Adoption of improved cowpea (*Vigna unguiculata* (L.) Walp) technologies in Ghana

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ABSTRACT

The Ghana Grains Development Project has developed and disseminated improved cowpea production technologies to farmers in Ghana since 1985. These technologies were improved varieties, row planting, and the use of pre- and post-flowering insecticides. To assess the extent of adoption of these technologies by farmers, eight cowpea production districts were surveyed across four agro-ecological zones in 1995 in Ghana. A random sample of 313 cowpea farmers participated in the survey. Results indicated that 70 per cent used recommended pre-flowering insecticides, and 26 per cent adopted post-flowering insecticides across the ecological zones. The highest adoption rate for improved varieties was observed in the Forest Zone (97 %). The adoption of row planting was highest in the Forest Zone (100 %), followed by the Guinea Savanna Zone (92 %), and lowest in the Coastal Savanna Zone (58 %). Most farmers agreed that by adopting improved production technologies, their yields and overall production increased, and they made more profit from cowpea cultivation.The whole family participates in various activities associated with cowpea production. However, men do strenuous work like land preparation, weeding and spraying of insecticides, while women and children participate in less strenuous work such as planting, harvesting and threshing.

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RÉSUMÉ

DANKYI, A. A., ASAFO-ADJEI, B., HOSSAIN, M. A., DASHIELL, B. K., ADU-DAPAAH, H. K. & ANCHIRINAH, V.: *Adoption des technologies de dolique (*Vigna unguiculata *(L.) Walp) amélioré au Ghana.* Le Project de Développement des Grains du Ghana a developpé et disséminé les technologies de la production de dolique amélioré aux cultivateurs au Ghana depuis 1985. Ces technologies étaient les variétés améliorées, la culture en lignes et usage d'insecticides avant et après la floraison. Pour évaluer le degré d'adoption de ces technologies par les cultivateurs, un sondage a été entrepris en 1995 en 8 districts de production de dolique à travers quatre zones agro-écologique au Ghana. Un échantillon pris au hasard de 313 cultivateurs de dolique participaient au sondage. Les résultats indiquaient que 70% utilisaient les insecticides d'avant floraison recommandés et 26% adoptaient les insecticides d'après floraison à travers les zones écologiques. La proportion d'adoption la plus élevée pour les variétés améliorées était observée dans la zone forestière (97 %). L'adoption de la culture en lignes est la plus élevée dans la zone forestière (100 %) et suivi par la zone savane-guinéenne (92 %) et la plus faible dans la zone savane-littorale (58 %). La plupart de cultivateurs étaient du même avis que par l'adoption des technologies de production améliorée, leur rendements et la production globale augmentaient, et ils avaient tiré plus de bénéfice de la production de dolique. Toute la famille participent aux activités différentes liées à la production de dolique. Cependant le travail ardu tel que la préparation de terre, le désherbage et la pulvérisation d'insecticide sont faites par les hommes alors que les femmes et les enfants participent aux travaux moins ardus tels que la plantation, la moisson et la battage.

Introduction

Cowpea is the second most important grain legume in Ghana, for production and consumption. It is a cheap source of high quality protein and also features prominently in the farming systems, especially in the Savanna zones where the soils are poor and cowpea's nitrogen-fixing properties are crucial for restoring and

maintaining soil fertility and, hence, more sustainable crop production.

Before 1980, cowpea received little research attention, and the total national production was low, estimated at 17,000 MT from about 10,000 ha in 1980 (MOA, 1991). At stakeholders' (Farmers, Research, Extension, NGOs) planning meetings held regularly since 1980 (GGDP 1983-95), several reasons were adduced for the low cowpea production in the country. The top three production constraints identified were lack of improved varieties and low yield potential of local varieties, insect pest damage, and low plant populations. Others were diseases and socio-economic constraints such as lack of inputs (insecticides, spraying machines) and access to credit, and marketing problems.

Between 1980 and 1997, the governments of Ghana and Canada provided funds to support research and development activities on maize and cowpea production in Ghana under the Ghana Grains Development Project (GGDP). The primary aim of the GGDP was to develop and disseminate production technologies targeted at addressing production constraints of maize and cowpea, and thereby improve farmers' productivity and national production to self-sufficiency levels.

By 1992, improved technologies on cowpea production, with 5 to 10 times potential yield advantage over those under farmers' practices, had been developed and disseminated to cowpea farmers in the major agro-ecological zones, using farmers' participatory methods. Several cowpea farmers who participated in the on-farm testing, validation and demonstrations of the improved technologies switched from their traditional to the improved production technologies. Most farmers, especially those in southern Ghana, who plant at random in mixed cropping systems did not only adopt the improved varieties, but also planted in rows under sole cropping and controlled insect pests by spraying recommended insecticides.

These observations notwithstanding, documentary evidence was needed on the level of adoption of the cowpea technologies that were disseminated to farmers, and also farmers' perception of the new technologies. The objectives of this study were, therefore, to assess the extent of use of improved cowpea varieties and crop management technologies (insect control with insecticides and row planting to enhance plant population) that had been developed and disseminated by the GGDP and its partners, to document farmers' perception of the effects of the technologies on their productivity and income, and to examine gender roles in cowpea cultivation.

Materials and methods

The survey area

Eight agricultural districts in Ghana were surveyed between December 1994 and January 1995. These were Apam and Sogakope Districts representing Coastal Savanna ecological zone, Atwima District (Forest), Wenchi, Ejura, Atebubu, and Somanya Districts (Transition), and Wa and Nadowli Districts (Guinea Savanna). These agricultural districts were selected because they represented areas of intensive or extensive cultivation of cowpea in Ghana (Fig. 1).

The sample

A complete list of all villages in each of the eight districts was prepared, and five villages were randomly selected from each district. In each selected village, a list of all cowpea farmers was prepared and eight farmers were again randomly selected. The sample size was 40 farmers per district. Therefore, the expected total sample size for the eight districts was 320. However, seven uncompleted questionnaires were discarded, leaving a total sample size of 313 farmers.

Male farmers constituted about 80 per cent of the sample and females, 20 per cent. The same pattern was observed in a previous survey in the Transition and Coastal savanna zones in 1991 where only 18.5 per cent of the sample were female farmers (Dankyi & Dakura, 1993). About 75 per

cent of farmers surveyed were natives, and remaining 25 per cent were settler farmers.

Cropping season

The cropping season in Ghana is defined by rainfall distribution. The southern half comprising the Forest, Coastal Savanna and the Forest-savanna Transition ecological zones has bi-modal rainfall distribution. The major rainy season spans March to April to July, while the minor season spans September to November. Cowpea farmers in southern Ghana can, therefore, plant in either or both seasons. Most farmers, however, plant in the minor season, ensuring that their crop matures at the end of the rains for good quality seeds or grains to be harvested. Northern Ghana has one long rainy season, which starts in May/June and ends in October/November. Early maturing cowpea may be planted early (late May/early June) for an early crop to fill the "hunger gap". The main crop is usually planted late July to mid-August, depending on maturity of the variety, and harvested at the end of the rains. In the target survey area, 89 per cent of the farmers cultivated cowpea from July to November.

Technologies

Three technologies were assessed in this survey:

1) *Improved varieties* (Table 1). The recommended cowpea varieties were early

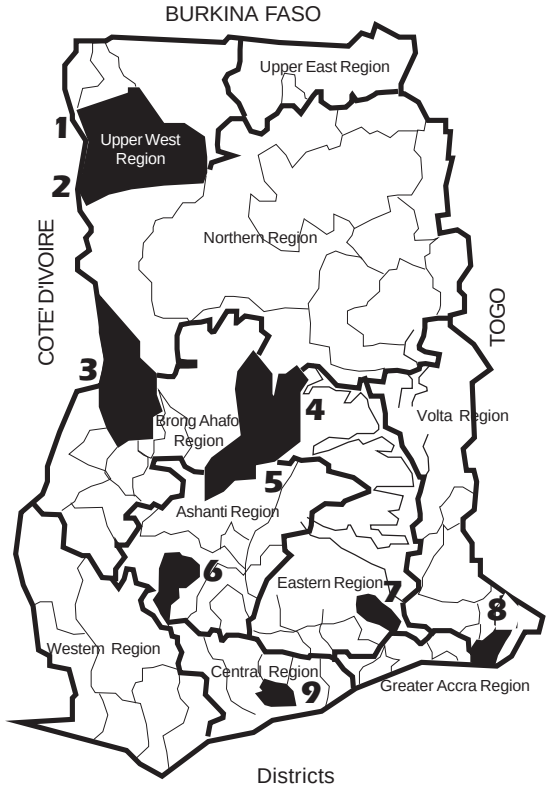

Fig. 1. Regional and district boundaries of Ghana showing the selected districts in the cowpea survey, 1995.

TABLE 1

Recommended Improved Cowpea Varieties in Ghana as at 1994

Variety	*Year released*	*Germplasm source*	*Maturity group*	*Seed colour*	*Potential yield kg ha^{-1}*
Boafo	1982/83	IITA	Medium	Reddish-brown	1,750
Soronko	1972/83	IITA	Medium	Light-brown	1,750
Amantin	1983/84	Ghana	Early	Mottled-purple	1,500
Asontem	1986/86	IITA	Extra early	Red	2,200
Bengpla	1992	IITA	Extra early	White	2,000
Ayiyi	1992	IITA	Extra early	White	2,200

Source: GGDP 1994

to medium-maturing and have determinate growth habit. Farmers were, therefore, encouraged to plant them sole.

2) *Row planting to enhance plant population.* Row widths for early and medium-maturing varieties were 60 and 80 cm, respectively. Within row spacing was 20 cm with two plants per hill. The target plant populations per hectare were about 16,700 and 125,000 for the early and medium-maturing varieties, respectively.
3) *Use of insecticide to control insect pests*. A maximun of two applications each of pre- and post-flowering insecticide(s) only when recommended, but farmers were encouraged to spray insecticides only when necessary. Most farmers, therefore, sprayed their crop one to three times during the season. The technologies were introduced as a package. However, farmers were free to adopt one or two components, or the whole package (GGDP, 1994).

Administering the questionnaire

A formal survey questionnaire was used. Information requested included production practices, sources of information on improved technologies, changes in farmer output and income, uses and preferences, and gender activities in cowpea production.

Results and discussion

Table 2 provides a summary of the adoption rates for improved cowpea varieties, row-planting, and insecticide application. Adoption rates for the technologies were generally high, except for application of post-flowering insecticides (less than 30 %). Based on the ecological zones, adoption of the technologies was high for all the zones except in the Guinea Savanna (Table 3).

TABLE 2

Adoption of Recommended Production Technologies for Cowpea

Technology	*Adoption rate (%)*
Improved variety	70
Row planting	71
Pre-flowering insecticides	83
Post-flowering insecticides	26

TABLE 3

Adoption of Improved Production Technologies for Cowpea in Four Ecological Zones of Ghana

Technology	*Adoption rates (%) in ecological zones*			
	Forest	*Transi-tion*	*Coastal sav.*	*Guinea sav.*
Improved variety	97	90	83	19
Row planting	100	87	89	15
Pre-flowering insecticides	68	90	92	58

Until recently, the bulk of the cowpea produced in Ghana was in the Guinea Savanna zone where it featured most in the cereal-based cropping system. Substantial amounts were also produced in the Forest-savanna Transition zone. However, cowpea cultivation in the Coastal Savanna and Forest zones expanded from the 1980s to the 1990s. Incidentally, this was the period when improved varieties and production technologies were developed and transferred by the GGDP to farmers throughout the country.

The lower adoption rates for the Guinea Savanna zone could be due to several factors such as inadequate extension education, lack of access to improved seed and insecticide, and reluctance among some farmers to change. One of the key reasons why farmers readily adopted the improved technologies was that they were fully involved in developing and transferring technologies by research and extension (Asafo-Adjei *et al*., 1995).

Improved varieties

Adoption of improved varieties was high (70 %), ranging from about 19 per cent in the Guinea Savanna to 97 per cent in the forest zone. The high rates of adoption of improved varieties suggest farmers' appreciation of the superior

yields and other desirable attributes of the improved varieties compared to their local landraces. It also shows that the extension techniques used by the project, such as farmer participatory variety evaluation, demonstrations and field days, and regular visits by extension agents to farmers, were effective. Farmers also had access to good quality seed at affordable prices in most districts surveyed. The GGDP promoted the use of good quality seed as an integral part of the technological package. Farmers were encouraged to purchase seeds from recognized seed dealers. They could also select good seeds from their fields after harvesting at the end of the season and test for germination before storage and before planting in their fields at the beginning of the next season. Table 4 presents the sources of seeds used by farmers.

TABLE 4

Farmers' Source of Seed

Source	*Percent of farmers*
Extension	33
Seed dealer	15
NGOs/government	3
Total (official)	51
Another farmer	12
Own (farm-saved)	9
Market	28
(N)*	(214)

* Number of respondents

Over half of the farmers secured their cowpea seeds from approved (official) sources, while about 21 per cent of them selected seeds from their own fields or collected seeds from other farmers. This indicates that most farmers were receptive to extension messages on use of good quality seeds of the improved varieties. For a self-pollinated crop like cowpea with less than 1 per cent natural out-crossing, use of farm-saved seeds makes more sense than purchased seeds to resource-poor farmers with no ready access to improved varieties. Farm-saved seeds contribute to seed security at the village level and provide the basis for informal trade through barter and cash sales.

About 28 per cent of farmers purchased their seeds from the grain market because of lack of access to seed outlets in their villages. In areas with seed dealers, the improved seed was very expensive, usually 3 to 4 times the price of seed (which is grain) bought from the open market. The viability and purity of such seed are usually unknown, and farmers sometimes have to buy fresh seeds when those bought from the market do not germinate.

Reports from stakeholders' review and planning meetings (for the GS zone) do confirm that absence of seed outlets in rural communities is one of the main reasons why fewer rural farmers use improved varieties. Farmers and input dealers agree that small villages lack input distribution outlets. Seed dealers claimed it was uneconomical for them to establish shops in small villages. One possible solution to this problem would be for seed dealers to use opinion leaders in villages as their agents to sell improved seeds and other inputs at the village level for their mutual benefit. This way, farmers may not have to travel to the towns and larger villages to purchase inputs such as seeds and agro-chemicals, because these inputs will be available at their doorstep. While this approach may address the seed availability problem, it may not necessarily address the problem of affordability. It is in this light that community seed production systems have gained wide acceptance as alternatives to formal seed production and distribution systems.

Farmers are encouraged and assisted to form groups and establish seed fields to produce commercial seeds of improved varieties. All rules governing commercial seed production, as laid down by the national seed laws, are applied. Thus, farmers have to purchase foundation seed from certified sources, and follow laid down procedures to produce seeds that meet the quality standards before they are issued with a certification tag for commercial seed by appropriate seed-certifying

institutions such as the Ghana Seed Inspections Unit (GSIU). The group keeps part of the seed for their own use and sells the rest to other farmers in their village and nearby villages at affordable prices. Community seed production systems have been successfully used to disseminate improved varieties of cowpea and soybean to several farming communities in northern Ghana (Marfo, 2000).

Row planting

Recommendations for row planting were proposed for higher plant density (125,000-167,000) and easy farm operations like weeding and insecticide application. Farmers were encouraged to use sighting poles or garden lines to help them plant in rows. Most farmers (94 %) used garden lines, although they complained it was tedious. Less than 2 per cent of the farmers used sighting poles. Of the remaining 4 per cent of farmers, a few used tractors to mark their fields, while some used other methods like unaided sighting of rows.

Irrespective of the method used, the recommended row planting increased the plant population by 400 to 600 per cent over farmers' practice (20,000-40,000 plants ha^{-1}). The increased planting density also ensured early closure of cowpea canopy, thereby reducing frequency of weeding from three to one or two, depending on maturity of varieties. The net benefit from row planting and consequent increased plant population was increased yields and incomes from cowpea cultivation. Apart from farmers who plant in rows, about 15 per cent of the farmers surveyed planted on mounds. Several reasons may be adduced for planting on mounds. Yields may be better because crops growing on mounds have direct access to nutrients that abound in the topsoil from which mounds are produced. Also, mounding helps to check soil erosion in fields on slopes.

Use of insecticide

Many insect pests attack cowpea right from the seedling stage to the grain or seed in storage (Singh & Allen, 1979). Aphids, leafhoppers, foliage beetles, and flower bud thrips are the most important pre-flowering pests; while flower thrips, maruca pod borer, and pod-sucking bugs (PSBs) are more important during the reproductive stage (Jackai & Adalla, 1997; Singh & Allen, 1979). High incidence of insect attacks can lead to total crop failure. Therefore, without stable and effective host plant resistance to major cowpea pests like thrips, the maruca pod borer and the PSBs, chemical control was recommended to farmers.

About 83 per cent of the farmers surveyed applied the recommended pre-flowering insecticides (Table 2), mostly synthetic pyrethroids (Trade names: Karate, Cymbush, Ripcord); while 26 per cent of the farmers applied post-flowering insecticides, either dimethoate (organophosphate) or endosulphan (organo-chloride). However, 70 per cent of the farmers sprayed with the "wrong" post-flowering insecticides, indicating that farmers recognized the need to control post-flowering insects, except that they did not know the right insecticides. Among farmers who used the wrong post-flowering insecticides, 61 per cent continued to apply Karate that was recommended for pre-flowering and flowering insects. This may be because farmers did not want to purchase two different types of insecticides for spraying their cowpea fields as recommended at that time, because none of the insecticide formulations available could control all the important pre- and post-flowering insects. The problem has since been solved by introducing broad-spectrum insecticides like Cymethoate, Cymbush Super and Sherpa Plus. These are combinations of synthetic pyrethroids and organophosphates; and can, therefore, control most important field pests of cowpea.

Insecticides can pose environmental and health problems. Farmers were, therefore, educated on the need to protect themselves and the environment against insecticide contamination whenever they used them. The use of protective clothing such as long-sleeved overalls, caps,

goggles and respirator (or handkerchief to cover their noses), and the proper disposal of insecticide containers were emphasized. Farmers were also educated on the need to clean spraying equipment and protective clothing after use.

Out of the total sample, 44 per cent of the farmers used, at least, one protective material. Most farmers (69 %) disposed of the insecticide containers by throwing them away into the bush, 12 per cent buried them,12 per cent re-used them at home (very dangerous), and 7 per cent used other methods of disposal.

Farmers' sources of information on new technologies

To ensure that stakeholders participate in generating and disseminating technologies, the GGDP established strong linkages between research, extension and farmers. Because all stakeholders were involved in developing the improved technologies, dissemination and adoption by farmers were easy. Over half of the farmers collected information on improved technologies from extension agents (Table 5). Farmers also got information on new technologies from their neighbours and other farmers who had previous exposure to the technologies. Farmer-to-farmer diffusion of production technologies is an appropriate and efficient method of transferring technologies in rural communities without regular access to extension services.

In this study, over 38 per cent of farmers got improved seed (purchased or *gratis*) from other farmers, while 19 and 23 per cent learned about row planting and insecticide use, respectively, from other farmers. Table 6 summarizes the 1st year that farmers used improved production technologies. Few farmers (under 4 %) used improved technologies to produce cowpea before 1985. However, 10 years later, over 75 per cent of farmers in surveyed areas had access to and used improved production technologies. This period (1989/90 to 1994) coincided with the final phase of the GGDP, during which technology transfer was the focal project activity. The first phase of the project (1980-1984) focused on capacity-building, especially human resource development, while most resources for the second phase were devoted to technology generation.

Uses and preferences

In Ghana, cowpea is used in preparing various foods. Ninety percent of the farmers surveyed consumed cowpea in various forms. Most (83.5 %) boil and consume it with rice or "gari" (a cassava food preparation) and stew, and 3 per cent use it in soups. Farmers and consumers have preferences for different seed coat colours. Table 6 presents farmers' responses to colour preferences for home consumption when boiled, flour preparation, and sale (whole grain). About 63 per cent of respondents preferred varieties with white seed coat followed by red (29 %), while under 10 per cent of respondents preferred other colours irrespective of whether the grain would be for home consumption, flour preparation, or for sale. Most farmers prefer white varieties because traders pay premium price for them. *Asontem* is the highest yielding variety

TABLE 5

How Farmers First Learned of the Improved Technologies

Source of information	*Improved variety*	*Technology Row planting*	*Insecticide*
Told by extension	45.3	40.9	49.4
Demonstration	10.7	25.5	20.7
Other extension	1.3	7.3	1.7
Total extension	(57.3)	(73.7)	(71.8)
Another farmer	38.5	18.6	23.2
Other	3.4	7.7	3.4
Don't know	0.8	0	1.6
(N)*	(234)	(247)	(237)

*Number of respondents

TABLE 6

Colour Preference of Cowpea for Various Uses

Seed colour	*Home consumption (%)*	*Flour preparation (%)*	*Sale (%)*	*Preference (%)*
White	58.0	65.8	65.6	63.1
Red	28.1	28.0	29.9	28.7
Brown	9.7	4.3	3.4	5.8
Mottled	3.9	1.9	1.1	2.3
Other	0.3	0	0	0.1
(N)*	(310)	(161)	(268)	(310)

* Number of respondents

cultivated by farmers. However, in the Transitional ecological zone, especially around Ejura, Atebubu and Nkoranza Districts, more farmers were switching to cultivation of *Bengpla*, a white variety with 10 to 15 per cent less grain yield compared to *Asontem*.

Evidence from stakeholders' planning meetings (unpublished meeting reports) indicate that consumers prefer white varieties because they are attractive, cook faster, taste better, and do not need to be decorticated before milling to give a uniform white or cream-coloured flour. About a third of the farmers, especially those in the Guinea Savanna zone, eat cowpea leaves. Consequently, application of pre-flowering insecticide is usually deferred till a few days before flowering when plants are about 5 to 6 weeks old for early-maturing varieties, and 6 to 7 weeks old for the medium and late varieties.

Changes in farmers' output and incomes

Farmers were asked if there had been any changes in the quantities of cowpea they produced and incomes generated from cowpea production since they were exposed to the improved production technologies. For most farmers, grain output, income, profit, quantity of produce sold or stored had increased (Table 7). Over 85 per cent of farmers said their cowpea production had been increasing after adopting the improved technologies. For those farmers whose cowpea production increased, 80 per cent said cowpea had become more profitable, while 13 per cent attributed the increase to its being the most consumed staple food. About 7 per cent of the farmers gave other reasons for the increased production. Better producer price for cowpea compared to that of maize for 1990-1995 may have motivated farmers to adopt the improved technologies and also increase the area cultivated to cowpea and, consequently, their production and incomes. For those farmers who responded that their cowpea production was decreasing (12 %), they assigned the main reason to high cost of input (insecticides). They could not afford to purchase insecticides to control insect pests on their crop, so they got low yields, which served as disincentive for maintaining even smaller fields.

When farmers' production increased, they consumed and sold more of their produce. The

TABLE 7

Changes in Farmers' Production and Income Levels from Cowpea after Adopting Improved Technologies

Item	*Direction of change*			
	Increased (%)	*Decreased (%)*	*No change (%)*	*Can't tell (%)*
Grain output	85.7	1.4	1.4	11.5
Quantity consumed	46.4	5.7	18.5	29.4
Quantity sold	83.3	2.1	1.9	12.7
Quantity stored	62.5	1.9	5.8	29.8
Income	82.5	2.0	3.3	12.2
Profit	80.0	3.8	1.4	14.8

increased consumption of cowpea would have a positive impact on the nutrition and health of those households. An estimated 29 per cent of Ghanaians were considered to be undernourished (FAO, 1999) mostly in rural communities, with children being the most vulnerable group. Increased consumption of cowpea would, therefore, contribute to improved protein and overall nutritional status.

As farmers' productivity improved with adoption of improved technologies, they tended to store more of their produce, waiting for higher prices later in the year to maximize their profits. It is, therefore, necessary that improved storage technologies such as solar de-infestation and double or triple-bagging techniques (CRSP Technical Bulletin No. 1 and 3) are extended to farmers.

Most farmers had no problem selling their cowpea. For farmers who sold cowpea, 92 per cent sold at least 40 per cent of their produce. Cowpea is marketed almost throughout the year, with the peak periods in March and September. About 11 per cent of the farmers did not have any specific time for selling their produce. They sold whenever necessary, such as when they needed money to pay their children's school fees, hospital bills, or to meet other social obligations.

Gender in cowpea cultivation

Gender issues are important in agricultural production. Among others, they provide information on leverage points for assistance to farmers based on sex. Table 8 presents the gender roles in cowpea production.

Male adults do most strenuous field activities like land preparation, weeding and spraying of insecticides. Females are mainly responsible for winnowing after threshing and sale of produce. The whole family does planting and harvesting, while grain is usually stored by adults. Women are responsible for sale of produce, but they have little or no control over the money accrued. Family heads, who invariably are men, control all monies accrued from the sale of produce from family farms. However, women keep the money if the produce comes from their own farms. Children's contributions to farm operations are low compared to those of adults. However, they contribute significantly to threshing (19 %) and winnowing (2 %), and may be involved in planting and storage of grains. The exclusion of women and children from insecticide application is a responsible decision that seeks to protect vulnerable members of the family from adverse effects of insecticide contamination.

Conclusion

The experience with cowpea technology in Ghana clearly shows that if small-scale farmers are provided with good technologies that address their real needs, besides institutional support, they will adopt the technologies. Although the adoption rates of the technologies surveyed were high in Ghana, the rates for the Guinea Savanna zone were lower than expected. Most of the estimated 80,000 Mt of total cowpea production

TABLE 8

Gender Roles in Cowpea Production

Activity	*Male (%)*	*Female (%)*	*Male and female (%)*	*Children (%)*
Land preparation	86.5	2.0	11.5	0
Planting	33.3	23.1	42.1	1.3
Weeding	75.4	2.9	20.7	1.0
Spraying	84.6	1.7	12.0	1.7
Harvesting	13.5	29.6	50.5	6.4
Threshing	35.0	11.9	33.8	19.3
Winnowing	14.8	47.6	16.7	20.9
Storage	41.7	32.4	14.6	11.3
Sale of produce	30.6	63.5	5.2	0.7

in Ghana comes from the Guinea Savanna zone. Therefore, extension education must be intensified on improved cowpea technologies for farmers in this area to improve their productivity and incomes.

The high cost of insecticides and inefficient distribution system caused the low adoption rates of insecticide use. The private sector has a role to play in input distribution, especially in smaller communities, for farmers to benefit from technological innovations needed to improve their productivity.

The study showed that an efficient extension system is key to effective transfer and adoption of technologies by farmers.

Improved storage technologies such as solar de-infestation and double or triple-bagging techniques should be disseminated to farmers to ensure proper storage of produce after harvesting.

More farm families now cultivate cowpea for income, and every member of the farm family is involved in one or more aspects of producing and marketing the crop. Government policies that ensure adequate institutional support to facilitate access to needed inputs at affordable prices are crucial for rapid adoption of improved production technologies and to improved productivity of farmers. Gender roles are seemingly dictated by perceived physical capabilities of family members.

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