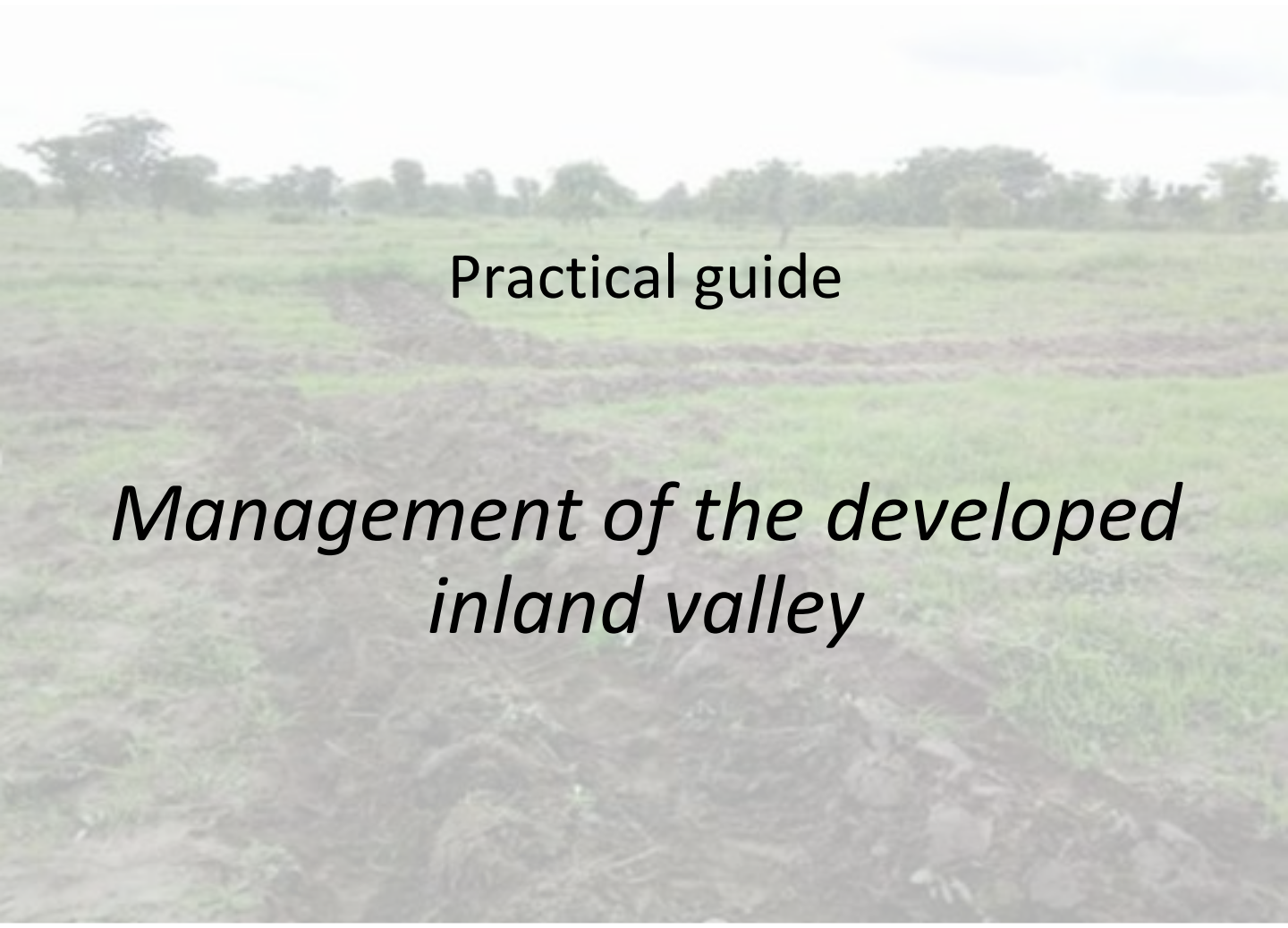

Practical guide

Management of the developed inland valley

Summary

About AfricaRice and Afrique-learning

AfricaRice:

AfricaRice is a leading pan-African rice research organization committed to improving livelihoods in Africa through solid science and effective partnerships. AfricaRice is a research center of CGIAR, which is part of a global research partnership on future food security. It is also an intergovernmental association of African member countries. Today, it has 30 member countries. The mission of AfricaRice is to contribute to poverty reduction and food security in Africa through research, development and partnership activities, aimed at increasing the productivity and profitability of the rice sector so as to guarantee the sustainability of the agricultural environment.

Afrique-Learning:

Afrique-learning is a Beninese cooperative which creates and manages vocational e-learning courses specially designed for African youth. Courses are tailor-made in collaboration with experts in the field with the aim of producing interactive, illustrated, interesting and easy-to-study courses that provide the student with important information in simple and appropriate language. Learning is done independently at the student's own pace, it is assessed and a course certificate is attained following a final test. Courses are available on computer, smartphone or android tablet. They only require a very modest bandwidth and are therefore within the reach of students. Registration and classes are free.

Acknowledgements

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Sources of images

[1] Photo provided by Christian ADJALLA

[2] Photo provided by AfricaRice

[3] Photo provided by Hendrik Pöhl

[4] Illustration produced by EUDOX BÉATITUDES

[5] https://fr.wikipedia.org/wiki/Fumier#/media/Fichier:Hestem%C3%B8j.jpg

[6] Photo provided by Dr. Ayewa Tchatchibara

[7] Photo provided by Désiré Guy K. HOUNDETE

References

This guide is based on "Reference 14 Nutrients and Reference 15 Integrated soil fertility management" developed by Wopereis et al., (2008) and "Smart-valleys: Trainer-facilitator's manual" developed by Africa Rice.

I. Management of the structures *(bunds and drainage canals)*

Course of the observation

- You must visit the site after each rain in order to make the possible corrections
- During the visit, you must take a route that enables you to observe the main developed structures:
  - protection bunds
  - drainage canals, main and transverse, and the main bunds
  - secondary drainage canals and bunds
- How frequently you need to check the structures depends on the rainfall

Observation in the field [1]

- It is recommended that you make a visit 2-4 times a week
  - the length of the visit depends on the nature of the damage and the inland valley area
  - a visit lasts on average between 90-120 minutes

Inland valley maintenance

- Irrigate when there is no water in the lockers and drain when there is too much
- We occasionally break bunds to bring water to the lockers or to drain water from the lockers
- We also build other bunds and drainage canals if necessary
- The damaged parts are repaired with a hoe and a daba then compacted by the repeated passage of the producers on foot
- Grassed canals must be cleaned because they:
  - prevent the proper circulation of irrigation water
  - can introduce weeds

Water damage in an inland valley [7]

Maintenance of drainage canals

- The quality of the drainage canals and how well they function will determine the success or failure of the development
- The maintenance of the drainage canals is done by:
  - increasing the height of the main drainage canal when necessary and filling the deepest parts with pebbles
  - widening the canals if the water flow excavates them
- It is the secondary drainage canals that will suffer significant damage from the first rains

Drainage canals [2]

Maintenance of bunds

- Proceed to the redevelopment of all the bunds
- Stabilize the main bunds especially, and the belt bund if possible, with rubble stones
- If possible reduce the water flow at the entrance of the development using rubble stones, particularly in areas with high rainfall such as the Sahel
- The secondary bunds must be raised regularly with each rain
- Particular attention must be paid to the intersection of bunds, drainage canals and slope inversion areas which are areas of intense erosion

Maintenance of bunds [2]

Maintenance of supply structures

- The structures that control water intake into the inland valleys must be strong enough and must be specially monitored
- Breaches of these structures are often quite large and can sweep away parts of the inland valleys
- They must be corrected systematically after each rain
- The destruction of the supply structures is corrected by repositioning the stones at the start of the main drainage canals
- Stones are more effective and suitable than sandbags for repairing and improving structures

Water control with stones [2]

Maintenance and points of singularity

Points of singularity (termite mounds, trees, rocks):

- are concerns to be taken into account in carrying out the development and management of structures
- are areas where the water prefers to flow. They must be closely monitored each time it rains because most of the time the structures are poorly sized in these places
- the most concerning are termite mounds and "whale backs"

Singularity points in a rice field [2]

II. Establishing the nursery

The nursery location

- The nursery is a area of land reserved for the multiplication of rice plants
- Good nursery management ensures plants that are vigorous and can cope with problems such as
  - floods
  - insect attacks and
  - competition from weeds
- The nursery must be established on a site that is
  - accessible and sunny
  - close to fields and to a water point
  - away from granivores and birds
- Establishing a nursery in the shade of trees is not recommended, because the seedlings become very stunted

Rice nursery [3]

Seed pre-germination

The pre-germination of the seeds aims to trigger the germination process and it is done in two phases:

1. soaking, which involves soaking the seeds in water inside a jute bag for 24 hours to allow the seeds to absorb the amount of water necessary for germination
2. incubation, which lasts 24 to 36 hours and involves keeping the seeds removed from the water, in a ventilated place, at a temperature of 30° C, until germination

Preparing the soil for the nursery

- Choose less clayey soils to facilitate the pulling up of the seedlings
- Spread a thin layer of sand (1 cm) on the seed bed after sowing to facilitate the pulling up of the seedlings
- After perfectly puddling and leveling the ground, divide the ground into rectangular seed beds, 1 m wide and 10 m long
- The seed beds should be 5 to 10 cm above the ground surface and separated by irrigation canals
- The canals (30 to 40 cm) provide access for the sower and constitute a barrier against certain pests

Ground leveling [4]

Sowing and water management

- The appropriate sowing density is 0.2 kg of seeds per m², a total of 50 m² of nursery (5 beds of 10 m²), or 10 kg of seeds for a quarter of a hectare, respecting a spacing of 20 cm x 20 cm
- The nursery area represents one tenth of the area to be transplanted (to transplant on 1 ha (10,000 m²), you need a nursery of 1000 m²)
- When sowing, spread the germinated seeds uniformly on the bed and cover it with straw
- In the case of developed inland valleys with water control, the nursery irrigation can be carried out as follows :

Sowing [4]

  - sow on a well-drained soil and only add water after 2 or 3 days to allow the roots to settle well
  - maintain a water depth of 2 to 3 cm until the tenth day
  - drain the excess water from the plot for 24 to 48 hours to prevent the development of weeds
  - gradually increase water depth until it is pulled out (5 cm)

Fertilization and pulling up seedlings

Fertilization

- when the seedlings have a slower growth, it is recommended that you apply a top-dressing fertilizer such as a light nitrogen fertilizer two weeks after sowing (10 g of urea per m²)

Pulling up seedlings between 14 and 21 days

- pulling out seedlings is a delicate operation - improper pulling can reduce yield or necessitate the replacement of missing seedlings
- it is necessary to pull out the seedlings under the water level and adopt the following technique to avoid damage:

Seedling uprootingl [4]

  - hold 2 or 3 rice seedlings between your thumb and index finger so that the index finger is almost perpendicular to the seedlings and the thumb is parallel with them
  - exert a slight pressure downwards before slowly pulling towards you, be careful to hold the seedlings at the base

III. Transplanting and water management

Transplanting

- Transplanting is the re-planting of seedlings from the nursery in a larger area
- Transplanting makes it possible to:
  - deal with floods
  - reduce weeds
  - and facilitates weeding and other maintenance activities
- When the young seedling is transplanted too deeply it is less productive because the soil is too compact for the roots to develop well
- Seedlings transplanted too superficially risk being uprooted by water
- The correct transplanting depth is 3 cm
- It is generally recommended to transplant seedlings that are 2 to 3 weeks old.
- For transplanting to be successful, it is necessary to:
  - develop water control and
  - level for good spatial distribution of water

Transplanting in a rice field [4]

Density and transplanting methods

- A good transplanting density makes it possible to obtain a good vegetative cover in order to make better use of the sunlight, water and fertilizers
- The choice of the transplanting density depends on the tillering capacity of the variety used
- Most varieties used give their best yield at 20cm of spacing
- There are two types of transplanting:
  - row transplanting which requires the use of a rope and a ruler graduated according to the desired spacing and makes it possible to control the number of seedlings per m²
  - random transplanting (at a rough guess) which consists of transplanting at random and in all directions
- Random transplanting is not a good option. It is recommended that you adopt row transplanting

Transplanted field [4]

Water Management

- There are critical stages during the rice cycle when the rice needs little, a lot or no water at all
  - rice needs little water during the vegetative phase (1)
  - rice needs a lot of water throughout the reproductive phase (which lasts from panicle initiation to flowering) and the first half of the ripening phase (2)
  - rice no longer needs water during the last half of the ripening phase (3)
- However, take care to ensure that the soil is flooded for the first 10 days after transplanting to prevent the development of weeds

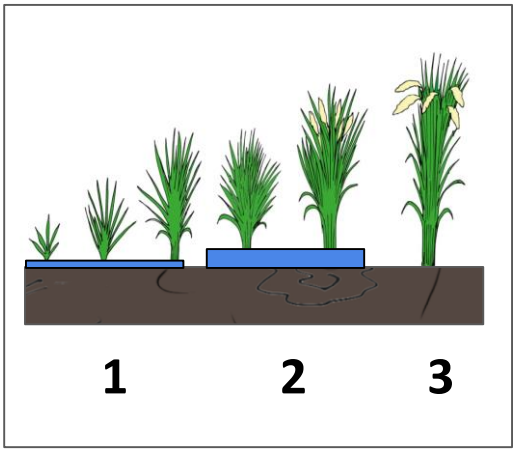

Diagram showing water requirements during the growth stages of rice [4]

- Absence of water during the vegetative phase promotes the development of weeds and a reduction in yield
- Urea application is preferably done at a low water depth (3–5 cm) to increase its effectiveness
- Lack of water during the reproductive phase can cause a significant drop in yield

IV. Management of soil fertility

Crop rotation

Combining or rotating crops with soybeans, peanuts or other legumes makes it possible to:

- protect the soil against weeds and also erosion
- bring significant income to producers
- add nitrogen fertilizer to rice
- and finally improve the nutrition of producers by promoting the consumption of plant-based proteins

Crop rotation with soybeans [3]

Other practices

- The preparation of the soil by making rice lockers in the inland valleys promotes:
  - the cleaning of the fields
  - the decomposition of organic matter
  - the improvement of seed beds
  - good water infiltration
- Spreading ash, which serves as fertilizer and insecticide, is recommended
- The use of farmyard manure or compost, when available, is also recommended
- It also happens that rice straw is spread in inland valleys at the end of the season

Residues spread in the field after harvest [6]

V. Integrated Weed Management

Preventive control methods

To prevent weeding in rice fields the following measures can be used:

- proper land preparation, followed by flooding the plot for two weeks to remove seeds from the previous crop and weeds
- proper leveling of the ground to facilitate flooding
- cleaning the canals and the area around the plot to prevent weeds entering the lockers with the irrigation water
- using quality seeds and making a good choice of the variety
- using pre-emergent herbicides to control weeds as soon as they germinate

A well prepared land [2]

Curative control method

- Curative weed control can be done by manual weeding (including purification), mechanical and chemical control
- Manual weeding and mechanical control are easy in the case of transplanting and / or row sowing
- Purification occurs when weeds escape weeding because of their resemblance to rice
- Purification involves removing from the plot after flowering all flowered plants other than the cultivated rice plant.
- In order to avoid damaging the crop by purifying, the following rules must be observed:
    - locate foreign plants and enter the plot from the side closest to those plants using your arms to clear your way
    - if the weed flowers earlier than the rice, remove it before the rice blooms
    - if the rice flowers earlier, wait for the flowering of the weeds to purify
- Curative control is also carried out with post-emergence herbicides which
    - have the advantage of reducing the workforce
    - must be used appropriately to maintain the health of producers and the soil

Weed treatment [2]

Cultivation practices

- Cultivation techniques that can help control weeds in irrigated rice cultivation are:
- Transplanting which gives the rice a "head start" in terms of growth and development over weeds
    - rice can be transplanted into the flooded field or the field can be flooded immediately after transplanting to reduce weeds
- Direct sowing of pre-germinated seeds under water to reduce weeds
- Good water management in the plot which helps to reduce weeds that find it hard to germinate in submerged conditions

Row sowing result [2]