

#5- 2023 POLICY BRIEFS

Project: (Developing and Managing) Irrigated Floodplains

Territorial approaches to rethink irrigated agriculture in large floodplains

Large floodplains, whether they are coastal or continental, have undergone major hydro-agricultural developments since the beginning of the 20th century to protect them from flooding and develop intensive irrigated agriculture. Despite these developments, they are nonetheless prone to and subject to flooding - at least partially and during major events. These large plains catalyse a wide range of socio-economic (population density, urbanised areas, etc.) and environmental (wetlands and rich biodiversity) issues, and are undergoing profound changes due to the combined effects of development upstream of the catchment areas and the acceleration of climate change.



ISSUES AT STAKE AND OBJECTIVES OF THE ACTION

For a long time hostile, the large floodplains, particularly the coastal and deltaic plains, have been the subject of colossal efforts since the 19th century to rehabilitate them, to limit the extent and impact of the flooding to which they are prone, to increase the availability of water resources during the dry seasons, and thus to intensify farming practices on land whose fertility was constantly renewed by the silt deposited there. These regions are now among the most densely populated on the planet, and are of major economic importance.

These development projects, based on the notion of 'control', have resulted in the construction of what is referred to as 'grey' infrastructure (the colour of concrete): ever higher dykes and ever more imposing networks of irrigation, drainage and sanitation canals, as illustrated by the Vietnam delta. As a result, irrigated floodplains are now among the most productive regions in the world (rice growing, aquaculture), but these development projects are also coming under growing criticism, as the infrastructures for controlling the water resources (and the associated risks) call for ever more infrastructures to face events with increasingly extreme and unpredictable consequences - a phenomenon known as 'infrastructure lock-in'.

The choice of agricultural intensification - through the control of water resources - has been accompanied by the growing vulnerability of these areas to hazards; it is now being called into question with a view to the need for resilience and adaptation to the effects of climate change. This is leading to a rethink of the ways in which large floodplains are developed and managed by putting their multifunctionality back at the heart of the approach.

KEY MESSAGES

- 1/ Large irrigated floodplains are subject to multiple risks and offer many functionalities: their development, and the irrigated agriculture that depends on it, should be considered from the perspective of shared control of water with a view to diversifying uses and distributing benefits rather than optimising the 'land' resource.
- 2/ The agricultural intensification of large irrigated floodplains raises environmental and health issues and tends to 'transfer' rather than limit risks: putting the ecosystem services of these plains back at the heart of development programmes can help populations to become more resilient, but remains a challenge.
- 3/ Participatory territorial consultation processes are needed to renew approaches to the development and governance of large irrigated floodplains.
- 4/ The socio-environmental dynamics of large irrigated floodplains are complex: to understand them, it is necessary to set up long-term decentralised observatories combining participatory monitoring, a network of in-situ measurements and remote sensing.

This is in line with the notion of a 'nature-based solution' and the principles of ecological engineering, which would be the key not only to environmental sustainability but also to fair and frugal development, that is respectful of planetary limits and their territorial and local variations. For COSTEA, this means thinking about the development of irrigated agriculture on the basis of the partial control of water resources, planned on a territorial scale and which is compatible with other uses of common resources dependent on the good functioning of fragile ecosystems facing multiple pressures.

PRESENTATION OF THE METHODOLOGY AND CONTEXTUAL ELEMENTS

COSTEA's 'floodplains' project was launched in December 2019 for a period of three years and was implemented in three countries, Cambodia, Ecuador and Morocco, by consortia involving research institutes, higher education bodies and non-governmental organisations (NGOs). The study areas selected combine what are referred to as 'developed' areas, i.e. with water control infrastructures for drainage and crop irrigation, and areas, often lower and wetter, where practices are generally less intensive and more diverse. COSTEA's activities were based on the past work of these consortia in each of these regions and benefited from the active partnerships they had forged with certain actors in these territories. In the three study areas, the projects had three components: (1) analysis of hydrological dynamics; (2) analysis of the multiple uses and services of large floodplains, with particular attention to the issue of trade-offs between intensification and vulnerability; and (3) multi-actor consultation processes. The studies were carried out:

- **in Cambodia**, in the upper Mekong delta, by a consortium comprising the Institut de Recherche pour le Développement (IRD, the French National Research Institute for Sustainable Development), the Royal University of Agriculture (URA), the Institut de Technologie du Cambodge (ITC, Institute of Technology of Cambodia) and the Irrigation Service Center (ISC). The project was carried out in the province of Kandal, where numerous canals known as preks form a complex meshed hydrographic network and are the subject of rehabilitation projects for the sustainable agricultural intensification of the floodplain.
- **in Ecuador**, in the floodplain of the river Daule, by a consortium comprising Agronomes et Vétérinaires Sans Frontières (AVSF, Agronomists and Veterinarians Without Borders) and the Escuela Superior Politécnica del Litoral (ESPOL, a university in Ecuador). The project was carried out in various cantons located in the catchment area, and in particular, in the floodplain of the river Daule, where irrigation and drainage systems and the exploitation of groundwater enable the development of rice-growing, which is intensive in terms of inputs, but not very profitable and highly vulnerable to flooding, which also

threatens the downstream city of Guayaquil and its water and sanitation services.

- **in Morocco**, in the Gharb floodplain, by a consortium comprising CIRAD and the Institut Agronomique et Vétérinaire Hassan II (IAV, Hassan II Agronomic and Veterinary Institute). The project was carried out in the area covered by the Office Régional de Mise en Valeur du Gharb (ORMVAG, Regional Agency for the Development of the Gharb), which includes both developed areas (with irrigation and drainage networks) and undeveloped areas (locally known as merjas) - the latter having received renewed attention over the past decade for their dual potential as agricultural land and as 'buffers' against flooding, which is particularly damaging for the town of Kenitra downstream from the plain.

RESULTS OF THE STUDY, KEY MESSAGES AND LIMITS OF THE APPROACH

The activities carried out as part of the structuring action on floodplains contribute to the debate on how to reduce the risks faced by irrigated farming and thus increase its resilience and environmental sustainability on a territorial scale.

- 1/ **Large irrigated floodplains are subject to multiple risks and offer many functionalities: their development, and the irrigated agriculture that depends on it, should be considered from the perspective of the shared control of water with a view to diversifying uses and distributing benefits rather than optimising the 'land' resource.** One of the specific features of large floodplains is that they are subject to multiple and joint hazards that are increasingly difficult to predict. Water control infrastructures (whether in the floodplains themselves or upstream of them) are built to minimise the risks of flooding and drought to which these regions are subject. While a risk mitigation and adaptation strategy cannot be called into question as such, development programmes still often make 'zero risk' an objective, even though it has become clear that this does not exist. It is necessary to acknowledge the inevitability of risks and design developments accordingly, from a multifunctional perspective, which leads to a rethink of the agricultural models sought. The COSTEA studies confirm that the construction of infrastructure to control water resources in large floodplains is accompanied by agricultural intensification and specialisation, including in the lowest-lying areas, which provide numerous ecosystem services such as flood control, the recharging of aquifers and the regulation of saline intrusions in the case of coastal plains. Of the three case studies, this intensification is most marked in the Gharb plain, where there is a public organisation dedicated to managing the area's hydro-agricultural developments. However, this intensification of the large floodplains has also led to a process of farm differentiation.

On the one hand, there are relatively large agricultural entrepreneurs (several dozen hectares) generating significant income, and on the other, small-scale farmers owning limited areas of land if they have not already become sharecroppers on land they have been forced to sell due to very high indebtedness. This differentiation can be explained in particular by the specialisation of the agricultural systems and areas, which makes them more vulnerable to external shocks, whether climatic (drought, floods), agricultural (disease) or economic (price fluctuations). This specialisation of areas and the resulting vulnerabilities are linked to the fact that total water control infrastructures tend to make land a 'fixed' resource whose uses need to be optimised, whereas the large floodplains are characterised by resources whose very nature changes. The same place can be 'land' or 'water' or 'forest' from one season to the next and from one year to the next, and can therefore be used in different ways. This changing nature of the large floodplains and the low-lying areas scattered across them (esteros, merjas, boeuings) is an obstacle to any control strategy (all the more so in a context of climate change); on the contrary, it is an asset from a resilience perspective (because different resources are not affected in the same way by different hazards). Thus, more basic investments in 'ecological engineering' aimed at the shared control of water and encouraging multiple modes of access and use (fishing, livestock farming, transport), could lead to a fairer distribution of benefits (as different social groups tend to use different resources) while at the same time ensuring resilience to crises. The aim here is to make the irrigated areas of the large irrigated floodplains tolerant to floods that will remain unavoidable - including by experimenting with agro-ecological technical itineraries.

2/ The agricultural intensification of large irrigated floodplains raises environmental and health issues and tends to 'transfer' rather than limit risks: putting the ecosystem services of these plains back at the heart of development programmes can help populations to become more resilient, but remains a challenge. The agricultural intensification made possible by the construction of water control infrastructures in the large floodplains is now leading to major environmental degradation. This is due in particular to the extremely intensive use of phytosanitary products, which accumulate in the environment and also raise public health issues. The 'natural capital' on which agricultural production depends is deteriorating, and it is important to reverse this trend. COSTEA has highlighted the existence of areas with more basic developments that are regularly flooded within the large irrigated floodplains: boeuings in Cambodia, esteros in Ecuador, and merjas in Morocco. These areas are cultivated for part of the year when the floods recede, often for input-intensive rice farming. They are also used as grazing land for livestock (merjas), capture fishing grounds when they are flooded (boeung, esteros), and for more diffuse uses (hunting, collection of natural vegetation, etc.). As a result of the multiplicity of resources and uses, these areas can be subject to tensions and conflicts over how they are accessed and developed, with a tendency

towards forms of land concentration and exclusion that are very real but not very visible. In addition, the local people recognise that these areas play a role in absorbing floods, which has yet to be assessed in detail (especially when towns are located downstream), and they emphasise that their biodiversity is higher than in areas that have undergone more extensive hydro-agricultural development. However, the 'ecological value' of these areas and the attachment of local populations to them have declined sharply in recent decades. This may partly explain why the vast majority of actors (including farmers) still always see them in terms of their potential for agricultural intensification, even though the intensification of floodplains may prove to be of limited profitability and a source of increased vulnerability for households as a result of massive recourse to credit, which generates debt. For COSTEA, putting the multifunctionality of these areas on the agenda and restoring it with a view to forecasting and managing risks, is an alternative to the current development trajectories which result in a concentration of short-term benefits for a minority of actors and increased vulnerability for the majority in the long term, including in downstream urban areas. However, there is a need for a more detailed analysis of the benefits that such an approach could generate and the ways in which it could be implemented, including with actors outside the agricultural world, in a context where pressure on water resources is constantly increasing. In practice, the scarcity of resources is often the result of a political and social desire to use and develop them in the short term, in this case by intensifying irrigated agricultural production, but as mentioned above, this can have many negative repercussions in the medium and long term. This awareness, which in some situations is difficult to accept, is nonetheless a necessity in the global context of environmental vulnerability, and requires a search for alternative solutions and support measures for those most affected. In Europe, for example, there are mechanisms whereby farmers are paid from public funds to maintain some of their plots of land in a natural state for all or part of the year in the public and environmental interest. Other awareness-raising, incentive and support mechanisms that are better adapted to local contexts still need to be devised and implemented.

3/ Participatory territorial consultation processes are needed to renew approaches to the development and governance of large irrigated floodplains. The COSTEA studies show that the large floodplains form heterogeneous 'mosaic landscapes' whose management is complex due to: (1) the multiplicity of actors involved and the diversity of their respective agendas and interests, but also (2) the lack of knowledge and the uncertainties that persist concerning the current socio-environmental dynamics of these mosaics and the impacts that various interventions could have on them. In such a context of uncertainty, multi-scale territorial consultation processes can help to bring out a wide range of knowledge, while at the same time bringing to light the diversity of viewpoints and roles that different actors may assign to the different entities that make up these mosaics.



This is a prerequisite for the concerted identification of development trajectories, whose consequences on various social groups can then be made explicit. Implementing such participatory processes also requires a detailed understanding of institutional and political networks and issues as well as of decision-making processes. Translating debates into action requires the implementation of multiple engagement strategies over the long term to set up 'advocacy coalitions' joining multiple actors, while being vigilant as to opening 'windows of opportunity' such as the formulation of new development projects or the elaboration of new policy frameworks. By way of example, in Cambodia, and within the framework of COSTEA, such a strategy has led to the rehabilitation of preks no longer being considered independently of each other, as could be the case in the past, but in an 'integrated' manner, taking into account not only hydrological factors, but also economic and social factors such as the dynamics of access to and the development of agricultural land. In Ecuador, the concerted construction of a shared vision of the risk of flooding and its differentiated causes and effects, has led stakeholders not linked to the agricultural world, such as the Guayaquil town council or the drinking water supply and sanitation company, to take an interest in the development of the catchment area and the use of agricultural land in the floodplain and beyond.

4/ The socio-environmental dynamics of large irrigated floodplains are complex: to understand them, it is necessary to set up long-term decentralised observatories combining participatory monitoring, a network of in-situ measurements and remote sensing. Determining the hydrographic limits of large floodplains remains a difficult exercise in itself, as these regions are characterised by complex networks made up of natural watercourses, earthen or concrete channels, water spreading and storage areas, and various aquitards and aquifers, all of which are in constant interaction. The directions of water flows can also vary from one season to the next, and even within the same day, as they depend on very sensitive level balances in regions with little relief that are sensitive to tides. Conventional models (such as HEC-RAS, Modflow, etc.), which require large amounts of data, have their limitations

and their results remain highly uncertain. To understand the hydrological dynamics of large floodplains, it is necessary to combine (hydrological) modelling with tools derived from remote sensing (satellite image analysis), but above all, in-situ hydrographic and sedimentary measurements, which remain essential in terms of calibration. Isotopic and hydro-chemical marking techniques can also be used to understand the dynamics of exchanges between groundwater and surface water, which play a crucial role in the functioning of ecosystems on large floodplains. While many governments continue to envisage the construction of water control infrastructure to develop large floodplains, the lack of data makes it impossible to analyse the relevance and potential impact of such projects. However, setting up networks of hydrographic (or more generally biophysical) measurements, while essential, is not sufficient. The complexity of large floodplains and the large number of actors involved means that such networks should be devised in the framework of decentralised participatory observatories in which national research and higher education institutes, governmental and non-governmental agencies and citizens all have a role to play. Such observatories could then contribute to inclusive territorial governance processes.

Limits of the approach

Understanding the hydrological dynamics of the study areas is essentially based on remote sensing approaches due to the limited availability of in-situ data and the complexity of the networks to be represented and modelled (which it has been possible to do on pilot areas of several km²). While COSTEA's work has highlighted the multiple environmental services provided by large floodplains, this qualitative understanding still needs to be supplemented by ecological studies to better characterise the trade-offs between agriculture and the environment. Lastly, territorial consultation activities are built up over a long period of time and could only be initiated in the context of COSTEA - they therefore call for continuation.

COSTEA OUTPUTS IN RELATION WITH THE STUDY

- Understanding the cambodian upper Mekong delta: towards new approaches for floodplain governance (www.comite-costea.fr/actions/zones-inondables)
- Les enjeux de la plaine inondable du sous-bassin versant de la rivière Daule [Issues of the floodplain of the sub-catchment area of the river Daule, in French] (www.comite-costea.fr/actions/zones-inondables)
- Les enjeux de la plaine inondable du Gharb au Maroc [Issues of the floodplain of the Gharb in Morocco, in French] (www.comite-costea.fr/actions/zones-inondables)
- Documentary database (www.comite-costea.fr/base-documentaire-eau-et-agriculture)