COSTEA
ENSEMBLE POUR RELEVER LES DÉFIS DE L'AGRICULTURE IRRIGUÉE

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# POLICY BRIEFS

## Structuring Action: Agroecological Transition of Irrigated Systems

# How can we move towards agroecological irrigated agriculture? Placing it on the political agenda to kick-start the transition

Until now, irrigated agriculture has mainly been developed on the basis of conventional intensification methods following the principles of the Green Revolution. Agroecology is a promising approach to tackle climate change and limit the impact of irrigated agriculture on the environment, while at the same time meeting countries' needs for food security and sovereignty.

## KEY MESSAGES

1/ Agroecology is a holistic and systemic approach that can only be developed if governments pursue proactive policies;

2/ Agroecological practices, mainly individual, are to be found in irrigated systems, but they are limited and do not form a system;

3/ The socio-economic and agro-environmental performances related to most of the agroecological practices observed in the irrigated systems are encouraging;

4/ Agricultural water and infrastructure management should be a lever for agroecological transition;

5/ Research and development should be continued and stepped up to further demonstrate that agroecology can enable irrigated agriculture to meet the challenges of climate change and food security.

## ISSUES AT STAKE AND OBJECTIVES OF THE ACTION

In view of the stakes of food and nutritional security, climate challenges, biodiversity protection and the fight against land degradation, agroecology is now high on the international agenda as a way to promote sustainable agricultural systems. However, questions remain as to the feasibility, efficiency and effectiveness of this form of agriculture to meet the challenges of food security.

In the spirit of the Green Revolution, irrigation has led to the intensification and specialisation of many crop and mixed crop-livestock systems, sometimes including the transition to several annual crop cycles thanks to the reduced risks associated with better water management. This intensification has often gone together with crop specialisation and the increased use of external inputs (mineral fertilisers, synthetic pesticides, selected commercial seeds) to increase yields and productivity. This objective of profitability has also been linked with that of making a return on the significant investments made in water infrastructure, particularly in large schemes combining dams, collective water distribution networks and management services.

However, although irrigation combined with agricultural intensification based on external inputs has led to remarkable gains in yields, this model is now showing its limitations at the level of farms, territories and small regions. In rice-growing systems, for example, diseases and parasitic attacks are on the increase while yields are stagnating; in market gardening systems in urban and peri-urban areas, the high level of exposure of farming and urban populations to pesticide contamination of water and food is creating obvious public health risks. Finally, the challenges of climate change and limiting greenhouse gas emissions (in particular CH4 and N20), are calling into question

the intensification schemes that have been proposed in the past. Irrigated farming contributes over 40% of the world's agricultural production on less than 20% of its agricultural land. An agroecological transition appears necessary, but convincing people that this transition will not jeopardise food security in the short, medium and long term remains difficult. It is also essential to demonstrate that water, in the face of increasingly recurrent droughts, is a real lever for agroecology and not exclusively a production factor (in the same way as external synthetic inputs) at the sole service of input-intensive irrigated agriculture that is disconnected from environmental and sustainability concerns. In this sense, the dichotomy between irrigated and rain-fed agriculture needs to be questioned at the relevant territorial levels, so that water, considered as a common good, can contribute as much to the greening of today's irrigated agriculture as to the rain-fed agriculture that will undoubtedly require supplemental irrigation in the future.

However, the references available in the field of agroecology and irrigation are still limited, partial or too dispersed (in space and between stakeholders), for different types of irrigated systems and farming, whether in terms of feedback, tested and/or validated practices, or the qualification and quantification of their effects and impacts. This is particularly true of large irrigated schemes, where questions are being asked about the introduction of diversification crops and the role of trees and livestock. Livestock has often been relegated to the outskirts of irrigation zones, with the result that organic matter of animal origin is not widely available or used. Furthermore, the extreme specialisation of certain irrigated systems linked to the existence of a highly structured value chain for a pivotal crop (e.g. rice), can block the rethink of the socio-technical system needed for an agroecological transition, which requires other species and other types of development via new value chains. Nevertheless, agroecological practices do already exist, based on traditional knowledge and sometimes hybridised with innovations (for example, fertigation using compost in drip systems). This is a 'silent agroecology' that is rarely identified or known about, and therefore even less qualified, validated, shared or enriched in conjunction with agricultural and territorial research and development actors.

To meet these challenges, the COSTEA action undertook to take stock of the situation and of evolutions in the greening of irrigated agriculture in different contexts in Algeria, Cambodia and Senegal.

The specific objectives were to:
- identify innovative agroecological practices by capitalising on feedback from farmers in irrigated systems;
- qualify their socio-economic and agri-environmental performance;
- identify constraints and conditions for the development of agroecological transitions;
- network national and regional actors and COSTEA members to strengthen multi-actor dialogue on this subject.

## PRESENTATION OF THE METHODOLOGY AND CONTEXTUAL ELEMENTS

To carry out this work, COSTEA commissioned a group of French organisations coordinated by AVSF (GRET, CARI, CIRAD) and their partners (ENDA Pronat, ISRA, University of Battambang, APEB, TORBA and CREAD).

This structuring action involved three countries with two study areas per country - one area with large-scale hydraulics and one with smaller systems, with the assumption that there would be greater flexibility of action towards transition in the smaller systems.

In Algeria, the study areas focused on the large scheme of the Mitidja and the oasis zone of Mzab; in Senegal, on the Guédé scheme in the SAED intervention zone and on the Mboro scheme with small market gardening schemes in the peri-urban zone of Senegal; in Cambodia, on the large rice-growing scheme of Kanghot with partial to total water control and on the rice-growing scheme of Veal Krorpeu with partial water control. These three areas have their own specificities in terms of the types of irrigated farming systems, the challenges associated with water resources, and specific questions in terms of agroecological practices and innovations.

The methodological approach used to carry out the six field studies was based on the integration and adaptation of various tools:
- **the Handbook for the Evaluation of Agroecology**, based on the global approach of the diagnostic study of agrarian systems in order to answer questions relating to agroecology. It proposes a series of indicators to measure the socioeconomic and agri-environmental effects of these practices and systems, and identifies obstacles and levers for their development.

- **the nexus analysis matrix**, a multi-scale and multi-dimensional framework used to understand irrigated systems in all their complexity and to highlight their main issues. It was filled in during the first stages of the diagnosis of the study areas. The issues identified made it possible to formulate evaluation questions that facilitated the selection of socioeconomic and agri-environmental evaluation indicators;

- **the matrix for inventorying and characterising agroecological practices**, which helps guide the choice of priority agroecological practices and systems to be studied in the following phase of evaluating and measuring the performance of agroecological systems;

- **the agroecology matrix**, which consists of estimating the extent to which a farm meets agroecological principles. To carry out this evaluation, the method calculates an 'agro-eco-score' based on these different principles. This matrix was used in the phase to characterise and compare the typology of the farms.

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Local consultation workshops were organised in each of the territories studied in order to share and debate: (i) the results of the territorial diagnosis and of the inventory of agroecological practices, then (ii) the results of the socioeconomic evaluations and the initially identified conditions for the development of agroecology in the irrigated schemes. The results and recommendations were then presented in national consultation workshops.

This brief shares a number of elements of the situational overview in relation to aspects of the management of irrigation and agrarian systems:

**The study revealed a significant difference in the diversity and combination of agroecological practices identified in systems with individual irrigation** (examples of the Mboro area in Senegal and the Mzab Valley in Algeria) **compared to the large-scale collective hydraulic systems** (examples of the west Mitidja in Algeria, the Kanghot area in Cambodia and the Guédé area in Senegal). This can be explained by the greater room for manoeuvre available to individual irrigation farmers in terms of access to water (wells, individual boreholes, sometimes collective boreholes), its use and the possibilities for diversifying production. However, there are other limitations that may justify the lack of diversification within the schemes studied.

Indeed, farmers who cultivate in large and medium-scale collective irrigation systems are often limited by:

- access to water that is coordinated by the group (EIG[1] in Senegal, FWUC[2] in Cambodia) or directed by the manager of the irrigation system (such as the strategic citrus, cereal and potato value chains prioritised by the ONID in west Mitidja in Algeria);
- the specialisation and intensification of these schemes. This has led to the homogenisation of cropping schedules and technical itineraries between water users in the plots in order to make costly developments profitable (e.g. rice and tomato production in the Guédé plots situated in the zone of intervention of the SAED). They are sometimes also the response to a political or market orientation or a cultural attachment to a crop (for example, the obligation in Cambodia to grow rice on a low-lying plot when it is irrigated, as a farmer who wanted to grow another crop would risk losing access to this plot). They can also result from the need to manage the collective organisation of tillage in the plots.
- problems of soil hydromorphism in some of these large schemes and relatively high upper water table rises, which in themselves limit the possibilities of diversifying production.
- difficulties in supplying organic matter due to the specialisation of large irrigated areas. These difficulties create a gap between plant and animal production that does not facilitate the reintegration of livestock farming, which is fundamental to gradually move away from these irrigated farms' dependence on chemical inputs. Experiments with the introduction of ducks and fish in rice fields in Cambodia, for example, have proven beneficial from an economic and environmental point of view.

These observations concerning the obstacles encountered by farmers in all the irrigated areas studied must also be linked to other factors, both internal and external to the farms, which were highlighted during the agrarian diagnoses and the evaluations of the conditions for the development of agroecological transition. However, some of the constraints, although identified in the irrigated farming territories of the COSTEA study, also concern agroecological development in rain-fed areas. Nevertheless, these constraints are reinforced by the structuring of the space and the developments specific to irrigated systems. They concern in particular:

- constraints at farm level (technical know-how, capital to invest, land constraints, availability of organic matter, working time);
- political, institutional and value chain constraints (absence of public policies; absence of markets; poor organisation/structuring of producers; still insufficient research results on the performance of agroecology in irrigated systems; infrastructural barriers related to traditional hydro-agricultural development models);
- environmental constraints (reduced water availability due to overexploitation of groundwater; soils with low water retention; soil impoverishment and pollution of groundwater and watercourses);
- organisational constraints (start-up of crops and irrigation of plots centralised at the level of the heads of unions of farmers' groups; weight of individual interests to the detriment of the collective and difficulty in agreeing on a transition model at the scale of the hydro-agricultural unit; social obstacles hindering any initiative to divide up plots and/or allocate them definitively).

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

The analyses resulting from the agroecological transition action have enabled COSTEA to formulate a number of messages and recommendations. Their general aim is to strengthen the environmental sustainability of irrigated agriculture and to support change through technical and institutional innovation. This action also contributes to providing elements linked to the economic and social development of irrigated territories

1. Economic Interest Group.
2. Farmer Water User Communities.

through the analysis of existing agroecological practices. Finally, by considering agroecological transition in irrigated areas, it suggests way of increasing the resilience of farmers and hydro-agricultural developments in the face of climatic and market risks.

**1/ Agroecology is a holistic and systemic approach that can only be developed if governments pursue proactive policies.** While the notion of agroecology is becoming increasingly widespread, with the aim of reconciling agriculture and the environment, multiple dimensions need to be considered and qualified in order to promote it. First of all, we need to recognise the reality of agroecological practices that are often silent and carried out by family farmers, particularly women, and to encourage them, even if they are sometimes limited in relation to all of the dimensions of agroecology. Indeed, if it is to have a truly transformative purpose, the development of agroecology must take place at several levels, ranging from the management of individual plots of land (or herds), to the holistic and systemic management of cultivated land, from small regions and their landscapes right through to the overall reorganisation of trade flows of agricultural and livestock products. However, in all the situations studied in this structuring action, there was a near total absence of tools to support and raise awareness of agroecological transition. This translates into an overall lack of technical knowledge in the field of agroecology and the various constraints to be overcome, but also in a lack of downstream promotion policy for agroecological farming products. These include: difficulties in accessing appropriate credit to equip farmers with water-saving irrigation systems; low availability of organic matter due to the absence of livestock farming in irrigated schemes; land that is often too small to take the risks involved in the transition; an available workforce that is often insufficient to meet the increased labour requirements associated with agroecological transition; and prices that offer little incentive to promote agroecological products. To succeed in getting governments to develop these policies, it will be necessary to demonstrate that agroecology can perform as well as conventional agriculture, particularly irrigated agriculture, which is still considered to be one of the pillars of the Green Revolution for the food security of many countries.

**2/ Agroecological practices, mainly individual, are to be found in irrigated systems, but they are limited and do not form a system. An inventory of practices was carried out in the six study areas of this structuring action.** A number of agroecological practices were observed, such as crop rotation, the integration of agriculture and livestock farming, the incorporation of manure into the soil for organic fertilisation, the implementation of water and soil conservation techniques, and some agroforestry practices. These practices are generally isolated at the individual, plot or farm level. The few signs of ecological services on the scale of an irrigated scheme are generally linked to deficient maintenance of the network, such as the grassing of canals or the presence of trees in the drainage networks. No practices were observed on a territorial scale. In short, the practices observed do not form a system. However, there is a notable difference between individual and collective irrigation systems. The number and diversity of agroecological practices identified in individual irrigation systems are far higher than in the large-scale collective irrigation systems, which are most often specialised and geared towards single crop farming. While around 20 different practices per site were identified in small and medium-scale hydraulic systems, only 10 or so practices per site were observed in large-scale hydraulic systems. In several situations, improved water-saving irrigation practices were observed, helping to improve the efficiency of water use.

**3/ The socio-economic and agro-environmental performances related to most of the agroecological practices observed in the irrigated systems are encouraging.** From a socio-economic point of view, farms that combine agroecological practices can achieve higher yields, lower input costs and greater resilience to annual climatic risks such as drought. The diversification of production, within or outside irrigated plots, can also play a key role in securing agricultural incomes for farming families. Finally, chemical inputs account for a large share of intermediate consumption in the cropping systems, making it all the more economically worthwhile to replace them with organic fertilisers made from local resources (in the case of rice cultivation in Kanghot, Cambodia, for example, mineral fertilisers account for 30% of production costs). From an agro-environmental point of view, fewer infestations are observed in agroecological cropping systems, and the soils respond rapidly to agroecological practices in terms of biological activity. For example, in the Kanghot area of Cambodia, a comparison between plots cultivated using green manure with direct sowing and ploughed plots showed a significant improvement in soil health from the very first years of cultivation, with a higher water retention and infiltration capacity.

**4/ Agricultural water and infrastructure management should be a lever for agroecological transition, and not an obstacle. Indeed, the current lack of initiatives in terms of agroecological practices in collective irrigation schemes can be partly explained by the lack of flexibility in terms of water management in these systems due to their design, especially when they are gravity-based.** This is a form of infrastructural blockage that would require a review of the design and management rules to allow greater autonomy for farmers in introducing more individualised and diversified crops and technical itineraries. This conceptual shift calls for a move beyond the technical and productivist approaches of rural engineering to develop genuine ecological engineering. On the other hand, efforts are being made to save irrigation water resources and increase their efficiency, in particular with the development of the drip irrigation technique observed in various study areas of the structuring action. However, experience from other studies has shown that this technique may not be mastered and that, since its use facilitates irrigation, it may lead to an increase in the irrigated area and pressure on water resources, particularly groundwater. Its adoption is therefore not necessarily synonymous with agroecological practice.

**5/ Research and development should be continued and stepped up to demonstrate that agroecology can enable irrigated agriculture to meet the challenges of climate change and food security.** The fact that irrigation is a strategy for adapting to climate change has, until now, mainly been considered from the perspective of controlling water resources by storing them and distributing them during periods of drought. The resulting model of irrigated agriculture, derived from the principles of the Green Revolution and based on specialisation and intensification, is now a source of new vulnerabilities. These vulnerabilities are mainly linked to the depletion of water resources as a result of increasingly severe droughts and ever more intensive use, long-term soil depletion, market fluctuations and farmers' indebtedness. Which agroecological models and which transition trajectory should be promoted in irrigated systems to develop sufficiently resilient and productive irrigated agriculture, including with less water inputs? In return, what gains can we expect in terms of greenhouse gas reductions, and what methods should be used to assess these gains, taking into account the water dimension (carbon impacts of developments, energy consumed in transporting and pumping water, emissions linked to certain irrigated crops such as rice, etc.)? The expected effects of agroecology in relation to the climate challenge in terms of adaptation and mitigation need to be more clearly set out, as do the other forms of pollution generated by agriculture, such as the over-exploitation and pollution of water resources, particularly groundwater, reduced fertility and pollution in various irrigated situations.

### Limits of the approach

The methodology used to carry out the studies nevertheless had a number of limits.

Despite the relevance of the methodology used, it was highly complex due to the multiple steps to be carried out in a short time: agrarian diagnosis, nexus matrix, inventory of practices, socioeconomic analysis, agri-environmental analysis, analysis of development conditions.

The teams also encountered difficulties in identifying agroecological practices given the few initiatives in the study areas and, in particular, in detecting those that are discrete. Furthermore, the teams lacked knowledge and hindsight to determine or estimate the degree of application/adoption of each identified practice at the scale of the zones.

The analysis of the economic and environmental performances of agro-environmental practices was carried out on the scale of cropping systems and not on larger scales (irrigated system or territory) due to the very nature and small number of practices identified.

Measuring the impact of agri-environmental practices needs to be a long-term process, which was not possible within the framework of this structuring action. The results obtained in this area are therefore incomplete and need to be combined with more permanent observation systems to be developed in the various irrigated farming contexts, with substantial observation, monitoring and analysis resources.

## COSTEA OUTPUTS IN RELATION WITH THE STUDY

- An inception report (www.comite-costea.fr/actions/agroecologie)
- Presentation of the sites in Cambodia (www.comite-costea.fr/wp-content/uploads/Presentation-Cambodge.pdf)
- Presentation of the Algeria Mitidja site (www.comite-costea.fr/wp-content/uploads/Presentation-Mitidja_Algerie.pdf)
- Presentation of the Algeria Mzab site (www.comite-costea.fr/wp-content/uploads/Presentation-Mzab_Algerie.pdf)
- Presentation of the Senegal sites (www.comite-costea.fr/wp-content/uploads/Presentation.SENEGAL.pdf)
- A report inventorying practices in Algeria (Mitidja) (www.comite-costea.fr/wp-content/uploads/L1a_Inventaire_PratiquesAE_NTissa_ALGERIE-vf.pdf)
- A report inventorying practices in Algeria (N'Tissa) (www.comite-costea.fr/wp-content/uploads/L1b_Inventaire_PratiquesAE_Mitidja_ALGERIE-vf-.pdf)
- A report inventorying practices in Cambodia (www.comite-costea.fr/wp-content/uploads/L1c_Inventaire_PratiquesAE_CAMBODGE-vf.pdf)
- A report inventorying practices in Senegal (Mboro) (www.comite-costea.fr/wp-content/uploads/L1d_Inventaire_PratiquesAE_Mboro_SENEGAL-vf.pdf)
- A report inventorying practices in Senegal (Guédé) (www.comite-costea.fr/wp-content/uploads/L1e_Inventaire_PratiquesAE_Guede_SENEGAL_vf.pdf)
- A report inventorying and characterising agroecological practices in irrigated systems (www.comite-costea.fr/wp-content/uploads/Grille-dinventaire-des-pratiques-AE_Costea_VF.pdf)
- A synthesis of agroecological inventories and practises (www.comite-costea.fr/wp-content/uploads/L1_Synthese_Inventaires_PratiquesAE-vf.pdf)
- A documentary database (www.comite-costea.fr/base-documentaire-eau-et-agriculture)