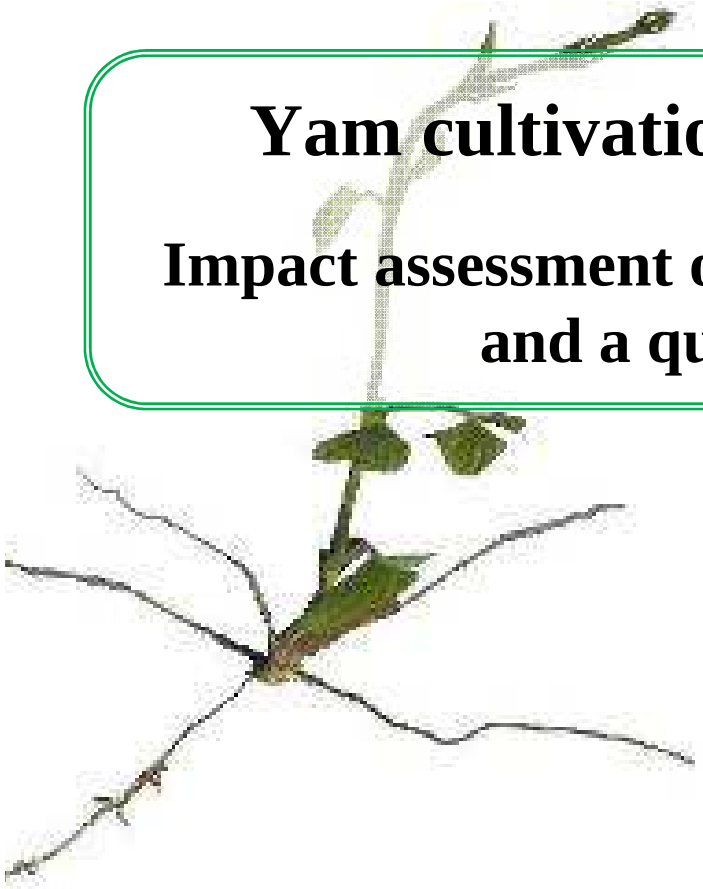
inter aide
Lancement et suivi de programmes concrets de développement
44, rue de la Paroisse
78000 VERSAILLES-FRANCE
Tél. 01.39.02.38.59
Fax 01.39.53.11.28
e-mail : interaide@interaide.org

AGENCE FRANÇAISE DE DÉVELOPPEMENT

Yam cultivation in Sella Limba, Sierra Leone.

Impact assessment of the introduction of a new *alata* variety and a quick multiplication technique

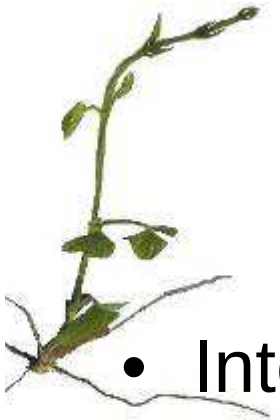


Tangui Barré
Michael Spada
Inter Aide Avril 2012
Relecture Lucie VINCENT pour Inter Aide
Diffusion Réseau Pratiques http://www.interaide.org/pratiques

Foreword

- The following synthesis presents the results of a 6-month internship implemented by Tangui Barré (AgroParisTech student);
- The internship took place between the second and third year of engineering school;
- Inter Aide provided logistical and methodological support;
- Augustin Pallière provided support to understand the agrarian context (Augustin is an AgroParisTech PhD student);
- Finally, Philippe Vernier (agronomist at Cirad) provided technical support.

cirad
AGRICULTURAL RESEARCH FOR DEVELOPMENT



Introduction

- Inter Aide (IA) has been involved in an agriculture development project in the Sella Limba chiefdom in Sierra Leone since 2007. More precisely, IA implements a food security programme in 3 chiefdoms with the objective to enhance the capacities of vulnerable communities **to manage and sustain their access to safe water and sanitation** and **to durably improve their crop production**.
- Among other activities, IA has introduced a new yam variety going along with a quick multiplication technique.

Summary

1. Generalities on yam
2. Local knowledge and practices on local yam
3. IA objectives and methodology for the introduction of white yam and its quick multiplication technique
4. Objectives & methodology of the study
5. Study results
    1. Characteristics of yam cropping systems
    2. White yam adoption assessment
    3. White yam multiplication assessment
6. Conclusions and recommendations

Summary

1. Generalities on yam
2. Local knowledge and practices on local yam
3. IA objectives and methodology for the introduction of white yam and its quick multiplication technique
4. Objectives & methodology of the study
5. Study results
    1. Characteristics of yam cropping systems
    2. White yam adoption assessment
    3. White yam multiplication assessment
6. Conclusions and recommendations

Generalities on yam (1)

- Genus: *Dioscorea*
- Cultivated under tropical climate
- Herbaceous and annual crop
- High soil fertility required
- Species:
  - *Dioscorea alata*: originally from South-East Asia, high productivity, hardy and may produce bulbils
  - *D. cayenensis-rotundata*: originally from the Guinean gulf, lower productivity but better gustative quality.

  Those 2 species account for 95% of the world production. Other species have also been identified in Sella Limba:
  - *Dioscorea esculenta* (“Chinese yam”): can be cultivated in temperate areas.
  - *Dioscorea bulbifera* (“Aerial yam”): high production of bulbils (up to 1kg), no edible underground tuber.

Generalities on yam (2)

Multiplication:

- Only vegetative multiplication possible for farmers
- Theoretically germination possible from any part of the tuber skin
- Seed yam = piece of tuber including skin OR a small and entire tuber (higher sturdiness and earliness)
- Germination gradient according to the provenance of the tuber piece (proximal part of the tuber = higher earliness and germination potential)
- Traditional use of the proximal part (“head”) of the tuber as seed yam (20 to 30% of the harvest kept for the next cropping cycle)
- Conservation for seed yam competing with human consumption
- Very low multiplication rate

Summary

1. Generalities on yam
2. Local knowledge and practices on local yam
3. IA objectives and methodology for the introduction of white yam and its quick multiplication technique
4. Objectives & methodology of the study
5. Study results
    1. Characteristics of yam cropping systems
    2. White yam adoption assessment
    3. White yam multiplication assessment
6. Conclusions and recommendations

Local knowledge and practices on yam in Sella Limba

Before IA introduction, mainly 1 variety locally called **Makakabi** (*D. cayenensis-rotundata)* had been cultivated for decades:

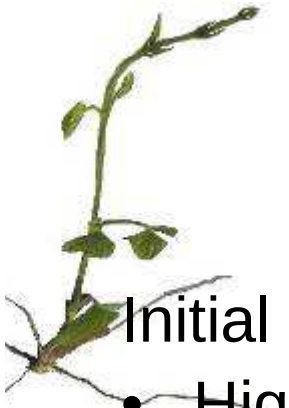
- About 50% of target farmers had Makakabi in 2009
- *Makakabi* multiplication:
  - Use of tuber heads
  - The tuber head can be divided into 2 to 4 big pieces (over 150g each) if the tuber is big enough
  - Along with the main tuber, secondary tubers can grow ➔ possible to use heads of secondary tubers
  - Generally, tubers are left in the ground during 2 cropping seasons to produce bigger tubers (up to 20 to 50 kg) from which sturdy seed yams can be collected
  - Farmers have less than 4 tubers (usually 1 or 2)
- Access and spreading of *Makakabi* :
  - Every farmer stresses the very difficult access to seed yam when demand is high
  - Among today's yam croppers: 57% received Makakabi seed yam as a gift from close relatives or friends, 43% bought them to a close farmer ➔ No seed yam market & unlikely to buy seed yam to unknown farmers
  - Mean price for one *Makakabi* tuber head: 3,000 Le (gold washer daily salary = 10,000 Le)
  - Losses can make farmers stop cropping yam regarding the difficult access to seed yam

Much less frequently, some farmers have cultivated a yam variety of the *D.alata* species locally called **Inné**.

Even less frequently, two appreciated varieties have been cropped for less than 3 years: **Tato yam** (*D.bulbifera*) and **Chinese yam** (*D.esculenta*).

Summary

1. Generalities on yam
2. Local knowledge and practices on local yam
3. IA objectives and methodology for the introduction of white yam and its quick multiplication technique
4. Objectives & methodology of the study
5. Study results
    1. Characteristics of yam cropping systems
    2. White yam adoption assessment
    3. White yam multiplication assessment
6. Conclusions and recommendations



IA objectives and methodology for the introduction of a new yam variety and a quick multiplication technique (1)

Initial findings in 2008 on *Makakabi* yam cultivation:

- Highly appreciated gustative properties
- Very large yam:
  - Not easily marketable
  - Cut into pieces for consumption BUT limited shelf life once it is cut
  - Limited multiplication: 1 to 4 seed yams from a 20 to 50 kg tuber every 2 years
- Difficult access to the local variety: high cost of planting material and very high demand

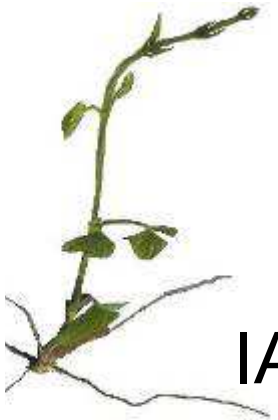
But IA has also identified other yam varieties unknown in the project area but available and cultivated 100km further south…

IA objectives and methodology for the introduction of a new yam variety and a quick multiplication technique (2)

IA objectives are to:

1. Introduce new varieties for yam production diversification. Mainly a *Dioscorea alata* variety presently called **White yam** and to a lower extent a *D.alata-nigeria* variety (**Red Yam**), crossed with Inné :
   - unknown varieties in the area
   - 1 to 5kg tubers on average
   - varieties identified by SLARI[1] as suitable for quick multiplication technique

1: Sierra Leone Agriculture Research Institute



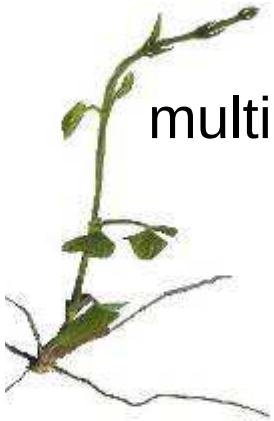
IA objectives and methodology for the introduction of a new yam variety and a quick multiplication technique(3)

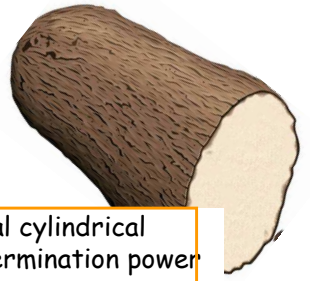
IA objectives are to:

2. Introduce a quick multiplication technique called “miniset” technique for a rapid introduction of white yam cultivation

Inter Aide experimented the introduction of White yam with the miniset technique (training done by SLARI specialists) during the 2008 rainy season with 11 farmers in 5 villages. The experience was technically convincing and many farmers of the area asked for support for this activity: White yam and its multiplication technique were introduced to 504 farmers during the 2009 rainy season in more than 56 villages; 400 farmers in 2010 in 40 villages; 168 farmers in 2011 in 21 villages. Those farmers were committed to spread the variety.

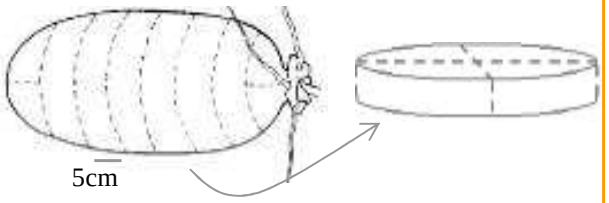
Description of the production cycle and the multiplication cycle with the proposed miniset technique





1. Select clean, healthy ware yam tubers (1kg), 2 to 3 months after harvesting (after tuber dormancy when sprouts begin to develop)

2. Cut the ware yam into several cylindrical pieces each about 5 cm wide (germination power increases towards the head)
Cut each of the pieces into 2 to 4, **make sure each piece has skin**



Multiplication cycle

3. Treat sets with **wood ash**, and dry under shade for 2 days

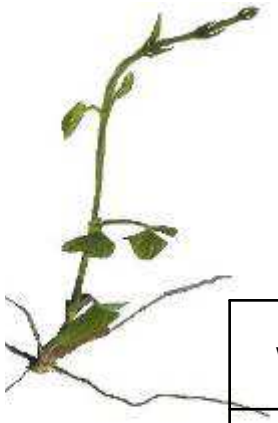
4. Mini sets can be pre-sprouted in May, in a nursery, depending on the quantity

5. Mini sets (or seed yams) can be planted directly in the plot in early June, at a distance of 25cm on ridges 1m apart
Plant sets with **skin surface placed downwards** at a depth of 10cm

6. Protect from **weeds** during the first 2 -3 months after planting.
Stake the vines when they are about 1.0m

7. Seed yam matures 6 to 7 months after planting. During harvest, care must be taken not to harm the tubers.
Store harvested tubers in a **well ventilated place**.
Seed yam can be eaten or planted at the following rainy season to obtain big yams

Production cycle



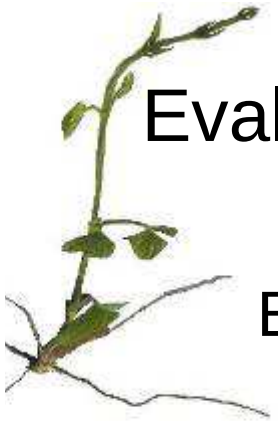
IA methodology

WHEN	March (year 1)	April	End of April	May ⇢ January		End of April ⇢ (year 2)	January (year 3)
INTER AIDE	**Training** of agriculture team on yam mini set technique by SLARI specialist	-**Selection of farmers** (10 per village on average according to the size of the village) -Signature of **MoU** (main clause on spreading the variety)	**Training of farmers** on the technique by field facilitators in each village	Technical, economical and social **follow up / advice and assessment** until harvest		Light follow up of : -variety spreading -2nd year of cropping Support the access to planting material for farmers who want to notably increase yam cultivation	
FARMERS USING YAM MINI SET TECHNIQUE		**Conditions to meet** to be selected for the yam activity: -Select a **plot often checked** near the village or next to the farmer's plot for example, -Prepare a **nematode free land** : bring five bags of straw material and burn it to sterilise the soil, -Prepare **10m² of plot** with ridges, for example 2 ridges of 5 meters, -Bring **manure** (at least 6 head pans), -Bring 30 **sticks** for the staking of the yams.	Each farmer prepares and receives 1kg of white yam cut into pieces covered with ash *(no risk of eating the yam)* 	2 days later : **planting of yams**. Each farmer plants his 1 kg of yam cut into pieces on his plot	**Stacking / Weeding / earthing up/Follow up** of the crops until harvest of sets	**Planting of sets** and **spreading of the variety** to other plots of the village	

Note on nurseries: Some farmers decided to set up a nursery. No difference in germination rate was identified in 2009 between sets in watered nurseries and sets planted directly. If the mini sets are big enough, they can be left one month in earth without being watered and they germinate with the 1st rains. Moreover, nurseries require more labour force to water the sets.
It can be useful to have a nursery if farmers decide to intensify yam cultivation by increasing the multiplication factor and thus reducing the size of mini sets, which therefore require more care.

Summary

1. Generalities on yam
2. Local knowledge and practices on local yam
3. IA objectives and methodology for the introduction of white yam and its quick multiplication technique
4. Objectives & methodology of the study
5. Study results
    1. Characteristics of yam cropping systems
    2. White yam adoption assessment
    3. White yam multiplication assessment
6. Conclusions and recommendations



Evaluation: objectives & methodology (1)

Evaluation objectives:

- Identify and characterize the main cropping patterns for yam cropping systems (White yam, Makakabi, Chinese yam and Tato yam)[1]
- Identify and characterize adoption mechanisms (White yam & miniset)
- Assess impacts when adoption

It raises the following questions:

- Do beneficiaries keep cropping White yam and multiplying it? How are they multiplying (use of miniset)?
- To which criteria can adoptions/non adoptions be correlated?
- How important are yam cropping systems in today's farming systems?

1: Red yam and Inné won't be further assessed in the following study as we didn't meet enough growers. However, the technical and economic outputs of red yam seem somehow comparable to white yam and should be still considered.

Evaluation: objectives & methodology (2)

Survey samples :

Only in villages targeted in 2009 (3 yam cultivation seasons done)

1st sample (S1) the “main sample” for quantitative & qualitative surveys to assess the adoption criteria, the typology of adopting farmers, the impacts:

- Individual and semi-directive surveys
- Purposive sample of 7 villages in 3 different agro ecological zones
- 1 control village
- Surveyed farmers: 55 receivers in 2009 and non-receiver farmers

2nd sample (S2) for quantitative interviews to assess the adoption and the evolution of seed yam quantity (13 additional farmers)

3rd sample (S3) for quantitative interviews only to assess the adoption (121 additional farmers)

Definition of adoption:

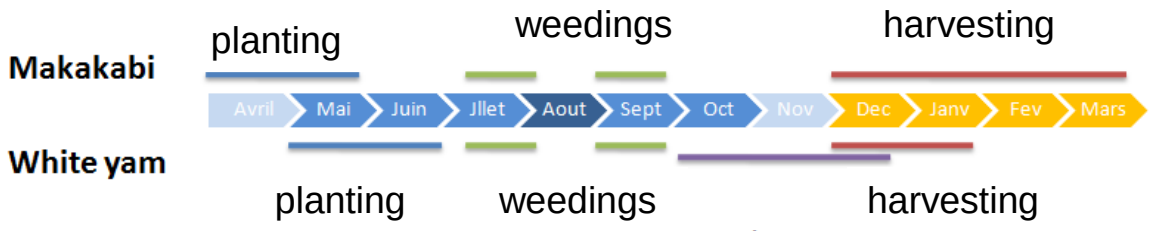
- Farmers adopting White yam are farmers still cropping white yam the 3rd year
- Farmers adopting miniset are farmers still cutting into pieces at least one whole tuber

Summary

1. Generalities on yam
2. Local knowledge and practices on local yam
3. IA objectives and methodology for the introduction of white yam and its quick multiplication technique
4. Objectives & methodology of the study
5. Study results
    1. Characteristics of yam cropping systems
    2. White yam adoption assessment
    3. White yam multiplication assessment
6. Conclusions and recommendations

Characteristics of yam cropping systems (1)

Yam is planted at the beginning of the rainy season and harvested at the beginning of the dry season



Plantation:

•Makakabi tuber heads are planted in a 350 liter hole with compost, mango leaves and rice straw, behind the house (easy to watch over and fertilization with domestic trash) next to a tree (and/or wood garden stake) to support the vines.

•White yam tuber heads are planted either on ridges (IA advice) with residues and compost incorporation or in a hole like the Makakabi (said to be more suitable to produce big tubers), which is 6 time longer. In 2011, 65% of white yam growers planted on ridges (those cultivating the largest number of tubers)

Small bulbil pro :

Characteristics of yam cropping systems (2)

Use of wood garden stakes for white yam cultivation was recommended by IA. Many farmers left yam branches lying on the ground because they noticed that bulbils became bigger when branches took root in the soil (presence of rootlets)… further experiments or literature research are required!

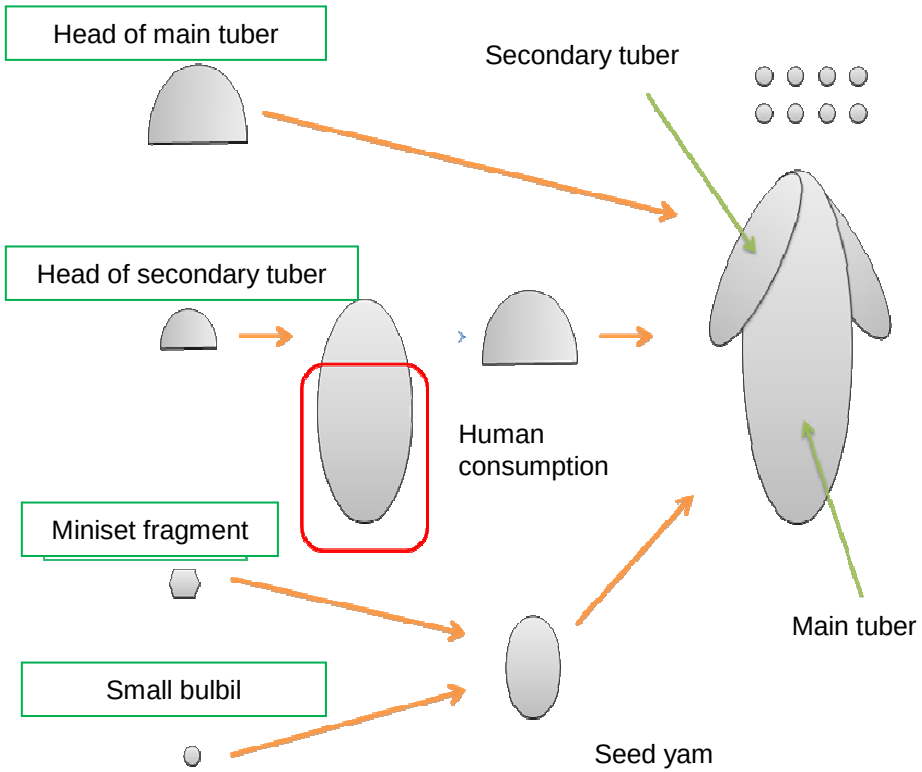
<u>Harvest:</u>

•Makakabi: generally left in the ground more than 1 cycle to get a bigger main tuber (twice bigger) and more secondary tubers (4,3 in the 2nd year – 2,5 the 1st year) ➔ The 1st year tuber is left as a seed yam for the 2nd cycle.

•White yam:

- Tuber extracted from the ground every year
- High correlation between seed yam size, number of secondary tubers and tuber size at harvesting time:
  - Main tuber head as seed yam (20 to 30% of the tuber) = 1 year cycle
  - Secondary tuber head, small bulbil or small miniset fragment = 2 year cycle to have a tuber as big as those from a tuber head seed
- Optimally 1 to 5 kg tubers, 1,5 secondary tubers and 8 bulbils.

Thus small seed yam will not produce tuber big enough for an optimal use as food after 1 cycle.



Characteristics of yam cropping systems (3)

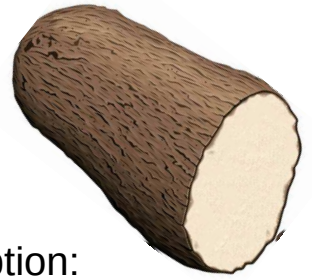
White yam harvest ⟶

Seed yam conservation:

•Tuber heads are cut at harvesting time, traditionally the cut side is rubbed with ash (to limit risk of pests and diseases) and they are stored in a cool place to avoid drying out until the next cropping season (under trees mixed with straw or in a humid valley with sporadic watering if necessary)

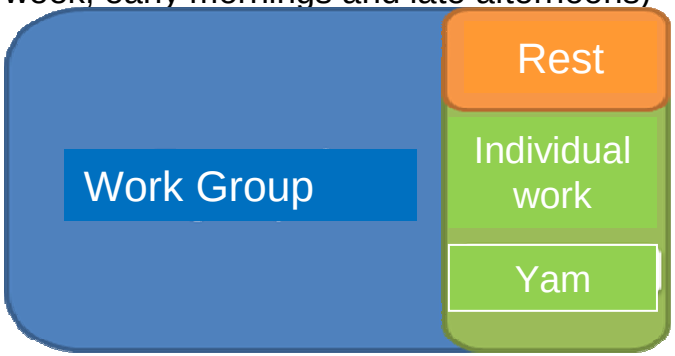
•Farmers using the miniset technique keep the entire yam until the next cropping season and some of them dry the tuber in the sun before storing

Characteristics of yam cropping systems (6)



This part gives further observations on farming systems after White yam adoption:

1. Location of the crops on the farm:
   - Mostly nearby the house as a “garden” crop (higher fertility) like okra, maize, sweet potatoes, crin-crin, fruit trees, etc. Use of compost or crop residues. In a marginalized place (nearby trees like Macabo) or as a plot (no clear rotation planned ➔ 2 or 3 years at the same place so far…)
   - On a plot in crop association with pepper (yam+pepper//groundnuts//yam+pepper//rice): new and rare (when high production or losses nearby the house because of small ruminants straying)
2. Work calendar: competes with group work for rain-fed rice at planting time. More available for other cropping patterns except if there are mining activities after rice harvest.
3. Secondary and personal crop:
   - Maximum 2% of the gross added value of the farm
   - Priority to the rain-fed rice based cropping system which is mainly carried out in work groups (major limiting factor = manpower availability). Indeed, most of the farmers depend on work groups and run out of additional working time for personal crops at yam planting time (2 free working days per week, early mornings and late afternoons)



4. 100% for consumption: highly appreciated for the afternoon meal – used instead of the *gari* (cassava flour) bought to flour processing farmers.

Characteristics of yam cropping systems (4)

Chinese yam*:

- Planted in May, harvested in November (1 month earlier than the 2 previous ones)
- Smaller tubers than White yam (*see picture*)
- 1 seed yam can produce about 10 tubers: 1 ➔ 10
- Planted on ridges (smaller ones required compared to White yam)
- Smallest tubers are planted the next cropping season as seed yam
- Food production every year

Chinese yam harvest →

* Not yet widely spread.

Characteristics of yam cropping systems (5)

Tato yam*:

•Planted in May, tubers harvested progressively from October to December

•Seed yam planted in a 10cm depth hole > LABOUR EXTENSIVE

•Production of bulbils: 1 ➔ 15. Different sizes. The biggest are over 0,5kg and the smaller are kept for planting time.

•Strong garden stake required

•The underground tuber is left after harvest and germinates again the next cropping season

•Thefts are easy (higher occurrence)

•Leaves = medicinal goodness (deeper assessment required)

Tato yam (mid August and end of September)

* Not yet widely spread.

Characteristics of yam cropping systems (7)

- No yam market yet (except for Makakabi that can be sold in cooked pieces to neighbors or neighboring villages) but:
  - We observed few spontaneous sales of White and Chinese yam on markets or in mining villages with a higher price than the opportunity cost of gari.
  - Middleman buyers want yam
  - High demand confirmed on markets
- Even though Cannabis is an illicit crop, it is often more attractive as a secondary and personal cash crop[1] (existing market) but not necessarily more economically attractive than yam (to be deeper assessed)
- Global comparison:
  - White yam:
    - A bit more productive than Makakabi.
    - Taste highly appreciated by farmers
    - More secure multiplication even with the local multiplication technique (many small tubers and bulbils = potentially many seed yams instead of 1 or 2 big Makakabi = the probability of variety losses is lower)
    - Easier to store several small tubers than a big one
  - Tato yam*:
    - 8x the mean GPL because very little work is required for plantation (small hole and no ridge)
    - Seed yams to sustain the current plantation size the next year = 7% of the harvest (as against 20 to 30% for Makakabi and White yam)
    - Possibility of quick and safe multiplication (several small tubers)

    BUT
    - Less appreciated taste
    - Strong wish from farmers to harvest bigger tubers
    - Easy to rob
    - Strong staking required (like trees)
  - Chinese yam*:
    - Highly productive
    - Taste highly appreciated by farmers
    - Seed yam to sustain the current plantation size the next year = about 10% of the harvest (as against 20 to 30% for Makakabi and White yam)
    - Possibility of quick and safe multiplication (several small tubers)

[1]Especially among young men

Tuber	Gross annual productivity of the work (Le/h)
White yam	1 700
Makakabi (2 years)	1 400
Chinese yam	2 300 *
Tato yam (2 years)	14 300 *
Macabo (Xanthosoma sagittifolium)	*1 400***

• yam value: no sale of white yam tuber even if there is a high demand on markets. Thus, its value is based on the *gari*'s according to the calorie content (yam tends to be cooked at noon instead of *gari*)
• productivity of labor more pertinent as access to manpower is a much more limiting factor than access to land

** Tato and Chinese yams assessed on a very small sample, the low data reliability should be considered*

*** Practices on Macabo can been compared to yam ➔ economic performances comparable to yam*

Summary

1. Generalities on yam
2. Local knowledge and practices on local yam
3. IA objectives and methodology for the introduction of white yam and its quick multiplication technique
4. Objectives & methodology of the study
5. Study results
    1. Characteristics of yam cropping systems
    2. White yam adoption assessment
    3. White yam multiplication assessment
6. Conclusions and perspectives

White yam adoption assessment (1)

Sample 1, 2 and 3.

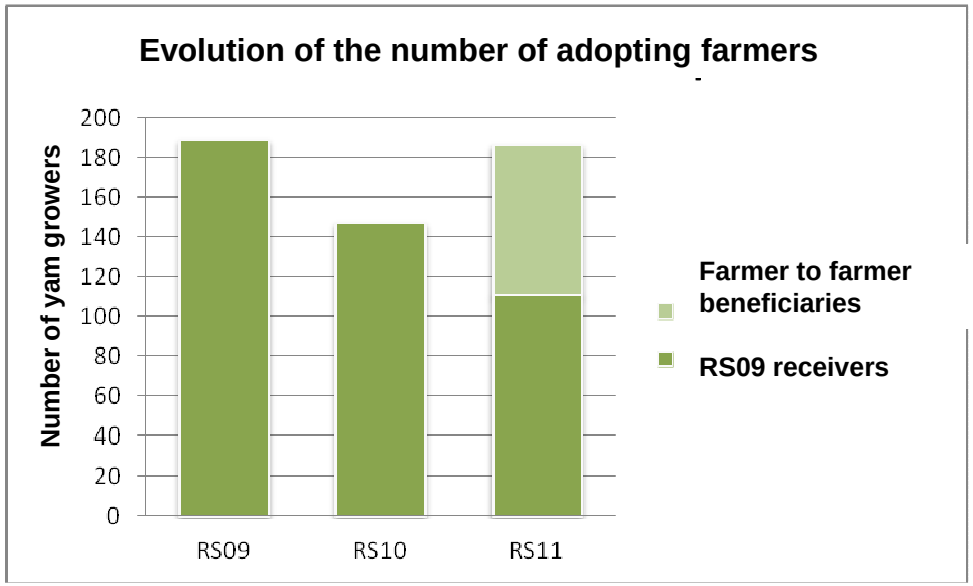
- 60% of RS09* receivers are still cropping the variety in RS11**.
- 20% give up after the 1st year, 25% after the 2nd year.
- +40% of new indirect beneficiaries (farmer to farmer spreading) → number of White yam variety croppers in 2011 = number of White yam variety receivers in 2009.

Reminder

Definition of adoption:

• Farmers adopting White yam are farmers still cropping white yam the 3rd year

• Farmers adopting Miniset are farmers still cutting into pieces at least a whole tuber



* RS09: rainy season 2009

** RS11: rainy season 2011

White yam adoption assessment (2)

Adoption linked to agro ecological areas*?

➔NO

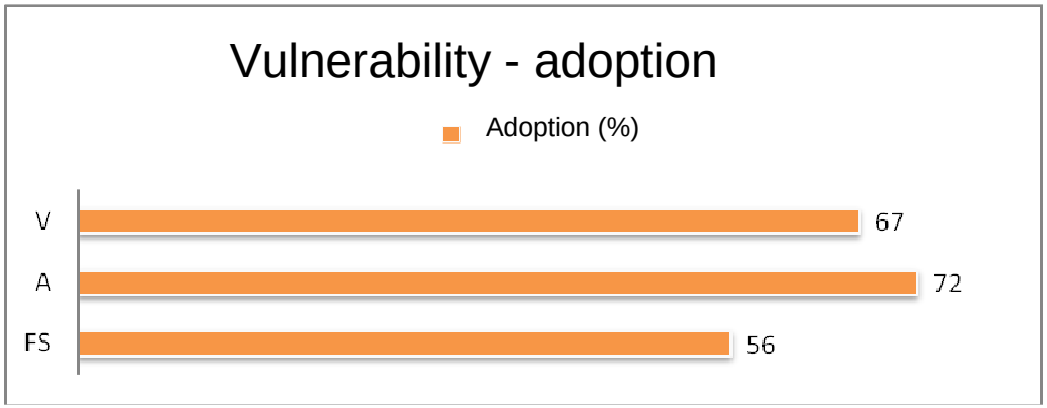
area	Adoption rate	Values number
1	0,7	10
2	0,6	56
3	0,6	102

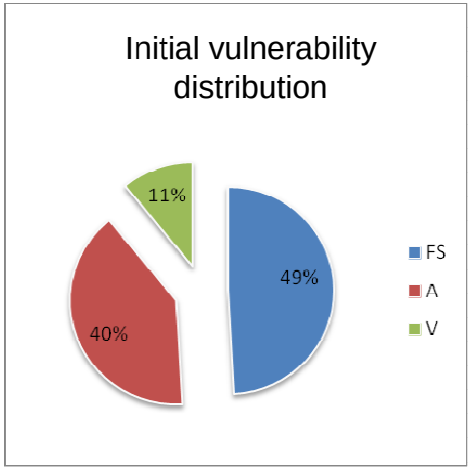
* Sample 1, 2 and 3

White yam adoption assessment (3)

Adoption linked to the vulnerability status*?

➔NO. More abandonments among food secure farmers but not significantly





A qualitative survey pointed out that most farmers gave up because of massive initial losses (1/2 of abandoning farmers stopped because of 100% non germination of the miniset fragments) ➔ Not linked to the will to cultivate yam but more likely to be linked to a technical issue

* Sample 1

Vulnerability assessment according to IA classification tools (based on the balance between manpower bought & sold)

V = vulnerable, A = average, FS = food secure

Summary

1. Generalities on yam
2. Local knowledge and practices on local yam
3. IA objectives and methodology for the introduction of white yam and its quick multiplication technique
4. Objectives & methodology of the study
5. Study results
    1. Characteristics of yam cropping systems
    2. White yam adoption assessment
    3. White yam multiplication assessment
6. Conclusions and perspectives

White yam multiplication assessment (1)

Assessment of the evolution of the number of tubers <u>for adopting farmers</u>* (whatever the multiplication technique is):

- Globally:

RS09 receivers	RI[1] of the number of seed yams/adopting farmer: RS10/RS09	RI of the number of seed yams/adopting farmer: RS11/RS10	RI of the number of seed yams/adopting farmer: RS11/RS09
78	- 13%	+ 45%	+ 27%

- At village scale (next slide):

* Sample 1 and 2

[1] Relative Increase

White yam multiplication assessment (2)

- At village scale:

Village (number of receivers RS09)	Germination rate in 1st year	Number of fragmented tubers for the 2nd plantation (RS10)	RI of the number of seedlings RS10/RS09	Germination rate in 2nd year	Number of fragmented tubers for the 3rd plantation (RS11)	RI of the number of seedlings RS11/RS10	RI of the number of seedlings RS11/RS09 (average number of seedlings RS11)
Kamakilie (11)	55 %	0	-35%	120%	5 (3 farmers out of 9)	+40%	-3% (20)
Kamathemuta (9)	55 %	2 (2 farmers **out of** 6)	-27%	85%	1 (1 farmer out of 5)	+33%	0% (7)
Kantirina-Kamabente (11)	50 %	4 (3 farmers out of 5)	+10%	64%	2 (1 farmer out of 5)	+20%	+33% (13)
Kagbumbor[1] (5)	90%	11 (4 farmers out of 5)	+20%	100%	7 (2 farmers out of 5)	+30%	+55% (20)
Herimakono (6)	100%	0	+18%	110%	0	+80%	+110% (24)
Kadabie (7)	75%	11 (4 farmers out of 5)	+32%	105%	13 (2 farmers out of 4)	+90%	+150% (27)
Kakontegeh	50%	6 (1 farmer out of 4)	-15%	70%	1 (1 farmer out of 3)	+55%	+40% (23)

[1] All the receivers were not met

White yam multiplication assessment (3)

• At village scale (analysis of the table):

High correlation between germination rate the 1st year and today's multiplication trend

- The use of miniset does not seem clearly correlated to the RI: for example no use of miniset at all in Herimakono (RI=110% btw 2009 and 2011) while 1/3 of farmers adopting the new variety in Kamakilie were using miniset in 2010 (but RI=-3% btw 2009 and 2011). Multiplication is carried out with secondary tubers and bulbils in Herimakono.
- The number of seed yams per farmer doesn't change much whatever today's RI is. This helped us raise another hypothesis ➔ even though IA gave about the same total weight of sets per farmer, the size of the fragments cut by IA agents could be different:
  - Villages where fragments were small = bad germination rate and low RI (but more fragments so that the total number of seed yams today can be as high as in "quick multiplication" villages)?
  - Villages where fragments were big = high germination rate and high RI (but less fragments)?

So far, it is difficult to directly link the germination rate and today's multiplication level, but it gives a lead! Deeper assessment has been done to answer this question (*see further*)

White yam multiplication assessment (4)

Multiplication trend at village level linked to fragment size?

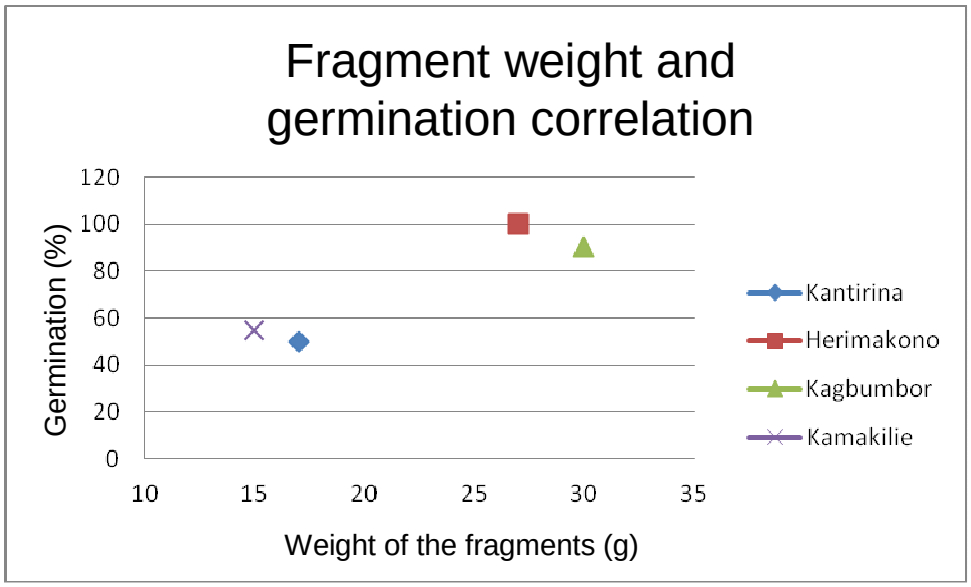
YES!

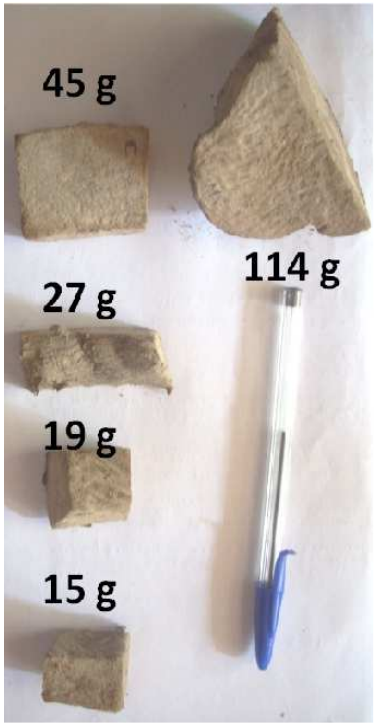
- Protocol: Miniset fragments of different sizes showed to villagers in a sample of 4 villages of Sample 1 to know the fragmentation size done by the IA agent in charge of the village in RS09 (to be considered: small sample).
- Result: fragment sizes were different from one IA agent to another which lead to germination differences.

➔ A minimum 30g fragments should be adopted by the team (= match box)

➔ <u>However</u>, variety adoption is not correlated to initial fragment weight or germination rate.

Indeed, 1st year germination failure was not a discouragement factor for farmers as long as they still had seed yam for the 2nd cycle.



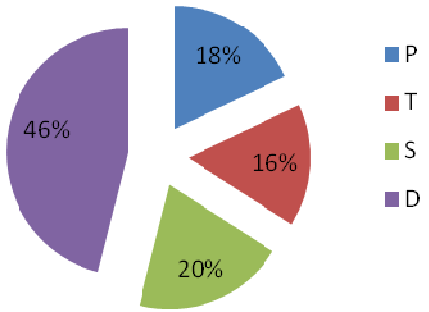


White yam multiplication assessment (5)

- At farmers scale (for adopting farmers):
  - Multiplication typology (all multiplication techniques)*:

Prolific farmers (P)	Good multipliers (T)	Calm multipliers (S)	*Decapitalizer* farmers (D)
> 200%	+100% to +200%	0 to +100%	<0%

Distribution of the RS11 farmers according to multiplication typology



➔Initial value = germinated seed yam in RS09 (in order not to include the impact of bad germination in RS09 because it wasn't necessarily linked to farmer practices but rather to IA advice). So assessment done for 2 cropping cycles only.

• >50% of adopting farmers have more tubers today than germinated seed yam in RS09.

* Sample 1 and 2

White yam multiplication assessment (6)

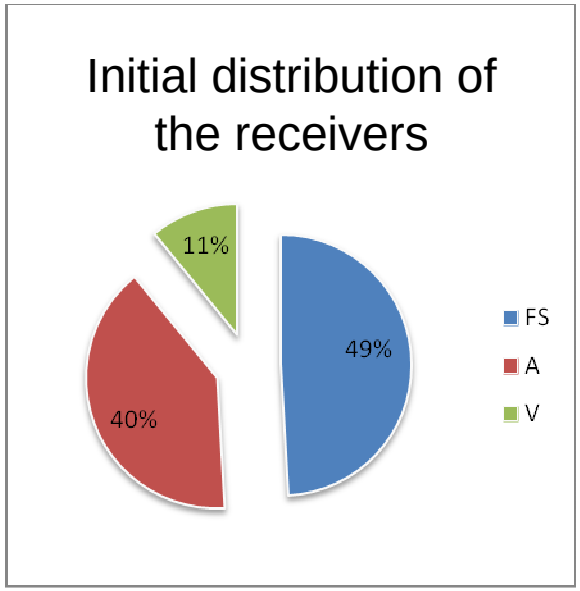
- At farmers scale (for adopting farmers):

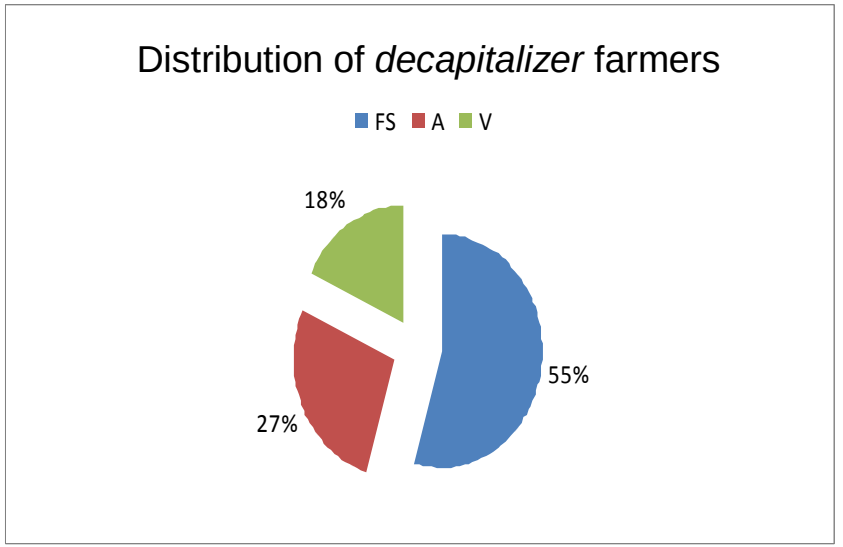
  Multiplier type linked to vulnerability status?

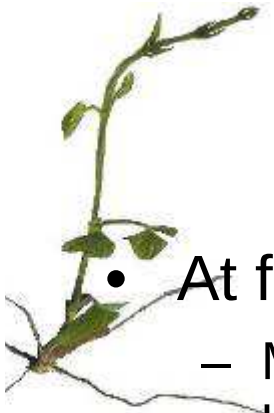
  YES a little!…

  ➔ **Even though the χ^2 test is not significant with regard to sample 1 (χ^2=1,6, df=1), it seems that "average" farmers are multiplying more as they are less represented in the "*decapitalizer* farmers" group compared to the whole sample. However, both vulnerable and food secure farmers are more represented in the *decapitalizer* group than in the whole sample. Some clues were given thanks to qualitative surveys with farmers:**

  - Multiplication is difficult for vulnerable farmers because food consumption competes with seed storage
  - "Food secure" farmers can be less interested in yam multiplication when they are more focused on important rice production

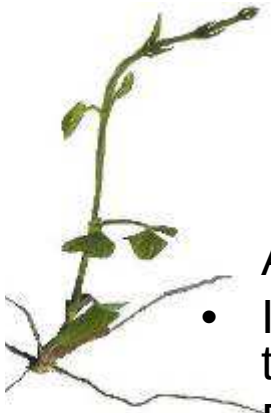






White yam multiplication assessment (7)

- At farmers scale (for adopting farmers):
  - Multiplication level not linked to previous practices (no correlation between “prolific farmers” and “Makakabi producers”)
  - Even if this should be further assessed, it seems that there is a link between prolific multiplication and the number of people the household head is in charge of. Indeed, many farmers stressed that yam is very handy for cooking quick meals to children at noon…
  - We noticed that almost half of the prolific farmers (5 people) weren’t part of a work group for rain fed rice cultivation (*kune* group) because they had enough family manpower or they could buy work group rounds. Thus, those farmers have more time for other personal crops. This raises the following question: **does the traditional involvement in work groups somehow limit farmers’ capacity to increase “individual” productions?**



White yam multiplication assessment (8)

Assessment of “miniset” adoption:

- In 2011: 29% of adopting farmers are still using the miniset technique today but adapted to local knowledge = bigger fragments (up to 100g).
- Farmers who failed because of too small fragments either stopped or started again with bigger fragments.
- Germination rate with miniset increases: 1st cycle = 63%, 2nd and 3rd cycle = 75%.
- Disappointment because small tubers after 1 cropping cycle with small miniset fragments:

  ➔ Despite observation made in slide 21, it was not clear for all farmers that the given fragments would produce small seed yams after one cropping season so they would have to wait another cropping season to get “normal” size tubers. We understood then that tuber size is closely linked to fragment size. Farmers didn’t expect to have to wait 2 cropping cycles to get normal size tubers (not suitable for vulnerable families). This is another reason for increasing the size of fragments.
- Later, we realized there was a high level of consciousness about the link between fragment size, germination and tuber size after 1 cycle.
- In the specific context of the Sella Limba agro ecological zone, nursery VS direct planting: no significant difference in germination rate confirmed while a nursery requires much more time.

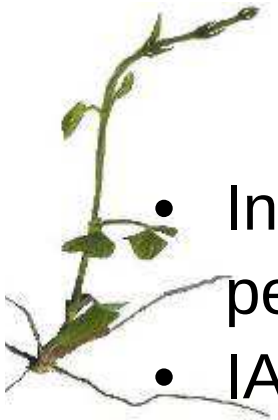
White yam multiplication assessment (9)

Trends:

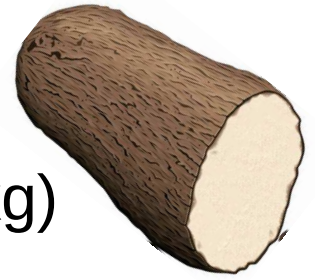
- Use of local knowledge on Makakabi to ensure high germination rate (planting of tuber heads) and big tubers after 1 cropping cycle.
- Use of bulbils:
  - Very used in some villages / not in others (no awareness – not yet advised by IA)
  - About 10 bulbils per plant
  - 70% germination rate
  - Bulbils > generally 2 cycles to get big tuber for consumption
- For those who already succeeded, miniset seems to be considered as a short term technique to reach a certain level of production (= resilience improvement). Once reached, farmers will use tuber heads. Therefore we can expect a slowdown in the use of minisets after a few years.

Summary

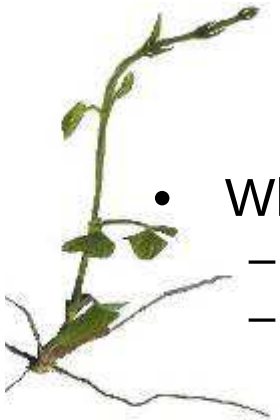
1. Generalities on yam
2. Local knowledge and practices on local yam
3. IA objectives and methodology for the introduction of white yam and its quick multiplication technique
4. Objectives & methodology of the study
5. Study results
    1. Characteristics of yam cropping systems
    2. White yam adoption assessment
    3. White yam multiplication assessment
6. Conclusions and perspectives



Conclusion (1)

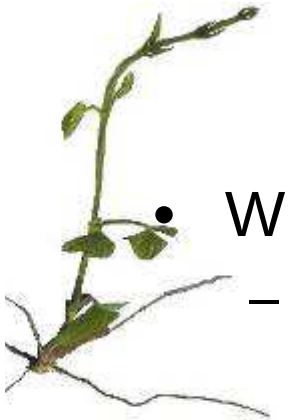


- Initially 1 old variety. 1 or 2 big tubers (up to 50 kg) per farmer and risky multiplication.
- IA has introduced mainly 1 new variety called “White yam” (up to 5 kg).
- Secondary crop (max 2% of the gross added value of the farms) among several others.
- Yam mainly cultivated individually during “spare time”– contrary to the main cropping systems based on rain-fed rice (which depend on work groups).
- Appreciated for quick cooking at noon, especially for children.
- Very high interest for the new variety:
  - Good gustative proprieties
  - Multiplication less risky (more small tubers = more seed yam = potentially lower occurrence of full losses)
  - Handy for storage, cooking and transportation



Conclusion (2)

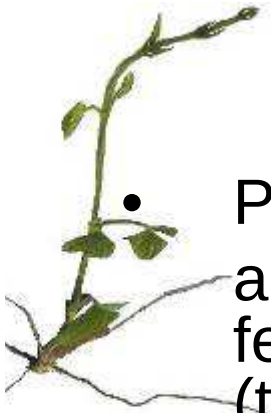
- White yam adoption after 3 cropping cycles:
  - 60% of initial receivers continue
  - Very few abandonments on purpose: abandonment highly linked to germination problems (½ of withdrawal mainly because of too small size of fragments <30g that didn't germinate)
  - +40% of new White yam growers (farmer to farmer spreading mainly among relatives and close friends)
  - Globally +45% of seed yam between the 2nd and 3rd cropping cycle ➔ -13% between the 1st and 2nd cropping cycle because of low germination rate!
  - Miniset adoption: 29% of farmers adopting White yam are still using miniset for the 3rd cropping cycle (even though most farmers plan to increase their yam cultivation):
    - Disappointment the 1st year because low germination rates in many villages (depending on the size of the fragments)
    - 75% of germination rate with miniset (2nd and 3rd cropping cycle) since farmers globally increased by themselves the fragment size (>30g)
    - Clear correlation between seed yam size and tuber size ➔ Farmers are generally expecting big tubers after 1 cycle: difficult with small to normal miniset fragments and small bulbils (2 cropping cycles required to get "normal" tubers).
    - Therefore, most farmers prefer using tuber heads (20% of the tuber), secondary and big bulbils (when aware of their germination proprieties) when they reach a satisfactory number of plants: 100% germination rate and big tubers harvested after 1 cycle.



Conclusion (3)

- White yam adoption after 3 cropping cycles:
  - 46% of adopting farmers reduced the number of planted seed yams (between the 2nd and 3rd cropping cycle). This seems to be somehow linked to the vulnerability status (not strictly):
    - For vulnerable farmers: tubers are more likely to be used for food consumption (difficult to store the tuber heads for next cropping cycle = 20% of the tuber) and it is more difficult for these farmers to dedicate extra time to yam
    - Food secure farmers are more likely to be dedicated to rice production
  - An interesting observation: ½ of prolific yam producers are not involved in a work group while work groups are supposed to involve more than 90% of farmers…

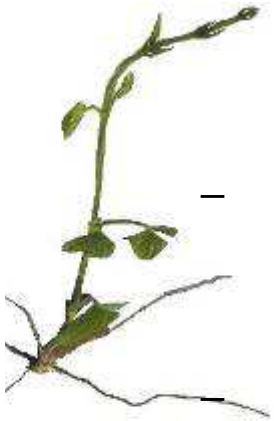
The proportion of decapitalizer farmers should be monitored to know if the trend is confirmed



Recommendations (1)

- Previous results for White yam and miniset adoption are globally encouraging. The study findings lead to a few recommendations for the coming activities on yam (to be integrated to the current methodology).
  - **which variety?**
    - In addition to White yam we stressed the interesting charasteristics and the high interest of farmers for Chinese and Tato yam. IA should also actively diffuse those yams.
  - **to whom?**
    - White and Chinese yam ➔ for active men (both household heads and young men still depending on another household who are also very interested in developing personal crops)
    - Tato yam ➔ for elders and women (suitable variety as they are not doing ridges & in priority to headed pot women or 2nd or 3rd wives left aside by their husband)

      Do not focus on a specific vulnerability status! We have noticed that White yam multiplication could be slightly better and more adapted for “average” farmers but we still assume that it is relevant to equally target every type of farmers.



Recommendations (2)

- **Ridges VS holes**
  - Hole to be experimented. Some farmers tried because it is similar to Makakabi. However, no clear productivity difference identified (ridges seem OK because tubers are quite small compared to Makakabi) ➔ For the moment, keep advising ridges (much quicker).
- **Which multiplication advise?**
  - Keep promoting miniset for white yam (with over 30g fragment =match box) for initial quick multiplication and for seed recapitalization after losses. Moreover, it is still an excellent way for large scale diffusion of the variety (low logistical constraints & low cost activity as the number of tubers to find + transport + buy is limited).
  - Create awareness on bulbil use
  - Create awareness on correlation between seed yam size – tuber size to avoid disappointment after the 1st cycle
- **Nursery VS direct planting**
  - No clear difference identified (nursery requiring much more manpower). Might be advisable for small miniset fragments (but this shouldn't be the strategy proposed by IA)
- **Wood garden stake or not?**
  - For White yam, no productivity difference has been observed. Specific trial should be done at IA office to compare (with White and Chinese yam). If it is confirmed, wood garden stake preparation could be avoided to save time (+20% of labor productivity).
  - For Chinese yam thinner stems require wood garden stake
- **Small ruminants attacks**
  - Very different situations according to villages (why?) ➔ awareness
- **Discuss cropping sequence including yam**
  - Avoid cropping yam several cycles on the same place (cf nematods in Brazil)
- **Post harvest storage**
  - Under shadow, dry, ventilated and rat free place (in a basket with straw: closed enough to be rat free, opened enough to be ventilated)

Recommendations (3)

Tato yam cropping patterns recommended:

- Select a place near a “strong” garden stake (tree) and easy to watch over
- Dig a small hole (hand length)
- Bring straw to burn (sterilization)
- Add local compost covered with soil
- Add the bulbil and cover it
- Add a small garden stake going to link to the “strong” one
- Harvest bulbil easy to take down
- Keep the smaller tubers for next planting
- Leave the tuber in the ground (it will germinate again the following cycle)
- Do not leave more than 2 years at the same place to prevent pest and diseases (take out the tuber and plant it again somewhere else)