# THE SOCIAL CONSTRUCTION OF COWPEA VARIETY DEVELOPMENT IN GHANA: WHAT IS MISSING?

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**Abstract:** This paper investigates how cowpea variety development has been organized over the past 20 years in Ghana using the concept of "Relevant Social Groups" and suggests possibilities of reconstructing cowpea variety designs to meet market demand dynamics. To a large extent, small-scale farmers' interpretative meanings of what an improved cowpea should be, which are tied to their needs, are addressed in the varietal development process but the same cannot be said for traders, processors and consumers. We conclude that technology utilization informs new design and plays an integral part in constructing demand. Therefore cowpea breeding activities in Ghana should be organized not only around production but also around the dynamics in market demand. Structural constraints to participation among "Relevant Social Groups" with respect to resources, funding and power issues need to be addressed to ensure effective participatory varietal development.

**Keywords:** Cowpea, development, variety, social groups

## INTRODUCTION

### *Background*

Cowpea (*Vigna unguiculata* (L) Walp) is a major plant protein source in Sub-Sahara Africa. In Ghana, cowpea is largely cultivated by small-scale farmers in the Guinea Savannah and forest transition zones mostly in Upper West, Upper East and Northern regions for household food consumption and income. In Ghana, cowpea is processed into various food products such as *waakye (*prepared from rice and whole cowpeas) and *koose* (prepared by adding water to cowpea flour, whipped, shaped into balls and deep fried) for sale in both rural and urban areas (Madode *et al.* 2011, Philip *et al.* 2003).

Urban markets in Ghana are flooded with imported cowpea from the neighboring countries such as Togo, Niger, Burkina Faso and Nigeria (Quaye *et al.* 2011 and Langyintuo *et al.* 2003). Foreign cowpea is becoming more popular than the locally produced cowpea in the urban markets (Quaye *et al.* 2011). The consumers' choice of foreign cowpea varieties over locally improved varieties is largely informed by the desirable qualities of cowpea, and to a lesser extent by price, but not necessarily the origin. Desirable qualities of cowpea identified by traders, processors and consumers include cleanliness, weevil damage, seed colour (preferable white), cooking time, seed size, taste, dryness and place of origin in decreasing order of importance. Some of these quality issues (such as colour, susceptibility to pest and insect damage, seed size and taste) can be resolved through breeding. The challenge for cowpea variety development in Ghana is how to improve on the market competitiveness of locally bred varieties. Although a better understanding of traders, processors and consumers preference is essential for improving cowpea market competitiveness (Mishili *et al.* 2009, Mishili *et al.* 2007), equally important is how to effectively integrate such information into the varietal development process.

Given the above mentioned increasing likeness for foreign cowpea on urban markets, we investigate how cowpea breeding activities have been organized in the past 20 years (and present) in Ghana, and how such socio-technological processes respond to domestic market demands using the concept of *"Relevant Social Groups"* (RSGs).

***The concept of "Relevant Social Groups"***

The concept of "Relevant Social Groups" (RSGs) developed under Social Construction of Technology denotes institutions and organisations, as well as organised and unorganised groups of individuals who share the same set of meanings attached to a specific artefact (Pinch and Bijker, 1984, Pinch and Bijker1989, Law and Callon, 1992; Bijker 1995). The most basic RSGs in technology development process are the users and the producers of the technology, but most often many subgroups can be delineated – for example users with different socioeconomic status and competing producers. There are also RSGs who are neither users, nor producers of the technology such as donors, policy makers and the media. In deciding which problem is relevant, the social group concerned with the technology and the meanings those groups assign to the technology play a crucial role. A problem that a technology needs to address is defined as such only when there is a social group for which it constitutes a problem.

The RSGs can be distinguished based on their shared or diverging interpretations of the technology in question. The key requirement is that all members of the same relevant social group share the same set of meanings, attached to a particular technology (Pinch and Bijker, 1984). Once the social groups are identified, they are described in more details in order to define a better function of the technology with respect to each RSG in the technological development process. The relevancy of a social group is an important aspect for how a technology develops in respect of its content and applicability. A social group becomes relevant only when the technology being developed (or already developed) has any meaning at all for the members of the group under investigation. However, this does not preclude any insightful information that could be obtained from non-relevant social group in the technological development process when necessary.

Having identified the RSGs for a technology, the meanings of problem or potential solutions each group construct for the technology are then established. Around each problem, there are variants of solutions. Impliedly, opening up technology development process to a wider range of interest groups and their concerns could lead to a better technological outcome or redesign of a technology for greater compatibility. Different social groups have different interpretations of a technology, and these different interpretations in the technological development process indicate the interpretive flexibility of a technology. Basically there are several alternative solutions to any given problem and social groups make the final choice among several viable options of solutions. Again, the problem definition often changes in the course of finding solutions and technology is what it is in the hands of the user (Schmid 2006). The variability of solutions or goals in technology development has been termed by Pinch and Bijker (1987) as the "***interpretative flexibility***". Thus, there are as many technological artifacts as there are interpretations, and each RSG has their own interpretation of a particular technology.

The more homogeneous the meanings attributed to a particular technology the higher is the "***degree of stabilization"*** for the technology within and among different RSGs (Bijker, 1993). At the planning of technology development stage but also in the construction stage, some RSGs can embed specific social meanings in the material design of technologies. Thus, stabilization occurs at different points in the design process and among different RSGs as a function of this. An indicator for stabilization is when the interpretation used for a technology becomes, over time, more accepted among the RSGs. One may consider an idealized form of scientific development in which there is the emergence of a victory in the competition between alternatives; and one may even speak about "**closure"**, when groups reach a consensus in relation to the meaning of a technology or to its problem-solving capacity or when the RSGs agree upon a redefinition of a problem and the function of the technology in solving that problem.

Closure in the interpretation of a technology manifests itself when there is the endurance over a period of time of a simplified form of standard design value (for example, priority to high yields) which is no longer challenged by RSGs. Closure is not permanent, however, and flexibility in the design process may be reintroduced through changing circumstances and the formation of new RSGs introducing new meanings into the design of the technology. It is possible, therefore, to re-open stable codes, to break through the closure in the social meanings ascribed to a technology, for example by the development of new insights from groups previously not considered relevant or just not considered.

Regarding the cowpea variety development process under investigation, several exotic lines from international research organization are introduced in Ghana for further breeding, evaluation and selection in the local social environment. Various RSGs like cowpea farmers, traders, processors and consumers

socially construct cowpea variety differently as reflected in their peculiar varietal preferences (Quaye *et al.* 2009). In this paper, we try to find out how the social construction of variety development evolve, the power relations among RSGs in the wider social context within which variety development evolve.

***Data collection methods***

A retrospective view of the past cowpea breeding activities in Ghana was investigated through interviews, formal and informal discussions as well as review of project documents. In addition, the objectives of breeding set at the conceptualization stage, the roles and responsibilities of RSGs involved in the varietal development process were examined at the point of practice through participatory observation (Dewalt and Dewalt 1996 and Russel 2006). This is similar to technographic approach that focuses on technology-society interactions in technological systems and the involvement of social actors in such systems (Almekinders, 2011, Jansen and Vellema 2010, Zannou 2006). However, in addition to observing what actually happens during cowpea variety development, this research also searches for opportunities to open new spaces for re-constructing cowpea variety designs. Primarily, the methodology used in this research pays attention to reflections on social relevance of empirical findings and opportunities for improvement. Here, the emphasis is on the interpretation rather than representation of reality on the basis of data collected.

Data collection was done in three phases. The first phase involved interviews with a stratified random sampling of 86 actors including 60 farmers and 26 processors were in selected communities in the Tolon-Kumbungu district in Northern Region of Ghana (Quaye et al 2009). The second phase involved a market survey conducted in selected markets in Accra (Greater Accra Region) and Kumasi (Ashanti Region). A total of 80 traders and 75 consumers were systematically sampled for interviews (Quaye et al 2011). The third phase involved expert interviews with 30 international and local breeders and participant observation of on-going cowpea varietal breeding programs. This basically involved field observation of how cowpea varietal development is conducted at the breeding phase and participation in 5 workshops on varietal development and varietal release programs in Ghana. Literature review, internet search, review of policy briefs and other relevant documents were also conducted. The data collected in phase 3 reported in this paper largely involved qualitative descriptions, reflecting on information and data collected, and then revealing the socio-cultural assumptions in cowpea varietal development vis-à-vis interpretative meanings constructed for cowpea variety among the RSGs.

## EMPIRICAL FINDINGS AND DISCUSSIONS

Three key issues from empirical findings are presented for discussions. First, we present the difference in interpretative meanings of cowpea variety choice by RSGs in Ghana. Second, we show the activities involved in cowpea variety development and the extent of involvement of local RSGs in relation to the multiple and diverse interpretative meanings of cowpea variety among the RSGs in Ghana. Third, we explore the possibilities of expanding the cowpea variety development network to include more local RSGs for enhanced market access by small-holder farmers.

***Interpretative meanings underpinning variety choice by key "Relevant Social Groups"***

***At the production level*** -Three major categories of actors or groups were identified in the cowpea network understudied including technology developers, end-users and intermediary groups. In the category of technology developers, there were two RSGs including international and local breeders/researchers. In the end-user category, key RSGs included the farmers, traders, processors and consumers. Other RSGs in the cowpea network who were neither users, nor producers of the technology but could be termed as intermediary groups included donors, extension agents, administrators, government and non-governmental organizations working with farmers. Within each RSG, subgroups could be delineated according to the level of operation and social implications of cowpea within the specific context of operation.

We contend that cowpea variety is socially constructed and a range of social factors affect which choices are made from a variety of technological options. These social factors include local farming systems, processing and consumption practices, purpose of cultivation, local knowledge and autonomy in preservation of seeds of a particular variety. Technical factors like yield, tolerance to diseases and pests, seed colour and maturity largely influenced choice of an improved variety by farmers and technology developers. Below we highlight the interpretative meanings underpinning variety choice

by key RSGs including farmers, traders, processors and consumers at the production centre.

Small-scale farmers interviewed were willing to consider trade-offs among variety of options related to insect tolerance characteristics, early maturing varieties, low input requirements, self-pollinating seeds and high yields. For household food provisioning, it was observed that small-scale farmers were less interested in high crop yields than in a balance of high yield and environmental tolerance as well as cowpea taste for traditional dishes. Small-scale farmers cultivating local varieties explained that due to their high resistance to the harsh environmental changes and to diseases and pests there was no critical need for agro-chemical application which both had low cost implications and allowed the leaves to be used as vegetables in the local dishes.

Usually, farmers attached social importance to varietal choice depending on the purpose of cultivation, either for household food security reasons and/or for commercial purposes. Subsistence farmers had to ensure that family needs were met first, before thinking about what to sell. Yet within the subgroup of subsistence farmers, those practicing mixed farming - in terms of crop type and variety - used local varieties with domestic food security needs in mind and treated improved varieties more as a means to provide some financial income from production surpluses. Early maturing varieties were selected for household food provision during the hunger season, while white seed varieties were selected for their nutritional and market value. Small-scale farmers interviewed also considered autonomy in seed production in varietal choice as a means to preserve their biodiversity and a cultural legacy for the community. The extreme condition of resource limitation of small-scale farmers made the practice of seed saving more of a necessity. Thus, small-scale farmers preferred to produce their own seeds and to preserve strains both for later use as well as for posterity. Producing their own seeds was valued as a traditional role and practice that empowered them to manage their natural resources.

Cowpea processors and consumers interviewed interpreted cowpea variety differently from farmers and even within the processors and consumers groups there were subtle differences in cowpea varietal preference depending on type of food processed or consumed. For instance, processors of '*koose*' and '*tubani*[1]' considered good whipping ability in their varietal choice while those using cowpea for '*waakye*' and '*boiled beans*' selected for relatively short cooking time. Generally, processors and consumers at the production level preferred white seed colored cowpea varieties, short cooking time and tasty.

**At the market centre** - Consumers identified the desirable qualities that form the basis of their interpretative meanings assigned to cowpea variety preference to include cleanliness, weevil damage, seed colour (preferable white), short cooking time, seed size, taste, dryness and place of origin in decreasing order of importance. This order of ranking was quite similar to perceived consumer preference enumerated by traders. At the trader level, cleanliness (stone free and no dirt), colour (white seed colour), short cooking time, taste, size (big to medium), less weevil damage, dryness (well dried cowpea) and place of origin were ranked as preferred desirable qualities in decreasing order of importance.

From the above responses on cowpea preference, it was evident that place of origin or source of cowpea on the Ghanaian market was not too relevant in the interpretative meanings assigned to what a preferred cowpea variety (technology) is, but rather the desirable qualities associated with a particular cowpea variety. The issue of cleanliness which is also related to post harvest handling of cowpea can be tackled through breeding cowpea varieties with high storability and less susceptibility to insect damage since some varieties store better and thus easier to clean. Foreign cowpea was considered cleaner than locally bred cowpea because of the relatively high content of stones and foreign materials in the latter. It was also evident that traders make decisions for their convenience based on their understanding of consumer needs and wants.

Table 1 shows some of the improved varieties that had been released in Ghana, their seed colouration, maturity and potential yields. Half of the locally improved cowpea varieties had off-white seed colour although the market preference was for white cowpea seed colour (Quaye *et al* 2011). With the observed differences in cowpea variety choice among RSGs, the obvious problem is how to connect production-consumption preferences in the cowpea varietal development process in Ghana. Next we investigate how cowpea varieties were developed in Ghana, the RSGs involved and possibilities for enhanced market access by small-holder farmers through the development of market driven varieties.

[1] *Tubani* is steamed cowpea flour

**Table 1: Characteristics of improved cowpea varieties recommended for planting in Ghana**

| Variety | Seed color | Days to maturity | Grain Yield (t/ha) |
|---|---|---|---|
| Asetenapa | Cream | 63-70 | 2.5 |
| Adom | Dark red | 66-72 | 2.5 |
| Ayiyi | White | 65-70 | 2.0 |
| Asontem | Light red | 60-65 | 2.0 |
| Bengpla | White | 62-67 | 1.8 |
| Soronko | Brown | 70-80 | 2.5 |
| Boafo | Red | 75-85 | 1.2 |
| Akpaagbala | White | 65-70 | 1.8 |
| Marfo-Tuya | Cream | 65-70 | 2.0 |
| Vallenga | Light red | 60-65 | 2.2 |

**Source: Food Crops Development Project, 2005**

***Cowpea variety development and the extent of involvement of local RSGs***

We categorize cowpea breeding activities in Ghana during the twenty-year period under review (1990-2010) into three distinct phases (1) The up-stream breeding phase, organized by international researchers with limited local inputs; (2) The down-stream breeding phase, organized by local researchers in collaboration with international researchers and the participation of local stakeholders; and (3) The validation and release phase, organized by local researchers and stakeholders (Fig.1).

**Up-stream breeding phase**

*Variety development objectives* - Up-stream breeding activities took place at the international breeding centres where conceptualization of variety development programs was initiated. At this up-stream breeding phase, the international breeding centers set the broad breeding objectives, sometimes with inputs from the National Agricultural Research System (NARS), and influenced decision making as well as the kind of results and data required at the down-stream breeding phase through breeding standards and procedures. Up-stream breeding objectives may include production gains, biodiversity enhancement, effective targeting of user needs, cost-effectiveness or community empowerment depending on the project type. Nevertheless, majority of the varietal development projects implemented in Ghana during the period under review were designed mainly with productivity increase and pest & disease resistance objectives. These broad breeding objectives were refined later in down-stream breeding to suit specific bio-social environment.

***Key activities*** - At this phase, germpalsm were collected from several countries including Ghana for advanced laboratory-based breeding work aimed at the development of improved variety designs with specific technical and social functionalities. The development of improved cowpea variety designs at the up-stream international breeding centers were driven by socially desirable and technical specifications for realizing specific goals such as increased yields, increased incomes and enhanced food security. The breeders at the international research organisations came up with several variety designs or exotic lines for further development at the breeding phase down-stream. A lot of genetic engineering and manipulation took place in the variety design space upstream. For example, International Institute for Tropical Agriculture (IITA) has a rich genebank that holds germplasm and wild accessions, containing cowpea genotypes collected over 100 countries that show wide variation of trait characteristics. Some of these trait characteristics include plant pigmentation, plant type, plant height, leaf type, photosensitivity, maturity, nitrogen fixation, fodder quality, heat and drought resistance, grain quality, disease resistance, root-knot nematodes, aphids, bruchids, thrips and parasitic weeds. Over the years, IITA scientists/breeders have tried to add genes for pests' resistance into improved cowpea breeding lines as well as selected varieties as recurrent parents for subsequent breeding activities down-stream in various countries in the sub-region including Ghana. The improved exotic lines were mostly breeding materials requiring selection and evaluation for local adaptation, and were therefore distributed for further breeding work in collaborating research institutions in the sub-region including Ghana.

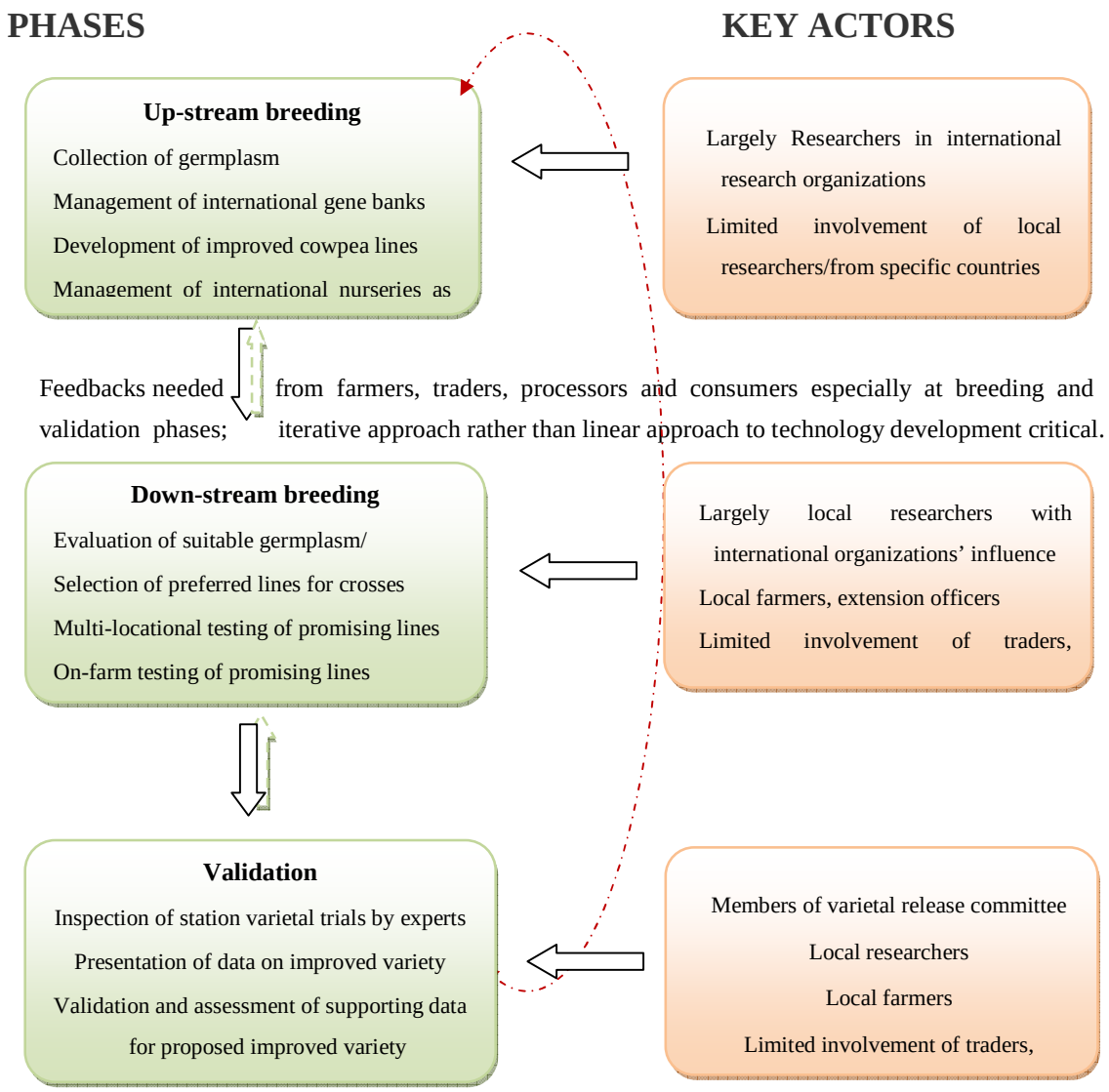


**Fig. 1: Diagrammatic representation of phases and actors involved in cowpea breeding in Ghana**

***Involvement of local RSGs*** - At this up-stream breeding phase, the involvement of local researchers was limited to the collection of germplasm from local farmers for the international gene bank, selection of sites for Cowpea International Trials (CITs) and management of CITs in collaboration with international breeders, according to internationally set standards and procedures that allowed for comparison of field results across countries. The CITs aimed to evaluate advanced breeding lines from IITA in various countries, allowing local scientists to select with farmers superior lines that were adaptable to local conditions at the down-stream breeding phase. Local farmers played a passive role in the up-stream breeding although they provided the germplasm needed for the variety development. Farmer participation at this stage could best be described as consultative, as in giving local germpalsm from a distance and not collaborative or task sharing (Sperling *et al.* 2001). The germplasm was de-contextualized from the Ghanaian context, and then used for the development of exotic lines inscribed in them specific technical specifications and social goals usually constructed by the international breeders. At this stage, the international breeders made a representation in respect of what other local RSGs notably, traders, processors and consumers want in an improved cowpea variety.

***Degree of interpretative and design flexibility*** - A lot of genetic engineering and manipulation took place in the variety design space upstream. Here, the international breeders were confronted with different variety designs that showed wide variation of cowpea trait characteristics for selection towards specific technical and social goals. The wide range of variety design options for further selection down-stream depict high degree of interpretative and design flexibility in the variety development process at this stage, which diminished as competition between alternatives was sorted out downstream and finally closure was achieved in the form of standard design at the validation phase which will be discussed later in this paper (Bijker 1993).

**Down-stream breeding phase**

This is the stage at which cowpea variety designs or exotic lines developed at the up-stream breeding phase are integrated back into a natural and social environment in Ghana. These improved cowpea designs or exotic lines were developed with socio-cultural and technical assumptions as well as the criteria for selection between several variety designs options made available downstream.

***Firming up variety development objectives and key activities*** - Prioritization of breeding objectives led by the international researchers were firmed up at the down-stream breeding phase through participatory stakeholder meetings and annual workshops involving mostly researchers, farmers, extensionists and Non-Governmental Organizations (NGOs) working with farmer groups. Commonly targeted traits at the CITs included yield potential, tolerance or resistance to major biotic and abiotic stresses, early maturity and food quality. Specific breeding objectives included adequate yields when cowpea varieties are unprotected from insects, extra-early maturity to allow a minimum of two crops during the growing season, resistance to *Striga generioides*, tolerance to mid-season and terminal droughts, and improved crop quality for fodder and grain characteristics.

Cowpea breeding programs in Ghana during the period under review focused on urgent needs and requirements for crop yield increases, resistance to pests and diseases and stress tolerance. These were the meanings constructed for improved cowpea variety largely by technology developers, and to some extent, by farmers participating in breeding activities. At the down-stream breeding phase, exotic lines were evaluated and the promising lines selected for on-farm testing. As shown in Table 2, activities conducted at the breeding phase include preliminary evaluation of suitable germplasm /exotic lines, evaluation and selection of varieties, multi-location testing of promising lines selected from cowpea station variety trials, pre-release seed multiplication and breeder seed multiplication of recommended varieties.

Decision on which improved cowpea variety get selected among the wide range of design options (presented by the technology developers) is made by local researchers with farmers. This was done in participatory varietal selection or participatory plant breeding depending on the extent of farmers' involvement.

**Table 2. Roles of Relevant Social Groups (RSGs) and Power Relations in cowpea breeding (Study period 1990-2010)**

| Study Period/Project | Roles of RSGs, their Power Relations and other emerging trends in Down-stream breeding |
|---|---|
| **1990-1996**<br>**Ghana Grains Development Project** | The following key observations can be deduced from the breeding documents:<br>(i) International breeders provide variety designs in the form of exotic lines that have explicit technical specifications such as high yields, early maturing and disease/pest resistance. However, variety designs also have implicit social meanings such as changes needed in social organization of production and cost implications with external input requirements when using improved varieties.<br>(ii) Specific breeding activities were conducted by local researchers with farmers and extension agents. But these breeding activities were highly controlled by international breeders from a distance through set rules and regulations as forms of domination over local RSGs.<br>(iii) No distinction was made with respect to types of farmers (commercial and subsistence) and their specific varietal needs in setting breeding objectives.<br>(iv) No involvement of cowpea traders, processors and consumers.<br>(v) Impact assessment of improved cowpea varieties developed under the Grains Development Project was limited to farmers ( Dankyi *et al* 2006). Less attention was paid to the performance of improved varieties at the domestic market level. |
| **1998**<br>**National Agricultural Research Project (NARP)** | (i) Breeding objectives almost the same as specified in 1990-1996.<br>(ii) International breeders still played the dominant role in supplying already developed exotic lines and controlling breeding activities from a distance through rules and regulations.<br>(iii) Local breeders, farmers and extension officers involved in evaluation and selection of variety designs. Selection driven mostly by the technical functionality of high yielding and early maturing varieties in relation to the bio-environment in Ghana.<br>(iv) Again, No distinction made with respect to types of farmers and their specific varietal needs.<br>(v) Consumer preferences were not fully integrated into breeding objectives |
| **2000**<br>**National Agricultural Research Project** | (i) Breeding objectives basically remained the same as specified in 1990-1998.<br>(ii) Slight improvement in the development of cowpea variety designs with local breeders' involvement in genetic improvement. However, local capacity strengthening needed for such research.<br>(iii) Farmers' involvement still limited to provision of local germplasm for up-stream breeding. In down-stream breeding, farmers' roles limited to evaluation and selection of variety designs.<br>(iv) Acceptable seed characteristics mentioned in the objectives but not specified in the key activities conducted. |
| **2002-2003**<br>**Cowpea Improvement Program in Savanna Agricultural Research Institute (SARI) under Food Crops Development Project** | (i) Slight change in the breeding objectives to include market value of cowpea varieties. However, traders, processors and consumers were not involved in the breeding process. Farmers were assumed to be consumers as well.<br>(ii) Role of international breeders the same over the years (i.e. developing exotic lines for further breeding work downstream and controlling the process from a distance).<br>(iii) Farmers' role in breeding remained unchanged.<br>(iv) Although breeding for market no distinction was made with the type of farmers involved in breeding activities. |
| **2005-2008**<br>**Savanna Agricultural Research Institute (SARI) Varietal Protocol submitted to the National Varietal Release Committee (NVRC)under the Challenge Program on Water and Food PN6** | (i) Breeding work specifically targeted subsistence farmers in the Northern Region.<br>(ii) Improved cowpea varieties with specific food uses specified (*koose*, *waakye* and *tubani)*.<br>(iii) Roles of international breeders, local breeders and farmers remained unchanged.<br>(iv) Farmers involved in Agronomic performance assessment through on-station and on-farm trails.<br>(v) National Varietal Release Committee (NVRC) inspects on-station and on-farm trails to check varietal release requirements. However, varietal release requirements set against internationally acceptable standards. Thus, even varietal release is somehow controlled from a distance. |
| **2010**<br>**Sensitization workshop on participatory varietal development** | (i) Stakeholders informed about objectives of the new project which had already been set by international breeders.<br>(ii) Breeding work targeted small-scale producers with emphasis on income generation and utilization of cowpea. However, traders, processors and consumers were not involved in sensitization of participatory varietal development. Here, emphasis was placed on farmer preference and not consumer preference because farmers were wrongly assumed to be representatives of all categories of consumers. |

**Involvement of local RSGs**

Most of the breeding activities during the period under review were conducted by local researchers (breeders) with farmers and other clients such as extension agents mainly through conventional breeding and participatory varietal selection (PVS) techniques. In some cases, molecular tools were used to assess the genetic diversity of released and elite lines (Asare *et al*. 2010, Adu-Dapaah *et al.* 2008). Farmers' roles and contributions to the practical breeding process were identified through field observations and analysis of documentation and reports on past breeding activities. Findings show that farmers provided social organisation especially breeding projects working with farmer groups at the community level, supplied inputs such as labour and land for the breeding work, shared indigenous knowledge on breeding and gave information on their varietal preferences and the trade-offs they were willing to accommodate among traits (e.g. yield, maturity, resistance levels). Farmers assisted in the selection of traits among competing options at this stage largely based on their experiences (Table 2).

Multi-location testing of newly developed varieties from station varietal trails was conducted under sole and additive series intercropping conditions at benchmark sites or locations for evaluation based on general adaptation to bio-physical conditions. Here, involvement of local researchers, extension officers and farmers was crucial. Adaptive trials were conducted both on-station and on-farm, with relatively strong farmer participation to ensure that proposed improved variety selected by farmers among varied variety design options addressed their interests and constraints. Farmers, subsequently, co-selected improved cowpea variety with local researchers. In most situations, farmers were perceived as a homogenous group although there were different types of farmers. For example, subsistence farmers had different interests from commercial farmers which were reflected in their cowpea variety choices. Impliedly, involving different types of farmers will certainly influence the potential outcome and impact of breeding efforts in terms of farmer type and adoption.

Again, as will be discussed later, adoption of improved variety by farmers did not necessarily connote high consumer acceptability or domestic market competiveness. Unfortunately, there was less involvement of other end-user groups such as traders, processors and consumers who were custodians of market level information relating to variety performance on the market in the down-stream breeding phase. At this stage the "*interpretative flexibility"* in variety designs gradually diminishes as the differences in variety meanings among RSGs involved in the variety development process were resolved, when a decision was reached on which improved cowpea variety should be considered for release.

**Validation and Variety Release Phase**

In Ghana, a National Varietal Release Committee (NVRC) funded by the government through Ministry of Food and Agriculture - Crops Services Division, was in charge of validation and variety release. Although the NVRC was an independent body internationally acknowledged standards for varietal release were adhered to.

*Key activities and varietal release requirement* - Before a proposed improved variety was considered for "release" two major inspections were conducted including station varietal trials and testing in farmers' fields. This involved field trips to sites or farms, taking of measurements, evaluation of yields, investigation of time of maturity, and inspection by a team of crop protectionists on planting material before multiplication for distribution to farmers. When a proposed improved variety submission was made, the breeder provided a minimum of two years of on-station and on-farm data to support the claim of superiority of new variety over existing ones. Data required for varietal release consideration included physiochemical analysis and morphological characterization of the proposed new variety, on station and on farm testing as well as sensory evaluation of farmer/consumer preferences. Others were economic analysis and environmental impact assessment. The breeder was also required to provide an appropriate name for the proposed new variety. The breeder established a breeders' seed plot which the varietal release committee visited at least twice, preferably at late vegetative or flowering and maturity stages. These visits enabled the NVRC to become familiar with the new variety and also to ensure that the descriptions or characteristics provided by the breeder fitted the variety. Selection of improved varieties for release considerations were based on Distinctiveness, Uniformity and Stability (DUS) principle. Stability in performance for grain yield and other superior qualities across sites and locations and distinctiveness from existing improved varieties (Gibson 2009).

**Table 3: Some stakeholders' views on participation of traders, processors and consumers in breeding**

| Relevant..? Necessary..? Possible..? | |
|---|---|
| *The traders and consumers are not represented on the varietal release committee. The assumption is that farmers usually grow what traders and consumers want. Farmer representation therefore takes care of consumers and traders needs…*<br><br>(code 19, 2010: Member of National Varietal Release Committee)<br><br>*…Conventional breeding work has been on Maruca pod borer pest. Breeding can take as long as 5 years. Varieties are released and there is a problem with marketing because most of the varieties are from IITA and are brought for farmer field trails and selection. Basically suitability to ecology and yield testing has been the focus. The current IITA breeding program does not include some of the popular varieties on the market. We need also traders and consumer views in selection trials. Some farmers have gone ahead to cultivate the foreign varieties but were not successful…*<br><br>(code 4, 2009: **Officer,** Ministry of Food and Agriculture)<br><br>*As a breeder, you are supposed to know what you want to breed for. In other words a breeder should know what both farmers and consumers want. Through earlier association with MOFA, farmer and consumer requirements are known. Currently, the procedure for finding out consumer requirements is weak. There used to be an annual cropping conference where feedbacks on breeding activities were obtained from extension staff.*<br><br>(Code 18: **Breeder, Crops Research Institute-Ghana**<br>& Code 20: **Crop Scientist, retired lecturer University of Ghana)** | *Well the question on whether consumers concerns are addressed in participatory breeding I will say yes. However, our breeding work has not been fully participatory due to financial constraints. Participatory breeding is very expensive and becomes more expensive if you want to fully involve traders, processors and consumers…*<br><br>(code 13, 2010: Breeder, Savanna Agricultural Research Institute-Ghana)<br><br>*Involvement of traders and consumers in participatory breeding is ideal but this group cannot be involved at the beginning. It is highly technical at the initial stages. However I believe gradually the extent of participation of traders and consumers in breeding activities will increase. Formerly breeding was highly focused on yield but now we look at market performance as well especially with rice where you need test marketing of improved varieties…*<br><br>(code 17, 2010: **Agronomist, Crops Research Institute-Ghana)**<br><br>*…As of now most breeding activities see the farmers as consumers. The consumer is does generalized as compared to breeding in developed country where farmers may just produce for the market with limited consideration to household consumption. Farmers in developing countries mostly produce what they consume. However what farmers want as consumers may be different from what the market demands. Too much emphasis is placed on production. The words 'participatory breeding' have been somehow abused. Sometimes people refer to participatory varietal selection as participatory breeding. Market influence in breeding activities is weak. Breeding for commercial purposes must start with a market survey. What informs consumer choices?*<br><br>(*code 15*: **Breeder- lecturer University of Ghana**) |

On the day of release, the 'breeding team' presented relevant data supporting the proposed varietal release to the public (i.e. stakeholders invited for the release programme). Afterwards, the varietal release committee pronounced a communiqué on varieties released to be included in national variety register when satisfied with all submissions. At this point, closure in interpretative and design flexibility could be said to have occurred rhetorically as the NVRC perceived the improved variety as a solution to a breeding problem identified at the conceptualization stage (Pinch and Bijker 1984, Cleveland 2001 and Clayton 2002). Nevertheless, the closure in interpretative and design flexibility in the variety development process was temporary because of the following reasons among others.

(1) Once an improved variety was selected and the NVRC confirmed that a proposed new improved variety was an improvement over existing varieties (distinct, stable and uniform), individual farmers had to decide to adopt or reject the improved variety according to their own further interpretations and experiences about the improved cowpea variety.

(2) An improved cowpea variety had to go through another level of social construction of interpretative meanings among RSGs at the market level. Farmers could adopt and produce an improved cowpea variety, but the market performance of this improved variety had to be decided by other end-users, notably traders, processors and consumers.

Representation of the National Varietal Release Committee (NVRC) excluded traders, processors and consumers who were key end-users of released varieties. The ultimate goal of varietal release process was more oriented towards farmer satisfaction and adoption of high yielding, insect pest and disease tolerance variety. Interviews with key informants on the need to include market and consumer levels representatives attracted diverse reactions. While some actors assumed that farmers grew what traders and consumers wanted hence farmer representation took care of consumers and traders needs, others supported all inclusive representation.

Some impressions on the composition of NVRC expressed by key informants are indicated below;

…On the varietal release committee, my own impression is that it is not well represented and has to be properly constituted. Currently we have a situation where the breeders are their own judges. The breeders have so much influence because they present the methodology and their results without having them re-checked. The committee is not well resourced to effectively evaluate the work of the breeders. We do not have well-documented register for varieties that have been released; such an important resource for future breeding work. We need to develop a prescribed format to store this kind of formation… (Code 20, 2010; retired crop scientist and an eminent scientist on National Varietal Release Committee).

…Currently the guidelines for breeding and varietal release are under review. The idea is to harmonize breeding and varietal release in the sub-region. There will be an independent body to conduct evaluation for varietal release. I think the varietal release committee is not well resourced to do their job effectively. Inspections are done at the invitation of breeders. Hence the breeders show what they want the varietal release committee to see… (Code 21, 2010; breeder Savanna Agricultural Institute, Ghana).

…The traders and consumers are not represented on the varietal release committee. The assumption is that farmers usually grow what traders and consumers want. Farmer representation therefore takes care of consumers and traders needs… (Code 19, 2010; member National Varietal Release Committee).

The impressions on the NVRC expressed above indicate the need to improve upon the efficiency of the committee, in terms of representation of relevant social actors or the composition, resources and autonomy of operation. At the time of interviews, an international breeding organization was reviewing the guidelines for breeding and varietal release. The purpose of the review was to harmonize breeding and varietal release in the sub-region.

There were tensions among local researchers (Table 3) regarding the involvement of traders, processors and consumers in varietal development.

Although some found the idea of widening the range of RSGs participating in varietal development to be a positive contribution for social construction of an improved variety, others did not. Some researchers considered the involvement of traders, processors and consumers in cowpea breeding as relevant but impossible due to practical limitations in terms of funding, technicality of breeding and time constraints, on one hand. On the other hand, some researchers saw breeding as too technical and unlikely to attract the attention of traders, processors and consumers. Some viewed small-scale farmers in Ghana as consumers and therefore were in a position to supply all the relevant information pertaining to consumers' choice of an improved variety. Cowpea

varietal preference information obtained from farmers needed to be cross-checked through sustained interactions with the various categories of traders, processors and consumers. The complexities about the mismatch between the demand of urban consumers and farmers supply of cowpea characteristics (Quaye *et al.* 2011), such as possible benefits from importation by traders was appreciated. However, the social implications for cowpea varietal development at the national level could not be overlooked. For some cowpea breeders, results obtained from sensory analysis were considered adequate for eliciting consumer preferences and informing varietal release decisions; thus sensory analysis was deemed as standard practice.

***Possibilities of expanding the cowpea variety development network to include more local RSGs***

We argue for opening up the current cowpea breeding network to include other RSGs, notably cowpea traders, processors and consumers. Improved cowpea varieties that are more local market responsive can be bred by strengthening participation of farmers and inclusion of cowpea traders, processors and consumers in the cowpea breeding network. There are three major dimensions of participation namely, stage of participation, degree of participation and roles of actors in participation (Sperling *et al.* 2001). With respect to stage of participation, not only cowpea farmers but cowpea traders, processors and consumers should participate in the decision-making process from conceptualization to implementation of breeding activities. That is, setting of breeding targets, generating variation through crossing or collections, selecting in segregating populations, variety testing and characterization. With respect to degree of participation, cowpea farmers, traders, processors and consumers should be co-researchers involved in collaboration, task sharing and all consultations relating to breeding activities. These RSGs should be given management roles including provision of social organization leadership, information-giving roles particularly on preferences and local knowledge on breeding, selection and evaluation as well as supply of inputs such as labour, land and germplasm collection in the varietal development process.

Widening the range of RSGs participating in cowpea varietal development to include active participation of not only cowpea farmers but also cowpea traders, processors and consumers may require a lot of money and time, but not involving these RSGs is much more expensive and poses serious threats to breeding efforts. Martin and Sherington (1997) have commented on the high cost involved in participatory plant breeding (PPB), especially in developing countries where breeding efforts are meant to target resource-poor farmers who are widely spread in marginalized and difficult to reach areas. This notwithstanding, the need to conduct participatory plant breeding that is informed by needs of technology users has become critical. This paper supports the social relevance of the roles farmers, traders, processors and consumers play in cowpea varietal development. From the on-going discussions, breeders understood the need to fully involve farmers, but involving other RSGs notably traders, processors and consumers in breeding activities was quite problematic.

We outline some possibilities of involving traders, processors and consumers in breeding activities as follows:

(1) Elicit the views of traders, processors and consumers through informal market surveys from the initial stage of setting the breeding objectives through to the final stage of release. Participatory appraisal methods using semi-structures interviews at various market centers could be employed regularly to keep pace with changing end-user preferences and the dynamics in market demand.

(2) Conduct consumer acceptance test of grains of proposed improved varieties as against varieties on the market, both locally improved and foreign varieties. Grain acceptability test should not just be limited to varieties at the production or farm level, but also include varieties found at the market level for better indication of market competitiveness of proposed improved varieties. Samples of improved varieties could be given to traders to evaluate against varieties found on the market. This approach should complement sensory evaluation which focuses on acceptability of cooked food products from cowpea varieties. Sensory evaluation investigates subjective traits like taste, aroma, appearance, texture and other characteristics that determine the suitability of a particular variety for culinary use (Morris and Bellon 2004).

(3) Consumer preferences should be obtained from traders, processors and consumers themselves throughout the breeding processes. This is useful for gauging market performance and competitiveness of proposed improved varieties, and gives society (market) the opportunity to shape and reshape variety (technology) through regular feedback mechanisms.

(4) The NVRC should be adequately resourced to work effectively and to ensure that societal needs are adequately captured in breeding. Representatives of

traders, processors and consumers should be included in the NVRC.

(5) Research institutions should incorporate budgetary allocation for partnering with all relevant local stakeholders.

## CONCLUSIONS

Using the case of cowpea varietal development process, this paper has shown that social needs of cowpea farmers and other end-users including local traders, processors and consumers should play an integral role in constructing demand for improved varieties. Technology utilization is an integral part of the social construction of technology not only that it informs new design, but also, plays a part in constructing demand. Cowpea breeding interventions in Ghana tend to concentrate heavily on technical issues like yield, time of maturity, stress tolerance, disease resistance and acceptable seed characteristics. However, technology development and more specifically varietal development is not just limited to technical issues but also social contextualities and therefore requires the active participation of all relevant stakeholders to bring their interests and priorities to bear in varietal development.

We argue that varietal development is an iterative process that requires the participation of all interested local stakeholders or as SCOT points out the differences among RSGs should be brought to bear in developing technically efficient and socially desirable cowpea varieties. Where certain critical RSGs are not engaged in the process, the technology development may not be completely successful (Winner, 1985 and Winner 1993). What is missing in the cowpea breeding system in Ghana is the focus on structural and power issues among actors that limits the level of involvement of others in the cowpea value chain.

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