

Mapping an inland-valley catchment area

The inland-valley bottom or lowland is the lowest part of an inland-valley catchment area, which includes from top to bottom: the hillcrest, the upland slopes (upper and lower slopes), the hydromorphic zone and the actual valley bottom (Reference 2). The catchment area is the entire land area in a valley depression that forms the hydrographic (water-channel) network, which conveys water to the valley bottom. Among others, this network determines the inflow (irrigation) and outflow (drainage) of water in the inland-valley lowland. The shape of the catchment area, the soil types and their depth, the vegetation, the rainfall regime and other factors also influence the functioning of the inland valley and determine its potential and limitations for agricultural use. To understand the functioning of the valley bottom, it is necessary to have an overview of the entire catchment area and its hydrological system. In many cases, farmers do not have a global view and clear understanding of the inland-valley catchment area and hydrological system.



Learning objectives

At the end of this module, farmers will be able to:

- Draw a map of the inland-valley catchment area they cultivate, while indicating key land sub-units as well as their relative dimensions, shape/morphology, hydrology, pedology (soil characteristics), vegetation and land use.
- Understand the importance of having an overview beyond the field level.
- Analyze the functioning of the inland valley, and identify its limitations and potentials for agricultural use.
- Reflect on activities to improve the functioning of the inland valley and realize that these activities often require collective action.

① Place a sheet of strong packing paper on the ground, preferably in the direction of the valley, and let the farmers decide among themselves who will draw the map.

② Visualize the inland-valley features, including the irrigation–drainage systems.

Introduce the concept of catchment area, lateral and longitudinal water movement and groundwater (groundwater table).

③ Identify and visualize the upland slopes, hydromorphic zone and valley bottom.

④ Visualize areas of excessive seasonal flooding and seasonal drought, and identify the possible causes.

⑤ Determine and indicate the main soil types on the map, including areas influenced by iron toxicity.

⑥ Identify the natural vegetation and the main crops grown, and visualize spots with high weed-infestation.

Module 2

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Procedure

1. Farmers and the PLAR-IRM team meet at the PLAR-IRM Center. The facilitator reviews the main issues discussed in the previous module and invites farmers to comment.
2. The facilitator reviews the list of participants and asks if a group leader and a deputy have been appointed. He (or she) checks whether someone will keep track of attendance during the sessions. The facilitator also asks if farmers have agreed on a name for the group and if they have agreed on a day, time and place for the PLAR-IRM sessions.
3. One of the PLAR-IRM team members explains the objectives of the meeting, the learning objectives and the procedure of the current session.
4. A large sheet of strong packing paper is displayed on the floor and markers are made available to farmers. The facilitator explains the idea of mapping the inland-valley system, and the need to use symbols for physical elements, such as irrigation canals and bridges. Farmers need to agree themselves on what symbols to use for each element.
5. The facilitator invites farmers to position the sheet of paper in the length-wise (longitudinal) direction of the valley bottom and to pinpoint the highest and the lowest points of the valley on the map.
6. Farmers are then asked to choose a person who will take the lead in drawing the map. However, farmers should agree with the principle that elements or landmarks are only put on paper if a consensus is reached. All farmers will, therefore, feel ownership of the final map, and agree that this is an adequate representation of their valley. All farmers are invited to gather around the paper and to contribute to the mapping process.

(The valley bottom)

7. Farmers first identify places where water enters the valley (upstream), then lakes, bridges, roads, dams and other landmarks. Farmers decide on the choice of colors and symbols to represent the various landmarks. The main irrigation and drainage canals are drawn from the upper to the lower part of the part of the valley, representing the natural river course in the valley bottom.
8. Next, farmers try to locate and draw their own fields, respecting as much as possible the relative dimensions of each field, again working from the upper to the lower part of the valley. They also draw the secondary irrigation and drainage canals.



(Catchment area)

9. The facilitator introduces the concept of a catchment area, and lateral and longitudinal surface water flow. Farmers indicate the highest point of the hillcrest and its relative distance from the valley bottom, i.e. the area covered by the upland slopes on both sides of the valley bottom.

10. The facilitator introduces the concept of a hydromorphic zone. Farmers generally recognize this zone as the area suitable for vegetable growing. Farmers try to demarcate—with dots on the map—the area where vegetable growing is possible, relative to the crest and the valley bottom. Next, a solid line is drawn linking the dots. This line represents the border between the hydromorphic zone and the rainfed upland slopes.

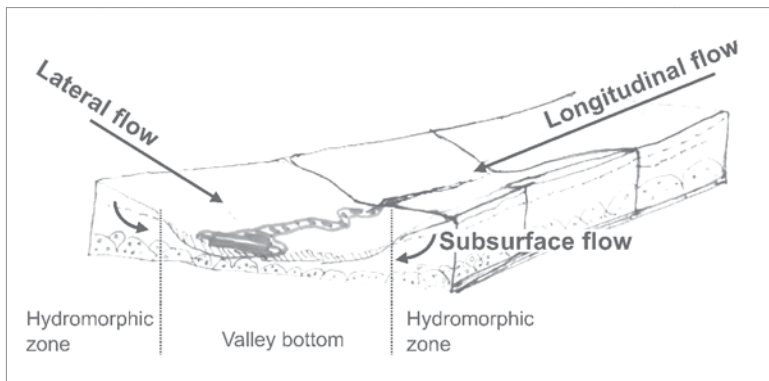
11. The facilitator introduces the concept of the groundwater table. Farmers are asked to compare the depth of groundwater in the upland slopes, the hydromorphic zone and the actual valley bottom.

The facilitator explains that water flows from the upland slopes to the hydromorphic zone and the valley bottom.

12. Farmers discuss the size of the area occupied by the upland slopes, the hydromorphic zone and the valley bottom at different locations in the inland valley (i.e. starting upstream and moving downstream). The facilitator explains the effect of a long and gentle slope on water supply in the valley and the risk of erosion and reduced groundwater recharge on a steep slope.

How to introduce the concept of a hydrographic system

The facilitator identifies a spot in the meeting place where the ground is undulating with a well-defined slope. He indicates the longitudinal direction of the lowest portion and the lateral slopes (borders) on both sides. With a big bucket, some quantity of water is first poured out at the upper part so that the water runs downward to the lowest depression. This is to show the longitudinal direction of water flow. Then, from a position on the lateral side (diagonal to the longitudinal direction) some quantity of water is poured to represent rainfall on the hillside, which partly seeps through the soil and partly runs-off towards the lowest depression (representing the valley bottom). Next, some water is poured on a shorter and steeper lateral section to show what is happening with water seepage and runoff. Finally, the concept of 'crest' is explained by pouring water on the highest lateral side: part of the water flows down one side towards the valley bottom, while the rest of the water flows down the other side, into another valley.



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(Hydrology and water management)

13. Farmers indicate areas of water stagnation and areas affected by seasonal drought. They discuss the importance, periods and duration of these phenomena. The facilitator encourages farmers to identify the causes of water shortages or stagnation (e.g. soil texture, topography). Farmers are also asked to indicate areas susceptible to erosion.

(Soil and subsoil)

14. Farmers identify the main soil types, preferably as a function of the toposequence in the catchment area (Reference 3). The facilitator thus encourages farmers to list various soil types identified on the upland slopes, in the hydromorphic zone and in the valley bottom. Farmers indicate the distinguishing criteria and specific features of the various land types.
15. Next, farmers indicate the spatial variability of the various soil types on the map for the upland slopes, the hydromorphic zone and the valley bottom.
16. Farmers also give an indication about the natural fertility of soils, and their water-holding capacity. The facilitator stimulates a discussion on the link between land sub-units and their characteristics, such as texture, color, soil fertility and permeability.
17. Areas prone to iron toxicity are also indicated on the map. The facilitator encourages farmers to discuss the link between iron toxicity, soil type and groundwater depth (Reference 4).

(Vegetation and crops)

18. Farmers list the crops, natural vegetation and main weeds predominant in the upland areas, the hydromorphic zone and the valley bottom.
19. For the valley bottom, farmers indicate which areas are especially infested with weeds. They briefly discuss weed species and their importance to rice growth.
20. Evaluation: the facilitator asks to what extent farmers:
 - Have appreciated Module 2—what did they appreciate most and what did they appreciate least?
 - Have learnt—what do they know now that they did not know before drawing the map?
 - Will put their newly gained knowledge into practise—what can be done with the new knowledge obtained?
21. The facilitator concludes the session, informs farmers about the topic of the next session and invites them to that session.



Time required

- At least two sessions of 2–4 hours.
- Depending on farmers' interest, the map can be more or less complete; however, it is always possible to go back to the map later and conduct a second or third session.



Materials required

- Large sheet of strong packing paper, markers, adhesive (Scotch) tape.
- An attendance book.
- A bucket.
- Water.

Module 2

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Box 2

About 30 farmers and the PLAR-IRM team met in Lokakpli. We provided farmers with a large sheet of strong packing paper and marker pens. To start with, farmers found it difficult to draw a map of their valley. After about an hour, farmers were not satisfied with the result and decided to start all over again. The aim of the exercise was not yet clear for a number of the farmers. Gradually, more farmers became involved and finally many among them expressed their points of view.

The map that was eventually drawn proved to be an important means of communication. It was obvious that fields are generally located between the peripheral irrigation canal and the central drainage canal. The map also indicated a large blank area, corresponding to fields of farmers who were not represented. Some farmers present said that the farmers in this blank area were not very cooperative. During the discussion it also became obvious that farmers working downstream do not often go to the fields upstream and vice-versa.

About 25 farmers and the PLAR-IRM team met in Bamoro. Bamoro farmers were much more at ease in mapping their inland-valley system than the Lokakpli farmers were. This may be due to the fact that the land outside the valley bottom and hydromorphic zone does not belong to the Lokakpli village. Lokakpli farmers had, therefore, much less detailed knowledge of the entire catchment area than did Bamoro farmers. In fact, at the start, Lokakpli farmers did not really see the point of discussing about land outside their irrigation system. We also observed that not all farmers understood the principle of groundwater movement.

We asked farmers to identify the various soil types encountered in Bamoro and they came up with three major categories: upland soils, hydromorphic-zone soils and valley-bottom soils. After a lot of discussion, farmers agreed on the following categorization (this took about 45 minutes):

Upland soils:

Type:	Fertility level
Black / white sand	Less fertile
Black / red gravelly	Fertile
Red / black sandy-clay	Very fertile

Hydromorphic soils:

Type:	Fertility level
Black / white sandy-clay	Fertile
Black / white / red sand	Fertile
Black / white sand, gravelly	Fertile
White clay	Less fertile

Lowland soils:

Type:	Fertility level
Clay with black clay-loam below	Very fertile
White sand	Less fertile
Black loam	Fertile

Crops do not perform well in hydromorphic zones on white clay soils, as these dry very quickly. We asked questions about the land-use history of the Bamoro valley. A lot of (sometimes heated) discussion (especially between the younger and more senior farmers) followed. Eventually, it seems that rice was cultivated in the valley of Bamoro before Ivorian independence, probably at least 70 years ago. In the beginning, rice and raffia were the main crops. After independence, the Prefect asked the village farmers to remove the raffia and to use the whole valley bottom for rice. Rice production has become more intensive over the last 10 years.

Farmers made an inventory of crops, natural vegetation and trees:

Upland: teak (tree), bamboo, cashew (tree), mango (tree), coconut, palm, monkey-bread tree, acacia, orange tree, cacao, yam, cassava, maize, *imperata*, millet.

Hydromorphic zone: sugar cane, okra, tomato, cucumber, sweet potato, taro, pineapple, banana, raffia, millet.

Valley bottom: rice, and several weeds with Baoulé names.