Good Wetland Agricultural Practices

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1 Introduction

Within the Guiding Agriculture Wetland Interaction (GAWI) project the Driver-Pressure-State-Impact-Response (DPSIR) approach has been adopted to describe and analyse agriculture-wetland interactions. The DPSIR approach provides a consistent framework to analyse the complex causal chain among drivers, pressures, state and impacts, and facilitates the targeted identification of response strategies aimed at improving the sustainability of wetlands (Fig. 1). These response strategies can address either (i) institutional changes, (ii) policy and planning, or (iii) the use and management of wetland resources, i.e. technical interventions aimed at reducing the impact of agriculture on the pressure that wetlands face. The Good Wetland Agricultural Practices (GWAP) module in the GAWI project specifically addresses wetland use and management by agriculture as a response strategy to reduce the pressure on wetlands. Through the identification and formulation of Good Agricultural Practices (GAP) for wetlands the disturbing and detrimental influence of existing agricultural practices on the state of wetland ecosystems could be minimized. The GAWI work program for 2010 encompasses the development of module on GWAP and its application in a number of case study wetlands.

The report describes the state of the art of the GAP concept as basis for GWAP and provides a set of guidelines for wetland managers to characterize the current means of agricultural production as a basis for identification of technical response interventions.

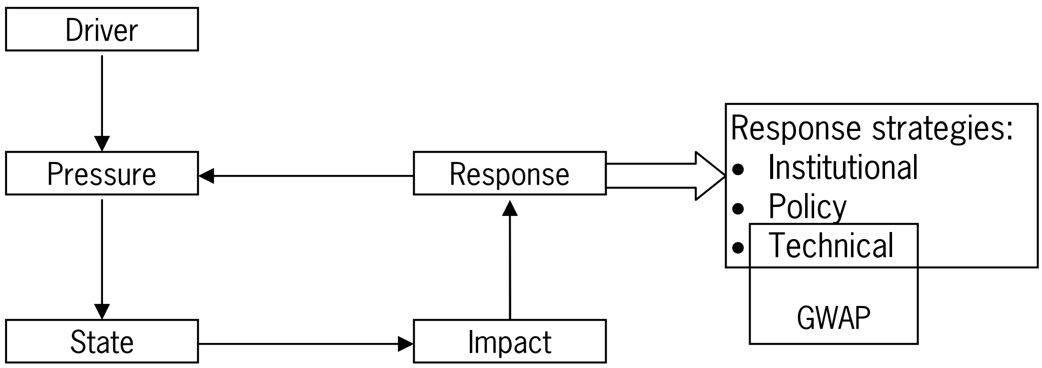

Figure 1. The DPSIR framework and three types of interventions (responses) to reduce the pressures of agriculture on wetlands. Good Agricultural Wetland Practices are part of the technical responses.

2 Good Agricultural Practices

2.1 Background

Good farming practices or Good Agricultural Practices (GAP) as a concept have been described in (i) a number of policy documents (e.g. CEC, 1991; 1999; FAO, 2007a), and in (ii) certification and labelling schemes mainly developed by the food industry and producer organizations (e.g. Globalgap, formerly known as EurepGAP) yet there remains little clarity concerning exactly what it is and exactly what farmers should be attaining.

In general, the term GAP is used to define farm management practices providing a minimum level of protection for some of the following (FAO, 2007b):

- Natural resources (energy, soil, air, water, biodiversity)
- Cultural resources (landscapes, traditional buildings, historic and archeological features and public access)
- Farm livestock (health and welfare)
- Farm labour (safety); and
- The general public (food safety and public health)

Hence, GAP describe the best farm management practices contributing to the realization of the before mentioned goals given current knowledge on management-effect relationships. Depending on the application domain of GAP these goals are described more quantitatively and qualitatively. In general, goals defined in the public domain are more quantitative, while in the private domain they are more qualitatively.

2.2 GAP in the public domain

GAP set in the public domain by governments are usually called regulations, and are generally mandatory. They may be based on international agreements or guidelines set by intergovernmental bodies, such as the Codex Alimentarius (FAO/WHO, 2006). Intergovernmental regulations are normally generic in nature to allow national governments to set more specific standards to the needs and situation of the country. For example, codes of GAP in the context of rural development programs of the European Union (EU) are defined as 'the standard of farming a reasonable farmer would follow in his region, and shall entail as a minimum compliance with general mandatory environmental requirements' (CEC, 1999). See Annex I for an illustration of GAP as described in the Nitrate Directive of the EU (CEC, 1991). Such intergovernmental Regulations allow EU member States to take into account the specific characteristics of their Member State or region, including soil and climatic condition, existing farming systems, farming practices and farm structure.

2.3 GAP in the private domain

GAP set by private and non-governmental organizations (NGOs) are voluntary in that farmers are not legally bound by them. However, in order for products to be certified or labelled, farms will have to produce according standards which may go beyond government regulations and they have to undertake a comprehensive auditing by and independent organisation. Yet, there is scope for farmers to implement the GAP according to his/her own farm-specific constraints and options. See Annex II for examples of control points and compliance criteria related to water/irrigation of crops within Globalgap. The development of GAP by the food industry and producer organizations has been a response to the increasing concerns of consumers about the way commodities are produced, especially the food safety and food quality. GAP developed by NGOs such as the Rainforest Alliance and Fair-trade organizations emphasise more the environmental and social aspects of production. Certification is not necessarily linked to premium product prices for farmers but can also include business-to-business labels to increase and secure transparency in the product chain (e.g. Globalgap).

2.4 Conclusions

In general, GAP are not pre-cooked blue-prints of farm management but are context-specific general management guidelines taking into account regional and farm differences. In practice, various management alternatives are offered enabling farmers to satisfy goals underlying GAP. In some of the literature GAP is considered a 'moving instrument' implying that with advancing knowledge 'good agricultural practices' can change into 'better agricultural practices'. In this way, the GAP concept allows tightening of the guidelines over time with increasing knowledge on management-effect relationships and farmer's capabilities to manage crop and livestock enterprises.

GAP set both in the public or private domain are formulated in close collaboration with stakeholders to (i) raise awareness about context-specific problems, (ii) to create ownership of these problems and their solutions, and (iii) to assure the feasibility of GAP in practice. This means that first a thorough analysis of the current means of production needs to be done to identify the most pressing problems and needs, and to create ownership. Second, alternative means of production need to identified and developed jointly with farmers taking into account the current means of production to assure the feasibility of the 'better agricultural practices'. This is often accompanied by considerable investments in stimulating agricultural innovation either through public or private funds.

One important aspect is that compliance with standards set by GAP **always** bears costs. Most of these costs relate to modification of farming practices, purchase of equipment, etc. to comply with standards. Generally, these costs are borne by the farmers. However, enforcement and monitoring are also costly and these may be borne by other stakeholders in the chain. In some cases farmers are compensated through premium prices (e.g. through fair-trade labels or organic products), but in other cases (e.g. Globalgap) buyers can impose requirements without compensating suppliers/producers. Latter situation appears to give an advantage to larger and wealthier producers as they are better able to bear the costs and implement GAP standards. In the public domain, costs associated with the modification of management practices to comply with GAP may be (partially) offset by subsidies or tax reductions.

2.5 Lessons from GAP for developing GWAP

Although existing GAP do not address agriculture-wetland interactions in a direct manner and have their own history (e.g. addressing food safety issues or regulations) they address environmental issues which are also relevant for agriculture-wetland interactions. In addition, the GAP provide some important lessons for the further development and implementation of the GWAP module in case study weltlands:

1 Adoption of GWAP needs to be done on voluntary basis if certification and Government regulation are not feasible project instruments. Though GAP are most often implemented using 'carrot and stick' methods, other incentives need to be developed to warrant the sustainable adoption of GWAP on voluntary basis. Such incentives may be similar to other technological interventions, including evidence-based improvement

of production and incomes/livelihood as this is the most important incentive for farmers to adopt new technologies and GWAP in particular.

2 GWAP as response to undesired agricultural impacts to wetlands need to be formulated in flexible manner to allow context-specific implementation taking into account prevailing goals, biophysical and socio-economic boundary conditions, and characteristics of location-specific farming systems, farming practices and farm structure. For example, GWAP formulated for floriculture farms need to be different from those specified for livestock farms in a similar situation although the objective of the response (e.g. reducing water pollution by nutrient emissions) may be the same. The analysis of the current means of production in specific case studies should provide information on the agricultural structure, and the magnitude and intensity of its production.

3 In all cases development of standard on GWAP needs to be a transparent and participatory process. Based on a dialogue with agricultural producers, environmentalists, policy makers, agricultural research and extension a joint R&D agenda needs to be developed aimed at reducing the impact of agriculture on wetlands. The 'carrot' for smallholders to participate in such a voluntary process is the support of research and extension to improve the economic performance of their farming systems (or livelihoods, - establishing a direct link with the livelihood module?). The GWAP module need to develop guidelines and to describe manuals on principles and processes facilitating and guiding local priorities definition of good practices in different systems and development of context-specific GWAP (Chapter 3). Such an approach matches best the description of GAP provided by FAO (2007a) as 'a way of working in a holistic manner with strategic stakeholders that promotes innovations and options rather than prescriptive solutions'. Case studies could provide 'the proof of the pudding' by developing such guidelines or (even better) by actually testing formulated guidelines and manuals and initiating a local R&D process aimed at developing GWAP options for farmers.

3 Guidelines for characterizing current agricultural production as basis for developing GWAP

3.1 Introduction

As discussed in section 2.5, insight in the current means of agricultural production in wetlands is key to identifying and developing GWAP. In this section guidelines are presented that aim at supporting wetland managers in analyzing and understanding the current means of agricultural production in a wetland.

The guidelines comprise a stepwise procedure that can be followed by wetland managers to characterize the current means of production. The content of presented tables is indicative and needs to be adapted and detailed for specific cases, such as where fisheries or aquaculture are dominant production systems.

The hierarchical approach describes the information needs from the agriculture production structure in relation to wetland type and size (section 3.2), most predominant farming system(s) (section 3.3), and predominant cropping and livestock system(s) (section 3.4).

3.2 Step 1: Characterization of agricultural production structure

The goal of this step is to identify nature and magnitude of the agricultural production in relation to the type and size of the wetland. It should provide information on the importance of different agricultural activities (farming systems) in relation to the wetland.

Table 3.1 illustrates the information needs (approximate numbers are sufficient) to identify the nature and magnitude of agricultural production in a wetland. This information enables the targeting of specific agricultural farming systems for developing GWAP. Table 3.1 provides information on the importance of different farming systems in the wetland under study.

Farming systems should be described in qualitative terms (e.g. lowland mixed rainfed cereal system) but the description should at least provide clarity about whether systems are rain fed or irrigated.

Table 3.1 Information to identify the importance of different farming systems in a given wetland.

Qualitative description:	Area (ha)	# dependent population	Total production value (Euro)
1. Wetland (type)			
2. Agriculture:			
2.1 Farming system A			
2.2 Farming System B			
Etc.			

3.3 Step 2: Characterization of predominant farming systems

The objective of this step is to characterize the most important farming system(s) based on results of step 1.

Table 3.2 illustrates the information needs to specify the nature of the most important farming systems. Provide average data or data ranges for typical farming systems.

Table 3.2 Characteristics of major farming systems in a given wetland.

	Land holding size (ha)	Crops (type)	Livestock (type)	# livestock	average farm income
Farming system A					
Farming system B					
Etc.					

3.4 Step 3: Characterization of crop and livestock systems.

The goal of this step is to characterize the most important crop and livestock system(s) based on results of step 2.

Table 3.3 illustrates the type of information that need to be collected (approximate numbers or ranges of data are sufficient) to identify the intensity of the most important crop systems. One farming system may consist of multiple crop and livestock systems.

Table 3.3 Illustration of the information needs to characterize the current means of production of crop systems in a given wetland.

	Crop yield (kg/ha)	Fertilizer use (kg/ha)	Pesticide use (kg/ha)	Water use (m3/ha)	Planting material	Gross margin
Crop system A						
Crop system B						
Etc.						

In general, the more quantitative the information is the better as it provides a better basis for discussion with stakeholders and for identifying problems and needs of stakeholders.

Since quantitative information may not be readily available to characterize crop and livestock systems, instead more qualitative information may be provided to enrich the description and to indicate the intensity level of crop and livestock systems. For example, the purchase of supplements for livestock may be indicator for the intensity level of a livestock system.

3.5 Step 4: Ecosystems services affected by crop and livestock management

The goal of this is step is to identify which wetland ecosystem services are most affected by the predominant crop and livestock systems. This information should contribute to awareness raising of stakeholders and to the identification of agricultural management practices that have a major impact on wetland services. These practices need to be targeted in a following step in the formulation of GAP.

Most important agricultural management practices that impact on wetland services can be classified into tillage, nutrient management, pest, weed and diseases (PWD) management, and water management. These can be easily related to those management characteristics of crop systems that have been identified in earlier steps.

On the basis of an inventory of the ecosystems services provided by a wetland the impact of crop and livestock characteristics on each of these services can be qualitatively scored using a range of +++ (no impact) to - - - (severe impact).

Table 3.4 provides an example of describing such impacts. The columns should correspond with the crop and livestock variables used in Table 3.3.

Table 3.4 Illustration of the impact of agriculture on wetland services.

Wetland service:	Tillage	Nutrient management	PWD management	Water management
Provisioning:				
Food	+/-	+	-	
Fresh water	-	- -	- -	- -
Fibre	+/-	+	-	
Fuel	+/-	+	-	
Etc.				
Regulating:				
Climate	- -	+/-	+/-	+/
Hydrology	-	- -	-	- -
Pollution control				
Etc.				
Cultural:				
Spiritual				
Recreational				
Aesthetic				
Etc.				
Supporting:				
Biodiversity				
Soil formation				
Nutrient cycling				
Etc.				

Obviously, the magnitude of the impact (the cells in Table 3.4) is difficult to assess without knowing the magnitude of the crop system in relation to the wetland size and characteristics. Hence, information from step 1 to 3 should be accounted for in an implicit way while assessing the impacts in Table 3.4. Some crop system characteristics such as tillage will not have a direct impact on for example many provisioning services of a wetland, which is indicated with +/- in Table 3.4, but may affect fresh water quality through turbidity problems associated with tillage close to surface water.

3.6 Diagnosis of current management practices and identifying alternatives

The goal of this is step is to target those agricultural management practices that affect wetland ecosystem services most (section 3.5). In a participatory setting and involving key stakeholders these management practices should be discussed to better understand the rationality of current practices and the constraints for change. Both constraints that farmers themselves are able to solve should be addressed and constraints that require changes in the enabling environment. For example, what are the underlying causes for inappropriate nutrient management resulting in a range of negative impacts on wetland ecosystem services? Are these related to a lack of knowledge of farmers, or the unavailability of good quality fertilizers, etc.? Based on the problem analysis and needs of stakeholders alternative management practices and associated changes in the enabling environment –if needed - can be identified.

For example, when the identified management problem relates to high fertilizer input resulting in emissions to ground and surface water, potential alternative management strategies aimed at curtailing fertilizer use are:

- Fine tuning fertilizer needs in time and space to crop demand: (i) simple methods to assess crop demand such as leaf color charts, (ii) split applications.
- Better use of crop residues
- Better use of manure
- The use of legumes in the crop rotation
- Other fertilizers
- Improve water management (less irrigation water, better infiltration)
- Etc.

There are a great number of technical guidelines on good agricultural practices available of which some are summarized in Bos et al. (2008). Recently, The International Rice Research Institute has made a website available for GAP of the major cereals, i.e. rice, maize and wheat (http://www.knowledgebank.irri.org/default.htm). The website also contains links to country–specific websites with GAP information for selected Asian countries. However, in many cases such technical guidelines should be fine tuned to, tested and demonstrated in the location-specific conditions, before they can be applied in practice. Out of the list of alternative management strategies identified, the most promising in a given context should be selected together with stakeholders to be further investigated and developed with support of local R&D.

References

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Annex I Nitrate directive (CEC, 1991)
Code or codes of good agricultural practice with the objective of reducing pollution by nitrates and taking account of conditions in the different regions of the Community should certain provisions covering the following items, in so far as they are relevant:

- periods when the land application of fertilizer is inappropriate;
- the land application of fertilizer to steeply sloping ground;
- the land application of fertilizer to water-saturated, flooded, frozen or snow-covered ground;
- the conditions for land application of fertilizer near water courses;
- the capacity and construction of storage vessels for livestock manures, including measures to prevent water pollution by run-off and seepage into the groundwater and surface water of liquids containing livestock manures and effluents from stored plant materials such as silage;
- procedures for the land application, including rate and uniformity of spreading, of both chemical fertilizer and livestock manure, that will maintain nutrient losses to water at an acceptable level.
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Member States may also include in their code(s) of good agricultural practices the following items:

- land use management, including the use of crop rotation systems and the proportion of the land area devoted to permanent crops relative to annual tillage crops;
- the maintenance of a minimum quantity of vegetation cover during (rainy) periods that will take up the nitrogen from the soil that could otherwise cause nitrate pollution of water;
- the establishment of fertilizer plans on a farm-by-farm basis and the keeping of records on fertilizer use;
- the prevention of water pollution from run-off and the downward water movement beyond the reach of crop roots in irrigation systems.

Annex II Examples of Control points and Compliance criteria for crops in Globalgap

No.	Control point	Compliance criteria	Level
CB.6.1.1	Have systematic methods of prediction been used to calculate the water requirement of the crop?	Calculations are available and are supported by data records e.g. rain gauges, drainage trays for substrate, evaporation meters, water tension meters (% of moisture in the soil) and soil maps.	Recommended
CB.6.2.1	Can the producer justify the method of irrigation used in light of water conservation?	The idea is to avoid wasting water. The irrigation system used is the most efficient available for the crop and accepted as such within good agricultural practice.	Minor Must
CB.6.2.2	Is there a water management plan to optimise water usage and reduce waste?	A documented plan is available which outlines the steps and actions to be taken to implement the management plan. Refer to CO.5.1.1 for Coffee and TE.5.1.1 for Tea certifications.	Recommended
CB.6.2.3	Are records of irrigation/fertigation water usage maintained?	Records are kept which indicate the date and volume per water meter or per irrigation unit. If the producer works with irrigation programmes, the calculated and actual irrigated water should be written down in the records. Refer to TE.5.1.2 for Tea certification.	Recommended
CB.6.3.1	Has the use of untreated sewage water for irrigation/fertigation been banned?	Untreated sewage water is not used for irrigation/fertigation. Where treated sewage water is used, water quality complies with the WHO published Guidelines for the Safe Use of Wastewater and Excreta in Agriculture and Aquaculture 1989. Also, when there is doubt if water is coming from a possibly polluted source (because of a village upstream, etc.) the grower has to demonstrate through analysis that the water complies with the WHO guideline requirements or the local legislation for irrigation water. See Table 3 in Annex AF.1 for Risk Assessments. No N/A.	Major Must
CB.6.3.2	Has an annual risk assessment for irrigation/fertigation water pollution been completed?	The risk assessment must consider potential microbial, chemical or physical pollution of all sources of irrigation/fertigation water. Part of the risk assessment should consider the irrigation method and the crop, frequency of analysis, sources of water, the resources and susceptibility for pollutants and drain water of the sources and the environment.	Minor Must
CB.6.3.3	Is irrigation water analysed at a frequency in line with the risk assessment (CB.6.3.2)?	The water analysis is carried out at a frequency according to the results of the risk assessment which takes the characteristics of the crop into account.	Minor Must
CB.6.3.4	Is the analysis carried out by a suitable laboratory?	Results from appropriate laboratories, capable of performing microbiological analyses up to ISO 17025 level, or equivalent standard, should be available.	Recommended
CB.6.3.5	Have any adverse results been acted upon?	Records are available of what actions have been taken and what the results are so far.	Recommended