FINAL TECHNICAL REPORT

Participatory Rice Variety Improvement in Ghana II

DFID Plant Sciences Research Programme Project R7657

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Crops Research Institute, Kumasi, Ghana

Savanna Agricultural Research Institute, Nyankpala, Ghana

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Acknowledgements

We would like to thank:

John Witcombe, David Harris and the staff of DFID Plant Science Research Programme at CAZS for their help and support throughout this project.

Farmers in Volta, Western, Northern and Upper East Regions of Ghana who willingly and enthusiastically participated in the PVS activities.

The Directors of CRI and SARI for their support for the project and the provision of facilities.

Joyce Haleegoah, CRI, for assistance with aspects of the work at Hohoe.

MOFA and NGO staff in Volta, Western, Northern and Upper East Regions of Ghana for their support and assistance.

Michael Dingkuhn, Timothy Dalton, Monty Jones and Myra Wopereis from WARDA for providing seed and support to the PVS process in Ghana and West Africa through the PRIGA program.

The Gatsby Foundation for supporting parallel PVS activities in Ghana and for their current support for rice production in Ghana.

EXECUTIVE SUMMARY

Increasing productivity and production of rice is a major challenge facing the government of Ghana which spends >100 million dollars annually on rice imports. In Ghana more than 50% of the rice lands can be described as upland and hydromorphic and these are distributed across the country. These are lands mostly used by the most vulnerable in society, i.e. women and the poor. In Ghana very few rice varieties adapted to these ecologies have been formally released. Even where released varieties exist, their seed is neither readily available to the poor farmers nor necessarily the type of cvs farmers or consumers want. Participatory approaches, including Participatory Varietal Selection (PVS), offer one way to overcome these constraints by involving farmers directly in the process of variety improvement and testing, as well as by utilising informal seed systems for dissemination.

The PVS programme in Ghana was initiated in 1997 and this report covers the period 2000-2003. The programme has so far been implemented in six out of the 10 Regions of Ghana and has involved more than 2500 farmers. Researcher-managed, extension/NGO-facilitated and community-managed PVS's and Mother & Baby systems have been piloted with farmers. Based on experiences of the above over the past six years, it is proposed in Ghana to have a PVS process starting with: (i) a cv needs assessment to identify plant types and bring the community into the process; (ii) nurseries or rice gardens in the community (i.e. 'Mother' trial) over one or two years; (iii) 'Baby' trials for two years in parallel with formal testing; (iv) cv release; and (v) formal and informal seed dissemination. Facilitation of the process would appear to be essential along with seed multiplication and the provision of seed for at least the first two years. Post-harvest traits must be evaluated as early as possible in the process.

Seed dissemination was monitored following seed distribution (1-2 kg per farmer) using different pathways in five communities around Hohoe. The most successful dissemination method was a community seed bank, whereby for each kg a farmer received, 2 kg had to be returned to the bank after harvest. Two communities independently organised such a seed bank. Irrespective of how seed was initially distributed, seed moved first through kin relations, often by exchange, and was only

sold when larger quantities were available. Seed sold at a premium and demand far outstripped supply in the first two years. However, by the third year a few seed producers were harvesting large quantities of seed and there was a noticeable increase in uptake. By 2003 seed had moved >100 km through informal channels.

A survey of C. 2500 upland rice farmers around Hohoe showed that 36% of them were growing a PVS cv, and 83% were aware of PVS cvs. The most popular cv was IDSA85, a cv with a highly desirable grain type, and which farmers named 'Idana', meaning you'll not be tired to reflect it's ease of threshing. Three other cvs from the original PVS were also being grown widely.

In northern Ghana, SARI formally released a cv, IR12979-24-1 using a combination of formal and PVS/ Mother & Baby data. This cv was first tested in 1985 but was promoted only after it's inclusion in a PVS in 2000 and subsequent selection by many farmers. This cv performed outstandingly well on-farm. An integrated system of PVS/Mother & Baby trials and formal multi-locational testing is proposed to release cvs in Ghana.

BACKGROUND

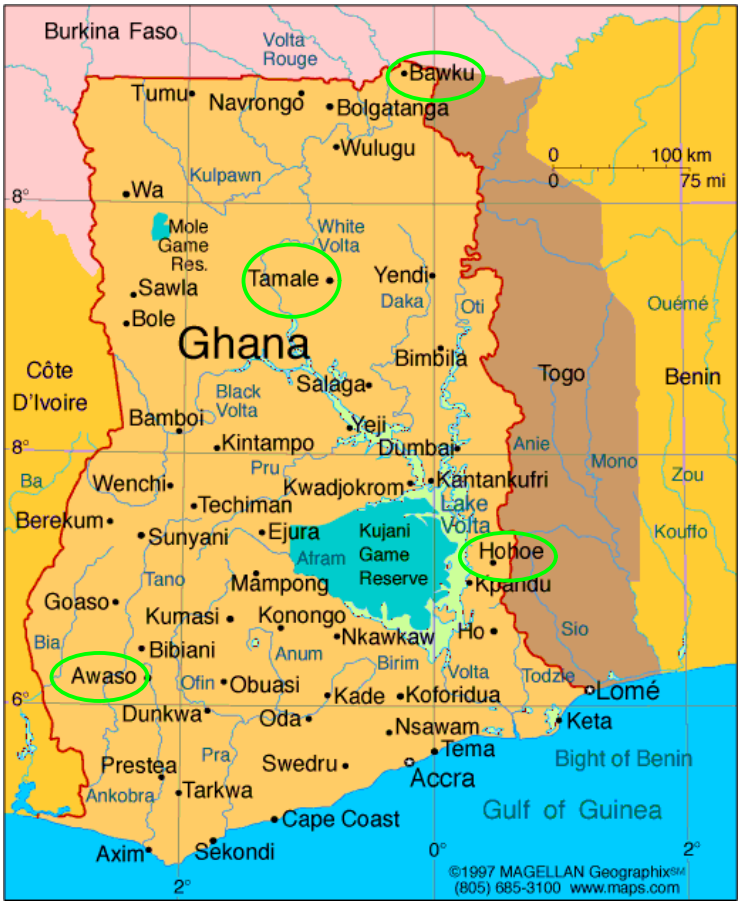
Rice is becoming an increasingly important staple food consumed throughout Ghana. The per capita consumption of rice has doubled from 7.0 kg year^{-1} in 1988/89 to 20 kg year^{-1} in 1997. Rice production has expanded to play a key role in achieving national food security, alleviating rural poverty and contributing to the overall economy, through import substitution and foreign exchange conservation. Ghana imports about 564,000 mt paddy annually, compared with domestic production of 221,000 mt. Imports are expected to rise to 672,000 mt by 2006. Imports of milled rice alone were worth $48 million in 1995 and $100 million in 2000. [Source: Ministry of Food and Agriculture (2003). National Rice Development Committee. MOFA]

Various reports have identified lack of improved cvs as an important constraint to increased rice production. In general, poor accessibility and poor adaptation of released cvs is a problem in all rice ecologies. Indeed, there have been no cvs formally released for upland rice to date in Ghana. Increasing the choice and availability of improved cvs. will improve farmers' livelihoods. Higher yield per unit area and the availability of cvs. commanding a high market price should benefit farmers' overall incomes directly. A wider choice of cvs. in terms of crop duration (maturity) should allow farmers more choice about when and where to plant, which will contribute to maximising returns on labour, as well as allowing food and/or income to be generated at specific times during the season. The greater weed-competitiveness of new cvs. should also reduce labour costs, again improving livelihoods. Another benefit particularly applicable to women is that new cvs. are easier to harvest because of their greater plant height.

PROJECT PURPOSE

PSP Programme Outputs: Pathways for the potential equitable uptake of technologies from PSP Outputs O2 to O6 identified and promoted

This Project will put in place in Ghana strategies to identify and test with male and female farmers improved rice cvs. The involvement of farmers, extension agencies and other stakeholders in the research and dissemination process will contribute to ensuring that outputs are appropriate and acceptable. The Project will also identify and test informal seed-uptake pathways. Participatory varietal selection will be promoted through the active participation of stakeholders in the process, and through field days and Local and Regional Workshops.



Map of Ghana showing project locations

PROJECT LOGFRAME

Purpose Pathways for the equitable uptake of technologies from PSP Outputs O2-O6 identified, piloted and promoted			
Outputs 1. Participatory varietal selection program to identify and evaluate drought-tolerant, weed-competitive and disease tolerant cvs. piloted in hydromorphic/upland systems in two agro-ecological zones [=methods modified and tested as needed from Phase I] 2. Seed-uptake pathways identified and the spread and adoption of new cvs. measured [=continuation of Phase I PVS activities, uptake pathways analysed] 3. Potential impact of new drought-tolerant and weed-competitive cvs. assessed [=carried over from Phase I] 4. Participatory cv improvement and release, and seed health and quality, promoted in Ghana [=evaluation and feedback, links with uptake organisations, promotion]	1. 50 farmers select and test new cvs. on their own farms in 2002 at each location Farmer participatory varietal selection program adopted by NARS as part of varietal release process by 2005 2. New cvs. are grown by 20 farmers in each project farming community in 3 areas in 2001, by at least 20 farmers in 4 communities in 3 areas in 2002, and by 20 farmers in 8 communities in 3 areas in 2003 Seed-uptake pathways identified and tested by 2003 and dissemination strategies developed to maximise benefits from informal seed-uptake pathways by 2005 3. Potential benefits of new cvs. quantified by 2003 4. Workshop recommendations published in 2003	• Project, WARDA and NARS reports • Publication in peer-reviewed journals, and presentation at scientific meetings • Release of cvs.	• Persistence of a socio-economic climate favourable to adoption of project findings. • Ongoing viability of WARDA and NARS partners. • Farmers are able to adopt new varieties and improve management strategies • New cvs. are higher yielding, more disease tolerant and of acceptable quality • Promotion pathways identified are developed • No legislative constraints to release of cvs. through participatory means • Improvement in milling quality
Activities 1.0 Complete analysis and interpretation of socio-economic and cv trait preference data from Phase I 1.1 Stakeholder and work planning and co-ordination meetings 1.2 Multiply seed for PVS/testing program 1.3 Training of key personnel from two sites in Needs Assessment, PVS protocols and data enumeration 1.4 Variety Needs Assessment exercises at two sites to identify desirable and acceptable plant types 1.5 Implement PVS program at two sites with targeted drought-tolerant, weed-competitive and disease tolerant cvs.	Data analysed and disseminated at Project planning meeting and PRIGA Workshop in April 2001 Two meetings held in each year and work plans produced At least 500 kg seed of each selected cv multiplied in each year Key personnel identified and trained by September 2000 Needs Assessments conducted at 2 locations in September and December 2000 PVS/testing formal and farmer trials conducted at 2 locations in 2001, and at least 4 locations in 2002	• Project, WARDA and NARS reports • Publication in peer-reviewed journals, and presentation at scientific meetings • Field visits and monitoring • Workshop and training materials	• Access to WARDA and NARS skill base and facilities is maintained. • Farmers and MOFA/NGOs agree to participate in PVS/testing program • Adequate seed of new cvs. is available

	Data collated and made available to Seed Release Committee by 2003		
2.1 Describe farmer and informal sector seed production practices, measure seed quality, cv purity and seed health, and identify seed-uptake pathways	Seed production practices assessed at 3 locations by end 2000 Seed-uptake pathways identified by April 2001 Seed quality and cv purity assessed at 3 locations by July 2001		
2.2 Test seed-uptake pathways identified in 2.1 by distributing seed of farmer-selected cvs. to identified seed-uptake stakeholders	At least 500 kg seed distributed in seed lots in each of 3 regions in 2001		
2.3 Monitor spread, and understand mechanism(s) of spread, of new cvs. from informal seed release and production systems	Surveys and interviews in 3 regions in 2002 and 2003		
3.1 Complete analysis of replicated yield data from Phase I	Data analysed and disseminated at Project planning meeting and PRIGA Workshop in April 2001		
3.2 Replicated yield trials at 4 benchmark sites to assess effect of soil fertility/ weed management and disease prevalence on yield and seed quality in new and traditional cvs.	Yield trials conducted at a minimum 4 locations in 2000		
3.3 Potential impact of new drought and weed-competitive cvs. assessed by simulation modelling	Yield gaps determined by June 2001 and simulations of potential yield and adaptation completed by 2002		
4.1 Annual stakeholder meetings, field-days, WARDA/PRIGA Workshops and Project stakeholders dissemination workshop in Ghana	Meetings and field-days held in each year, Workshop held in Ghana in February 2003		

CONTRIBUTION OF OUTPUTS

- PVS, Mother & Baby and informal seed dissemination methods have been successfully implemented and promoted with upland rice farmers in four regions of Ghana – Volta, Western, Northern and Upper East
- A formal survey revealed that 36% of c. 2500 farmers interviewed in eight communities near Hohoe, Volta Region grew PVS cvs in 2002. Eighty-three percent of these same farmers said they were aware of PVS cvs. Most of this spread and awareness is through informal pathways. Thirty percent of farmers who did not grow PVS cvs said they were unable to get seed
- Around Hohoe seed has spread about 30 to 40 km per year through informal pathways, despite very small initial inputs (1-2 kg per farmer). Two communities independently organised very successful community seed banks to promote spread new cvs. Farmers who participated had to return twice the quantity of seed borrowed at the end of the season
- A cv from the PVS at Hohoe in 1997 & 98, IDSA85, has been very widely adopted by farmers in the Hohoe region. This cv has highly desirable grain characteristics commanding a good market price. It is also adapted to several ecologies/hydrologies. Farmers have named this cv 'Idana', meaning 'You'll not be tired' because it threshes easily
- Three others other cvs from the same PVS, namely WAB209, WAB126 and WAB340 have also been adopted in the Hohoe region. At least six others cvs from the original PVS are also still being grown
- A release and testing system combining formal and participatory Mother & Baby trials has been implemented by SARI rice programme to identify and release cvs for the Northern and Upper East Regions. This is outlined in the Figure at the end of this section.
- IR12979-24-1, named locally as *Digang*- meaning it does not discriminate any ecology, has been formally released through SARI for northern Ghana using data from participatory and formal trials. More than 200 farmers tested this cv in a Mother & Baby system in 2001

- Awareness of participatory method in crop improvement and cv release has been increased in agricultural institutions and among scientists in Ghana through Workshops, field days, Seed Release procedures and presentations
- Following the success of the PVS work, The Gatsby Foundation is funding further work with the National Programme on rice improvement and marketing in Ghana which will consolidate DFID and Gatsby-funded PVS work
- Drought patterns for the main upland rice growing regions have been analysed using dry spell and water-balance analyses. Durations from sowing to flowering and maturity of cvs representing traditional and improved types have been simulated at key locations. In northern locations, where end of season (terminal) droughts are the norm, relatively photoperiod-insensitive and short juvenile phase cvs are required. In the Volta Region, where the season is much longer but with a risk of drought during August, later maturing cvs are needed with early sowing dates and vice-a-versa with later sowing dates. In the western region, where sowing dates are early in the season, drought is not a serious problem. In all cases traditional, late flowering *O. glaberrima* cvs , which are highly photoperiod-sensitive, are prone to drought
- Results and experiences of the PVS work has been disseminated through: farmer field days, research field days, media including radio, scientific presentations, training and awareness for NGOs and MOFA extension staff, local and international workshops, presentations to Seed Release Committee, presentations to policy makers and potential donors

Key findings

- Farmers report weeds and drought as the major constraints to rice production in Ghana
- Local *O. glaberrima* cvs from Volta Region are highly photoperiod-sensitive and crop duration is very dependent on sowing date. Most improved cvs, such as WAB lines and interspecifics, are much less sensitive to photoperiod and are early flowering
- An analysis of drought patterns, using dry spells and water-balances, showed that the probability of a 5d dry spell at flowering, the most sensitive stage, is

high in the northern areas and at Hohoe and Western Region with later sowings. Late flowering local cvs are highly likely to be droughted during flowering and grain filling

- Yields of local cvs were on average 671 kg/ha in the Northern Region and <250 kg/ha in Volta Region in 2001. Improved cvs yielded on average 1100 kg/ha and 500 kg/ha, respectively
- Participatory trials (PVS and on-farm) have shown no differences between male and female farmers in trait or cv preference among the very wide range of cvs tested. The adoption of PVS cvs was also the same by male and female farmers
- Pre-harvest, farmers are most concerned with lodging and yield. Post-harvest, ease of threshing, cooking quality, taste, aroma, grain shape and size, expansion ability, keeping quality of prepared rice and storage ability are all very important traits
- In 2001 and 2002 upland rice production in Volta was severely affected by drought. Local, long-duration cvs failed to produce any yield in many cases while new cvs, which are much earlier maturing, did produce something. These new cvs were named ‘ miracle rice’ by some farmers
- Informal channels are the most common source of seed and means of spread of new cvs: the survey at Hohoe showed that: 35% seed used was saved from previous harvest; 33% of seed was from exchange of seed of existing varieties for the new cultivars; while 17% of seed was to be replaced in kind. Kin relations are very important in this process, as a source of new cvs and information about new cvs
- Seed of new cvs sold at a premium – as much as 30% above the price of seed of the local cv. Demand for seed was high, both because of the desirable grain characteristics and earlier maturity and performance under drought.
- The process of cv spread was similar in all communities, irrespective of how seed was introduced or year of introduction
- Although informal channels dominated seed spread due to of absence of a well developed input market, four farmers reported purchases from seed dealers and seed of PVS cvs was observed in a dealer in Hohoe within two years of

the PVS. This seed sold at upto double the price of seed of local cvs. However, cvs were mislabelled, adding to the apparent problem of seed mixtures

- The survey revealed that in 2002 1106 kg of IDSA 85 was produced for sale by farmers questioned. Only two farmers were responsible for 75% of this total, indicating the importance of local seed producers in the process of (informal) spread. However, these farmers supplied this seed in relatively larger quantities to a very few farmers
- Some farmers reported germination problems with IDSA85. Further investigation revealed that seeds of Kawumo (local *O. glabberima* cv) took more than six months after harvest to lose dormancy while the improved cv IDSA 85 reached plateau (100%) faster and therefore lost viability very quickly. However, the interspecific varieties (WAB 450-24-3-2-P18-HB, WAB 450-I-BP-160 and WAB 450-I-BP-38) and IRAT 262 maintained better viability and vigour in storage than Kawumo

Recommendations

- The project has piloted several different methods to 'manage' the PVS process, from researcher through to community/farmer managed PVS. Experience has shown that the process requires facilitation and there should be a nursery or rice garden in the first year
- A cv Needs Assessment exercise is a very important first step in implementing a PVS programme. The Needs Assessment allows appropriate cvs to be identified and chosen with the community and brings the community into the process at the start
- It is essential to have adequate seed at the start of the process, and to provide seed for at least the first two years for a successful programme. Communities with high uptake were those that received follow-up from research and extension, including support to seed production.
- Local seed producers are clearly very important initially to generate surplus seed for sale, especially for farmers growing larger areas. Kin relations are very important for disseminating smaller quantities of seed and it may be

important to target different kin groups in order to maximise the initial spread of a new cv

- Post-harvest traits are very important to all farmers and must be assessed by plant breeders prior to testing and release. Ease of threshing, cooking quality, taste, aroma, grain shape and size, expansion ability, keeping quality of prepared rice and storage ability are all very important traits. Some of these traits can only be assessed *in situ* and over the longer term by farmers themselves, reinforcing the need for farmers to be given seeds to grow and use as early as possible in the process. The apparent poor storability of some new cvs needs to be addressed
- A greater intuitional capacity for seed multiplication, particularly at CRI, is needed. Throughout this process the limiting factor for participation and dissemination was the availability of seed
- In order to facilitate official seed release and satisfy current institutional seed release committees' requirements, it may be best to grow selected PVS varieties on station or in researcher-managed trials as well after year 2 of a PVS programme. Attitudes of institutions and individuals to the reliability of data from PVS are only likely to change with time and exposure to the process

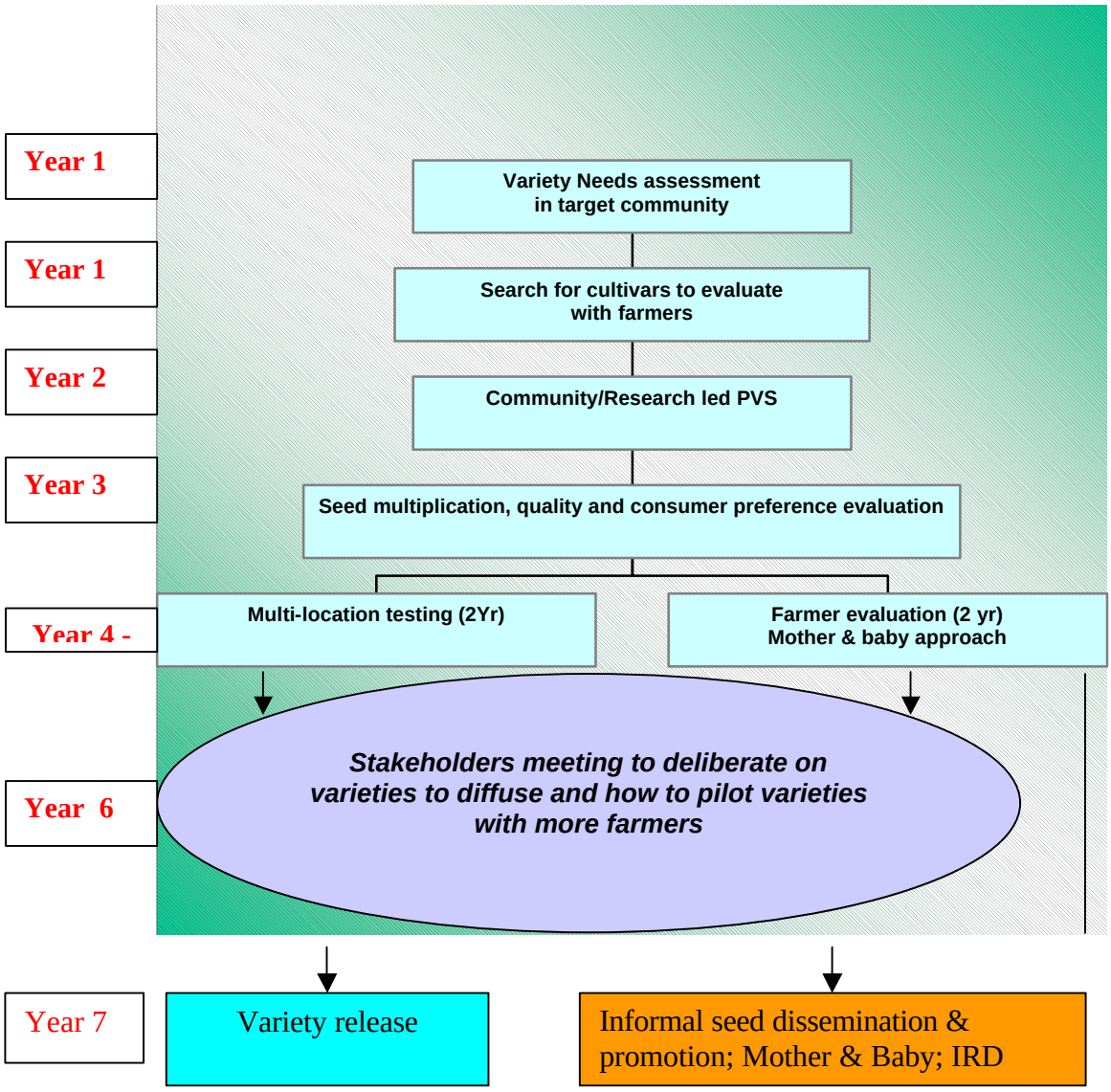


Figure. Schematic diagramme of proposed integrated PVS and formal release system in Ghana

RESEARCH ACTIVITIES

1 Introduction

This report covers work carried out in Ghana between 1999 and 2003 and as such includes a summary of Phase 1 (1997-99) activities. The overall framework of the project is shown below in Fig. 1. The report is in four main sections. The first section describes the initial researcher-managed PVS process carried out in Phase 1. The second section describes cultivar needs-assessment and facilitated PVS, including the Mother & Baby system (i.e. managing the PVS process). The third section describes the spread of cvs in Volta region following seed distributions in 1999 and 2000. The fourth section describes how the PVS process has been integrated into the formal cv release system in Ghana.

DFID PVS in Ghana

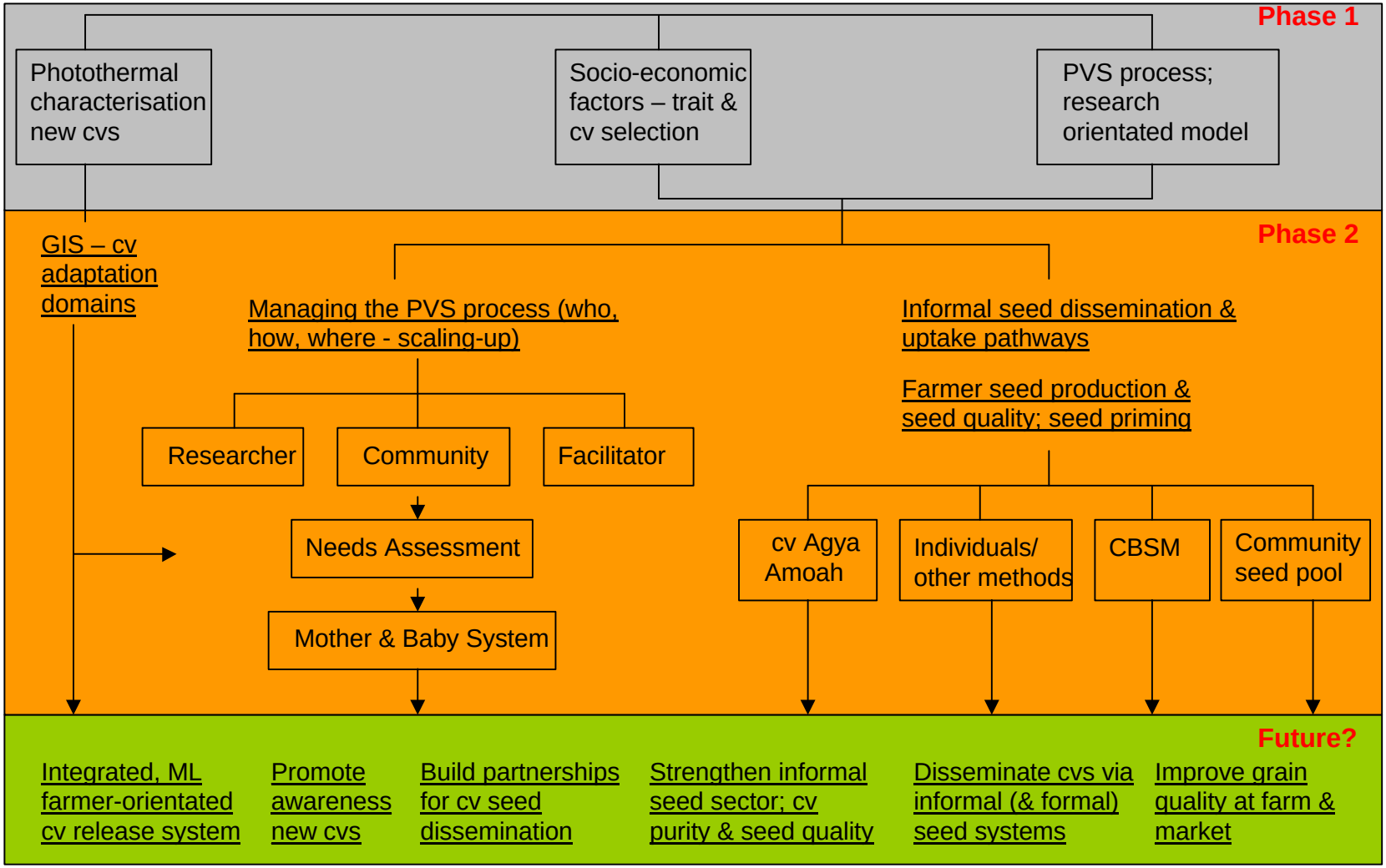


Fig. 1. Schematic diagramme of Phases I and II of the Ghana Upland Rice PVS Project

2 Summary Phase 1(1997-2000)

2.1 Researcher-managed PVS

Between 1997 and 1999, participatory research was conducted in three agroecological zones in Ghana: in the forest zone at Hohoe (Plate 1), which has a weakly bimodal rainfall pattern and an annual rainfall of 1578 mm; in the transition zone at Aframso, which has a bimodal rainfall pattern with a high probability of drought during the growing season; and in the savanna zone at Nyankpala (Plate 2), which has a monomodal rainfall pattern and an annual rainfall of 1143 mm. Rice culture at Hohoe is pure upland in a slash and burn system; in contrast at Nyankpala rice is grown in hydromorphic conditions.

Hohoe, in the Volta Region, is an important upland rice growing area where traditionally most rice farmers were women. However, as tree crops such as cocoa have declined, more men are now entering rice farming. This summary will concentrate on Hohoe, since many activities in Phase 2 follow from this work.

2.1.1 Characteristics of farmers at Hohoe

Meetings were organised at the start of the project with local extension officers, village heads and farming communities in three adjacent villages near Hohoe. These were Akpafu Odomi, Akpafu Mempeasem and Akpafu Todzi. Farmers in Todzi only cultivate upland rice while both lowland and upland rice are cultivated in the other villages. Thirty men and 30 women farmers who volunteered to participate in the PVS took part in a number of PRA activities in groups or individually to describe local rice farming practices, including cv selection criteria. There was no *a priori* selection of farmers. A household questionnaire was also administered to determine the socio-economic status of the participants.

Farmers varied in age and experience of rice farming from <29 to >60 years, and <5 to >20 years, respectively, with a good distribution between minimum and maximum

Plate 1. Upland rice field near Todzi, Volta Region

Plate 2. Hydromorphic field near Nyankpala, Northern Region

values (Figure 2). Most farmers (82%) were educated to at least Senior Secondary school level and were therefore literate. Rice is grown both for household consumption and as a cash crop, with about 60% farmers selling more than half their produce. Farmers have no access to formal sources of credit, and where credit has been used, this is largely from relatives or neighbours and friends.

(a) Age (b) Experience

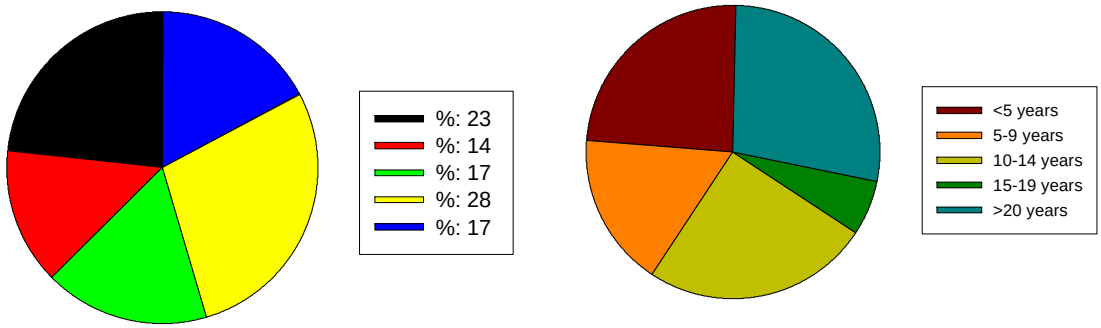


Fig. 2. Age (a) and experience of rice farming (b). Source: PVS questionnaire, Hohoe 1997

Most rice farms were between 0.5 and 1.0 acres, largely reflecting the amount of land that can be easily cleared as all land preparation is by slash or slash and burn (Fig. 3). Sowing is by broadcasting or dibbling in rows and fertilizer is not used because in general land is considered fertile. Upland rice is planted mostly in June or July so that it matures in November or December when rainfall is lower. Weeds are controlled manually by all farmers and no pesticides are used at all. Land preparation, weeding, bird scaring and harvesting/threshing are all labour intensive and labour is a big constraint, with 58% farmers reporting labour problems.

Upland rice farmers grow only one cv, Kawumo, and this cv has been grown for at least 55 years. Kawumo is an *O. glaberrima* cv with a crop duration of 150-160 d. The cv is low yielding and lodges badly, but has good taste and excellent storage characteristics.

(a) Farm size (b) Proportion of rice crop sold

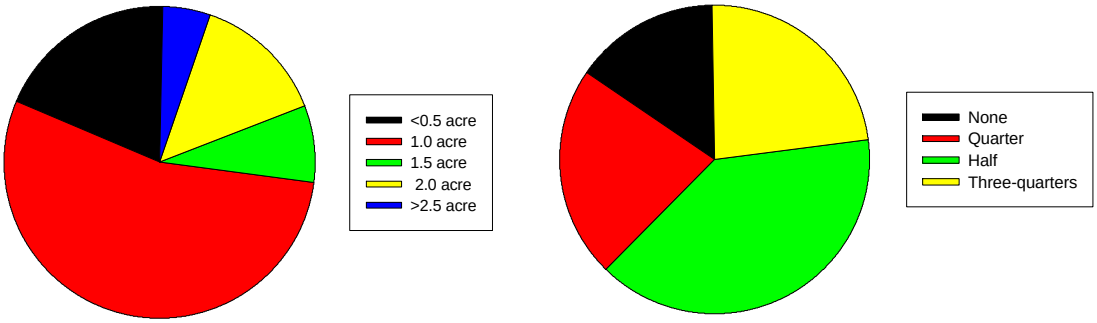


Fig. 3. Farm size (a) and proportion of rice crop sold (b) Source: PVS questionnaire, Hohoe 1997

More than 90% farmers use their own seed for planting and the rest obtain seed from neighbours or friends. No improved cvs are grown on the uplands and farmers are unaware of new cvs. Farmers report that bird damage, weed infestation, lack of credit and labour shortage as their major constraints (Fig. 4).

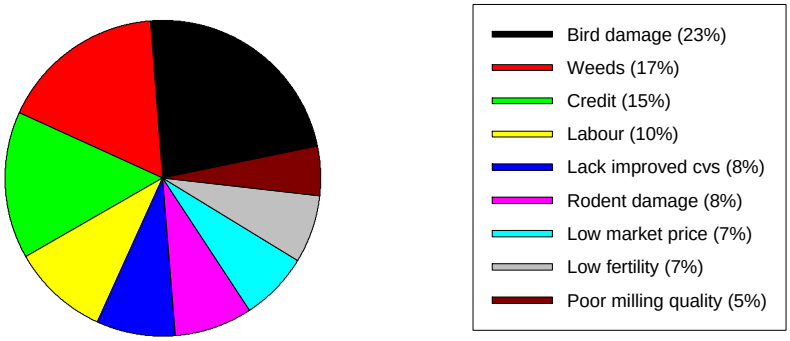


Fig. 4. Constraints to rice production. Source: PVS questionnaire, Hohoe 1997

2.1.2 PVS trials at Hohoe

Participatory varietal selection (PVS) trials were established at Hohoe in 1997 and 1998 with 100 and 60 entries, respectively. Entries in 1998 were chose by farmers and researchers in 1997. These entries included lowland, hydromorphic and upland

cvs and breeding lines. The PVS trials were arranged in two blocks, low and high input, differing in weed pressure and fertility, with repeated checks. Each plot was $10m^2$. These were therefore researcher managed on-farm trials. The site for the trials was classified as favourable upland/ hydromorphic. Men and women farmers were invited to evaluate plots and select cvs on three occasions: during the vegetative and flowering stages, and at harvest (Fig. 5). On each occasion, farmers were asked to choose upto five cvs/plots. Post-harvest evaluations were also carried out with a subset of cvs with farmers and market traders. Mean yield in 1998 was 1.52 t/ha with a maximum yield of close to 4 t/ha.

Farmers used a wide range of criteria to evaluate new cvs, depending on the stage of crop growth (Fig. 6). During vegetative growth, farmers selected for traits that contributed to greater weed competitiveness, e.g. broad leaves, plenty of tillers and vigorous early growth. Post-flowering it was plant height, panicle and particularly grain traits that farmers equated to yield. Unsurprisingly, therefore, cv selection varied with the stage of crop growth. For example, at the vegetative stage glaberrimas and indicas with profuse tillering were selected; post-flowering it was predominantly cvs with desirable grain size and shape.

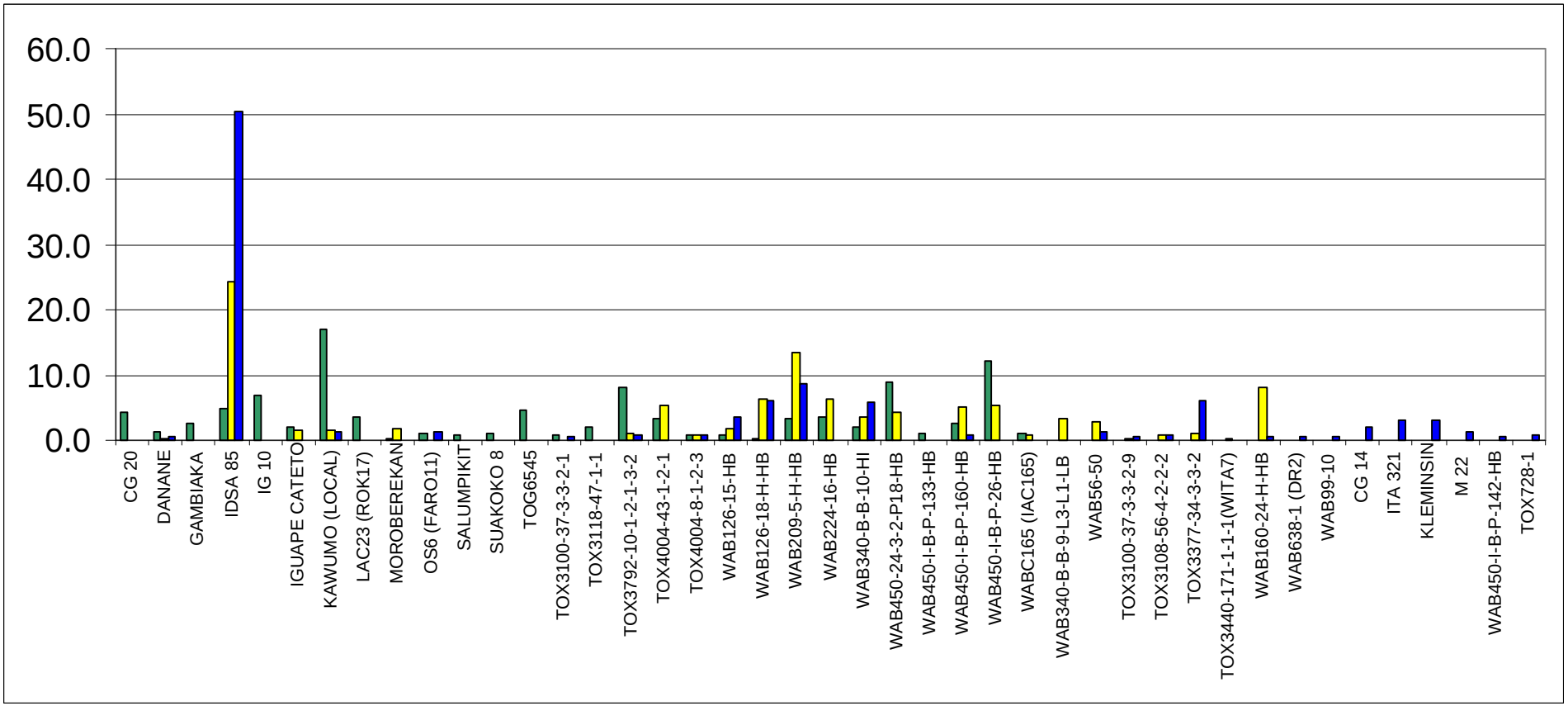


Fig. 5. Frequency of cv selection at the vegetative (green bars), flowering (yellow bars) and maturity (blue bars) stages of crop development. Frequencies are based on selections by 60 farmers at each stage

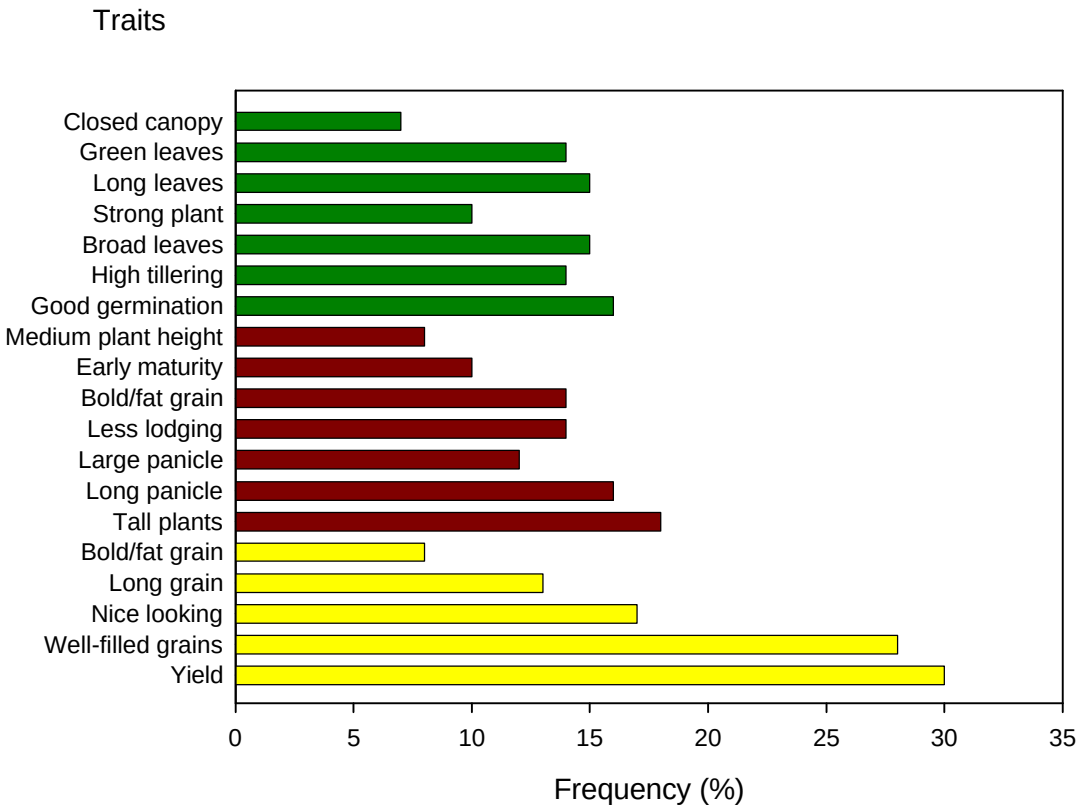


Fig. 6. Characteristics of cvs liked by farmers during cv evaluations at the vegetative (green bars), flowering (brown bars) and maturity (yellow bars) stages of crop development. Frequencies are based on responses of 60 farmers at each stage, Hohoe, 1998

At Hohoe (and other locations) male and female farmers made independent selections at all four stages of development. At each stage of development male and female farmers generally made similar choices, illustrated by vegetative phase selections below (Fig. 7). The only notable difference between male and female selections was that females always included some local cvs with red grain colour among their selections, as these are used in the preparation of traditional dishes for festivals.

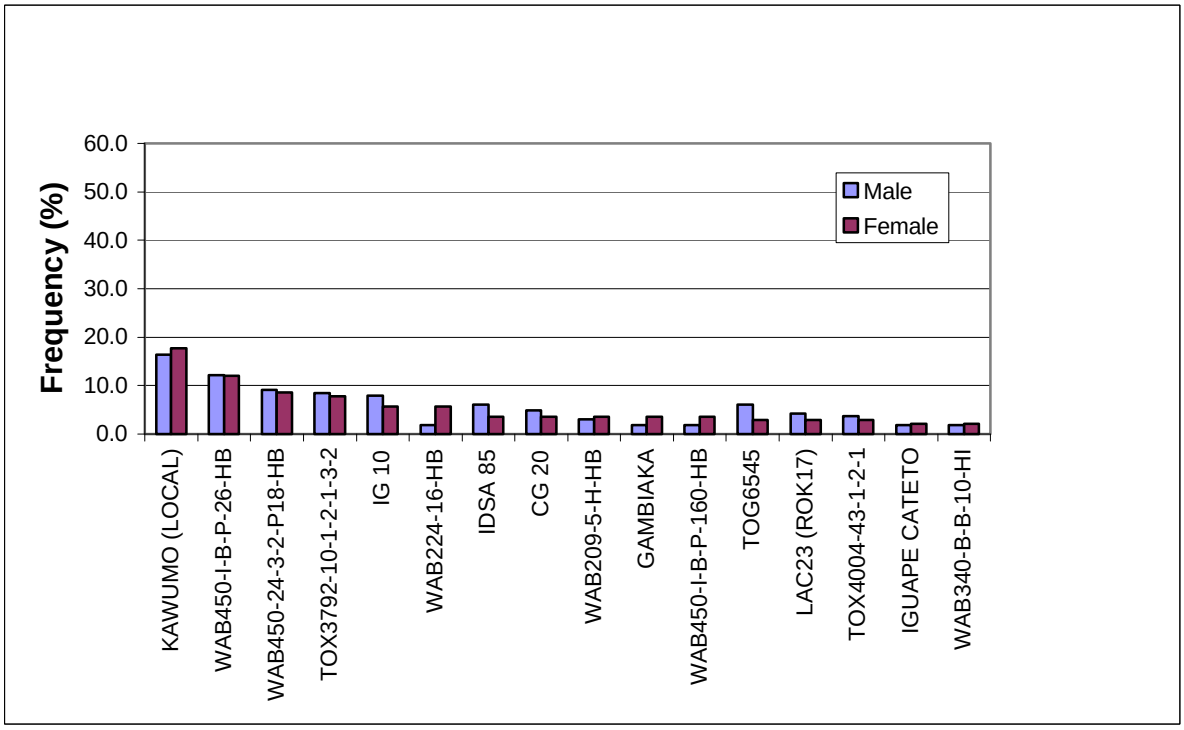


Figure. 7. Frequency of selection of cvs during vegetative stage by male (n=30) and female (n=30) farmers at Hohoe in 1998

Taste and other organo-leptic traits are also extremely important selection criteria and superior taste and higher market price are key reasons why local cvs of rice are preferred. Between 10 and 18 cvs were milled and evaluated by male and female traders at two major markets at Tema (Accra) and Kumasi, and by farmers in Todzi. Market traders value long, bold, white grained cvs as these are closest to those of imported rice (Fig. 8). IDSA 85 and WAB 126-15-HB both scored highly for these traits. Genotypes with coloured grains were also selected as these command a price premium for local dishes.

Overall, IDSA85 was preferred by more farmers, both male and female, than any other cv (Fig. 9). This cv was also chosen by traders. The most frequently chosen cvs were upland japonicas, glaberrimas or japonica × glaberrima interspecifics. Compared with the local cv Kawumo, selected cvs were all much earlier flowering, of similar plant height but did not lodge, high tillering and higher yielding (Table 1).

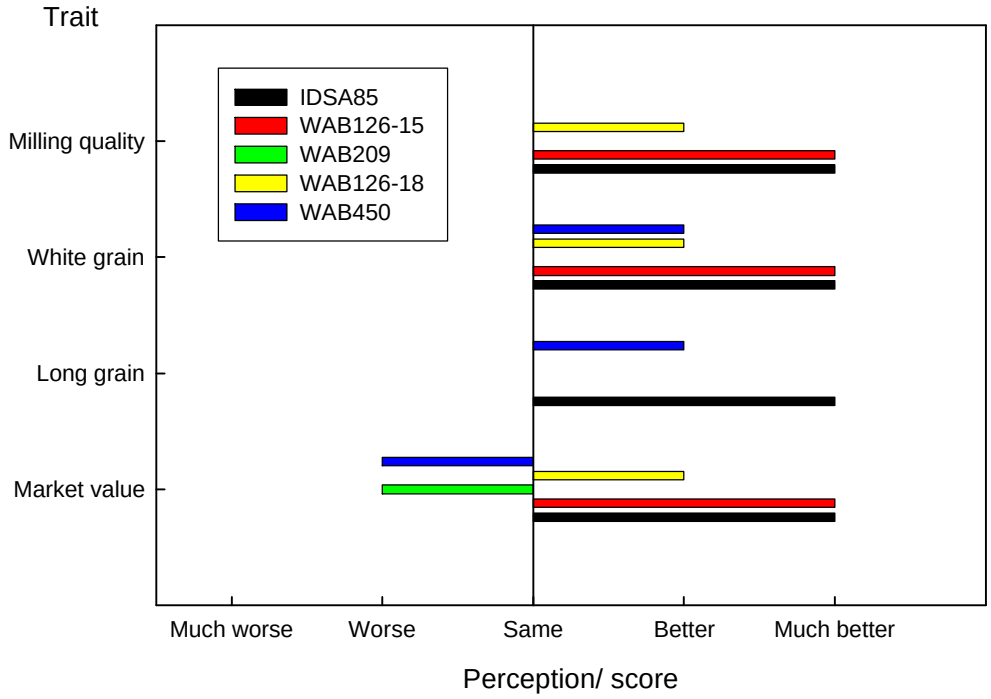


Fig. 8. Comparison of post-harvest traits of selected PVS cvs with local *O. glaberrima* cv Kawumo by market traders. Data are average of responses by 10 traders, Tema, 1998

Table 1. Characteristics of the local cv Kawumo and PVS cvs selected by farmers

Cultivar	Days to flower	Plant height (cm)	No. panicles (m^2)	Grain yield (t/ha)	Ecotype
Kawumo (local)	113	97	152	0.68	Glaberrima
IDSA 85	85	126	160	1.45	IUJ¶
WAB209-5-H-HB	93	106	84	1.78	IUJ
WAB450-I-B-P-26-HB	104	85	248	1.63	Interspecific
WAB450-24-3-2-P18-HB	75	108	72	1.20	Interspecific
WAB126-18-H-HB	93	101	106	1.23	IUJ
WAB340-B-B-10-HI	79	123	158	1.51	IUJ
TOX3792-10-1-2-1-3-2	107	105	233	3.08	ILI

¶ IUJ= Improved upland japonica; ILI= improved lowland indica

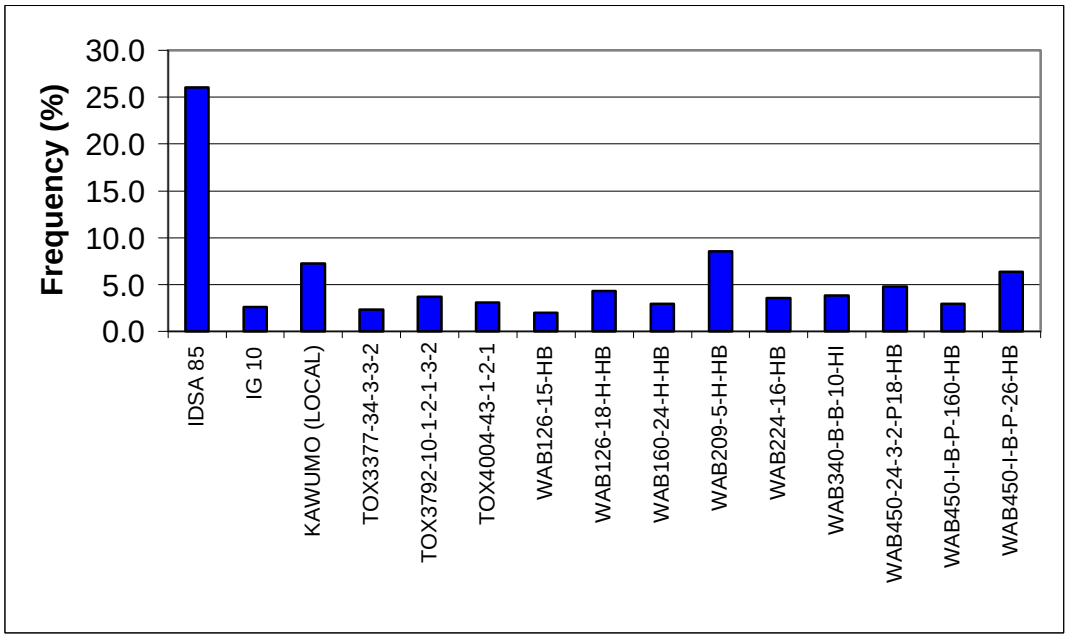


Figure 9. Overall frequency of selection of cvs by 30 male and 30 female farmers at three stages of development. Hohoe, 1998

2.1.3 Other PVS locations

Results were very similar at other locations with a broad range of traits and cvs chosen depending on agroecological environment. Male and females again chose similar cvs. At Nyankpala farmers made selections independently in the low and high input blocks, and the frequency of selections at harvest are shown in Fig. 10. Of the 14 most frequently selected cvs in low or high input blocks, 11 were selected in both blocks, many with similar frequencies. This is encouraging, since it suggests that the traits of interest to farmers are expressed in different agronomic conditions and that a number of cvs are adapted to high and low input conditions.

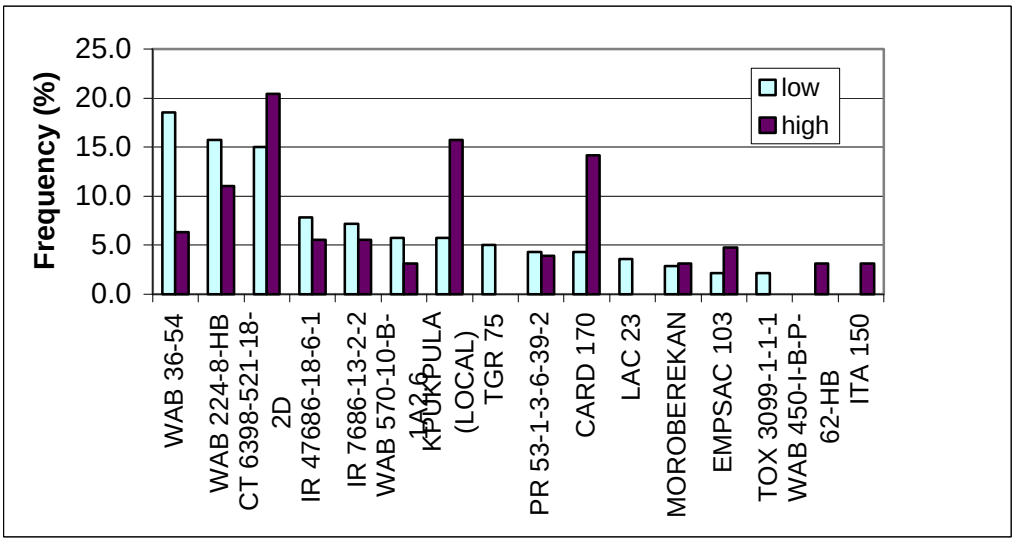


Figure 10. Frequency of selection of cvs at harvest under low and high input conditions at Nyankpala in 1998

2.2 On-farm paired comparisons

The objective of this report is to present an overview of farmer testing of varieties selected from the observation nurseries in 1997 and 1998 around Hohoe. It covers the methodology followed in testing the varieties, the results of the testing and farmers' criteria for selection, and the lessons and implications for future work on PVS.

2.2.1 Weather in 1999

Rainfall in 1999 was above average (Fig. 11). The normal growing season for upland rice is June/ July through to November/ December and rainfall between July and December was 955 mm. Average maximum and minimum monthly temperatures are between 30°-35°C and 22°-24°C respectively over the same period.

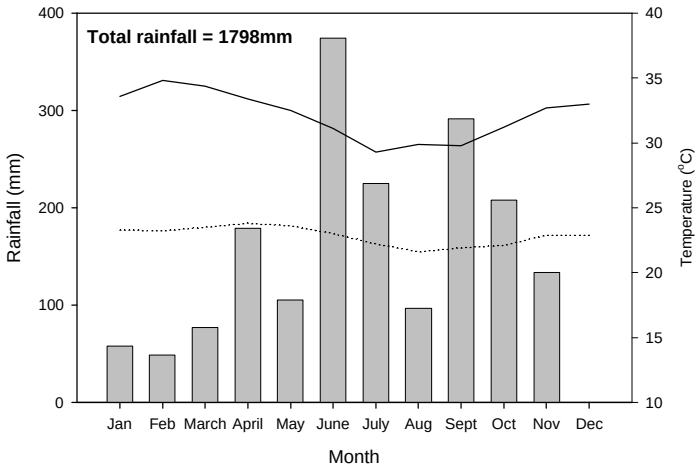


Fig. 11. Total monthly rainfall and average monthly maximum and minimum temperatures at Hohoe in 1999

2.2.2 Farmer selection and supply of seed

Ten cvs were supplied to 94 farmers who participated in the PVS trials at Hohoe (Table 2), half of whom were female. Farmers were from three communities within 5 km radius. Each farmer was supplied with one kg of two improved varieties.

Table 2. Distribution of seed (kgs) to three communities near Hohoe in 1999

Cultivar	Total
IDSA 85	43
WAB209-5-H-HB	37
WAB450-I-B-P-160-HB	19
WAB450-24-3-2-P18-HB	11
WAB 56-60	4
WAB126-18-H-HB	14
WAB224-16-H-HB	9
WAB160-24-H-HB	10
WAB340-B-B-10-HI	4
Moroberekan	16

Instructions to farmers were limited to the following:

- The rice was to be planted on upland fields
- The two rice varieties should be planted beside their own major variety on separate parts of the same field to facilitate comparison of performance under uniform field conditions
- The management practice should be uniform for all the varieties, and should be as normally carried out for upland rice production.
- Each field should be clearly identified by the name of the variety.

2.2.3 Criteria for varietal selection and evaluation procedure

Researcher and farmer evaluations were planned for the following stages of the rice cropping cycle: i) vegetative, ii) flowering, iii) harvest, and iv) post-harvest. Farmers were interviewed for their perceptions on the performance of introduced cvs in relation to their major variety. The research team also carried out a separate evaluation. Both farmers and researchers used the same set of criteria, and these were similar to those used for the evaluation of the PVS trials. There were also open-ended questions for the farmer to express views on the performance of the new varieties against their own. The most important criteria are given in Fig. 6 for each of three stages of development.

A rice breeder and an economist were the two key researchers who together with farmers evaluated the performance of the varieties. An agronomist and a rural sociologist also provided support. The breeder and agronomist carried out the following tasks:

- Identification of the varieties supplied to confirm whether they were the same as those that had been recorded
- Scoring of performance on the basis of the selection criteria from the perspective of the breeder
- Yield of each plot

The economist and rural sociologist carried out the following tasks:

- Individual and group interviews with farmers on their fields to obtain information on their perceptions of performance of varieties and their preferences

The evaluation up to the harvesting stage was carried out on the field. It was not possible to visit all fields, and so the group interviews were useful in providing a broader opinion. Farmers visited individual fields as a group with the researchers, and this facilitated group discussions. The post-harvest evaluation was carried out after the produce had been transported home. Farmers were requested to carry out processing and food preparation using their own methods and to score for given traits. In each case, farmers were asked to compare each of the two cvs supplied to the individual's most preferred variety, and to compare each of the supplied cvs to one another. They scored the supplied cvs as: better than, same, or worse than their local cv. Full results are given in the Appendices.

2.2.4 Farmer preference at pre- and post-harvest stages

Between 10 and 15 farmers who grew IDSA85 and WAB209-5-H-HB were interviewed pre- and post-harvest; totals for WAB340-B-B-10-HI and WAB160-24-H-HB were five or less. At the pre-harvest stage most farmers stated a preference for the new cvs (Fig 12), citing a number of different reasons (Fig. 13). The most commonly cited reason for preferring the new cv were earlier maturity. Larger, broader leaves, less lodging and greater tillering were also important. The local cvs are glaberrimas that have many tillers, many small panicles, and thin stems leading to lodging.

(a) Pre-harvest (b) Post-harvest

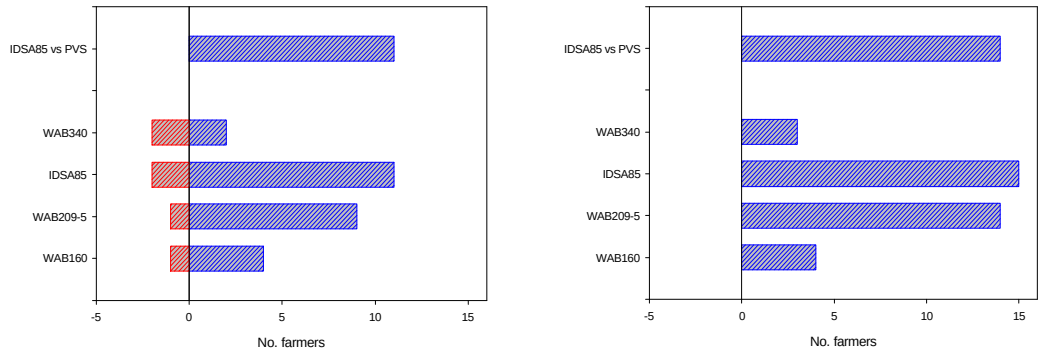


Fig. 12 Results of paired on-farm comparisons pre- (a) and post-harvest (b) of new cvs with farmer's existing cv. Blue and red bars show number of farmers expressing a preference for the PVS and local cv, respectively

(a) Pre-harvest (b) Post-harvest

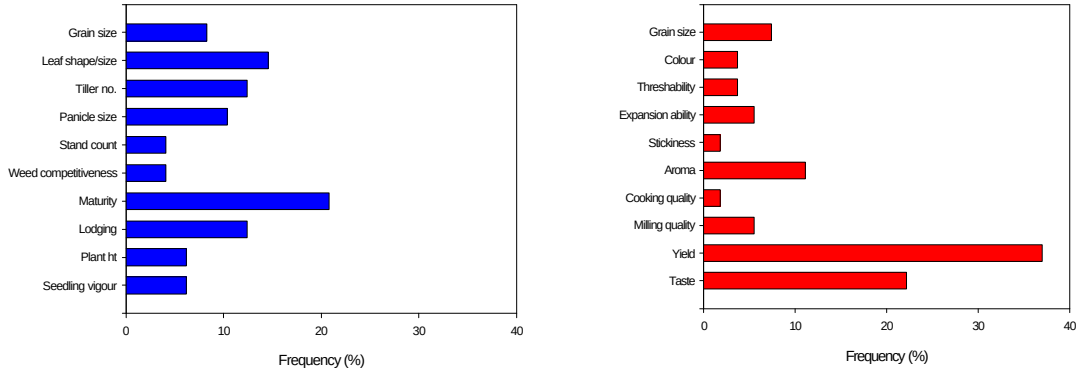


Fig 13. Cultivar characteristics/traits given by farmers when comparing PVS and local cvs pre- (a) and post-harvest (b)

Post-harvest, all farmers interviewed preferred the new cv, largely because of higher yield and superior taste. It was also clear from discussions at this stage that grain type was very important, although this was rarely cited as the main reason for preference. The group discussions at the harvest and post-harvest evaluation showed that the post-harvest criteria, particularly quality, were more important to the farmers than those of the vegetative and flowering stages.

One important criteria which was not evaluated was storage ability, as evaluations were done within 2 months of harvest. Farmer's cvs are known to have excellent storage characteristics, with little insect damage and good germination. Subsequent interviews and studies have confirmed the superior storage ability of local cvs.

Farmers were also asked to rank the new cvs. In all cases where IDSA85 was grown, it was preferred to the other new cv. WAB209. The preference for IDSA 85 by most farmers was due to its perceived superior food quality attributes and ease of processing (threshing and milling).

Grain yields of the new cvs and the local for comparison were also measured, but these data have not been made available by the breeding programme.

2.2.5 Farmers' comments on the on-farm comparisons

Farmers identified several factors which made it difficult for them to compare cvs easily. They were as follows.

i) Soils: steep slopes, long distance between fields with the different varieties

ii) Weeds: differences in weed pressure; some fields were planted at a time of high weed competition as fields were not planted at the same time, and some fields were planted sometime after land preparation when weeds had developed

iii) Pest pressure: termite activity on some fields

iv) Seed germination: differences in seed germination or insect/bird damage to seed at time of planting

v) Moisture availability: differences in moisture availability when planting was on different days

vi) Quantity of seed supplied. One kg seed supplied was small, especially against the background of the need to bird scare by new upland rice growers

2.2.6 Naming of new cvs

Following the success of the on-farm evaluations in 1999, and evidence of farmer-to-farmer spread, the farmers in Todzi were asked to give the new cvs local names (Table 3). Todzi is exclusively an upland rice area and farmers in this village had formed a rice farming group to participate in the PVS programme in 1997 and 1998, and were keen to share and promote new cvs.

Table 3. Local names and their meaning given to new cvs by farmers in Todzi

Variety	Local name	Meaning
IDSA 85	Idana	You'll not be tired (cv is easy to thresh)
WAB 340	Kaeme	Remember me
WAB 209	Elebode	Is good to eat
WAB 160	Adime	Saviour
WAB 224	Eleme	It's good for me
WAB 450	Malamanyo	I'll take care of it and see
WAB 56-50	Eteyalå	It will be well
Eguape Cateto	Leyawor	I will not perish

2.3 Drought and adaptation simulations

2.3.1 Phenology simulations

Duration from sowing to flowering and maturity was simulated in three cvs representing the major types grown in Ghana using DSSAT. DSSAT was chosen as it has a tried and tested phenology sub-routine that was compatible with available data. It was also planned to collaborate with WARDA use ORYZA-W, but the departure of key staff and disruption to WARDA's activities in Cote d'Ivoire by rebels meant this never occurred.

2.3.2 Genotypes

Phenology was simulated in three genotypes, representing the major types of rice grown in the uplands in Ghana. These were: IG10, an *O. glaberrima* landrace to represent local cvs; Bouake 189, an *O. sativa* indica cv widely grown in Cote d'Ivoire; and WAB 56-104, a short duration improved *O. sativa* japonica.

2.3.3 Calibration data

The genotype specific parameters required to simulate phenology in DSSAT were estimated from data on duration to flowering and maturity collected in two experiments.

In the first experiment, WARDA planted 83 of the PVS varieties in each of lowland, hydromorphic and upland ecologies on five occasions between May and September 1997 at WARDA Headquarters at Mbé to characterise photothermal responses. Full details of this experiment are given in Dingkuhn and Asch (1999).

In a second experiment, a subset of 21 of the genotypes evaluated by Dingkuhn and Asch (1999) was grown in controlled environment glasshouses at Reading in 1999. Genotypes were grown in a factorial combination of two photoperiod regimes (11 and 13 h d^{-1}), two temperature regimes (mean 28° and 22°C) and two hydrology regimes (waterlogged to simulate lowland conditions and free-draining to simulate upland conditions). Full details are given in Hauser (1999) and Craufurd *et al*. (2003).

Data from both experiments were combined and analysed to estimate DSSAT parameters (Table 4). A common response to temperature (i.e. Tb = 10°C, To = 34°C and Tmx = 42°C) was assumed for all three genotypes. The basic vegetative phase (BVP) and photoperiod sensitivity (PSP, Pc), the major determinants of duration to flowering and maturity, varied substantially among genotypes. The duration of the grain-filling phase (GS3) was similar in all genotypes.

Table 4. Parameter values used to simulate duration from sowing to flowering and maturity in DSSAT. All thermal times assume Tb = 10°C

Genotype	Phyllochron (°Cd $leaf^{-1}$)	BVP (°Cd)	PSP (°Cd h^{-1})	Pc (h)	GS3 (°Cd)
WAB 56-104	65	219	100	11.0	356
Bouake 189	85	701	300	12.0	362
IG10	45	389	2500	12.6	360

BVP = basic vegetative phase or P1 PSP = photoperiod-sensitivity or P2R
Pc = critical photoperiod or P2O GS3 = grain-filling duration or P5

Model parameters were calibrated in DSSAT using experimental data and independent data published in Dingkuhn *et al*., 1998 and 1999. These parameters simulated flowering and maturity dates in independent data in Ghana well (Fig. 14).

DSSAT also simulates growth and yield, and has routines for water and nitrogen. However, there was insufficient data available to accurately calibrate DSSAT for growth and yield. Accordingly, it was not possible to simulate potential yields.

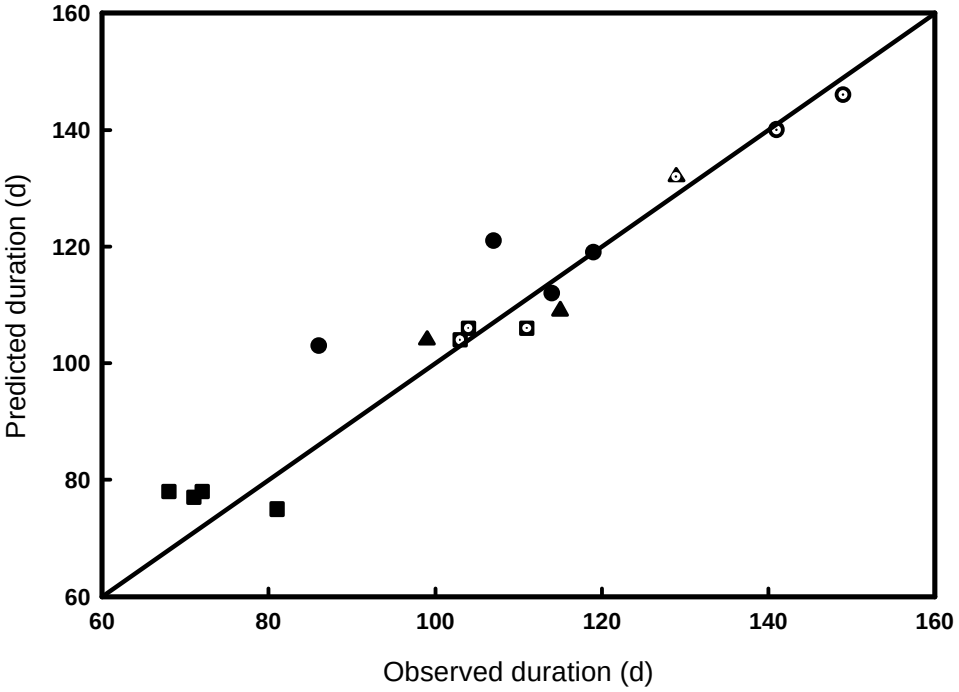


Figure 14. Observed and predicted durations from sowing to flowering (closed symbols) and maturity (open symbols) in IG10 ( ), Bouake 189 ( ) and WAB 56 -104 ( ) grown at several locations in Ghana.

2.3.4 Weather data for simulations

Thirteen years (1986-98) of daily weather data for seven locations were provided by the Ghana Meteorological Department (Table 5). These locations covered the major upland and hydromorphic growing areas of Ghana, from Volta and Western region in the south to Upper East and Upper West in the north. Data quality were carefully checked and missing values interpolated using DSSAT. Values of sunshine hours were converted to radiation (MJ) using WGEN in DSSAT.

Table 5. Region, latitude and longitude, and altitude of synoptic weather stations in Ghana

Location	Region	Latitude (°′N)	Longitude (°′)	Altitude (masl)
Sefwi Beckwai	Western	6.20	-2.33	171
Hohoe	Volta	6.60	0.45	158
Kumasi	Ashanti	6.72	-1.59	286
Wenchi	Brong Ahafo	7.75	-2.10	339
Tamale	Northern	9.42	-0.85	183
Wa	Upper West	10.50	-2.50	323
Navrongo	Upper East	10.90	-1.10	201

Table 6. Start date for simulations, and simulated planting date, standard deviation (STD) and range of dates used for phenology simulations in Ghana. Data are from simulations with 13 years daily weather

Location	Latitude (°N)	Start date (DOY)	Planting date ±STD		Range
Hohoe- June	6.60	01 Jun (152)	08 Jun	4	03 to 15 Jun
July	6.60	01 Jul (182)	06 Jul	5	01 to 15 Jul
Aug.	6.60	01 Aug (213)	23 Aug	13	03 Aug to 11 Sep
Sept.	6.60	01 Sep (244)	11 Sep	8	02 to 23 Sep
S. Beckwai	6.20	15 Mar (74)	16 Mar	1	15 to 16 Mar
Kumasi	6.72	01 Apr (91)	11 Apr	8	01 to 19 Apr
Wenchi	7.75	01 Apr (91)	12 Apr	11	03 Apr to 05 May
Tamale	9.42	15 May (135)	30 May	11	15 May to 17 Jun
Navrongo	10.50	01 Jun (152)	13 Jun	12	01 Jun to 12 Jul
Wa	10.90	01 Jun (152)	13 Jun	8	03 to 26 Jun

Simulations at each location were started on different dates depending on rainfall pattern (see Table 6) and normal planting dates, and ranged from March in the south to June in the north.

In Hohoe, where the rainy season starts in February /March, farmers usually plant in June or July, but may plant earlier and later than this and so four sowing dates were simulated. Within each year, planting was simulated to occur when 30 mm rainfall fell within 3d, and there was no dry spell of 10 days in the following 30 days. Sowing dates varied by upto a month in the northern locations and with late sowings in Hohoe; at other location and sowing dates the range was much smaller.

Simulated planting, maturity and durations from sowing to maturity for Bouake 189, WAB 56-104 and IG 10 at the different locations are given in Tables 7 to 9. Bouake 189, which has a moderately long BVP and is photoperiod-sensitive, matured between 90 and 140 DAS (Table 7). Crop durations were >120 d at all locations except the late sowings at Hohoe. More northern locations have longer daylengths in June than southerly locations, while earlier sowing in southerly locations exposes plants to lengthening and then shortening days, resulting in long crop durations in both cases. In contrast, late sowings at Hohoe are exposed to rapidly shortening days which substantially reduce crop duration. DSSAT also simulates growth and yield, and simulated yields for Bouake 189 are given in Table 7. These data should be treated with caution as there was insufficient data to calibrate the model. Nonetheless, they do show clearly the effects of drought with late sowing at Hohoe, and that average yields at other locations are broadly similar.

WAB 56-104 is a relatively photoperiod-insensitive, short duration improved japonica. Across all locations WAB 56-104 was predicted to mature in about 100 to 110 d, with little variability between years (Table 8).

IG10, which is an *O. glaberrima* landrace, is highly photoperiod-sensitive. Simulated durations ranged from 85 to 180d, and durations at typical sowing dates at all locations were >130d (Table 9). However, when this genotype was sown late at Hohoe, durations were shorter than even WAB 56-104. This is because IG10 has a short BVP and so when days are short, flowering occurs quickly.

Table 7. Simulated planting, sowing and maturity dates, duration from sowing to maturity and grain yield in cv Bouake 189. Simulations are based on 30 years daily weather data

Location	Latitude (°N)	Planting date	Maturity date	Duration (d ± STD)		Grain yield (kg ha^{-1})
Wa	10.90	13 Jun	26 Oct	135	3.1	1752
Navrongo	10.50	13 Jun	22 Oct	131	2.8	1506
Tamale	9.42	30 May	12 Oct	135	3.9	988
Wenchi	7.75	12 Apr	02 sep	141	2.9	1641
Kumasi	6.42	11 Apr	28 Aug	139	2.3	1655
S. Beckwai	6.20	16 Mar	20 Jul	126	1.3	643
Hohoe- Jun	6.60	08 Jun	23 Oct	137	2.5	1515
Hohoe- Jul	6.60	06 Jul	14 Nov	132	3.1	1240
Hohoe- Aug	6.60	23 Aug	22 Dec	94	2.3	737
Hohoe- Sep	6.60	11 Sep	07 Jan	90	2.0	477

Table 8. Simulated planting, sowing and maturity dates, and duration from sowing to maturity in cv WAB 56-104. Simulations are based on 30 years daily weather data

Location	Latitude (°N)	Planting date	Maturity date	Duration (d ± STD)	
Wa	10.90	13 Jun	27 Sep	106	1.9
Navrongo	10.50	13 Jun	23 Sep	102	2.2
Tamale	9.42	30 May	11 Sep	104	4.1
Wenchi	7.75	12 Apr	26 Jul	104	3.1
Kumasi	6.42	11 Apr	24 Jul	103	1.9
S. Beckwai	6.20	16 Mar	19 Jun	95	1.5
Hohoe- Jun	6.60	08 Jun	24 Sep	108	1.9
Hohoe- Jul	6.60	06 Jul	20 Oct	106	1.9
Hohoe- Aug	6.60	23 Aug	30 Nov	98	1.8
Hohoe- Sep	6.60	11 Sep	16 Dec	96	2.5

Strong photoperiod-sensitivity and a short BVP is an adaptive mechanism typical of other landrace crop species in West Africa that are also grown across the latitudinal (north/south) transect. This mechanism imparts considerable flexibility in planting date which is necessary given labour constraints within the cropping system as a whole. Interestingly, Bouake 189, which has a longer BVP and is less photoperiod- sensitive than IG10, exhibits a similar response to sowing date (illustrated at Hohoe; Fig. 15). However, Bouake 189 is slightly earlier in longer days (June planting) and later in shorter days (September sowing).

Table 9. Simulated planting, sowing and maturity dates, and duration from sowing to maturity in cv IG10. Simulations are based on x years daily weather data

Location	Latitude (°N)	Planting date	Maturity date	Duration (d ± STD)	
Wa	10.90	13 Jun	24 Oct	152	6.1
Navrongo	10.50	13 Jun	11 Nov	153	3.9
Tamale	9.42	30 May	05 Nov	160	8.9
Wenchi	7.75	12 Apr	10 Oct	179	3.5
Kumasi	6.42	11 Apr	28 Sep	170	3.9
S. Beckwai	6.20	16 Mar	26 Jul	132	2.6
Hohoe- Jun	6.60	08 Jun	11 Oct	149	3.6
Hohoe- Jul	6.60	06 Jul	13 Nov	131	4.4
Hohoe- Aug	6.60	23 Aug	28 Nov	97	7.8
Hohoe- Sep	6.60	11 Sep	05 Dec	85	5.2

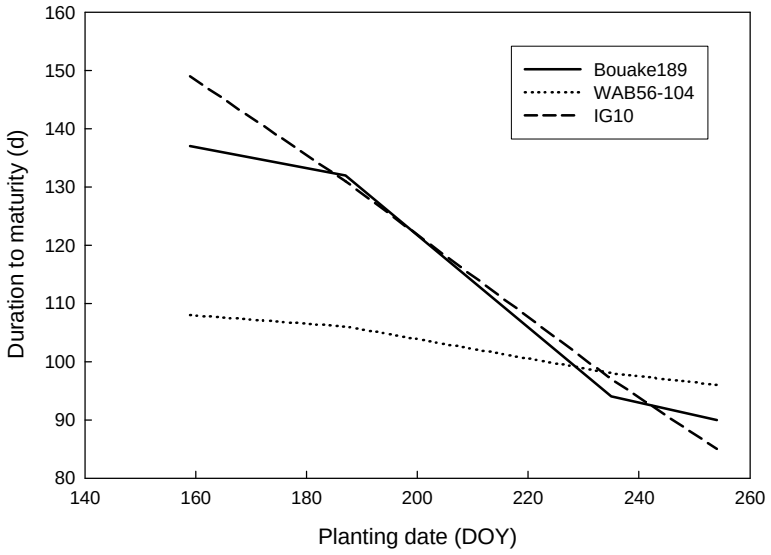


Fig. 15. Effect of planting date at Hohoe on duration from sowing to maturity in Bouake 189, WAB 56-104 and IG10

2.3.3 Climate

Long-term (30 years, 1961-90) daily values for rainfall and minimum and maximum temperature were obtained from the Ghana Meteorological Services, Kumasi for a number of locations from about 7° to 11°N (Table 10). Daily values for sunshine hours, relative humidity and windspeed were not available, but monthly mean values were supplied. The rainfall data for selected locations covering a transect from south to north were analysed, using the climate statistical package INSTAT (Stern and Knock, 1999) to determine the rainfall characteristics, the start and end of the rains, the probability of dry spells and the Crop Performance Index (Frere and Popov, 1979). Full details of the analysis are given in Tanu (1999).

Average monthly rainfall, minimum and maximum temperature, solar radiation and photoperiod for two locations in the forest zone (Hohoe and Sefwi Beckwai in the south west) and two locations in the savanna (Tamale and Navrongo) are given in Figs. 16 & 17 . At Hohoe, there is no dry season and rain falls in every month. Temperature is fairly constant throughout the year. The peak of the rains occurs in May/June and October, with a drier period in between in August. The rainfall pattern is therefore weakly bimodal. Sefwi Beckwai, further west, has a similar climate to Hohoe. Long term rainfall totals are 1468 amd 1578 mm at Sefwi Beckwai and Hohoe, respectively, with standard deviations of around 60 mm (Fig. 18).

2.3.3.1 Dry spells

The growing season (defined as when 30 mm rain falls over 2 d and there is no dry spell of 10 d in the next 30 days) at Hohoe and Sefwi Beckwai starts in March and ends in November (Table 11). The average growing season length is 231 days, though this can vary from 100 to nearly 300 d depending on the August rainfall. The weakly bimodal patterns means that a major and minor season can be defined about the August ‘break’. The variability of the end of the rains is greater than that of the start.

In the northern savannas, there is a distinct dry and wet season, with little or no rain between November and February. The peak of the rains occurs in August/September. The rainy pattern is therefore monomodal and the growing season clearly defined.

The long term average rainfall was 939 and 1092 mm at Navrongo and Tamale, respectively, with a standard deviation of about 85 mm. Maximum temperatures are high during the dry season, exceeding 35°C. Radiation levels are high throughout the year. Photoperiods are longer at these higher latitudes. The growing season in the savannas starts at the end of May and ends in October/November. Season length is about 150d on average, but may vary from 110 to 190 d. The variability associated with the start and the end of the season is similar and generally less than that of the forest zone. However, the variability in long term rainfall was greater in the savanna than in the forest zone, with a cv of about 9% cf 4% for Hohoe (Fig 18).

Table 10. Details of the sites used for rainfall analysis

Site	Longitude and latitude	Altitude (m)	Mean annual rainfall (mm)	Mean no. raindays	Agro-ecological zone
Navrongo	10°54'N; 01°06'W	201	982	69	Savanna (dry)
Wa	10°03'N; 02°30'W	323	939	87	Savanna (dry)
Nyankpala	09°42'N; 00°85'W	183	1092	91	Savanna (moist)
Yendi	09°27'N; 00°01'E	195	1241	99	Savanna (moist)
Ejura	07°29'N; 01°02'W	315	1166	100	Transition
Sunyani	07°20'N; 02°20'W	309	1177	103	Transition
Kumasi	06°72'N; 01°59'W	286	1405	128	Transition
Hohoe	07°09'N; 00°29'E	158	1578	119	Forest

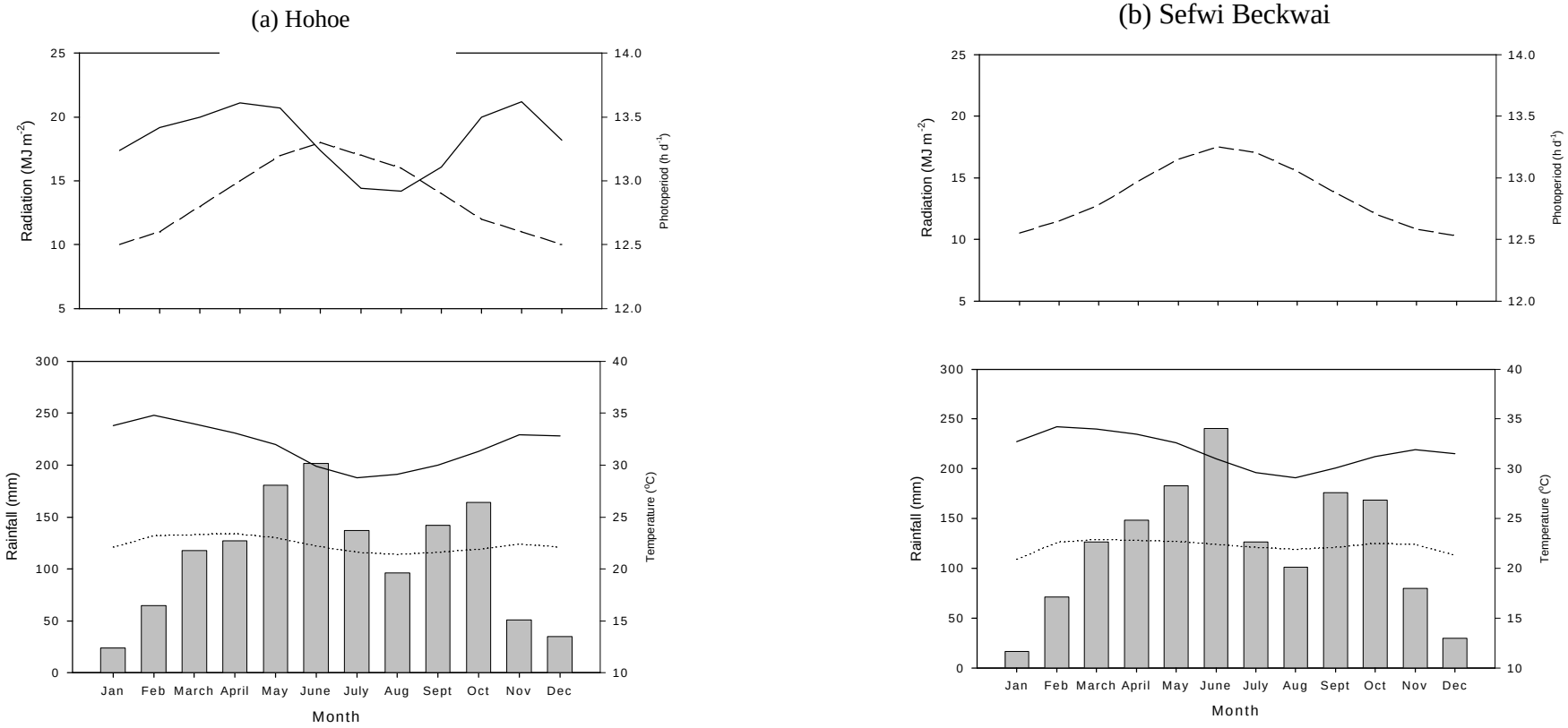


Fig. 16. Long-term (1960-89) monthly weather data and photoperiod on 15th each month for (a) Hohoe and (b) Sefwi Beckwai

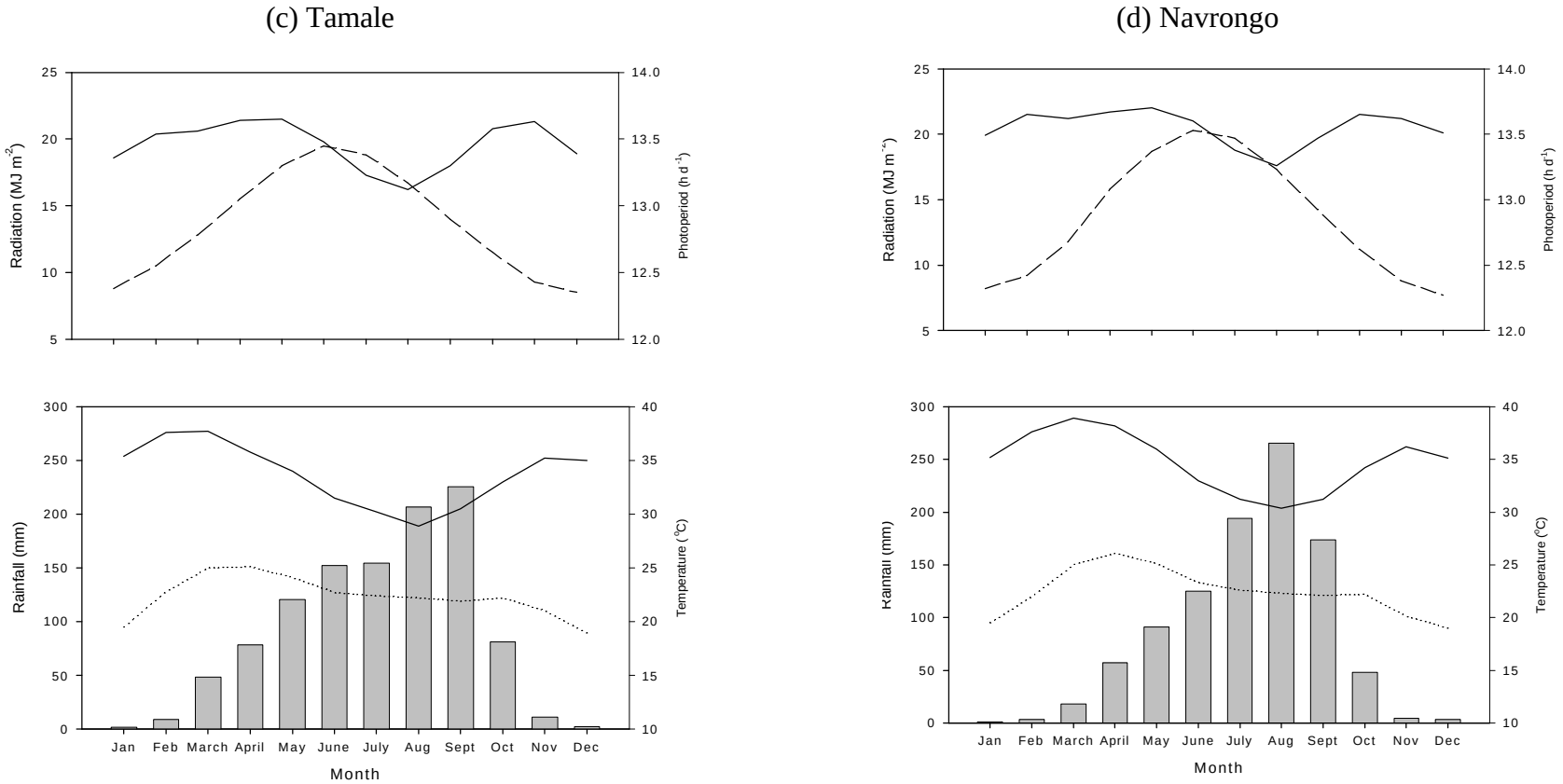


Fig. 17. Long-term (1960-89) monthly weather data and photoperiod on 15th each month for (c) Tamale and (d) Navrongo

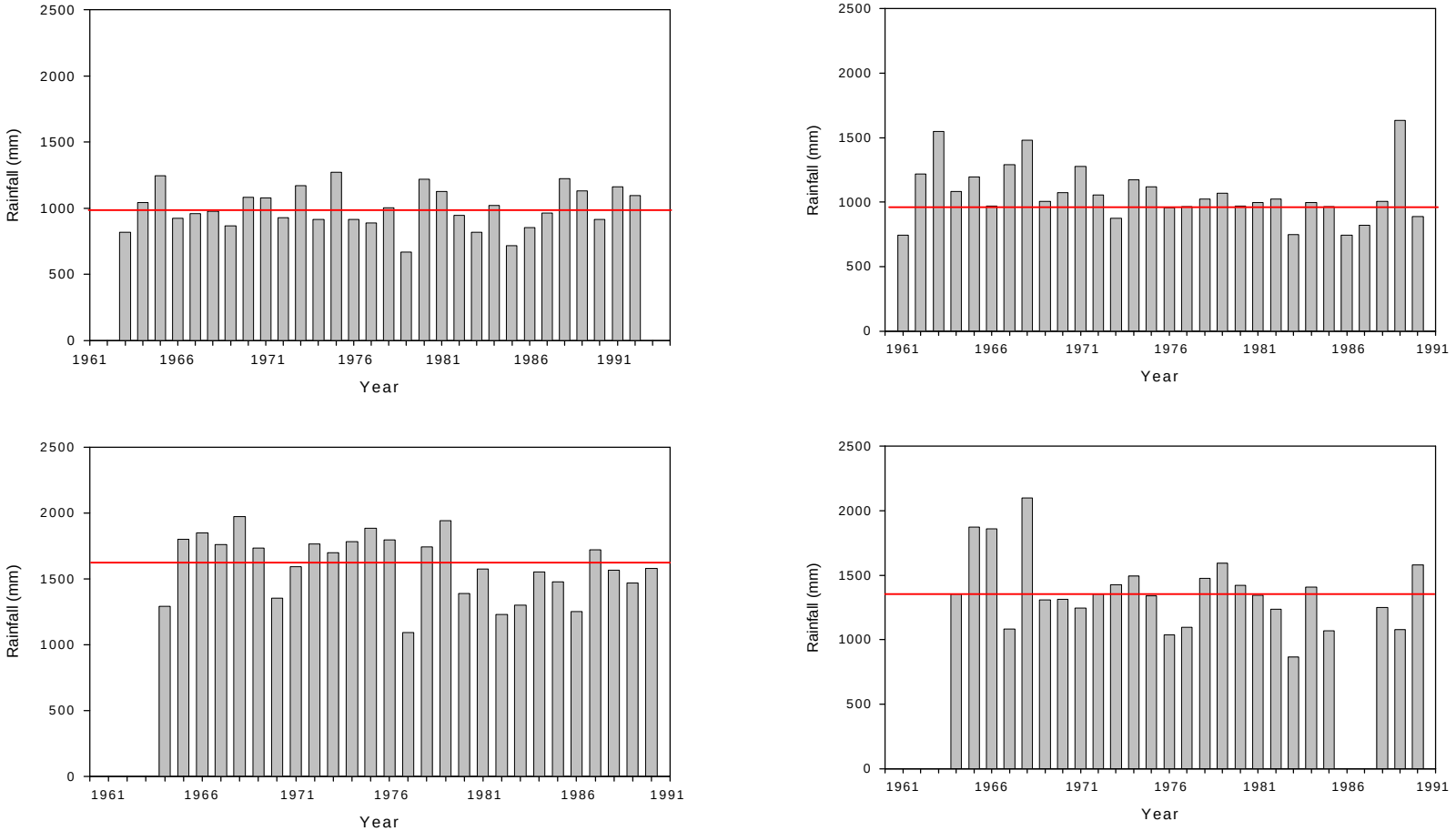


Fig. 18. Total annual rainfall between 1961 and 1990 at (a) Navrongo, (b) Tamale, (c) Hohoe and (d) S. Beckwai

Table 11. The mean dates, range and standard deviation (SD) for the onset, end and duration of the major and minor seasons in three agro-ecological zones in Ghana. Data are based on 30 years of daily weather data from selected locations in each zone.

	Onset			End			Season length		
Zone	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD
				Major season					
Dry savanna	15/05-17/06	27/05	12	04/10-06/11	22/10	10	113-173	148	17
Moist savanna	15/05-19/06	23/05	9	14/10-25/11	05/11	11	132-189	166	13
Transition	15/04-16/05	24/04	9	11/06-13/12	31/08	51	71-242	126	52
Forest	15/03-17/04	24/03	9	22/07-23/12	11/04	44	102-278	231	45
				Minor season					
Transition	15/08-28/09	28/08	12	16/10-13/12	16/11	17	30-115	80	21
Forest	15/08-10/09	23/08	7	21/10-12/12	01/12	16	63-127	100	15

Dry spells were calculated from daily rainfall probabilities fitted to a Markov-model (Fig. 19). At Navrongo, the growing season starts on average at the end of May (DOY 150) and early and late maturing cvs flower between early September (DOY 240) and late October (DOY 290). Flowering in rice is particularly sensitive to drought and high temperature. Prior to flowering there is little chance of a long dry spell (>10d), though shorter dry spell occur quite frequently (Table 12). However, from September onward, during the flowering period, the frequency of dry spells increases greatly. Late flowering and maturing cvs such as local cvs run a high risk of suffering from drought at this time. Tamale, which has a slightly higher rainfall and longer season, is much less likely to suffer drought during flowering.

Table 12. Mean date of sowing and flowering, and probability of a 5d dry spell at flowering, in three cvs of rice at four locations in Ghana. Data are based on simulations of phenology from 8 to 13 years data and dry spells from 31 years data

Site	Sowing date	WAB56-60		Bouake189		IG10	
		Flowering date	Dry spell	Flowering date	Dry spell	Flowering date	Dry spell
Navrongo	13 June	28 Aug	0.73	28 Sep	0.99	20 Oct	1.00
Tamale		17 Aug	0.58	17 Sep	0.85	11 Oct	0.99
Hohoe	06 Jun	29 Aug	0.33	28 Sep	0.37	16 Sep	0.26
Hohoe	07 Jul	25 Sep	0.32	28 Oct	0.90	24 Oct	0.86
Sefwi Beckwai		25 May	0.56	25 Jun	0.82	30 Jun	0.85

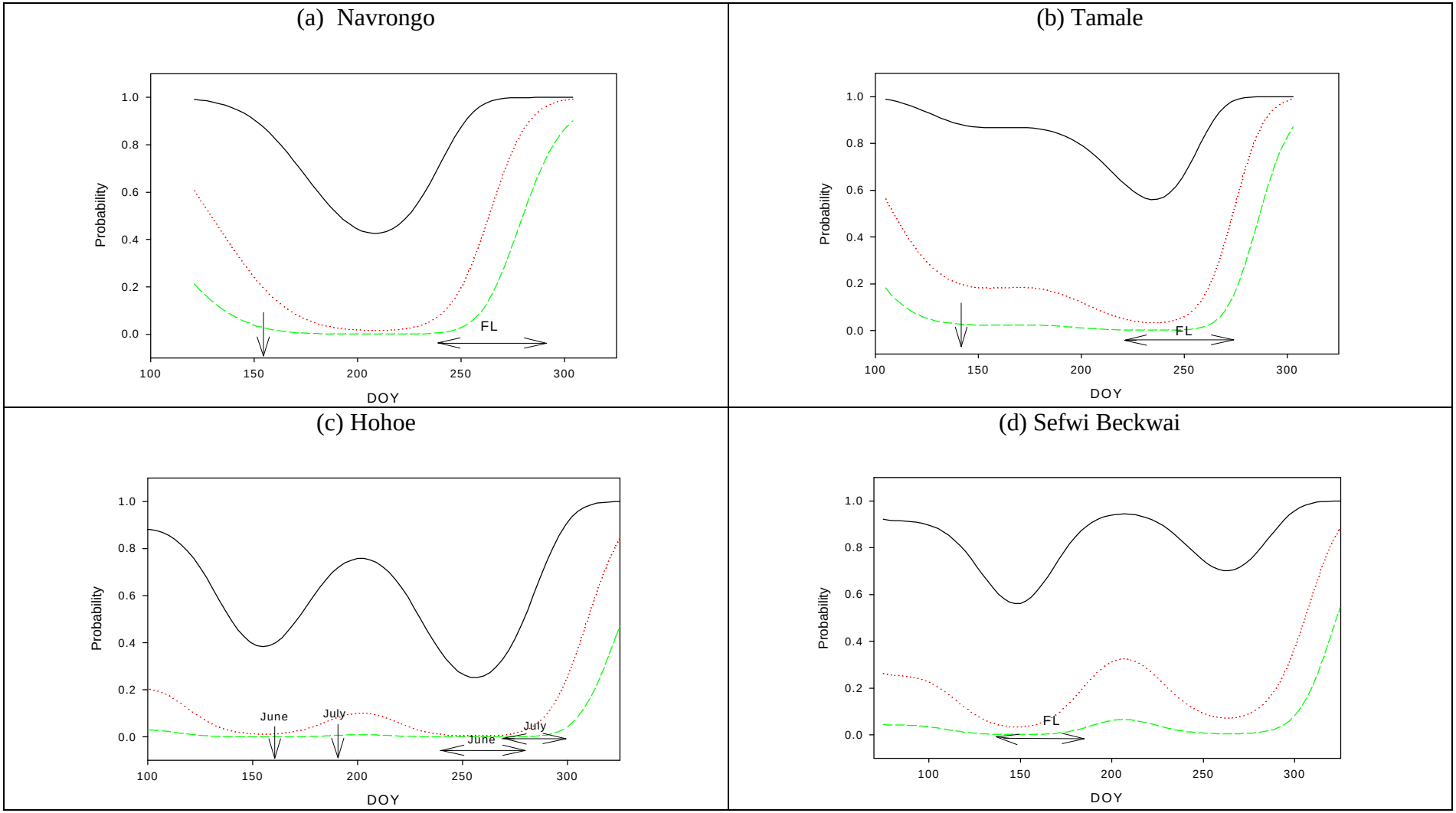


Fig. 19. Probability of dry spells of 5 (-------), 10 (------) and 15 (------) days duration at (a) Navrongo, (b) Tamale, (c) Hohoe (2 sowing dates) and (d) Sefwi Beckwai. Vertical arrows show planting date and horizontal arrows range in flowering dates

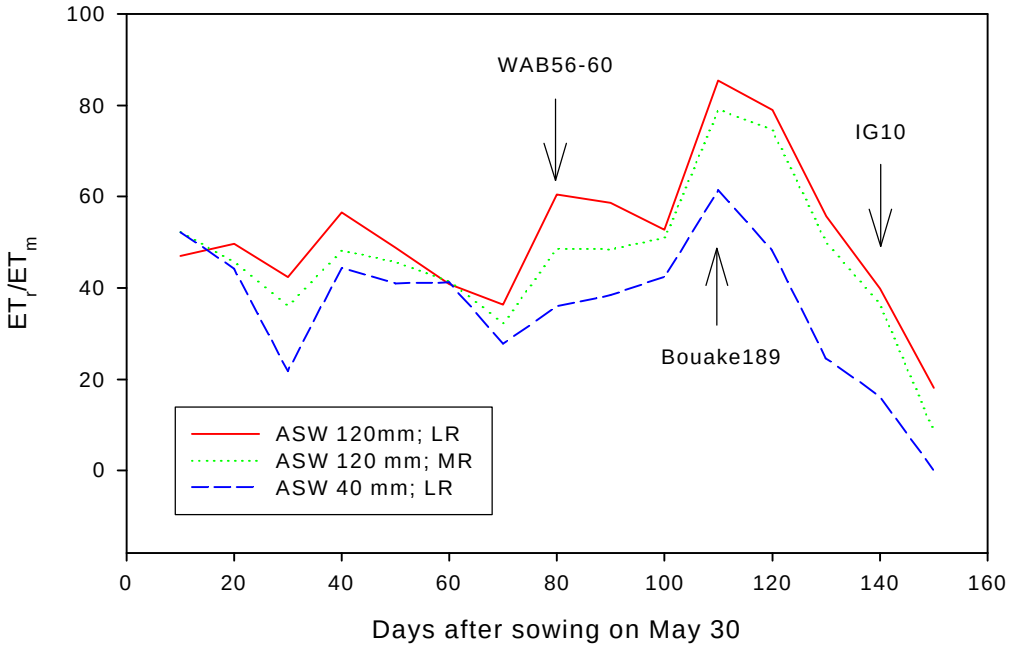
At Hohoe, upland rice is usually planted in June or July and not at the start of the rains in March, In this much higher rainfall zone, the probability of a long dry spell is very low for much of the growing season, particularly if the crop is sown early (e.g. at the start of June). Later sowings, however, do run the risk of drought occurring during flowering and grain-filling. At Sefwi-Beckwai rice is planted in March or April at the start of the growing season and flowers in June when the risk of drought is very low.

2.3.3.2 Water-balance analysis

An alternative to the dry spell analysis is to calculate the water-balance for a crop of rice. Daily weather data were used to calculate water balances in order to examine drought patterns. The water-balance of cvs varying in crop duration at different levels of available soil water (ASW) and runoff (to simulate slope in the uplands) was calculated from 10 to 13 years of weather data. The water-balance model SARRA was used for this purpose as this model works well in West Africa and was going to be coupled to ORYZA-W by WARDA. This model uses a crop coefficient and daily values of evaporation and rainfall along with soil and crop evaporation, drainage, runoff and rooting routines. Examples from Tamale and Hohoe are shown in Fig. 20 using the ratio of actual (ET_r) to potential (ET_m) crop water use or evaporation. When this ratio is high (>80%), there is no drought. Conversely, when values <40%, drought is occurring and when values <20% drought is severe. The values of ET_r/ET_m (for 10d periods after sowing) given are the 80% frequency values, i.e. the cumulative value of ET_r/ET_m that occurred in each decade in 1 out of 5 years. Hence a value of say 40% at 60 DAS shows that in 4 years out of 5 ET_r/ET_m was greater than 40%.

At Tamale and Hohoe ET_r/ET_m was smaller with 40 mm ASW than 120 mm ASW as expected, with the effect being somewhat greater at Hohoe. Runoff had little effect at 120 mm ASW and none at 40 mm (not shown) since capacity was so low anyway. At Tamale, the value of ET_r/ET_m was around 40 to 50% for the first 100 or so days, and then increased reaching a maximum value of 60 to 80% at 110 DAS. These conditions would probably result in transient water stress when dry spells

(a) Tamale



(b) Hohoe

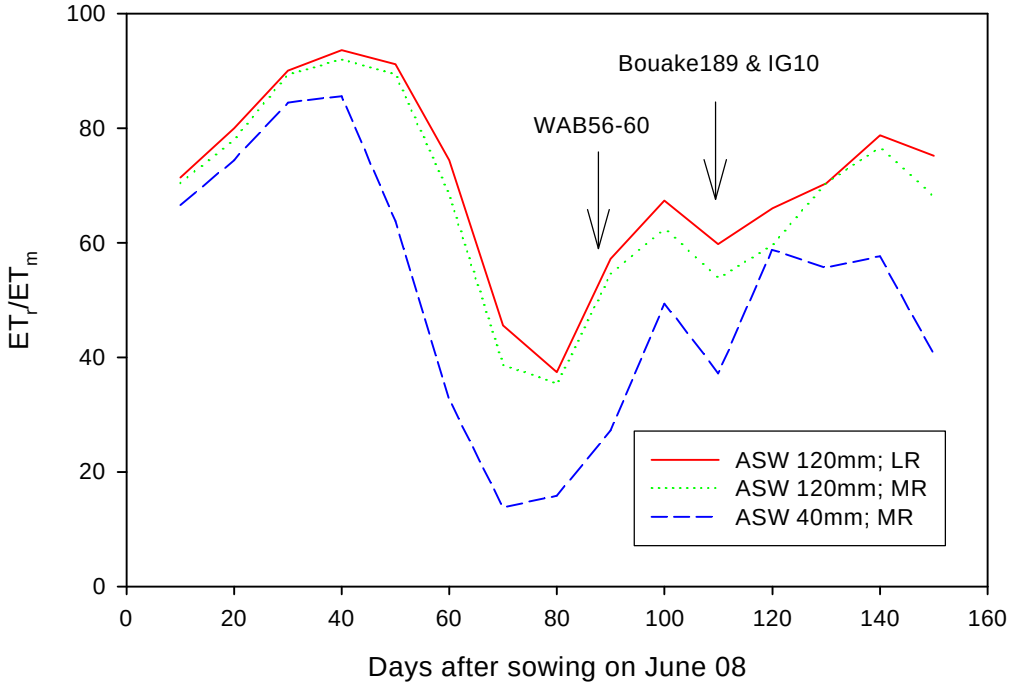


Fig. 20. Simulated 80% frequency of decadal values of ET_r/ET_m at two levels of available water (ASW) and either low or medium runoff in three cvs of upland rice at (a) Tamale and (b) Hohoe. Frequencies are calculated from x years of water-balance simulations

exceeded 5 d. After 120 DAS, the value of ET_r/ET_m declined rapidly, to <20% by 150 DAS. Early flowering cvs such as WAB56-60 would largely escape drought, especially in deeper soils. Medium maturity cvs such as Bouake 189 may suffer some drought stress during grain-filling, but not at the most sensitive stage of flowering. Late maturing cvs such as IG 10, however, would be likely to suffer severe stress during flowering and grain-filling.

At Hohoe, ET_r/ET_m was very favourable at the start of the season and drought does not occur. However, during August when the rainfall totals decline, drought does occur, particularly in shallow, steep soils. Early flowering cvs are likely to suffer stress at flowering if they are sown early. Later flowering cvs escape this period in August and suffer little serious drought during flowering or grain-filling

3. Managing the PVS Process (2000-03)

3.1 Introduction

The PVS in the Phase I was very much a research exercise focussed on cvs and traits, and the influence of socio-economic and other factors on cv and trait choice. These PVSs had large numbers of cvs and frequent, semi-formal evaluations. As such, the process was time consuming and could not be easily or cost-effectively replicated elsewhere. In Phase II, we examined how the process could be implemented more widely using a cv Needs Assessment to set up the PVS with facilitators or as a community-led process. This work was carried out in two communities in northern Ghana and south-western Ghana. In the first year a PVS nursery was established in each community; in the second year a Mother & Baby system was used to increase participation and access.

3.2 Cultivar Needs Assessment

3.2.1 Sayerano and Aferi, Western Region

3.2.1.1 Introduction and aims

The objectives were to:

1. Gain an overall understanding of rice growing in the area
2. Identify desirable and acceptable rice varieties with farmers for inclusion in a Participatory Varietal Selection (PVS)
3. Identify formal and informal seed production practices and potential uptake pathways
4. Set up a PVS with farmers

PVSs conducted within the first phase of the project and by WARDA in Ghana have to date generally involved introduction of a large number of varieties to a location (up to 100 varieties) in the first year. A further objective of including needs assessments prior to setting up a PVS at a location was to explore whether this improves the overall process. In particular it was to explore whether this enables plant variety characteristics which farmers and traders

consider important at a location to be clarified, and sets of appropriate varieties to be identified for PVS.

Sayerano community is situated in Western Region, approximately 30 km by dirt road from the District capital Juaboso. Sayerano is at 6°20′ N and 2°49′ W and at a height of approximately 280m. Farming is the main activity. The predominant vegetation is natural and semi cleared forest and the area is close to a protected forest reserve.

This report firstly describes how the needs assessment was undertaken. Findings from activities conducted with different groups of farmers are then presented in full and against each of the objectives of the study. These are then discussed briefly and conclusions drawn.

3.2.1.2 Method

Survey Team:

The needs assessment was conducted by a team of eight staff from the Crops Research Institute (CRI) Kumasi, the Savannah Agricultural Research Institute (SARI) Tamale, MOFA and the University of Reading (UK). The team worked in pairs with groups of farmers and used standard PRA approaches including seasonal calendars, group discussions, and scoring and ranking. Following introductions to the community and division into groups, day 1 was spent exploring the general farming system and rice production. Day 2 focused on farmers' preferences regarding rice varieties, and included discussion based around examples of rice plants and seed samples of varieties. Farmers' seed storage and selection practices were also described. On day 3 farmers discussed and decided on whether and how they wished to conduct a PVS and the team briefly reported back its main findings regarding variety preferences for information and verification.

Name of scientists	**Discipline**	**Institute**
Ralph Bam	Agronomist	CRI
Florence Ansere Bioh	Rural Sociologist	CRI
Dr Peter Craufurd	Agronomist/Physiologist	University of Reading
Dr Kofi Dartey	Rice Breeder	CRI
Wilson Dogbe	Agronomist	SARI

Dr Peter Dorward	Farm Management	University of Reading
Dr K A Marfo	Socioeconomist	CRI

Subdivision into groups:

A meeting of farmers from the village was arranged by the MOFA Agricultural Extension Agent (AEA) at the start of the exercise. He had been asked to ensure that all types of rice farmers were invited irrespective of wealth or extent of contact. A village meeting was called and 139 people attended. Following introductions, people were asked to divide into groups on the basis of any differences between them that they were aware of in relation to rice farming. Six groups formed but mainly on the basis of who farmers would like to work with e.g. relatives, friends, young people, and did not indicate differences in socio-economic or farming practices. This was not surprising as the large size of the initial group made it difficult for farmers to discuss and identify differences/similarities. Furthermore, despite explaining at the outset that the exercise would not result in direct or material benefits, expectations clearly existed at this stage.

Groups were therefore created as follows:

1. Men who farmed rice on rented land (‘land renters’)
   These farmers made up the largest proportion of farmers present (68 of 139). The majority of these were young men aged between 16 and 25. A group of 10 farmers were randomly selected from the 68 to work with.
2. Men who were already in a ‘rice growing group’ (‘rice growers association’)
   The Sayerano IPM Rice Growers Association was set up last year and has a membership of 30 (all male). It aims to train other farmers in rice production methods as well as to help members of the group in group labour activities. Nine participated in the needs assessment (11 were present at the initial meeting, but 2 dropped out early in the discussion).
3. A women’s group
   This consisted of all 18 women present at the initial meeting. Of these 13 rented and 5 owned land.
4. Men who owned land (‘land owners’)
   There were 42 ‘land owners’ in the 139 farmers present at the initial meeting. A group of 10 farmers were randomly selected from the 42 to work with. All farmers in the group

owned and farmed their land. Half of them also rented out land to other farmers. Most needs assessment exercises were conducted with these separate groups.

3.2.1.3 Results

Farming systems and rice production (objective 1)

Land renters

Two additional farmers joined the group early on making a total of twelve. Eight of the farmers were under 25 years old. The five most important crops grown (in order of importance) were reported to be rice, cocoa, plantain, maize and cocoyam (Table 13). Other crops included yam, tomato, onions, groundnuts, pepper, garden eggs, okra, cowpea, oil palm, sugar cane, pineapple and ginger. Each farmer grows 5 to 8 of these crops. Rice is grown on rented land and other crops on owned land. Rice is associated with young men as a way of them earning cash. After clearing land the following are relay planted - maize, followed by plantain, cocoyam, cocoa and a little cassava. The crops provide shade for the cocoa and all crops are removed by the third year once the cocoa is established.

Rice is sole cropped but with some maize interplanted (and harvested during bird scaring). It is continuously cropped on the same land for three years due to the scarcity of land in the area. Following this farmers clear land which has been fallow for 3-4 years. Farmers reported that there was little variation in soils in the area. Rice is grown as a cash crop (farmers estimated that 98% is sold).

Table 13: Areas (acres) of crops grown by 'land renters' (Cocoa refers to fully established cocoa, other crops includes immature cocoa areas interplanted with other crops)

Farmer	Rice	Cocoa	Other crops
1	5	1	1.5
2	2	2	1
3	3	2.5	1
4	1	5	1.25
5	2	4	2
6	3	1.5	2
7	3	1	1
8	2	2	1
9	2	3	1
10	2	6	3
11	1.5	1	1
12	2.5	5	1.5

Rice yields were reported to be between 3 and 5 bags per acre (1 bag = 85 kg) depending on conditions in any year. Farmers in the group were growing between 1 and 5 acres of rice, 1 and 6 acres of fully established cocoa and 1 and 3 acres of other crops.

Activity	J	F	M	A	M	J	J	A	S
Rice									
Land clearing	x x								
Burning		x							
Seeding			x x						
Weeding				x x					
Fencing					x x				
Scaring						x x x			
Harvesting								x x x x	
Other crops (maize, plantain, cocoyam,cocoa,cassava)									
Land clearing	x x x								
Seeding			x x x x x x						
Weeding						x x x x x x			
Labour shortage	x x x					x x x x x x			

Figure 21: 'Land renters' cropping calendar

Labour shortages were reported in January to February and June to August when clearing and weeding of several crops occurred (see diagram). The long harvest period was evidently due to the labour required (as this is done by farmers themselves) and can result in lodging.

Table 14: 'Land renters' constraints

Constraint	Score
High rent/land shortage	25
Lodging	1
High loan interest rate (300%)	5
Labour is expensive	23
Weeds	9
Birds take seeds (when?)	3
Stalk borer	1
Bird damage before harvest	2
Fencing and shortage of materials	7
Storage	4

Landowners charging high rents was considered to be caused by land shortage and 50 % of farm produce is paid as rent. The second most important problem was labour. This is expensive (C8,000 per day) and is not available throughout the year. Reasons given for this included the high prices of goods in the country, and that more people had gone into rice production recently. Weeds were a major problem but can be controlled with sufficient labour (Table 14). Materials for fencing against grass cutters has also become more difficult to obtain. Only informal credit is available and repayment at the end of the season was reported to be 300% of the amount borrowed.

Rice growers association

Four of the farmers present rented land and five owned their rice growing land. The major crops grown are plantain, cocoyam, rice, maize, yam, cassava and cocoa (Fig. 22). Details of the main activities and their timing are given in the cropping calendar. Tomato, beans and okra are minor crops and may be planted after harvesting rice. Most farmers interplant rice with a little maize (eaten fresh during bird scaring). Some farmers who own land interplant plantain, cocoyam or cocoa into the rice crop. Rented land can sometimes have crops interplanted into the rice crop by the landowner. Sole-crop rice can be planted for three consecutive years on the same land depending on its fertility. However, recently rice has normally been grown for one year only in shifting cultivation, due to declining soil fertility and high weed pressure.

Areas of rice grown ranged from one to four acres (mean = 2 acres). The total acreage of other crops grown ranged from two to five acres (mean = 3 acres). The group identified two major reasons for planting rice. For cash (to finance activities in other food crops and cocoa farms and to support family income when cocoa is out of season and to bridge the hunger gap in July (Kwawonsa).

Table 15: Areas of rice grown and yields obtained by nine farmers in the most recent season

Acreage grown	2	3	4	1	3	3	2	3	3
Total rice yield	25	5	10	4	15	3	5	4	5
Yield per ‘acre’	12.5	1.7	2.5	4.5	1	2.5	1.3	3	1.7

Note: An ‘acre’ is 24x24 extended arms lengths and equivalent to approximately 2,500 square yards.

Activity	J		F		M		A		M		J		J		A		S		O	
Rice																				
Tomatoes: weeding, irrigation, harvesting	x	x	x	x	x	x														
Clearing of land	x																			
Creating fire belt, burning & collecting trash			x	x	x	x														
Seeding					x	x	x	x												
Weeding 1st									x	x	x	x								
Weeding 2nd													x	x						
Fencing									x	x	x	x								
Scaring														x	x	x	x	x		
Harvesting														x	x	x	x	x		
Other crops (maize, plantain, cocoyam, cocoa, cassava)																				
Tomatoes: weeding, irrigation, harvesting	x	x	x	x	x	x														
Planting maize, yam & cocoa			x	x	x	x														
Weeding 1st									x	x	x	x	x	x						
Weeding 2nd																	x	x	x	x
Planting cocoyam			x	x	x	x	x	x	x	x	x	x	x	x	x	x				
Planting plantain			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Figure 22: 'Rice growers association' cropping calendar

Table 16: Constraints reported and scored by 'rice association' farmers

	Farmers									
Constraint	Rank	R.A.	B.	K.T.	K.A.	T.	N.R.	A.K	O.P.	Total
Weeds	5	5	4	4	3	7	4	4	3	39
Soil fertility	4	4	3	3	3	0	3	0	0	20
Credit	3	3	2	4	2	2	5	3	4	28
Marketing	2	2	0	0	3	0	0	0	0	7
Processing	0	0	3	0	0	0	0	3	2	4
Access to land	0	0	0	0	3	5	0	4	3	15
Seed	0	0	2	3	0	0	2	0	2	9
Total	14	14	14	14	14	14	14	14	14	

Among the constraints mentioned by farmers, weeds scored highest followed by credit and then poor soil fertility (Table 16). Only informal credit is available but at very high rates - 2 bags of rice for every C30,000 borrowed at the start of the season (equivalent to C240,000 at current prices).

Land rents are high and ranged from 2-3 bags (or the equivalent cash value) depending on the area cropped. Poor soil fertility and high land rents are in part due to the lack of access to land (reported by other groups). None of the farmers had used fertilisers or other chemical inputs in the past but since attending the IPM field school some had tried using herbicides this year, with varied effectiveness.

Land owners

A group of 10 land owners participated and all were male and farmed land themselves. Practices for this are described below. In addition, half of the farmers rented out land. This is paid for with part of the produce at the end of the season, or with cash at the start of the season. The latter is becoming more common due to poor repayment.

Migrants from northern Ghana introduced rice cultivation to the area many years ago. Approximately 20% of the community are not local people and the main other ethnic group are the northerners. Some now own land they have purchased or obtained as a consequence of marrying local women. Rice production moved to the forest reserve area when it became possible to do so in approximately 1983. However farmers returned to farm the local land when they were no longer allowed to farm in the forest reserve. The number of farmers

growing rice has increased in the last 3 years following an increase in prices. Formerly, low rice prices (caused by traders controlling the market) had led to many farmers ceasing rice production.

Credit can be obtained from local traders or other farmers. Credit from traders resulted in reduced bargaining power when selling rice. Credit from farmers can be repaid in cash or by barter e.g. 1 bag of rice requires 1 bag of cocoa.

The main cropping systems other than rice were:

-maize/cassava/cocoyam/plantain intercrop

-cassava

-maize

Table 17: 'Land owners' timing of main cropping activities (all crops)

Crop	Land clearing	Planting	Crop duration (months)
Rice	February	March/April	3-5
Plantain	February	March/April	12-24
Cocoyam	February	March/April	12
Cassava	February	March/April	>9
Yam	February	March/April	?
Maize	February	March/April	3-4
Cocoa	February	March/April	?

Note: Land clearing/preparation starts at same time for all crops

Rice cropping systems were (in order of importance):

-rice followed by cocoa (relay)

-rice-fallow-rice

-rice-rice-fallow-rice

Activity	J	F		M		A		M		J		J		A		S		Responsibility
Land clearing & preparation		x	x															Male
Burning			x															Male
Seeding (dibbling)				x	x	x	x											Male & female
Weeding 1st						x	x	x	x	x	x							Male & female
Weeding 2nd								x	x	x	x	x	x					Male & female
Fencing								x	x	x	x							Male
Scaring										x	x	x	x	x	x			Male & female & children
Harvesting & transporting														x	x	x	x	Male & female & children
Storage															x			
Threshing															x			

Figure 23: Rice cropping calendar for land owners (the same for sole rice as intercropped rice)

Note: Timing and duration of weeding is dependent on weed pressure and field size. Second weeding coincides with flowering stage. Bird scaring is from flowering to harvest. Harvest is in September for late planting. Panicles are threshed at the time of sale.

Table 18: Areas grown under different systems by land owners and rice yields obtained

System	Field size (acres)	Yield (bags/acre)	Notes
Rice followed by cocoa	2-5	6-7	
Rice-fallow	2-5	6-8	Depends on fallow period, weed control
Rice-rice-fallow	2-5	6-8	Second year rice could yield more than first year
Maize/plantain/ cocoyam/cassava	2		
Maize	2-4		
Cassava	2		
Cocoa	2-4		
Vegetables	1		

The productivity of the soil/land depends on the fallow period which is 3-5 years fallow for good rice. Where the fallow is for a long period, the cleared land has large amount of debris, stumps and wood which limit performance of rice. Under these conditions the second year of rice is higher yielding.

Table 19: Constraints to rice production identified by land owners

Constraint	Rank	Score
Weed control	1	50
Seed/seedling damage by birds & rodents	4	10
Moisture stress	3	15
Scarcity of fencing materials	5	3
Lodging	6	2
Bird damage at flowering & maturity	2	20
		Total=100

Labour is virtually the only input applied to the land. Only one of the 10 farmers used herbicide this year. Labour is seen as the main constraint as apart from variety characteristic, labour to weed, fence and scare birds, was reported to determine the yield for a given land/soil quality.

Women farmers

Eighteen women farmers participated and there was a wide cross section of ages from young to old. Most women have to rent land to grow rice and only five in group said they owned land. At the outset the women expressed concern that if any process went through the village chiefs they would get nothing and they preferred to be dealt with directly. Rice is predominantly upland rice with very little lowland area. Female northerners were reported not to grow rice and that they are sent away and do not inter-marry.

Plantains were the most important crop followed by rice. Rice is not a traditional crop and was introduced by northern migrants who came to work on cocoa farms. The land area available for rice farming is a constraint as it has been much reduced after access to government land in the forest reserve was stopped. Rice is now grown as a cash crop instead of cocoa and many cocoa farms are being cut for rice and other crops.

Land can only be rented for a specific period, i.e. for a 3 to 4 month cropping period - so only sole rice can be planted on rented land. Land areas rented (or owned in some cases) vary from 1 to 4 acres (mean =2). Land that is owned is usually intercropped with other crops being planted at the end of the rice season, e.g. rice/cassava, rice/cocoa, rice/plantain.

	J	F	M	A	M	J	J	A	S	O	N	D
Weeding & clearing	x	x	x									
Burning			x	x	x							
Planting			x	x	x							
Weeding					x	x						
Bird scaring						x	x	x	x	x		
Harvest								x	x	x		

Fig 24: Women farmers seasonal calendar for sole rice cropping

Farmers who own land plant early so that a second crop can be planted in August.
Land is usually cropped for 3 years before becoming exhausted, either sole rice or rice followed by the intercrop crop (e.g. cassava). Planting is by dibbling 3-4 seeds per hole. Weed problems are very severe due to the short fallow. Bird scaring and fencing against grass-cutters are essential. Diseases are a problem – a root disease which kills the whole plant and a black leaf spot. Panicles are harvested individually, and sickles are not used. Yields are about 4 bags an acre. No fertiliser is applied. The cost of labour is Cds 5000 per day.

When discussing constraints the women initially believed all problems could be solved by money and it was impossible to get other constraints discussed independent of money. For example they didn't believe land per se to be a problem (i.e. money can overcome this), similarly labour. (This response may have been due to the presence of the facilitators leading to raised expectations). There was also no rice mill in village.

Other constraints identified were ranked in order of importance as follows:

Land quality. Land is rented and where land is poor yields are low and so no profit.
Rent is by half yield or 1.5 to 2.5 bags acre
Birds
Rodents
Diseases

Weeds and drought were not mentioned.

Identification of farmers' preferences for rice varieties and for characteristics (Objective 2)

Land renters

Characteristics of varieties currently grown that 'land renters' like and dislike

Farmers grew mainly Agya Amoah and a very small amount of Bosome miensa ('three months rice'). Agya Amoah was introduced to the area from the Ivory Coast in the 1980s by a member of the village, Mr Agya Amoah. A more detailed description of its introduction is given by the 'farmers association' group in section 3.2.2.1. Agya Amoah is now the most widely grown and preferred variety in the area. Bosome miensa was reported to have been introduced to the area over 30 years ago (and most of the 'land renters' present were too young to remember this). Farmers were asked to say what they liked and disliked about the two varieties (Table 20).

Table 20: Characteristics liked and disliked about existing rice varieties grown by 'land renters'

Liked about Agya Amoah	Liked about Bosome miensa
High yielding	Doesn't 'shatter' in field when harvest is delayed
Doesn't lodge	Early maturing
High tillering	Good taste
Easy to thresh	
High milling recovery	
Tasty	
High expansion in cooking	

Disliked about Agya Amoah	Disliked about Bosome miensa
'Shatters' in field when harvest is delayed	Lodges
High stem borer infestation	Low yielding

Characteristics 'land renters' would like to see in new varieties

Farmers were asked what characteristics they would like to see in new varieties. Additional points to those given above were 'bold' grain (i.e. long but full/ rounded grain shape), good storability and goes fluffy and not hard when cooked. Farmers were asked about drought tolerance and this was added to the list. A complete list was then scored and discussed (Table 21). Farmers preferred to use percentages rather than scoring to express preferences.

Table 21: Characteristics 'land renters' would like to see in new varieties

Characteristic	Importance (out of 100)
High tillering	100
Lodging resistance	87
High yielding	98
Ease of threshing	60
High milling recovery	60
Less broken grains	40
Good taste	50
High volume expansion	80
Good storability	40
Bold grain and size	55
Fluffy when cooked	40
Large panicle size	85
Low shattering	45
Maturity date	70
Resistance to stem borer	20
Drought tolerance	90

High tillering, yield, drought tolerance, lodging resistance and large panicle size were considered extremely important. Maturity date had been discussed before scoring. Farmers wanted an early maturing rice as prices are good at the start of the season when rice is scarce. However labour competition and the fact that harvesting is done by the farmers themselves mean that a spread of durations and harvest dates is preferable. Agya Amoah matures in 3.5 to 4 months.

Land renters selection of examples of varieties and reasons given

The group were then shown 10 complete rice plants (9 taken from another PVS site 3 days before and an Agya Amoah plant grown locally). These were mainly mature and displayed a range of characteristics. Farmers were asked to select plants they liked. After examining and discussing the examples 3 were selected: the locally grown Agya Amoah, and 2 other plants. One of these displayed some similar characteristics to Agya Amoah and farmers claimed it was also Agya Amoah. (Interestingly this variety was known by the same name at the other PVS site). These were selected for their large grain size, tillering and for their height. Farmers said that they selected the third variety (IDSA 85) for its long grain and high tillering. Other varieties were discarded for a variety of reasons including the grain types and that the plants were too tall and may lodge.

Land renters selection of grain samples and reasons given

The group were given 22 small plastic bags containing grain samples from different varieties with a range of characteristics and again asked to compare and discuss them. Five were selected and put in the following order of preference:

Agya Amoah
Iguape cateto
WAB450-I-B-P-133HB
WAB450-I-B-P-129HB
Moroberekan

Agya Amoah and Iguape cateto displayed fairly similar grain characteristics.

Rice growers association

Characteristics of varieties currently grown that 'growers association' farmers like and dislike

Agya Amoah is the main variety of rice grown by farmers in the group. This was reported to have given good yields in the past but they have seriously declined with soil fertility. Yields for this variety this season for each farmer varied considerably as indicated above.

Other varieties grown are Abankra, Bosome miensa and Bosome num but only very small areas. Agya Amoah was named after the man who introduced the variety (Agya Amoah) from Akupe in Cote d'Ivoire. He is currently secretary of the IPM association and brought a margarine tub of the seed and began planting it in 1987. Since then the variety has spread and was one of the main varieties present at a rice mill visited at Asawinso, approximately 15 km away.

Table 22: Time line indicating the introduction and spread of agya amoah and bosome mmiensa varieties

Agya Amoah	Date	Bosome mmiensa ('three months')
	1978	Grown by Mt Adamah from Northern Region. The seed probably came from northern Ghana.
	1980	Labourers collected seed and planted
	1981	'Taungya' agroforestry system – planting rice in forest along with trees. Many planted in this system
New cv introduced by Agya Amoah	1987	
Some friends bought some of the seed	1988	
Increase in demand for the cv	1989	Farmers started planting Bosome mmiensa with Agya Amoah
Increase in area grown – spread all over district and beyond	1995	Decline in area grown
About 95% village rice area to this cv	2000	Only about 5% area to Bosome mmiensa

Farmers gave the following reasons for the replacement of Bosome mmiensa with Agya Amoah:

- Bosome mmiensa lodges, has a lot of leaves and produces a lot of chaff/unfilled panicles, especially when lodged
- Even though Agya Amoah lodges during heavy winds, you can still obtain good yield
- Unlike Bosome mmiensa, which has brownish grain colour, Agya Amaoh has a white grain which is preferred by traders
- The milling output from Agya Amaoh is higher than from Bosome mmiensa
- Agya Amaoh has a longer duration (4 months) and fits better into cropping calendar. However, the maturity period of Bosome mmiensa coincides with weeding the other food crops and cocoa and results in competition for labour.

<u>Characteristics 'growers association' farmers would like to see in new varieties</u>

Farmers were asked to select the 5 most important characteristics they desire in a new variety among those listed (Table 23). Following this the group ranked them (1 is most important).

Table 23: Characteristics 'rice growers association' farmers desire in a new variety

Characteristic	Farmers										Group rank
	A.M	A.A	M.	A.	B.	O.P.	Badu	A.K.	Ag.	T.	
High tillering ability	•	•		•	•	•	•	•		•	2
Low shattering			•			•	•				8
High yield		•				•					11
Low lodging					•				•		10
Bold, large grains (a)	•	•	•	•	•	•	•	•	•	•	1
Vigorous and tall plants with broad leaves that can compete with weeds	•			•	•		•	•	•	•	4
4 months duration				•	•		•	•	•		6
Heavy panicles		•	•	•							9
Aromatic	•					•			•	•	7
Long grain like imported rice											
Good expansion on cooking											
Drought tolerance	•		•	•		•		•	•	•	3
Resistant to pest and diseases (b)		•	•		•		•	•	•		5
Easy to thresh											
Good storage											

Notes: (a) The group reported that the bold and large grains are able to occupy a larger space than small slender grains and as a result a farmer is not cheated during sales. (b) Diseases like false smut (djanzuruku), stem borers (white head) and leaf and seed blast were mentioned.

<u>Rice growers association farmers selection of examples of varieties and reasons given</u>

Whole plant samples were pulled from Bibiani PVS to show different characteristics

Table 24: Varieties selected by growers association farmers (whole plants)

Variety	Reasons
	Like
B (IDSA 85)	Grains are white and will taste nice. High tillering and market will prefer it
A	Bold grains and white grain. Will taste nice
D	White, long grain, good tillering with medium height
	Dislike
F	Likely grains will shatter, grains are very small in size and round
H	Grain size small and slender, seeds red and has a lot of unfilled grains
I	Don't like grain colour, brownish like 'Mercy', because there used to be a cv with similar colour and poor threshing ability

Rice growers association farmers selection of grain samples and reasons given

Grain samples (22) were provided for examination and the farmers selected the following varieties.

Table 25: Varieties selected by growers association farmers (seed samples)

Variety	Reasons
1. Agya Amoah (unnamed sample)	Large bold grains, clean, no unfilled grains, white
2. Iguape Cateto	Large and bold grains
3. WAB340-B-B-9-L3-L1-LB	Long and bold grains
4. M22	Long and bold grains, no chaff
5. IDSA 85	White, long grain, it will taste good, traders will like it

Farmers gave the following reasons for not liking grains of the other varieties:

- The grains are small, slender and you need a lot to fill a sack, and it is a disadvantage to the farmer if he is to sell
- Slender grains will break while milling
- Some of them, especially those with brown/straw colour will have threshing problems (they have an experience with a variety that colour which was very difficult to thresh)

Land owners

Characteristics of varieties currently grown that 'land owners' like and dislike

Farmers mainly grow Agya Amoah which accounts for about 95% of the rice cropped area (Table 26). Bosome mmiensa ('three month' rice) accounts for the remaining 5% area together with a very small area of mixed varieties. Both Agya Amoah and the 'three month' variety are grown for sale and home consumption but mainly for sale. The market therefore largely determines the popularity of the variety. Two other varieties were grown in the past and but are no longer - Abankora (disliked for its long duration and being difficult to thresh) and Kotoko (which gave low seed yield from harvested panicles).

Table 26: Varieties grown and their sources

Year introduced	Variety	Introduction
1960	Basome Mmiensa 'Three months'	By settlers from northern Ghana who were the first to cultivate rice in the area
1978	Abankora	By a local farmer (Abankora) from Afare village, 36 km away
	Kotoko	By a local farmer from Nkwanta, 30 km away Not a popular variety as is difficult to thresh
1983	Basome Nnan 'Four months'	From Cote d'Ivoire by a local farmer (called Amadu) who was originally one of a group of settlers from northern Ghana. Introduction coincided with farming in the forest reserve.
1985	Agya Amoah	By a local farmer of the same name. The variety is originally from Cote d'Ivoire and is now the dominant variety in the area.

Other varieties have been introduced since 1985 but have all been considered undesirable. Reasons for their rejection given were:

-Susceptibility to drought

-Difficulty in threshing

-High starch content (too sticky)

-Difficult to mill

-Too much 'thrash'

Characteristics ‘land owners’ would like to see in new varieties:

A list of desirable characteristics of rice varieties was created (Table 27). Farmers ranked the importance of the desirable characteristics (first column) and then the extent to which Agya Amoah meets these.

Table 27: Characteristics ‘land owners’ desired from new variety

Desirable characteristics	Rank of desirability	Rank of Agya Amoah in meeting desired characteristics	Score for Agya Amoah in meeting desired characteristics
Yield	1	2	15
Large grain size	6	5	7
Resistance to lodging	5	9	3.5
Ease of threshing	10	4	8.5
Earliness (short duration)	8	6	6
Weed competitiveness	2	1	25
High grain recovery	9	3	9.5
Tillering ability	4	7	5
Aroma	15	12	2
Taste	13	11	2.5
Expansion ability	14	10	3
Storability	12	8	4
Stickiness	16	13	1.5
Drought tolerance	7	16	0
Disease tolerance	3	15	0.5
Termite/insect tolerance	11	14	1.5

Land owners selection of examples of varieties and reasons given:

Of the plant types shown, one farmer selected IDSA 85, one rice plant ‘K’ and the rest of the group Agya Amoah.

Land owners selection of grain samples and reasons given:

Of the 22 grain types shown, farmers selected Agya Amoah, Iguape Cateto and WAB450-IBP-129-HB. They said that they preferred large, round and bold grains. They did not like IDSA 85.

Women farmers

Characteristics of varieties currently grown that women farmers like and dislike

Five cvs are currently grown:

- Agya Amoah – most popular variety, 90 days, white, high yielding. Could have up to 40 tillers. Some disease on seeds. Roundish, hard, becoming powdery with false-smut which can cause complete yield loss. Smut turns pounded rice blackish. (Note: false smut not unique to this variety). White heads widespread in fields. Non-specific, occurs during rainfall. Heads can be pulled out (ie stem borer). Introduced about 15 years ago.
- Bosome mmiensa (three months) – best taste, but lodges and not high yielding. Aromatic. Only planted when Agya Amoah cannot be obtained. Lodges at flowering. Sticky on soaking. Disliked more for lodging than yield (lodging – poor grain filling). Introduced more than 50 years ago by migrant northerners, probably same time as Bagoran and Kotoko.
- Bagoran – Long duration and flowers after 5 months, therefore drought a problem. (note may be photoperiod-sensitive?). Variety was already present in community and introduced over 50 years ago.
- Kotoko Red – (a glaberrima and best variety) but long duration and very low yielding. From Western Region.
- Mercy – 85 days, but grown by only one male farmer

Women farmers ranking of preferences:

1 Yield	6 Grain size
2 Weed suppression	7 Big panicles
3 Taste	8 Big grains
4 Earliness	9 White grains (preferred by traders)
5 Aroma	

Traders preferences

Female rice buyer

A female trader who buys rice from Sayerano and surrounding villages was interviewed. She had been doing so for three years. She sold rice to mills at Asawinso (on road to Bibiani, about 15 km from Sayerano). Milled rice is sold to middlemen and women from Bogoso, Kumasi, Njema, Enkye. She sells the remaining milled rice at Asawinso and Sayerano. She was shown the bags of rice samples (22) and selected the following (Table 28):

Table 28. Rice traders selection of varieties from seed samples

Sample	Reasons
1. Agya Amoah (unnamed)	Described it as Bibiani rice. Grains are white, bold and a 2 month cv
2. WAB450-24-3-2-P18-HB	Aromatic red rice that has a good market in Kumasi
3. Iguape Cateto	Aromatic rice, white and bold
4. LAC 23	Slender white rice, good market in Bogoso

Asawinso rice mill

Asawinso mill is on the main road to Bibiani and about 15 km from Sayerano. This was visited and the following varieties noted by a local trader:

Four months (white)
Four months (red)
Three months (white)
Agya Amoah (white). Preferred locally
Mercy or Asante-mo (white). Slender grains, short variety (lowland indica)
Kotoka Red (red). Very good taste

Women traders reported that the same price is paid for all varieties, although there is some premium on Kotoka Red in urban areas.

Informal seed production practices and potential uptake pathways (objective 3)

Land renters seed production and potential uptake pathways

Farmers saved grain for food and seed on the panicle. This is stored above the cooking area and the smoke helps deter infestation and damage. Seed is taken from this and threshed and winnowed when required. No particular measures appear to be taken in the selection of seed

from the panicles. However, two of the group soak their seed for 5 minutes and then let it dry before planting. Unfilled and wasted grain floats to the top and is discarded.

Rice growers association farmers seed production and potential uptake pathways

Seed for planting is normally from a farmers own source. However, if he didn't cultivate rice the previous year or has insufficient seed, it is bought from a neighbour or rice mill. Seed is normally stored as panicles on a storage barn with a source of heat underneath. Panicles are not treated by any other means. Poor storage sometimes results in cooking of the grain (abinkyi) and poor germination. Grains may also be attacked by storage pests even when on panicles.

Details of spread and uptake of varieties in the past were given by 'rice growers association' farmers in section 3.2.2.1.

Land owners seed production and potential uptake pathways

Seed of existing varieties is stored on the panicle over the fire place for up to one year and can also be obtained from other farmers and paid for in kind. Borrowing 1 bucket of rice seed requires repayment of 10 buckets.

Farmers obtain seed of new varieties from farmers who introduced them and from each other. Some farmers mentioned that seed could be obtained from traders and millers but other members of the group considered that once varieties were with traders and millers they were already widely available and unlikely to be new to the area. Further details are given in section 3.2.3.1.

Women farmers seed production and potential uptake pathways

Farmers reported that as cash is often needed many sell all produce soon after harvest and do not keep back seed. Those who kept their own seed described the following practices. Samples are taken from the bulk sample. Three of the 4 women put panicles in the hut above the cooking area and smoke and 1 threshed first and kept seed. No chemical treatments are used and seeds are dried by smoking to prevent germination. When seed is dried, they do not smoke it as excess heat will prevent germination.

Table 29: Seed sources reported by women farmers

Source	No. of farmers
Buy from next village	1
Buy from another farmer in same village	9
Family gave seed	1
Own seed	4
Brought from family	1
Brought from mill	1

No formal seed source is available and none of the farmers obtained seed from traders (Table 29). Seed is readily available but expensive ie about Cds 30,000 for a size 34 bucket. Seed can be obtained on credit: one size 34 bucket for one bag rice (at least double value).

Diffusion is reported to be by observation on farmers fields and collecting (begging) small samples. Details of the introduction and diffusion of examples are given in section 3.2.4.1.

3.3.1.4 Setting up the PVS

At the close of day 2, each group discussed the PVS, and assuming they were interested in setting up one, were asked to think about how this could best be achieved. The importance of the process benefiting the whole community (and not just their group) was noted. Thirty-eight farmers (26 men and 12 women) attended the meeting on day 3 to consider this further. Dr Marfo led the meeting and asked farmers whether they wanted to regroup (randomly ie not in existing groups) to discuss the PVS or as one group. Farmers decided on the latter. Initially the members of the rice association stood apart (due to underlying tensions with the rest of the community) but later were included in discussion. The farmers wanted to conduct a PVS and decided to manage it as a single group, with those present representing the community. Dr Marfo explained that they would need to plant a rice garden in the first year - the minimum size they should consider would be need to be about 1 acre. The need for the community to manage the garden, including land clearance and weeding was noted. The group said everyone would help and thought that they could manage up to 3 acres. They discussed possible sites and although one lady offered 3 acres nearby the group decided to approach Chief for land as a community project. The group appointed a committee made up of one person from each of the four groups worked with on the previous days. The farmers

said seed should be provided by February and this was agreed and that the team would be back to discuss this further before then.

3.3.1.5 Discussion and conclusions

Farming systems, rice production practices and constraints

Upland rice is an important crop in the area and generally similar systems of rice production were reported by the different types of farmers. All grew rice mainly as a cash crop and most farmers had between one and four acres of rice. Land renters made up the largest proportion of farmers and young land renters were growing rice as a means of building up capital (often to move into other forms of business). The most important differences that emerged were between farmers who owned and rented land. Renters normally sole cropped rice whereas owners interplanted rice or had a fallow every other (or every third) year. Owners rice yields were therefore higher. Some land owners were also reported to be able to plant early and get a second rice crop planted in August. Land shortage was a major constraint to all other farmers together with the associated problem of declining fertility. The high costs of credit (which is only available locally) and of land rents were also common problems.

Labour was a major constraint to all farmers and there was good agreement between cropping calendars which demonstrate the periods of labour competition. Weeds were reported by all groups to be a major problem and linked to the lack of labour. Bird scaring, and fencing against rodents were reported to be essential. Other pests and diseases were not reported to be major constraints. No fertiliser or other inputs were used with the exception of one or two farmers who had tried herbicides.

Farmers preferences for rice varieties and characteristics

It is evident from the system and constraints described in section 4.3, that for any new variety introduced into the area to be successful, it will need to cope with poor / declining soil fertility, no inputs and high weed competition. Agya Amoah accounts for approximately 95% of rice grown by the community and reasons for its popularity consistently given by groups were its yield, good tillering (and therefore weed competition) and its white and large ‘bold’ (ie long, full and rounded) grain. Other reasons given by one group included limited lodging, good recovery from threshing and milling and good taste and expansion.

To be widely acceptable any new variety is likely to need to have these characteristics as well as offer some improvements. Susceptibility to stem borer was specifically identified as a limitation of Agya Amoah by three groups (although this was not one of the major constraints identified earlier). Susceptibility to some diseases and that Agya Amoah shatters in the field when harvest is delayed was noted by one group. From identification and scoring/ranking of characteristics which farmers would like to see in a new variety, they consistently identified yield and high tillering / weed suppression to be the top two most important.[1] However there was less consistency between groups regarding other characteristics. Those in the top half of groups' lists were maturity date / duration (4 groups), drought tolerance (3 groups), grain size (3 groups), lodging resistance (2 groups), aroma (2 groups), and pests and disease tolerance (2 groups). Stem borer is noted above and specific diseases identified were false smut (2 groups) and leaf and seed blast (one group). A wide range of other desired characteristics were included as shown in the original tables and these need to be taken into consideration when selecting varieties for the PVS.

All groups wanted shorter duration rice than the four month Agya Amoah except for the rice association farmers who specifically wanted four months duration. They noted that this better fitted their cropping calendar and avoided competition for labour at harvest with weeding of other crops. In contrast land renters wanted earlier maturing (to obtain better prices). They also noted that existing planting of rice was staggered partly to avoid labour constraints at harvest. It is likely that an earlier maturing rice would therefore help stagger harvesting.

The results from farmers' selection of whole plant and grain samples showed consistent preferences for varieties and their characteristics. From the ten whole plants examined, three groups included Agya Amoah and IDSA85[2]. The local variety from the Bibiyani PVS site was also popular as it was very similar to Agya Amoah.

The production of rice as mainly a cash crop means that the characteristics demanded by the market are extremely important and one farmers group specifically noted this. From the 22 grain samples, groups selected 3 to 5 varieties. All groups selected Agya Amoah and Iguape Cateto for their similar large, 'bold' white grains which were reported to be preferred by traders. Other varieties were not selected by more than one group. One group selected

[1] One group identified weed suppression in relation to plant height and vigour as well to tillering.
[2] Data was not available from the womens' group for this exercise

IDSA85 and another specifically noted they did not like the look if it. The woman trader also selected Agya Amoah and Iguape Cateto plus two others. However, further investigation may be warranted to determine more precisely and on a wider scale what traders want, what variations there are in the market and the extent to which farmers are aware of this.

Seed sources and uptake

Details in section 3.2 and 3.3 provide evidence of the informal introduction of several varieties and their evaluation and uptake or rejection by farmers. Some varieties were popular for several years until they were replaced by better varieties. Several were brought with migrant farmers moving into the area and others more recently by farmers from the area who had travelled into Cote d'Ivoire. Of particular interest was the rapid spread of Agya Amoah over a relatively short period (since 1987) and from one small sample. Farmers actively seek new material and then observe its performance on their own and neighbours fields. A study to investigate the spread of Agya Amoah is warranted and specifically to investigate mechanisms of spread, extent, rate and issues regarding identification.[3]

Usefulness or otherwise of needs assessment

The needs assessment proved to be relatively straightforward as rice is grown almost entirely as a cash crop in this community and there were relatively minor differences between farmers in terms of their production systems, constraints and preferences. More complex systems may require slightly more time. The farmer categories identified at the start of the exercise proved to be logical but the processes by which this was achieved could be improved in future needs assessments conducted elsewhere. Discussion with a small number of key informants prior to the community meeting (e.g. the day before) should enable key differences in farmers systems and in farmers access to resources to be identified effectively. A further minor improvement would be to ask farmers, once they have identified characteristics they would like to see in new varieties, to score the extent to which existing varieties meet these. In addition farmers should be specifically asked what ranges they may like to see in a characteristic (achieved through several varieties) e.g. several varieties to give a range of times to maturity.

[3] The local variety at the Bibiyani PVS was called Agya Amoah and although similar was different to the variety at Sayerano. Some groups at Sayerano recognised the differences.

The needs assessment took a team of eight people 2.5 days to conduct (a total of 33 person days including travel time and 5 days to write up). This is likely to have been justified given the benefits of the exercise. Through the needs assessment, the research team gained an understanding of the local farming system, rice farming practices and constraints and in particular of farmers preferences for rice varieties and characteristics. In comparison to other PVS projects conducted to date this should enable a better informed choice of which varieties to include in the first year. Whilst taking care not to limit variation and choice this should enable a smaller number of varieties to be used. Previous experience suggests that the inclusion of too many varieties makes it difficult for meaningful comparisons to be made by participants. In addition the needs assessment created considerable interest amongst farmers and scope exists to develop community ownership of the PVS process.

3.2.2 Tambalug and Nyorigu, Northern Region

3.2.2.1 Introduction

Although Rice Researchers have in recent times developed cultivars that satisfy different needs of farmers and consumers alike, most of these potential cultivars never get to the farmer for various reasons. Increasing the choice and availability of these cultivars to farmers and consumers will contribute to the improvement in domestic rice production, reduce importation and thus save the scarce foreign exchange.

To make available these new cultivars to farmers a new approach to the selection and diffusion of new varieties (participatory rice varietal selection) was piloted in two communities in the Bawku East District of Upper East Region. Under the programme farmers were to evaluate and select in a participatory manner improved drought, weed, and disease tolerant and high yielding rice varieties that meet their needs and the needs of traders and consumers.

In other to compose a package of varieties for such an exercise, it is important that the rice cv needs of farmers and consumers are considered. PVSs conducted within the first phase of the DFID project and by WARDA in Ghana have to date generally involved introduction of a

large number of varieties to a location (up to 100 varieties) in the first year without assessing the cv needs of the community. A methodological objective of including needs assessments prior to setting up a PVS at a location is to explore whether this improves the overall process. In particular, it is to explore whether this enables plant and cultivars characteristics which farmers and traders consider important at a location to be clarified, and sets of appropriate cultivars to be identified for PVS.

The objectives were to:

1. Gain an overall understanding of rice growing in the area
2. Identify desirable and acceptable rice varieties with farmers for inclusion in a Participatory Varietal Selection (PVS)
3. To identify farmers' considerations in selecting rice varieties for planting and the characteristics they will like to see in a new variety.
4. Identify formal and informal seed production practices and potential uptake pathways.
5. Set up a PVS with farmers.

3.2.2.2 Method

Survey Team

The survey was conducted between 22 – 25 of November by a team made up of the following rice scientists from the Savannah Agricultural Research Institute, Nyankpala, the Crops Research Institute, Fumesua. The rest are interpreters from the collaborating institutions (Bawku East Women's Development Association (BEWDA), Garu Agricultural Station (GAS) and Manga Agric Station (MAS). Wilson Dogbe led the team.

Name of Scientists	Discipline	Institute
Dr. K.A. Marfo	Socio-economist	CRI
Ralph Bam	Agronomist/physiologist	CRI
Wilson Dogbe	Agronomist (FSR)	SARI
Dennis Djagbletey	Agronomist	SARI
Isaac K. Bimpong	Asst. Breeder	SARI
Jonathan Agawuni	Field supervisor	MAS
Zacharia Abugri	Field assistant	GAS
Patricia Abaah	Facilitator	BEWDA
Azuma Achiriga	Facilitator	BEWDA

Approach

The rice variety needs assessment was conducted in the Bawku East District of the Upper East Region. Bawku East was selected because it is a major upland rice growing area in northern Ghana and frequently suffers from food insecurity. This is due partly to frequent terminal drought suffered by most crops as a result of the changing rainfall pattern and low fertility of the soils. The district is also the most populated rural district in Ghana.

Before the actual survey, a pre-survey visit was conducted on 14-16 of November 2000 to get an overview of rice production in the Bawku East district and to identify collaborators and communities. The collaborators were to help in the identification of communities and also serve as facilitators within the communities.

During the pre-survey visit key informant interviews were conducted with major stakeholders in agriculture in the district (Ministry of Food and Agriculture (MoFA) BEWDA, GAS and MAS). The criteria used in selecting a community were the presence and intensity of upland rice production in the area, the accessibility of the community and the willingness of the community to collaborate. A visit was then made to the proposed communities to assess their suitability.

The pre-survey visit was followed by a needs assessment exercise on the 22 to 25 November 2000 in two selected communities. The need assessment exercise took the form of group interviews, using participatory tools such as checklist, cropping calendar, ranking, transect walk etc. The first day was used for reconnaissance and meeting with opinion leaders in both communities. On the second day the team worked at Tambalug in the morning and at Nyorigu in the afternoon. On the 3rd day the survey team was divided into two groups, one group went to Tambalug and the other to Nyorigu. In each community following the exchange of greetings, farmers present were divided into smaller groups. The survey team worked in pairs with these smaller groups within the community.

The second day was spent exploring the general farming system and rice production. Day 3 focused on farmers' preferences regarding rice varieties, and included discussion based around examples of panicles of 46 different rice cultivars. Farmers' seed storage and selection practices were also described. At the end of the exercise, a feed back on major

findings were reported to the farmers for their comments. This was followed by a discussion on how to set up a community based PVS.

3.3.2.3 Results

Pre-survey visit

Overview of rice production in Bawku East District.

Bawku East District is currently the leading rice producing district in the Upper East Region. The district accounts for more than 30% of the rice area as well as total regional production, Table 30. While rice area and production in the region increased by about 250% from 1992 to 1998, it increased by about 640% for the same period in Bawku East. The sharp increase has been attributed to the development of irrigation facilities under the IFAD sponsored LACOSREP project.

All the three major rice production systems (rainfed Upland, rainfed lowland and Irrigated) practised in Ghana are found here with the rainfed lowland and upland systems predominating. Rice farm sizes are small and rarely exceed 4 ha. Most of the varieties grown under the rainfed upland and lowland systems are the local varieties. The MoFA is however seriously promoting the cultivation of improved varieties from research.

Table 30. Estimates of rice area and production in the Upper East Region and the Bawku East District.

Year	Rice production				% of regional production	
	Regional		Bawku East District			
	Area 000 ha	Production 000 MT	Area 000 ha	Production 000 MT	Area	Production
1992	17.2	29.0	2.6	4.5	15.3	15.5
1993	16.0	26.3	5.3	10.6	33.1	40.33
1994	22.7	45.7	8.9	20.5	39.1	44.7
1995	31.8	75.9	10.6	27.4	33.6	36.0
1996	37.9	82.2	13.6	32.8	36.0	39.8
1997	na	na	na	na	na	na
1998	49.7	129.3	17.0	37.5	34.3	29.0

Identification of collaborators and communities

At the end of the interactions, two NGO's (BEWDA in Bawku and GAS in Garu) were selected as collaborators. BEWDA proposed Nyorigu community whiles GAS proposed the Tambalug community. A visit was then made to the proposed communities (Tambalug and Nyorigu) to assess their suitability. After the visit the two communities were endorsed and 22nd to 25th of November was fixed for rice variety needs assessment in the two communities. Patricia Abaah and Zacharia Abugre, field assistants with BEWDA and GAS respectively were identified as facilitators.

Bawku East Women's Development Association (BEWDA)

The BEWDA was formed in 1989 as an umbrella organisation for small women's group in Bawku East district. The Association currently works in ten villages (communities) through 61 groups with a membership of 921. Membership is open to women above the age of 15, resident in the area and interested in undertaking any small business activity for the purpose of improving their finances.

BEWDA's principal mission is to strengthen existing capacities of rural poor women through an integrated development approach that will improve the quality of lives so that they can support their families economically and socially. The main areas of support are in Savings mobilisation, Credit Delivery and Management, Soil & Water conservation, Group Development and Sanitation. BEWDA has an executive council, Board of Trustees, Programme Manager, operations and field officers and administrative staff. Currently, BEWDA depends on WOMANKIND WORLDWIDE for its administrative and operational costs. BEWDA has strong linkages with both governmental and non-governmental organisations.

Garu Agricultural Station

3.3.2.4 Needs Assessment Exercise

Rice variety needs assessment in the Tambalug Community

Tambalug is a farming community with 52 compound houses and a population of about 400 people with a headman as a leader. All the inhabitants are kusasi. Tambalug is located in the Temne river basin about 5 km west of Garu. The community is linked to Garu, the major market in the area by a tractor tract. Although the community lacks a school and a clinic, it has three boreholes that provide drinking water for the population. The Garu Agric station has in the past had some extension activities (group formation, soil and water conservation, and extension of soybean and maize varieties) with some members of the community. No formal extension work on rice has ever been done in this community.

For the needs assessment, members of the community present were divided into three groups namely, the adults group, the women's group and the young men's group on the 2nd day. On the 3rd day, the women's group was maintained whiles the young and older men's groups were merged. The discussions were conducted through interpreters.

Men's group (Moderators: Wilson Dogbe & Jonathan Agawuni)

Overview of cropping system and rice production in the Tambalug community (objective 1)

The group consisted of 10 men all above 35 years. About 70% of them cultivated rice in year 2000 with acreage's ranging from 1 to 3 acres and yield from 1 to 10 bags per acre with an average of 4.5 bags. Six of the farmers grew Mendi whiles one grew Agona varieties.

Other crops grown are early millet, sorghum, late millet, maize, soybean, cowpea groundnuts and bambara groundnuts. Total acreage devoted to these crops per farmer ranged from 2 to 10 acres with a mean of 6.8 acres. With exception of rice, which is grown as a sole crop, all the other crops are grown as intercrops.

Land preparation for upland crops is either by bullocks or hoe in April. Planting of upland crops begins in May with early millet and is followed by cowpea, late millet and sorghum in the same field. Land preparation for rice is in June. Early maize (NAES EE) is planted around the same time and may be intercropped with soybean, cowpea or groundnut. Planting of rice starts by the 2nd week of June and is supposed to end by mid July. Planting of rice

after middle of July will normally result in reduced yield or complete failure mainly due to terminal drought.

Most farms receive two weeding. Rice is weeded in August and September. Harvesting of crops is in the order of early millet (Nara), cowpea, maize, groundnut, soybean, rice sorghum and late millet.

Land preparation and planting of dry season crops begin in November and continues till the end of April. The major dry season crops are Onion, tomatoes, garden eggs, Okra, pepper, water melon etc. The dry season is also the time they do maintenance work on their buildings or build new houses or compounds.

General constraints to crop production (Table 31):

- Lack of bullocks for early land preparation
- Lack or access to improved planting material of cultivated crops
- *Striga hermonthica*.
- Pests and diseases on sorghum
- Marketing (Farmers are at the mercy of middlemen)

Table 31. Constraints to rice production

Constraint	Rank
Weeds	1
Soil fertility	2
Improved seeds	3
Drought	4
Labour	5
Marketing	6
Lack of credit	7

Time line for varieties grown in the community (objective 2)

In the Tambalug community rice is grown mainly for cash. In most compounds, less than 20% of the harvest is consumed. The first variety grown in the area about 100 years ago was called Atebubu. Because of its shattering, Agona and Mr More were introduced about 36 and 20 years ago respectively. Despite the fact that these two varieties have high consumer

preferences, they are long in duration and suffer from terminal drought most of the time especially these days when there is a reduction in the rainfall period. This has led to the introduction of varieties like Mendi, Kukuoso mu (extra early), Agondiga, and Worigaworiga in the past 3 to 5 years.

Majority of the farmers (86%) cropped mendi the year 2000. According to the farmers, the high preference for Mendi is due to its initial plant vigour, weed competitive ability and drought tolerance compared to Agona and Mr. More. In terms of consumer preference it's the same as Agona and Mr. More. The outstanding agronomic and grain qualities of these three varieties (Mendi, Agona and Mr. More) are:

- High initial vigour of plants
- Ease of threshing
- Ease of hulling (less % broken grains)
- They are white when milled
- Have good expansion on cooking
- Maintains its quality (tenderness) for a long period
- And above all is palatable

Because of these qualities they attract premium price at the market compared to the other varieties.

Farmers considerations in selecting varieties and desired characteristics of a new variety (objective 3)

The major factors that influence the varietal choice of farmers in this group and the characteristics they would desire in a new variety are;

- Type of rice land (moisture availability)
- Drought tolerance of variety
- Weed competitive ability of the variety
- Consumer preference

Table 32. Characteristics farmers desire in a new variety

Characteristic	Score	Rank
Drought tolerance	110	2
High consumer preference (White grain, long grain, expansion, palatable)	55	3
Good weed competitive ability	123	1
Heavy panicles	31	4
High tillering ability	9	5
Duration		
2.5 months variety	3	6
3 months variety	0	
4 months variety	0	

Type of panicles and grain type preferred:

Fifty panicles of different varieties of rice were displayed for farmers to select those ones they would like to grow and those they would not like and then assign reasons for their choice. The preferred panicles selected, farmers reasons for selecting them and measured panicle and grain characteristics are presented in Table 32.

Table 32. Selected panicles and reasons for preference.

Source of Panicle	Reason for selecting
IDESSA 85	Long grain, heavy panicle and large grains
WAB 181-37	Long grain and heavy panicles
Kleminson	White grain and appealing
WAB 33-17	Long grain heavy panicles
WAB 375-B-5-H1-1	Heavy panicle, long and big grains.
WAB 515-13-13A-8 (aromatic rice)	Will be very palatable; will attract premium price at market
Gambiaka	No particular reason
IRAT 216	No particular reason
WAB 337-B-B-15-H1	No particular reason
WAB 99-1-1	No particular reason
Tox 3108-56-4-2-2-2	Grain is white; looks like imported rice.

Some reasons given for not selecting panicles of the other varieties were:

1. They do not appeal to them
2. Seeds are small

3. Panicles are small
4. Short grain types may not appeal to consumers

Seed sources, seed production practices and seed uptake pathways (objective 4)

There is no certified rice seed distributor within the community or at Garu. Farmers source of seed is usually from their previous farm. When a farmer has no seed of his own, he either buy from friends, relatives or from the market. New introductions to the community are usually from the market. Diffusion within the community is from farmer to farmer. Farmers claim they maintain seed purity by harvesting separately off types at the time of harvest. Harvested paddy is stored in sacks stacked in a room. No seed treatment is performed.

Young Men's group (Moderators: K.A.Marfo & I.K. Bimpong)

Overview of cropping system and rice production in the Tambalug community (objective 1)

The major crops and typical farm size are shown in Table 34. All households engage in the production of these crops

Table. 34. Major cropping systems and farm sizes in the Tambalug community.

Cropping system	Size (acres)
Millet/cowpea	3-7
Rice	Up to 3 for matured; 0.5 to 1 for the youth
Groundnut/cowpea	3.0
Maize/soybean	2.0
Bambara	0.5
Sweet potato	0.3
Persa	0.3
Okra	0.3
Tomato	0.3
Pepper	0.3
Egg plant	0.3
Onion	0.1

With the exception of rice and dry season vegetables all fields are intercropped with cowpea. The major staple in this community is millet. Millet/cowpea is considered to belong to the household and therefore are managed by all the economically active members of the household. Individuals within the household cultivate other crops mainly for cash. A household thus produces almost all the above crops in a year.

Rainfed production:
Production starts in April-May with land preparation for the millet/cowpea field, and planting is normally in may. After leaving the planting to women in the household, each individual go to clear land for the other crops over which he has control. Rice cultivation begins in June-July and depends on availability of enough soil moisture. Land preparation is by bullock, tractor or by hoe and is usually done by the men. Both men and women do planting, weeding and harvesting. Household heads who are normally not young men control the millet fields.

The cultivation of the other crops also starts in June to July in the following order:
Rice, maize, groundnut, Bambara, Soybean, Tomato, sweet potato, Egg plant, Perse and okra.

Dry season gardening:
Dry season gardening starts in September/October. The crops produced are onion, okra and tomato.

Use of inputs:
Those who can afford fertiliser use it on the following crops; maize, okra, onion, rice, tomato and pepper. Manure is used on millet in the compound fields. Pesticide (Karate) is used on the vegetables (tomato, onion, Okra, pepper and egg plant). Rice seed is treated with pesticide before planting.

Labour use:
Whiles on the household field (i.e. millet/cowpea) there is division of labour (male prepare land, women plant and both men and women weed and harvest), for the other fields (i.e. individual fields) each member provide labour for all his activities on his farm except planting where they may be assisted by spouse or mother.

Constraints to rice production:
Pair wise ranking of constraints to rice production showed the following order of importance

- Moisture stress
- Low soil fertility/weeds
- Flooding of fields during planting that usually wash off seeds planted. (This happen even when seeds are dibbled.

- Labour for planting

The farmers perceived the problem of soil fertility and weeds to be related hence put them together.

Varieties grown in the community (objective 2)
Varieties grown are mostly three months in maturity and are shown in Table 35.

Table 35. Rice varieties grown by the young farmers.

Variety	Duration (months)
Walegawalega	2
Avazare	3
Agona	3
Bandi (Mendi)	3
Agondziga	3
Agombila	3
Musimua (Mr. More)	3
Akokosubo	4

Seed sources, seed production practices and seed uptake pathways (objective 4)
Seed is either from farmers own source, other farmers or from the market. There is no formal source of rice seed to the community.

Women's group (Moderators: Ralph Bam, Dennis Djagbletey and Zacharia Abugre)
Overview of cropping system and rice production in the Tambalug community (objective 1)
Major crops
The main crops cultivated were mentioned as groundnuts, rice, bambara, maize, seseme, neri, cowpea, soybean, millet, sorghum, okra, pepper, tomato and onion. Groundnuts was ranked as the most important crop followed by bambara, rice, seseme and okra in that order.

Cropping calendar.
The cropping season starts with land preparation in March-April. The land is slashed, burnt and subsequently tilled by hoe or ploughed by bullock traction. Early millet is the first crop to be sown in June. It is intercropped with late millet and sorghum. The seeds are mixed during

sowing. Millet and sorghum are the family staples. Later on still in June, groundnut and bambara sowing is undertaken either as sole crops or intercropped. Cowpea and okra are regular intercrops in the early millet/late millet/ sorghum complex. Since women are involved in the sowing of the family staples, and are actually left to ensure its completion, land preparation for rice cultivation by the women occurs in July. Seseme cultivation begins in August.

Size of cultivated fields and yield:
The size of plots cultivated by individual women and some yields for their three most important crops are:

Table 36. Crops grown by women in the Tambalug community and their acreages

Crop	Field size (acres)	Yield (kg)
Groundnut	0.5 – 0.75	
Bambara	0.5 – 0.5	
Rice	0.5 – 1.0	250 - 1200

NB: Total crop failure is a common phenomenon.

Input use:
Fertilizers are commonly used in both the compound and bush farms but to a greater extent in the later.

Constraints to cropping**:**

- Unavailability of seed. This usually happens after total crop failure or following low productivity years when farmers are compelled to consume their seed stock.
- Poor access to bullocks for land preparation. Women can get access to the bullocks of their family only after the men have completed preparing their land.
- Drought

<u>Time line and characteristics of varieties grown in the community (objective 2)</u>
Unlike the family staple crops, which are cultivated as a joint venture of the entire family, rice is cultivated on individual basis. Rice is planted sole and cultivated mainly for cash. Only

up to 40% of rice produced by the women may be consumed at home. Several varieties with varying characteristics exist in the community. The varieties, their preferred ecology, duration and date of introduction into the community are shown in the table below.

Table 37. Rice varieties cultivated in Tambalug, the year of introduction, preferred ecology and duration

Variety	Ecology	Duration	Year of introduction
Mandii	Lowland	3 months	1997
Agric	Upland/hydromorphic	3 months	1997
Agona	Lowland	4 months	<1950
Agondiga (short agona)	Upland/hydromorphic		
Warigawariga	Upland	2 months	1995
Kukuesimbok	Upland/hydromorphic	3 months	<1950
Agongbuila	Lowland		1990

Of these varieties, Mandi was mentioned as the most popular and reasons given for its popularity are:

- It is newly introduced
- It is easy to thresh
- It can be milled without parboiling
- It is high yielding
- The milled grain is appealing and commands good price
- It is able to give good yield with little or no fertiliser application.

When asked whether there are some characteristics of Mandii which are undesirable to them, they quickly mentioned its lack of tolerance to drought, high shattering ability and susceptibility to lodging.

Characteristic the women would like to see in a new variety (objective 3)

Table 38. Characteristics women would like to see in a new cv ranked in order of preference

Characteristic	Rank
High yielding	1
Drought tolerant	2
Easy to thresh	3
Able to grow well on poor soils	4
High volume expansion of cooked rice	5
Able to mill without par-boiling	6

Variety selection (Panicle inspection)

To gain an insight into the type of panicle and grain type preferred by the women, they were made to inspect and select some panicle and seed types they will like to grow from a collection of panicles. The two most frequently selected varieties are IRAT 262 (IDESSA 10) and IDESSA 85.

The reasons given for the choice include

- Large grains
- Ease of threshing
- Heavy panicles

Setting up PVS at Tambalug

At the close of day 2, the PVS concept was introduced to each of the groups, and assuming they were interested in setting up one, was asked to think about how this could best be achieved. The importance of the process benefiting the whole community was stressed. A total of 48 farmers (22 men and 26 women) took part in deciding on the PVS the 3rd day. It was indicated to the groups that they would be planting a rice garden, which is to be managed by the groups the first year on about an acre. SARI would be involved only in the planting and evaluation of the varieties. The women indicated that if they run a joint seed garden (nursery) with the men, all the work would be left on them. After consultations at group levels the groups decided to manage two nurseries, one for the men and another for the women. The groups agreed on communal type management. The headman volunteered to

provide land for the nurseries. Zacharia Bugri the GAS field assistant is to liase with the community to identify a suitable land for the nurseries. A team from SARI is to visit the community in the middle of January to discuss this report, work plan and MOU with managements of BEWDA, GAS and the community. During that visit the team is to inspect the fields selected for the nurseries and enquire when seed should be supplied.

3.3 PVS nursery and Mother & Baby PVS

3.3.2 Sayerano and Aferi, Western Region

3.3.2.1 Introduction

The Needs Assessment conducted in 2000 was used to set up a community-led PVS at Sayerano in October 2000. A second community, Aferi, was added after discussions with the District MOFA directorate showed that it was noted as very important for rice production, and that impact could be expected.

3.2.2.2 **2001**

Method

In contrast to the approach adopted for PVS in the work at Hohoe in 1997-2000, the role of researchers was very limited. Farmers were given the leading role in selecting varieties with desirable agronomic and consumer characteristics and in planning and managing the PVS.

Results

Community-managed nurseries were established at Sayerano and Aferi as planned. However, the performance of all the varieties was below expectation because of delays in planting the rice. The delays were caused by a number of factors:

<u>Sayerano</u>

i) Land for testing: The farmer who originally volunteered to offer her field for the testing changed her mind at the time clearing of land was to be done

ii) Labour for land clearing and planting: Community members gave priority attention to their individual fields. They failed to follow plans agreed with them on each visit and only made themselves available when the CRI researchers visited the sites.

iii) Blast problem leading to destruction of the already low yields of grain. This affected other rice fields; nothing was harvested from rice planted under a MOFA-sponsored IPM activity.

Aferi

i) The group members left the responsibility of clearing land on three farmers, because of the priority given to their own fields

ii) The field had large trees that had to be felled before planting could take place

iii) Farmers were concerned with scaring birds on their own fields, leaving the nursery to be attacked by the birds at both the milking and matured stages

The rice was planted on two plots for each variety – one having the seed primed and the other not. The rice varieties were selected on the basis of the needs assessment exercise at Sayerano in 2000. Farmers were given another opportunity at the time of planting to confirm their preferences by displaying all the varieties before planting. Rice traders (middlemen) also participated in this exercise. In addition, varieties that had been selected by farmers at Hohoe were added to the farmers' choice.

Table 38. Varieties planted at the two locations.

Variety	Selected by	Basis for inclusion
Iguape Cateto	Farmers	Bold grains
Kleminson	Farmers	
WAB 450-IBP-160-HB	Farmers	Bold grains
WAB 450-5-1-B21-DV6	Farmers	Bold grains
WAB 450-IBP-20-HB	Farmers	Bold grains
M22	Farmers	Bold grains
IDSA 85	Farmers	Long grains
WAB 99-10	Farmers	Bold grains
WAB 340	Researchers	Selected at Hohoe
WAB 209	Researchers	Selected at Hohoe
WAB 126	Researchers	Selected at Hohoe
Agya Amoah	Farmers*	Local check
Sikamo	Farmers*	Improved variety check

* Even though these would have been included as checks, farmers selected them for inclusion in the trial on basis of grains being bold

The yields were so low that records are not worth reporting.

Farmer assessment of varieties
Sayerano

In comparison to the new varieties:
i) *Sikamo*, though having appealing (i.e. bold) grains, was later maturing and therefore less tolerant to drought
ii) *Agya Amoah* was the latest maturing among all the varieties, and therefore the only variety left on the field after harvesting all the other varieties, which exposed it to bird attack. It should be noted that the fact that *Agya Amoah* was late maturing did not necessarily imply that on farmers' fields it would be the target for bird attack. This will not be so if a large number of farmers are planting varieties with similar harvesting period as the birds would be distributed among the fields. Moreover, for large fields, farmers would found it worthwhile to scare birds, as is the practice.
iii) There was an unusual high incidence of a disease identified as blast by plant pathologists from CRI and SARI. This affected yields of all the rice varieties, with up to total loss in some cases. The normal experience was for plants attacked by blast early in the season to recover

Preferences
The criteria for selecting preferred varieties did not differ between men and women.
They were as follows:

- Early-maturing: this was particularly stressed
- Good looking grains (defined as bold grains)
- Tolerance to drought (note this is related to early maturity)

Table 39. Varietal characteristics

Variety	**Reasons for selection** (in order of importance)
WAB 450-IBP-20-HB	Bold grains Early-maturing
WAB 99-10	Early maturing Bold grains
IDSA 85 (only one in ten farmers)	Long grain

Aferi

i) Farmers tended to select varieties that were similar in grain characteristics to the major existing varieties, especially *Agya Amoah*, which is preferred for its bold grains, and *Mercy*, which though not bold is preferred for its ability to remain whole after milling (i.e. does not break). Mercy does not break when milled because the grain is short.
ii) The preference for varieties with grains that milled well (i.e. bold or medium in length) was particularly important among farmers who sold the rice in the paddy form, and this was informed by traders' preferences. Since the traders purchased rice in the paddy form to mill before selling, they purchased those with grains that were not broken when milled.
iii) Farmers selling rice in milled from preferred the bold grains because of the high recovery rate (estimated to be about 70% for *Agya Amoah*).

Preferences

The criteria for selection that was agreed upon were:

- Bold grain
- Medium length
- Taste

The PVS varieties selected for planting in subsequent years and the reasons are as follows.

Variety	**Reasons for selection**
WAB 450-IBP-160-HB*	- High yield (compared to other varieties though generally low yield of all entries) - Grain does not break when milled - Good taste Preferred over the existing *Mercy* variety because it (*Mercy*) is too short and therefore could be outgrown by weeds (and also difficult to harvest), and does not mature uniformly (problem of seed mixture?)
WAB 450-5-1-B21-DV6	- Bold grain - Good taste
M 22	- Bold grain - Good taste
IDSA 85	- Grain type; the long grain characteristic was so attractive that it took precedence over other factors that would normally be considered (particularly ease of milling)**

* Nick-named *Eno Mercy* (meaning "Mother Mercy") because of similarity in grains
** Fortunately, it milled well

Seed multiplication

Even though no meaningful data was collected from the nurseries, one individual farmer at Afere had succeeded in producing over 100 kg of seed of IDSA 85. This was from a plot outside the nurseries where surplus seed was planted. He intended to multiply it further in the 2002 season for sale to farmers who had expressed interest in that variety.

Suggestions for future work

Sayerano

The young men were particularly of the opinion that they were let down among their more elderly colleagues who showed less interest in the nursery because of pre-occupation with their individual farms. These older colleagues naturally served as the leaders. It was therefore felt that the young men could do a better job if they were together in their own group, or better still if there was individual farmer management.

Aferi

There was unanimous view that group work was likely to fail. A way was therefore to be found to give individual farmers responsibility for testing the varieties in future. There was preference was for the fields to lie close to each other to facilitate comparison of performance and exchange of views.

Although *Sikamo* performed poorly in the nursery, it was observed that it did well in individual farmer fields (not related to the PVS work). While some expressed the desire to include it in future testing, others said its height was too short for upland fields, making harvesting difficult.

3.2.2.3 2002

Introduction

In spite of the fact that the nursery stage of the work was not as successful as hoped, the decision was taken to proceed with the second stage of having farmers plant seed on their own fields, rather than repeating the nurseries. This was because it was observed that the problem of farmers giving priority to their fields would persist. The varietal testing procedure was, however, modified incorporate the “mother & baby” approach.

The testing at Sayerano was transferred to Mafia. This was as a result of the transfer of the collaborating MOFA extension officer from Sayerano to Mafia plus on-going internal community conflicts in Sayerano.

Testing procedure in 2002

The mother trial had all the entries on farmers' fields, while in the baby trials each farmer selected one PVS variety. This approach had the following advantages:

i) Facilitating comparison of the performance of the varieties under the same level of management (the "mother" trial)

ii) The risk of poor management as experienced in the first year was removed as farmers would now plant and manage varieties on their own fields ("baby" trials)

Given the limitation of seed of the varieties initially introduced as a result of the very low yields, farmers had to be supplied with seed available from the PVS work at Hohoe as a new injection. The hope is that the limited seed from the nursery may disseminate with time, but at a somewhat slow pace (initial seed available key to spread).

Performance of varieties

Mafia

(*The results of the mother trial not complete*)

In the "mother" trial WAB 450 (*check on the specific variety*) was the earliest in maturity, while Iguape Cateto was the latest in maturity.

Records are available from only seven farmers In the "baby" trial.[4] Yields were overall low. The highest yield of almost 1 t/ha was recorded for WAB 209. Overall, however, IDSA 85 and Iguape Cateto, which had similar yields, performed better than WAB 209.

[4] The target number of farmers was 15. However, one of the two MOFA extension officers who was supplied with seed for farmers was unable to carry on with the work for reason of time constraint. It also resulted in the problem of unable to report on all the cultivar types that were supplied.

Table 40. Results of "mother" trial 2002, Mafia
(*…complete with yield data from harvested grain sent to CRI*)

Variety	Date to first flowering	Date to 50% flowering	Yield (t/ha)
WAB 209	62	73	
IDSA 85	72	84	
Iguape Cateto	79	90	
WAB 340	64	76	
WAB 450…	53	61	
Agya Amoah			

Table 41. Results of "baby" trial 2002, Mafia

Farmer	Variety	Yield (t/ha)
Paulina Adade	IDSA 85	0.45
Okyeame Awuah	IDSA 85	0.77
Kojo Bannie	WAB 209	0.99
Luke Kesseh	Iguape Cateto	0.62
Mallam Hamidu	WAB 209	0.33
Kofi Samah	WAB 209	0.32
Akosua Tanaa	IDSA 85	0.62
Agya Amoah (local check)		
Average		

Assessment

Mafia

i) The wide range in days to maturity did not matter to the farmers since earliness was not an important factor in selecting varieties.

ii) Pre-harvest performance was less important, and the decision to plant a particular variety was based on the yield and post-harvest characteristics.

iii) In pre-harvest assessment, tillering ability was more important than earliness. At this stage WAB209 (the second earlist after WAB 450) was preferred to WAB 450, implying that even though earliness was not critical, very late varieties are also of low preference.

Aferi

(*…Still awaiting data from MOFA extension officer*)

The pre-harvest assessment of varieties is summarised for eight farmers below. With the exception of *Iguape Cateto* for which one farmer assessed not to be suitable for hydromorphic environments, and another to be too tall, the assessment up to harvest was generally good.

Table 42. Assessment of PVS cvs by farmers, at Aferi in 2002

Farmer	Sex	Age	Variety	Ecology	Pre-harvest assessment
Mary Manso	F	40	Iguape Cateto	Upland and hydromorphic (on slope)	- Poor germination, so transplanted - The rice on the part of the field with upland ecology performed well with good tillering, but the rice on the hydromorphic part performed poorly - Primed all the seed so not able to assess difference between primed and non-primed
Susana Owusu	F	25	Iguape Cateto	Upland	- Good germination - Good tillering and post-flowering performance - A disease identified as "dying back" caused by *Diopsis vectar* was identified at the early stage of the plant's growth but was perceived not to have serious effect on yield because it did not cause much harm at that stage of the plant's growth
Rachel Benie	F	22	Iguape Cateto	Upland	- Poor germination, so transplanted - Good tillering and post-flowering performance
Sebulon Gyedu	M	42	Iguape Cateto	Hrdromorphic	- Good germination - Poor tillering - Too tall for liking, and perceives that shorter varieties tiller better*
John K Kwarteng	M	40	Iguape Cateto	Upland and hydromorphic (on slope)	- Good germination, even though the seed not primed - Good tillering and overall post-flowering performance
Kwaku Afum	M	38	Iguape Cateto	Hrdromorphic	- Good germination - Good tillering and post-flowering performance
David Asieyie	M	28	WAB 209	Hrdromorphic	- Good germination - Good tillering and post-flowering performance
Joseph K Owusu	M	54	WAB 209	Upland	- Poor germination - Good tillering
??	M	44	IDSA 85	Upland and hydromorphic (on slope)	- Good germination on both upland and hydromorhic parts of field - Good tillering and post-flowering performance

* The shade of forest trees close to the field (it shared border with forest fallow) perhaps accounted for the tall plants

3.3.2 Tambalug and Nyorigu, Upper East Region

3.3.2.1 2001

In December 2000, a rice variety needs assessment was conducted in Nyorigu and Tambalug in the Bawku East District of Upper East Region (see 3.3.1). Group and focus discussion, time line and ranking were tools used to solicit information on varieties desired by farmers from these two communities. Panicles and grains from different plant types were exhibited for farmers to select from. The team also collected samples of farmers' varieties (a total of 10) which were included in 2001 PVS nurseries (see Table 45). Both communities participated in the PVS; at Nyorigu men and women elected to have separate PVS nurseries in the same field while at Tambalug a single PVS nursery was established.

Method

Based on the results of the needs assessment, cv selections were made from germplasm at SARI for the composition of a PVS nursery. Thirty varieties from research and 10 farmers' varieties were composed into a PVS nursery (Table 45). Each nursery thus consisted of 40 unreplicated entries and was evaluated in Nyorigu and Tambalug communities.

Collaborating farmers were identified during the needs assessment exercise. Two levels of research involvement were implemented in this study. At Nyorigu the PVS was facilitated by a local NGO, BEWDA and SARI whereas at Tambalug the PVS was facilitated only by Garu Agric. Station. In May 2001, a facilitator from each collaborating NGO and a farmer from each community were invited for two days training on PVS. Participants were taken through the objectives and expected outputs of the project and the roles of collaborators. During a practical section they were asked to evaluate some varieties on the field. At the end of the training, each community was given two sets of 40 varieties to be evaluated in a nursery by men and women.

At Nyorigu, the PVS was situated on an upland field close to the valley bottom, i.e. on a favourable upland site. At Tambalug, the PVS was sited in a hydromorphic field in

an inland valley. Farmers at Tambalug do not believe rice can be grown as a pure upland crop and refused to site the PVS on an upland field. In both communities fields were prepared manually with a hoe and crop established by dibbling at 20 x 20 cm spacing. Field layout and planting at Nyorigu was facilitated by SARI and BEWDA whilst that at Tambalug was facilitated by the Presby. Agric. Station at Garu. Fields were weeded two times at three and six weeks after planting. Labour was supplied free of cost by collaborating farmers. Fertilizer rate was 60-60-30 N-P_2O_5-K_2O per hectare and was supplied by the project. At Nyorigu the method of fertilizer application was by dibbling. Fertilizer was not applied at Tambalug because farmers claim they don't apply fertilizer to their rice.

Responsibilities of collaborators during the PVS exercise:

Activity	Responsible person
1. Layout of trial	Facilitator
2. Sowing of the trial	Farmer supervised by facilitator
3. Field management	Farmer
4. Monitoring	Farmer & Facilitator
5. Data collection	Facilitator
6. Harvesting	Farmer supervised by facilitator
7. Plot weighing	Facilitator (whole plot harvest)

Apart from two formal evaluations, which were conducted at maturity and post harvest stages, farmers were encouraged to visit the nurseries at their own leisure times. During evaluation at maturity each collaborating farmer was given the chance to rank his three best choices and to select one variety that he would not like to grow the following year with reasons.

Results

One hundred and sixteen and 59 farmers at Nyorigu and Tambalug, respectively, participated in the PVS (Table 43). The field at Tambalug suffered from flooding during which all varieties were submerged for about two weeks in October. The PVS at Nyorigu had no problems.

Table 43. Number of male and female farmers participating in the PVS in two communities in Upper East Region in 2001

Communities	Number of participating farmers		
	Male	Female	Total
Nyorigu	49	67	116
Tambalug	22	37	59

Farmers' Preference of varieties in PVS nurseries:

The characteristics that influenced farmer's decision on a variety at the maturity and post harvest stages across farmers in the two communities are presented in Table 44.

Table 44. Characteristics that influenced farmers' decision on a variety

Growth Stage	Characteristics
Maturity	Number of panicles, panicle size, grains per panicle and grain type are of paramount importance. The ability of a variety to withstand lodging and its earliness are also very important at this stage
Post harvest	Varieties with a premium (i.e. meet consumer preference) at the market. Such a material should also be able to fill sacks easily. According to farmers such materials have long slender grains, big or bold grains, and should not break easily during milling

The cvs most frequently selected by men and women in the two communities are presented in Table 45. In general, the two communities chose different cvs, which given the different PVS locations was to be expected. The only cvs selected at both sites (by either men or women) were IR12979-24-1, WAB181-18, IDSA85 and Kleminson.

At Nyorigo, WAB337-B-B-7-H4 and the aromatic cv WAB515-13-13A-8 were selected by both men and women; other choices were different. IDSA46 was selected by half of the men. At Tambalug only Kleminson was selected by men and women. More than 70% men chose WAB450-1-B-P-163-4-1, and 45% WAB450-1-B-P-163-

2-1 (both NREICAs),neithet of which were selected by women. The cv selected most frequently by women was WAB586-1-1.

Table 45. Varieties selected by men and women in Nyorigu and Tambalug PVS nurseries (%)

	Nyorigu (n=71)		Tambalug (n=26)	
Variety	Men (n=22)	Women (n=49)	Men (n=11)	Women (n=15)
WAB 337-B-B-7-H4	32	22		
WAB 96-11	23			
IDSA 46	50			
IR 12979-24-1 (LC)		33		20
WAB 181-18	23			36
WAB 450-I-B-P-157-1-1				20
WAB 450-1-B-P-160-HB		26		
WAB 450-1-B-P-163-4-1			73	
WAB 450-1-B-P-163-2-1			45	
IDSA 85		12		33
KLEMINSON		24	27	20
WAB 515-13-13A-8 (AROMATIC)	32	33		
WAB 96-5-1		35		
WAB 586-1-1				67
WAB 96-3				
WAB 56-50			27	

Paddy yield in PVS nurseries.

Mean paddy yield was 3.1 t/ha at Nyorigu and 0.9 t/ha at Tambalug. Yield at Tambalug was affected by the flooding during flowering. The men's and women's PVS nurseries at Nyorigo had similar mean yields (Table 46). The highest yielding cvs at Tambalug were Tox 3108-56-4-2-2-2 (2.7 t/ha) and IR 12979-24-1 (1.8 t/ha), the former being a lowland cv released at Sikamo. At Nyorigo a number of cvs yielded about 5 t/ha, including TOX 3108-56-4-2-2-2 and IR 12979-24-1. Overall, the improved cvs at both sites were higher yielding than the locals cvs.

Table 46. Yield of upland rice varieties in Nyorigu community in Northern Ghana, 2001

Variety name	Paddy yield (kg/ha)			
	Nyorigu			
	Men	Women	Mean	Tambalug
WAB 450-24-3-2-P18-HB	1972	2510	2241	1076
WAB 450-I-B-P-91-HB	2896	2715	2805	1267
WAB 337-B-B-7-H4	5436	3624	4530	732
WAB 570-35-53	3914	3558	3736	1067
WAB 96-11	2660	1862	2261	1241
IDSA 46	3277	1811	2544	1380
WAB 181-32	3777	1924	2850	1431
IR 12979-24-1 (LC)	5527	5438	5482	1808
WAB 181-18	3213	1910	2561	892
WAB 99-1-1	3288	1817	2552	374
WAB 450-I-B-P-157-1-1	2677	3588	3132	714
WAB 450-1-B-P-160-HB	3699	1832	2765	1064
WAB 450-1-B-P-163-4-1	1074	1074	1074	1074
WAB 450-11-1-2-P41-HB	2088	2262	2175	1051
WAB 450 –1-B-P-38-HB	1608	1429	1518	536
WAB 450-1-B-P-163-2-1	2162	2163	2162	1081
IDSA 85	4344	3982	4163	1448
KLEMINSON	4256	3369	3812	887
WAB 33-17	3986	3080	3533	362
WAB 375-B-5-HI-1	3209	1961	2585	535
WAB 515-13-13A-8 (Aroma)	2358	3620	2989	395
GAMBIAKA	4163	2255	3209	977
TOX 3108-56-4-2-2-2 (LC)	3863	6145	5004	2772
IDSA 10 (IRAT 262) (LC)	2529	2167	2348	722
WAB 96-5-1	2472	3531	3001	1059
WAB 586-1-1	5360	4467	4913	1429
WAB 96-20	4486	3051	3768	718
WAB 515-177-2	4477	4298	4387	716
WAB 96-3	4636	5705	5170	713
WAB 56-50	3910	3554	3732	889
KPUKPULA (L)	3139	2093	2616	349
MENDI (L)	-	-	-	-
GOMBA (L)	4056	4585	4320	705
KUKUOSO MU (L)	1398	2447	1922	699
ABONGIMA (L)	1897	2415	2156	-
AGONA (L)	3244	2703	2973	742
AGONGIMA (L)	1978	4676	3327	540
AGONDIGA (L)	1798	2158	1978	719
ABONSANGA (L)	3597	2158	2877	719
MR MORE (L)	2671	3918	3294	1063
Mean	3259	3022	3140	945

L= Local variety from farmers LC = Improved local check

Milling characteristics of varieties:

Milling characteristics of some farmer preferred varieties are presented in Table 47. With the exception of IDSA and Sikamu, the more preferred varieties have very high milling out turn (70%). Percent broken grains were however very high for all the varieties especially for IDSA10. To reduce percentage of broken grains however, these varieties may have to be parboiled before milling.

Table 47. Milling characteristics of the six most preferred upland rice varieties across the three communities.

		Milling out turn		Percent broken grain	
Variety	Moisture content	Brown rice	Polished rice	Brown rice	Polished rice
WAB 337-B-B-7-H4	10.9	80	70	10	33
WAB 570-35-53	11.4	82.5	73	10	37
SIKAMU (Tox 3108-56-4-2-2)	9.8	82.5	63	0	27
WAB 450-I-B-P-157-1-1	10.3	80	70	17	37
WAB 515-13-13A-8	9.3	85	72	23	50
IDSA 10 (IRAT 262)	9.3	85	62	20	67

3.3.2.2 2002

PVS nursery at Tambalug

A community PVS activity was repeated at Tambalug at the request of the collaborating local NGO (Presbyterian Agricultural Station) and farmers. This was necessitated by the destruction of the nursery last year by flood. Thirty varieties from research and 10 farmers' varieties (Same as those used in 2001) were composed into a PVS nursery. In contrast to 2001, both men (15 farmers) and women (22 farmers) elected to have separate PVS nurseries. Each nursery consisted of 40 non-replicated entries.

Land preparation was done manually using a hoe. Crop was established by dibbling at 20 x 20 cm spacing. Farmers managed all plots with facilitation by a Technician from the Presbyterian Agricultural Station at GARU. Fields were weeded two times at three and six weeks after planting. Facilitators suggested additional weeding as

required. Labour was supplied free of cost by collaborating farmers. Fertilizer rate was 60-60-30 N-P_2O_5-K_2O per hectare and was supplied by the project. The method of fertilizer application was by dibbling.

Apart from two formal evaluations, which were conducted at maturity and post harvest stages, farmers were encouraged to visit the nurseries at their own leisure times. During evaluations each collaborating farmer was given the chance to rank his three best choices and to select one variety that he would not like to grow with reasons. Varietal selections were recorded for each farmer during the two evaluations, and at the end of the season each farmer's choices were analyzed.

Mother & baby trials at Nyorigo and Tambalug

Methodology

Farmer preferred cvs were tested on-farm in 2002 using the mother and baby approach. A total of 65 farmers who participated in the PVS nursery in 2001participated in the trials in 2002. The six most frequently selected cvs across the two communities were included in the mother & baby trials.

A mother trial comprised of all the six PVS varieties and was replicated in five farmers' fields. Mother trials were managed by facilitators together with farmers. Baby trials within a community consisted of all possible combinations of two out of six most preferred (i.e 15 combinations or trials each with two treatments). Each farmer received one of the 15 combinations (most often made up of 0.5 kg each of his two most preferred varieties) which he/she was supposed to plant in his/her farm with his own variety as a control. Each baby trial (a pair of two varieties) was replicated four times within the two communities; each variety was therefore replicated 20 times. Farmers had responsibility for the layout, sowing, management and harvesting of the baby trials. Fifty five farmers from Nyorigu (4 Mother and 51 Baby Trials) and 10 from Tambalug (1 Mother and 9 Baby trials) participated in the evaluation.

For ease of identification of varieties on farmer's field, PVS varieties within a community were colour coded. Evaluations of varieties were done at maturity and after harvest. Facilitators from Bawku East Women's Development association (BEWDA) and Presbyterian Agricultural Station (PAS) were trained to monitor the

implementation with regular backstopping from SARI. Farmers' fields were visited in October by a combined team of Research, NGO's and farmers to interact with farmers and monitor performance of varieties.

Agronomic and farmer preference data on varieties were collected using qualitative (Participatory) and quantitative methods. At maturity and post harvest, farmers ranked each trait of interest as:

1. Much better than own variety
2. A little better than own variety
3. The same as own variety
4. A little worse than own variety
5. Much worse than own variety

Yield was also measured in bowls/unit area or per kg seed planted. Mean Yield of a variety across farmers was compared to that of farmers and expressed as percentage yield of farmers' variety.

Results

Results are only reported from Nyorigo where there were more trials. PVS varieties performed significantly better than farmers' varieties on-farm in both the mother and baby trials (Tables 48 & 49). Pair wise comparison of PVS varieties revealed Percent yield increases above farmers variety ranging from 17 to 98 for baby trials and 7 to 65 for mother trials. IR12979-24-1 was outstanding in both sets of trials.

Table 48. Grain yields of PVS rice varieties compared to farmers' variety in mother trials in Nyorigu in 2002.

Variety	Number of respondents	Yield (Kg/ha)
IR 12979-24-1	5	1858
IDSA 85	5	1421
WAB 337-B-B-7-H4	5	1633
WAB 515-13-13A1-8	5	1201
WAB 586-1-1	5	1408
WAB 96-5-1	5	1300
Farmers variety (varied)	5	1120

Table 49. Yield of PVS and local cvs in baby trials at Nyorigu in 2002

Selected cv	No. trials	Yield (kg/ha)		LSD (5%)
		Selected cv	Local cv	
IR 12979-24-1	17	1541	775	356
IDSA 85	18	1166	698	234
WAB 337-B-B-7-H4	15	1056	730	290
WAB 515-13-13A1-8	8	1018	870	241
WAB 586-1-1	18	1380	730	303
WAB 96-5-1	15	1270	755	287

Farmer assessment of agronomic characteristics of the varieties ranged from similar (score 3) to much better (score 5) than their own varieties (Table 50). No cvs were considered much worse than their own cv.

Table 50. Farmer assessment* of upland varieties according major agronomic characteristics at Nyorigu

Variety	Number of farmers	Agronomic characteristics				
		Tillering ability	Maturity period	Panicle size	Visual yield assessment	Overall assessment
IR 12979-24-1	18	4.6	5.0	4.6	4.9	4.8
IDSA 85	18	4.3	4.6	4.7	4.6	4.5
WAB 337-B-B-7-H4	18	4.4	4.6	4.6	4.7	4.6
WAB 515-13-13A1-8	18	4.6	4.5	4.6	4.8	4.6
WAB 586-1-1	18	4.3	4.8	4.4	4.1	4.4
WAB 96-5-1	18	2.8	4.9	2.8	3.5	3.5

Across both communities, the three most preferred varieties that farmers will like to continue with are IR 12979-24-21, IDESSA 85 and WAB 96-5-1 (Fig 1).

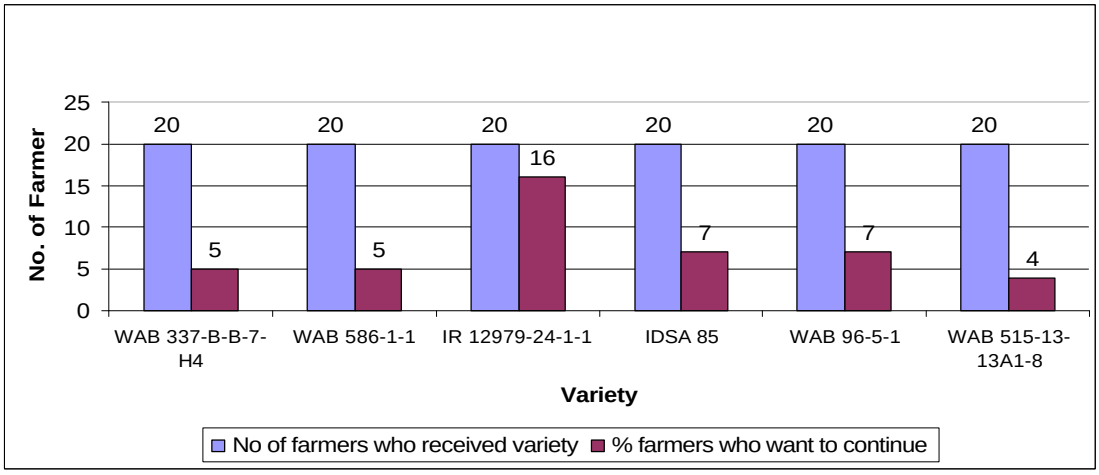


Fig 25. Acceptance* of PVS varieties in Nyorigu and Tambalug communities

Evaluation of PVS varieties at multi-location sites and on farmers fields

The six PVS varieties selected by farmers were evaluated simultaneously at three research station sites, namely Salaga (Northern Region), Manga (Upper East) and Nyankpala (Northern), in formal replicated yield trials. Two varieties IRAT 262 and Akukuosomu were included as an improved check and farmers variety in this study. Yield and agronomic characteristics of the PVS varieties were compared to these varieties.

The mean yields of all the PVS varieties across the three sites were significantly higher than that of the local variety. Only two of the PVS varieties, IR 12979-24-1 and WAB 337-B-B-7-H4, out performed significantly the improved local check IDSA10 (Table 51.). The performance of IR 12979-24-1 at both the multi-locational and on-farm trials was outstanding (Table 51).

Table 51. Grain yields of PVS rice varieties evaluated at multi-location sites in Northern Ghana in 2002

	Mean paddy yield (kg/ha)				Mean yield as % of:	
Variety	Manga	Salaga	Nyankpala	Mean	IDSA10	Farmers variety
IR 12979-24-1	3186	3301	4405	3631	194	360
IDSA 85	637	2100	1942	1560	83	154
WAB 337-B-B-7-H4	1928	2476	2896	2433	130	241
WAB 515-13-13A1-8	848	2305	1241	1465	78	145
WAB 586-1-1	1727	2424	2587	2246	120	222
WAB 96-5-1	1871	2337	1897	2034	108	202
IRAT 216	1463	2822	2691	2325	124	230
WAB 450-I-B-P91-HB	1277	2625	1996	1996	107	198
WAB 96-20	1109	1952	2483	1848	99	183
IDSA10 (improved check)	856	2218	2530	1868	-	185
Kukuosumo (farmer's cv)	493	1311	1220	1008	53	-
LSD 5%		ns		502		

4 Informal Seed Dissemination and Uptake Pathways

4.1 Seed distribution in Volta Region in 2000

The aim of this activity was primarily to monitor and examine how seed was disseminated through informal channels, i.e. farmer to farmer. The formal sector is ineffective for upland rice and new cvs are most likely to be popularised through informal rather than formal channels. A secondary objective was to obtain further data on farmer preference for the new cvs. Seed was distributed through different pathways in five new communities near Hohoe and to a seed multiplication group at Todzi.

4.1.1 Weather

Total rainfall in 2000 was only 1220 mm compared with 1800 mm in the previous year. The long term (1960-90) mean rainfall is xxxx. The July to December rainfall was only 617 mm compared with 955 mm in 1999 (Fig. 26). Drought was therefore widespread and many farmers failed to harvest any rice from local, long duration cvs cvs.

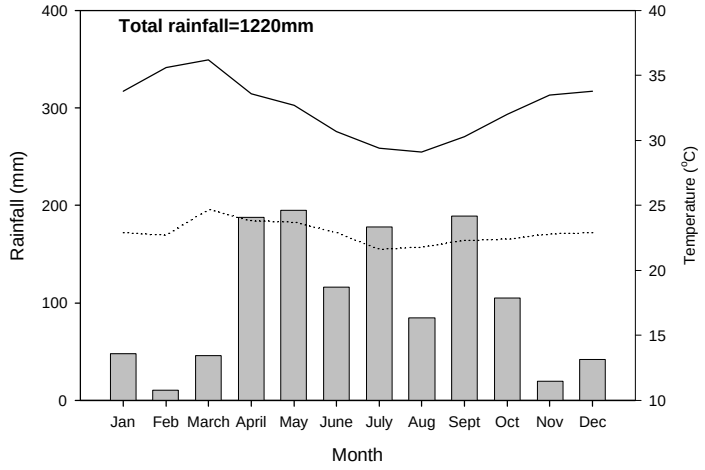


Fig. 26. Total monthly rainfall and average monthly maximum and minimum temperatures at Hohoe in 2000

4.1.2 Traditional rice production practices

Both men and women farmers follow the same practices and these are similar to those described previously for Hohoe. Rice production was traditionally a female activity but male farmers have been attracted as a result of the increased market orientation of the crop's production. Cocoa is the traditional cash crop of the male farmers but its production is on the decline.

Farmers mostly grow three varieties:

i) Local upland red - Kawumo (*O. glaberrima*)
ii) Local white (*O. glaberrima*)
iii) Improved white (*O. sativa*)

Different varieties are planted on separate fields or on demarcated plots on the field to prevent varieties mixing up. However, the varieties do sometimes get mixed up. The mixing up of varieties occurs on the field and in storage. The mixtures on the field result from planting on fields cropped to a different rice variety in a previous season.

Rice to be used as seed is stored separately from what is earmarked for consumption or sale, but only in terms of physical separation. Both are managed the same way. The rice is threshed immediately after harvest on the field and carried home. They are stored in bags without any chemical treatment.

Farmers identified three major uptake pathways:

i) Outright purchase
ii) Payment in kind after harvest: twice the amount of the seed borrowed
iii) Exchange: the same amount of seed of different varieties exchanged. Both could be planted (if each wanted to try the other's variety) or the seed of the old variety given in exchange for the new one would be used to replace harvest of new variety that would have been consumed as grain

4.1.3 Seed distribution

Seed was multiplied during 1999 and distributed in five communities using different mechanisms (Table 52). The five communities were within 20 km of the Hohoe PVS but did not participate in the earlier phase of the project. The communities were selected in such a way as to facilitate monitoring of different approaches to seed dissemination and approach. Other mechanisms such as distribution through churches, clinics and schools were also planned but the failure of a seed multiplication reduced the amount of seed available.

Table 52. Seed uptake study communities

Community	Location	How organised
1. Santrokofi-Benua	On major highway	Contact farmer of MOFA the focal point. He played the leading role in the selection of farmers and distribution of seed
2. Lolobi-Ashambi	On major feeder road	Researchers and MOFA agricultural extension agent selected cross-section of interested male and female rice farmers representative of the different age groups
3. Lolobi-Kumasi	On major feeder road	Contact farmer of MOFA identified individuals from different wealth categories
4. Likpe-Bakua	Off major feeder road	MOFA agricultural extension agent and Chief Farmer selected farmers
5. Likpe Agbozume	Off major feeder road	Farmers who had organised themselves into a group were provided the seed

4.1.4 Farmer preference

Results of informal interviews on preferences in the five communities are presented below. These interviews were carried out at group meetings with farmers who were supplied with the varieties for planting on their fields under their management. In general, there were no differences in opinion between the male and female farmers. Full details are provided in Appendix.

Seed yield

Yields were measured in as many fields as possible and these are summarised in Table 53 for all five communities. In all 87 fields were evaluated. Overall, yields were

highest at Likpe Bakua and the highest individual yield (2.9 t/ha) was by a lady farmer in this community. Yields generally averaged about 1 t/ha and were very variable. WAB209 was generally the highest yielding new cv (Table 54). Yields of local cvs were o to 0.3 t/ha.

Table 53. Distribution of seed and grain yields in 2000

Community	Method of seed distribution	No. farmers	Cultivars (No)	Yield	
				(t/ha)	Range
Lolobi Kumasi	Wealth ranking	22	WAB209 (8)	1.15	0 - 2.3
			IDSA85 (4)	0.88	0.4 - 1.3
			WAB126 (6)	0.31	0 - 0.9
			Mean		
Lolobi Ashambi	Extension Agent	22	WAB209 (8)	1.10	0.5 - 1.0
			IDSA85 (4)	1.00	0.3 - 0.8
			WAB126 (6)	0.43	0.2 - 2.8
			WAB340 (4)	1.13	0.4 - 2.0
			Mean		
Likpe Bakua	Chief Farmer & Extension Agent	18	WAB209 (6)	2.00	1.2 - 2.9
			IDSA85 (3)	1.10	0.6 – 1.3
			WAB126 (7)	1.30	0.3 – 3.1
			WAB160 (2)	2.50	
			Mean		
Likpe Agbozome	Assembly Man	15	WAB209 (3)	0.67	0.3 – 0.9
			IDSA85 (4)	1.48	0.8 – 2.6
			WAB126 (8)	1.45	0.4 – 2.7
			Mean		
Santrokofi Benua	Contact Farmer	10	WAB209 (3)	1.13	0.3 – 1.9
			IDSA85 (3)	0.65	0.2 – 1.1
			WAB126 (4)	0.90	0.2 – 1.7
			Mean		
	Total	87			

Table 54. Average seed yields (t/ha± Std) of four new cvs in five communities near Hohoe in 2000

Village	IDSA85	WAB126	WAB209	WAB340
Lolobi Kumasi	0.88	0.31	1.15	-
	(0.550)	(0.297)	(0.905)	
Lolobi Ashambi	1.00	1.03	1.10	1.13
	(0.458)	(1.476)	(0.882)	(0.797)
Likpe Bakua	1.10	1.30	2.00	-
	(0.436)	(1.018)	(0.670)	
Likpe Agbozome	1.48	1.45	0.67	-
	(0.806)	(0.878)	(0.321)	
Santrokofi Benua	0.65	0.90	1.13	-
	(0.636)	(0.678)	(0.802)	

Likpe Bakua

The Chief farmer and Extension officer formed a Community Taskforce to distribute the seed of new cvs, so that a seed pool would be built up for other members of the community and other nearby communities. Fields were monitored by the extension officer and the process worked well.

Overall rating:

IDSA 85 was preferred to the existing (local) upland variety because of:

i) Better drought tolerance

ii) Higher yield

iii) Longer grain and better market value

Market rating:

All the new varieties (IDSA 85, WAB 209 and WAB 126) were rated higher than the existing (local) upland varieties. Within the PVS varieties, IDSA 85 was ranked highest, and WAB 209 lowest. The market is more important than home consumption in overall rating for the purpose of increasing production. This is perhaps explained by the objective of tendency to produce for the market as home requirements are met.

Home consumption rating:

The new varieties were rated lower than existing varieties because of the lower starchy content of the new varieties. There is preference for sticky rice for local preparations.

IDSA 85 rated lowest for home consumption because it is considered fluffy.

Seed dissemination:

i) Individual farmers had sold some seed. These sales were not able to meet requests, especially for IDSA 85.

ii) Requests were received from other communities (e.g. Dodi Papase and Abotiase) but the inability to meet local demand fully constrained the spread of the varieties to these communities.

iii) Seed of the new varieties were sold at 5,000 cedis/2 kg bowl, irrespective of variety. Where the buyer was a kin of the farmer, the price could be as low as 2,500 cedis/2 kg bowl.

iv) All farmers expressed the intention to plant IDSA 85, in addition to their own varieties (and other introduced varieties for those who want to plant more than one of the introduced varieties) in 2001.

v) There was less willingness to continue with WAB 209; only one farmer (female, age 40) intended to continue production

Subsequent interviews in 2001 showed that about one third of seed was kept, one third eaten and one sixth either sold or gifted. A small proportion was also exchanged (Fig. 27). All the exchange and gifts were within the community. In 2002 one farmer gave seen to kin in Dodi papese and seed was also sold to a farmer from Danyi in neighbouring Togo. Seed also went to Jasikan and Fodome Afegame in 2001.

Likpe Bakua

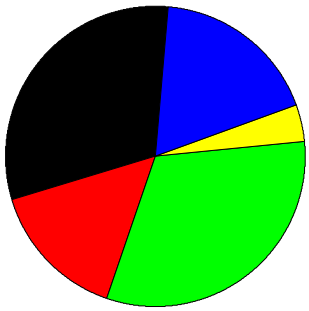


Fig. 27. Use of seed harvested in 2000 at Likpe Bakua

Remarks/feedback to research and extension:

The following were mentioned as problems associated with WAB 209:

i) Difficult to thresh using traditional method of beating
ii) Difficult to process paddy into grain using traditional method of pounding in mortar
iii) Prepared food hardens when kept after preparation for later use

Problem of difficulty in threshing mentioned by some farmers for WAB 209. One (female) farmer, however, of the opinion that the problem is faced only when the threshing is delayed after harvesting. She had no problems because she threshed immediately after harvesting. There is the need to find out the length of time beyond which if threshing is carried out it becomes difficult.

While some farmers observed that prepared food from WAB 209 hardened after some time, and that this was a problem, others did not see that as a problem. To this latter group, the problem arises when the rice is prepared in the same way as the traditional varieties. The WAB 209, they explained, had to be prepared with less water than what is used for other varieties. Some of the farmers were of the opinion that the high starch content, which was responsible for the hardening of the cooked rice, was a good attribute because "it was filling". Its high starch content was similar to one of their lowland varieties (Viono), which was popular for use at home.

Likpe-Agbozume

A Community Task Force was also formed at Likpe Agbozume by the local Assemblyman, who was also a rice farmer, to distribute seed. This Task Force monitored fields regularly and collected relevant data on performance and yield. The Task Force also operated a 1 kg out: 2 kgs returned system to build a community seed pool. At the end of 2000, the Task Force visited other nearby villages and helped to set up similar Task Forces as well (see below).

<u>Preferences and reasons:</u>

IDSA 85 was ranked highest among existing varieties and the introduced ones. The major factors accounting for its high acceptability are:
(i) High yield
(ii) Tolerance to drought

WAB 209 ranked better than local, with the following as the good traits mentioned.

(i) Better yield

(ii) Better tolerance to drought

WAB 126 ranked better than the local, with the following as the reasons.

(i) Better yield

(ii) Good tillering

Seed dissemination:

The following were mentioned as the plans to disseminate seed of the new varieties.

i) Increase acreage of new varieties. Land of their own a problem (limiting) and so the participating farmers intend to get land and carry out block farming in groups of four each.

ii) Provide seed (2 kg each) to farmers in other communities (Likpe-Kukurantumi and Likpe-Ablade). Four kilograms of seed has been taken from each of the 15 participating farmers for that purpose. The requests received are overwhelming but the group cannot satisfy all the communities.

iii) From a survey in 2001, farmers kept about two thirds of the remaining yield, and sold about 20% (Fig. 28). All gifts and exchanges were within the community. Seed also moved to Golokwati in 2001 (a farmer from Agbozome planter her trial there).

Fig. 28. Use of seed harvested in 2000 at Likpe Agbozome

iv) In 2002 seed moved to Ve Koloenu, Ve Wudome, Gbi Wegbe, Logba Alakpeti, Teikrom and Badu in Togo. In 2003 seed also moved to Gbi-Godenu.

Remarks/feedback to research and extension:

There was evidence of farmers' willingness to pay a premium for seed of new varieties.

Prices (in cedis) on 15 June 2001 were as follows:

Local variety: 4, 000/bowl of 2 kg
IDSA 85: 7,000 – 8,000/bowl of 2 kg
WAB 209: 7,000 – 8,000/bowl of 2 kg
WAB 126: Up to 10,000/bowl of 2 kg (mentioned by only one farmer)

Lolobi-Ashiambi and Lolobi-Kumasi

Results from these two villages are very similar. In both villages facilitation was poor and farmers did not give new cvs priority. At Lolobi Kumasi where seed was supposed to have been distributed by wealth categories, it turned out the contact farmer gave seed to friends or relatives, most of whom were not rice farmers. Fields were also poorly maintained.

Preferences and reasons:

All the varieties were rated good (with the exception of WAB 340 for which there was no farmer present to provide an assessment). The major reasons accounting for preference were the grain type and cooking quality. Cooking quality tests carried out by the community produced the following opinions:

- WAB 209 and WAB 126 do not keep well overnight
- The food quality improves, however, if each was mixed with IDSA 85 before cooking, and was best if all three were mixed before cooking; mixing varieties before cooking was a common practice in these communities.

Seed dissemination:

There was high demand from other farmers who wanted to try the new varieties. However, there was low willingness among the farmers to give out seed because of interest to continue with multiplication to increase stock. The crop performance was affected by terminal drought (planting started in July), particularly at Lolobi-Kumasi. The poor harvest limited the seed available for use by farmers.

In the cases where there was seed dissemination, it was through seed exchange and sale on individual basis. Some farmers planting the PVS varieties exchanged some of their varieties to have access to a broader range. Some of these exchanges were done at the beginning of the 2000 season (i.e. before planting of the original seed supplied), but the grater proportion of the exchange was after the end of the season (i.e. after the initial cropping).

Seed produced in the community was disseminated through exchanges: equal measure at planting time or 1:2 (one in exchange for two) if it would be replaced after harvest. Some farmers were expected to buy seed from Akpafu-Todzi

Remarks/feedback to research and extension:

Generally low yields because of late planting due to a combination of factors:

- Seed delivered later than desired (at Lolobi-Kumasi)
- Some farmers who received the varieties were described as "not serious rice farmers" by their colleagues and therefore gave low priority to managing the crop on the field

Santrokofi-Benua

No useful data was collected from this village. Facilitation was poor and some farmers reported that herbicide killed the crop.

4.1.5 Conclusion

All three cvs were found to be acceptable with the greatest preference for IDSA85. IDSA85, however, does have a seed germination problem and this is being investigated elsewhere (R. Bam, *pers. comm.*). All farmers expressed a willingness to plant more area to the new cvs and to plant other cvs. Exchange was common for this purpose. Many farmers could not get access to seed however, due to the small initial amounts and a severe drought in 2000.

The two communities where the seed distribution worked best were Likpe Bakua and Likpe Agbozume. In both these villages – independently – a community Taskforce was

set up by a respected individual for the good of their own and other communities. Farmers were also clearly motivated to test the new cvs and accordingly managed their fields well. Frequent monitoring by the Taskforce also helped maintain interest and motivation. These two communities both opted for a system where for each 1 kg provided from the seed pool, 2 kgs were returned for the following year. The remaining yield was kept by the farmer to do with as he pleased. In this way both these communities were able to provide seed to other communities.

4.1.6 Seed multiplication group at Todzi

Following the seed distribution in Todzi in 1999, the community decided to set up a common seed multiplication plot. Seed was provided for this purpose. In the event four farmers managed this plot and distributed seed in 2001. Seed of eight cvs were multiplied (IDSA85, WAB126, WAB209, WAB340, WAB56-60, I. Cateto , WAB450-P18 and OS6).

4.2 Seed dissemination in Volta Region in 2001

In 2001, farmers who were known to have received seed from communities or individual farmers in 2000 were visited and the position of their farm and the cv they were growing noted. Yields were also measured.

4.2.1 Weather

The 2001 season was another poor season with an annual rainfall of only 1076 mm (Fig. 29), compared with a more normal 1800 mm in 1999. The July to Decmber rainfall was only 429 mm resulting in a serious drought.

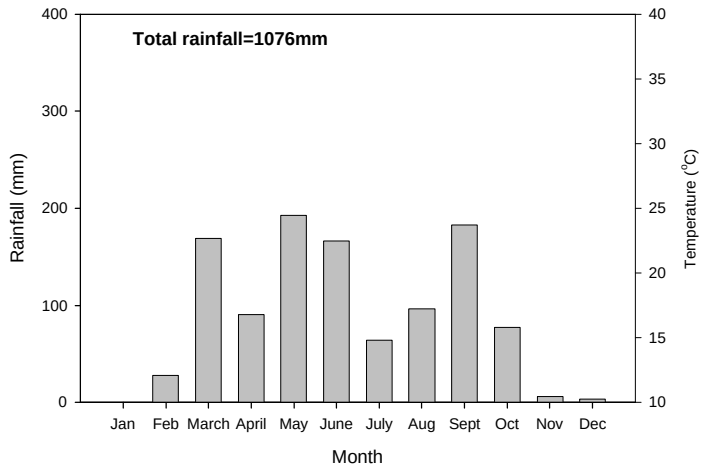


Fig. 29. Total monthly rainfall and average monthly maximum and minimum temperatures at Hohoe in 2001

4.2.2 Todzi seed group

The Todzi seed group distributed seed to 78 farmers in three nearby communities (Table 55). Average yield in the three communities ranged from 0.24 to 0.90 t/ha.

Table 55. Distribution of seed from Todzi and grain yields in 2001

Village	No. farmers	Cultivars (no)		Mean yield
Santrokofi	15	IDSA85 (1)	WAB340 (1)	
Bume		WAB126 (3)	WAB56-60 (2)	
		WAB209 (4)	I. Cateto (3)	0.90
Apaku Sokpo	26	IDSA85 (5)	WAB160 (2)	
		WAB450-P18 (2)	WAB340 (3)	
		WAB209 (11)	I. Cateto (3)	0.24
Akpafu	37	IDSA85 (12)	WAB340 (2)	
Adorkor		WAB450-P18 (3)	I. Cateto (4)	
		WAB209 (12)	WAB56-60 (2)	
		WAB160 (1)	OS6 (1)	0.29
Total	78			

4.2.3 Likpe Agbozume Taskforce

The Likpe Agbozume Taskforce distributed seed to four nearby villages in which they had helped to set up community Taskforce (Table 56).

Table 56. Distribution of seed from Likpe Agbozome and grain yields in 2001

Village	No. farmers	Cultivars (no)	Yield
Likpe Kukurantani	20	IDSA85 (5) WAB126 (12) WAB209 (3)	0.54 0.60 0.50
		Mean	
Likpe Abrani	15	IDSA85 (4) WAB126 (8) WAB209 (3)	
		Mean	0.29
Likpe Koforidua	14	IDSA85 (5) WAB126 (5) WAB209 (4)	
		Mean	0.41
Likpe Todome	4	IDSA85 (1) WAB126 (2) WAB209 (1)	
		Mean	0.22
Total	53		

4.2.4 Likpe Bakua Taskforce

Seed was distributed to 62 farmers in four nearby villages by the Taskforce (Table 57).

Table 57. Distribution of seed from Likpe Bakua and grain yields in 2001

Village	No. farmers	Cultivars (no)	Yield
Likpe Bala	38	IDSA85 (7) WAB126 (13) WAB209 (15) WAB160 (3)	
		Mean	0.32
Likpe Mate	20	IDSA85 (5) WAB126 (6) WAB209 (6) WAB160 (3)	
		Mean	0.45
Fodome-Amele	4	WAB209 (4)	
		Mean	0.13
Likpe Bakua	10	IDSA85 (2) WAB126 (4) WAB209 (3) WAB160 (1)	
		Mean	0.32
Total	62		

4.2.5 Seed spread post 2001

Farmers who were given seed in 2000 were monitored by researchers or by the Taskforces themselves to determine where seed had spread to. These results are summarised in Fig. 30 below. Not all farmers could be followed up and so spread is undoubtedly greater than that shown. Nonetheless, it is clear that seed spread upto 40km in 2001, and at least 100km in 2002. Seed also spread over the border into Togo where farmers came to Likpe Bakua in both 2002 and 2003 to purchase seed.

4.3 PVS and seed distribution at Tolon, Gbulung and Nyankpala, Northern Region 2000-02

4.3.1 PVS in 2000

4.3.1.1 Weather

The rainfall pattern in 2001 was very atypical, with heavy rain early in the year when it is usually dry (Fig. 31). During the main season, between May and October, droughts occurred in July and at the end of the season.

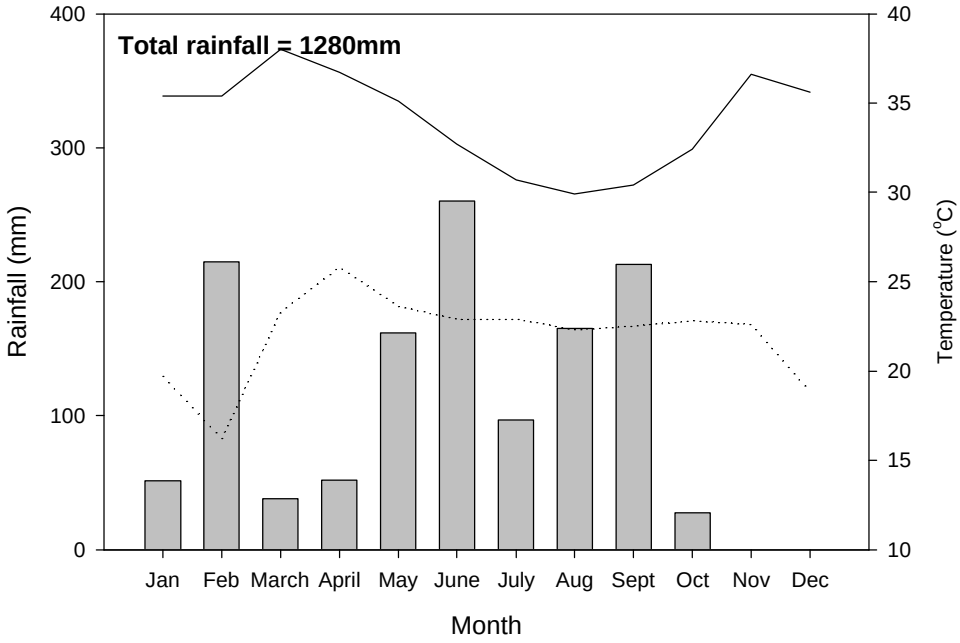


Fig. 31. Rainfall and temperature at Nyankpala in 2000

4.3.1.2 Tolon PVS

A PVS with 40 cvs (Table 58) was planted and managed by researchers at Tolon. This VS was conducted under high (60:30:30 NPK & 2 hand-weedings) and low (30:15:15 & one hand-weeding). Men and women farmers evaluated the PVS during the vegetative, maturity and post-harvest stages.

Farmer preferences of varieties are presented in Tables 59 to 62. Farmers' preference of varieties in terms of the management system varied significantly. With exception of Moroberekan, which had high preference under both the low and high input systems, different varieties were preferred under the two systems. Surprisingly, the NERICA's which were supposed to be adapted to low input system were most preferred rather under high input system. The most preferred varieties were not always the best in terms of yield. Half of the best varieties in terms of yield (WAB 450-I-B-P157-2-1, IR 12979-24-1 and WAB 586-1-1), however, were among the most preferred by farmers under the low or high input system.

Table 58. Varieties used in DIFID PVS nursery at Tolon in 2000

Variety no.	Variety name	Variety no.	Variety name
1	CAN 762069	21	WAB 96-3
2	MENDI	22	WAB 181-32
3	WAB 450-11-1-1-P31-HB	23	WAB 36-54
4	WAB 96-20	24	IRAT 216 (IDSA 6)
5	WAB 450-1-B-P-133-HB	25	TGR 75
6	WAB 450-1-B-P-106-HB	26	IRAT 262 (IDSA 10)
7	MASHURI	27	IR 33461-39-3
8	WAB 450-1-B-P-91-HB	28	IR 12979-24-1
9	WAB 450—B-P-157-1-1	29	WAB 56-50
10	GRUG 7	30	CT 11248-1-1-M-M
11	WAB 506-126-3	31	KLEMENSON
12	WAB 450-24-3-4-P18-3-1	32	IR 33356-22-3-1-2
13	WAB 515-177-2	33	KPUKPULA
14	WAB 337-B-B-7-H4	34	RP 1822-15-2-2-3
15	WAB 586-1-1	35	BANKROM
16	WAB 450-1-B-P-157-2-1	36	TOX 3100-37-3-3-2-1
17	GR 21	37	RP 1641-31-5-113
18	IDSA 46	38	TOX 3118-47-1-1
19	WAB 450-24-3-2-P18-HB	39	WAB 99-1-1
20	WAB 96-5-D	40	MOROBEREKAN

Table 59. Best varieties in terms of farmers' preference and yield

Low input system	High input system	Best in terms of yield
WAB 181-32	WAB 450-I-B-P91-HB	WAB 450-I-B-P157-2-1
IRAT 216	WAB 450-I-B-P157-2-1	GR 21
TGR 75	WAB 337-B-B-7-H4	IR 12979-24-1-1
IR 12979-24-1	WAB 586-1-1	WAB 515-177-2
WAB 56-50	WAB 450-I-B-P157-1-1	Mendi
Moroberekan	Moroberekan	WAB 586-1-1

Table 60. Reasons for selecting varieties

Varieties selected	Reason	
	Men	Women
IR 12979-24-1-15	Large panicles, tillers, weed competitive, long and slender grains	Large panicles, tillers, weed competitive, well filled grains
WAB 450-1-BP-157-2-1	High tillering, weed competition, large panicles, early maturing, large and attractive grain, more grains per panicle	High tillering, weed competition, large panicles, large and attractive grain
WAB 181-32	Early, good heads, nice looking grain	Weed competitive, no lodging, Early maturing, large panicles, attractive seed colour
MOREBEREKAN	Weed competitive, large panicles, attractive seed colour, high tillering, early maturing, Tough stalk, long broad grains	Weed competitive, large panicles, attractive seed colour, high tillering,
WAB 450-1-B-P-91-HB	High tillering, does not lodge, weed competition, large panicles and long grain	High tillering, large panicles, weed competition, attractive seed
WAB 586-1-1	Weed competitive, large panicles, Plenty grains per panicle, high tillering,	High tillering, Well filled grains, Big head and attractive grain colour
WAB 337-B-B-7-H4	Weed competition, high tillering, large panicles, long grain.	Large panicles, attractive grain (big and long).
WAB 96-20	Early maturing, Large panicles, weed competition, long bold grains	Early maturing, Large panicles, weed competition, long bold grains, high grain per panicle
WAB 450-11-1-1-P-31-HB	Weed competition, high tillering, big panicles and high grain per panicle	Weed competition, high tillering, big panicles, high grain per panicle early maturing, long and attractive grains
IRAT 216	Weed competitive, large panicles, high tillering, Plenty grains per panicle	Tillers, large panicles, long grain, early maturing, no lodging
WAB 56-50	Weed competitive, big panicles, long and broad grains	Weed competitive, large panicles, high tillering, early maturing and grains/panicle

Table 61. Reasons for disliking varieties

Variety disliked	Reasons	
	Men	Women
WAB 450-I-B-P-157-1-1		Poor tillering, cannot compete with weeds, poor tillering
IR 33356-22-3-1-2	Long duration, few tillers, small panicles, poor weed competitive ability	Long duration, small panicles, poor competition with weeds
WAB 96-5-D	Poor weed competitive ability	Small panicles poor tillering
RP 1822-15-2-2-3	Long duration, poor competition with weeds	Long duration
WAB 450-24-3-2-P18-HB	-	Long duration, small panicles, poor competition with weeds, poor tillering
KLEMENSON	Long duration, small panicles, poor tillering	Long duration, and poor competition with weeds
CAN 762069	Long duration, small panicles, poor competition with weeds, poor tillering	Long duration, small panicles, poor tillering
MASHURI	Long duration, small panicles, poor competition with weeds, poor tillering	Long duration, small panicles, poor competition with weeds, poor tillering and small grains
IR 33461-39-3	Long duration, small panicles, Short cannot compete with weeds, poor tillering	Long duration, small panicles, poor tillering
Tox 311847-1-1	Long duration, Short cannot compete with weeds	Long duration, small panicles

Table 62. Characteristics that influence farmer's preference for a variety at different stages of growth of rice:

Stage of growth	Characteristics
Vegetative stage	Plant height and number of tillers and its ability to compete with weeds. Farmers prefer heavy tillering varieties with droopy leaves that enhance its weed competitive ability
Maturity	At maturity farmers' preference is influenced by number of effective panicles, heavy panicles, number of grains per panicle, grain type, the duration of the variety and its ability to lodge. Early maturing varieties resistant to lodging, with heavy panicles and long or bold grain types are preferred
Post-harvest	At post-harvest farmers will go for varieties that will have higher premium at the market (meet consumer preference) and attract higher price. Such materials according to them have long and slender grain types (length > 6.6mm and L/W >3)

4.3.2 Seed distribution in 2001

4.3.2.1 Weather

The rainfall pattern in 2001 was much more typical than in 2000. Rains were poor in June and October.

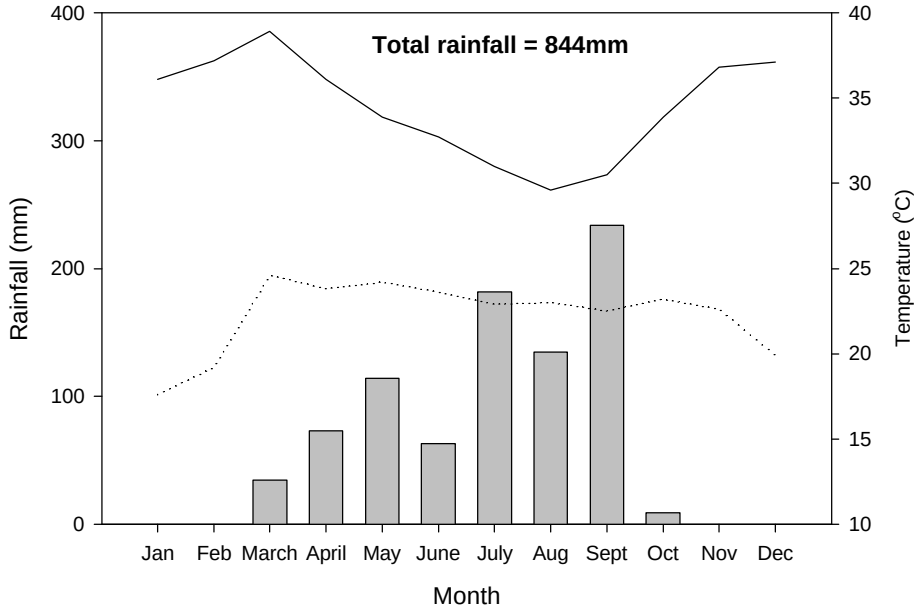


Fig. 32. Rainfall and temperature at Nyankpala in 2001

4.3.2.2 Seed distribution

In 2001 farmers in Tolon, Gbulung and Nyankpala communities who participated in PVS nursery the previous year and expressed interest in evaluating the new upland varieties were given 0.5 kg each of their 3 most preferred varieties. The farmer's variety was used as a control. Farmers had responsibility for the layout, sowing, management and harvesting of the trials. A total of 212 farmers participated in evaluating 19 varieties eight of which were NERICAs (*O. glaberima* x *O. sativa* interspecific crosses). For ease of identification of varieties on farmer's fields, farmers were put into groups. Farmers within a group were given the same varieties which had the same colour coding. The number of farmers evaluating a particular variety ranged from 6 to 55. All the 55 farmers evaluated IR 12979-24-1. IR 12979-24-1 was given to all farmers for two reasons. The first reason is that it has been proposed for release and we wanted to use the PVS approach to test its acceptance by farmers and the second reason, was because unlike the other varieties there was enough seed to reach all farmers. Farmer evaluations were done at maturity and after harvest. Two extension field staff were trained as facilitators to monitor the implementation. Research and MoFA jointly implemented the farmer evaluations. Project staff completed a 3-page data sheet on the qualitative evaluation. Yield was measured in bowls and was transformed to kg/ha using seed rate.

Table 63. Number of farmers given seed of selected PVS cvs in 2001

Communities	Number of participating farmers			
	Male	Female	Per site	Per year
Tolon	43	12	55	212
Gbulung	59	29	88	
Nyankpala	53	13	69	

The 11 varieties being evaluated by farmers were also included in a researcher managed multi-location trial made up of 23 best selections from an upland rice screening sets (URSSN1) and a Rainfed Upland Advanced Yield Trial (RUAYT) evaluated on station in 2000. IRAT 216 and 262 were used as local checks. The trials were conducted at Nyankpala, Salaga and Manga using standard management practices for rainfed rice. The design was an RCBD and replicated 3 times.

The objective of the multi location trial was to assess the effect of environment on yield and yield components, grain quality and other agronomic parameters of the varieties under different ecologies. It is also to be used as agronomic data collection point for the PVS2 materials being evaluated on farm which is to be used to support varieties if they are to be proposed for release.

4.3.2.1 Results

Performance of farmer selected varieties on-farm

Two hundred and twelve farmers grew IR12979-24-1 on farm and between nine and 36 farmers grew PVS cvs. Many farmers had lost their crops due to terminal drought. The most affected farmers were those who planted late or planted up the slope. Farmers attributed the late planting to late distribution of seed.

Across the three communities, only IR 12979-24-1 was selected at each location, by between 30 and 60% of farmers. Fifty percent of Tolon farmers preferred WAB450-I-B-P-91-HB while at Nyankpala WAB181-18, WAB56-60 and WAB450-I-B-P160-HB were selected. Gbulung farmers preferred IR12979-24.1. Most other cvs were not selected more frequently than the farmers' variety.

Grain yield of varieties on farmers field at Tolon ranged from 0 to 2320 kg/ha (Table 63). Yields on-farm were very low compared to yields of the same varieties in a PVS nursery in Upper Easr Region and in a replicated multi-locational yield trial. Farmers attributed the poor yield to late planting and terminal drought.

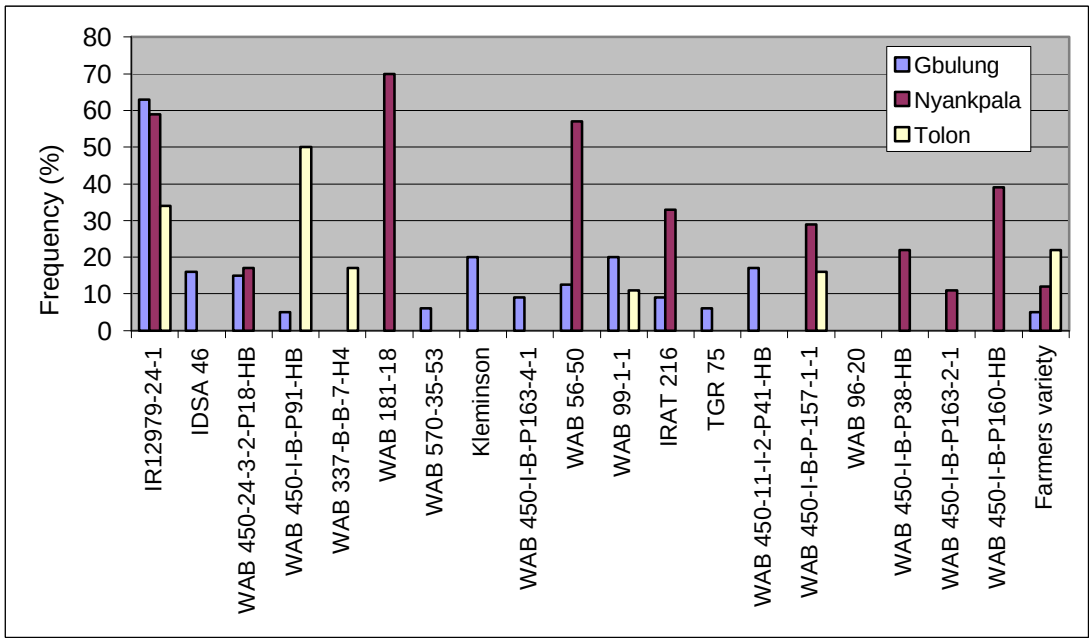


Fig. 33. Frequency of selection of PVS cvs

In the Tolon community, >40% of farmers who grew IR12979-24.1 said they would continue to grow the cv (Fig. 34).

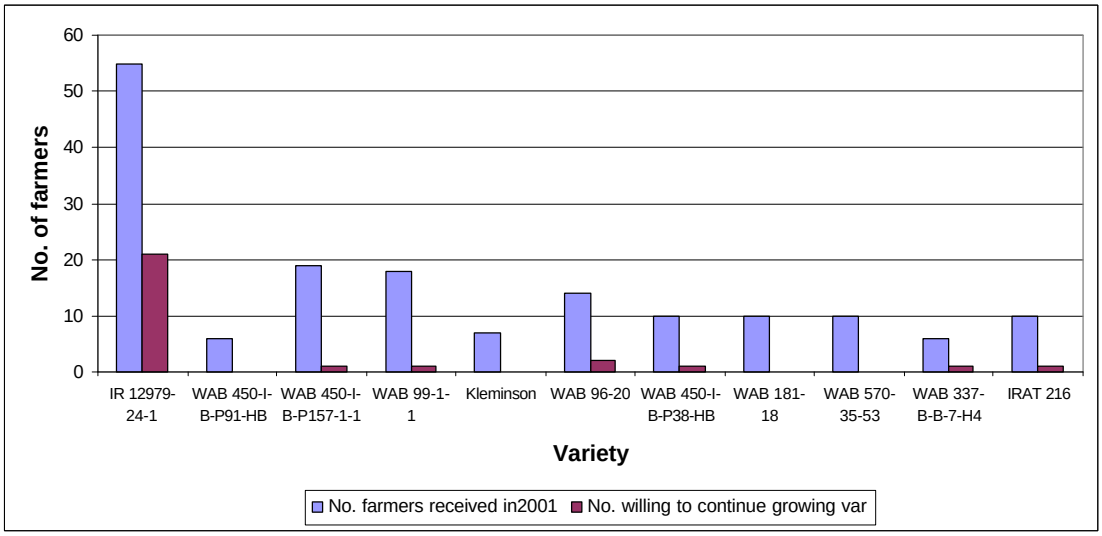


Fig 34. Farmer acceptance of PVS varieties in Tolon community 2001/02

Table 63. Comparative grain yields of upland rice varieties preferred by farmers in different evaluations/trials in 2001

	Grain yield (kg/ha)				
	Multi-location replicated trial (mean of 3 sites)	Community PVS nursery (mean of Nyorigo & Tambalug)	On-farm evaluation at Tolon, Gbulung & Nyankpala		
Variety			No. of farmers assessed	Yield range (mean of 3 communities	Mean yield
IR12979-24-1	4309	3816	30	0 to 2320	832
IDSA 46	2150	2166	-	-	-
WAB 337-B-B-7-H4	2608	3471	2	0	0
WAB 181-18	2247	1915	4	0 to 400	82
WAB 570-35-53	2242	2998	2	0 to 1210	725
Kleminson	3011	2819	0	0	0
WAB 56-50	2075	2314	-	-	-
WAB 99-1-1	-	1860	3	0 to 972	495
IRAT 216	2249	-	1	835	835
TGR 75	-	-	-	-	-
WAB 96-20	2334	2324	6	0	0
WAB 450-I-B-P163-4-1	1967	1377	-	-	-
WAB 450-24-3-2-P18-HB	2017	2008	-	-	-
WAB 450-I-B-P91-HB	2238	2124	4	0 to 1232	431
WAB 450-11-I-2-P41-HB	1879	1850	-	-	-
WAB 450-I-B-P-157-1-1	2589	2523	5	0 to 334	60
WAB 450-I-B-P38-HB	1950	1597	6	0 to 835	337
WAB 450-I-B-P163-2-1	2200	1952	-	-	-
WAB 450-I-B-P160-HB	2692	2354	-	-	-
IDESSA 85	2581	2875	-	-	-
Sikamu	3989	3850	-	-	-
IRAT 262	1923	2295	-	-	-
WAB 96-11	2716	2122	-	-	-
WAB 586-1-1	2636	3222	-	-	-
Gambiaka	3044	2113	-	-	-
WAB 515-13-13$_{A1}$-8	2295	1963	-	-	-
Farmers variety (Control)					
LSD 0.05	1100	987			

4.3.3 Seed distribution in 2002

We followed up on farmers who received seed in Tolon community in 2001 to monitor the performance of the varieties on-farm and their acceptability by farmers. Farmers who lost their seed as a result of drought in 2001 and were willing to

continue evaluating the varieties received seed from their friends. Information was also sort on performance of the varieties within the community by matrix ranking of varieties. A monitoring team made up of Research, MoFA and farmers went round collaborating farmers fields in October to interact with farmers and monitor performance of varieties. At a farmer's forum during post-harvest yield assessment, farmers discussed the major positive and negative traits of the PVS varieties from their experience.

Out of 25 farmers who continued with the evaluation of PVS varieties in 2002 in the Tolon community, only 12 farmers were assessed for their paddy yields. Most of them claimed they either lost their materials as a result of late planting, terminal drought or had eaten them. Mean yield of varieties from those assessed ranged from 449 to 1235 kg/ha (Table 64) with IR 12979-24-1 being the highest yielder and the most preferred. Thirty-eight percent of farmers growing IR1279-24-1 said they would continue growing the variety; for the other varieties only between 5 and 16% said they would continue growing the same cv next year.

Table 64. Grain yields of upland rice varieties evaluated under farmer management (baby trials) in Tolon Kumbungu district of Northern Region in 2002

Variety	Number of respondents	Mean yield (kg/ha)			
		Range	Mean	SD	CV
IR 12979-24-1	5	500 to 2333	1235	759	61
IRAT 216	1	-	500	-	-
WAB 337-B-B-7-H4	1	-	1166	-	-
WAB 450-I-B-P91-HB	2	667 to 1000	833	236	28
WAB 96-20	3	333 to 833	556	255	46
WAB 450-I-B-P38-HB					
Farmers variety	9	200 to 800	449	207	46

Table 65. Narrative summary of traits of upland rice varieties at maturity as perceived by farmers in the Tolon community in 2002

Variety	Positive traits	Negative traits
IR 12979-24-1	- Matures early - Has heavy panicles with more grains - Expands on cooking and is palatable	- Short - Grains may shatter if not harvested on-time
IRAT 216	- Good tillering ability - Matures early - Good grain colour	- Small panicles with grains which breaks easily
WAB 337-B-B-7-H4	- Early maturing - Has a lot of grains per panicle	-
WAB 450-I-B-P91-HB	- Matures early - Good tillering ability - Big panicles with long grains	-
WAB 96-20	- Good height - Matures early - Large panicles with bold grains	- It lodges
WAB 450-I-B-P38-HB	- More tillers - Matures early - Has big grains	- Lodges if left long on the field

5 The spread and adoption of new upland rice varieties introduced through participatory varietal selection in Hohoe, Ghana

5.1 Introduction

5.1.1 Participatory Varietal Selection

The formal or conventional system of seed production and distribution has failed to deliver new and improved varieties of upland rice to small-scale farmers in Ghana. Although the problem is not limited to upland rice, it is most severe for this rice type. It is only in the case of maize and cowpea, which have received substantial funding from the government and donors in crop improvement activities, that seed are available. The participatory approach to crop improvement has the aim of making available to farmers seed of varieties that meet location-specific requirements. It is also intended that this approach cuts down on the time it takes to make seed available. In addition, the involvement of farmers in the process should minimise the problem of non-acceptance that is sometimes associated with improved varieties.

What constitutes participatory approach can be interpreted in various ways. For example, carrying out surveys among farmers and consumers to determine their varietal preferences, and involving them in on-farm trials, could be said to be participatory. This is the approach adopted for crop improvement in Ghana since 1979. In this approach, the researcher largely determines the criteria for choice of variety for verification at the end of the process by the farmer, although the characteristics identified by the farmers/consumers are, to some extent, taken into consideration. The farmer/consumer is presented with just one variety proposed for release for evaluation alongside the farmer's or other variety that the new one is expected to replace.

In the participatory varietal selection work, however, the farmer/consumer is presented with a large number of varieties for testing and selection at a much earlier stage in the overall process, and farmers make their own choice. In this sense, the participatory approach to crop improvement in Ghana is recent. Since 1997, a participatory varietal selection (PVS) programme has been implemented in upland/hydromorphic areas in

the forest zone in southern Ghana and the savanna zone of northern Ghana. This has been in collaboration with the University of Reading, UK with funding from the UK Department for International Development (DFID) and the West Africa Rice Development Association (WARDA).

Studies carried out at the beginning of the programme showed that most farmers continued to grow either *glaberrimas* or one or two old varieties obtained from informal sources. It was also observed that varietal diversity was not high, and that very few varieties adapted to upland conditions had been formally released in Ghana.

The PVS work brings together researchers, farmers and extension staff of the Ministry of Food and Agriculture (MOFA) throughout the process. It started with observation nurseries at each location, which provided an opportunity for a large number of varieties to be tested and evaluated. The second stage involved testing of varieties identified by farmers at the nursery to be of high potential within a limited number of communities on individual farmer fields. The third and final stage was seed multiplication and dissemination. The varieties with high frequency of choice at the farmer testing stage were distributed to farmers in other communities.

5.1.2 Study area and rice production practices

Location

The Hohoe District, which is in the Volta Region of Ghana and is located between latitude 7° 15’ and 7° 10’ and longitude 0° 30’ and 0° 35. It is in the ‘Forest Zone’ and is an important uplnd rice growing area. The district is made up of the Ewe (Gbi, Ve) and Guan (Lolobi, Akpafu, Likpe).

Physical features

The area is made up of lowlands surrounded by hills of about 2000m above sea level. The communities growing upland rice are located on the lower slopes of such highlands. Some of the farms are on slopes, and this exposes the land to erosion, resulting in low yields.

Rainfall

The area falls within the wet semi-equatorial type, which, is characterised by two seasonal rainfalls with a mean annual rainfall of 1250 to 2000 mm. The main rainfall season being between May and June while the second or minor rainfall season is between September and October.

Due to changes in climatic conditions, there is a 4 to 5 month dry season between November and April. The rainfall pattern has become highly unpredictable. The hitherto well-defined two peaks of rainfall have almost merged into one. The rains start in late March and end in November. Farmers cannot be sure of a double cropping season, and irrigation is not within the reach of the farmers. The rainfall pattern therefore requires that farmers either plant early to avoid the possibility of the crop facing terminal drought or plant early maturing upland varieties. However, farmers are not always able to plant early because of other time commitment. Early maturing upland varieties are also not available. These constraints compel rice farmers, particularly the women, to migrate to grow rice in lowland areas.

Vegetation

The area falls within the forest ecological zone of Ghana. The original moist deciduous forest vegetation has largely been cleared and most of what remains is secondary forest, swamp forest and thickets. The original forest has been lost due to rapid expansion of agriculture particularly cocoa industry, timber and charcoal burning. The secondary vegetation consists of climbers, shrubs, and soft woody plants while a few giant trees remain standing on farmland to provide shade.

Soils

The soils are principally forest ochrosols, and these are underlain by rocks of the Togo series. The soils generally tend to be sandy overlying iron pans; drainage is poor subjecting the area to extreme variations in soil moisture. The torrential nature of the rains leads to the leaching of these soils and erosion. The soils are suitable for rice production but not fertile.

Rice in the local economy

The cultivation of rice has been in practice among the Guans in the district (Akpafu, Lolobi and Likpe) people for so long that no one seems to remember anything about its introduction.

In the traditional system, rice was not usually grown in pure stands. They are intercropped with yam, cashew, maize and sometimes plantain. It is broadcast or dibbled in about 4 – 10 seeds to each hole and covered to prevent birds picking them up. A cleared area is usually cropped for three years after which time, it is allowed to fallow. The *oryza glaberrima* varieties under many local names like 'kamo' is usually grown. Today, there are a lot of *Oryza sativa* varieties in the lowlands (but not the upland fields) due to the activities of research and extension.

Traditionally most upland rice farmers are women but with the decline in the cocoa market more men have been practising upland rice farming. Practices are labour intensive and consequently farms are normally less than 0.4 ha. Land preparation is by slash and burn and upland rice is sometimes grown in mixed gardens alongside other annual and tree crops. Fertilisers and pesticides are not used and weeds are controlled by hand.

5.1.3 Objectives of the study

This study has the following objectives:

- To determine the extent and nature of the uptake and spread of the new varieties
- To understand the processes by which uptake and spread occurred and to identify factors which influenced this
- To identify the extent to which the characteristics of the PVS varieties meet farmers' requirements

The first objective indicates the extent to which the PVS approach has been successful in this context. Regarding the second objective there has been considerable interest in the processes of adoption of crop varieties and in recent years some research on adoption from participatory research and development approaches. A few studies have specifically explored PVS approaches with regard to crops (Witcombe *et al* 1999).

However these have generally involved introducing larger quantities of seed (eg 8-31 kg per farmer) to communities. Having sufficient seed quantities to distribute is often a major limitation in and can take several seasons to produce thereby delaying the process. This is exacerbated when projects are operating in new areas and starting with large number of varieties to try, as was the case in this research. An objective of this study therefore is to investigate the effectiveness and processes of spread from the introduction of small amounts of seed (i.e. 1-2 kg per farmer) and to investigate both indigenous and introduced mechanisms of seed spread.

A major factor in the uptake and spread of new varieties is the extent to which they meet farmers requirements and preferences for characteristics such as drought tolerance, taste and ability to compete with weeds, and in comparison to varieties that are currently grown (objective 3). Understanding this is important for both the development of further improved varieties and for the process of introduction.

5.1.4 PVS activities and seed distribution

Varieties introduced through PVS

The varieties that were selected for testing on farmers' fields are shown in Table 65. All the introduced cultivars mature earlier, and yield higher than the local variety under the same management conditions. Most of the new cultivars have longer grain than the local varieties and have white grain colour in contrast to the red grain colour of the local variety.

Table 65. Characteristics of the local cv Kawumo and PVS cvs selected by farmers

Cultivar	Days to flower	Plant height (cm)	No. panicles (m^2)	Grain yield (t/ha)	Ecotype
Kawumo (local)	113	97	152	0.68	Glaberrima
IDSA 85	85	126	160	1.45	IUJ¶
WAB209-5-H-HB	93	106	84	1.78	IUJ
WAB450-I-B-P-26-HB	104	85	248	1.63	Interspecific
WAB450-24-3-2-P18-HB	75	108	72	1.20	Interspecific
WAB126-18-H-HB	93	101	106	1.23	IUJ
WAB340-B-B-10-HI	79	123	158	1.51	IUJ
TOX3792-10-1-2-1-3-2	107	105	233	3.08	ILI

¶ IUJ= Improved upland japonica; ILI= improved lowland indica

Activities in 1997 and 1998

PVS trials were established at Akpafu Todzi in Hohoe in 1997 and 1998 with 100 and 60 cultivars and breeding lines respectively most of which were from the West African Rice Development Agency (WARDA). Interested male and female farmers (30 of each) were invited to evaluate the cultivars at three stages: vegetative, flowering and harvest. At each stage each farmer selected up to five varieties they liked best and indicated the criteria they used for selection.

Activities in 1999

Based on these selections 94 farmers (47 male and 47 female) from three nearby communities were supplied with seed of two of ten selected varieties in 1999. One kg of seed per variety was given to each farmer who was asked to grow them on their own fields, next to and under the same management as their local variety. Farmers and research staff visited farmers' fields and evaluated performance at different stages of growth and for post-harvest.

Table 66. Distribution of seed¶ (kgs) to the three communities near Hohoe in 1999

Cultivar	Akpafu Todzi	Akpafu Mempeasem	Akpafu Odomi	Total
IDSA 85	27	0	16	43
WAB 209-5-HB	24	7	6	37
WAB 450-I-B-P-160-HB	0	13	6	19
WAB 450-3-2-P18-HB	6	0	5	11
WAB 56-60	4	0	0	4
WAB 126-18-HB	0	14	0	14
WAB 126-16-HB	6	0	3	9
WAB 126-24-HB	10	0	0	10
WAB 340-B-B-10-H	4	0	0	4
Moroberekan	0	0	16	16

¶ Each farmer was supplied with seed of two varieties 1999, 1 kg seed per variety

Activities in 2000

From the previous years' work three of the PVS cultivars were consistently popular with farmers: IDSA 85 followed by WAB 126-15-HB and WAB 209-5-HB. These

three main varieties were therefore distributed to a further five communities (see Table 67. Other cvs were selected and distributed on the basis of farmers' choices and cvs which displayed characteristics demanded. Of these not all were sent to all communities as there was insufficient seed. Seed was introduced to the communities by research and extension staff and contact farmers who supplied them to individual farmers to grow on their own fields. Seed of each cultivar was distributed in 2 kg amounts.

Table 67. Distribution of varieties of seed¶ to farmers in communities in 2000

Community	Name of variety	No. of farmers
Lolobi - Kumasi	IDSA 85	4
	WAB 126-15-HB	10
	WAB 209-5-HB	8
Lolobi-Ashambi*	IDSA 85	4
	WAB 126-15-HB	6
	WAB 209-5-HB	8
	WAB 340-B-B-9-L3-L1-LB	4
Likpe Bakua*	IDSA 85	3
	WAB 126-15-HB	7
	WAB 160-24-H-HB	2
	WAB 209-5-HB	6
Likpe Agbozome*	IDSA 85	4
	WAB 126-15-HB	8
	WAB 209-5-HB	3
Santrokofi-Benua	IDSA 85	3
	WAB 126-15-HB	4
	WAB 209-5-HB	3

¶ Each farmer was supplied with 2 kg of seed in 2000
* Communities included in uptake survey

Table 68. Summary of distribution of seed in 2000

Name of variety	No.of farmers
IDSA 85	18
WAB 126-15-HB	35
WAB 209-5-HB	28
WAB 340-B-B-9-L3-L1-LB	4
WAB 160-24-H-HB	2
Total	87

Activities in 2001

In 2001 seed was introduced to a further 10 communities. Seed was provided by three of the communities who had grown seed in the previous year. Again the three most popular varieties were given to all but one of the communities and some additional cultivars were given to three of the new communities to try. Seed of each cultivar was distributed in 1kg amounts.

Table 69. Distribution of varieties of seed¶ to farmers in communities in 2001

Community	Name of variety	No. of farmers	Source of seed
Likpe Kukurantumi*	IDSA 85	5	Likpe Agbozome
	WAB 126-15-HB	12	
	WAB 209-5-HB	3	
Likpe Abrani*	IDSA 85	4	Likpe Agbozome
	WAB 126-15-HB	8	
	WAB 209-5-HB	3	
Likpe Koforidua	IDSA 85	5	Likpe Agbozome
	WAB 126-15-HB	5	
	WAB 209-5-HB	4	
Likpe Todome	IDSA 85	1	Likpe Agbozome
	WAB 126-15-HB	2	
	WAB 209-5-HB	1	
Likpe Bala*	IDSA 85	7	Likpe Bakua
	WAB 126-15-HB	13	
	WAB 160-24-H-HB	3	
	WAB 209-5-HB	15	
Likpe Mate*	IDSA 85	5	Likpe Bakua
	WAB 126-15-HB	6	
	WAB 160-24-H-HB	3	
	WAB 209-5-HB	6	
Fodome-Amele	WAB 209-5-HB	4	Likpe Bakua
Santrokofi-Bume*	IDSA 85	1	Akpafu Todzi - Seed
	Iguape Cateto	**3**	Group
	WAB 126-15-HB	3	
	WAB 209-5-HB	5	
	WAB 56-50	2	
	WAB340-B-B-9-L3-L1-LB	1	
Akpafu Sokpo	IDSA 85	5	Akpafu Todzi - Seed
	Iguape Cateto	3	Group
	WAB 160-24-H-HB	2	
	WAB 209-5-HB	11	
	WAB 340-B-B-9-L3_L1-LB	3	
	WAB 450-24-3-2-P18	2	
Akpafu Adorkor*	IDSA 85	12	Akpafu Todzi-Seed
	Iguape Cateto	5	Group
	OS6	1	
	WAB 160-24-H-HB	1	
	WAB 209-5-HB	8	

¶ Each farmer was supplied with 1kg of seed in 2001

* Communities included in survey

Table 70. Summary of distribution of seed in 2001

Name of variety	No.of farmers
IDSA 85	45
WAB 126-15-HB	49
WAB 209-5-HB	60
WAB 340-B-B-9-L3-L1-LB	4
WAB 160-24-H-HB	9
Iguape Cateto	11
WAB 56-50	2
WAB 450-24-3-2P18	2
OS6	1
Total	183

It is important to note that there was no intervention by after this and therefore no spread or distribution initiated by the research team in 2002.

5.2 Methods of study

The study started with pre-survey activities in September to December 2002. This was followed by survey of 12 communities in late January to early February 2003. Preliminary analysis was carried out in March, after which a number of follow-up surveys were carried out between May and July. The final analysis of the survey results were also carried out at the same time.

5.2.1 Pre-survey activities

The pre-survey activities comprised questionnaire preparation, pilot survey, revision of questionnaire, preparation of farmers' list (i.e. sample frame) and training of enumerators.

Project scientists from the three collaborating institutions, Reading University, CRI and SARI, were involved in the preparation of a questionnaire and pilot study. The results of informal interviews on seed uptake pathways carried out during the 2001 season provided information that was used in the design of the questionnaire. The pilot survey provided an opportunity to test the appropriateness of the questionnaire with respect to the clarity of understanding by farmers (i.e. identify the best way to

ask the questions) and the adequacy of the pre-coded responses. The results of the pilot study were used to revise the questionnaire. The preparation of farmer lists was carried out in December 2002 with assistance from MOFA extension staff and their contact farmers. The enumerators who were all drawn from CRI (scientists and technicians) were given training with the aim of ensuring that data collected were of good quality. The major topics covered in the training were the objectives of the study, explanation of each question and how to complete the questionnaire, and the sampling procedure.

5.2.2 Choice of communities

The study was carried out in 12 communities, which had been supplied with seed through one of the dissemination pathways that are known to the researchers. The broad groupings are communities with farmer testing in 1999, communities supplied with seed by CRI in 2000, and those supplied with seed by other communities in 2001. This comprised all the three communities where farmer testing was initiated in 1999, three of the five communities that were supplied with seed by CRI, and six of the communities that received seed in 2002 from communities that were supplied with seed in 2001. These six communities comprised two recipient communities for each of the three communities receiving seed in 2001.

Field survey

Twenty farmers from each community were randomly selected from a list of farmers prepared with the assistance of extension agents and their contact farmers.

The modified quota sampling approach was used. This was to ensure that there were sufficient cases of farmers growing PVS cultivars in 2002 and those who did not. The sampling followed the normal procedure of random sampling. However a minimum quota of five out of the 20 farmers should have planted a PVS cultivar. Thus, the selection was to make a special effort to include a farmers with PVS cultivars only if the normal random sampling did not have at least five of these category of farmers.

Complete survey

A separate complete survey of all households in the selected locations (2,289) was carried out to collect information on the rate of use of the new cultivars in each community. This was required to obtain a more accurate measure of use because the modified quota sampling approach used in the main survey biased the results in favour of users of the new cultivars.

Observations of spread

Follow-up informal interviews were conducted to:

i) Gain further understanding of the patterns and explanations of spread, following preliminary analysis of results of the questionnaire surveys, and

ii) Obtain more complete information on locations where seed of the new cultivars had spread.

In addition a formal follow-up survey was conducted, using the questionnaire for the original study to collect information from an additional number of farmers. One reason was to target farmers growing a particular PVS cultivar (WAB 126) to obtain additional observations to facilitate comparison with two other major PVS cultivars on their mode of spread.[5] A second reason was to interview additional upland rice farmers, as the initial analysis of the main survey showed that a significant proportion of the farmers interviewed did not grow upland rice in 2002. These additional farmers were selected in such a way as to ensure fair representation of each category of farmers (PVS and non-PVS). The complete survey revealed that in about half the communities the number of non-PVS farmers was underrepresented.

Problems and potential bias?

The deliberate attempt to have a significant number of farmers planting PVS cultivars in the field survey sample implies that the proportion of this group of farmers in the sample is not necessarily a reflection of the population. The proportion in the sample is higher than that of the population. Thus, the complete survey of households was carried out to provide an estimate of the use of the varieties.

[5] WAB126 was observed to be one of the three PVS cultivars preferred in preceding informal interviews. The inability to capture this variety in the main survey is due to the limited quantity of the seed of this variety that was supplied to the communities.

5.3 Results and discussion

5.3.1 Farmers' characteristics and farming practices

The characteristics of the rice farmers surveyed and their farming practices are summarised in Table 71.

Age, gender composition and household numbers

Women constituted over 60 percent of the sample. This is consistent with the observation that rice farming, particularly on the upland is a female-dominated activity in the district. The attraction of men into upland rice production is largely due to the decline in cocoa production which is the traditional cash crop.

Over 60 percent of the farmers were up to 50 in age, and an additional 32 percent aged 51-65 could also be said to be productive farm workers. People engaged in rice farming tend to be younger than the general farming population. The age composition was similar for both male and female.

Number of persons in the household ranged from one to 30, with a mean of about six, while those able to provide farm labour ranged from zero to 18, with a mean of about three.

Household access to institutional support

The farmers had good access to education; 72% reported having some basic education, and 16% had at least secondary school education. Contact with extension was fair, with over 47% male and 40% female having had contact with extension. The low level of access to formal credit (10% and 9% for male and female respectively) is a reflection of the low development of formal financial services in the country in general.

Table 71. Sample characteristics

Characteristics	Description	Values
Gender, % (N=255)	Male Female	34.9 65.1
Age, male (N=89)	Up to 35 36-50 51-65 Over 65	16.9 50.6 23.6 9.0
Age, female (N=166)	Up to 35 36-50 51-65 Over 65	16.3 43.4 30.7 9.6
Education, % (N=255)	No education Basic education Secondary education & above	12.2 71.7 16.1
Contact with extension, %	Male Female	47.2 40.4
Formal credit access, %	Male Female	10.1 9.0
Ability to hire labour: always (%)	Male Female	24.7 22.9
Ability to hire labour: sometimes, %	Male Female	49.4 51.8
Farming characteristics in 2002, mean values	Years of farming (N=255) Years of rice production (N=255) Farm size (in ha) in 2002 Upland rice (N=249) Lowland rice (N=139) Total rice (N=255) Other food crops (N=207) Tree crops (N=74) Total farm (N=255)	19 15 0.48 0.54 0.77 0.67 1.01 1.61
Reasons for growing rice, % (N=255)	Mainly for consumption Mainly for market Both	32.9 11.8 52.2
Most important constraint to upland rice production, % (N=255)	Weeds Water stress Land preparation Soil fertility Plant establishment Seed scarcity Other No problem	42.7 17.3 8.2 3.5 2.7 1.6 14.1 9.8
Awareness of PVS cultivars, % (N=255)	Yes No	82.7 17.3

Farm characteristics

The mean number of years of growing rice was 15, compared to 19 for farming. Thus, on average, rice production was added on as a farming activity after some years of entering into farming. This is a reflection of the increasing attention to rice as a commercial crop with the decline in the production of cocoa, the traditional source of cash.

The mean size of upland rice produced by farmers in 2002 was just under 0.5 ha. Over half the farmers growing upland rice also had lowland rice fields. The mean size of the lowland rice fields for these farmers in the same year was 0.54 ha, which was a little bigger than the size of upland farms. Four-fifths of the farmers had other food crops in addition to the rice. The size of these fields for these farmers was on average bigger than upland rice or lowland rice taken separately but not when all rice fields were put together. Tree crop fields were, on average, the largest of the fields for any one individual but less than one in three farmers had a tree crop field. Tree crop fields are established over time, thus their relatively bigger sizes for those individuals who owned them.

Rice production

Fifty two percent of the farmers produced for both home consumption and market, 12% mainly for market and 33% mainly for home consumption. The most important upland rice production constraint mentioned was weeds (43%), followed by water stress (17%). It might appear strange that water stress is mentioned as a constraint in an environment that is classified as humid. However, experience of working here confirms this. In 2001 drought conditions were experienced leading to severe crop losses (up to 100% for some farmers).

Awareness of new upland rice (PVS) cultivars was high, with over 83% reporting knowledge of their existence. This should be considered in the context that the study was carried out in communities where the cultivars have been introduced through one means or another.

5.3.2 Seed spread and uptake

Based on the survey of all farmers in 11 of the 12 communities Table 72 presents the number and percentage of farmers growing PVS in the communities in 2002.

Table 72. PVS by community (from complete survey)

	Male			Female			Total		
Community	Total upland rice	Total PVS	Percent PVS	Total upland	Total PVS	Percent PVS	Total upland	Total PVS	Percent PVS
Akpafu-Todzi	144	137	95	212	208	98	356	345	97
Akpafu-Mempeasem	54	7	13	70	11	16	124	18	15
Akpafu-Odomi	127	36	28	201	60	30	328	96	29
Akpafu-Adokor	41	39	95	68	58	85	109	97	89
Santrokofi-Bume	54	8	15	117	23	20	171	31	18
Likpe-Bakua	49	24	49	136	53	39	185	77	42
Likpe-Mate	12	5	42	43	32	74	55	37	67
Likpe-Bala	85	8	9	201	31	15	286	39	14
Likpe-Agbozume	86	28	33	157	49	31	243	77	32
Likpe-Kukurantumi	104	8	8	109	9	8	213	17	8
Likpe-Abrani	97	4	4	122	17	14	219	21	10
Total	853	304	36	1436	551	38	2289	855	37

Overall 37% of farmers were growing PVS varieties in 2002 i.e. 908 farmers in the communities surveyed. The use was very high in some communities, namely Akpafu-Todzi (97%), Akpafu-Adokor (89%) and Likpe-Mate (67%). The high use at Todzi is to be expected because of the intensity of PVS activities in the community since 1999. Apart from the testing of varieties, a group of farmers initiated seed multiplication of the new cultivars. CRI scientists and a MOFA extension agent provided the group with technical support. In addition, rice cultivation in this community is almost entirely on upland fields.

The high use of the PVS cultivars at Akpafu-Adokor, in spite the fact that it was not until 2001 that seed of the new cultivars was formally sent to the community, is explained by the close relationship (kinship) between members of this community and those of Todzi. Follow-up interviews revealed that the two communities are the same people with a common chief (i.e. traditional head). Many members of the Todzi community own fields at Akpafu-Adokor. Up to 1980 it served as the site for cocoa

production when cocoa was an important crop. Some members moved to settle permanently at Adokor to be close to the cocoa fields.

The high use at Likpe-Mate is largely due to the small number farmers cultivating upland rice in the community. This is because the seed available, which would otherwise be very limited to go round many farmers, got to a large percentage of the farmers who total only 55.

The low use of the cultivars at Akpafu-Odomi and Akpafu-Mempeasem may be due to the low priority given to upland rice because of the dominance of lowlands in these communities. In fact, it was precisely because of the lower importance of upland rice production that it was decided not to intensify the research activities in these communities.

Out of total of 2,289 farmers interviewed in the complete survey, 63% were women. Figure 36 shows that in most communities there is little difference between the percentage of male and female farmers who grew PVS varieties. The exception is Likpe Mate where 74% of female upland rice farmers grew PVS varieties compared to 42% of male upland rice farmers. However, as noted above, this is by far the community with the smallest number of upland rice farmers. Overall across the communities there was no marked difference in percentage uptake between male and female farmers (35% and 38% respectively).

Fig 36 Use of PVS cultivars by gender in each community, 2002

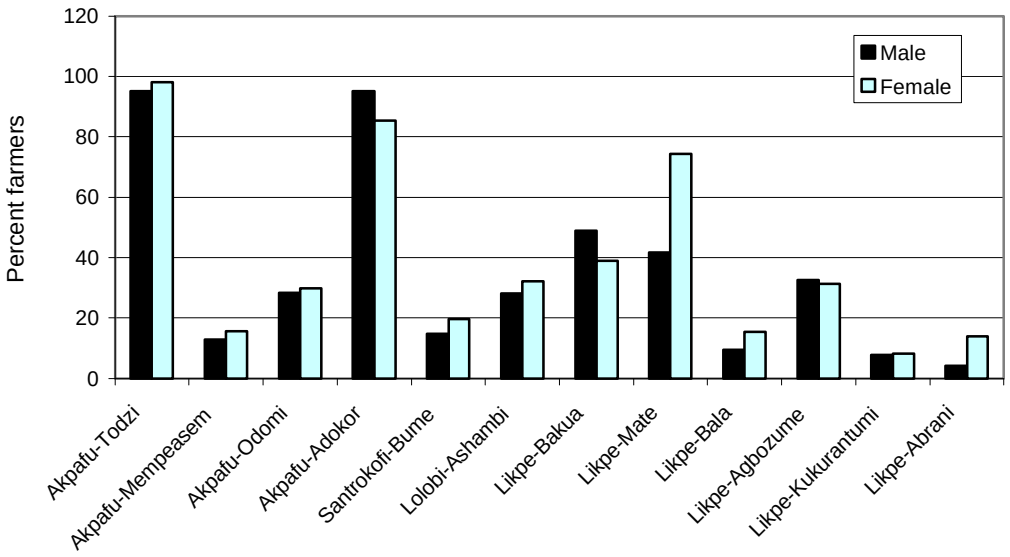
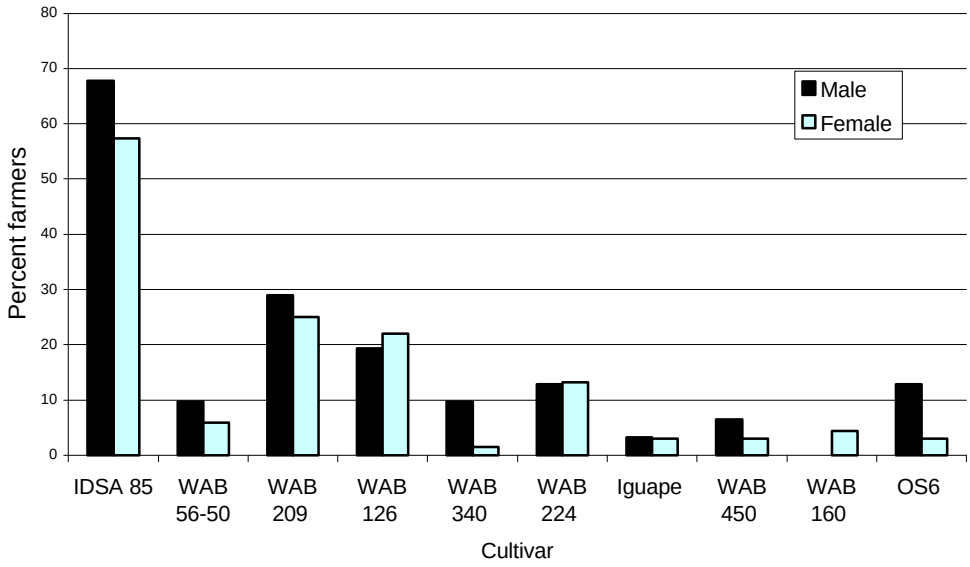


Figure 37 Farmers using each cultivar in 2002, %



N: male 31; female 68

Figure 37 shows that IDSA 85 was the most widely cultivated cultivar in 2002. The distinctive characteristic of this cultivar, among the introduced ones, is its extra-long grain shape. On one hand, the fact that this cultivar had the highest frequency of selection at Akpafu-Todzi, the community from where most of the seed currently produced primarily originated, might have created a bias in favour of the availability of this cultivar. The demand for the new cultivars far exceeds the available seed, and thus farmers tend to plant what is available. On the other hand, the fact that there was a high demand for this cultivar wherever it was introduced in a community shows that the cultivar was preferred on its own merit.

An additional factor favouring the spread of IDSA 85 is that it is perceived to be plastic in that it also survives under a wider range of ecological conditions, namely near- lowland conditions which is experienced on hydromorphic fields in times of excessive rainfall. WAB 209 and WAB 126 are the varieties preferred most after IDSA 85.

The cumulative frequency of use of PVS varieties increased steadily between 1999 and 2001 but increased more dramatically between 2001 and 2002 (Figures 35 and 36). This is particularly interesting, as there was no distribution of seed by the research project after the start of the 2001 season. The higher rate of increase in most

years amongst women farmers probably reflects the higher population of women farmers in the area and that at the start of the process in 1999 the same number of varieties were given to equal numbers of male and female farmers. There was a dramatic take-off for IDSA 85 in 2001

Fig 38 Cumulative use of PVS cultivars by gender, 1999-2002

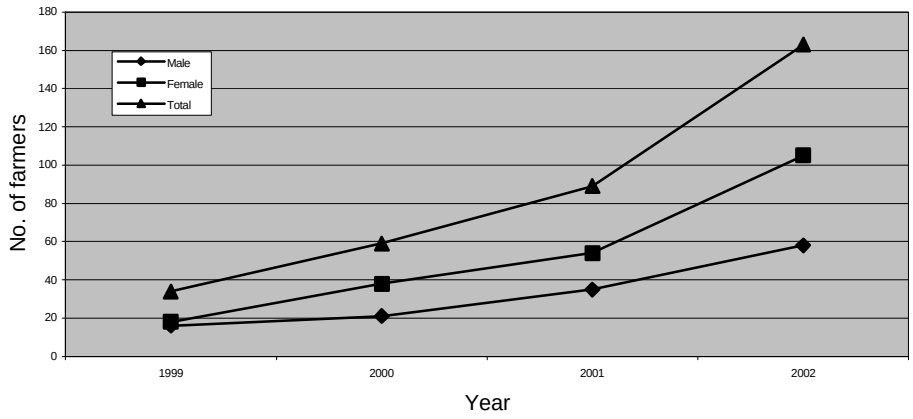
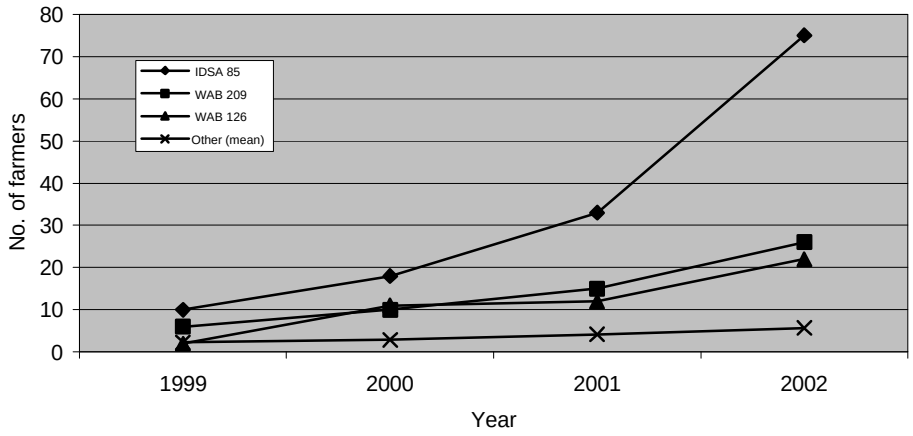


Fig 39. Cumulative use of PVS cultivars by type, 1999-2002



The cumulative frequency does not reflect where farmers may have discontinued growing a variety. Eighty seven percent of the number of farmers who had ever grown PVS varieties grew them in 2002.

As expected amounts of PVS seed used were much smaller in the first year than amounts of local varieties. IDSA 85 recorded the highest mean amount followed by

WAB 126. These are more than double the amounts distributed directly by the project (Table 73).

Table 73. Amounts of seed planted and size of field among farmers planting PVS cultivars

	Kg seed planted in first year of use		Kg seed planted in 2002		Size of field in ha	
	N	Mean	N	Mean	Mean	N
Kawumo	62	13.24	47	13.60	0.22	125
IDSA 85	72	4.80	75	7.42	0.12	71
WAB 56-50	7	3.71	8	3.25	0.14	9
WAB 209	24	3.18	28	6.14	0.08	27
WAB 126	22	4.10	18	6.78	0.13	18
WAB 340	2	0.63	4	9.19	0.14	4
WAB 224	11	3.71	13	5.21	0.06	12
Iguape Cateto	3	2.57	3	3.00	0.02	3
WAB 450	5	0.60	4	2.83	0.15	3
WAB 160	4	1.44	2	4.25	0.06	1
OS6	4	0.73	6	4.04	0.51	6
Total local variety			93	20.09		
Total local upland			67	13.29		
Total PVS			113	9.15		

All PVS increased between the year of first use and 2002, except for WAB 56-50. The highest amount of increase among the sub-sample of farmers using PVS is of WAB 340, followed by IDSA 85. Amounts in 2002 were lower than local varieties but overall mean of amount of PVS seed planted by farmers using PVS cultivars is 44% of the amount of local varieties planted. These figures include communities where PVS varieties have only been introduced in 2002.

Similar patterns exist for areas planted by farmers of different varieties. Of the PVS varieties the highest mean area is for WAB 340, followed by WAB 56-50 and IDSA 85.

Information on the wider spread of PVS varieties outside the communities surveyed was obtained by questioning some members from the communities about wider spread, by visiting several other communities and based on information obtained working in the area during the project. Figure 40 summarises the findings from this. Although the information will not completely show spread it indicates widespread distribution from village to village in 2001 and 2002 and over greater distances in 2002.

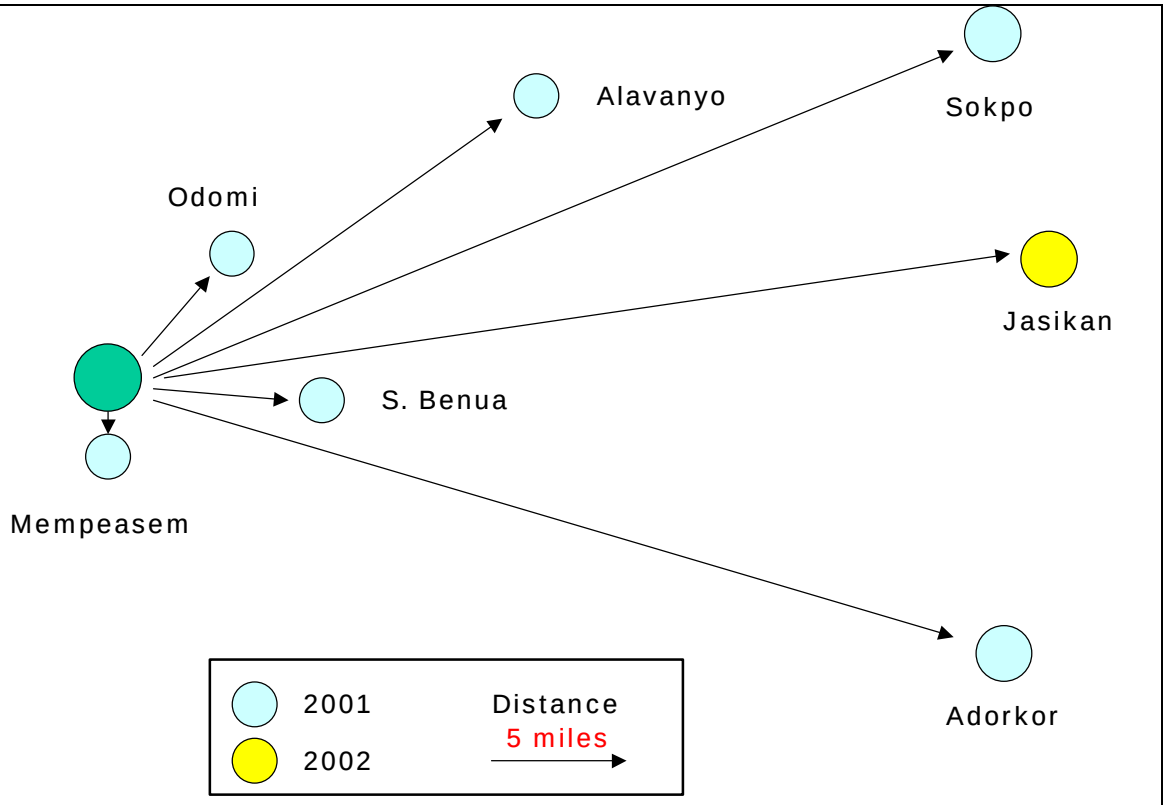


Fig. 44a. Seed dissemination from 4 seed producers in Todzi supplied with seed in 2000

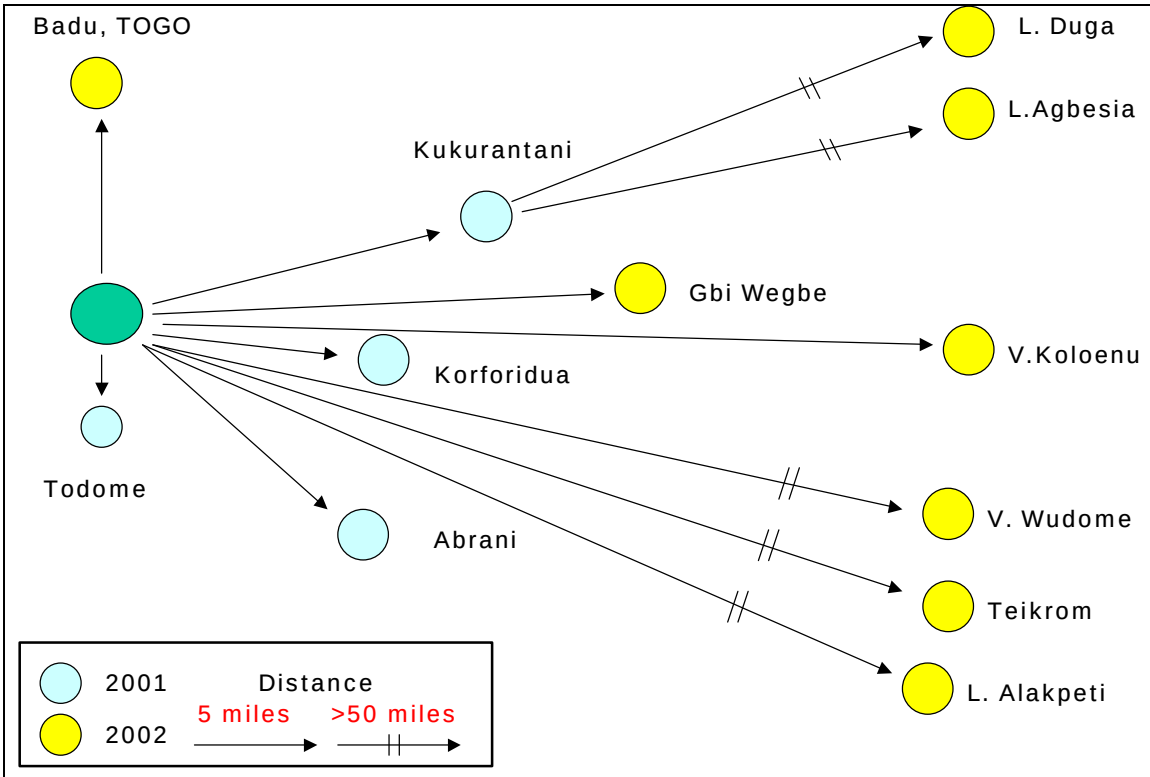


Fig. 44b. Seed dissemination from 15 farmers in Agbozome supplied with seed in 2000

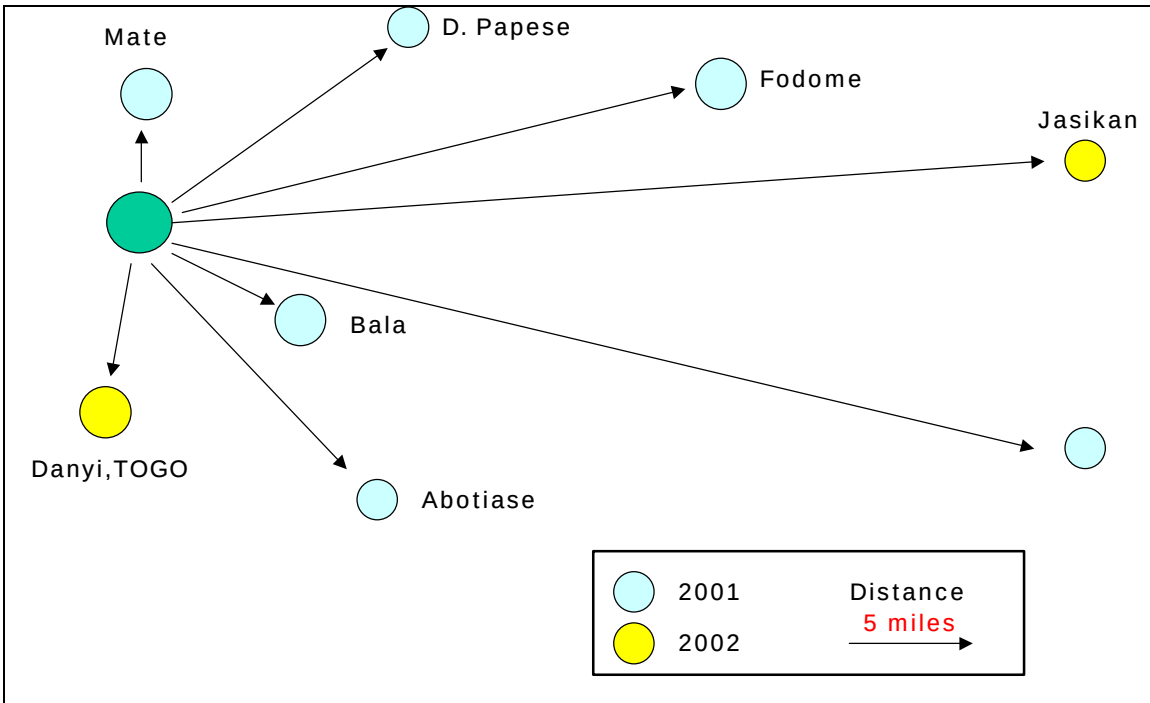


Fig. 44c. Seed dissemination from 20 farmers in Likpe Bakua supplied with seed in 2000

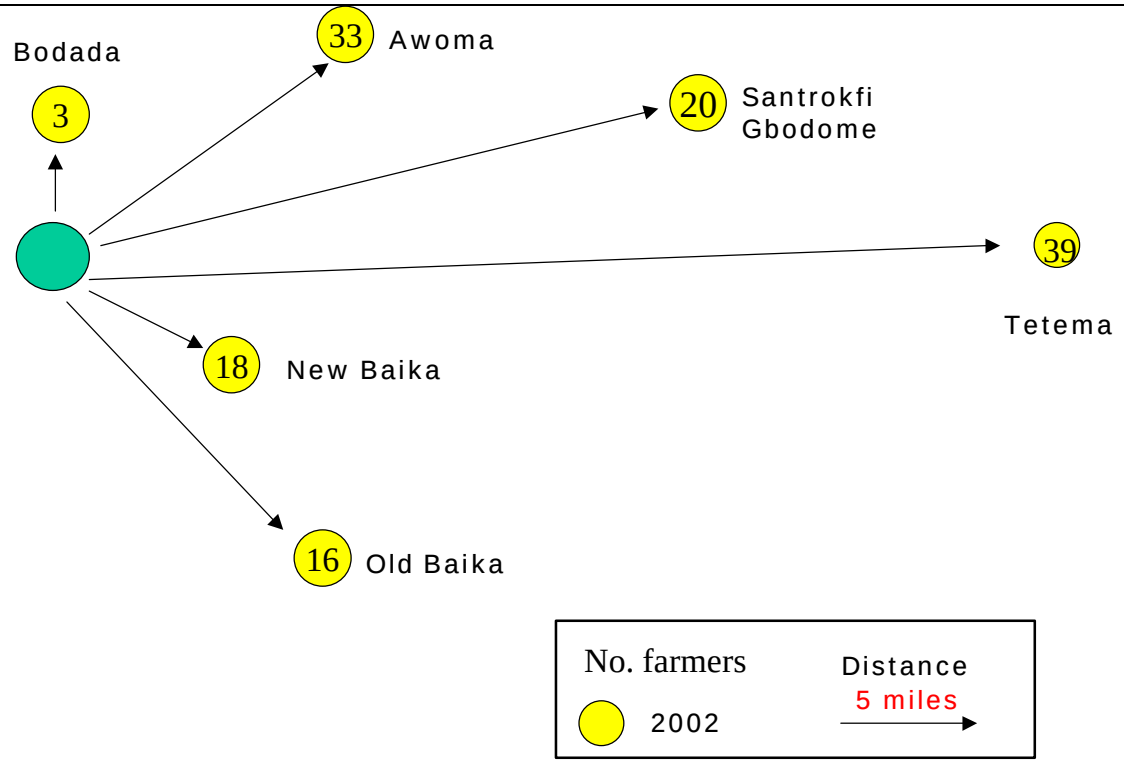


Fig. 44d. Seed dissemination by extension officer in 2002 from seed collected from farmers in Todzi, Sokpo and Adokor

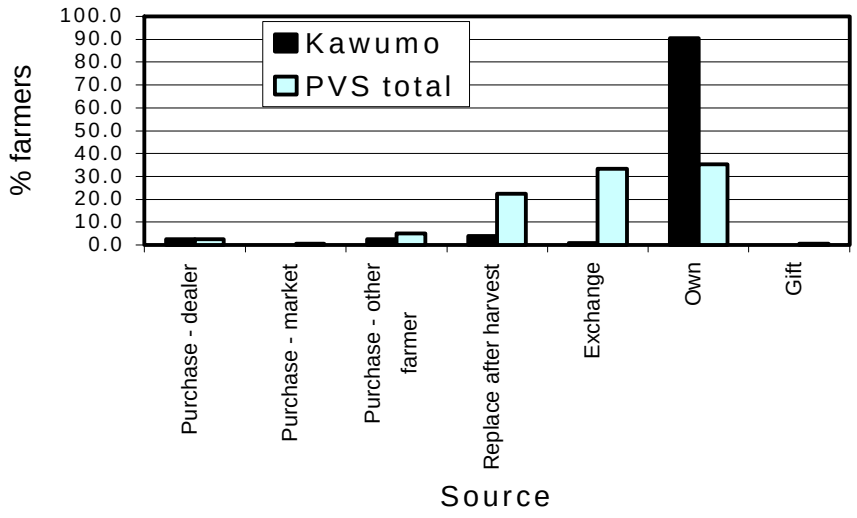
5.3.3 Processes by which uptake and spread occurred

Source of seed in 2002

Fig 40 shows farmers' sources of seed of PVS varieties in 2002. The sources of seed of *Kawumo*, the major farmers' upland variety is also shown. Informal channels of seed distribution were the most common means of spread of the new cultivars. Over 35% planted their own seed (i.e. seed saved from previous harvest). Farmers planting new cultivars for the first time exchanged seed of existing varieties for the new cultivars (33.3%) or replaced in kind (22.4%). Where seed is exchanged, the same amount of seed is given out in return for the new variety at the time of planting. An exchange normally takes place when the farmer with the new variety has sufficient quantity of the seed to meet his or her requirement, or if there is kin relationship in which case there is an obligation to assist. There may also be cases when the two exchanging the seed receive seed of cultivars both of them lack. When seed has to be replaced the normal practice is for the recipient farmer to provide twice the quantity

received of the same cultivar after harvesting the crop. This is common in situations where the farmer giving out seed of the new cultivar has limited quantity and therefore is interested in multiplying the seed. Kin relationship is also an important factor in such an exchange (but not always).

Fig.40. Source of seed in 2002, % farmers



Both seed exchange and replacing in kind after harvest are common means of sharing seed within this area and elsewhere in Ghana. They do not require cash and should enable seed to be obtained by all categories of farmers irrespective of resources and contact with institutions. Normally, amounts of seed involved by this are fairly small. Table 74 shows that the mean amounts of seed planted are generally low. In particular the amounts exchanged (9.4 kg) or that have to be replaced after harvest (6.9 kg) were lower than cases where the seed was purchased from a seed dealer or another farmer. Therefore much fewer farmers purchased seed than exchanged or replaced after harvest but they purchased larger quantities. Also, the supply was skewed towards a few farmers in the case of these informal exchanges. The median values of less than 3 kg implies that half the farmers who accessed seed through the informal exchanges planted just this amount of seed.

Nine out of 10 of the farmers who planted the major existing farmer variety (i.e. *Kawumo*) used seed saved from the previous harvest. This is an indication that farmers use their own saved seed. Of the remaining 10%, half of them obtained the seed through seed exchange or replacing after harvest, and the other half purchasing from other farmers or a dealer. These were presumably new farmers, or farmers who had insufficient seed saved due, for example, to poor yields, storage losses or household demands.

Table 74. Kg seed of PVS cultivars planted in 2002

(a) Kg seed by PVS cultivar planted in 2002, mean values

Cultivar*	Mean	N
IDSA 85	7.4	75
WAB 56-50	3.3	8
WAB 209	6.1	28
WAB 126	6.8	18
WAB 340	9.2	4
WAB 224	5.2	13
Iguape Cateto	3.0	3
WAB 450	2.8	4
WAB 160	4.3	2
OS6	4.0	6

(b) Kg seed of PVS varieties by source in 2002, mean and median values

Source of seed	Mean	Median	N
Purchased from dealer	14.3	10.0	3
Purchased from market	0.75	0.75	1
Purchased from another	14.7	15.0	7
farmer	6.9	2.6	28
Replace in kind after harvest	9.4	2.8	28
Seed exchange	10.5	7.5	37
Own	1.2	1.2	1
Gift			
Total PVS	9.2	9	113

* Some farmers planted more than one PVS cultivar

The process of spread was similar in all communities, irrespective of how seed was introduced or year of introduction (see Table 75). The dominance of informal channels of distribution is the result of an absence of a well-developed input market

(note the underlying reason for this project). It is noteworthy, however, that four farmers reported purchases from seed dealers – three in the community where seed was introduced through farmer group in 2000 (i.e. Agbozume) and one at Odomi, a community where seed was introduced in 1999 but with no follow-up activities.

Table 75. Seed source of PVS cultivars in 2002 by year and type of introduction, percentage of responses

Year	Village type	Purchased from dealer	Purchased from market	Purchased from another farmer	Replaced in kind after harvest	Seed exchange	Own	Gift	N
1999	PVS nursery, intensive follow-up	0.0	0.0	6.8	9.1	47.7	36.4	0.0	44
1999	PVS nursery, no follow-up	7.1	7.1	14.3	35.7	7.1	21.4	7.1	14
2000	Researcher/extension-led distribution	0.0	0.0	40.0	20.0	20.0	20.0	0.0	5
2000	Farmer group-led distribution	17.6	0.0	0.0	23.5	29.4	29.4	0.0	17
2000	Extension-led distribution	0.0	0.0	0.0	11.1	11.1	77.8	0.0	9
2001	Secondary distribution from PVS intensive village	0.0	0.0	3.6	7.1	35.7	53.6	0.0	28
2001	Secondary distribution from farmer group-led village	0.0	0.0	0.0	62.1	31.0	6.9	0.0	29
2001	Secondary distribution from extension-led village	0.0	0.0	0.0	0.0	40.0	60.0	0.0	10
	All locations	2.6	0.6	5.1	22.4	33.3	35.3	0.6	156

Seed supply

Table 76 describes the supply of seed to other farmers in 2002. In total, 65 instances of seed supply were reported by farmers interviewed; 36 of *Kawumo* and 29 of PVS varieties. The majority (59%) of instances of PVS seed supply were of IDSA 85 and the mean amounts of seed supplied of *Kawumo*, the existing major variety, and IDSA 85 are similar (65kg and 64kg respectively).

Table 76. Kg seed of varieties supplied to other farmers in 2002

Cultivar	Number of farmers supplied with seed	Total kg seed supplied	Mean kg seed supplied
Kawumo	36	2290	63.6
IDSA 85	17	1103	65.0
WAB 56-50	1	2.0	2.0
WAB 209	6	33.5	5.6
WAB 126	0	0.0	0.0
WAB 340	1	5.0	5.0
WAB 224	2	10.5	5.3
Iguape Cateto	0	0.0	0.0
WAB 450	1	2.5	2.5
WAB 160	0	0.0	0.0
OS6	1	2.0	2.0

Table 77 shows that 75% of the reported seed supply of 1103 kg of IDSA 85 seed was produced by only two farmers. However 73% (i.e. 52 out of the 71) of farmers that received seed had been supplied by farmers supplying amounts less than 20 kg each. A large number of farmers were responsible for supplying small quantities of seed to a large number of other farmers. In contrast the small number that have specialised in seed production on a large scale are supplying relatively large amounts to a very few farmers. Overall, on average each farmer supplied at least four others with seed. The number of farmers supplied with seed from within the same community was higher than those supplied by farmers from other communities. However, the kg seed supplied from outside was five-fold that supplied within the community. Thus, mean supply to farmers outside tended to be in commercial quantities, in contrast to the lower amounts involved in intra-community seed exchanges.

The two farmers who accounted for 75% of the seed supply were from Todzi and Ashiambi, and the bulk of the seed was supplied to farmers outside the community. The high sale by a farmer at Todzi is not surprising given the intensity of activities there. The relatively large producers supplied the seed to farmers outside their respective communities. The reason for the emergence of a seed producer is not immediately clear, but this may be a case of a farmer taking advantage of an opportunity to develop on his seed production.

Table 77. Seed supply of IDSA 85 in 2002

Quantities of seed supplied by individual farmers (kg)	Kg seed supply	Total no. of farmers supplying	No. of farmers within community supplied	No. of farmers outside community supplied	Total no. of farmers supplied	Mean kg supplied to farmers	Mean no. of farmers supplied by supplier
Up to 10	32	8	8	7	15	2.1	2
11 to 20	90	5	22	15	37	3.0	7
21 to 100	156	2	7	2	9	17.3	5
100+	825	2	5	5	10	82.5	5
Total	1103	17	42	29	71	15.6	4

Table 78. Kg seed supply of IDSA 85 in 2002 by community

Community	No. of farmers supplying	Supply within community	Supply outside community	Total supply
Todzi	9	116	425	541
Mempeasem	1	4	0	4
Ashiambi	1	0	400	400
Agbozume	2	38	0	38
Adokor	2	0.5	0	0.5
Abrane	1	0	100	100
Bakua	1	20	0	20
Total	17	181	925	1103.5

Reasons for not planting PVS cultivar in 2002

Among those not using the PVS cultivars over 56% gave reasons that were related to knowledge of the varieties; 37.4% stated that they had not heard of the new varieties while 18.7% said that they did not know enough about them. About 30% of the farmers mentioned that they wanted to grow the cultivars but could not get seed. Just a little under 10% of the farmers did not plant the new cultivars because they were satisfied with their own varieties or considered it too risky to grow the new cultivar. Overall, the desire to plant new varieties was high.

Table 79. Reasons for not planting PVS cultivar in 2002, % respondents

	Not heard of new varieties	Don't know enough about them	Not as good as own varieties	Wanted to but seed not available	Too risky	Satisfied with existing varieties	Other	N
Todzi	33.3	0.0	0.0	33.3	0.0	33.3	0.0	6
Odomi	12.5	37.5	0.0	25.0	0.0	12.5	12.5	8
Mempeasem	33.3	0.0	0.0	44.4	0.0	11.1	11.1	9
Ashiambi	25.0	25.0	0.0	25.0	25.0	0.0	0.0	4
Agbozume	46.7	6.7	0.0	40.0	0.0	0.0	6.7	15
Bakua	50.0	33.3	0.0	16.7	0.0	0.0	0.0	6
Bume	0.0	33.3	16.7	16.7	0.0	33.3	0.0	6
Adokor	20.0	40.0	10.0	0.0	20.0	10.0	0.0	10
Kukurantumi	61.9	4.8	0.0	33.3	0.0	0.0	0.0	21
Abrane	33.3	20.0	0.0	46.7	0.0	0.0	0.0	15
Bala	50.0	25.0	0.0	25.0	0.0	0.0	0.0	4
Mate	33.3	66.7	0.0	0.0	0.0	0.0	0.0	3
All locations	37.4	18.7	1.9	29.9	2.8	6.5	2.8	107

4.3.4 The extent to which PVS varieties meet farmers requirements

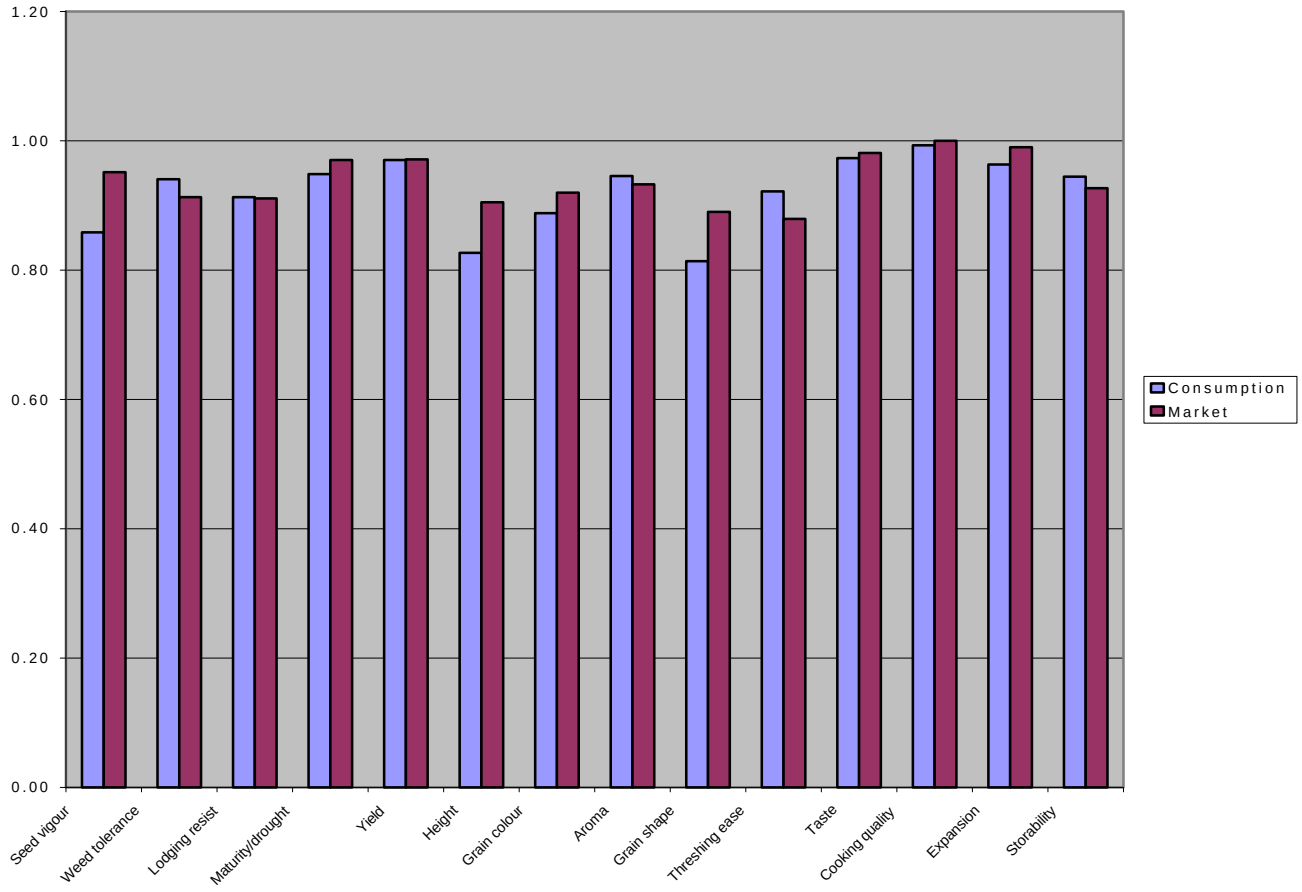
As part of the random survey farmers were asked a series of questions about the extent to which varieties meet characteristics they preferred for rice grown for home consumption or market. Previous fieldwork had indicated that preferences varied with respect to these two uses for some farmers. A list of characteristics was used based on experience of working with farmers over the period of the project (ie PRA activities and formal evaluations with farmers of varieties). Regarding each characteristic respondents were asked whether its importance was ‘very important’, ‘important or ‘not so important’. Each respondent was also asked to name their best local variety and PVS variety (if grown) and to indicate how good each of these were for each characteristic ie ‘very good’, ‘good’ or ‘poor’.

Farmers were reluctant to distinguish between ‘very important’ and ‘important’ and between ‘very good’ and ‘good’ as these distinctions are not easily made in the local language. For analysis these differences were not included and responses were scored as 1 (for very important/ and important very good/ good) and 0 for not so important and poor.

Table 80. Scores (0-1) of importance of characteristics to farmers of rice grown for consumption or market

	Consumption				Market			
	Important	Not so important	Importance score	N	Important	Not so important	Importance score	N
Seed vigour	122	20	0.86	142	99	5	0.95	104
Weed tolerance	128	8	0.94	136	95	9	0.91	104
Lodging resist	126	12	0.91	138	92	9	0.91	101
Maturity/drought	130	7	0.95	137	101	3	0.97	104
Yield	135	4	0.97	139	103	3	0.97	106
Height	115	24	0.83	139	96	10	0.91	106
Grain colour	135	17	0.89	152	103	9	0.92	112
Aroma	141	8	0.95	149	97	7	0.93	104
Grain shape	118	27	0.81	145	97	12	0.89	109
Threshing ease	130	11	0.92	141	95	13	0.88	108
Taste	150	4	0.97	154	107	2	0.98	109
Cooking quality	149	1	0.99	150	107	0	1.00	107
Expansion	134	5	0.96	139	99	1	0.99	100
Storability	136	8	0.94	144	101	8	0.93	109

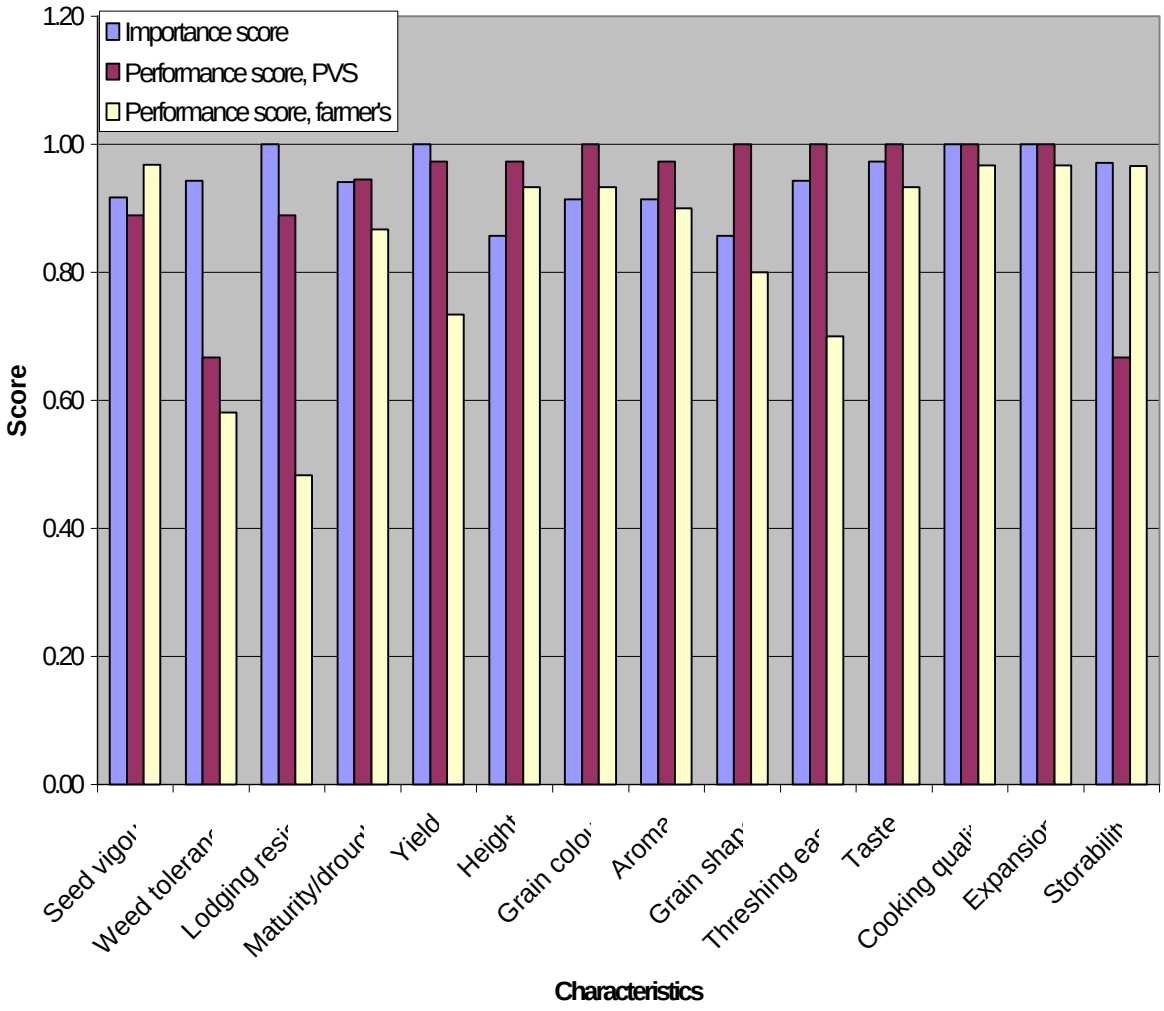
Fig. 41. Score (0-1) of importance of characteristics of rice to farmers for consumption or market



Scores of importance of characteristics vary little between consumption and market and Figure 41 shows that the relative differences in importance of characteristics is very similar for both uses ie they follow the same pattern. All characteristics are considered important and have a score greater than 0.8. The post harvest characteristics of cooking quality, expansion and taste score highest closely followed by yield and maturity/drought tolerance.

Figures 42 and 43 show performance of PVS varieties against the performance of the same farmers best local varieties (whichever were grown by the same farmer). Scores of importance of characteristics are given for those farmers too.

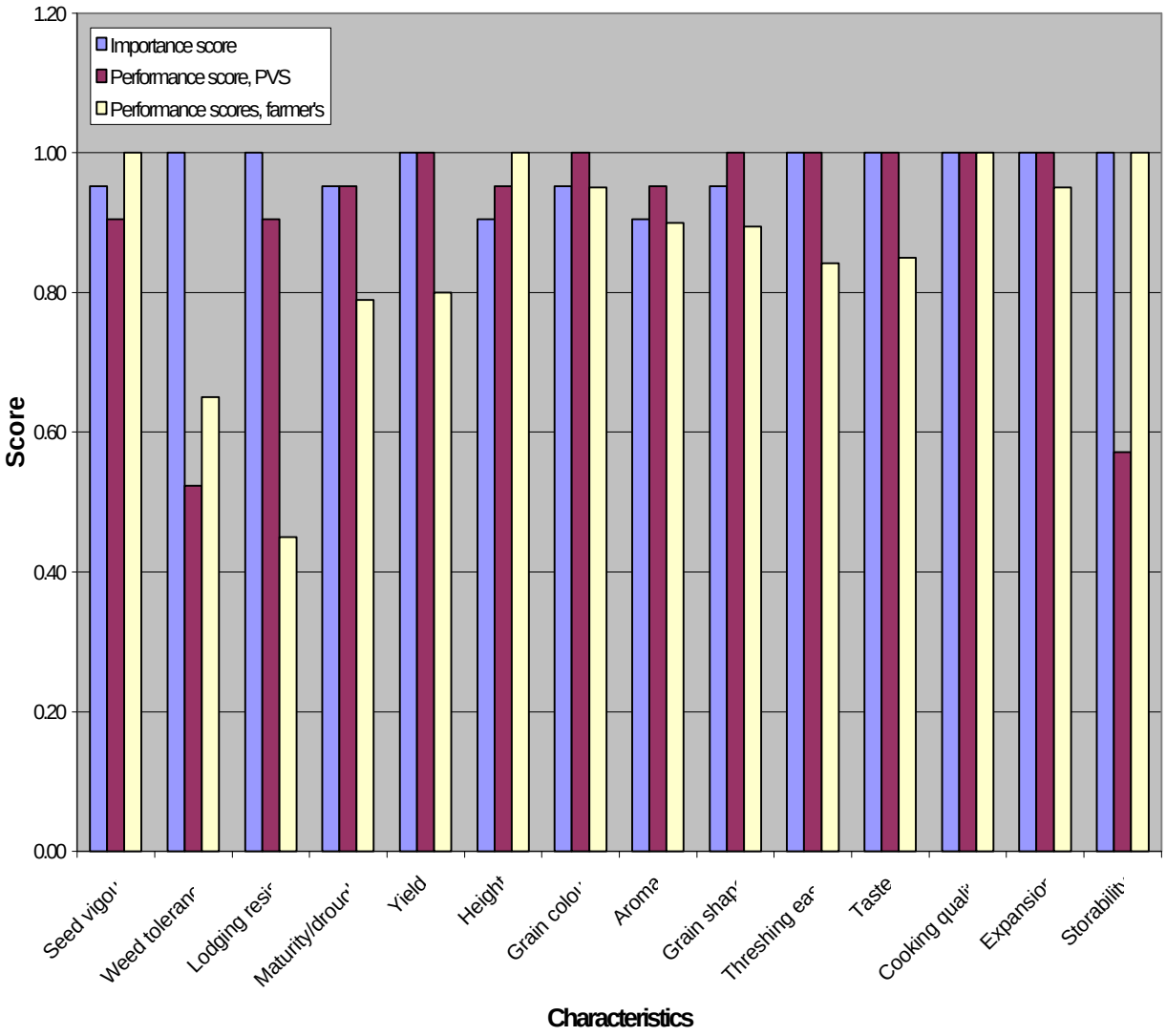
Figure 42. Importance and performance scores (0-1) of characteristics for consumption, IDSA85 and best farmer variety



N ≥ 29

Regarding consumption, for most characteristics IDSA85 has higher performance scores than best farmer's variety. Greatest difference in scores exists for lodging resistance, threshing ease, yield and grain shape. However best farmer's variety has a higher score for storability.

Figure 43. Importance and performance scores (0-1) of characteristics for market, IDSA85 and farmer variety



N ≥ 19

With respect to rice grown for the market, for most characteristics IDSA85 again has higher or equal performance scores compared to best farmer's variety. The greatest differences are for lodging resistance and yield. Again best farmer's variety has a higher score for storability.

The numbers of respondents that could be included in analysis for the other PVS varieties were low and results should be interpreted with caution. For WAB126 grown for consumption, performance scores (n ≥ 8) were equal or higher than those for the

best farmer's variety for all characteristics except for storability. Regarding rice grown for market ($n \geq 7$) best farmer's variety scored higher for weed tolerance. For WAB209 grown for consumption, performance scores ($n \geq 7$) were higher than those for best farmer's variety for yield, lodging resistance and maturity/drought but lower for storability. Regarding market ($n \geq 5$) best farmer's variety scored higher for storability.

Comparison of importance and performance scores gives an indication of the extent to which varieties meet farmers preferences. This is useful both for evaluating newly introduced varieties but also for identifying characteristics which have not yet been met and that breeding and further PVS work may need to address. For both consumption and market IDSA85 performance scores match importance for all characteristics except for storability and weed tolerance. Best farmer's variety scores for performance do not match scores for importance for lodging resistance, weed tolerance and yield for consumption or market. Threshing ease is lower for market only. IDSA85 meets all characteristics except for storability and weed tolerance.

5.4 Conclusions

The complete survey provided a clear picture of current levels of farmers growing PVS varieties and the field survey together with evidence gathered informally during the project provided detailed information on methods of uptake and farmers preferences. There were no differences between men and women farmers uptake, methods of reasons for growing rice. The spread of cvs is summarised in Fig. 44a-d.

Upland rice is an important crop in the area for both home consumption and as a cash crop, particularly since the decline of the cocoa market. Constraints faced by farmers and the characteristics of local varieties indicate the need for improved varieties.

The uptake to date of varieties introduced through PVS has been high, 37% of farmers overall and 97% of farmers in one community. IDSA 85 has been the most popular PVS variety. Of particular interest is the high rate of uptake given the small amounts of seed provided to farmers. Other PVS projects have generally involved supply of greater quantities of seed. The observed levels of use of the new cultivars do not necessarily represent adoption in the long run. This includes the first stage of testing by some of the farmers, some of whom may discontinue. On the other hand, the limited seed available put a constraint on the number of farmers who had access to seed. Time will tell the number of farmers adopting and the relative proportions of land that would be grown to new and existing varieties. Seed spread between communities expanded in 2000 and 2001 including to communities approximately 60 km away.

Uptake increased dramatically in 2002. No seed was supplied by the project in this season and furthermore 2001 was a drought year. It is possible that once amounts of seed are above certain level in the informal system spread can be rapid. In the drought year PVS varieties will have performed better than local varieties thereby adding to demand.

The informal system is the dominant system of seed delivery, even for the emerging new varieties of rice. The initial access is largely through seed exchange or replacement after harvest. Once a farmer has the variety, seed saved from previous harvest becomes the main source for future planting.

The informal system delivers seed to farmers who may be constrained by the absence of seed dealers or lack of cash to purchase seed of new cultivars. However, this system of seed delivery poses challenges to the management of seed. First, given the fact that farmers plant more than one variety, there is the danger of seed passed on being contaminated. The possible sources of contamination are the field (if it was cropped with a different variety in a previous season), and threshing and drying (if more than one variety is harvested and threshed at the same time). Second, the high use of saved seed, which consequently results in low demand for new seed leads, to a situation where it is difficult for a formal seed sector to develop. However some form of addressing issues of purity needs to be considered.

Both the production of, and access to, seed of the new cultivars were skewed to a small proportion of the farmers. A small proportion of farmers produced the bulk of the seed, and the seed produced by these farmers was supplied in relatively large amounts to a very few farmers whose demand for seed were in commercial quantities. This was in contrast to the other observed pattern of a large number of farmers supplying small quantities of seed to a large number of other farmers. Kinship appeared to be a major factor influencing who intitial recipients passed seed onto both within and between communities. PVS activities may in future need to ensure that farmers receiving seed are from different families and kins.

5.4.1 Importance of traits and how new cultivars meet farmer requirements

All the listed traits were scored as higher than 0.8 out of 1. This suggests that in this region because of the local language, without using restrictions such as ranking or considering alternative scoring approaches, all traits tend to be considered as important. In relative terms, however, post-harvest traits together were considered to be more important than pre-harvest traits, with the exception of maturity cycle/drought tolerance and yield, which had scores similar to the post-harvest traits.

The best local variety was not considered by farmers to have performed well for weed tolerance, lodging resistance, yield and threshing ease. In both cases of rice grown for consumption and for market, for most characteristics the major PVS variety (IDSA85) had higher or equal performance scores compared to best local variety. The only exception was for storability and to a lesser extent seed vigour. The major problem to address is how to manage the PVS variety in storage given that this trait is among the highest scored for importance, and that the cultivar is so popular.

The PVS approach worked well and the farmer evaluation and selection of varieties was essential to their identification and spread. Local names have been given to the main varieties and encouraging this at an earlier stage is likely to increase ‘ownership’ and make following spread easier. Given the importance of post-production factors, their inclusion in evaluation was essential although small quantities of seed limited the extent to which some evaluations (eg taste, cooking qualities) could be conducted.

Further work is required regarding storability and storage mechanisms (and is the subject of an ongoing research project). The strong informal system ensures the spread of popular varieties and that they are available to resource poor farmers. However consideration is needed as to how to encourage seed purity as well as quality of processed products. Partnerships between formal institutions and farmer informal systems to deliver seed may offer means of addressing these issues.

6 Integrating PVS and formal release systems in Ghana

6.1 Workshop on Participatory Crop Improvement at CRI, Kumasi, Ghana

6.1.1 Introduction

A one day workshop was held at CRI with scientists, extension and farmers to introduce PVS and discuss PVS and cv release. After introducing PVS, workshop participants were divided into two groups – a scientist/technician group and an extension/farmer group to discuss the PVS process. These discussions are summarised below.

6.1.2 Scientist/technician group recommendations for PVS programme

The scheme proposed by the group is given below. The group did not feel any consultation was necessary with farmers about the choice of cvs to be given to farmers. In general the group was not concerned with issues of social equity and equality of access to cvs within the community. Questions of how and whom should evaluate the cvs and select cvs were also not considered.

Minimum data set

Group felt that a data-set comprising standard agronomic/breeding evaluation criteria should be made for all cvs in years 1 through 3 (e.g. duration, panicle no, weed pressure, disease incidence). How this to be done not discussed. Why this was necessary not really debated, though it will contribute to release.

Requirements for Formal Release

Rice is unlike many other crops in that a large number local preferences and environments are known to exist, so release for particular areas will be the norm (i.e. MET performance not necessary).

Minimum requirement is that cvs:

- are liked and accepted by farmers and consumers
- are of good organoleptic quality
- are adapted to environment/location/zon
- have acceptable yields

Suggested that PVS at two sites per zone for a minimum 2 years plus supporting data enough for release. Details of exactly what supporting data are needed were not agreed upon.

Seed uptake/promotion

Formal system – GGDB- has been rejuvenated and should make seed of released cvs available (though to date no upland rice cvs have been released). The rice system will be based on the maize system, i.e. registered growers producing certified seed.

The group also felt that CBSM and seed distribution directly to individual farmers should be tried.

Table 80. Scientist/technician model for PVS

Year	Activity	Notes
1	Preliminary screening of cvs on-station	-Breeders can see cvs and their characteristics, remove obviously poor cvs, multiply and ensure pure seed of good quality
2	Researcher-managed rice garden on-farm with 30-60 cvs at two locations per target agro-ecological zone	-Unreplicated plots with high & low management, local checks ± specific checks -Rice garden planted where community can get access easily -Evaluation at maturity and post-harvest only by farmers; undecided whether evaluation in groups or individually -Question of how to ensure equal access to all in community?
3	Community-managed rice garden on-farm with 10-15 cvs	-Believed that farmers could not handle larger numbers of cvs successfully, so farmer managed garden only following preliminary evaluation
	Farmer comparisons of cvs on-farm	-In parallel, seed given to farmers (how many cvs, no. farmers) for testing on their own farm so that wider range conditions experienced. (It was suggested that farmers would copy researchers methods and so cvs would not experience farmers' conditions in a rice garden)
4	Formal release for target zone	-Minimum data set?

6.1.3 Summary of discussion by 3 farmers and 6 MOFA staff (Agricultural Extension Agents) all with experience of PVS. One of the farmers was also a facilitator of a PVS

The group suggested the following points regarding the running of PVSs.

1. Farmers should be allowed to try all cvs available, rather than research determine this. (Note that the concept of a needs assessment with farmers to identify a smaller number of cvs had not been discussed with farmers before this discussion.).
2. It was proposed that cvs be grown in three seed gardens at different locations in the area with different soils and environments. In order to make the number of cvs manageable, it was suggested that the seed gardens should each run for three years and grow each cv once.
3. The seed gardens should be set up and run by farmers groups especially formed for the PVS and with the help of a facilitator (eg an AEA).
4. Evaluation of the cvs should be conducted throughout the growing period with organised visits and meetings. This would include assessing taste.
5. If different interest groups exist in the area (ie farmers with different preferences for types of rice as a result of eg ethnic background, farming system) they should each discuss and evaluate the cvs at the meetings.
6. A limited number of cvs should then be selected from the seed gardens and given to selected farmers to grow on their own fields, both to continue evaluating the cvs and to multiply seed. Some of the discussion group thought up to 10 cvs should be selected for this purpose whilst others argued for only 2 in order to avoid confusing the market.
7. Seed should be actively disseminated by the group and facilitator through:

- Giving seed (1 kg) to farmers who requested it. In return they would give back 2-4 kg to the group to disseminate further. Initially this should be to people who are considered good farmers.
- Giving seed to farmers who requested it, for free or for sale or barter.

Some farmers would also obtain seed from other farmers and through ‘pilfering’ panicles from fields!

6.1.4 Proposed community-based PVS

Following the discussion within and between groups, a community-based PVS process was proposed and discussed by the whole group (Table 81). The following comments on the proposed Community-Based PVS Model were made during the discussion.

Crops Research Institute

- Suggested Model is OK for seed dissemination but not for cv release
  - PVS should be conducted as an experiment with an appropriate experimental design
  - Standard evaluation data need to be collected (SARI comment – do we need all these quantitative data?)
- MOFA cannot release cvs

Savanna Agricultural Research Institute

- Risk to leave everything under the control of the community
- Suggested that within a community there should be two PVS – one controlled by the community themselves with help/oversight from a facilitator (NGO,MOFA) and one controlled by researchers and managed by MOFA.

Farmers Group

- The community should control the process.
- PVS should be in the form of a rice garden for the first two years, but with two sites per community if possible (community farms are far apart in uplands, conditions will vary within a community)
- The community can keep accurate records and measure yields for researchers. Literate farmers from Hohoe have kept detailed records and these were shown. In the north, Mr Bimpong confirmed that farmers given seed through Action Aid had measured the yields and all the records were given to him at the end of the season.

Table 81. Model for Community-Based PVS

Year	Activity	Notes
	Pool of tested cvs, including organoleptic quality	-Tested in region (e.g. by WARDA, NARS) or in Ghana. -Sufficient seed is available for seed multiplication. (Critical assumptions)
0	Select 2 locations in target area or zone	-Suggested minimum for cv release purposes
0	Select community(ies) at each location for PVS	-Select in consultation with MOFA or NGO local officers
0	Needs Assessment with community	-Identify rice farming practices and constraints. -Identify plant types & cvs being grown and needed. -Conduct during growing season so that rice farms and local cvs can be seen and discussed, and examples of new plant types can be shown and discussed.
	Set up Community-Based and controlled PVS. (2 sites per community suggested)	-Identify facilitator with community (e.g. MOFA AE officer, someone within community). -Discuss management/ conduct of PVS. -Discuss record keeping.
0/1	Off-season seed multiplication of community preferred plant types	Target 2 × 0.5 kg seed per community
1	Community-Based PVS- year 1	-Suggested PVS is conducted as a rice garden in first year. -Monitoring by CRI/SARI, including disease/pest assessments. -Maturity and post-harvest assessments by CRI/SARI, including cooking and taste evaluations.
2	Community-Based PVS- year 2	-Suggested that PVS repeated as a rice garden, perhaps in more locations within community and/or some seed given directly to individual farmers. -Monitoring by CRI/SARI, including disease/pest assessments.
3	Community-Based Seed Dissemination (within and between communities)	-Set up CBSM. -Discuss record keeping of seed dissemination

6.1.5 Conclusions

The objective of presenting a model, and of the Workshop, was to initiate discussion about cv release, seed dissemination and scaling-up the process, and to get the Institutes to think and plan beyond the research project objectives, especially given the PSP cassava project and WARDA's regional projects and initiatives.

The main conclusions were:

- There seems to be widespread agreement that PVS is an excellent means of disseminating cvs and farmers, extension and CRI/SARI were happy with the process to date
- There was broad agreement that the PVS should last for three years and that at least in the first year a rice garden was the most appropriate way to start the process
- The institutes expressed concern over whether a community-based PVS was an appropriate means to release cvs. There were two main issues:

  (1) MOFA (or other extension agency) are not authorised to release cvs – this is the prerogative of the research institutes. However, MOFA are responsible for adaptive research with farmers, and in essence would be the local manger for the process, not the executing agency.

  (2) The Seed Release Committee require some data in order to release cvs, and this will need to be collected somewhere in the process. However, what data are required, and where, when and how (or by whom) these should be collected, needs to be resolved. In general the scientist/technician group also felt that the PVS process should be conducted as an experimental process, and that it was necessary to collect 'data' for this reason.
- Farmers felt strongly that they were capable of managing the process and that with proper consultation, and technical support where needed, they could conduct a PVS as well as organise CBSM and an equitable distribution of seed

6.2 Proposed model for PVS and cv release and promotion in Ghana

A model for the integration of PVS and formal release procedures is presented in Fig. 45. In this model, needs assessment with farmers is an integral part of the identification of cvs for selection and testing. The needs assessment exercise brings farmers and other key stakeholders such as consumers and traders/ marketers into the process at the start. A potentially large number of farmers and contrasting testing environments can be utilised using this approach. Furthermore, this ensures that post-harvest and quality traits are given prominence in the process.

The second stage of the process is to conduct PVS nurseries in selected communities over one or two years. These nurseries can be researcher, researcher/facilitator, facilitator/community or community-managed depending on circumstances. In general, a research or facilitator managed nursery in the first year seems to be the best approach as this maximises the chance of the nursery succeeding. Communities can manage this process if they are highly motivated. The major limitation to this process is producing enough seed for post-harvest consumer preference testing. Experience has shown that these are very important traits. Another constraint is that storage ability is also important trait that may affect quality; this cannot be easily assesses until farmers can store their own seed.

Following the PVS nursery and the selection of promising cvs by farmers, it is proposed to use a mother & baby system for on-farm evaluation in parallel with formal on-station replicated yield trials. Replicated yield trials and screening by crop protectionists provide necessary data for release while on-farm data and farmer preference data confirm the utility of cvs. Cultivars can then be put forward for release.

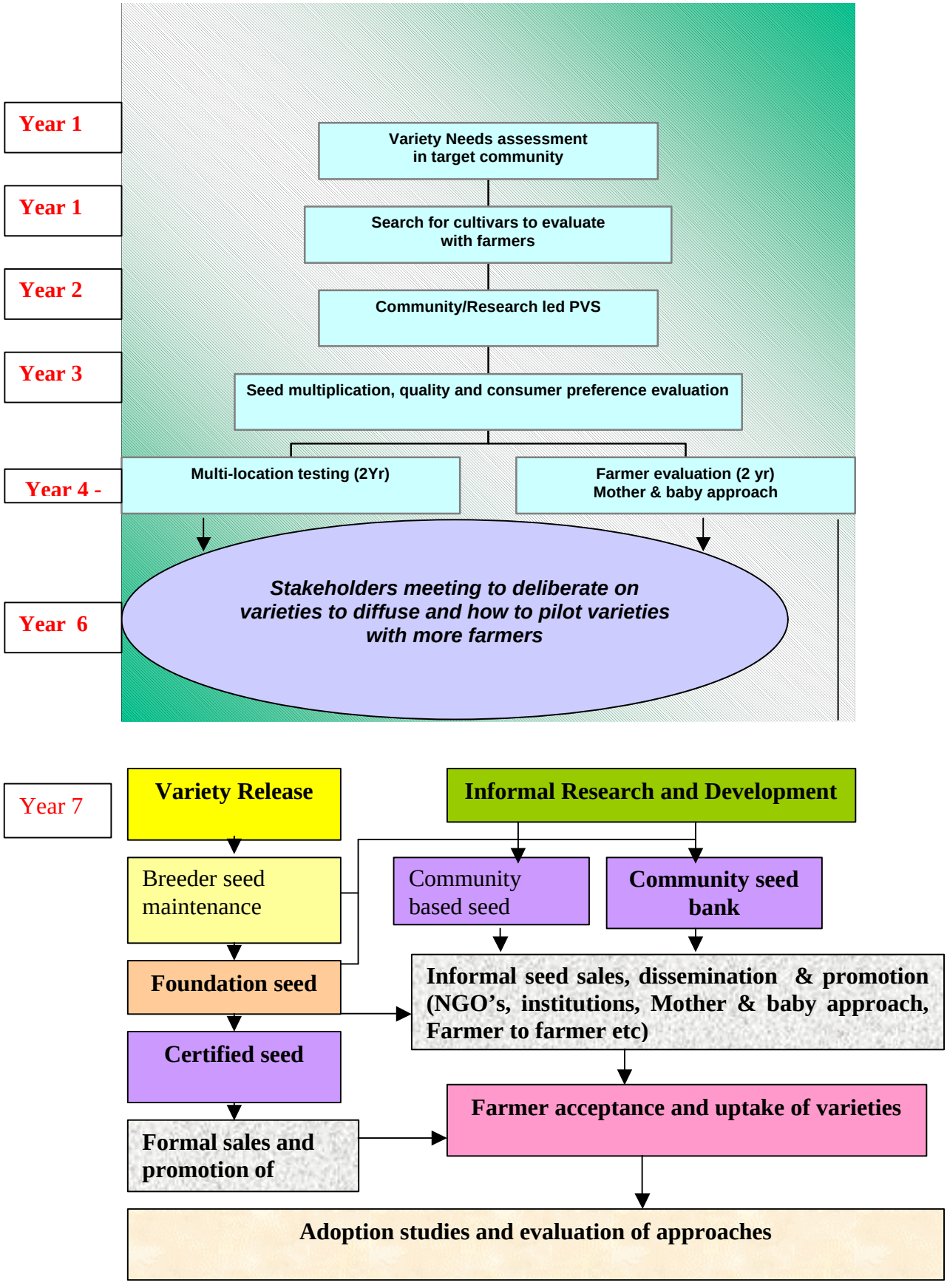


Fig. 45. Schematic diagramme of proposed integrated PVS and formal release system in Ghana

SARI have recently had IR12979-24.1 officially released (Dogbe, 2002). This cv was first tested by SARI in 1985 and was included in a PVS at Tolon in 2000 (see xxxx). This cv had high yield and was selected by many farmers who evaluated the PVS. As a result, this cv was then included in other PVS nurseries (n=5), in all mother & baby trials (n=216) and in multi-locational replicated yield trials in 2001. Data from all these sources contributed to release. Two other cvs, IDSA10 (IRAT262) and IRAT216, which were also included in the same trials were not approved for release. Although these two cvs were higher yielding on-farm than local cvs, they were not higher yielding in on-station trials than existing cvs. The Seed Release Committee is apparently still most concerned with yield *per se*, even though cvs have a demonstrated yield advantage on-farm.

7 Summary conclusions and recommendations

7.1 Introduction

Increasing productivity and production of rice is a major challenge facing the government of Ghana who spends more than hundred million dollars annually on rice imports. Among the factors hindering productivity and increased production of rice, low adoption of high yielding varieties by farmers stands out. Major barriers to adoption of improved varieties are;

- Poor adaptation of varieties selected by research to farmers cropping system
- Released varieties may not meet the requirements of end users (consumers)
- Poor or lack of access to improved varieties

In Ghana more than 50% of the rice lands can be described as upland and hydromorphic ecologies which are distributed across the country. These are lands mostly used by the most vulnerable in society (women and the poor). The risks associated to these lands and the high poverty of most upland rice farmers makes it difficult for increasing yields through input use. A most promising way to achieve productivity increase in upland rice systems is through variety improvement. In Ghana very few rice varieties adapted to these ecologies has been released. Even where released varieties exist, their seed is not readily available to the poor farmers who mostly need them. The national breeding programmes have suffered from lack of fund and personnel for multi location and large scale on-farm evaluation of upland varieties. Two important set of data required by the national variety release committee before a variety is released. The consequence of this is promising varieties identified by breeders at on-station remain forever on shelves whilst farmers are in dare need for varieties.

This report describes how using the PVS approach we are gradually addressing above problems in some major upland rice growing environments in Ghana.

7.2 Methodology/approach

The PVS programme in Ghana was initiated in 1997 (Opoku-Apau, 2001) with a grant from DFID and intensified in 2000-2002 with funding from Gatsby Charitable Foundation of UK and DFID Plant Science Programme. The programme has so far been implemented in six out of the 10 regions of Ghana (with 13 communities in 8 districts) and has involved almost 800 farmers (Table).

The approach involves understanding farmers' production constraints and variety needs (characteristics they will like to see in new varieties), and participatory selection of varieties to satisfy farmers' variety needs.

The programme has used the Mother & Baby trial concept (Witcombe, 2002) which involves the evaluation of varieties in a nursery the first year. The most preferred varieties by farmers are multiplied, analysed for their quality and consumer preference and then evaluated on-farm in Mother & 'Baby' trials for two subsequent years (see Fig. 45).

7.2.1 The Mother & Baby trial system

The Mother and Baby trial system recognises the difficulty of obtaining reliable yield data from many, widely dispersed participatory trials. Yield data are collected from the Mother trials – carefully managed and monitored trials where all entries are compared with each other. In Baby trials – only farmers' perceptions on yield are collected.

Mother trial

The Mother trial
- Many cultivars, several locations, one or more replicate per location
- Researcher designed, farmer managed, farmer level of inputs

Baby trial

The Baby trial
- One or two new cultivars per farmer
- Compared to local cultivar or second new variety
- Farmer managed, farmer inputs
- Evaluation of farmers perception only

In northern Ghana where permanent Research managed multi location sites exist, farmer preferred varieties being evaluated on-farm are evaluated concurrently at these sites.

Over the years, the PVS projects have tried the following in an effort to come out with a workable and a sustainable model for the selection, testing and dissemination of upland rice varieties in Ghana.

- Creating an awareness among stakeholders (NGO's, District Assemblies, extension, seed growers, processors, researchers and farmers)
- Empowering stakeholders in the variety development process through training and joint planning, monitoring and evaluation
- Researcher and community led PVS
- On-farm evaluation (Mother & Baby)
- Testing of different seed dissemination pathways

7.3 **Results and achievements**

- Modest gains have been achieved in awareness creation and empowerment of farmers and stakeholders in the districts and communities that we have worked in and which need to be consolidated.

- The variety needs assessment gave us the opportunity to understand farmer's constraints and also provides information on the characteristics farmers would

like to see in new varieties. Farmers are not just looking for high yielding varieties but those that will address some of their production constraints or meet consumer preference, even when relatively lower in yield. Even though the needs of male and female farmers in the Savanna and Forest zones in terms of characteristics they considered important are generally similar, there exist some ecological and gender differences (Table 82). For example in the northern Savanna zone drought tolerance is an important characteristic for both men and women, but this is not the case in the Forest zone. Also women in both zones consider consumer characteristics which was not the case with men.

This difference was also expressed as important in the choice of varieties selected by 117 male and 84 female upland rice farmers in a PVS nursery across 5 communities in Northern Ghana (Fig 46).

Table 82 Characteristics men and women rice farmer's desire in new upland rice varieties.

Characteristics desired in new upland rice cultivars in the Savanna zone		Characteristics desired in new upland rice cultivars in the Forest zone	
Men	Women	Men	Women
• Weed suppression ability • Drought tolerance • High market value • High tiller ability • High yielding • Earliness	• High yielding • Drought tolerance • Easy to thresh • **High Expansion of grains & tasty** • Grow well at low fertility • **Mill without parboiling**	• High yield • Suppress weeds • Disease resistant • High tiller ability • Resistant to lodging • Large grains	• High yielding • **Taste** • Suppress weeds • Early maturity • **Aroma** • Large grains

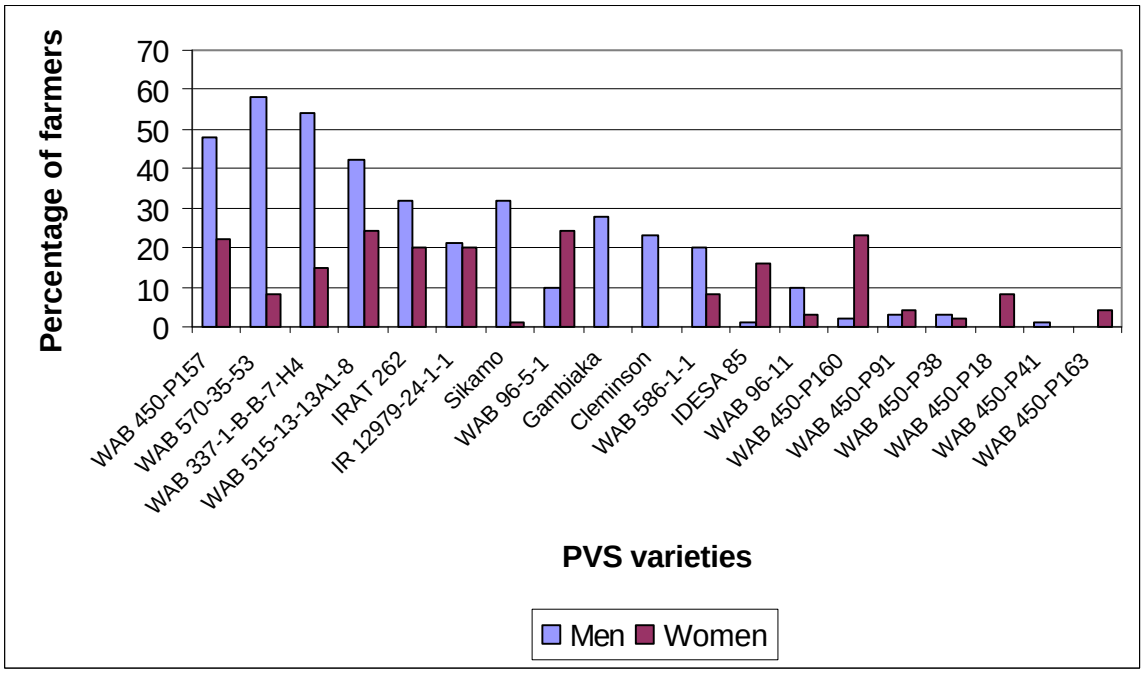


Figure 46. Percentage of male and female upland rice farmers who selected PVS varieties at harvest across 5 communities in Northern Ghana.

* Twenty one of the varieties which had very low selection rate were not included in

- Farmers have tested and accepted PVS varieties eg. IDSA 85 and IR 12979-24-1 named locally as *Idana and Digan (*meaning you will not be tired and it does not discriminate any ecology, respectively).

Table 83 Grain yields (kg/ha)of PVS rice varieties evaluated at multi location sites (Research mgt) and on-farm (in a mother and baby trials) in Northern Ghana

Variety	Multi-location trial mean yield	Mother trial		Baby trial		
		No. of farmers	Mean yield	No. of farmers	Mean yield	Yield range
IR 12979-24-1	3631	10	1832	119	1197	80-3000
WAB 337-B-B-7-H4	1893	10	1421	30	1168	0-4320
IDSA 85	2433	5	1393	18	1158	726-2160
Farmers variety	1008	10	920	167	671	0-1600

- Yield increase of more than 100% with PVS rice varieties over farmers variety have been recorded in most farms (Table 83)

- Farmers access to new rice varieties has improved

- The PVS varieties are selling for a premium (up to 2x normal price) in the Hohoe District.

- Local seed dealers are selling seeds of these varieties within 2 years of giving seed to farmers

- PVS varieties have moved more than 100 km from their original communities to new communities

- The approach was used to enhance the release of IR 12979-24-1, a variety for the hydromrphic ecology in 2002 in Northern Ghana.

7. 4 Important experiences

- Success of approach depends on
    - Availability of seed
    - Partnership with other stakeholders

- Needs assessment enhances farmer participation and effectiveness of the approach

- Concurrent multi location testing and on-farm testing (Mother & Maby trial) with farmer selected varieties is possible and should be the preferred approach for variety testing

- Concurrent evaluation has the potential of reducing variety testing time and should provide data needed for variety release

- Community led PVS is possible and enhances farmer participation

7.5 Conclusion

- PVS approach is an easier way to identify varieties preferred by farmers
- The approach improves farmer access to improved varieties
- Seed of farmer selected varieties are moving rapidly through informal channels
- Community Seed Production (CBSM) and Community Seed Bank (CSB) are two important informal ways to disseminate improved varieties

7.6 Way forward

1. Discuss project findings, conclusions and recommendations with targeted focus groups (donors, policy, NGOs, research etc)
2. Develop proposal to scale up the approach for submission to donors

7.7 Potential areas to scale up

- Scaling up the process through Informal Research and Development
  - Awareness creation among Scientists, Policy makers, NGO's and farmers
    - Focus group discussion
    - Mass media
    - Posters/fliers
    - Seed fairs
  - Identification of partners
  - Seed production and dissemination
    - Who? (public, private or NGO)
    - How? (CBSM, CSB, institutions etc)
  - Pre and Post harvest management to improve quality of local rice
    - Planting
    - Harvesting
    - Threshing

    - Parboiling
    - Processing
- Capacity building (researchers farmers, facilitators and NGO’s)
    - On the approach
    - Seed production
    - Post harvest management
- Promotion of approach in wider geographical coverage and more farmer coverage

Appendix

List of available documents containing Project data and information.

Document description	**Format**	**Source**
DFID Project 2001 Annual Report from SARI	WORD	SARI
DFID Project 2002 Annual Report from SARI	WORD	SARI
Report on Tolon PVS in 2000	WORD	SARI
Needs Assessment at Tambalug and Nyorigu, Upper East Region, 2002	WORD	SARI
Summary of DFID & Gatsby PVS Projects	WORD	SARI
Needs Assessment at Sayerano, Western Region, 2001	WORD	UoR
Report on Workshop on Participatory Crop Improvement, CRI, Kumasi	WORD	UoR
Final Survey Report, Volta Region, 2003	WORD	CRI
Report on seed uptake at Todzi, Volta Region	WORD	CRI
Report on PVS activities in Western Region	WORD	CRI
The spread and adoption of new upland rice varieties introduced through participatory varietal selection in Hohoe, Ghana	WORD	CRI
The role of participatory crop improvement for upland rice in Ghana. In: Breeding Rainfed Rice for Drought-prone Environments: Integrating Conventional and Participatory Plant Breeding in South and Southeast Asia (Eds. JR Witcombe, LB Parr & GN Atlin). Proceedings DFID Plant Sciences Research Programme/IRRI Conference, 12-15 March 2002, IRRI, Los Banos, Laguna, Philippines	WORD	UoR
Institutionalising participatory crop improvement in Ghana: a case study of upland rice. PRGA Meeting, Bouaké, Cote d'Ivoire April 2001	WORD	CRI
Proposal for the release of rice varieties	WORD	SARI