshold to be defined according to the producers' aversion to the risk of drought) can also be identified. This is a simplified approach to the potential of the environment, taking into account only the 'statistical' rainfall of independent decades. A complete analysis of the inter-annual variability of the level of satisfaction of the water needs of rice would require a water balance taking into consideration the useful soil reserve (taking account of the distribution of rainfall over the season and the storage capacity of excess rain in the soil), which would be costly to implement for a detailed preliminary design. The water deficits observed under rainfall conditions should be compared with the potential for mobilising run-off with the planned structure or facility.
- However, this approach needs to be supplemented by local information on the duration of run-off and the period of waterlogging, the presence of persistent water tables to take account of possible inflows of water through capillary rise, which is often significant in valley bottoms, and also other perceptions (wind, erosion, flooding, heat) which could supplement a vision based on a 10-day water balance methodology, smoothing out daily phenomena.

Water balance approach to assess the impact of storage facilities and management scenarios

In the case of a development creating a reservoir, a water balance tool should make it possible to respond to three concerns: (i) assess the water resource that can be mobilised for various uses by establishing the reservoir's operating curve; (ii) estimate the areas that could potentially be cultivated in the different sections of the valley bottom at different periods (depending on the dynamics of water recession and land emergence), and for rice growing, the associated water levels, involving varietal choices (cycle length, stem height) and sowing or transplanting dates; (iii) simulate the effects of cofferdam management rules for filling and lowering the reservoir. Regulating the water body may be necessary for a number of reasons: to prevent the risk of rice flooding at the start of the cycle, to arbitrate water and land allocation choices between uses (draining for rice harvesting and market gardening, or conserving water for livestock watering, fish farming and groundwater recharge).

The method comprises the following stages:

- As the initial condition for the water balance model, it is necessary to have the **height-surface-volume** curve of the water body, which gives the storage capacity. This data comes from the topography of the basin and the choice of setting of the spillway level.
- Secondly, **the filling** conditions linked to the inflow from the catchment area have to be defined. As micro-dams generally have a low capacity relative to the size of the catchment area, the reservoir is usually full at the end of the wet season, even in a dry year. An estimate of siltation dynamics is also indicated to assess the sustainability of the reservoir. These variables in annual water supply and sedimentation are generally taken into account in current detailed preliminary designs which apply reference estimate methods (CIEH, Turc, Coutagne, Dubreuil cited in FAO 54, etc.).
- The conditions for water recession are then established by estimating **losses through infiltration and evaporation and the water requirements of crops and livestock**. It should be noted that for wet season flooded rice, the evapotranspiration of the crop is close to the evaporation of a free water surface, so it is considered that the needs are met for the area of evaporated water corresponding to the area of rice. Adequate management of the water body and of the cropping calendar will ensure that the requirements are met. For the irrigation of market gardening on the edge of a reservoir, a choice has to be made between pumping from wells or from the reservoir.
- The **operating curve** of the reservoir is established from the start of the dry off-season (hypothesis of a full reservoir) by iteration on the basis of a 10-day water balance taking into account withdrawals and losses, as well as a gate management rule (whether or not to keep the gates closed). The height-volume equation is used to combine data on evaporated and infiltrated water and volumes withdrawn, to arrive at the volume stored at the end of the 10-day period. The distribution of the initial volume stored between the various uses and losses can then be demonstrated and used to discuss management rules. The operating curves are not estimated in the current detailed preliminary designs.
- The **areas** of the reservoir and its surroundings **that can be used for rice cultivation and market gardening** can then be estimated from the operating curve by transforming the stored volumes into flooded areas. Market garden crops can be grown in the basin after the water has receded and the rice has been harvested, up to a set date for cultivation to be defined. For rice growing, the sections suitable for the different types of rice according to the height of the water level (rice under high submersion, rice with a low water level that is better controlled, rain-fed rice assisted by the rise of groundwater from a shallow water table, and flooding limited to highwaters) must first be determined. For each section, we then identify the cycle length that allows sowing in the rain and harvesting without having to partially empty the reservoir (choice of a water conservation rule for other uses). We can then define the management of the rise in the level of the water body by regulating the gates to accompany the development of the rice. The application of the operating curves to the two cases studied in Mali showed that the areas of rice that could be secured by the reservoir were greatly overestimated in the detailed preliminary designs.

Debate and recommendations of the workshop

The workshop discussions focused on the relevance and feasibility of the two methods proposed to: (i) take into account climatic risks for crops and the capacity of the facilities to mitigate them, (ii) better assess the potential impacts of the facilities on how the land is exploited. PARIIS reported on the discussions.

Arguments in favour, strengths of the methods

- The exposure of crops to water risks is a fundamental problem that needs to be resolved, and the climatic balance method provides an understanding of these risks. The 10-day time step is relevant.
- Climate change needs to be taken into account, and analysis over a long climatic series would be useful to adapt infrastructures to this change and anticipate current trends.
- The countries have a network of weather stations that can provide climatic data (synoptic stations are preferable).
- The water balance of the dam reservoirs is useful for planning irrigable areas and areas that can be cultivated during flood recession.

Weaknesses

- Considerable need for weather data, which is costly. Response: possibility of a regional agro-climatic approach using clusters of sites within a fairly homogeneous climatic zone; access to low-cost international weather databases such as WaPOR/FAO;
- Uncertainties as to the contribution of groundwater, despite its importance in the hydrology of valley bottoms. Knowledge of the potential of valley bottom water tables is low, there is a lack of reference piezometers and it is difficult to extrapolate data. Need for local data. Response: Niger's experience in

understanding groundwater recharge based on field surveys - inventory of wells and their operating conditions. Use local knowledge;

- Difficulty in finding hydrological experts with the right profile and dual agro-hydrological skills to be sensitive to the issues of crop water requirements.

Recommendations
The agro-hydrological approach is highly relevant. The water balance method for reservoirs is applied for the design of type 3 PARIIS development projects, i.e. 'small community irrigated schemes' but not for type 1 projects with partial water control in valley bottoms. It would be appropriate to extend the use of this method to all projects involving micro-dams.

The cost of complementary agri-hydrology approaches still needs to be assessed, bearing in mind that there is pressure not to increase the cost of valley bottom development.

2.4 Socio-land diagnosis for equitable access to post-development valley bottoms

Justification and issues at stake

The issue of land in development projects is often a source of tension. Access to land determines the exploitation and sustainability of the development. The provision of land is an issue that projects address to ensure that the populations agree to the development of a given area. But in this framework, the land issue is not considered in all its complexity, and attention is focused only on the land near the structure/facility (notion of right of way) without taking into account the consequences of the development on the valley bottom as a whole and on the balance between uses and between users within the production and activity systems. The methodological proposal therefore aims to complete and improve the socio-economic study as carried out in current detailed preliminary design studies (organisations, value chains, inequalities, societal expectations) with an in-depth socio-land diagnosis in order to gain a better understanding of local land issues, promote equitable access to valley bottom land and anticipate the risks of land tensions related to the implementation of the development.

In the framework of the approach promoted by PARIIS for the development of valley bottoms, feedback and capitalisation made it possible to identify the stages required to set up the project's land tenure system:

(i) Delineate the site (participatory mapping);
(ii) Identify the landowners affected;
(iii) Characterise the valley bottom areas that are used according to the land pressure existing before development.

However, the work carried out in Niger, Mali and Burkina Faso as part of the valley bottom structuring action has shown that this approach is not fully applied, and that the socio-land diagnosis method needs to be developed further.

The socio-land diagnostic process

The methodology to carry out the socio-land analysis is based on four stages that aim to provide a better understanding of the territory in which the future project will be located:

- 1st: Delineate the area impacted by the developments and the associated land issues;
- 2nd: Understand the pre-development land management rules: organisational and institutional analysis;
- 3rd: Identify the owners and rights holders and their land use strategy;
- 4th: Anticipate land reallocation and formalisation procedures.

The first stage aims to characterise the project area and the various issues at stake. This characterisation takes up **proposal 1: 'Interdisciplinary spatial approach'** to the site and its context'. This therefore involves mobilising the sociologist expert alongside the rural engineering expert and the GIS specialist in order to identify the areas exploited, the various associated uses and their relationships. The question of the degree of influence of the structure on each zone and its uses can be examined in greater depth by drawing on the results of the topographical and hydrological studies: past effects of the structure in the case of rehabilitation or simulated potential effects in the case of a new structure (in particular by using the water balance tool of proposal 3 for a micro-dam type of structure). The existence of areas where forms of land tenure tension can be observed is an essential point in this stage through the participatory mapping carried out with the users. The aim of setting up a participatory mapping workshop is to be able to delineate the 'valley bottom territory' and its various components according to the actors. This territorial approach to the valley bottom will make it possible to avoid excluding or overlooking certain users within the framework of the development by involving representatives of the users of the different areas exploited (from the different hamlets and villages included in the area of influence of the structure, and/or exploiting the agricultural areas). To ensure the legitimacy of the activity, the areas identified must be validated and delineated in the presence of the customary representatives and village chiefdoms. A simplified forecasting exercise can be used alongside this mapping to illustrate, through the map, the influence of the development of the structure (possibly on a seasonal time scale) on the various areas.

The second stage aims to understand the pre-development land management rules through an organisational and institutional analysis. At this stage, the rules governing access to land are identified through focus groups with representatives of the valley bottom users, in order to understand how they access the areas they use, through whom, and according to what rules (particularly in terms of time). It is important that the various management institutions are approached at this stage of the diagnosis to identify the legitimate institutions in the territory, their mandates, their scales of intervention and their specific skills. To do this, it is preferable to opt for semi-qualitative interviews. The key expert of the consultancy firms at this stage is the sociologist, who will have to assess the relationships established between the management institutions and the local actors in order to produce a policy brief on institutional support backed by the diagnosis.

The objective is to identify the networks of actors for whom communication with the users is legitimate (recognised by all) and effective (enabling the actors to react in the event of a crisis) and on whom the project could rely. Relational gaps between institutions and actors could limit communication, and therefore the adaptation of the system to manage the space following the development of the new structure. The sociologist's brief could thus go so far as to propose a multi-actor workshop format to be organised at the start-up of the works, focusing on current management practices and possible improvements.

The third stage aims to identify the owners and rights holders in the valley bottom area to be developed and their exploitation strategy. As tested in the field by the COSTEA team, this stage can be organised around the observation of three to five transects of the valley bottom (depending on the size of the site and the pre-identified areas). The users and their nearest neighbours are identified along the transect. For each of the users identified, an interview will be carried out to note the conditions of access to land and water, the surface area exploited and the type of use (orchard, rice-growing, market gardening, etc.). This stage therefore requires the agronomist's input on the agricultural exploitation. This could feed a layer of the GIS created under proposal 1, 'Interdisciplinary spatial approach to the site', on aspects of access to land and the ways in which it is put to use. Feedback should be provided at this stage to present the sub-areas identified and validate the issues specific to them. The list of rights holders in the 'valley bottom territory' can be compiled as part of this.

The fourth stage of the diagnosis aims to support the actors in anticipating the implementation of land reallocation procedures. The issue of post-development land redistribution is closely tied to the project's sustainability. The aim of land redistribution is to ensure that a satisfactory level of exploitation of the land is achieved. It is important that users who are interested in and committed to exploiting the valley bottom should be able to benefit from a plot when the land is redistributed. The aim of the anticipation stage is to identify the bottlenecks or, on the contrary, levers, that could have an impact on the exploitation rate. For example, it will also be necessary to take into account suitable areas that are not cultivated due to a lack of access to water and/or lack of means of production. In addition to the levers for action that could be identified (securing access to the resource following development, improving access to credit, etc.), it will be necessary to discuss the possibilities in terms of land distribution with all the users. This is often entrusted to the users, who have to organise themselves to redistribute the land without support from the project. Land tenure problems, or lack of ownership of the land, are often at the root of failures in valley bottom development. On the contrary, the land parcels should serve as a basis for dialogue between the users themselves, and between the users and the project managers. This anticipation stage is therefore based on detailed knowledge of the territory of the land, acquired during the three previous diagnostic stages. The land mapping produced in stage 1 and completed in stage 3 will be used as a baseline of the situation before development, making it possible to pinpoint any sticking points or areas of dispute that need to be the subject of more in-depth collective discussions in parallel with the implementation of the works. The anticipation exercise will be organised through various collective discussion sessions. Users will be organised into working groups according to their areas of action (areas previously identified using transects and participatory mapping). The working groups will be asked to explore collective solutions to be found for the various situations at stake:

- Cultivation of a rainfed area for which an individual has recognised rights of use;
- Impossibility of cultivating plots of land affected by the structure (too much submergence);
- Allocation of land to a beneficiary who was not cultivating before the development.

After pooling the possible solutions put forward by the working groups, a village assembly will be held to:

- draw up a list enabling the precise identification of land claimants following the development (possible land disputes are identified, and therefore avoided);
- draw up a summary handbook making it possible to define the procedures for compensation, redefining the boundaries of the cultivated area, reallocating plots and selecting claimants;
- define the principles of equity in access to developed land in order to guard against the risk of conflict, and to guarantee fair and equitable access (in the eyes of the actors themselves).

Summary of expectations and of the necessary collaborations

Stage	Tool mobilised	Collaboration across disciplinary interfaces	Outputs
Characterisation of the project area and of the land issues involved	Participatory mapping (option: simplified forecasting)	Sociologist Rural engineer	Map based on actors' accounts Report of the assembly
Understanding of the pre-development land management rules	Focus groups on 'management rules' Meetings with local institutions for land and water management	Sociologist	Interview reports Policy brief for support to institutions
Identification of owners and rights holders, and of their strategy for exploiting the area of influence of the structure	Transects	Sociologist Agronomist	Transect schema (option: GIS layer) List of rights holders
Supporting actors in order to anticipate the implementation of land reallocation procedures	Group facilitation	Sociologist with legal knowledge	List of claimants Simplified handbook Description of principles of equity

Debate and recommendations of the workshop

The workshop debate focused on the feasibility of a socio-land diagnosis, on the constraints linked to the specific features of the rural environment in Niger, Mali and Burkina Faso, and on the possible links with the other activities to be carried out in the detailed preliminary design.

Arguments in favour, strengths of the methods

The issue of land tenure, as addressed here, provides a link with the agronomic approach (through the superposition of activities). The strong spatial dimension will also facilitate the link with the other proposals for improving detailed preliminary design methods.

A detailed analysis of the actors and land management rules can help to identify the actors who really hold the power to make land decisions, as this is often where current studies are lacking. It should be noted that certain influential stakeholders in the sphere of land tenure are sometimes not on site but in the regional capital, the capital of the country, or even abroad.

Weaknesses

The willingness to discuss land redistribution is an important but delicate point. In Niger, for example, such redistribution is difficult because private parties have already invested heavily (what can be done where people have already bought 100 ha, as in Tadiss?).

On sites in Mali, the owners have been on the land for a long time and know the boundaries of their plots; it therefore seems difficult to encourage them to reconsider these land use boundaries.

However, it is still useful to consider this redistribution on sites that are more community-based where there is little individual investment, particularly in Burkina Faso, where there are allocation committees with the involvement of regional managers.

Recommendations

- The socio-land approach should enable the following aspects to be addressed:
  - identify the land tenure status within the selected site (are there concessions, land titles, etc.)
  - identify the legitimacy and legality of the rights holders present (ownership rights and delegated rights);
  - redefinition of the rules governing access to land (who wins, who loses? in the context of the future development);
- To avoid having to deal with cases of land redistribution where private investment has already been made, it is preferable to intervene in less developed areas where there has been less investment;
- The question of the means of compensation must be addressed;
- It is essential to identify the existing frameworks for land regulation. In most cases, land management takes place outside these existing legal land frameworks: identify the frameworks to build on them.

2.5 Agronomic study for 'sustainable development' (agri-environmental approach)

Justification and issues at stake

For the sustainable agricultural development of the wetlands of territories, the detailed preliminary designs consulted proved to be:

- too standardised, revealing a lack of local consultation, which does not make the most of local know-how or proposals, and does not make it possible to find a development suited to the site,
- unfinished (soil and groundwater analyses);
- incomplete: basic themes (agronomy, environment) not addressed, or dispersed in other baseline studies, or subsequent to the detailed preliminary design (as in the case of the environmental baseline of the ESIS);
- to contain prescriptive and normative development advice, based solely on the production criterion and on current technical data sheets in the soil study. Local knowledge is not capitalised on.

The observed absence or dispersal of agronomic data between the various detailed preliminary design reports, and the low priority given to this thematic in an agricultural project, leads us to suggest adding a specific 'agronomic' or, better still, 'agri-environmental'[4] study in order to better prioritise sustainability from the outset.

The main objective is to understand the current system of exploitation of the valley bottom, its place in the territory and expectations with regard to the development, and thus to lay the foundations for a process of co-construction of a more sustainable development project.

Three stages therefore seem to be necessary: (i) the establishment of an agri-environmental baseline (at the same time and in the same capacity as the other baseline studies of the detailed preliminary design), (ii) the performance of an agri-environmental diagnosis (to be carried out on a few pilot sites that are representative of their region), and finally (iii) the drawing up of a draft agricultural development project based on both the expert diagnoses and the beneficiaries' expectations.

Stage 1: 'Agri-environmental baseline'

The agri-environmental baseline should characterise the current resources, uses and agro-biodiversity.

The investigation tools, which can be pooled with other thematics, are:

- Photo-interpretation using Google Earth;
- Landscape unit recognition sheets: resources, uses;
- Focus group interview guides;

4. It should be borne in mind that 'agro-ecological' is used in another sense (agro-ecological practices and policies, based more on the activation of ecological processes than on techniques). Agro-ecology is one of the options in the search for environmental sustainability in agriculture.

- The rice crop observation sheet (10 plots, women and men) (on the pilot site);
- The survey sheet on the cultivation system developed (10 plots, women and men) (on the pilot site);
- The survey sheet on the place of valley bottom activities in the family production system and their contribution to costs, work, income and food security (10 farms, 5 with rice, 5 candidates) (on the pilot site).

Resources

This point should lead to a mapping of soil, vegetation, animal (fishing) and water resources (spatial analysis, calendars, seasonal maps) and provide explanatory factors for the current situation (historical elements, for example, previous projects, boom in certain produce, etc.).

The sources of information are photo-interpretations, joint field visits and focus group surveys (producers, women, young people). The first joint diagnostic mission should take place in the dry season, when travel is easier: convene a village assembly where information will be exchanged on current and past development methods (agricultural, pastoral, forestry, other). Focus groups targeting different types of producers and authorities (State, municipality, village) can be used to gather information on practices and expectations. Accompanied transects can be used to carry out a study by landscape unit, as well as soil sampling if this had not been done during the soil survey.

The second joint in-depth diagnostic mission should take place in the wet season, on a pilot site in a regional cluster of valley bottoms to be developed: focus groups should be organised by category (producers, women, young people, local actors); accompanied transects should be carried out to look in greater depth at the issues that emerged in mission 1. Additional observations and investigations can be carried out during the rice ripening phase (October) on site (10 plots) and in the village (10 family farms) and post-harvest (in December) on a pilot valley bottom in a cluster of projects. It is not possible to take directly part in the harvests, which are very staggered. Discussion meetings make it possible to provide feedback on and validate certain diagnoses, and to raise new questions.

Production and collection uses and practices on landscape units (multifunctionality)

Once the uses and production practices have been inventoried, an inventory of the species exploited (agro-biodiversity) should be carried out and attention should be paid to practices with impacts and 'agro-ecological' practices (based on natural processes and biodiversity).

This involves making an inventory of uses and production activities, based on the assumption that every valley bottom, the only wetland in the territory, is subject to multiple uses and fulfils multiple functions (access to water, foraging, agriculture, livestock farming, fishing, symbolic roles, etc.), often on a seasonal basis. In order not to omit any uses, focus groups should be conducted by categories of producer (men, women, young people, livestock farmers, fishers, etc.), and field surveys should be conducted seasonally by landscape unit. This makes it possible to produce a calendar of seasonal uses by landscape unit (field survey, data sheets). Although the technical supervisors can provide some essential information in separate interviews, it is preferable to carry out the survey without their influence in order to limit the risk of the responses being affected. Conversely, only focus groups can provide access to certain collective concerns.

For the main crops and per landscape unit, the cropping systems are explored by focus groups over different time steps (long-term trends, inter-annual, inter-seasonal, average technical itineraries for a cycle, water management methods), and their diversity is studied by surveying 10 plots on the pilot site. The minimum for each site would be to be able to reproduce a map of uses by season, the crop rotation in the valley bottom (% of each seasonal use, calendar (sowing/harvest dates, fire dates, etc.) and a few indicators of the level of intensification (use of which inputs and facilities: harnessed or motorised tools, varieties, herbicides, fertilisers, pesticides, irrigation, etc.). A calendar in table format (month columns, activities in lines) shows how different seasonal activities fit together on the same land or within the same society (work peaks, fires, access to pasture land, etc.).[5]

It should also highlight the limitations and constraints perceived by type of activity or technical itinerary (e.g. seasonal pests such as birds depending on harvest dates, duration of soil moisture available to rice at the end of the season).

Endogenous innovations or innovations adopted on the basis of technical support proposals, opportunities and potential are to be sought.

It will be possible to identify high-impact practices (for example, herbicides and pesticides, e.g. the extensive use of herbicides in Nambé before ploughing and during the vegetative phase, and in Tialla (after tillage), some of which are not approved.

Aspirations and forecasts/expectations in the event of development will be collected during these interviews.

Agro-biodiversity

The current agro-biodiversity (range of varieties per species used) should be known in order to understand the best adapted current strategies and practices, some of which can be preserved. Data collection on the plant material used (in groups or per plot surveyed) aims to understand its diversity, the choice and use of this plant material (sowing dates, planting methods, harvesting date), and what forms of adaptation are sought (yield potential, photoperiodism, the harvesting date, sensitivity to pests/diseases, sensitivity to excess water or drought at the end of the cycle, compatibility with each planting and cultivation method, etc.).

5. By way of example, the calendar of uses of the Nambé valley bottom shows that four activities share the valley bottom in time and space. Early irrigated corn harvested in July excludes rice (unless it is transplanted late in July) but allows early market gardening from August. Rice is generally harvested late (December) due to the lack of time available and partly due to the late varieties, given the risk of bird damage from early ripening. There is therefore no possibility of rotation with market gardening, unless a short-cycle rice is chosen along with a short-cycle market garden crop (e.g. 70-day potato), which is highly suitable for the following rice crop.

The inventory of varieties and the analysis of their characteristics (sowing dates, observed stage, foreseeable harvest date) and properties should be carried out on the 10 plots surveyed, and can be completed in 'rice grower' focus groups.

This survey makes it possible to identify varietal types (photoperiodic, fixed cycles), harvest dates for photoperiodic varieties (early, late), cycle lengths for fixed-cycle varieties and preferred planting methods (sowing, transplanting). It shows the forms of adaptation of local varieties to be maintained (photoperiodism, trade-off between water risk and bird risk, which means that early harvests are favoured depending on the ability to manage this risk, and late harvests on land with prolonged humidity (near low-flow channels and reservoirs).

Stage 2: Crop diagnoses and current environmental impacts

Crop diagnoses enable explanations to be put forward for current practices and any mediocre results (in terms of production or the environment), and to suggest ways of improving them, in particular through hydraulic developments, their management, or cropping systems with less environmental impact and greater input efficiency. The diagnoses also provide an opportunity for the agronomic expert to work alongside hydrological and socio-economic colleagues.

While a rapid diagnosis should be carried out on each site, an in-depth diagnosis, including observations of crops and surveys, should be carried out on a pilot site in a regional cluster of projects.

Fertility diagnosis

An 'agri-environmental' approach to soil goes far beyond the search for cultivation aptitudes of the current pedological approach. It also involves assessing the soil in terms of agronomic constraints for current or planned cropping systems (i.e. 'limiting factors' and unfavourable behaviours that need to be overcome or anticipated), as well as long-term environmental objectives (less erosion, more carbon sequestration, more biodiversity, reduced chemical and plastic inputs and pollution, etc.).

The information and diagnostic elements come from two sources: the expertise of the agronomist consultant and his/her skills in terms of observation, information (search for references, soil analyses, surface observations) and judgement, and local knowledge gathered in focus groups and in situ on each landscape unit with a small group of producers on the pilot site. These surveys complement the soil analysis (map and diagnosis of aptitudes) and the hydrological analysis of the water regimes in each landscape unit, in order to integrate the implications of the water status of the land for crops. The agronomist sometimes needs to supplement the soil information when his/her concerns have not been taken into account by the soil survey. It is also necessary to find consistency between expert points of view and local knowledge, and in the event of divergences, to discuss them.

The sub-topics to be addressed are:

- Soil types, textures, structure, behaviour, aptitudes, constraints, fragilities, etc.;
- Marks of degradation and erosion (gullies, incised low-flow channels, sedimentation);
- The search for bio-physico-chemical constraints (Fe toxicity in the form of surface re-oxidation spots, nitrogen deficiency, organic and mineral balance, soil saturation time) and opportunities (high levels of certain characteristics, biological richness).

The tools are:

- Transects with descriptive sheets;
- A geo-referenced soil sample per landscape unit and full analysis (5-fraction texture, available C, N, P, P, available K, CEC, pH, etc.);
- A collection of local knowledge: names and extension of soils, behaviour, qualities, seasonal water regime, perceived problems, etc.;
- A collection of fertility management practices, quantifying the importance of fallow land;
- A mapped presentation showing the planned developments.

The problem of references and judgement thresholds arises in soil evaluation as there is not one single judgement criterion when considering the dual objective of production and the environment. It is already possible to assess the content of the various fertility parameters using a conventional fertility scale (FAO scales with five classes of content in absolute value, used by Bunasol in Burkina Faso).

It is also possible to use an 'ecological' scale (relative to the content references for types of natural ecosystem, savannah, forest, etc.) which takes into account the level of fine elements (Serpantié and Ouattara, 2000), because organic matter combines with clay to form a stabilised 'clay-humic complex', and the type of ecology modifies the balance level. This gives a better idea of how far these soils are from a potential 'natural' content, according to the benchmark ecosystem, derived from an analysis of the valley bottom's ecological past. For example, in a soil that is apparently rich in N or P in absolute values (the cases of Nambé and Tialla), but very clayey and rich in metal oxides, the nutrients that can be assimilated and mineralised may be limited because they are retained in the organic matter associated with the clays (N), or adsorbed onto the oxides (P). It is also possible to compare each soil with a regional dataset of cultivated valley bottom soils (a more empirical approach), in order to situate the relative state of the soil of this valley bottom and propose feasible objectives.
Diagnosis of crops: constraints, performances, impacts, potential for improvement and agro-biodiversity, on a pilot site with a regional scope
The agri-environmental diagnosis seeks to quantify yield and its components, on the one hand through focus groups, and on the other through plot evaluations, as well as research into other ecological and economic indicators.

Next, the aim is to explain the diversity of yields, based on a map of the plots, on practices and varieties, on comparisons between potential yield assessed in October (component counts) and actual yield, and on gathering farmers' opinions on the causes of losses[6].

Diagnosis of the agro-socio-economic interface
This diagnosis is primarily based on the collection of diagnoses of local people and expectations with regard to the development project (role of focus groups), but also on individual surveys carried out on a pilot site. The 10-plot survey (five men and five women) and a rapid farm/household survey can provide an overview of the current contribution of valley bottom plots to crop rotation, income, labour and costs, and facilitate the assessment of the economic risks of lowland cultivation (on the pilot site) (see Nambé case study, deliverable 2 report).

Agro-hydrological interface (carried out as part of the hydrology thematic)
An agro-climatological and surface water table frequency analysis should be carried out, taking into account climate change, trends and the management of developments (see 'hydrological diagnosis').

Stage 3: Joint preparation of a draft agricultural development project

Based on the collection of expectations and the agri-environmental diagnosis, co-define the exploitation issues and discuss scenarios
This involves anticipating how practices will need to be adapted to the planned development (to capitalise on it, but also to cope with the constraints), foreseeing impacts and considering changes. The questions to be addressed in various focus groups with men and women producers and project managers, and in interdisciplinary debates, would be:

- How sustainable is the current exploitation?
- What are the expected results of the development (production, economic, social, environment?)
- Should the valley bottom continue to play a multi-functional role?
- How can we meet expectations and make the most of local skills (know-how, resources?)
- How can the various current uses and developments be linked to the project (including uses by people from outside the territory)?
- How can unsustainable cropping systems or uses be made more ecological?
- Development scenarios (practices to be preserved, varieties, what needs to be improved, which adaptations, which changes?).

Anticipating adaptation to the development
Adapting does not necessarily mean changing, as some current practices and knowledge will remain adapted to the situation with the development, and may be retained.

In conjunction with the agro-climatological study, it must first be realised that a retention facility will certainly result in a partial securing of the crop's water needs, but also in a heterogeneous distribution of water (time and space). As a result, a number of questions should be discussed with the project actors:

- What adaptations could be made in terms of varieties and cropping practices (cropping systems, technical itineraries), management of the development and land distribution, to smooth out these variations, or the differences in soils?
- How can drainage systems be managed (collectively versus individually) to reduce the risk of flooding and excess water, while still allowing fishing in the channels?
- How should supplementary water resources be managed (piping, reserve zones and pumping zones to avoid competing uses, particularly for market gardening or livestock watering)?
- Which forms of reasoned intensification in relation to risks and sustainability objectives?
- What forms of land distribution would enable each beneficiary to combine several types of environment, favouring a diversity of practices and reducing risk?

Example of diagnoses and adaptation approaches in Tialla and Nambé, based on discussions with local stakeholders
The two valley bottoms are currently multi-functional (Tialla: six activities, Nambé: five activities), with perennial vegetation providing other services (water and erosion regulation, biodiversity, cultural values, fodder cut by women from the village and others coming from Ouagadougou). Development for rice growing will impoverish nature, reduce certain uses and force certain users, both local and external, to stop or move their activity (need for a plan of uses, reserved areas, restoration of degraded or eroded areas).

- In Tialla, it was noted that expectations (seeking water for market gardening), innovative know-how and advice from local people to be prudent with regard to the risk of erosion - a risk overlooked in the ESIS, were not taken into account to any great extent. Greater emphasis should therefore be placed on consultation and listening.
- In Nambé, even though the rice-growing project has existed for a long time, at the village's request, the priority expressed by men to consolidate their market gardening strategy (repairing the bouli, or pondage), and by women to gain access to land and wells as organised producers (rice and market gardening), should not be ignored.

6. The 2022 study carried out on 10 Nambé plots showed: a variability of 0 to 6 t/ha (avg. 3 t/ha), revealing the existence of more fertile areas or areas with a better regime and more adapted or intensive practices. A comparison of potential and actual yields shows the importance of bird losses for the earliest varieties introduced, and the impact of the October drought for the latest local varieties, which are less sensitive to bird losses, and therefore the importance of supplementary irrigation. As far as the environment is concerned, the first stumbling block is the conversion of semi-natural environments (ponds, wet savannahs, tree felling, degradation of riparian forests). As far as fertilisers are concerned, there are excessive doses in certain plots of land (risk of eutrophication). The third environmental stumbling block to rice farming in Nambé is the increasing use of pesticides, while the downstream lakes already contain levels close to the health threshold.

Example of adaptation of cropping practices in Tialla and Nambé: anti-risk crop intensification, diversification, more ecological practices

In the two valley bottoms, taking sustainability into account means breaking with the traditional vision of rice intensification based on single crop, single variety farming and a standard technical itinerary 'recommended by research'. This was in fact a standard system designed at a time when the only priority was 'optimisation' through maximum production in a buoyant economic context and a dirigiste management system, opting for strict specialisation of the areas. The multi-producer context (women, men of varying wealth, young people), new societal issues and the presence of a water retention scheme, mean that these standard guidelines need to be adapted and options for using the resources discussed with local actors (see details on deliverable 2).

Taking advantage of opportunities for breakthrough innovations

Nambé's peri-urban location is particularly favourable to breakthrough innovations, as shown by the rise of market gardening and irrigated corn, and the self-development of a bouli and its filling system from the river. It is possible to suggest training in agro-ecology with dedicated NGOs and organic input and market gardening value chains, riverside reforestation projects, guided tours, etc.

As for Tialla, its level of degradation due to linear erosion is such that breakthrough innovations are needed to stabilise this process (ecological engineering, the sustainability of which could be based on riparian forest species providing not only an anti-erosive regulatory service and a 'habitat' service, but also provisioning services such as fruits, medicines and cosmetics). The breakthrough would be to introduce a partnership between PARIIS and associations or organisations dedicated to ecological engineering (CNSF, ODE etc.) and agroforestry.

Debates and recommendations of the workshop

It emerged from the discussions that an agri-environmental study is essential right from the detailed preliminary design stage, but that the stumbling block lies in its feasibility, since current ToR, limited by budgets, have not emphasised agronomy, which is supposed to concern the post-development support phase managed by decentralised agricultural services, and have passed the environment over to the ESIS, managed by the World Bank. However, as the development is intended for agricultural purposes and is taking place in a wetland area with high environmental and social stakes (multi-functionality), the participants agree that agronomy and the environment should be addressed right from this early stage to ensure that the project is better designed.

In addition, the technical capacity of consultancy firms to deal with agri-environmental issues is not guaranteed; it would therefore be necessary to also turn to researchers, and carry out in-depth diagnoses (surveys) with a view to a more regional diagnosis on a representative pilot site, with lighter but systematic local diagnoses on each site.

It will be necessary to ensure that the socio-economic study of the detailed preliminary design broadens its scope to include questions about the valorisation of production, market opportunities and the composition of household incomes, so that the agronomic study can draw on it without also having to carry it out.

The choice of species and varieties for agricultural development should also depend on the type of soil, not just hydro-climatic or phytosanitary considerations (e.g. filtering soils, better suited to rain-fed rice types).

Finally, it will be necessary to facilitate the adoption of the tools developed in the agri-environmental approach by consultancy firms, producers' organisations and technical support agents. To do this, it will be necessary to draw up a list of the essential actions to be carried out, and even to prioritise them.

3. ORGANISATION SCHEME AND RESOURCES ALLOCATED TO DEVELOPMENT PROJECT STUDIES, PROPOSAL FOR THE IMPLEMENTATION OF COMPLEMENTARY METHODS

The relevance of the proposals for new detailed preliminary design methods was validated by the workshop participants. However, the question of the human and budgetary resources necessary to implement them was raised at the end of the workshop, but could not be discussed in the absence of precise and complete data on the current costs of project studies. The following proposal to reallocate resources is therefore based solely on the work of the COSTEA team of experts.

In the team's opinion, the implementation of the recommended new methods should be considered not simply in terms of additional resources to be mobilised, but firstly by redeploying existing resources as part of a revision of the organisation scheme for project studies.

The current process for project studies (see figure 1) is marked by a dissociation between the detailed preliminary design study (four baseline studies which feed a design study), and the environmental and social impact assessment.

The allocation of budgets to studies was consulted for three valley bottom development programmes financed by the World Bank (PARIIS 2020 and PRECA 2022 in Burkina Faso and PARIIS 2018 in Niger), with three detailed preliminary design studies and one ESIA. These programmes cover clusters of projects ranging from 10 to 40 sites, and the cost indicators (Table 1) have been reduced to the unit of site and hectare developed. The following points emerge:

- there is significant variability in the costs of detailed preliminary design studies, with differences of 1 to 2 for the cost per site and 1 to 5 for the cost per hectare. The maximum cost allocated to detailed preliminary design studies is 500 000 CFA francs/ha, i.e. around 10% of the cost of the development works. Expertise

Table 1: Budget for detailed preliminary design and ESIA studies for valley bottom development, PARIIS & PRECA 2018-2020

		Expert time days/site		Total budget K CFA franc/site		Total budget KF/ha		Budget as a %	
		mini	maxi	mini	maxi	mini	maxi	mini	maxi
Baseline studies	socio-economic	3	6					11%	10%
	topographic	3	9					20%	19%
	soil	3	9					22%	14%
	hydrological-hydraulic	6	8					16%	12%
Design study + bidding documents	Rural engineering	6	20					31%	45%
Total detailed preliminary design		**21**	**52**	**5 500**	**10 000**	**90**	**500**	**100%**	**100%**
Environmental and social impact assessment (ESIA)	environmental assessment	20						40%	
	sociology	20						35%	
	natural resource management	10						15%	
	GIS mapping	10						10%	
Total ESIA		**60**		**10 000**		**200**		**100%**	

time, which accounts for most of the cost of detailed preliminary design studies, ranges from 21 to 52 days per site (for the 5 experts combined).

- economies of scale play a part in the variability of detailed preliminary design costs; they are linked to the size of the valley bottoms (20 ha to some 100 ha) and to the number of sites included in the development programme (notion of a cluster of valley bottoms).
- the budget for the ESIA is 1 to 2 times that of the detailed preliminary design studies. It mobilises 4 experts for a total of 60 days per site, which is more than the maximum allocated to a detailed preliminary design study.

The resources allocated to detailed preliminary design studies appear to be clearly undersized for both programmes, which cover several dozen valley bottoms (minimum variant of table 1). Under these circumstances, allowing only an anecdotal presence in the field, detailed preliminary designs can only use standard solutions that are poorly specified to the sites. The maximum variant corresponds to a programme limited to around ten sites, which seems appropriate for designing adapted facilities.

On the contrary, the resources allocated to the ESIA appear to be substantial in view of the mandate of this study, which gives some leeway for reallocating expert time to activities with a greater impact on the design of sustainable projects, as identified in this report. The COSTEA team therefore proposes to revise the organisational scheme as follows (see figure 2):

(i) Replace the preliminary study of general information on the site to be developed by a geographical study providing a spatial and interdisciplinary overview of the issues at stake on the site (methodological proposal 1). The contribution usually made by the socio-economist or rural engineering specialist should be reinforced by a geographer specialised in GIS. To this end, we would propose mobilising the GIS specialist of the ESIA for five days per site. This transfer of resources from the ESIA to the detailed preliminary design seems all the easier to achieve as the 'General Information' section is duplicated in the ESIA.

(ii) Reposition the environmental study on the initial state of the site's ecosystem and its current degradation factors, carried out in the ESIA, to integrate it into the detailed preliminary design. The development project could therefore take account of an environmental objective right from the design phase (proposal 2), with no need for additional expertise.

(iii) Complement the hydrological study (proposal 3) with, on the one hand, an agro-climatic analysis on the scale of small region, which may include several sites (generally 2 or 3 agro-climatic regions for a programme of around 20 sites), involving 3 days of expertise per small agro-climatic region. On the other hand, for developments with micro-dams, draw up operating curves for the reservoirs and surface areas impacted, i.e. an additional 3 days of expertise per site.

(iv) Add a socio-land diagnosis to the socio-economic study (proposal 4). The need for additional expertise is estimated at 8 days per site given the extensive fieldwork involved. This time could be taken from the sociological expertise of the ESIA, which appears to be oversized at 20 days per site.

(v) Introduce an agronomic study with a view to sustainable development (proposal 5) right from the detailed preliminary design phase. The expertise requirements are estimated at 10 days per site, with two field missions. Here too, expertise resources could be transferred from the ESIA (natural resource management expert assigned 10 days per site) to the detailed preliminary design study. However, it would be advisable to go beyond 'natural resource management' to also take into account technical knowledge and production objectives, and therefore call on the services of an environmental agronomist or agro-ecologist.

(vi) The rural engineering design study can no longer be a simple 'structure option and its sizing', but should envisage an 'integrated' development project combining environmental and maintenance measurements and agronomic and land tenure focuses with the structures.

Figure 1: Current organisation of the detailed preliminary design studies and ESIAs for valley bottom development, PARIIS Burkina Faso and Mali

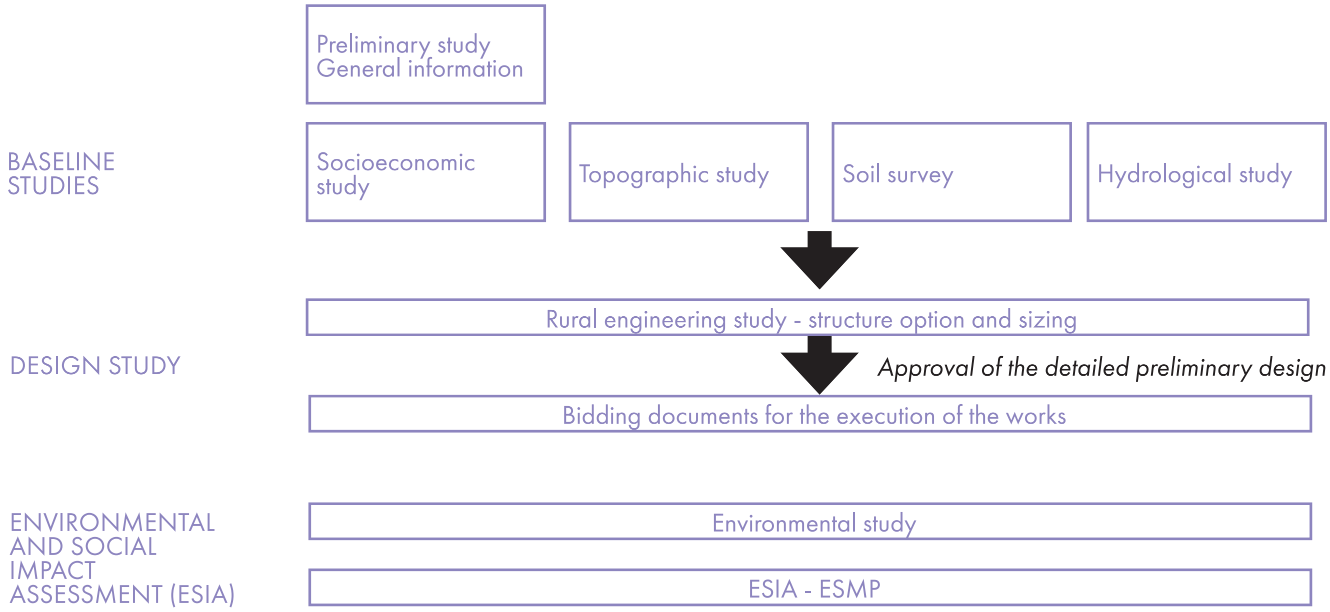
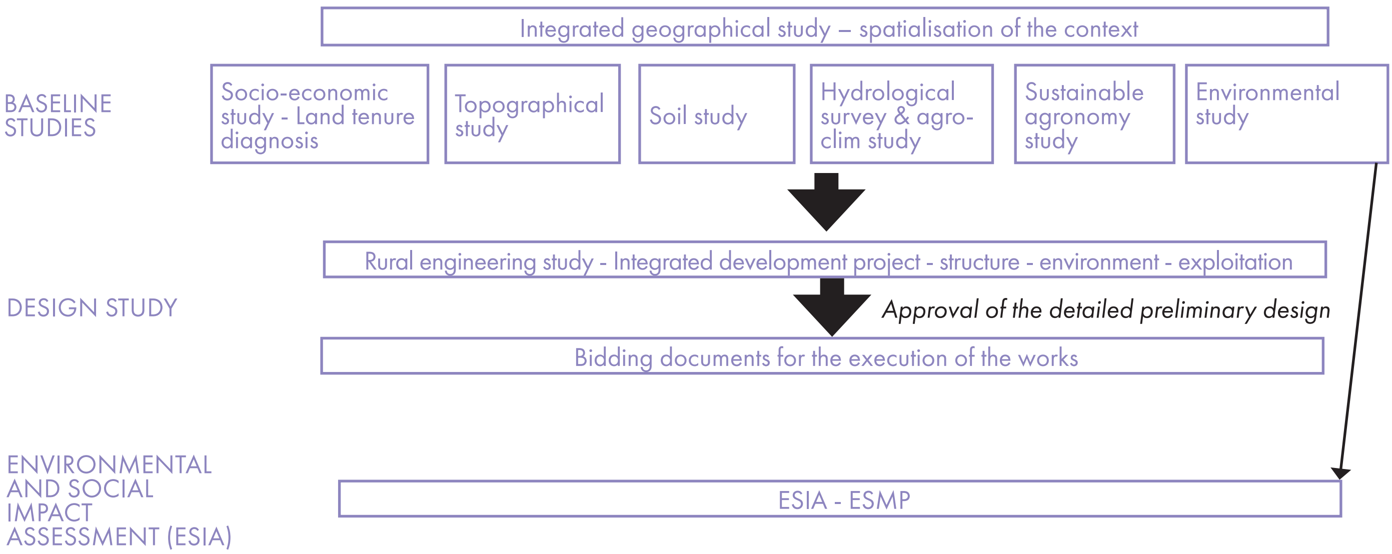


Figure 2: Revised organisation of the detailed preliminary design and ESIA, integrating the complementary studies



ANNEXES

PROGRAMME OF THE COSTEA / CILSS WORKSHOP: DISCUSSIONS ON THE RESULTS OF THE VALLEY BOTTOM STRUCTURING ACTION, OUAGADOUGOU, 14 AND 15 MARCH 2023

DAY 1: 14 March 2023

Introductory session

- Opening, F. Dabiré CILSS-PARIIS
- Presentation of the issues of valley bottoms for PARIIS, C. Ouedraogo CILSS
- Presentation of COSTEA and of the Valley Bottom SA S. Seck STP COSTEA
- Presentation of the intervention strategy of PARIIS Representatives of PARIIS
- Elements involved in the co-construction of a valley bottom irrigation solution: (i) planning aspects, land and water issues and management, responsibilities of the actors; (ii) technical aspects, innovations, sustainability, adaptation, good practices; (iii) financing aspects and economic viability; (iv) capacity building and knowledge management aspects.
- National contexts and project progress in the countries
  Burkina Faso, PMU Coordinator PARIIS Burkina Faso
  Mali, PMU Coordinator PARIIS Mali
  Niger, PMU Coordinator PARIIS Niger
- Presentation of the team of consultants and of the implementation of the study (thematic focuses, interdisciplinary approach, national and field mechanisms, timetable), J-L. Fusillier CIRAD, Valley Bottom SA Coordinator

Sequence 1: Presentation of case study results and methodological lessons learned

- Burkina Faso, Y. Yira HCS, M. Dama INERA, G. Serpantié IRD, M. Ouedraogo
- Mali, A.M. Kouyaté, B. Tangara IER
- Niger, L. Dambo, T. Hertzog INSUCO, Y. Nazoumou Univ. Niamey

Sequence 2: Review and discussion of the six methodological proposals for pre-development diagnosis to enhance project design studies

- Plenary, First series of introduction to methodologies

1. Providing a synthetic and integrated overview of the resources and uses of the valley bottom and their implications for development using mapping approaches. G. Serpantié IRD
2. Focusing the hydrological analysis on agronomy and the management of structures. Assessments to evaluate water risks for crops, the operation of the structures and their capacity to mitigate risks (agro-climatic analysis, operating curve of micro-dam reservoirs, drainage/contour bund retention functionalities). J. L. Fusillier CIRAD
3. Fostering the involvement and inclusion of the beneficiary populations throughout the development process. T. Hertzog INSUCO
4. Group work on the relevance of the proposals led by a tandem made up of an agronomist and sociologist, 2 reporters per group (1 COSTEA expert + 1 PARIIS).

- Plenary - second series of methodological presentations.

4. Rationalising the adaptation of cropping models for development, using an 'agronomy of practices' approach based on existing practices and know-how, and reasoning adaptations and transformations. G. Serpantié IRD .
5. Understanding land tenure issues through a socio-land diagnosis to anticipate post-development tensions and promote equitable access to valley bottom land. A. Adamscewski CIRAD
6. Integrating the environment from the pre-development study phase and making the environmental management plan operational. Assessment of provisioning, support, regulatory and cultural ecosystem services; prospects for greening productive development. Compensation procedures for lost ecosystem services. Serpantié IRD

- Group work on the proposals.

DAY 2: 15 March 2023 (morning)

Introductory session

- Presentation of the reporters of day 1.

Sequence 3: Feasibility of the methodological proposals plenary gathering

- Identification of the constraints of development projects that could hinder the implementation of the recommendations;
- Discussion on finding a compromise between the costs of the proposed complementary methods and the constraints associated with setting up and implementing projects;
- Feasibility of standardising methods at sub-regional level.

Concluding session - Review of the proposals for revising pre-development diagnostic methods.

SUMMARY OF THE AGRI-ENVIRONMENTAL STUDY PROCESS

Stage 1: Inventory of the resources (land, biological resources) and of their uses (each site)

This deepens the overview of the resources and uses of the valley bottom mapped in proposal 1 for a spatial approach to the context. The uses are the subject of 'agronomy of practices' type surveys, giving access to actual practices and their variations, underlying know-how and the plant materials used (agro-biodiversity).

Stage 2: Agri-environmental diagnosis (simplified version on each site and 'survey' version on a pilot site)

This diagnosis involves observations of developments and cultivated plots, soil analyses and field surveys of individual and family farmers. It should make it possible to carry out a diagnosis of the land, of the current plant material and of the crops, and a simplified agro-economic assessment per plot or per farm/household.

In order to integrate this theme with the other components of the study - environment, socio-eco, hydro (detailed preliminary design), we also propose that the agronomist participate with his/her other colleagues in interface thematics: mapping of uses and resources, agro-climatology, agricultural use of water, agro-economics, environmental issues affecting agriculture (maintaining multifunctionality, fertility management, erosion control, maintaining agro-biodiversity, management or restoration of relict biodiversity).

It is also at this stage that the local agronomic, environmental, economic and land tenure expectations of each group (farmers, women, young people, leaders and the municipality, etc.) and the opinions of the technical services involved in the development (technical support zones in Burkina Faso, NGOs, etc.) are gathered, with a view to the co-construction of a development project based on both the diagnoses and the expectations.

Stage 3: Once the development strategy has been adopted, co-construction of the sustainable development project, consisting of three options:

- maintain practices, adapted plant materials and environmental assets (trees, ponds, etc.), bearing in mind that small-scale farming in Africa is already based on certain agroecological principles (diversity, recycling, adapted varieties, agro-ecosystems rich in biological interactions, including agri-livestock relations, tree parks, etc.);
- adaptive transformations in relation with the development project and local expectations, with a view to achieving economically attractive and sustainable results.
- breakthrough models depending on the opportunities in the area (market, available support) or local strategies to propose more ambitious models in terms of taking account of the environment and social diversity (e.g. women's community organic food gardens, pesticide-free rice value chains, etc.).