STAFF PAPER

Economic Impacts of Bio-control Research to Manage Field Insect Pests of Cowpea in Burkina Faso: Baseline Survey Report

by

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Executive Summary

Cowpea (*Vigna unguiculata*) is an important staple in Burkina Faso as well as many other countries in West Africa. Among the major cowpea pests affecting the crop are the legume pod borer (*Maruca vitrata*), flower thrips (*Megalurothrips sjostedti*), bruchids (*Callosobruchus maculatus*), and pod-sucking bugs, for which conventional plant breeding has not been effective and the use of pesticides has economic, health and environmental limitations. Through support from the USAID funded Collaborative Research Support Program (CRSP), the project team led by the University of Illinois is developing alternative strategies to control these insect pests and reduce the levels of pesticide used on the crop. One of these strategies includes implementing a comprehensive bio-control program. The current study was designed to collect baseline data (and eventually end line data) to be able to evaluate the long-term impacts of bio-control research. The baseline data (described in this document) will serve as the 'before' scenario, which will be compared with an "after" scenario where the same households will be re-visited after several years.

The main purpose of the baseline survey was to measure the following indicators: (1) the incidence and severity of damage caused by biotic (particularly insects) and abiotic stresses; (2) the use of insecticides; farmers' knowledge/awareness about beneficial insects to control cowpea pests; (3) pesticide management practices; (4) toxic health effects from pesticide use (misuse); and, (5) use of labor during cowpea production. Other economic indicators include the quantity of cowpea grain produced, revenues from grain sales, input and transportation costs, and relative importance of cowpea as a source of income and food security.

The baseline survey was conducted between March and May 2012 and was designed to collect information about the 2011 production season. The sampling areas were designated by first selecting target geographic provinces, then randomly selecting villages within these provinces according to their geographic location and then systematically randomly selecting households within each village. The sample design covered a total of 560 households distributed across 56 villages, 10 provinces, and two ecological zones called "bio-areas." Two questionnaires were developed specifically to collect the baseline data. The results were disaggregated by province and bio-area to be able to assess the impact in areas where the beneficial insects will be released (i.e. south bio-area) versus in areas where they will not be released (i.e. north bio-area). For the analysis, sampling weights were estimated to be able to make inferences about the population of interest. The data was analyzed using descriptive statistics, estimating t-test of differences between the two bio-areas whenever possible.

The results suggest that the main biotic stress affecting the crop was insect incidence and the main abiotic stress was drought. More than one-half of farmers reported that the incidence of insect pests in 2011 was worse when compared with the two previous years. Insect incidence (especially of legume pod borer) was more problematic in the north bio-area. Further, the use of chemical insecticides in 2011 on the cowpea crop was common, especially in the north bio-area. Although one might wrongly conclude that the project needs to release the beneficial insects in the north bio-area where this pest appears to be more problematic, doing this would require annual releases of beneficial insects since is likely that these will not survive after the rainy season. This is because the insect pest that the beneficial insects parasite is not endemic to the

north. Thus, the project plans to release beneficial insects in the south bio-area, where the pest is endogenous; thus reducing the pest damage by limiting its south-to-north migration. However, this depends on at least two factors: (a) that the bio-control agents are able to control this insect pest in the south bio-area, and (b) the populations of these agents are large, which depends in part on farmers recognizing the beneficial insects and taking actions that favor the increase of their populations.

Farmers who applied insecticides to the cowpea crop mostly used three insecticides: Cypercal/Lambdacal, Decis and Conquest. For all three insecticides used, very few farmers (less than one-third) reported that the trend on the quantity applied has decreased over time. It is expected that the number of farmers reporting using less insecticides will increase after the project intervention. Although it was suspected that the quality of the insecticides might be low, the results suggest this may not be true since most farmers were satisfied with the effectiveness of the insecticides they used.

Not surprisingly, few farmers knew about the existence of beneficial insects that can help to control cowpea pests and even fewer farmers knew about the existence of beneficial entomopathogenic viruses. The main source of information about beneficial insects came from government extension agents.

In general, farmers stored pesticides in a proper way (i.e. in a locked place). However, a higher share of farmers in the south bio-area stored pesticides in locked places, compared to farmers in the north bio-area. Despite this, few farmers reported that the place where they store the pesticides was easily accessible to children. Although almost two out of three farmers bury empty pesticide containers, which is good, a small share of farmers reported re-using the empty containers (especially in the south bio-area) and more shockingly, almost one-half of farmers who re-used these containers used them to drink water. This clearly demonstrates the need to educate farmers to better manage pesticides.

Although most farmers still cannot correctly identify the color of the label used to identify the most toxic pesticides, especially in the north bio-area, nine out of ten farmers consider that pesticides could be toxic to their health when exposed to them. Despite this, one-third or more farmers reported that someone they know had either been sick or died due to pesticide poisoning. The findings about pesticides management suggest that farmers in the south bio-area may be better informed on how to manage and use pesticides than farmers in the north bio-area.

Only 16% of farmers who applied pesticides to the cowpea crop in 2011 hired labor for this activity. Although family labor is mostly used, very few farmers reported that someone younger than 16 applied pesticides to the cowpea crop in 2011. Although very few farmers reported that the person applying pesticides either drank water or smoked cigarettes during the application, the use of protective gear was scarce, almost one-half of farmers reported that the clothes/skin of the person applying pesticides got wet during application, and a little over one-half of farmers stated that this person experienced at least one toxic side effect. The fact that fewer farmers in the south bio-area reported that the clothes/skin of the person applying pesticides got wet during application confirms that farmers in the south bio-area may know better how to manage pesticides than farmers in the north bio-area.

The demand for labor was highest for harvest & post-harvest activities. Further, for most field activities farmers in the north bio-area used statistically significantly more person-days than farmers in the south bio-area. Not surprisingly, hiring personnel for field-related activities was rare and the demand for female workers was highest for harvest and post-harvest activities.

Cowpea grain yields averaged 317 kg/ha and were much higher than yields observed in Senegal, where cowpea grain yields in three regions of the country averaged 241 kg/ha. However, the estimated yields were lower than county-level yields estimated from FAOSTAT (470 kg/ha) and much lower than the yields reported in the village-level questionnaire (667 kg/ha). It is possible that the yield differences between the household- and village-level data in the sample might be given because the village-level yield information was obtained from one source that may have overestimated yields.

Both the total grain harvested and the value of harvest were statistically significantly higher in the south bio-area, where farmers harvested an average of 337 kg with a market value of CFA 97,710 (US$211), compared to only 148 kg of grain with a market value of CFA 43,001 (US$93) in the north bio-area. In the sample, the farmers harvested an average of 252 kg of cowpea grain with a market value of CFA 73,112 (roughly US$158). Harvesting fodder was a common practice.

Forty six percent of households sold cowpea grain. The number of households selling grain was higher in the south bio-area. On average, farmers in the south bio-area sold 271 kg of grain compared to 100 kg sold by farmers in the north bio-area. Total revenues from cowpea sales (grain and fodder) averaged CFA 60,483 (roughly US$131) and farmers in the south bio-area obtained higher revenues from sales than farmers in the north bio-area.

Given that cowpea grain sales as a source of income, share of annual grain consumption satisfied by own production, and length of time that food grain reserves of cowpea last after harvest all were important across all households, the cowpea crop is an important source of income and food security, especially among farmers living in the south-bio area.

Finally, the challenges faced before and during data collection described in this document should be considered during the collection of end line data to improve the quality of the data.

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KEY TO ABBREVIATIONS

CFA	Currency for West African nations, 1 USD = 463 CFA in March 2012
CRSP	Collaborative Research Support Program
GOBF	Government of Burkina Faso
HH	Household
INERA	Institut de L'Environnement et de Recherches Agricoles
MSU	Michigan State University
NPK	Nitrogen Phosphorus Potassium fertilizer
SL	Significance Level
TLU	Tropical Livestock Unit
UIUC	University of Illinois at Urbana-Champaign

Economic Impacts of Bio-control Research to Manage Field Insect Pests of Cowpea in Burkina Faso: Baseline Survey Report

1. Introduction

Cowpea (*Vigna unguiculata*) is an important staple in Burkina Faso and many other countries in West Africa. FAOSTAT average data for 2006-2011 demonstrate that Burkina Faso's cowpea production was the third largest (457,964 MT) among West African cowpea producers,[2] after Nigeria (2.7 million MT) and Niger (1.2 million MT), the largest producers in the region (FAOSTAT, 2013). Further, for the same period, Burkina Faso's average cowpea production per capita ranked second (28.9 kg per capita) after Niger's (82.2 kg per capita) (FAOSTAT, 2013).

Among the major cowpea pests affecting the crop are the legume pod borer (*Maruca vitrata*), flower thrips (*Megalurothrips sjostedti*), bruchids (*Callosobruchus maculatus*), and pod-sucking bugs, for which conventional plant breeding has not been effective. The CRSP's Phase II UIUC-1 project team, which includes scientists from UIUC and INERA, is developing alternative strategies to control these insect pests and reduce the levels of pesticide used on the crop. One of these strategies includes implementing a comprehensive bio-control program, which is expected to have the following long-term impacts on cowpea growers in the region: (1) health and environmental benefits from the reduced use (and misuse) of pesticides; and, (2) economic benefits from increased productivity (due to reduction in crop losses) and increased profitability (due to reduction in input costs).

The realization of these impacts depends on the following two factors: (1) the movement and spread of bio-control agents in relation to where the pest population is present; and, (2) the pest control strategies practiced by farmers to control the pests in the absence of bio-control agents. The Phase I UIUC-1 project has collected (and is collecting) data towards the first factor. The current study was designed to collect baseline data to be able to evaluate the long-term impacts of bio-control research. The data collected related to farmers' pest control practices or productivity outcomes or both (i.e. towards the second factor above). Thus, the baseline data will serve as the 'before' scenario, which could ultimately be compared with an "after" scenario where the same households will be re-visited after several years and the impacts can be assessed.

[2] Includes Burkina Faso, Guinea-Bissau, Mali, Mauritania, Niger, Nigeria, and Senegal.

2. Methodology: Survey objectives, sample design and overview of the questionnaires

The following sub-sections describe the objectives of the survey, the design used to sample farm families, and the questionnaires used for data collection.

2.1. Survey objectives

The main purpose of the baseline survey is to measure indicators that could later be used to assess the socio-economic impacts of the bio-control research among cowpea producers in the country. Further, these indicators and additional information can help us to control for effects caused by unexpected events on the outcomes of the project. These indicators are the ones that are expected to measure the effect of the project intervention and include: (1) the incidence and severity of damage caused by biotic (particularly insects) and abiotic stresses; (2) the use of insecticides; (3) farmers' knowledge/awareness about beneficial insects to control cowpea pests; (4) pesticide management practices; (5) toxic health effects from pesticide use (misuse); and, (6) the use of labor during cowpea production. Other economic indicators included the quantity of cowpea grain produced, revenues from grain sales, input and transportation costs, and relative importance of cowpea as a source of income and food security. The results were disaggregated by provinces and bio-areas (details are included in the next sub-section) because this will allow us to assess the impact of the project interventions in the future.

The baseline survey, conducted between March and May 2012, was designed to collect information about the 2011 production season, before the release of the bio-control agents (i.e., before the project intervention). The primary tasks required for implementing the baseline survey included:

- Determining the areas/provinces where the bio-agents would be released and where spillovers could be expected, so we could sample households within areas where the bio-control agents are released (i.e., the direct beneficiary or treatment group) and outside this area (i.e., the potential beneficiary group or the control group in a scenario where the bio-agents are not successful in curtailing all the insect pests that migrate from south to north).
- Designing survey instruments for household- and village-level data collection, and translating these questionnaires into French.
- Training of enumerators for data collection and data entry using Excel.
- Assessing the quality of the baseline data.
- Analyzing both the household- and village-level data to describe key characteristics of sampled farmers that would capture the future impact of the project.

2.2. Impact evaluation design

Research conducted by the CRSP UIUC-1 project team in Burkina Faso has demonstrated that one of the main insect pests (i.e., *M. vitrata*) affecting the cowpea crop migrates from South to North during the wet season, surviving in the southern endemic zone during the dry season (Ba. *et al*., 2009; DGP CRSP, 2011). Because of this, the project plans to release the bio-control agents that will help to control *M. vitrata* in southern provinces, expecting them to reduce the pest population in these areas; hence limiting the south-to-north migration of this pest.

The overall impact evaluation design of this research activity can be considered as a 'natural' experiment. This is because, other than the expected south-to-north migration habit of the pest,

the actual geographic pattern in which the beneficial insects control the insect pest after their release in the environment is stochastic and remains unknown at the time of the planning of the baseline survey. It is expected to take several years for the bio control agents that will be released in few sites in the 'south bio-area' to control the spread of *M. Vitrata* in all the regions. Thus, at the time of a follow-up survey (3-4 years after the release of the bio-control agents), it is expected that some villages would potentially fall within the endemic areas of *M. Vitrata* and will immediately benefit from the release of the bio-control agent due to proximity to where it is released, and some will remain outside this direct 'zone of influence' or some insect pests (*M. Vitrata*) may escape and migrate from south to north. At the time of the follow-up survey, the villages that will naturally fall within the 'zone of influence' and record the presence of the beneficial insects (through the monitoring activity of the research project) would be considered the 'treatment villages', and those not recording any presence of the beneficial insects will be considered the 'control/comparison' group for the differences-in-difference analysis to estimate the effects.

For the baseline survey, the provinces were purposively disaggregated by two bio-areas – the south bio-area where the beneficial insects are planned to be released and the north bio-area where they are not planned to be released but the expectation is that the insect pest population (i.e., *M. Vitrata*) that migrates from south to north will be reduced. Although these may not strictly correspond to the treatment and control groups in the impact evaluation after the follow-up survey, for the purposes of this report, the data are presented by provinces that fall under these two ecological zones or bio-areas.

2.3. Sample design

The sample was designed by first selecting target geographic provinces, then randomly selecting villages within these provinces according to their geographic location for which hard copies and electronic maps were used. The sample design covered a total of 560 households distributed across 56 villages and 10 provinces. The list of villages is provided in Table A1. The provinces were selected according to their geographical location, following a south to north pattern across two horizontal lines as represented in Figure 1. Although at the time of sampling it was not decided in which southern provinces the bio-control agents would be released, five provinces (i.e., Houet, Tuy, Ioba, Zoundweogo, and Boulgou) located across a horizontal line in the south (referred to as 'south bio-area' from now on) were selected for the study (Figure 1). The bio-control agents will be released in at least two of these provinces and it is expected that the largest impact will be achieved in these provinces. However, five additional provinces (i.e., Banwa, Mouhoun, Sanguie, Bazega, and Ganzourgou; referred to as 'north bio-area' from now on) located north of the southern provinces were also selected to be able to assess the impact of the beneficial insects in provinces where the bio-agents are not planned to be released, but where it is expected that there will be an impact due to limited south-to-north migration of the pest (due to the beneficial insects controlling the pest in southern provinces).

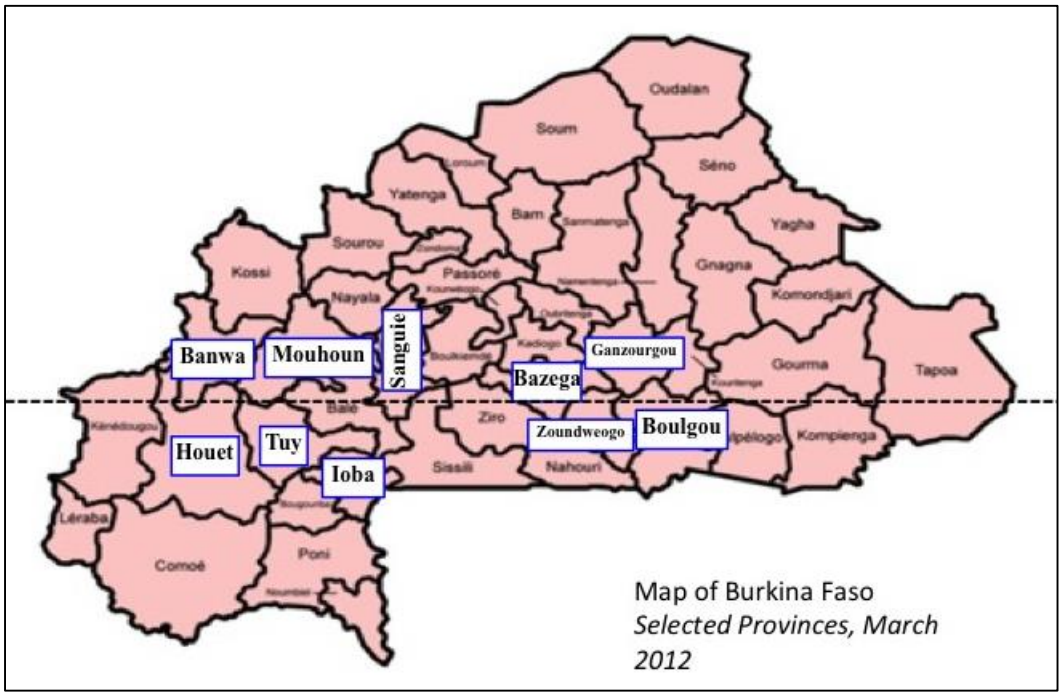


Figure 1. Selected provinces distributed across two bio-areas: South and North (separated by dotted line). Burkina Faso, 2012.

After the provinces were selected, five or six villages were randomly selected within each province following the same south-to-north pattern, as illustrated in Figure A1 for the south bio-area and Figure A2 for the north bio-area. Whether five or six villages were selected depended on the 2009 cowpea production in the province--six villages in provinces with high production. Although maps were used as the main visual aide to select the villages, accessibility and other factors were also considered during village selection (e.g., some villages in specific regions within a province were excluded because the main economic activity was mining, not agriculture).

Finally, within each village, ten households were systematically randomly selected for interview. Enumerators were asked to obtain the total number of households in the village from the Village Committee for Development while conducting the village-level survey. It was assumed that all households in any village would be cowpea producers, a reasonable assumption given the importance of cowpea in the country. Enumerators then divided this number by the number of households needed per village (i.e. ten) and obtained a fixed interval that was used for household selection (e.g. if the fixed interval was 25, every 25th house was selected for interview). They randomly selected the first household and used the fixed interval to select the second household (by counting homes). Enumerators repeated this step until ten households were selected throughout the village. If a survey could not be conducted in a chosen household, enumerators replaced this household with the one next to it but kept the original order. Additional details and examples are included in Annex 1.

2.4. Village and household weights

In order for the sample estimates from the baseline survey to be representative of the population covered by the survey, the data were multiplied by a sampling weight or expansion factor. The weights were estimated as the inverse of the probability of selection. For each household, the probability of selection was estimated as follows:

$$P_{vpi} = \frac{n_i}{N_i} \cdot \frac{v_p}{V_p} \cdot \frac{h_v}{H_v}$$

where:

P_{vpi} = probability of selection of households in village *v*, province *p*, and bio-area *i*.

n_i = number of selected provinces in bio-area *i*.

N_i = total number of provinces in bio-area *i*.

v_p = number of selected villages in province *p*.

V_p = total number of villages in province *p*.

h_v = number of selected households in village *v*.

H_v = total number of households in village *v*.

The inverse of the first two components of this probability of selection were used to weight the data collected at the village-level and these weights are included in Table A2. In contrast, the sampling weight or expansion factor for each household (Table A3) and used to analyze the household-level data was estimated as the inverse of P_{vpi} (all three components), or:

$$W_{vpi} = \frac{N_i}{n_i} \cdot \frac{V_p}{v_p} \cdot \frac{H_v}{h_v}$$

where W_{vpi} = weight for households in village *v*, province *p*, and bio-area *i*.

2.5. Questionnaire design

Experiences in Latin America, Africa (in particular), and Asia were useful in designing the survey instrument. Two questionnaires were specifically designed to collect the data required to assess the impact of bio-control research in Burkina Faso: a village-level questionnaire and a household-level questionnaire. Although these questionnaires were translated into French for their use in the field by the enumerators, for all the villages, the questions were asked in local languages (More, Dioula, Dagara, Bissa, Gourounsi) because farmers could not understand French. In these instances, the enumerators made an in situ translation of the questions as they

were asked. Although this could have influenced the accuracy of the data (since the quality of the translation depended on the enumerator's knowledge of French and the local language), it is assumed that this effect was not large.

All questions in both questionnaires were field-tested prior to their use and were modified as needed. Enumerators were trained for one week at INERA's headquarters outside of Ouagadougou on how to conduct the surveys and sample farmers. In the field, during the same visit to the village, enumerators first conducted the village-level survey so they could learn the overall conditions in the village before conducting the household-level survey. The village-level survey helps to control for changes in the overall environment faced by households and included information on infrastructure, public and private services, agriculture-related information, and other key aspects (Annex 2).

In contrast, the household-level questionnaire included information on household composition, socioeconomic characteristics, sources of work and income, assets and infrastructure owned, and specific questions related to the relative importance of cowpea as a source of food and income, cowpea production, input use, pesticide management, labor use, and marketing activities, focusing on the 2011 production season (Annex 3).

3. Characteristics of the villages

We analyzed three categories of village-level characteristics: (1) location-specific characteristics (distance to main commercial town, distance to paved road, most common way to reach commercial town, road condition between village and commercial town, and bus service), (2) access to basic services (electricity, water network, cell phone network, health centers, banks, schools, government's extension services, services provided by NGOs, and access to video viewing facilities), and (3) agriculture-related characteristics (visits by extension officers, environmental conditions in 2011, technical assistance between 2009-2011, and local input and output markets). The results of the next three sub-sections were disaggregated by province and bio-area and are included in Table A4. The focus of the discussion is about differences found between the two bio-areas.

3.1. Location-specific characteristics

Overall, the differences in most of the location-specific characteristics between the two bio-areas were not statistically significant. However, villages located in the north bio-area were farther from the main paved road than villages in the south bio-area by an average of 8.6 km (1% significance level, SL) (Table A4). In contrast, villages were located approximately 25.3 km away from their main commercial town. Further, farmers mostly use motorcycles/tricycles (38%) to get to this commercial town, followed by using a bicycle (20%) and taking a bus (18%; Table A4). Other modes of transportation mostly included a combination of bus and motorcycle or motorcycle and bicycle. Since most farmers use small vehicles to get to commercial towns, which are far away, it is likely that most farmers sell their outputs in local markets.

For most villages (40%), the road between the village and its main commercial center was made of dirt and was in poor condition with many damaged sections. Surprisingly, in 24% of the villages, the road was made of asphalt and was in good condition (i.e. no damaged sections).

While better roads (both made of asphalt and dirt) were slightly more common in the south bio-area, poor roads were slightly more common in the north bio-area (Table A4). However, these differences were not statistically tested.

Finally, approximately 34% of villages had bus service and the differences between the two bio-areas were not statistically significant (Table A4). In villages with bus service, most (91%) reported having this service every day.

3.2. Basic services

The village-level data suggest that all differences in access to basic services between the two bio-areas were not statistically significant (Table A4). While 17% of villages had access to electricity, only a very small share of villages (3%) had access to a tap water service network.[3] In contrast, most villages (97%) had access to cell phone networks and approximately three out of four villages had a local health center (Table A4).
As expected, access to financial institutions was limited and only 15% and 26% of the villages reported having a private bank or rural bank available, respectively. Further, while all villages had a local primary school that children could attend, less than one-half (46%) of villages had a secondary school (Table A4). However, this does not mean that children do not have access to secondary education since there is generally a secondary school for several surrounding villages.

Access to technical assistance from either the government or NGOs was common--55% of villages had a government's agricultural extension office in the village and NGOs providing agriculture-related services were reported in 41% of villages. Finally, almost one half of the villages had access to video viewing facilities (Table A4), which is beneficial because videos with extension-related materials could be shown to farmers in these facilities.

3.3. General agricultural information

The data suggest that agricultural extension officers from the government regularly visit most (88%) villages (Table A4). This was expected since the government of Burkina Faso (GOBF) has extension offices distributed across the country, each assisting several close-by villages.

Although less than one-third of villages had a local permanent input dealer where farmers could purchase their inputs, a higher share (46%) of villages in the north bio-area had a local input dealer, compared to villages in the south bio-area (13%, 1% SL; Table A4). Between 2009-2011, a higher percent of villages received training related to post harvest/storage techniques (63%) and pesticide use (57%), compared to only 28% of villages receiving training on integrated pest management (IPM) techniques (Table A4). There were statistical differences in the training received--more villages in the south bio-area received training related to pesticide use (67%) and integrated pest management (39%) than villages in the north bio-area (44% and 14%, respectively; Table A4).

[3] As it will be discussed later, this does not imply that households do not have access to water sources since the government provides them with access to wells from where they fulfill their water needs.

Abiotic (i.e. rainfall) and biotic (i.e. insects) stresses affected the cowpea crop differently in 2011. While rainfall was lower in most villages (91%), suggesting droughts may have been a problem in 2011, insect damage was not an issue since only in 28% of the villages insect damage in 2011 was higher than in a normal year (Table A4).

Surprisingly, the village-level data suggest that cowpea yields are high, averaging 667 kg/ha, and are much higher in the north bio-area (Table A4). This finding contrast with the estimations of yields using household-level data, which suggest that average area-weighted yields were 317 kg/ha (Table 10), almost half of what was reported in the village-level survey. These differences may be given by the fact that, the village-level information most likely does not account for the harvest of fodder (since this was not asked, there is no way to confirm this), while the household-level data does account for this information. Further, farmers may have provided inaccurate figures for the area planted with cowpea, which directly influences yield. Additional details are discussed in Section 5.5 below.

Strangely, cowpea producers can sell their grain harvest either to intermediaries (or grain collectors) in the village or by themselves in other villages/towns. Finally, as expected, the village-level price of cowpea grain was higher at the beginning of the 2011 season than at harvest (CFAs 432/kg (US$0.93/kg) vs. CFAs 231/kg (US$0.50/kg), respectively; Table A4). These two village-level prices were averaged and used to estimate household grain revenues. The same average price was used for households within a particular village. This allowed controlling potential endogeneity problems in the revenue estimations due to the use of endogenous prices.

4. Characteristics of the households in 2011

In this section we examine (1) socioeconomic characteristics of the households, (2) types of work and use of agricultural credit, (3) sources of income, (4) home and farm infrastructure, (5) farm characteristics and cowpea crop management, and (6) cowpea marketing decisions. Given that the disaggregation of the results follows a pest bio-control strategy, most (or the lack of) differences were challenging to explain. Surprisingly, there were statistical differences in many of the characteristics between the two bio-areas, as discussed below.

4.1. Socioeconomic characteristics

The socioeconomic characteristics were classified into general, house-related, and agriculture-related characteristics. There were statistical differences in most of the socioeconomic characteristics, especially the general characteristics of the households. The household data suggest that most households (99%) were male-headed, especially in the south bio-area (Table 1). Further, respondents have lived in the village an average of 45 years. The average number of years living in the village was higher in the south bio-area--farmers have lived in the village four years longer than farmers in the north bio-area (1% SL).

As expected, the average household size for the entire sample was large (10.5 members). Family size tends to be smaller among households located in the south bio-area, where households had an average of three fewer members, compared to households in the north bio-area (Table 1). Further, for all age categories, households in the south bio-area had fewer members, compared to households in the north bio-area (1% SL). In addition, approximately 1.5 members older than 16

who lived in the household between 2008 and 2010 were not living in the household anymore and, in approximately one out of seven households, this absent member had died (Table 1).

Adult literacy may be limited in the sampled regions since fewer than two adults (or 35% of adult members) reported finishing primary school. Further, the data suggest that adults may be better educated in the south bio-area since 2.2 adults (or 44% of adult members) reported finishing primary education vs. only 1.6 adults (or 28% of adult members) in the north bio-area (1% SL, Table 1). Although more children were enrolled in school in 2011 in the north bio-area (2.6 vs. 2.3 in the south bio-area), it is possible that this literacy gap will remain wide in the next few years because these numbers represent 68% and 85% of all children in the household, respectively. However, the data suggest that literacy for the next generation of adults will improve, given such high school enrollment rates for children.

Although the village-level data discussed in the previous section suggested that households were approximately 9.9 km away from the main paved road and 25.3 km away from their main commercial center (see Table A4), the household-level data suggest that farmers sell their cowpea grain somewhere else because farmers reported they were 4.8 km away from the main road where they could sell cowpea (Table 1). However, farmers in the south bio-area live closer to the main road where they could sell cowpea grain than farmers in the north bio-area--3.4 km vs. 6.6 km, respectively (1% SL; Table 1).

The materials used to construct the homes were collected as an indication of wealth. It is expected that wealthier households will have, among other assets, homes built with better materials. In the sample, it was more common to find homes with roofs made of permanent materials such as zinc (81% of homes) and floors made of cement (58%), than homes with walls made of cement or stone (18%; Table 1). Further, more homes in the south bio-area (24%) had walls made of cement or stone compared to homes in the north bio-area (10%, 1% SL). In contrast, having cement floor was more common among homes in the north bio-area (63% vs. 54% in the south bio-area, 5% SL; Table 1).

Table 1. Socioeconomic characteristics of the households (HH), by bio-area and province. Burkina Faso, 2011.

	Bio-area/Province													
	South						North							
Characteristics	**Houet**	**Tuy**	**Ioba**	**Zound-weogo**	**Boulgou**	**Total South**	**Banwa**	**Mouhoun**	**Sanguie**	**Bazega**	**Ganzor-gou**	**Total North**	**t-test[1]**	**Total**
General														
Gender of HH head (% male)	100	98	100	100	98	99	100	100	92	100	98	98	*	99
No. of years living in the village	50	46	39	48	48	47	47	34	49	42	37	43	***	45
Average HH size	6.9	7.9	12.3	13.1	10.1	9.1	18.4	12.1	9.5	12.0	16.2	12.3	***	10.5
No. male members >17 yr.	2.5	2.6	3.0	2.4	2.0	2.5	3.9	3.3	2.3	2.6	4.8	2.9	***	2.7
No. female members >17 yr.	1.9	2.3	3.2	3.3	2.6	2.5	4.5	2.9	2.0	3.2	3.2	2.9	***	2.7
No. male members 7-17 yr.	1.0	0.9	1.6	2.3	1.7	1.3	3.5	1.9	1.6	1.5	2.6	1.9	***	1.6
No. female members 7-17 yr.	1.3	0.9	1.6	2.0	1.8	1.4	3.4	1.6	1.6	1.8	2.3	1.9	***	1.6
No. children <7 yr.	0.3	1.1	2.9	3.1	2.0	1.4	3.1	2.5	2.0	2.8	3.3	2.6	***	1.9
No. members >16 yr. not living in the HH anymore	1.1	1.5	1.7	2.0	0.4	1.3	4.2	0.1	1.1	2.1	2.5	1.7	*	1.5
For members not living in the HH, has anyone died between 2008-2010? (% yes)	5	0	17	43	46	14	0	100	17	16	23	15		14
No. adults who finished primary school	2.5	2.7	2.1	1.8	0.7	2.2	3.0	2.1	2.0	0.8	1.1	1.6	***	1.9
No. members 7-17 yr. enrolled in school in 2011	2.1	1.7	2.3	3.4	2.5	2.3	3.9	2.7	2.4	2.3	3.4	2.6	**	2.4
Distance to main road where cowpea could be sold (km)	3.5	4.8	1.8	2.5	3.1	3.4	29.8	2.3	2.1	4.4	9.7	6.6	***	4.8
House materials (% yes)														
Walls made of cement or stone?	39	27	4	10	7	24	29	30	0	1	15	10	***	18
Floor made of cement?	51	59	38	96	16	54	66	51	28	95	68	63	**	58
Roof made of zinc, tile, or aluminum?	96	96	68	54	26	78	98	61	77	93	87	83		81
Agriculture-related														
No. of cowpea fields planted	1.3	1.1	2.1	1.2	1.4	1.4	1.0	1.1	1.2	1.1	1.4	1.1	***	1.3
Households growing 1-2 cowpea fields (%)	100	99	74	100	92	96	100	100	100	100	94	100	--	97.5
Households growing 1-3 cowpea fields (%)	100	100	95	100	100	99	100	100	100	100	100	100	--	99.7

Table 1 (cont'd).

	Bio-area/Province													
	South						North							
Characteristics	**Houet**	**Tuy**	**Ioba**	**Zound-weogo**	**Boulgou**	**Total South**	**Banwa**	**Mouhoun**	**Sanguie**	**Bazega**	**Ganzor-gou**	**Total North**	**t-test[1]**	**Total**
No. Tropical Livestock Units	4.0	4.2	5.8	7.5	3.5	4.7	5.0	7.8	3.2	6.8	5.5	5.6	*	5.1
Farm assets index[2]	-0.21	0.10	-0.25	-0.13	0.44	-0.06	0.74	0.47	-0.13	0.50	-0.20	0.30	**	0.10
Transportation and household assets index[3]	0.30	0.41	-0.53	0.55	-1.02	0.11	1.12	0.63	-1.13	0.34	0.93	0.08		0.10
No. hectares owned (includes homestead)	9.03	10.24	9.51	5.97	4.21	8.36	13.60	17.30	3.91	9.26	5.60	9.33		8.80
No. hectares cultivated (all crops)	4.83	7.63	6.22	4.05	3.24	5.34	8.82	13.55	3.06	4.57	3.57	6.09	*	5.68
No. hectares cultivated with cowpea (includes inter-crop)	1.76	1.20	2.47	0.94	1.75	1.59	1.04	0.83	0.73	0.91	1.47	0.89	***	1.28
No. hectares cultivated with cowpea (monocrop equivalent)	0.90	0.72	0.98	0.60	1.17	0.86	0.99	0.80	0.39	0.81	1.05	0.72	**	0.80
HH purchasing cowpea seed (%)	45	62	71	53	55	55	5	74	6	18	34	23	***	40
Amount buyers spent on seed purchases (CFAs)	6,451	1,483	2,609	3,142	5,365	3,918	1,750	4,271	2,192	1,624	6,074	3,493		3,808
Number of observations	60	50	50	49	60	269	60	50	60	60	60	290	--	559

[1] Test of difference between means of households in the South and North bio-areas: *significant at 10%; **significant at 5%; ***significant at 1%; -- not tested.
[2] Estimated using primary component analysis. Index includes number of tractors, tractor plows, animal plows, backpack sprayers (manual), backpack sprayers (motor), metal silos, irrigation pumps, and bag sewing machines. The percentage of the covariance explained by the first component is 42.7% and the first eigenvalue is 3.41.

[3] Estimated using primary component analysis. Index includes number of carts, bicycles, motorcycles, car/pick up, trucks, cell phones, televisions, and radio/stereo. The percentage of the covariance explained by the first component is 36.7% and the first eigenvalue is 2.94.
Estimates weighted to reflect population (except number of observations).
Source: CRSP Baseline Survey on Management of Field Insect Pests of Cowpea, Burkina Faso, 2012.

On average, farmers planted 1.3 cowpea fields, with most households planting less than three fields (Table 1). Households located in the south bio-area planted slightly more cowpea fields than households in the north bio-area (1% SL). The numbers of animals owned were used to estimate the number of tropical livestock units (TLU), following FAO's conversion factors, where one cow equals 0.7 TLU, a donkey equals 0.5 TLU, a horse equals 0.8 TLU, a goat or sheep equals 0.1 TLU, a swine equals 0.2 TLU and a hen equals 0.01 TLU (FAO, 2013). While sampled households owned an average of 5.1 TLU, households in the north bio-area owned almost one more TLU than households in the south bio-area (10% SL; Table 1).

To analyze wealth across various types of assets, we estimated two asset indices, one for farm assets and another for transportation & household assets. These indices were estimated using primary component analysis and the theory and construction of these indices are described in Annex 4. While the number of tractors, tractor plows, animal plows, backpack sprayers (manual), backpack sprayers (motor), metal silos, irrigation pumps, and bag sewing machines owned were included in estimating the farm assets index; the number of carts, bicycles, motorcycles, cars/pick ups, trucks, cell phones, televisions, and radio/stereo owned were included in the transportation & household assets index. By construction, the mean value of the index is zero. Thus, while negative values mean that the particular household is below the mean index, positive values mean the household is above the mean index. At the household level, a higher value of a particular index indicates that a higher number of these assets were owned, implying greater wealth. The mean index for both assets was 0.10 (Table 1), which was slightly greater than zero due to the use of weights in the estimation. While there were no statistical differences in the transportation & household assets index between the north and south bio-areas, households in the north bio-area owned more farm assets and had a higher index than households in the south bio-area, suggesting these type of households were wealthier (as indicated by the farm assets index).

In the sample, each household owned an average of 8.8 hectares of land (including the homestead), cultivated almost 5.7 hectares with all crops (or 65% of their land), and planted 0.8 hectares of monocrop-equivalent[4] cowpea (or 14% of the area planted to all crops) (Table 1). While the number of hectares cultivated with all crops was higher in the north bio-area, the number of monocrop-equivalent hectares cultivated with cowpea was higher in the south bio-area, suggesting that cowpeas may be slightly more important in the south bio-area.

Finally, less than one-half of households purchased cowpea seed in 2011, spending an average of CFAs 3,808 on seed (Table 1). While 55% of households in the south bio-area purchased cowpea seed in 2011 compared to only 23% in the north bio-area (1% SL), the differences in the amount spent on seed between the two bio-areas were not statistically significant (Table 1).

4.2. Farm, off-farm, and non-agricultural work, and use of agricultural credit

Farmers were asked how many adults (i.e. >17 years of age) worked in 2011 in different types of jobs, including on-farm, off-farm, livestock, and non-agricultural jobs. However, farmers'

[4] Since cowpeas were planted intercropped, the share of the area planted with cowpeas (e.g. 25%, 50%, 75%) was used to estimate the monocrop-equivalent area planted with cowpeas by multiplying this value with the total area of each field where cowpeas were planted.

responses to working in non-agricultural jobs were judged inaccurate. The main reason for these inaccuracies were due to enumerator error when asking the question, because non-agricultural jobs should have excluded working with livestock. Despite this, enumerators did not make this distinction and some responses included livestock as a non-agricultural job. Since it was impossible to correct this error, responses to non-agricultural jobs were excluded from analysis.

As expected, a large number of adults (4.7 members or 87% of adult members) worked on-farm in 2011. In contrast, while only a few (less than one member) worked off-farm, almost three members (or 52% of adult members) worked in livestock (Table A5). The data also suggest that households in the north bio-area had more members working off-farm in 2011 than households in the south bio-area (1% SL).

The village-level data in Table A4 and discussed in Section 3 showed that most villages had limited access to financial institutions (i.e. private bank or rural bank). Thus, it is not surprising that only one out of 32 farmers used agricultural credit during the 2011 cowpea production cycle (Table A5). Further, the use of agricultural credit was more common among farmers in the north bio-area than in the south bio-area (4.4% vs. 2.0%, respectively).

4.3. Sources of income

Although farmers reported different sources of income, we focus our discussion only on the main sources of income reported by farmers, which are included in Table A5. While 18% of farmers received cash remittances in 2011, more farmers in the south bio-area (24%) received cash remittances than farmers in the north bio-area (10%, 1% SL).

Not surprisingly, almost nine out of ten farmers reported that their household had non-crop income. The main sources of non-crop income were livestock and commerce. On average, 39% of households reported having each of these sources of income in 2011. While there were no statistical differences in the number of households reporting livestock as a source of income in 2011, there were statistical differences in the number of households reporting commerce as their main source of non-crop income--more than one-half of the households in the north bio-area had this source of income compared to only 29% of households in the south bio-area (Table A5).

4.4. Home and farm infrastructure, and improvements made

In addition to the types of materials used to construct the homes and the asset indices, home and farm infrastructure was studied also as an indicator of wealth. Farmers were asked if they had any of ten types of infrastructures in their home or farm, access to sources of water, and if they had made any improvements to these infrastructures. These responses are included in Table A6 and are discussed below.

4.4.1. Home infrastructure and services

Home infrastructure and services included having a well, latrine, bathroom, water service, and electricity service at home. While having a well or latrine at home was very common, having a bathroom, water, or electricity service was rare (Table A6). While more than one-half of sampled farmers had a well in their home, more farmers in the south bio-area (66%) had wells than farmers in the north bio-area (38%). Similarly, while 46% of all farmers reported having a latrine

in their home, the number of farmers reporting having a latrine was higher in the north bio-area (51% vs. 42% in the south bio-area).

No farmer reported having water service through a water network (Table A6). This does not imply that they do not have access to water since many reported having wells. In addition, the GOBF has provided them with access to water points through wells drilled within their village. Further, the number of farmers having a bathroom inside their home or electricity at home was very small (three and four percent, respectively), and having a bathroom or electricity at home was more common in the north bio-area than in the south bio-area (1% SL; Table A6).

Finally, the average age[5] of all home infrastructures was ten years (Table A6). Further, among farmers having these home infrastructures (excluding water and electricity services), 40% of them reported they had made major improvements in at least one of these infrastructures since these were constructed/obtained.

4.4.2. Farm infrastructure

Farm infrastructure included having a well for irrigation, dam for irrigation, irrigation equipment (flood, sprinkler, or drip), and access to water sources that could be used for irrigation such as a river or a lake. While 15% of farmers reported they had a well they could use for irrigation and nine percent of farmers reported they had a dam they could use for the same purpose, more farmers in the north bio-area had these two infrastructures in their farm compared to farmers in the south bio-area (1% SL; Table A6).

Not surprisingly, it was more common for farmers to own equipment for flood irrigation (e.g. pump) than equipment for sprinkler or drip irrigation, since the latter two require large investments in the farm. While owning equipment for flood irrigation was more common in the north bio-area (5% SL), owning equipment for sprinkler irrigation was more common in the south bio-area (10% SL) and no farmers reported owning equipment for drip irrigation. Further, while 27% of farmers had access to water sources for irrigation, a higher percent of farmers in the north bio-area (31%) had access to water sources than farmers in the south bio-area (24%; Table A6).

Finally, the average age of all farm infrastructures (excluding access to water sources) was 13 years (Table A6). Further, farm infrastructure was four years older in the north bio-area than in the south bio-area (5% SL). Among farmers having these farm infrastructures, 42% of them reported they had made major improvements in at least one of these infrastructures since these were constructed/obtained.

4.5. Field characteristics and crop management

For each field where farmers grew cowpeas in the 2011 production season, farmers were asked about the characteristics of these fields, land tenure, and their use in the previous year, which are discussed next. Further, farmers were asked many questions related to their cowpea crop

[5] Age refers to the number of years since the infrastructure or service was constructed or acquired.

production and management. From these, responses about intercropped production, use of improved varieties (IVs), use of fertilizers (inorganic and organic), and use of fungicides during the 2011 production season are discussed next.

4.5.1. Field characteristics

While farmers planted an average of 1.3 fields with cowpeas, the number of fields planted with cowpeas was statistically (1% SL) higher in the south bio-area, where farmers planted an average of 1.4 fields with cowpea versus 1.1 fields in the north bio-area (Table 2). From these fields, most were flat (0.85 fields) to medium-sloped (0.39 fields), which together represented 99% of the cowpea fields planted in the 2011 season (Table 2). While the number of flat fields was statistically (1% SL) higher in the south bio-area, the number of medium-sloped fields was statistically (1% SL) higher in the north bio-area.

Overall, most fields (0.91 fields) had no rocks that could affect crop production. However, the number of fields without rocks was statistically (1% SL) higher in the south bio-area. Further, the number of cowpea fields with none-to-some rocks represented approximately 97% of all cowpea fields. While almost 90% of the fields used for cowpea production were owned; sharing or borrowing fields was common--approximately one in nine cowpea fields were shared or borrowed (Table 2).

In the sample, 0.15 fields were in fallow in the previous season, or roughly 12% of the fields. This may be an indicator that farmers have learned to fallow their fields to help restore soil fertility. Further, crop rotation was very common, especially rotating cowpea with cereals--approximately 0.71 of the 1.3 cowpea fields (or 55% of the fields) were planted with cereals in the previous season. The number of fields that were planted with cowpeas two seasons in a row was very small (approximately 7% of the cowpea fields), which is good since crop rotation helps to improve soil fertility, control pests and diseases. Finally, as expected, male heads managed most cowpea fields (Table 2).

Table 2. Cowpea field characteristics, crops grown prior to cowpea, and field management, by bio-area and province. Burkina Faso, 2011.

	Bio-area/Province													
	South						North							
Detail	**Houet**	**Tuy**	**Ioba**	**Zound-weogo**	**Boulgou**	**Total South**	**Banwa**	**Mouhoun**	**Sanguie**	**Bazega**	**Ganzor-gou**	**Total North**	**t-test[1]**	**Total sample**
Characteristics of cowpea fields														
No. of flat fields	1.10	0.99	1.30	0.72	1.09	1.03	0.71	0.87	0.76	0.22	1.25	0.61	***	0.85
No. of medium-sloped fields	0.24	0.12	0.70	0.44	0.29	0.30	0.26	0.27	0.40	0.84	0.15	0.51	***	0.39
No. of steep-sloped fields	0	0	0.09	0	0.01	0.01	0.03	0.01	0.01	0.04	0.04	0.03		0.02
No. of fields without rocks	1.20	0.78	1.02	1.03	1.05	1.03	0.62	1.06	1.09	0.34	0.92	0.75	***	0.91
No. of fields with some rocks	0.14	0.32	0.75	0.13	0.33	0.27	0.37	0.08	0.07	0.63	0.51	0.33		0.30
No. of fields with a lot of rocks	0	0.02	0.32	0	0	0.04	0.01	0	0.01	0.13	0.01	0.05		0.05
No. of fields owned	1.34	1.03	1.83	0.85	1.15	1.23	1	0.71	0.94	0.99	1.44	0.95	***	1.11
No. of fields rented in	0	0.02	0	0	0.10	0.01	0	0	0	0	0	0		0.01
No. of fields shared/borrowed	0	0.06	0.26	0.32	0.14	0.11	0	0.44	0.23	0.11	0	0.18	**	0.14
Share of cowpea fields flat-to-medium sloped (%)	100	100	94	100	100	99	97	99	99	96	98	98		99
Share of cowpea fields with none-to-some rocks (%)	100	98	85	100	100	98	99	100	99	87	100	95	**	97
Share of cowpea fields owned (%)	100	92	88	75	85	91	100	61	84	89	100	85	**	88
Crops grown prior to cowpea														
No. of fields in fallow	0.22	0.07	0.36	0.10	0.19	0.18	0.00	0.21	0.21	0.04	0.09	0.11	**	0.15
No. of fields with cereals[2]	0.75	0.62	0.78	0.77	1.07	0.76	0.66	0.34	0.92	0.53	1.02	0.65	**	0.71
No. of fields with cowpea[3]	0.16	0.04	0.16	0.01	0.02	0.09	0	0	0.02	0.16	0.21	0.07		0.09
No. of fields with cotton	0.19	0.35	0.38	0.03	0.05	0.21	0.06	0.05	0	0	0.08	0.02	***	0.12
No. of fields with peanut	0	0	0.41	0.22	0.04	0.09	0.05	0.12	0.01	0.36	0.02	0.16	***	0.12
No. of fields managed by:														
Male heads	1.25	1.09	1.47	0.90	1.26	1.18	1	1.05	1.04	0.90	1.25	1	***	1.10
Female heads	0	0.02	0	0	0	0.003	0	0	0.10	0	0	0.03	**	0.02
A male spouse	0	0	0.03	0.03	0.03	0.01	0	0	0	0	0.02	0.001		0.01
A female spouse	0.09	0	0.16	0	0.04	0.06	0	0.10	0.02	0.07	0.06	0.05		0.05
No. of cowpea fields planted	**1.3**	**1.1**	**2.1**	**1.2**	**1.4**	**1.4**	**1.0**	**1.1**	**1.2**	**1.1**	**1.4**	**1.1**	***	**1.3**
Number of observations	60	50	50	50	60	270	60	50	60	60	60	290	--	560

[1] Test of difference between means of households in the South and North bio-areas: *significant at 10%; **significant at 5%; ***significant at 1%; -- not tested.
[2] Cereals only include maize, sorghum, and millet; [3] Includes monocropped and intercropped cowpea. NOTES: Estimates weighted to reflect population (except number of observations). Number of observations is at the household level: each field-level variable was re-estimated (by creating binary variables for each category) at the household level. Source: CRSP Baseline Survey on Management of Field Insect Pests of Cowpea, Burkina Faso, 2012.

4.5.2. Intercropped production, adoption of IVs, and details about most common IV and local varieties grown

The results suggest that 37% of the cowpea fields were planted intercropped and that in almost all of these intercropped fields (97%), cowpeas were planted intercropped with cereals (Table 3A). Further, both the share of cowpea fields planted intercropped and the share of intercropped fields planted with cereals were statistically significantly (1% SL) higher in the south bio-area.

From all IVs, the variety most commonly grown was KVX 396-4-5-2D (36% of fields), followed far behind by KVX 61-1 (8% of fields, Table 3A). The use of improved cowpea varieties (IV) in the sampled provinces was high both on the number of farmers growing an IV and the share of the cowpea area planted with an IV. While 58% of all farmers grew at least one IV, a statistically significantly higher (1% SL) share of farmers in the south bio-area (67%) grew at least one IV compared with farmers in the north bio-area (46%). Further, 51% of the cowpea area was planted with an IV[6] and the adoption rate was statistically significantly higher (1% SL) in the south bio-area, where 59% of the area was planted with IVs compared to 42% in the north bio-area (Table 3A).

Given that most farmers grew only one IV, the following discussion only focuses on the most common IV (KVX 396-4-5-2D) and on local varieties. While the most common sources of seed of the variety KVX 396-4-5-2D were the government (46% of fields grown with this IV used seed from this source), purchases from seed producers (22%), and stored grain (15%), the most common sources of seed of local varieties were stored grain (64% of fields grown with local varieties used seed from this source) and grain purchased in the market (31%; Table 3B). Since the GOBF has subsidized farmers with seed of IVs during the past five years, it is no surprise that farmers reported this as the main source of seed of IVs. Further, the data suggest that there is a potential market for seed of IVs since in 22% of the fields with KVX 396-4-5-2D, the seed was purchased from seed producers (Table 3B).

Interestingly, while the main traits farmers liked from the improved variety KVX 396-4-5-2D were its good yield (72% of responses), early maturity (42%), and good market value (40%) --all market-related characteristics,-- the main traits farmers liked from local varieties were the good cooking quality or taste (51%) and good yields (37%; Table 3B). These results suggest that farmers may be growing the IV with the intention of selling their output (for which cooking quality/taste is not too important to them) and the local varieties for home consumption.

When asked about what traits farmers disliked from the variety KVX 396-4-5-2D, 79% of the responses indicated its susceptibility to diseases and insects. However, an equally important share of responses (76%) indicated there was nothing they disliked from this IV, which, together with the fact that only 2% of responses indicated low yields were an issue, suggest that farmers

[6] The following IVs were grown by farmers and used in the estimation of adoption rates: KVX 396-4-5-2D, KVX 61-1, IT 98K-205-8, KVX 745-11P, KVX 414-22-2, KVX 442, and improved varieties for which farmers did not know their names but that were identified as such.

Table 3A. Intercropped production, varieties grown, and adoption of improved varieties in the 2011 cowpea production season, by bio-area. Burkina Faso.

Detail	Bio-area[1]			Total sample
	South	North	t-test[2]	
Cowpea fields planted intercropped (%)	42	28	***	37
Share of intercropped fields with cereals? (%)[3]	99	91	***	97
Varieties grown (% of fields):				
KVX 396-4-5-2D	40	31	--	36
KVX 61-1	8.6	6.7	--	8
Other improved varieties (named)	0.7	1.6	--	1
Other improved varieties (unknown name)	8.5	5.0	--	7
Local varieties (no name)	42	49	--	45
Did not know variety name/type	0.5	6.4	--	3
Number of observations	391	345	--	736
Farmers growing at least one improved variety (%)	67	46	***	58
Adoption rates of improved varieties (% of cowpea area)	59	42	***	51
Number of observations	270	290	--	560

[1] The south bio-area includes the provinces of Houet, Tuy, Ioba, Zoundweogo, and Boulgou. The north bio-area includes the provinces of Banwa, Mouhoun, Sanguie, Bazega, and Ganzorgou.

[2] Test of difference between means of households in the South and North bio-areas: *significant at 10%; **significant at 5%; ***significant at 1%; -- not tested.

[3] Cereals only include maize, sorghum, and millet. Most commonly planted cereal when intercropped was sorghum.

Estimates weighted to reflect population (except number of observations).

Source: CRSP Baseline Survey on Management of Field Insect Pests of Cowpea, Burkina Faso, 2012.

Table 3B. Seed sources, traits farmers like and dislike, amount of seed used, and current and future use of most commonly grown improved variety and local varieties in the 2011 season, by bio-area and province. Burkina Faso.

	Bio-area/Province													
	South						North							
Detail	Houet	Tuy	Ioba	Zound-weogo	Boulgou	Total South	Banwa	Mouhoun	Sanguie	Bazega	Ganzor-gou	Total North	t-test[1]	Total sample
Fields planted with KVX 396-4-5-2D (%)[2]	54	46	35	6	31	40	6	33	40	31	25	31	**	36
Seed sources (% yes)[3]:														
Stored grain	29	11	17	56	12	22	6	9	0	0	13	2	***	15
Grain purchased in market	0	0	38	0	19	8	11	0	0	0	32	2	*	6
Bought from seed producers	44	0	9	0	29	26	0	70	0	0	11	13	**	22
Given by the government	17	89	11	0	5	30	0	15	88	100	25	74	***	46
Main traits farmers like (% yes)[4]:														
Good yields	74	56	59	0	82	67	100	66	96	78	35	81	**	72
Early maturity	28	32	38	0	35	31	0	50	59	80	64	64	***	42
Good cooking quality/taste	20	32	55	44	33	30	100	26	13	42	49	29		30
Good market value	65	62	38	44	15	55	0	7	19	1	37	11	***	40
Main traits farmers dislike (% yes)[4]:														
Nothing	88	76	70	44	41	78	100	7	93	81	85	73		76
Low yields	0	4	13	11	0	3	0	0	0	0	11	1		2
Susceptible to insects/diseases	100	94	88	100	36	91	41	93	74	22	28	56	***	79
Susceptible to striga (weed)	5	0	0	0	48	7	0	16	0	0	0	3		6
Quantity of seed used (kg)	9.8	10.0	4.4	5.6	9.9	8.9	10.5	9.6	6.7	5.1	9.4	6.9	**	8.2
Years using this variety	4.5	3.2	6.8	4.3	5.6	4.7	5.1	2.0	5.0	1.0	12.5	3.5	**	4.3
Will grow it in 2012 (% yes)	97	96	64	100	74	89	100	97	100	81	95	92		90
Fields planted with local varieties (%)[2]	38	32	49	78	21	42	43	51	46	51	60	49	**	45
Seed sources (% yes)[3]:														
Stored grain	99	74	78	36	5	70	44	38	50	72	57	56	***	64
Grain purchased in market	0	18	18	64	89	27	50	44	49	16	43	36	*	31
Bought from seed producers	0	0	0	0	0	0	0	0	0	0	0	0	--	0
Given by the government	0	0	0	0	0	0	0	0	0	0	0	0	--	0

Table 3B (cont'd.)

	Bio-area/Province													
	South						North							
Detail	**Houet**	**Tuy**	**Ioba**	**Zound-weogo**	**Boulgou**	**Total South**	**Banwa**	**Mouhoun**	**Sanguie**	**Bazega**	**Ganzor-gou**	**Total North**	**t-test[1]**	**Total sample**
Main traits farmers like (% yes)[4]:														
Good yields	1	15	35	51	34	24	93	43	38	64	33	53	***	37
Early maturity	4	21	7	29	3	13	17	53	28	7	0	21	**	17
Good cooking quality/taste	77	85	35	20	63	54	72	61	15	51	88	48		51
Good market value	10	2	23	19	12	14	5	11	39	18	64	26	***	19
Main traits farmers dislike (% yes)[4]:														
Nothing	60	56	53	41	22	51	100	4	86	89	94	74	***	61
Low yields	38	59	44	30	44	41	0	28	8	8	12	11	***	28
Susceptible to insects/diseases	58	34	40	71	38	52	0	82	18	40	23	37	***	45
Susceptible to striga (weed)	0	0	2	18	47	8	0	4	0	15	0	6		7
Quantity of seed used (kg)	5.3	6.6	4.2	5.3	7.8	5.4	7.6	5.0	5.4	6.2	7.4	6.0	*	5.7
Years using this local variety	7.1	4.3	23.4	4.3	10.4	9.8	3.9	4.1	12.6	10.7	23.5	10.6		10.2
Will grow it in 2012 (% yes)	100	42	51	78	84	75	100	76	100	75	100	87	***	80
Number of observations	80	59	101	59	92	391	60	59	70	69	87	345	--	736

[1] Test of difference between means of households in the South and North bio-areas: *significant at 10%; **significant at 5%; ***significant at 1%; -- not tested.

[2] For variables within each variety grown (i.e. KVX 396-4-5-2D or local) the number of observations is different (less) than in the last row because means were estimated at the variety level (i.e. subset of farmers), not at the field level.

[3] Seed sources exclude other categories (e.g. given by NGOs, other farmers); therefore, columns may not add to 100%.

[4] Farmers were asked what traits they like/dislike from the variety they planted. They were asked for the two main traits. These two answers were combined to estimate the percentages shown. Therefore, columns may not add to 100%.

Estimates weighted to reflect population (except number of observations). Number of observations refers to number of cowpea fields grown.

Source: CRSP Baseline Survey on Management of Field Insect Pests of Cowpea, Burkina Faso, 2012.

are satisfied with the performance of this variety. Although a similar pattern was found when farmers reported what traits they disliked from local varieties (i.e. main two responses were nothing and their susceptibility to insects/diseases), 28% of responses indicated that low yields were an issue with these varieties (Table 3B), which was no surprise.

While farmers have been growing the variety KVX 396-4-5-2D for more than four years, they have been growing their local varieties for slightly more than 10 years. Finally, most farmers indicated they intend to use the same IV and local variety in the following year (Table 3B).

4.5.3. Use of chemical and organic fertilizers

Surprisingly, the use of both chemical and organic fertilizers in at least one cowpea field was high. While three out of five farmers reported using chemical fertilizer in at least one cowpea field, slightly more than two out of five farmers (46%) reported using organic fertilizer in at least one cowpea field in the 2011 season (Table 4). Most farmers who applied chemical fertilizer did so to cowpea since only 13% of the fields where fertilizers were applied were grown intercropped. There were no statistically significant differences in the number of farmers using fertilizers between the south and north bio-areas.

The most commonly used chemical fertilizers were NPK and UREA. While most farmers (89%) using chemical fertilizers applied NPK to at least one cowpea field, only 20% of farmers applied UREA. This may not be a surprise since NPK is generally applied at planting, which makes it easier to apply, while UREA is generally applied several weeks after planting (and sometimes is not recommended due to the symbiotic relation between cowpea plants and *Rhizobium* bacteria, which fixates nitrogen), and since NPK was cheaper than UREA--farmers reported unit purchase and transportation costs of 357 CFA/kg (US$0.77/kg) for NPK and 402 CFA/kg (US$0.87/kg) for UREA (Table 4).

While there were no statistically significant differences in the number of farmers applying UREA between the two bio-areas, it is worth mentioning that, while the use of UREA was spread across most provinces in the south bio-area, the use of UREA was concentrated in only two provinces (mainly in Bazega and far behind in Sanguie) in the north bio-area. In contrast, the number of farmers applying NPK was statistically significantly higher in the south bio-area and the use of NPK was spread across all provinces in the study (Table 4).

Farmers applied more than twice the amount of NPK than UREA. Further, 50% of farmers using UREA reported applying more in 2011 than in the previous two years, compared to only 24% of farmers using NPK. While 46% of farmers using UREA reported purchasing it in local markets, only 31% of farmers using NPK bought this fertilizer in local markets (Table 4). Since most farmers used NPK, most farmers purchased this fertilizer from places other than their local market, and given the difference in time when NPK and UREA are needed, it is likely that is easier for farmers to purchase NPK at the beginning of the season, when they are investing in their crops, than purchasing UREA later in the season, when they may be cash-constrained.

Finally, farmers using organic fertilizer in at least one cowpea field applied an average of 1,264 kg per hectare. Further, farmers in the south bio-area applied statistically significantly more organic fertilizer than farmers in the north bio-area (Table 4).

Table 4. Farmers' use of fertilizer during the 2011 production season, by bio-area and province. Burkina Faso.

	Bio-area/Province													
	South						North							
Detail	**Houet**	**Tuy**	**Ioba**	**Zound-weogo**	**Boulgou**	**Total South**	**Banwa**	**Mouhoun**	**Sanguie**	**Bazega**	**Ganzor-gou**	**Total North**	**t-test[1]**	**Total sample**
Use of fertilizer in at least one cowpea field (%)														
HH applying chemical fertilizer	61	75	68	41	51	61	59	52	85	45	38	59		60
HH applying organic fertilizer	74	47	18	20	33	48	38	10	66	36	61	42		46
Number of observations	60	50	50	50	60	270	60	50	60	60	60	290	--	560
For farmers using fertilizer in at least one cowpea field[2]														
Farmers using Urea (%)	8	0	64	49	33	20	0	0	5	64	0	20		20
Quantity used (kg/ha)	36	n.a.	14	37	42	28	n.a.	n.a.	20	23	n.a.	23		26
Used more urea in 2011, compared to last 2 yrs (% yes)	0	n.a.	36	28	51	31	n.a.	n.a.	0	94	n.a.	81	***	50
Purchased in local market (% yes)	100	n.a.	8	68	18	39	n.a.	n.a.	100	49	n.a.	54		46
Per unit purchase and transportation cost (CFA/kg)	344	n.a.	363	463	270	370	n.a.	n.a.	380	450	n.a.	443	***	402
Farmers using NPK (%)	96	100	98	86	77	94	100	100	98	36	100	81	***	89
Quantity used (kg/ha)	92	68	28	21	53	66	33	66	41	31	42	43	***	57
Used more NPK in 2011, compared to last 2 yrs (% yes)	0	4	49	26	54	15	75	53	30	3	10	38	***	24
Purchased in local market (% yes)	14	6	5	47	7	13	36	58	78	4	54	59	***	31
Per unit purchase and transportation cost (CFA/kg)	293	313	329	524	291	325	584	308	392	392	411	404	***	357
Number of observations	35	38	34	24	35	166	32	25	42	16	23	138	--	304
For farmers using organic fertilizer in at least one cowpea field[2]														
Quantity applied (kg/ha)	1,244	1,935	2,081	460	1,704	1,426	1,753	688	990	747	1,701	1,039	***	1,264
Number of observations	46	22	8	10	24	110	19	5	32	22	34	112	--	222

[1] Test of difference between means of households in the South and North bio-areas: *significant at 10%; **significant at 5%; ***significant at 1%; -- not tested.
[2] For quantity of fertilizers (chemical and organic) used, hectares refer to total hectares where cowpea was planted (either monocropped or intercropped); not monocrop-equivalent hectares.
Estimates weighted to reflect population (except number of observations). n.a. = not applicable.
Source: CRSP Baseline Survey on Management of Field Insect Pests of Cowpea, Burkina Faso, 2012.

4.5.4. Use of fungicides

Two out of three farmers reported using fungicides in at least one cowpea field during the 2011 season (Table 5). Perhaps the training they received between 2009-2011 (as reported in Table A4) on pesticide use has contributed to the use of fungicides, especially in the south bio-area. Further, only 18% of farmers reported that disease incidence was worst in 2011 compared to the previous two years (see Table 6, discussed in section 5.1).

The most commonly used fungicides were Calthio (active ingredient, a.i.: Thirame + Chlorpyrifos-ethyl) and Caiman Rouge (a.i.: Thirame + Endosulfan). Although farmers reported Caiman Rouge as a fungicide, this product (a) is not officially registered for commercial use in the country and (b) is a mixture of a fungicide and an insecticide. Thus, since farmers reported it in fungicide category, this product is reported in this section of the document. While most farmers (64%) using fungicides applied Calthio to at least one cowpea field, only 31% of farmers applied Caiman Rouge in 2011. Further, the number of farmers applying Calthio was statistically significantly higher in the north bio-area and the use of Calthio was spread across all provinces in the study. In contrast, the number of farmers applying Caiman Rouge was statistically significantly higher in the south bio-area and, while the use of Caiman Rouge was spread across most provinces in the south bio-area, the use of Caiman Rouge was concentrated in only two provinces (mainly in Mouhoun and far behind in Banwa) in the north bio-area (Table 5).

Farmers applied more Calthio than Caiman Rouge (100 g/ha vs. 61 g/ha, respectively). Further, 10% of farmers using Calthio reported applying less[7] in 2011 than in the previous two years, compared to only 7% of farmers using Caiman Rouge. While farmers using Calthio applied 1.4 times this fungicide during the crop cycle, farmers using Caiman Rouge made only one application during the crop cycle. Additionally, while 55% of farmers using Calthio reported purchasing it in local markets, eight out of ten farmers using Caiman Rouge bought this fungicide in local markets (Table 5).

The results also suggest that Calthio may be easier to obtain in the north bio-area because 82% of farmers in this bio-area purchased it in local markets, compared to only 34% of farmers in the south bio-area (1% SL). Further, either farmers in the north bio-area were over-using this product in 2011 or the incidence of diseases in this bio-area was high in 2011 because farmers in the north bio-area applied more of this fungicide (124 g/ha vs. 81 g/ha in the south bio-area) and made more applications during the crop cycle (1.8 vs. 1.1 applications in the south bio-area; Table 5). Since statistically significantly more farmers in the north bio-area reported that the incidence of diseases was worst in 2011 compared to the previous two years than farmers in the south bio-area (23% vs. 14%, respectively; see Table 6, which is discussed in section 5.1), it is likely that the high incidence of diseases was the reason behind the increased use of fungicides in 2011.

[7] While the trend in the use of fertilizer was reported for farmers using more fertilizer in 2011 than in the previous two years, for use of fungicides and insecticides, this trend is reported for farmers using less of these inputs in 2011 than in the previous two years because it is expected that, after the project intervention, the number of farmers reporting they have used less insecticides may increase (and the same may be observed for farmers using fungicides).

Table 5. Farmers' use of fungicides during the 2011 production season, by bio-area and province. Burkina Faso.

	Bio-area/Province													
	South						North							
Detail	**Houet**	**Tuy**	**Ioba**	**Zound-weogo**	**Boulgou**	**Total South**	**Banwa**	**Mouhoun**	**Sanguie**	**Bazega**	**Ganzor-gou**	**Total North**	**t-test[1]**	**Total sample**
Farmers applying fungicides in at least one cowpea field (%)	97	90	56	53	73	81	59	64	83	1	80	47	***	66
Number of observations	60	50	50	50	60	270	60	50	60	60	60	290	--	560
For farmers using fungicides in at least one cowpea field[2]														
Farmers using Calthio (%)	43	33	79	77	89	52	99	58	100	100	96	90	***	64
Quantity used (g/ha)	86	59	59	101	89	81	92	366	81	43	73	124	**	100
Used a lower amount, compared to last 2 yrs (% yes)	7	35	6	4	0	10	0	43	4	100	2	9		10
No. of applications (all fields)	1.0	1.0	1.6	1.1	1.1	1.1	2.4	1.0	1.9	1.0	1.0	1.8	***	1.4
Purchased in local market (% yes)	23	36	37	77	19	34	25	65	100	100	87	82	***	55
Farmers using Caiman Rouge (%)	54	67	0	19	10	45	1	6	0	0	0	2	***	31
Quantity used (g/ha)	64	62	n.a.	43	25	62	13	40	n.a.	n.a.	n.a.	37		61
Used a lower amount, compared to last 2 yrs (% yes)	4	8	n.a.	0	38	6	0	50	n.a.	n.a.	n.a.	45	**	7
No. of applications (all fields)	1.0	1.0	n.a.	1.0	1.4	1.0	1.0	1.0	n.a.	n.a.	n.a.	1.0		1.0
Purchased in local market (% yes)	86	74	n.a.	65	19	79	100	100	n.a.	n.a.	n.a.	100		80
Number of observations	58	45	27	28	43	201	35	32	44	2	50	163	--	364

[1] Test of difference between means of households in the South and North bio-areas: *significant at 10%; **significant at 5%; ***significant at 1%; -- not tested.
[2] For quantity of funcigides used, hectares refer to total hectares where cowpea was planted (either monocropped or intercropped); not monocrop-equivalent hectares.
Estimates weighted to reflect population (except number of observations). n.a. = not applicable.
Source: CRSP Baseline Survey on Management of Field Insect Pests of Cowpea, Burkina Faso, 2012.

4.6. Marketing strategies for cowpea grain

This sub-section describes farmers' strategies for selling their cowpea grain outputs. Farmers selling cowpea grain were asked when they sell their surpluses and why they sell at that particular time during the year. They were also asked where they sell their grain surpluses and why. Their responses are presented at the household level in Tables A7 and A8 for households selling cowpea grain--46% of households sold cowpea grain; 52% in the south bio-area and 40% in the north bio-area (1% SL).

4.6.1. Timing of sales

Regarding the timing of their sales, there were slight differences in the month when farmers sold their surpluses between the two bio-areas. While most farmers in the south bio-area reported February (18%) and March (19%) as the main months to sell grain, most farmers in the north bio-area reported December (25%) and February (22%) as the main months for sales (Table A7). Further, in the south bio-area, the period between October to December was also important to sell grain. In contrast, in the north bio-area, the months of October, January and March were also important for sales (Table A7).

The main reasons for selecting any given period to sell surpluses were the good price in the market (40% of sellers reported this reason) and other reasons (55%), which included school-related expenses, cash needs, and paying for health-related problems (Table A7). However, there were differences in the reasons provided between the two bio-areas. While 55% of farmers in the south bio-area reported the good price as the reason for selling in any given period (vs. 42% of farmers stating 'other reasons'), 76% of farmers in the north bio-area reported 'other reasons' for selling in a particular period (vs. only 18% reporting good price), being the main 'other reason' farmers' need for cash.

Lack of storage was rarely cited as a reason for selecting a particular period to sell, which suggests that storage may not be a constraint. One reason for this may be due to the fact that the PICS (Purdue Improved Cowpea Storage) project heavily promoted the use of triple bagging as a storage method between 2008-2011. Further, this technology has been promoted for several years prior to 2008. Moussa *et al.* (2011) reported that 13% of the cowpea farmers in Burkina Faso in 2003 and 2004 stored cowpeas using this technology.[8] However, further interviews are needed to better understand the link between sales and potential storage or marketing constraints.

4.6.2. Location of sales

Not surprisingly, across the two bio-areas, most farmers used their local markets for selling cowpea grain surpluses, and indicated that this location is chosen because it is easily accessible (Table A8). In fact, accessibility to markets was the main reason cited for selling at any particular location across both bio-areas. About 57% of farmers in the south bio-area and 79% of farmers in the north bio-area used local markets to sell, and the majority of those farmers

[8] Researchers knowledgeable about this technology in Burkina Faso suspect that this estimate reported by Moussa *et al.* (2011) reflects the practice of storing cowpea grains in a triple bag after "solar heating" or in association with insecticides.

indicated that they sold in local markets because they were easily accessible (51% in the south and 35% in the north) or the good price (6% in the south and 29% in the north; Table A8). Selling from the home occurred with about 32% of the households in the south bio-area and only 8% of households in the north bio-area. Finally, the main reason for farmers who sold cowpea grain in other markets was the good price (Table A8).

5. Indicator/outcome variables

This section contains information about the variables considered as key indicators to evaluate the effect and magnitude of the project intervention in the future. Among the indicators are the major stresses affecting cowpea in the 2011 season, farmers' use of insecticides, farmers' knowledge about bio control agents to control insect pests, pesticide management practices, negative health effects from pesticide (mis)use, use of labor during cowpea production, cowpea outputs, cowpea revenues, and the importance of the cowpea crop as a source of income and food security.

5.1. Biotic and abiotic stresses and primary insect pests in 2011

All farmers were asked whether different biotic (e.g. insects) and abiotic (e.g. droughts) stresses were worst in 2011 compared to the previous two years. Further, farmers who had applied pesticides at least once to cowpeas were asked what were the main insect pests affecting their cowpea crop in 2011. The data shows that the main biotic stress affecting the crop was insect incidence and that the main abiotic stress was drought. While 52% of farmers reported that the incidence of insect pests in 2011 was worst than in the previous two years, this incidence was more problematic in the north bio-area, where 79% of farmers responded that this was true for at least one of their cowpea fields, compared to only 30% of farmers in the south bio-area. Further, while almost nine out of ten farmers reported that droughts were worst in at least one of their cowpea crops in 2011 compared to the previous two years, a statistically significantly higher share of farmers in the north bio-area reported droughts were worst in 2011 than in the south bio-area (Table 6).

One out of four farmers who had applied pesticides at least once to cowpeas reported that the main insect pest affecting the cowpea crop in 2011 were coreid pod-sucking bugs.[9] Other insect pests affecting this crop included legume pod borer (18% of farmers reported this insect), groundnut aphids (17%), and thrips (16%; Table 6). The reliability of farmers' responses to this question depends on how well they can identify the different pests affecting the crop, which was not evaluated in this study. Since 16% of farmers did not know the name of the insect pests affecting the cowpea crop, these results should be interpreted with care.

Since the project will use bio-control agents to control the legume pod borer, further information about the damage caused by this pest is also provided in Table 6. Among farmers who reported legume pod borer as the main pest affecting their cowpea crop, 30% reported that the severity of the damage caused by this pest in 2011 was high. However, only farmers in the north bio-area reported that the damage in 2011 was worst than in the previous two years. This was unexpected since previous data suggest that damage was more severe in 2010 than in 2011 (Traore *et al*., 2013).

[9] Coreid bugs include *Anoplecnemis curvipes, Riptortus dentipes, Clavigralla tomentosicollis, C. shadabi, and C. elongata* (IITA, 1985; p 219).

Table 6. Biotic and abiotic stresses affecting cowpea crop during the 2011 season, by bio-area and province. Burkina Faso.

	Bio-area/Province													
	South						North							
Detail	**Houet**	**Tuy**	**Ioba**	**Zound-weogo**	**Boulgou**	**Total South**	**Banwa**	**Mouhoun**	**Sanguie**	**Bazega**	**Ganzor-gou**	**Total North**	**t-test[1]**	**Total sample**
This stress was worst in at least one cowpea field compared to previous two years (% yes):														
Insects incidence	9	3	92	36	78	30	100	93	93	53	84	79	***	52
Diseases	1	3	66	13	23	14	93	19	6	10	71	23	***	18
Droughts	93	95	81	67	72	86	100	68	97	99	83	92	**	89
Floodings	0	0	1	0	8	1	0	1	5	0	14	3		2
Number of observations	60	50	50	50	60	270	60	50	60	60	60	290	--	560
Main insect pest was (% yes):														
Legume pod borer	26	7	13	5	51	18	21	11	33	1	26	17		18
Coreid pod-sucking bugs	21	0	25	17	13	14	58	77	46	0	41	39	***	26
Groundnut aphids	14	16	34	37	18	21	3	8	21	9	26	13	**	17
Thrips	28	56	3	3	8	26	0	3	0	12	3	5	***	16
Don't know name of pest	9	15	0	26	10	12	18	1	0	56	0	20	**	16
Other insects	0	1	26	12	0	6	0	0	0	21	5	7		6
For farmers reporting legume pod borer as the main insect pest (% yes):														
Severity of damage in 2011 was high?	0	0	68	0	84	30	100	24	8	0	67	30		30
Damage in 2011 was worst than in previous two years?	0	0	0	0	0	0	88	49	0	69	59	27	***	12
Number of observations	40	45	43	45	41	214	59	50	47	30	52	238	--	452

[1] Test of difference between means of households in the South and North bio-areas: *significant at 10%; **significant at 5%; ***significant at 1%; -- not tested.
Estimates weighted to reflect population (except number of observations).
Source: CRSP Baseline Survey on Management of Field Insect Pests of Cowpea, Burkina Faso, 2012.

5.2. Use of insecticides

The use of chemical insecticides in 2011 was common--83% of farmers applied insecticides to any crop grown, especially cowpea (79%). Further, the use of insecticides on cowpea was statistically significantly more frequent in the north bio-area than in the south bio-area (85% vs. 74%, respectively; Table 7). While two-thirds of farmers who applied insecticides reported that the largest quantity of insecticide was applied to cowpea, 27% reported they applied the most to cotton and only 4% reported they applied the most to cereals (Table A9). This was surprising since in nine of the ten provinces in the study, cotton is an important crop and the use of insecticides on this crop is common. Further, a statistically significantly higher share of farmers in the north bio-area reported applying the most insecticide to cowpeas than farmers in the south.

Farmers who applied insecticides to the cowpea crop mostly used three insecticides: Cypercal (a.i.: cypermethrine + profenofos) /Lambdacal (a.i.: lamda-cyalothrine + profenofos) (45% of farmers), Decis (a.i.: deltamethrine; 26% of farmers), and Conquest (a.i.: acetamipride + cypermethrine; 23% of farmers). Farmers generally applied more Conquest per hectare (1,678 ml/ha) than Cypercal/Lambdacal (1,528 ml/ha) or Decis (1,479 ml/ha). Further, the average number of applications ranged from 2.3 applications for farmers using Cypercal/Lambdacal to 2.7 applications for farmers using Conquest (Table 7). Generally, Cypercal/Lambdacal and Conquest are recommended for use on cotton (and not cowpea). Thus, these results suggest that farmers may be misusing these insecticides since they are applying them to the cowpea crop.

While slightly more than two thirds of farmers using either Conquest or Decis were satisfied with the effectiveness of these insecticides, a higher share of farmers (76%) were satisfied with the effectiveness of Cypercal/Lambdacal. Additionally, between 21% (farmers applying Decis) and 33% (farmers applying Conquest) of farmers reported using a lower amount of insecticide in 2011 compared to the previous two years (Table 7). It is expected that this number will increase after the project intervention.

There were statistically significant differences in the use of insecticides between the two bio-areas. A statistically significantly higher share of farmers (34%) in the south bio-area used either Decis or Conquest, compared to only 18% of farmers applying Decis and 11% of farmers applying Conquest in the north bio-area. Further, while the use of Decis was spread across all provinces, the use of Conquest was concentrated to three provinces in the south bio-area and two provinces in the north bio-area (Table 7). In contrast, the use of Cypercal/Lambdacal was statistically significantly higher in the north bio-area, where 59% of farmers used this product compared to only 31% of farmers in the south bio-area. Similar to Decis, the use of Cypercal/Lambdacal was spread across most provinces in both bio-areas (Table 7).

Farmers in the north bio-area applied statistically significantly more insecticide to their fields and made more applications during the crop cycle than farmers in the south bio-area (Table 7), which is understandable since a statistically significantly higher share of farmers in the north bio-area reported that insect incidence in 2011 was worst than in the previous two years, compared to farmers reporting this in the south bio-area (see Table 6). Further, while farmers in the south and north bio-areas were equally satisfied with the effectiveness of Decis and Conquest, a higher share of farmers in the south bio-area were satisfied with the effectiveness of Cypercal/ Lambdacal, compared to farmers in the north (94% vs. 66%, respectively; Table 7).

Table 7. Farmers' use of insecticides during the 2011 season, by bio-area and province. Burkina Faso.

	Bio-area/Province													
	South						North							
Detail	Houet	Tuy	Ioba	Zound-weogo	Boulgou	Total South	Banwa	Mouhoun	Sanguie	Bazega	Ganzor-gou	Total North	t-test[1]	Total sample
HH applying insecticides on (%):														
Any crop grown	68	94	91	89	68	80	100	100	87	74	77	85		83
Crops other than cowpea	0	19	8	3	0	6	0	0	0	0	0	0	***	3
Cowpea (mono + inter cropped)	68	75	83	86	68	74	100	100	87	74	77	85	***	79
Number of observations	60	50	50	50	60	270	60	50	60	60	60	290	--	560
For farmers applying insecticides on cowpea in 2011:[2]														
Farmers using Decis (%)	22	2	27	67	96	34	31	16	30	1	40	18	***	26
Quantity used (ml/ha)	1,432	2,000	194	559	2,101	1,202	2,085	2,328	2,060	2,000	1,232	2,018	***	1,479
Used a lower amount, compared to last 2 yrs (% yes)	15	100	29	28	7	20	16	63	8	0	33	22		21
No. of applications (all fields)	1.7	2.0	2.8	2.3	2.5	2.3	2.9	3.2	2.5	3.0	2.8	2.7	***	2.4
Satisfied with effectiveness of insecticide (% yes)	80	100	93	67	44	66	100	33	75	100	74	73		68
Farmers using Conquest (%)	44	57	38	0	0	34	62	15	0	0	0	11	***	23
Quantity used (ml/ha)	898	1,632	594	n.a.	n.a.	1,133	4,122	1,523	n.a.	n.a.	n.a.	3,400	***	1,678
Used a lower amount, compared to last 2 yrs (% yes)	63	22	37	n.a.	n.a.	42	0	8	n.a.	n.a.	n.a.	2	***	33
No. of applications (all fields)	2.0	2.1	2.6	n.a.	n.a.	2.1	4.7	3.4	n.a.	n.a.	n.a.	4.3	***	2.7
Satisfied with effectiveness of insecticide (% yes)	55	78	79	n.a.	n.a.	68	89	0	n.a.	n.a.	n.a.	65		67
Farmers using Cypercal/Lambdacal (%)	32	60	12	20	2	31	0	48	65	87	60	59	***	45
Quantity used (ml/ha)	892	1,485	369	923	250	1,124	n.a.	2,861	2,302	1,016	1,139	1,741	*	1,528
Used a lower amount, compared to last 2 yrs (% yes)	17	30	68	29	0	27	n.a.	50	12	21	4	22		24
No. of applications (all fields)	1.1	1.9	2.0	2.4	3.0	1.7	n.a.	3.2	2.5	2.7	1.8	2.7	***	2.3
Satisfied with effectiveness of insecticide (% yes)	86	100	84	100	100	94	n.a.	3	49	98	99	66	***	76
Number of observations	38	40	43	43	41	205	59	50	46	27	50	232	--	437

[1] Test of difference between means of households in the South and North bio-areas: *significant at 10%; **significant at 5%; ***significant at 1%; -- not tested.
[2] For quantity of insecticide used, hectares refer to total hectares where cowpea was planted (either monocropped or intercropped); not monocrop-equivalent hectares.
Estimates weighted to reflect population (except number of observations). n.a. = not applicable.
Source: CRSP Baseline Survey on Management of Field Insect Pests of Cowpea, Burkina Faso, 2012.

5.3. Bio control agents, pesticide management, and health effects

Farmers who had applied pesticides at least once to cowpeas were asked about their knowledge about beneficial insects & viruses, their pesticides storage and disposal practices, knowledge about pesticides' toxicity labels, negative effects from (mis)use of pesticides, and their pesticides application practices. These results are discussed next.

5.3.1. Knowledge about beneficial insects and viruses

Not surprisingly, few farmers knew about the existence of beneficial insects that can help to control cowpea pests and even fewer farmers knew about the existence of beneficial viruses. While eight percent of farmers have heard about beneficial insects (mostly from government extension agents), only two percent of farmers have heard about beneficial viruses that could help to control cowpea insect pests. Further, although a slightly higher share of farmers in the south bio-area knew about beneficial insects and viruses than in the north bio-area, these differences were not statistically significant (Table 8). This lack of knowledge could have a negative impact in the outcomes of the project intervention since farmers do not know how to recognize and increase the populations of these beneficial insects that, after their release, may be killed by the indiscriminate use of insecticides. Therefore, teaching farmers to recognize and increase the population of beneficial insects may be necessary to achieve a greater impact from the project interventions.

5.3.2. Pesticide storage and disposal practices

In general, farmers stored pesticides in a proper way. Most farmers stored pesticides outside the house in a locked place (49% of farmers). Although 15% of farmers stored pesticides inside the house, most of them stored pesticides in a locked place (12% vs. 3% who stored in an un-locked place). Further, 22% of farmers reported storing pesticides over a tree or in the crop-field (un-locked) and only 8% of farmers reported that the place where they store the pesticides was easily accessible to children (Table 8).

There were statistically significant differences in the storage practices between the two bio-areas. While 55% of farmers in the south bio-area stored pesticides outside the house in a locked place, 41% of farmers did so in the north bio-area (1% SL). Similarly, while 16% of farmers in the south bio-area stored pesticides inside the house in a locked place, only 8% of farmers did so in the north bio-area (1% SL). This suggests that a higher share of farmers in the south bio-area stored pesticides in locked places, compared to farmers in the north bio-area. However, the share of farmers who stored pesticides un-locked was also statistically significantly higher in the south bio-area. Finally, storing pesticides over a tree or in the crop-field was more common in the north bio-area (Table 8).

Although only 10% of farmers reported re-using the pesticide containers after they are empty, mostly in the south bio-area (Table 8), almost one-half (47%) of farmers who re-used these containers used them to drink water, which is shocking, given the negative health implications of doing this. However, most farmers (65%) bury these containers after they are empty.

Table 8. Knowledge of beneficial insects & viruses, pesticides storage & disposal, toxicity & health effects, and pesticides application practices among farmers who have used pesticides on cowpea, by bio-area and province. Burkina Faso, 2011.

	Bio-area/Province													
	South						North							
Detail	**Houet**	**Tuy**	**Ioba**	**Zound-weogo**	**Boulgou**	**Total South**	**Banwa**	**Mouhoun**	**Sanguie**	**Bazega**	**Ganzor-gou**	**Total North**	**t-test[1]**	**Total sample**
Beneficial insects & viruses (% yes)														
Knows existence of beneficial insects to control cowpea pests	18	4	12	5	0	10	0	3	1	9	36	5		8
Knows existence of beneficial viruses to control cowpea pests	3	0	6	0	0	2	0	0	0	0	25	1		2
Pesticides storage & disposal (% yes)														
Stores pesticides inside house (locked)	13	23	9	19	14	16	15	7	7	9	2	8	***	12
Stores pesticides inside house (un-locked)	1	8	2	8	0	4	2	4	0	0	0	1	**	3
Stores pesticides outside house (locked)	68	66	57	19	47	55	82	71	25	13	86	41	***	49
Stores pesticides outside house (un-locked)	18	3	6	4	11	10	0	7	0	10	0	5	**	7
Stores pesticides over a tree or in the field (un-locked)	0	0	10	42	11	10	0	4	65	47	2	35	***	22
Pesticide storage is easily accessible to children	14	10	4	7	14	10	0	9	2	11	0	6		8
Re-use empty pesticide containers	33	16	3	10	7	18	7	1	0	1	0	1	***	10
Bury/burn empty pesticide containers	55	27	56	72	65	52	93	76	99	59	88	81	***	65
Pesticides toxicity (% yes)														
Knows color of most toxic pesticide label	3	29	18	43	58	24	12	26	5	0	62	12	***	18
Thinks pesticides are toxic when exposed to them	93	100	90	100	93	96	97	100	100	53	100	85	***	91
Pesticide health effects (% yes)														
Someone they know has been sick due to pesticide poisoning	12	25	84	50	19	32	24	100	9	20	34	33		33
Someone they know has died due to pesticide poisoning	3	14	93	43	14	26	5	100	67	22	6	48	***	36
Number of observations	40	45	43	45	41	214	59	50	47	30	52	238	--	452

Table 8 (cont'd.)

	Bio-area/Province													
	South						North							
Detail	**Houet**	**Tuy**	**Ioba**	**Zound-weogo**	**Boulgou**	**Total South**	**Banwa**	**Mouhoun**	**Sanguie**	**Bazega**	**Ganzor-gou**	**Total North**	**t-test[1]**	**Total sample**
For farmers applying pesticides on cowpea in 2011 (% yes)														
Hired labor to apply pesticides to cowpea in 2011	19	2	15	10	2	11	0	5	21	40	5	20	***	16
Person applying pesticides in 2011 was <16 yr. old	3	3	2	0	14	3	5	0	2	9	0	4		4
Clothes/skin got wet with pesticide after the application	30	32	63	82	13	42	14	91	55	40	37	51	*	46
Person applying pesticides ate or drank water during application	0.9	4.1	0	0	1.2	1.4	0	0	2.2	0.9	0	1.0		1.2
Person applying pesticides smoked during application	0.9	0	0	0	1.2	0.5	0	0	0	0	0	0		0.2
Used rubber gloves & boots and face mask during application	11	3	39	38	27	19	91	3	12	50	78	36	***	27
Reported that person applying pesticides in 2011 experienced at least one toxic side effect	29	40	68	85	70	51	45	88	74	12	51	52		52
Number of observations	38	41	43	42	41	205	59	50	47	26	52	234	--	439

[1] Test of difference between means of households in the South and North bio-areas: *significant at 10%; **significant at 5%; ***significant at 1%; -- not tested.
Estimates weighted to reflect population (except number of observations). From the 560 households, 108 reported they have never applied pesticides to cowpea.
Source: CRSP Baseline Survey on Management of Field Insect Pests of Cowpea, Burkina Faso, 2012.

5.3.3. Pesticide toxicity, health effects, and application practices

Although most farmers know how to properly store and dispose pesticide containers, they still cannot correctly identify the color of the label used for the most toxic pesticides. When asked to state the color of the label used for most toxic pesticides, less than one out of five farmers correctly stated that red was the color used for this purpose (Table 8). However, more farmers in the south bio-area correctly identified this color than did farmers in the north bio-area (24% vs. 12%, respectively). Despite this, nine out of ten farmers consider that pesticides could be toxic to their health when exposed to them, with statistically significantly more farmers stating this in the south bio-area than in the north bio-area (96% vs. 85%, respectively; Table 8).

When asked whether someone they know had either been sick or died due to pesticide poisoning, one-third or more farmers responded this was true. While there were no statistically significant differences in the number of farmers reporting that someone they know had been sick due to pesticide poisoning between the two bio-areas, a statistically significantly smaller share of farmers in the south bio-area reported that someone they know had died due to pesticide poisoning, compared to farmers in the north bio-area (26% vs. 48%, respectively; Table 8). All these findings suggest that farmers in the south bio-area may be better informed on how to manage and use pesticides than farmers in the north bio-area.

Only 16% of farmers who applied pesticides to the cowpea crop in 2011 hired labor for this activity. Although family labor is mostly used, very few farmers (4%) reported that someone younger than 16 applied pesticides to the cowpea crop in 2011, which is good (Table 8). Further, very few farmers reported that the person applying pesticides either drank water or smoked cigarettes during the application. In contrast, only 27% of farmers reported that the person applying pesticides used rubber boots and gloves during the application and using boots and gloves was statistically significantly more common in the north bio-area. Surprisingly, while 46% of farmers reported that the clothes/skin of the person applying pesticides got wet during application, 52% of farmers stated that this person experienced at least one toxic side effect[10] (Table 8). The fact that only 42% of farmers in the south bio-area reported that the clothes/skin of the person applying pesticides got wet during application, compared to 51% of farmers in the north bio-area (10% SL), confirms that farmers in the south bio-area may know better how to manage pesticides than farmers in the north bio-area.

[10] Side effects included skin irritation, blurred vision, eye irritation, nausea & vomit, upset stomach, dizziness, headaches, diarrhea, muscle aches, and difficulty to breathe.

5.4. Use of labor during the 2011 season

Farmers were asked about the use of labor during the 2011 production cycle. This information was collected per activity and was used to estimate the number of person-days required for each category (i.e. activities were divided into four categories). These categories were consistent with cowpea-related activities. However, it seems that farmers may have provided labor information at the farm level (i.e., for all crops cultivated, not only cowpea).

Not surprisingly, the highest number of person-days was needed for harvest & post-harvest activities,[11] followed by post-planting activities, planting activities, and pre-planting activities (Table 9). While 58 person-days were used for harvest & post-harvest activities, only 18 person-days were used in pre-planting activities. Further, for all field activities except during post-planting activities, farmers in the north bio-area used statistically significantly more person-days than farmers in the south bio-area (Table 9). This may be explained by the fact that farmers in the north bio-area grew more area (cowpeas + other crops; thus requiring more labor) and had larger households (thus more labor available) than farmers in the south bio-area (see Table 1 for details).

Farmers were also asked to separate the labor used into hired and non-hired labor and to provide estimates on the number of people and days they worked, by gender. These responses are discussed below.

5.4.1. Non-hired labor

As expected, the number of person-days worked by non-hired (i.e., family) labor was highest than that of hired labor. Although the total number of non-hired men was higher than the number of non-hired women within each bio-area, it appears that farmers in the north bio-area used slightly more non-hired person-days (both male and female) than farmers in the south bio-area (Table 9). The latter is no surprise since, as mentioned above, households in the north bio-area cultivated more area (cowpeas + other crops; thus requiring more labor) and had more family labor available than farmers in the south bio-area. While non-hired females seldom worked in the field before or during planting (especially in the south bio-area), most non-hired females worked on harvest and post-harvest activities (Table 9). This may be explained by the fact that women generally help to clean the grain from impurities and dirt before storage or sale.

5.4.2. Hired labor

Not surprisingly, hiring labor for field-related activities was rare. While few women in the south bio-area were hired for activities conducted prior to harvest, no female workers were hired for these activities in the north bio-area (Table 9). In general, female workers were hired for harvest and post-harvest activities, which is understandable due to the reasons explained above--females generally help with post-harvest activities.

[11] Pre-planting activities only included land preparation. Planting activities included planting, fertilizer application, and other planting-related activities. Post-planting activities included first weeding (with and without fertilizer application), second weeding, and insecticide application. Harvest & post-harvest activities included harvest, drying, threshing & winnowing, and bagging.

Table 9. Use of labor during the 2011 season, by bio-area and type of labor. Burkina Faso, 2011.

	Bio-area/Labor type (Number of person-days)											
	South					North						
Activity	Non-hired men	Non-hired women	Hired men	Hired women	Total South	Non-hired men	Non-hired women	Hired men	Hired women	Total North	t-test[1]	Total sample
Pre-planting	7	3	1	0	11	14	12	1	0	26	***	18
At planting	8	7	1	1	16	13	11	2	0	26	***	21
Post-planting	22	17	3	2	44	24	20	4	0	48		46
Harvest & post-harvest	25	23	2	4	54	29	31	2	2	64	**	58
TOTAL	62	50	7	6	125	79	75	8	2	164	***	143
Number of observations	--	--	--	--	270	--	--	--	--	290	--	560

[1] Test of difference between means of households in the South and North bio-areas: *significant at 10%; **significant at 5%; ***significant at 1%; -- not tested.
Estimates weighted to reflect population (except number of observations).
Source: CRSP Baseline Survey on Management of Field Insect Pests of Cowpea, Burkina Faso, 2012.

5.5. Cowpea grain yields and total grain & fodder harvested

We provide two yield estimations using household level data: un-weighted yields (i.e. estimating yields at the household level, then averaging at the province/bio-area/country level) and area-weighted yields (i.e. estimating total weighted production and area planted at the province/country level, then estimating yields). For robustness, we compare these yield estimations with the yields obtained from the village-level data and from yields estimated from FAOSTAT data (country-level only). Further, we provide estimates for the value of the cowpea grain harvested (using village-level prices in an attempt to control for endogeneity of household-level prices).

While the un-weighted yields averaged 345 kg/ha in the sample, un-weighted yields were statistically significantly higher in the south bio-area, compared to un-weighted yields in the north bio-area (418 kg/ha vs. 256 kg/ha, respectively). While yields in the south bio-area may have been driven up by unusually high yields observed in the province of Tuy, yields in the north bio-area may have been driven down due to extremely low yields observed in Bazega. Further, higher yields in the south were expected since most provinces in this bio-area belong to the Soudanian zone, where rainfall is generally higher and soil fertility is better than in provinces in the north bio-area (located in the Sahelo-Soudanian zone). The area-weighted yields averaged 317 kg/ha in the sample and the yield differences between the two bio-areas were not statistically significant (Table 10).

These two yield estimations are much lower than the yields reported in the village-level questionnaire (667 kg/ha for the sample, 528 kg/ha in the south bio-area, and 832 kg/ha in the north bio-area) and also lower than the yields estimated using FAOSTAT country-level data for 2006-2011 (470 kg/ha; FAOSTAT, 2013). Although it is not clear why these differences arise, it may be possible that informants for the village-level yield data may have overestimated yields. Further, FAOSTAT yields cannot be fully compared to the yields estimated here since the former statistic reflects country-level yields and the latter yields are representative of 10 provinces only. However, these yield estimations are much higher than the yields observed in Senegal, where cowpea grain yields in three regions of the country averaged 241 kg/ha (Magen, 2012).

Farmers harvested an average of 252 kg of cowpea grain with a market value of CFA 73,112 (roughly US$158) (Table 10). Both the total grain harvested and the value of harvest were statistically significantly higher in the south bio-area, where farmers harvested an average of 337 kg with a market value of CFA 97,710, compared to only 148 kg of grain with a market value of CFA 43,001 in the north bio-area (Table 10). Finally, almost two out of three farmers harvested fodder. On average, farmers harvested 112 kg of fodder (Table 10).

Table 10. Cowpea yields and quantity of grain and fodder harvested, by bio-area and province. Burkina Faso, 2011.

	Bio-area/Province													
	South						North							
Detail	Houet	Tuy	Ioba	Zound-weogo	Boulgou	Total South	Banwa	Mouhoun	Sanguie	Bazega	Ganzor-gou	Total North	t-test[1]	Total sample
Cowpea grain yields (kg/ha)	468	553	253	341	257	418	266	387	306	150	254	256	***	345
Area-weighted yields (kg/ha)[2]	484	535	235	296	196	349	204	335	204	138	234	223		317
Cowpea grain harvested (kg)	437	387	229	177	230	337	203	269	80	112	246	148	***	252
Value of grain harvested (CFAs)[3]	118,453	102,845	77,149	73,936	71,810	97,710	62,862	73,345	22,122	34,299	75,161	43,001	***	73,112
Households harvesting fodder (%)	70	72	25	71	83	67	9	63	58	76	67	60		64
Cowpea fodder harvested (kg)	176	109	31	63	174	125	3	140	45	121	226	95		112
Number of observations	60	50	50	50	60	270	60	50	60	60	60	290	--	560

[1] Test of difference between means of households in the South and North bio-areas: *significant at 10%; **significant at 5%; ***significant at 1%; -- not tested.
[2] Yields weighted by the area planted. That is, both area planted and production were estimated at the province/country level first, then yields were estimated and reported.
[3] Prices (CFA/kg) reported in the village-level questionnaire at planting and harvesting were averaged and used. The same price was used for farmers within a particular village.
Estimates weighted to reflect population (except number of observations).
Source: CRSP Baseline Survey on Management of Field Insect Pests of Cowpea, Burkina Faso, 2012.

5.6. Gross revenues from grain and fodder sales, and transportation costs

As mentioned above, 46% of households sold cowpea grain. The number of households selling grain was statistically significantly higher (1% SL) in the south bio-area, where 52% of farmers sold cowpea grain, compared to 40% of farmers in the north bio-area.

On average, farmers in the south bio-area sold 271 kg of grain compared to 100 kg sold by farmers in the north bio-area. Because of this, it is not surprising that farmers in the south bio-area obtained more than twice revenues from grain sales than farmers in the north bio-area (Table 11).

Selling fodder was concentrated to only four provinces, two in each bio-area. Although there were no statistically significant differences in the amount of fodder sold between the two bio-areas, revenues from selling fodder were much higher in the south bio-area (albeit not statistically significant). The reason for this was the higher price reported by fodder sellers in the south bio-area (CFA 257/kg) compared to the price reported in the north bio-area (CFA 202/kg) (Table 11). Since fodder prices were not collected in the village-level questionnaire, it was not possible to confirm whether the price reported by farmers was accurate (may be overestimated).

The total revenues from cowpea sales (grain and fodder) averaged CFA 60,483. Farmers in the south bio-area obtained statistically significantly higher revenues from sales than farmers in the north bio-area (Table 11). Grain transportation costs accounted for almost all transportation costs, since fodder transportation cost were practically zero. This suggests that, while grain was most likely sold away from the field (for which transportation was needed), fodder was mostly sold in the field or nearby.

Surprisingly, although Ganzourgou, Sanguie, and Houet accounted for the highest amount of cowpea produced in 2009 among the ten provinces in the study (see Table A2 for details), it was in Houet where the largest quantities were produced and sold (Tables 10 and 11). In fact, it was in Houet and Tuy (which ranked ninth among the ten provinces in our study) where the largest quantities of cowpea grain were produced and sold (Tables 10 and 11).

Table 11. Gross revenues from cowpea sales and transportation costs per household (hh), by bio-area and province. Burkina Faso, 2011.

	Bio-area/Province													
	South						North							
Detail per household	**Houet**	**Tuy**	**Ioba**	**Zound-weogo**	**Boulgou**	**Total South**	**Banwa**	**Mouhoun**	**Sanguie**	**Bazega**	**Ganzor-gou**	**Total North**	**t-test[1]**	**Total sample**
Revenues														
Grain sales (kg/hh)	387	313	149	71	217	271	86	177	46	67	126	100	***	205
Grain revenues (CFA/hh)[2]	105,552	87,478	47,733	30,008	59,777	77,182	24,294	48,548	13,839	20,362	38,032	28,671	***	58,532
Fodder sales (kg/hh)	16	0	0	0	6	8	0	0	0	14	26	8		8
Fodder revenues (CFA/hh)[3]	4,718	n.a.	n.a.	n.a.	1,584	2,276	n.a.	n.a.	n.a.	2,852	3,946	1,430		1,951
Total revenues (CFA/hh)	110,271	87,478	47,733	30,008	61,361	79,458	24,294	48,548	13,839	23,214	41,979	30,101	***	60,483
Transportation Costs (CFA/hh)														
Grain transportation costs	207	58	830	99	310	258	8	38	195	404	173	225		245
Fodder transportation costs	0	0	0	0	1	0.1	0	0	0	0	17	1		0.4
Total transportation costs	207	58	830	99	311	258	8	38	195	404	190	226		245
Number of observations	38	16	28	28	33	143	22	35	17	26	26	126	--	269

[1] Test of difference between means of households in the South and North bio-areas: *significant at 10%; **significant at 5%; ***significant at 1%; -- not tested.

[2] Prices (CFA/kg) reported in the village-level questionnaire at planting and harvesting were averaged and used. The same price was used for farmers within a particular village.

[3] Prices reported by the farmers (only for farmers who sold fodder) were used. Average price reported in the south bio-area was CFA 257/kg and in the north bio-area was CFA 202/kg.

Estimates weighted to reflect population (except number of observations). n.a. = not applicable.

Source: CRSP Baseline Survey on Management of Field Insect Pests of Cowpea, Burkina Faso, 2012.

5.7. Cowpea crop as a source of income and food security

Farmers were asked about the importance of the cowpea crop as a source of income and food security. Overall, cowpea is a very important agricultural source of income. However, it appears that cowpea is a slightly more important source of income for farmers in the south bio-area because (a) for 23% of farmers in the south bio-area, cowpea grain sales accounted for a quarter or less of their household income, compared to 57% of farmers in the north bio-area, suggesting that farmers in the north bio-area may have more diverse sources of income; and (b) 64% of farmers in the south bio area reported that between one quarter and three quarters of their household income came from grain sales, compared to only 39% of farmers in the north bio-area reporting the same (Table 12). The higher revenues from cowpea grain sales observed in the south bio-area (see Table 11) explain why the cowpea crop contributes more to the household income than in the north bio-area.

While 34% of farmers reported that a third or less of their annual cowpea grain consumption is satisfied by their own production, 36% of farmers reported that their production satisfies between one third and two thirds of their annual consumption. It appears that own production is more important to satisfy home consumption for farmers in the south bio-area than in the north bio-area because 41% of farmers in the south bio-area reported that their cowpea production satisfies between one third and two thirds of their annual cowpea consumption, compared to only 29% of farmers in the north bio-area (Table 12).

For a considerable number of farmers (45%), grain reserves generally last until the next harvest. However, this is more common in the south bio-area where 53% of farmers in this bio-area reported that their grain reserves generally last until the next harvest, compared to only 35% of farmers reporting this in the north bio-area (Table 12). Further, for 47% of farmers, their grain reserves generally last between 3-9 months, especially for farmers in the north bio-area. Given that, in the sample, grain production was higher in the south bio-area, it is not surprising that grain reserves last more in this bio-area than in the north bio-area.

Although a high share of farmers (34%) reported that they never purchase grain after their reserves are depleted (perhaps because, for a considerable number of farmers, their reserves last until the next harvest), most farmers purchase cowpea grain for home consumption when this happens (Table 12). Not surprisingly, farmers rarely purchase grain every day.

Given that cowpea grain sales as a source of income, share of annual grain consumption satisfied by own production, and length of time that food grain reserves of cowpea last after harvest all were important across all households, is likely that the cowpea crop is an important source of income and food security, especially for farmers living in the south-bio area.

Table 12. Importance of cowpea as a source of income and food security, by bio-area and province. Burkina Faso, 2011.

	Bio-area/Province												
	South						North						
Detail (% of households)	**Houet**	**Tuy**	**Ioba**	**Zound-weogo**	**Boulgou**	**Total South**	**Banwa**	**Mouhoun**	**Sanguie**	**Bazega**	**Ganzor-gou**	**Total North**	**Total sample**
Share of HH income that comes from cowpea grain sales:													
A quarter or less	15	15	21	62	15	23	4	9	89	70	61	57	38
Between one quarter and half	49	34	26	0	4	30	11	55	8	22	17	22	26
Between half and three quarters	34	48	29	35	10	34	58	36	0	8	17	17	26
More than three quarters	0	0	10	0	26	4	22	0	0	0	2	3	3
Do not know	3	3	14	3	45	9	5	0	3	0	3	1	6
Share of HH yearly consumption satisfied by own production:													
A third or less	9	13	12	37	17	15	8	19	70	80	42	56	34
Between one third and two thirds	70	17	52	23	6	41	0	71	25	20	32	29	36
More than two thirds	21	67	35	40	45	39	27	11	4	0	26	8	25
Do not know	0	3	2	0	31	5	65	0	0	0	0	7	6
Length of time that food grain reserves of cowpea last after harvest:													
Less than one month	0	3	4	0	1	1	0	3	0	0	0	0	1
1-3 months	0	11	8	17	3	6	0	29	0	8	0	8	7
3-6 months	12	0	38	38	9	16	1	62	33	35	0	33	24
6-9 months	25	19	12	29	21	22	4	5	45	25	6	24	23
Until harvest in the following season	63	67	39	16	59	53	96	2	22	32	94	35	45
Do not know	0	0	0	0	6	1	0	0	0	0	0	0	0.4
Times you purchase grain after reserves are depleted:													
Never	12	10	93	44	73	33	15	70	14	42	30	35	34
Every day	0	0	0	0	0	0	0	0	0	0.4	5	0.4	0.2
Few times per week	13	52	0	7	1	18	6	16	7	20	2	13	16
Once a week	28	28	3	4	2	19	0	10	11	18	0	12	15
2-3 times per month	36	3	0	12	13	18	2	3	26	17	27	16	17
Once a month	11	8	0	32	6	11	0	0	36	2	37	13	12
Do not know	0	0	3	1	5	1	77	0	7	0	0	11	6
Number of observations	60	50	50	49	60	269	60	50	60	60	60	290	559

Estimates weighted to reflect population (except number of observations).
Source: CRSP Baseline Survey on Management of Field Insect Pests of Cowpea, Burkina Faso, 2012.

6. Review of key results

We focus the following discussion on the indicators expected to change after the project intervention, starting with the incidence of stresses affecting the crop, use of insecticides, knowledge of bio-control agents, pesticides management and health effects, use of labor, cowpea grain yields, quantity harvested and sold, revenues from sales, and importance of cowpea as a source of income and food security.

While the main biotic stress affecting the crop was insect incidence, the main abiotic stress was drought. More than one-half of farmers reported that the incidence of insect pests in 2011 was worst than in the previous two years (although recent data suggest that pest damage in 2010 was worst than in 2011, which contradicts this finding). Insect incidence (especially of legume pod borer) was more problematic in the north bio-area. Further, the use of chemical insecticides in 2011 on the cowpea crop was common, especially in the north bio-area, where almost three out of four farmers using insecticides applied the largest quantity on cowpeas. Although one might wrongly conclude that the project needs to release the beneficial insects in the north bio-area where this pest appears to be more problematic, doing this would require annual releases of beneficial insects since it is likely that these will not survive after the rainy season. This is because the insect pest that the beneficial insects parasite is not endemic to the north. Thus, the project plans to release beneficial insects in the south bio-area, where the pest is endogenous; thus reducing the pest damage by limiting its south-to-north migration. However, achieving this depends on at least two factors: (a) that the bio-control agents are able to control this insect pest in the south bio-area, and (b) the populations of these agents are large, which may depend in part on farmers recognizing the beneficial insects and taking actions that favor the increase of their populations.

Farmers who applied insecticides to the cowpea crop mostly used three insecticides, two of them not recommended for cowpea production. Since these insecticides are non-selective (i.e. kill all species of insects, including the beneficial ones), to augment the impact of the project intervention, farmers may need to learn how to identify beneficial insects and to not apply insecticide in places where these insects live. Further, for all three insecticides used, very few farmers (less than one-third) reported that the trend on the quantity applied has decreased over time. However, it is expected that this number will increase after the project intervention.

Although it was suspected that the quality of the insecticides might be questionable (hence poorly controlling insect pests), the results suggest this may not be true since most farmers were satisfied with the effectiveness of the insecticides they used.

Not surprisingly, few farmers knew about the existence of beneficial insects that can help to control cowpea pests and even fewer farmers knew about the existence of beneficial viruses. The main source of information about beneficial insects came from government extension agents. As discussed above, this lack of knowledge could negatively affect the expected outcomes of the project, since farmers do not know how to recognize these beneficial insects and protect them.

In general, farmers stored pesticides in an appropriate way. While most farmers stored pesticides in a locked place (outside or inside the house), a higher share of farmers in the south bio-area stored pesticides in locked places, compared to farmers in the north bio-area. Despite this, few

farmers reported that the place where they store the pesticides was easily accessible to children. Although almost two out of three farmers bury empty pesticide containers, which is good, a small share of farmers reported re-using the empty containers (especially in the south bio-area) and more shockingly, almost one-half of farmers who re-used these containers used them to drink water.

Although most farmers still cannot correctly identify the color of the label used to identify the most toxic pesticides, especially in the north bio-area, nine out of ten farmers consider that pesticides could be toxic to their health when exposed to them, which is good. Despite this, one-third or more farmers reported that someone they know had either been sick or died due to pesticide poisoning. Further, the number of farmers reporting someone they know had died due to pesticide poisoning was statistically significantly higher in the north bio-area. The findings about pesticide management suggest that farmers in the south bio-area may be better informed on how to manage and use pesticides than farmers in the north bio-area.

Not surprisingly, only 16% of farmers who applied pesticides to the cowpea crop in 2011 hired labor for this activity. Although family labor is mostly used, very few farmers reported that someone younger than 16 applied pesticides to the cowpea crop in 2011. Further, very few farmers reported that the person applying pesticides either drank water or smoked cigarettes during the application. However, only a little over one out of four farmers reported that the person applying pesticides used rubber boots and gloves during the application, almost one-half of farmers reported that the clothes/skin of the person applying pesticides got wet during application, and a little over one-half of farmers stated that this person experienced at least one toxic side effect. The fact that fewer farmers in the south bio-area reported that the clothes/skin of the person applying pesticides got wet during application confirms that farmers in the south bio-area may know better how to manage pesticides than farmers in the north bio-area.

The demand for labor was highest for harvest & post-harvest activities. Further, for all field activities except during post-planting activities, farmers in the north bio-area used statistically significantly more person-days than farmers in the south bio-area. This may be explained by the fact that farmers in the north bio-area grew more area (cowpeas + other crops) than farmers in the south bio-area, requiring more labor to work in the fields; and that households were larger in size in the north, thus having more labor available. Not surprisingly, hiring labor for field-related activities was rare and the demand for female workers was highest for harvest and post-harvest activities. The latter may be explained by the fact that women generally help to clean the grain before storage or sale.

Cowpea grain yields averaged 317 kg/ha and were much higher than yields observed in Senegal, where cowpea grain yields in three regions of the country surveyed averaged 241 kg/ha. However, the estimated yields were lower than county-level yields estimated from FAOSTAT (470 kg/ha) and much lower than the yields reported in the village-level questionnaire (667 kg/ha). It is possible that the yield differences between the household- and village-level data in the sample might be given due to overestimation of yields at the village-level.

Both the total grain harvested and the value of harvest were statistically significantly higher in the south bio-area, where farmers harvested an average of 337 kg with a market value of CFA

97,710, compared to only 148 kg of grain with a market value of CFA 43,001 in the north bio-area. In the sample, the farmers harvested an average of 252 kg of cowpea grain with a market value of CFA 73,112 (roughly US$158). Harvesting fodder was a common practice.

Forty six percent of households sold cowpea grain. The number of households selling grain was higher in the south bio-area. On average, farmers in the south bio-area sold 271 kg of grain compared to 100 kg sold by farmers in the north bio-area. Because of this, it is not surprising that farmers in the south bio-area obtained more than twice revenues from grain sales than farmers in the north bio-area. Further, total revenues from cowpea sales (grain and fodder) averaged CFA 60,483 and farmers in the south bio-area obtained higher revenues from sales than farmers in the north bio-area. The fact that grain transportation costs accounted for almost all transportation costs suggests that, while grain was most likely sold away from the field, fodder was mostly sold in the field or nearby. Surprisingly, Tuy in the south bio-area (which ranked ninth among the ten provinces in our study) was among the provinces where the largest quantities of cowpea grain were produced and sold, which contradicts our prior beliefs that cowpea production (hence sales and revenues) would be higher in the north bio-area.

Finally, given that cowpea grain sales as a source of income, share of annual grain consumption satisfied by own production, and length of time that food grain reserves of cowpea last after harvest all were important across all households, the cowpea crop is an important source of income and food security, especially among farmers living in the south-bio area.

7. Lessons learned and suggestions for future data collection

The baseline data presented in this report will serve as the 'before' scenario, which will be compared with an 'after' scenario where the same households will be re-visited several years after the project intervention. This will allow us to construct panel dataset that will be used to assess the impact of the project intervention through the evaluation of changes in key indicators (using the differences-in-difference analytical technique).

There were several challenges in executing this survey that are worth noting. First, we relied on available web maps and printed copies of maps (generally outdated) to select the villages for the study. Thus, it is possible that the results are biased towards relatively highly populated villages (since villages with small populations are likely not included in web and printed maps). To reduce this potential bias, we relied on the field experience of the enumerators (most of whom were agricultural extension staff) for the selection of villages. Further, since one of the enumerators did not complete the surveys of the assigned households in his respective province due to unforeseen circumstances, another enumerator had to finish these surveys, which meant that he had to complete twice the number of interviews than any other enumerator. Further, some enumerators lacked survey experience and perhaps needed more training on how to double check farmers' answers using the questions in the questionnaires since several inconsistencies were observed in the data.

Although the questionnaires were translated into French, the questions were asked in local languages because farmers could not understand French. In these instances, the enumerators made an in situ translation of the questions while conducting the interviews. Although this may have influenced the accuracy of the data (since the quality of the translation depended on the enumerator's knowledge of French and the local language), it was assumed that this effect was small (although there is no way to verify this). Thus, for future data collection, these challenges need to be considered in the planning process.

One question from the household-level questionnaire had to be dropped from the analysis because of inconsistencies in the responses. The question was "*E103f. How many members older than 17 years worked in non-agricultural (including livestock) jobs in 2011?*" It is suspected that the enumerators did not understand the question well. To know this, we used question E103e to double-check the data. Question E103e specifically asked about the number of people working on livestock jobs in 2011. It was expected that the responses in E103f should be greater than or equal to the responses in E103e; however, for most answers, the numbers reported in E103f were less than the numbers in E103e, clearly suggesting errors in the data.

The main purpose of the baseline survey was to measure the following indicators: the incidence and severity of damage caused by biotic (particularly insects) stresses; the use of insecticides; farmers' knowledge/awareness about beneficial insects to control cowpea pests; pesticide management practices; toxic health effects from pesticide use (misuse); and use of labor during cowpea production. Other economic indicators include the quantity of cowpea grain produced, revenues from grain sales, input and transportation costs, and relative importance of cowpea as a source of income and food security.

Since the project will release bio-control agents to control legume pod borer in several of the

villages included in this study (in the south bio-area), it is expected that the indicators will be affected by this intervention in the following ways. First, the incidence and severity of the damage caused by insects, particularly legume pod borer, will decrease. This is perhaps the most direct indicator of a successful project intervention. Then, since fewer insect pests will affect the cowpea crop, the use of insecticides will decrease in both the amount applied at the time of the end line data collection and over time (since end line data collection will happen a few years after the bio-control agents are released).

Additionally, since the number of insecticide applications is expected to decrease, the number of person-days required for field activities is also expected to decrease. This is expected to decrease the cost of producing cowpeas (and thus increase profitability). Because of less damage to the crop (due to bio-control agents), it is also expected that grain yields may increase. Finally, it is expected that with higher production, either more grain will be sold or the grain reserves will last longer than in the baseline.

Annexes

Annex 1. Instructions for household selection. Burkina Faso, 2012.

Step	Instructions for enumerators	Example 1	Example 2
1	Ask the president of the Village Committee for Development to provide the **total number** of households in the village.	Total number = 38	Total number = 54
2	**Divide** the **total number** of households in the village **by 10.** If this number is a decimal below 0.5 (for example 7.49) round this number down. If this number is a decimal equal to or above 0.5 (for example 8.5) round this number up. This number will be used as a **fixed interval** to select the households.	38 / 10 = 3.8 Round up to 4.0 (use this number)	54 / 10 = 5.4 Round down to 5.0 (use this number)
3	The **fixed interval** from Step 2 will be used to select the households distributed throughout the village. Select the first household randomly (choose any household).	Choose any household. This will be your first interview.	Choose any household. This will be your first interview.
4	From the selected household, use the **fixed interval** from Step 2 and count from the first household selected. From this new household, count again and select another household. Repeat this for all other households.	Count 4 households. This will be your next interview.	Count 5 households. This will be your next interview.
5	Repeat *Step 4* for all other households until you have 10 households in the village. Mark them in a map of the village (draw one by hand) for you to follow (if possible).	Repeat until you have 10 households	Repeat until you have 10 households
6	Start the interviews. You should know already which households you will interview.		
7	If a household can't be included in the study (because responsible of cowpea production was not available or didn't want to be included in the study), select a household next to the one you just selected but KEEP the original order. Do not count with the **fixed interval** from this new household!	House # 4 not available? Choose house 5. House 8 will be next (not house 9).	House # 5 not available? Choose house 6. House 10 will be next (not house 11).

Annex 2. Village-level questionnaire. Burkina Faso, 2012.

Management of Field Insect Pests of Cowpea in Burkina Faso
Community-level Questionnaire for Baseline Survey, 2012

INSTRUCTIONS: *Read the CONSENT STATEMENT and if he/she agrees to be interviewed, begin the interview.*

CONSENT STATEMENT

My name is _____. I am assisting the Institute for Environment and Agricultural Research (INERA) from Burkina Faso and the University of Illinois at Urbana-Champaign (UIUC) and Michigan State University (MSU) from the U.S. in conducting a study to document cowpea production practices and the effect of insect pests on this crop in Burkina Faso. **I would like to ask you** some questions related to **your village**. The **information you provide** will be used to document cowpea production practices and the main constraints to increasing farmers' yields in your village and the region. The USAID-funded Dry Grain Pulses Collaborative Research Support Program (DGP/CRSP) at MSU, is **funding this study**. Our collaborator in Burkina Faso is INERA.

The interview will take approximately **45 minutes**. Your participation is **voluntary**. Your **refusal to participate** or to withdraw from the study carries **no penalty** or loss of any benefits. You are **free to not answer any** of the questions I will ask. However, your answers will be valuable to assess the constraints to cowpea production in your country. All information provided by you will be **kept confidential**. Your privacy will be protected to the maximum extent allowable by law.

If you have any **questions or concerns** about your participation in this study, please contact Professor Mywish Maredia at Michigan State University, 83 Agriculture Hall, East Lansing, MI 48824, USA, phone (517) 353-6602, e-mail maredia@msu.edu **or**, Malick Ba at INERA, CREAF Kamboinsé, 01 BP 476 Ouagadougou 01, Burkina Faso, Tel: +226 50 31 92 02.

By answering my questions, you indicate your willingness to **voluntarily** participate in the study.

CA. Community's general information

*To be completed **BEFORE** the interview***:**

<table>
<tr><td colspan="2">CA01. Date of the Interview:
_____ / _____ / 2012
CA01a. Month CA01b. Day CA01c. Year</td><td>CA02. Enumerator name:</td><td>CA03. Supervisor name:</td></tr>
<tr><td>CA04. Region ID:
_____
[1] Hauts-Bassins
[2] Boucle du Mouhoun
[3] Centre Sud
[4] Centre Est
[5] Centre Ouest
[6] Sud-Ouest
[7] Plateu Central</td><td>CA05. Province ID:
_____
[01] Houet [06] Banwa
[02] Tuy [07] Mouhoun
[03] Ioba [08] Sanguie
[04] Zoundweogo [09] Bazega
[05] Boulgou [10] Ganzourgou</td><td>CA06. Department name:</td><td>CA07. Village name:</td></tr>
<tr><td colspan="2">CA08. Village Code (combine CA04-CA07):</td><td colspan="2">CA09. Village's GPS coordinates (from central park):
CA09a. Latitude: _____° _____ . _____ (degrees & minutes N)
CA09b. Longitude: _____° _____ . _____ (degrees & minutes W)
CA09c. Elevation: _____ m.a.s.l.</td></tr>
</table>

CB. Location-specific characteristics

CB01. What is the main commercial town (name) where residents of this village go to when they need to purchase goods and services?

_____

CB01a. How far away is your village from the **town** mentioned above? _____ KM

CB01b. What is the most common way residents of your village use to get to that town? _____

[1] Bus service
[2] Truck
[3] Pick up/small car
[4] Motorcycle/tricycle
[5] Bicycle
[6] By foot
[99] Other (specify): _____

CB01c. What is the condition of the road between your village and the town mentioned above? _____

[1] Dirt with damaged sections (e.g. a lot of holes / interrupted)
[2] Dirt in good shape (no holes)
[3] Asphalt with damaged sections
[4] Asphalt in good shape
[88] Not applicable (if in the same village)

CB02. How far away from your village is the **main paved** (asphalt) **road**? _____ KM
(***Write zero if the village is crossed by or bordering a paved road***)

CB03. Is there a bus service in this village? _____
[1] YES [2] NO => ***Go to Section CC***

CB03a. If YES, how often do the bus stops in the village? _____
[1] Every day [2] Several times a week [3] Once a week

CC. Basic services

	CC100	**CC101a**	**CC101b**
Service	ID	Is this service currently available in your village? [1] YES [2] NO	If NO, what is the distance to the closest available service center? KM
Access to electricity	11		
Access to water service (network)	12		
Access to wells	13		
Access to radio	14		
Access to television network	15		
Access to cell phone network	16		
Access to telephones (landlines)	17		
Access to health centers	18		
Access to private bank services	19		
Access to community/rural banks	20		
Is there a primary school in this village?	21		
Is there a secondary school in this village?	22		
Is there a government's agriculture extension service office in this village?	23		
Are there any NGOs providing agricultural-related services in this village?	24		

CC02. Are there any video viewing clubs/facility in which the community can get together to view educational and extension videos? _____

[1] YES [2] NO

CC03. Do agricultural extension officers regularly visit this village? _____

[1] YES [2] NO => ***Go to CC04***

CC03a. If YES, how often do these visits happen? _____

[1] Every week
[2] Every other week
[3] Every month
[4] Every other month
[5] Once or twice a year
[99] Other (specify): _____

CC04. Where do producers generally get farm credit for their crops? _____

[0] Don't have access to farm credit
[1] Private banks
[2] Community/rural banks
[3] NGOs
[4] Government's farm banks
[99] Other (specify): _____

CD. Agricultural-related information

CD01. Is there any permanent input dealer in this village? _____

[1] YES [2] NO => ***Go to CD01d***

CD01a. If YES, do producers generally purchase their **fertilizer** at this input dealer? _____

[1] YES [2] NO

CD01b. If YES, do producers generally purchase their **pesticides** at this input dealer? _____

[1] YES [2] NO

CD01c. If YES, do producers generally purchase their **cowpea seeds** at this input dealer? _____

[1] YES => ***Go to CD02*** [2] NO => ***Go to CD02***

CD01d. If NO, where do producers generally obtain their **fertilizer**? _____

[1] In the local market (other than at input dealer)
[2] In other markets/towns
[3] Receive from NGOs (as credit or free)
[4] Receive from Government (as credit or free)
[99] Other (specify): _____

CD01e. If NO, where do producers generally obtain their **pesticides**? _____

[1] In the local market (other than at input dealer)
[2] In other markets/towns
[3] Receive from NGOs (as credit or free)
[4] Receive from Government (as credit or free)
[99] Other (specify): _____

CD01f. If NO, where do producers generally obtain their **cowpea seeds**? _____

[0] They use grain saved from their previous harvest
[1] They borrow/purchase grain from other farmers
[2] They borrow/purchase seed from other farmers
[3] They purchase grain in the local market
[4] Purchase in other markets (villages) as grain
[5] Purchase in other markets (villages) as seed
[6] Receive from NGOs
[7] Receive from Government
[99] Other (specify): _____

CD02. In 2011, how much did it cost to rent one hectare of land (without irrigation)? ____CFA/month

CD03. How did the **rainfall** in 2011 compare to a normal year? _____
[1] Lower [2] The same [3] Higher [77] Don't know

CD04. How did the **insect damage on cowpea** in 2011 compare to a normal year? _____
[1] Lower [2] The same [3] Higher [77] Don't know

CD04a. Please **list** the main cowpea **insects** affecting cowpea production in this village:

CD04aa. Insect 1: _____ CD04ac. Insect 3: _____

CD04ab. Insect 2: _____ CD04ad. Insect 4: _____

CD05. How did the **disease damage on cowpea** in 2011 compare to a normal year? _____
[1] Lower [2] The same [3] Higher [77] Don't know

CD05a. Please **list** the main cowpea **diseases** affecting cowpea production in this village:

CD05aa. Disease 1: _____ CD05ac. Disease 3: _____

CD05ab. Disease 2: _____ CD05ad. Disease 4: _____

CD06. In this village, in the past three years (2009-2011), has there been any **training** related to:

	[1] YES	[2] NO
CD06a. Crop management techniques?	_____	
CD06b. Fertilizer use?	_____	
CD06c. Pesticide use?	_____	
CD06d. Integrated pest management?	_____	
CD06e. Post-harvest/storage techniques?	_____	
CD06f. Marketing strategies?	_____	

CD07. In 2011, what was the typical agricultural daily **wage rate** to work on cowpea for:

CD07a. Men (without in-kind payments): _____ CFAs/day
CD07b. Men (with in-kind payments): _____ CFAs/day
CD07c. Women (without in-kind payments): _____ CFAs/day
CD07d. Women (with in-kind payments): _____ CFAs/day

(Note: Wage with in-kind payments MUST be lower than without in-kind payments)

CD08. Was this agricultural daily wage constant throughout the cowpea season? _____
[1] YES => ***Go to CD09*** [2] NO

CD08a. If NO, when (stage) was the wage <u>highest</u>? _____
[1] At Planting [2] At Weeding [3] Insecticide spraying [4] At Harvesting [99] Other (sp): _____

CD08b. And, when (stage) was the wage <u>lowest</u>? _____
[1] At Planting [2] At Weeding [3] Insecticide spraying [4] At Harvesting [99] Other (sp): _____

CD09. In a normal year, on average, what is the cowpea grain yield (kg/ha) when no green pods or leaves are harvested during the production cycle? _____ kg/ha

CD10. How widespread are the following practices in your village:

[0] No one does it
[1] Less than 25% of cowpea producers do it
[2] 25-50% of cowpea producers do it
[3] More than 50% of cowpea producers do it (but not all)
[4] Everyone does it
[77] Don't know

CD10a. Harvest cowpea green pods? _____
CD10b. Harvest cowpea leaves? _____
CD10c. Use cowpea as a fodder crop? _____

CD11. Do cowpea producers generally sell the grain to intermediaries in the village? _____
[1] YES [2] NO

CD12. Do cowpea producers generally sell the grain in other villages/towns? _____
[1] YES [2] NO

CD13. What was the cowpea grain price in the village in 2011 at the **beginning** of the planting season? _____CFAs/kg

CD14. What was the cowpea grain price in the village in 2011 at **harvest**? _____CFAs/kg

CD15. In 2011, what was the price of the following inputs in this village:

	CD15a	**CD15b**	**CD15c**	**CD15d**
Input Name	Input ID	Input type [1] Fertilizer [2] Insecticide [3] Fungicide [99] Other (specify)	Price **CFAs**	Unit [1] 50 kg sack [2] Liter [3] 250 gr. bag [99] Other (specify)
NPK	11	1		
DECIS	21	2		
SYSTOATHE	22	2		
CALTHIO	31	3		

THANKS VERY MUCH FOR ANSWERING MY QUESTIONS!

ENUMERATOR: Please answer the following question after collecting all the household-level data:

How many households could not be interviewed because the responsible of cowpea production was not available or because they declined to participate in the study or because nobody was home?

_____

Annex 3. Household-level questionnaire. Burkina Faso, 2012.

Table of Contents of the Questionnaire

Page(s)	Section ID	Section Detail	Estimated time (minutes)
1	--	Instructions, consent statement and notes	--
2	A	Screening questions and respondent's general information	2
2-4	B1	Field characteristics, use of varieties and cowpea production during the 2011 season	15
4	B2	Total cowpea sales during the 2011 season	5
5-8	B3	Use of fertilizer and pesticides during the 2011 season	10
8	B4	Use of labor during the 2011 season	10
8-11	C	Pesticide sources of information, management and health effects	10
11-12	D1	Assets	5
12	D2	Infrastructure & services	5
12	D3	Livestock & small animals	2
12	D4	House characteristics	1
13-14	E	Household (HH) composition and characteristics	10
14	F	Importance of the cowpea crop as a source of income and food security	5
TOTAL			**80**

Management of Field Insect Pests of Cowpea in Burkina Faso
Questionnaire for Baseline Survey, 2012

INSTRUCTIONS*: Complete A01-A10 (next page)* ***BEFORE*** *the interview. Please ask to speak to the person primarily responsible for COWPEA production decisions. If this person is not available, complete A11 (next page) and then end the interview. If this person is available, read the CONSENT STATEMENT and if he/she agrees to be interviewed, begin the interview starting on question A11 (A01-A10 should be completed before the interview).*

CONSENT STATEMENT

My name is _____. I am assisting the Institute for Environment and Agricultural Research (INERA) from Burkina Faso and the University of Illinois at Urbana-Champaign (UIUC) and Michigan State University (MSU) from the U.S. in conducting a study to document cowpea production practices and the effect of insect pests on this crop in Burkina Faso. **I would like to ask you** some questions related to your **last cowpea production cycle**. The **information you provide** will be used to document cowpea production practices and the main constraints to increasing farmers' yields in the region. The USAID-funded Dry Grain Pulses Collaborative Research Support Program (DGP/CRSP) at MSU is **funding this study**. Our collaborator in Burkina Faso is INERA.

The interview will take approximately **80 minutes**. Your participation is **voluntary**. Your **refusal to participate** or to withdraw from the study carries **no penalty** or loss of any benefits. You are **free to not answer any** of the questions I will ask. However, your answers will be valuable to assess the constraints to cowpea production in your country. All information provided by you will be **kept confidential**. Your privacy will be protected to the maximum extent allowable by law.

If you have any **questions or concerns** about your participation in this study, please contact Professor Mywish Maredia at Michigan State University, 83 Agriculture Hall, East Lansing, MI 48824, USA, phone (517) 353-6602, e-mail maredia@msu.edu **or**, Malick Ba at INERA, CREAF Kamboinsé, 01 BP 476 Ouagadougou 01, Burkina Faso, Tel: +226 50 31 92 02.

By answering my questions, you indicate your willingness to **voluntarily** participate in the study.

NOTES

**Sentences in "italics" are instructions for the enumerator*

*ID = Identification

*sp = Specify / provide details

*HH = Household

*m.a.s.l. = meters above sea level

*NGO = Non-government Organization

A. Screening questions and respondent's general information

*To be completed **BEFORE** the interview*:

A01. Date of the Interview: _____ / _____ / **2012** A01a. Month A01b. Day A01c. Year		**A02**. Enumerator name:	**A03**. Supervisor name:
A04. Region ID: [1] Hauts-Bassins [5] Centre Ouest [2] Boucle du Mouhoun [6] Sud-Ouest [3] Centre Sud [7] Plateu Central [4] Centre Est	**A05**. Province ID: _____ [01] Houet [06] Banwa [02] Tuy [07] Mouhoun [03] Ioba [08] Sanguie [04] Zoundweogo [09] Bazega [05] Boulgou [10] Ganzourgou	**A06**. Department name:	**A07**. Village name:
A08. Village Code (*combine A04-A07*):	**A09**. Household number: (*01-10*)	**A10**. Respondent ID (*combine A08 and A09*): _____ (*write this ID at the top of each page*)	

*To be completed **DURING** the interview*:

A11. Did your HH grow cowpeas in the **last** planting season (July-October 2011)? _____ [1] YES => *Go to **A13** and **refer to this season** for all production-related questions* [2] NO => *Give thanks to the producer and end the interview*	
A12. Name of the respondent: _____ , _____ A12a. First Name A12b. Last Name	**A13**. Respondent's relation to the head of the HH: _____ [1] Self [3] Son/Daughter (>18yrs) [2] Spouse [99] Other (specify): _____

I would like to start by asking you questions regarding your cowpea production in 2011. Then, I would like to ask you questions about the assets your HH owns, members of the family and other general information.

B100a. Have you grown cowpea for more than 2 years (< 2009)? [1] YES [2] NO	
B100b. In how many fields did you grow cowpea **in 2011**?	

***Enumerator**, please use the answer to B100b to know how many rows need to be filled in Tables B. Start with the biggest field.*

B1. Field characteristics, use of varieties and cowpea production during the 2011 season

B100a	B100b	B100c	B101a	B101b	B101c	B101d	B102	B103	B104a	B104b	B104c	B105a	B105b
Field ID	Planting date for cowpea		How is the […] on this field?				Was this field irrigated?	What is the size (area) of this field?	Was cowpea inter-cropped?	If YES, crop associated with?	What proportion of this area was planted to **cowpea**?	Amount of seed used	
	Month	Week	Slope	Soil quality	Presence of rocks	Land tenure						Quant.	Units
	[1-12]	[1-4]	[1] Flat [2] Medium [3] Steep	[1] Sand [2] Silt [3] Clay [77] Don't know	[1] None [2] Some [3] A lot	[1] Owned [2] Rented in [3] Shared / borrowed [4] Government's land [99] Other (sp):	[1] YES [2] NO	Ha	[1] YES [2] NO => *Go to B105a*	[1] Maize [2] Sorghum [3] Millet [4] Cotton [99] Other (sp):	[1] 25% [2] 50% [3] 75%		[1] kg [99] Other (sp):
F1													
F2													
F3													
F4													
F5													

B1. Field characteristics, use of varieties and cowpea production during the 2011 season (continued)

B100a	B106a	B106b	B106c	B106d	B106ea	B106eb	B106fa	B106fb	B107a	B107b	B107c	B107d
Field ID	Information about the variety used								Did you have the following problems more in 2011 compared to the previous 2 years?			
	Name	Seed source	Year when first planted this var.	Do you plan to grow this variety in 2012?	What are the two characteristics you <u>like</u> the most?		What are the two characteristics you <u>dislike</u> the most?		Insects	Diseases	Drought	Flooding
	[1] KVX 396-4-5-2D [2] KVX 61-1 [3] IT 98K-205-8 [4] KVX 396-4-4 [5] KVX 745-11P [6] IT 82D-2-994 [7} KN1 [10] Local (no name) [20] Improved (no name) [77] Don't know [99] Other (sp):	[1] Grain saved from previous harvest [2] Other farmer [3] Purchased in the market as grain [4] Purchased from seed producers [5] Given by NGO [6] Given by Government [99] Other (sp):	YYYY	[1] YES [2] NO [77] Don't know	[1] Good yield [2] Resistant to some diseases [3] Resistant to some insects [4] Early maturity [5] Good cooking quality/taste [6] Good price/mkt. value [7] Good quality of the grain [8] Striga (weed) resistance [99] Other (sp):		[0] Nothing [1] Low yield [2] Susceptible to some diseases [3] Susceptible to some insects [4] Late maturity [5] Poor cooking quality/taste [6] Poor price/mkt. value [7] Poor quality of the grain [8] Striga (weed) susceptibility [99] Other (sp):		[1] YES [2] NO [77] Don't know	[1] YES [2] NO [77] Don't know	[1] YES [2] NO [77] Don't know	[1] YES [2] NO [77] Don't know
					1st	2nd	1st	2nd				
F1												
F2												
F3												
F4												
F5												

B1. Field characteristics, use of varieties and cowpea production during the 2011 season (continued)

B100a	B108	B109a	B109b	B110a	B110b	B110c	B111a	B111b	B111c
Field ID	Crop grown in this field prior to cowpea? [0] Fallow [1] Maize [2] Sorghum [3] Millet [4] Cowpea [5] Cowpea inter-cropped [6] Cotton [99] Other (sp):	About the person responsible of this field		Total **grain** harvested			Total **fodder** harvested		
		Relation to the HH head? [1] HH Head [2] Spouse [3] Son/Daughter (>18yrs) [4] Head + spouse [5] Friend [99] Other (sp):	Gender [1] Male [2] Female	Quantity *If 'zero' => Next field OR go to B111a*	Units [1] kg [99] Other (sp)	Did you sell any part of this harvest? [1] YES [2] NO	Quantity *If 'zero' => Next field OR read instructions below*	Units [1] kg [2] Bundle (specify weight) [99] Other (sp)	Did you sell any part of this harvest? [1] YES [2] NO
F1									
F2									
F3									
F4									
F5									

***Enumerator**: If the producer answered YES to B110c or B111c above, fill in Table B2. If all answers were NO, go to B3.*

B2. Total cowpea sales during the 2011 season

	B200	B201a	B201b	B202a	B202b	B203a	B203b	B204a	B204b	B205	B206a	B206b
Harvest type	ID	Month when you sold the **largest** quantity [1-12]	Why this month? [1] Harvest [2] Good price [3] Can't store [99] Other (sp)	Place where you sold the **largest** quantity [1] Farm/home [2] Local market (community) [3] Other market (nearby community) [99] Other (sp):	Why this place? [1] Easily accessible [2] Got good price [3] Can't transport [4] Good relation with traders [99] Other (sp):	**Total** sales in 2011		Price received for **largest** qty. sold per unit of B203b **CFAs**	Was this price negotiated before harvest? [1] YES [2] NO	Total transport cost of **largest** quantity sold? **CFAs**	About the person responsible for this sale	
						Quant.	Units [1] kg [2] Bundle (specify weight) [99] Other (sp):				Relation to the HH head? [1] HH Head [2] Spouse [3] Son/Daughter (>18yrs) [4] Head + spouse [5] Friend [99] Other (sp):	Gender [1] Male [2] Female
Grain	1											
Fodder	2											

B3. Use of fertilizer and pesticides during the 2011 season

CHEMICAL FERTILIZERS

B300. Did you apply any <u>chemical fertilizer</u> during the 2011 cowpea production cycle in […]: [1] YES [2] NO [3] Applied to the main intercropped crop (other than cowpea)	**B300a.** FIELD F1?	
	B300b. FIELD F2?	
	B300c. FIELD F3?	
	B300d. FIELD F4?	
	B300e. FIELD F5?	

*If **all answers** above were **NO:***

B301. Why you <u>DID NOT</u> apply chemical fertilizers to cowpea in 2011 (main reason)? _____

[1] Could not afford it/too expensive
[2] Did not know I needed to use chemical fertilizer in cowpea
[3] Not available in the community
[99] Other (specify): _____

*If **at least one** of the answers above was **YES:***

B302	**B303a**	**B303b**	**B304**	**B305**	**B306**	**B307**
Name of the fertilizer applied	**Total** quantity applied in all cowpea fields		Cost per unit of B303b **CFAs**	Place where you bought this fertilizer? [1] Local market (community) [2] Other market (nearby community) [3] Given by an NGO or Government [99] Other (sp):	How much did you pay to transport this amount of fertilizer to your farm? **CFAs**	How does the quantity used in 2011 compare to the last two years? [1] Lower [2] Same [3] Higher [77] Don't know [88] Not applicable
	Quantity	Units [1] kg [99] Other (sp)				

ORGANIC FERTILIZERS

B308. Did you apply any <u>organic fertilizer</u> (e.g. manure) during the 2011 cowpea production cycle in […]: [1] YES [2] NO [3] Applied to the main intercropped crop (other than cowpea)	**B308a.** FIELD F1?	
	B308b. FIELD F2?	
	B308c. FIELD F3?	
	B308d. FIELD F4?	
	B308e. FIELD F5?	

*If **all answers** above were **NO:***

B309. Why you <u>DID NOT</u> apply organic fertilizers to cowpea in 2011 (main reason)? _____

[1] Could not afford it/too expensive
[2] Didn't know how to apply
[3] Not available in the community
[99] Other (specify): _____

*If **at least one** of the answers above was **YES**:*

B310. How much (kg) of this organic fertilizer did you apply to all your fields? _____ kg

INSECTICIDES (Chemical or Organic)

B311. Did you apply any chemical or organic (such as neem sprays) insecticides during the 2011 cowpea production cycle in: [1] YES [2] NO [3] Applied to the main intercropped crop (other than cowpea)	**B311a.** FIELD F1?	
	B311b. FIELD F2?	
	B311c. FIELD F3?	
	B311d. FIELD F4?	
	B311e. FIELD F5?	

*If **all answers** above were **NO:***

B312. Why you DID NOT apply insecticides to cowpea in 2011 (main reason)? _____

[1] Could not afford it/too expensive
[2] Didn't know how to apply/prepare them
[3] Not available in the community
[4] No insect problems
[99] Other (specify): _____

*If **at least one** of the answers above was **YES:***

B313	**B314a**	**B314b**	**B315**	**B316**	**B317**	**B318a**	**B318b**
Name of the insecticide applied	**Total** quantity applied in all cowpea fields		Cost per unit of B312b **CFAs**	Total **number** of applications in the cowpea production cycle *(Sum all fields)*	Place where you bought this insecticide? [1] Local market (community) [2] Other market (nearby community) [3] Given by an NGO or Government [99] Other (sp):	How does the quantity used in 2011 compare to the last two years? [1] Lower [2] Same [3] Higher [77] Don't know [88] Not applicable	How satisfied were you with the effectiveness of this insecti-cide in contro-lling pests? [1] Very satisfied [2] Somewhat satisfied [3] Dissatisfied [77] Don't know
	Quantity	Units [1] kg [2] liters [3] mililiters [99] Other (sp)					

FUNGICIDES

B319. Did you apply any fungicide during the 2011 cowpea production cycle in: [1] YES [2] NO [3] Applied to the main intercropped crop (other than cowpea)	**B319a.** FIELD F1?	
	B319b. FIELD F2?	
	B319c. FIELD F3?	
	B319d. FIELD F4?	
	B319e. FIELD F5?	

*If **all answers** above were **NO:***

B320. Why you DID NOT apply fungicides to cowpea in 2011 (main reason)? _____

[1] Could not afford it/too expensive
[2] Didn't know how to apply
[3] Not available in the community
[4] No fungal problems
[99] Other (specify): _____

*If **at least one** of the answers above was **YES:***

B321	B322a	B322b	B323	B324	B325	B326
Name of the fungicide applied	**Total** quantity applied in all cowpea fields		Cost per unit of B320b **CFAs**	Total **number** of applications in the cowpea production cycle *(Sum all fields)*	Place where you bought this fungicide? [1] Local market (community) [2] Other market (nearby community) [3] Given by an NGO or Government [99] Other (sp):	How does the quantity used in 2011 compare to the last two years? [1] Lower [2] Same [3] Higher [77] Don't know [88] Not applicable
	Quantity	Units [1] kg [2] grams [3] liters [4] mililiters [99] Other (sp)				

B327a. Did you apply <u>chemical insecticide</u> on crops grown in any other fields in 2011? _____

[1] YES [2] NO => ***Go to B328a***

B327b. If YES, among all the crops on your farm, on which crop did you <u>apply the most</u> amount of chemical insecticide in 2011? _____

[1] Cowpea [3] Sorghum [5] Cotton [6] Sesame
[2] Maize [4] Millet [99] Other (specify): _____

B327c. If YES, how does the quantity used on the crop noted in B327b compare to the last two years? _____

[1] Lower [3] Higher [77] Don't know => ***Go to B328a***
[2] Same => ***Go to B328a*** [4] Applied first time in 2011 => ***Go to B328a*** [88] Not applicable => ***Go to B328a***

B327d. If LOWER / HIGHER, what is the <u>main reason</u> for this change? _____

[11] Insect damage has decreased
[12] Insecticide price has increased
[13] Insecticides are not available anymore
[14] Started using beneficial insects
[15] Started using neem/plant extract sprays
[16] I use/started using BT Cotton
[31] Insect damage has increased
[32] Insecticide price has decreased
[33] Insecticides became available
[34] Stopped/reduced using beneficial insects
[35] Stopped/reduced using neem/plant extract sprays
[99] Other (specify): _____

B328a. Did you apply <u>fungicide</u> on crops grown in any other fields in 2011? _____

[1] YES [2] NO => ***Go to B329***

B328b. If YES, among all the crops on your farm, on which crop did you <u>apply the most</u> amount of fungicide in 2011? _____

[1] Cowpea [3] Sorghum [5] Cotton [6] Sesame
[2] Maize [4] Millet [99] Other (specify): _____

B328c. If YES, how does the quantity used on the crop noted in B328b compare to the last two years? _____

[1] Lower [3] Higher [77] Don't know => ***Go to B329***
[2] Same => ***Go to B329*** [4] Applied first time in 2011 => ***Go to B329*** [88] Not applicable => ***Go to B329***

B328d. If LOWER / HIGHER, what is the <u>main reason</u> for this change? _____

[11] Fungal damage has decreased
[12] Fungicide price has increased
[13] Fungicides are not available anymore
[99] Other (specify): _____
[31] Fungal damage has increased
[32] Fungicide price has decreased
[33] Fungicide became available

B329. How much did you spend on all the cowpea seed you purchased for planting in 2011?
(***Write 'zero' if the producer did not purchase cowpea seed***) _____CFAs

B4. Use of labor during the 2011 season

	B400	B401a	B401b	B401c	B401d	B402a	B402b	B402c	B402d
Activity	ID	Family / Non-hired Labor				Hired Labor			
		No. men	No. days	No. women	No. days	No. men	No. days	No. women	No. days
Pre-planting:									
Land preparation	11								
At planting:									
Planting	21								
Fertilizer application	22								
Other (sp):	23								
Post-planting:									
First weeding (with fertilizer application)	31								
First weeding (without fertilizer application	32								
Second weeding	33								
Insecticide application	34								
Other (sp):	35								
Harvest & post-harvest:									
Harvest	41								
Drying	42								
Threshing & winnowing	43								
Bagging	44								

C. Pesticide sources of information, management and health effects

C1. How do you decide **when to apply** pesticides to the cowpea crop? _____

[0] Never apply pesticides => **Go to section D**
[1] By tradition (that is, at fixed time intervals learned by experience)
[2] As soon as I see some damage
[3] When the damage is becoming a problem
[4] When the extension agent tells me to
[5] Accordingly to the training I received
[6] At fixed time intervals recommended by the input dealer
[99] Other (specify): _____

C2a. From whom do you receive information on **which pesticides** to apply? (***main source***) _____

[1] Input dealer
[2] Relative
[3] Neighbor (other than relative)
[4] Learned from past training
[5] Extension agents (no dealers)
[6] Radio
[7] Television
[8] Cell phone-based services
[9] Pesticide flyers
[10] NGOs / Peace Corps Volunteers
[11] Research Institute (INERA)
[12] DVD/vCD or Video viewing clubs
[77] Don't know => ***Go to C3***
[99] Other (speficy): _____

C2b. On a scale of one to three, one being no trust at all and three being complete trust, how much do you **trust** this source of information? _____

[1] No trust at all [2] Medium trust [3] Complete trust

C3. Regarding your **2011** cowpea **production**:

	C300	C301	C302	C303	C304
Type of insect ***In order of importance***	ID	What were the primary <u>insect pests</u> that have damaged your cowpea crop? [0] None => ***Go to C4a*** [1] Legume pod borer [2] Coreid pod-sucking bugs [3] Groundnut aphids [4] Thrips [77] Don't know => ***Go to C4a*** [99] Other (specify)	Severity of the damage caused by these <u>insect pests</u>? [1] Not very severe [2] Somewhat severe [3] Very severe [77] Don't know	Comparing this damage to the previous two years, the damage has: [1] Decreased [2] Same [3] Increased [77] Don't know [88] Not applicable	At what stage during the season was the damage most noticeable? [1] At germination [2] Two weeks after planting [3] Three weeks after planting [4] At flowering [5] At pod filling [99] Other (sp):
First	1				
Second	2				
Third	3				

C4a. Do you know that there are **beneficial insects** that help to control cowpea pests? _____
[1] YES [2] NO => ***Go to C5a***

C4b. If YES, where did you **first** learn about these beneficial insects? (***the first time***) _____

[1] Input dealer
[2] Relative
[3] Neighbor (other than relative)
[4] Learned from FFS IPM training
[5] Extension agents (no dealers)
[6] Radio
[7] Television
[8] Cell phone-based services
[9] NGOs / Peace Corps Volunteers
[10] Research Institute (INERA)
[11] DVD/vCD or Video viewing clubs
[77] Don't know
[99] Other (speficy): _____

C4c. If YES, to help increase the number of these beneficial insects in your field do you:

[1] YES [2] NO

C4ca. Not apply pesticides where they live? _____
C4cb. Grow plants that host these insects? _____
C4cc. Apply neem based preparations instead of insecticide? _____

C4d. If YES, how does the **beneficial insect populations** in 2011 compare to a typical year? _____
[1] Lower [2] Same [3] Higher [77] Don't know

C5a. Do you know that there are **viruses** that help to control cowpea pests? _____
[1] YES [2] NO => ***Go to C6a***

C5b. If YES, where did you **first** learn about these beneficial viruses? (***the first time***) _____

[1] Input dealer
[2] Relative
[3] Neighbor (other than relative)
[4] Learned from FFS IPM training
[5] Extension agents (no dealers)
[6] Radio
[7] Television
[8] Cell phone-based services
[9] NGOs / Peace Corps Volunteers
[10] Research Institute (INERA)
[11] DVD/vCD or Video viewing clubs
[77] Don't know
[99] Other (speficy): _____

C6a. Where do you generally **store** the pesticides? _____

[1] In the kitchen
[2] Inside the house (locked)
[3] Inside the house (un-locked)
[4] Outside the house (locked)
[5] Outside the house (un-locked)
[99] Other (specify): _____

C6b. Is the place where pesticides are stored easily accessible to children? _____
[1] YES [2] NO

C6c. Do you **re-use** the pesticide containers after they are empty? _____
[1] YES [2] NO => ***Go to C7***

C6d. If YES, what do you re-use the containers for? (***main use only***) _____

[1] To drink water
[2] To store food (solid or liquid)
[3] To use when buying small quantities of pesticide
[4] For my children to play with it
[99] Other (specify): _____

C7. How do you **dispose** the pesticide containers after they are empty? _____

[1] Bury them
[2] Throw them to the garbage
[3] Burn them
[4] Sell them
[5] Give them to friends/relatives
[6] I re-use the containers
[99] Other (specify): _____

C8. Have you or any family member ever received training on integrated pest management/FFS? _____

[1] YES [2] NO

C9a. Do you think pesticides are harmful/toxic to people if they are exposed to them? _____

[1] YES [2] NO

C9b. Does anyone you know (friend or family) have **died** due to pesticide poisoning? _____

[1] YES [2] NO

C9c. Does anyone you know (friend or family) have been **sick** due to pesticide poisoning? _____

[1] YES [2] NO

C10. What is the color of the label used to identify the most toxic pesticide? _____

(without reading the answers to the producer, write one)

[1] Yellow
[2] Blue
[3] Red
[4] Green
[77] Don't know
[99] Other (specify):_____

Enumerator: *Ask the following questions only if the farmer reported using PESTICIDES in any of his/her fields in 2011 (answered YES to 311a-311e or 319a-319e or B327a or B328a). If all these answers were NO, go to Section D.*

C11	**C12a**	**C12b**	**C12c**	**C13a**	**C13b**
Who primarily applied pesticides in the 2011 cowpea production cycle? [1] Family member [2] Hired Labor [3] Both	Number of people involved in this activity (in 2011)			Were any of them younger than 16? [1] YES [2] NO	
	Males	Females	Total	Males	Females

C14	**C15**	**C16**
Did the clothes or skin of any of them get **wet** with pesticide after the application? [1] YES [2] NO	Did any of them **eat or drink** (sodas/water) during the pesticide application? [1] YES [2] NO	Did any of them **smoke** during the pesticide application? [1] YES [2] NO

C17a	C17b	C17c	C17d	C17e	C17f	C17g
Did any of them use […] to apply the pesticides? [1] YES [2] NO						
Long sleeve shirts	Overalls	Rubber gloves	Rubber boots	Face mask	Eyeglasses	Other (specify):

C18a	C18b	C18c	C18d	C18e	C18f	C18g	C18h	C18j	C18k
Did any of them experience […] after the pesticide application? [1] YES [2] NO (*If all answers are NO, go to Section D*)									
Skin irritation	Blurred vision	Eye irritation	Nausea & vomit	Upset stomach	Dizziness	Headache	Diarrhea	Muscle aches	Difficulty to breathe

C19. Did the person showing any of these symptoms seek medical treatment? _____
[1] YES [2] NO [77] Don't know

C20. How many days the sick person could not work because of this sickness? _____ days
[77] Don't know

D. Assets, infrastructure & services, livestock & small animals and house characteristics.

D100. Farm Assets

D100a	D100b	D100c	D100d	D100e	D100f	D100g	D100h
How many […] does your HH own today? *If 'none', write zero and go to the next asset*							
Tractor	Tractor plow	Animal plow	Backpack sprayer (*manual*)	Backpack sprayer (*motor*)	Metal silo	Irrigation pump	Bag sewing machine

D101. Transportation and Household Assets

D101a	D101b	D101c	D101d	D101e	D101f	D101g	D101h
How many […] does your HH own today? *If 'none', write zero and go to the next asset*							
Carts	Bicycle	Motorcycle / tricycle	Pick up / car	Truck	Cell phones	Television	Radio / stereo

D102. How many <u>hectares</u> of land does your family <u>own</u> (include homestead)? _____ Ha
[77] Don't know

D103. How many <u>hectares</u> of land did your family <u>cultivate</u> (all crops) in 2011? _____ Ha
[77] Don't know

D2. Infrastructure & services

	D200	D201	D202	D203
Infrastructure/service type	ID	Do you own / have […]? [1] YES [2] NO => *next type*	Year when this infrastructure or service was constructed / obtained [YYYY]	Year when you made major improvements on this infrastructure/asset after it was obtained [YYYY] *If no major improvements have been made, write 0*
Farm:				
Well for irrigation	11			
Dam for irrigation	12			
Flood irrigation equipment	13			
Sprinkler irrigation equipment	14			
Drip irrigation equipment	15			
Access to water (river, lake)	16			
Home:				
Well (home use)	21			
Latrine (outside)	22			
Bathroom (inside)	23			
Water service	24			
Electricity service	25			

D3. Livestock & small animals

	D300	D301
Type	ID	How many […] does your HH own today? *If 'none', write zero and go to the next type*
Cows	11	
Donkey	12	
Horses	13	
Goats	14	
Sheep	15	
Swine	16	
Hen	17	

D4. House characteristics (*observe and write*)

D401	D402
House walls made of [1] Straw [2] Compacted mud/clay [3] Cement [4] Stone	House floor made of [1] Dirt [2] Cement

D403
House roof made of [1] Non-permanent materials (straw) [2] Permanent materials (zinc, tile, aluminum, etc.)

E. Household (HH) composition and characteristics

E100a. How many people lived in this HH in 2011 (12 months)? _____

E100b. How many years have you lived in this community? _____ years.

About your household composition:

E101a	**E101b**	**E101c**	**E101d**	**E101e**	**E101f**
I would like to know the number of members of the household in the following age categories in 2011:					
TOTAL	Members **older** than 17 years		Members **between** 7 and 17 years		Children (younger than **seven** years)
	Male	Female	Boys	Girls	

E102a. How many children between 7 and 17 years were enrolled in school in 2011? _____

E102b. How many children between 7 and 17 years **applied pesticides** in your farm in 2011? _____

E103a. How many members older than 17 years finished primary school (years 1-6)? _____

E103b. How many members older than 17 years participated in farmer organizations in 2011? _____

E103c. How many members older than 17 years worked **in** the farm in 2011? _____

E103d. How many members older than 17 years worked **outside** the farm in 2011? _____

E103e. How many members older than 17 years worked in **livestock** in 2011? _____

E103f. How many members older than 17 years worked in **non-agricultural** (including livestock) jobs in 2011? _____

E103g. How many members older than 17 years **applied pesticides** in your farm in 2011? _____

E201	**E202**	**E203**
Did your HH purchase cowpeas for consumption in 2011? [1] YES [2] NO	Did your HH use agricultural credit for the 2011 cowpea production? [1] YES [2] NO	Did your HH receive remittances (cash only) from a relative in 2011? [1] YES [2] NO

E204a	E204b	E204c	E204d
Did your HH have income from **non-agricultural** sources in 2011? [1] YES [2] NO => ***Go to E205a***	What were the <u>three main sources</u> (in addition to agriculture) of HH income in 2011? [1] Commerce (activities where products are sold) [2] Services (paid jobs such as carpenter, construction, washerwoman, etc.) [3] Agricultural labor (work in other farms) [4] Remittances, subsidies [5] Handcrafts (making hats, soaps, wood figures) [6] Processed food & drinks [7] Livestock [8] Forest products (shea butter) [9] Fishing [99] Other (specify):		
	First	Second	Third

E205a. How many adult members (>16 yr old) that lived in the HH between 2008-2010 are not living in the HH anymore (not included in Table E above)? (***If none, write 'zero' and go to E206***) _____

E205b. Did any of the adult members that don't live in the HH anymore died between 2008-2010? ____
[1] YES [2] NO

E206. How far away is your HH from the main road where you could sell cowpea? _____ KM
(***Write 'ZERO' if the road is in front of the home***)

F. Importance of the cowpea crop as a source of income and food security

F1. In a typical year, what share of your HH **income** comes from cowpea grain sales? _____
[1] A quarter or less
[2] Between one quarter and half
[3] Between half and three quarters
[4] More than three quarters
[77] Don't know / can't answer

F2. In a typical year, what share of your HH annual cowpea **grain consumption** is satisfied by your own production? _____
[1] A third or less
[2] Between one third and two thirds
[3] More than two thirds
[77] Don't know / can't answer

F3. In a typical year, how long does your **food grain reserves** of cowpea last after harvest? _____
[1] Less than one month
[2] One to three months
[3] Three to six months
[4] Six to nine months
[5] Until the harvest in the following season
[77] Don't know / can't answer

F4. In a typical year, after your cowpea grain reserves are over, how many times do you **purchase grain** for home consumption? _____
[1] Never
[2] Every day
[3] Few times per week
[4] Once a week
[5] 2-3 times per month
[6] Once a month
[77] Don't know / can't answer

THANK YOU VERY MUCH FOR ANSWERING MY QUESTIONS!!!

Annex 4. Estimation of asset indices.

To construct the asset indices, we followed the methodology described by Filmer and Pritchett (2001); Minujin and Hee Bang (2002); McKenzie (2005); Córdova (2008); and Reyes *et al*. (2010). Two asset indices were estimated: a farm assets index and a transportation & household assets index. For each index, the following methodology was used:

The set of assets, a^*_{1j} to a^*_{Nj} (N=1,…,N) representing the number of N assets owned by each household *j* were normalized by its mean (a^*_N) and standard deviation (s^*_N). For example, for the first asset, the normalized number of this asset owned by household *j* was:

$$a_{1j} = (a^*_{1j} - a^*_1) / (s^*_1)$$

Where a^*_1 is the mean number of the first asset owned across all households and s^*_1 is its standard deviation. After normalizing every asset or indicator, the asset index for each household *j* was estimated by expressing these indicators as a weighted linear combination, following:

$$A_j = f_{11} \times (a^*_{1j} - a^*_1) / (s^*_1) + f_{12} \times (a^*_{2j} - a^*_2) / (s^*_2) + \ldots + f_{1N} \times (a^*_{Nj} - a^*_N) / (s^*_N)$$

Where A_j is the asset index for household *j*, and f_{11} to f_{1N} are the weights obtained from the first principal component (eigenvector of the first component) estimation.[12]

[12] The principal component estimation gives as many components as indicators entering the computation. For each indicator or asset, eigenvectors (or weights) are provided. We used the eigenvector of the first component only, using STATA's *pca* command.

Annex Tables

Table A1. List of selected villages. Burkina Faso, 2012.

Bio-Area	Province	Villages selected
South	Houet	Leguema, Bana, Karangasso Vigue, Boudiedara, Peni, Diorossiamasso
South	Tuy	Bereba, Dossi, Founzan, Kari, Koumbia
South	Ioba	Zodoun Tampouo, Dissin, Koper, Pouleba, Oronkua
South	Zoundweogo	Kaibocentre, Gogo, Guiba, Basgana, Nobere
South	Boulgou	Boumbin, Koabtenga, Zampa, Gourgou, Pargou, Bourma
North	Banwa	Kouka, Sagouita, Bama, Ban, Kie, Daboura
North	Mouhoun	Kera, Tia, Ouakara, Kosso, Tikan
North	Sanguie	Kyon, Villy-Bongou, Goundi, Zoula, Koukouldi, Zawara
North	Bazega	Doulougou, Gaongo, Ipelce, Guirgo, Kombissiri, Sapone
North	Ganzourgou	Mankarga v6, Nedogo, Guingo, Rapadama v4, Rapadama v9, Zoungou

Table A2. Production and weight estimation for each village. Burkina Faso, 2012.

					Province-level		Village-level				
No.	Province	Selected?	Bio-area	Cowpea production (MT, 2009)[1]	Probability of selection	Weight	Total # of villages[2]	# of selected villages	Probability of selection	Weight	Village weight
					(A)	(B)	(C)	(D)	(E)	(F)	(G)
1	Houet	yes	South	15,139	0.7143	1.4	199	6	0.0302	33.2	46.4
2	Tuy	yes	South	4,699	0.7143	1.4	99	5	0.0505	19.8	27.7
3	Ioba	yes	South	6,013	0.7143	1.4	160	5	0.0313	32.0	44.8
4	Zoundweogo	yes	South	2,546	0.7143	1.4	167	5	0.0299	33.4	46.8
5	Boulgou	yes	South	10,562	0.7143	1.4	298	6	0.0201	49.7	69.5
6	Banwa	yes	North	11,427	0.8333	1.2	110	6	0.0545	18.3	22.0
7	Mouhoun	yes	North	6,813	0.8333	1.2	185	5	0.0270	37.0	44.4
8	Sanguie	yes	North	20,186	0.8333	1.2	135	6	0.0444	22.5	27.0
9	Bazega	yes	North	11,272	0.8333	1.2	219	6	0.0274	36.5	43.8
10	Ganzourgou	yes	North	25,986	0.8333	1.2	203	6	0.0296	33.8	40.6
11	Ziro	no	South	6,270	n.a.	n.a.	178	n.a.	n.a.	n.a.	n.a.
12	Sissili	no	South	7,635	n.a.	n.a.	178	n.a.	n.a.	n.a.	n.a.
13	Boulkiemde	no	North	19,806	n.a.	n.a.	178	n.a.	n.a.	n.a.	n.a.

Notes: n.a. = not applicable. For bio-area *i*: (A) = (# provinces selected in bio-area *i*) / (total provinces in bio-area *i*).
(B) = 1 / (A); (E) = (D) / (C); (F) = 1 / (E); (G) = (B) * (F).

[1] Source: Burkina Faso National Statistical Institute (INSD), provided by Malick Ba, INERA.

[2] Source: Burkina Faso National Statistical Institute (INSD), provided by Malick Ba, INERA. Since data on number of villages in the last three provinces were not collected, the average number of villages across the other ten provinces was assumed for these two provinces. This information was only used to check whether the weights were correctly estimated.

Table A3. Weight estimation for each household (HH). Burkina Faso, 2012.

No.	Province	Village	Population[1]	Average HH size[2]	Total # of HH	# of selected HH	Probability of selection	HH weight	Village weight	Final HH weight
			(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)
1	Houet	Bana	756	6.9	110	10	0.0913	11.0	46.4	508.7
2	Houet	Boudiedara	1,682	8.4	200	10	0.0499	20.0	46.4	929.8
3	Houet	Diorossiamasso	4,410	5.8	760	10	0.0132	76.0	46.4	3,530.5
4	Houet	Karangasso Vigue	5,660	7.7	735	10	0.0136	73.5	46.4	3,413.2
5	Houet	Leguema	5,349	7.0	764	10	0.0131	76.4	46.4	3,548.2
6	Houet	Peni	4,034	6.8	593	10	0.0169	59.3	46.4	2,754.6
7	Tuy	Bereba	1,895	8.6	220	10	0.0454	22.0	27.7	610.8
8	Tuy	Dossi	5,154	5.7	904	10	0.0111	90.4	27.7	2,506.5
9	Tuy	Founzan	5,351	10.6	505	10	0.0198	50.5	27.7	1,399.3
10	Tuy	Kari	5,246	7.2	729	10	0.0137	72.9	27.7	2,019.7
11	Tuy	Koumbia	7,728	8.9	868	10	0.0115	86.8	27.7	2,407.0
12	Ioba	Dissin	4,474	12.7	352	10	0.0284	35.2	44.8	1,578.2
13	Ioba	Koper	964	8.3	116	10	0.0861	11.6	44.8	520.3
14	Ioba	Oronkua	2,335	13.7	170	10	0.0587	17.0	44.8	763.6
15	Ioba	Pouleba	2,073	12.7	163	10	0.0613	16.3	44.8	731.3
16	Ioba	Zodoun Tampouo	2,907	12.2	238	10	0.0420	23.8	44.8	1,067.5
17	Zoundweogo	Basgana	3,020	16.5	183	10	0.0546	18.3	46.8	855.8
18	Zoundweogo	Gogo	4,758	13.1	363	10	0.0276	36.3	46.8	1,696.9
19	Zoundweogo	Guiba	938	10.4	90	10	0.1109	9.0	46.8	421.7
20	Zoundweogo	Kaibocentre	4,172	11.5	363	10	0.0276	36.3	46.8	1,696.4
21	Zoundweogo	Nobere	3,594	14.1	255	10	0.0392	25.5	46.8	1,191.9
22	Boulgou	Boumbin	1,054	12.6	84	10	0.1195	8.4	69.5	581.7
23	Boulgou	Bourma	905	9.2	98	10	0.1017	9.8	69.5	684.0
24	Boulgou	Gourgou	355	13.2	27	10	0.3718	2.7	69.5	187.0
25	Boulgou	Koabtenga	1,068	8.6	124	10	0.0805	12.4	69.5	863.5
26	Boulgou	Pargou	1,245	12.3	101	10	0.0988	10.1	69.5	703.8
27	Boulgou	Zampa	1,855	9.0	206	10	0.0485	20.6	69.5	1,433.2
28	Banwa	Bama	1,005	16.3	62	10	0.1622	6.2	22.0	135.6
29	Banwa	Ban	2,313	21.1	110	10	0.0912	11.0	22.0	241.2
30	Banwa	Daboura	7,697	20.7	372	10	0.0269	37.2	22.0	818.0
31	Banwa	Kie	5,073	12.7	399	10	0.0250	39.9	22.0	878.8
32	Banwa	Kouka	12,878	21.3	605	10	0.0165	60.5	22.0	1,330.1
33	Banwa	Sagouita	933	11.6	80	10	0.1243	8.0	22.0	176.9

Table A3 (cont'd).

No.	Province	Village	Population[1]	Average HH size[2]	Total # of HH	# of selected HH	Probability of selection	HH weight	Village weight	Final HH weight
			(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)
34	Mouhoun	Kera	1,991	12.7	157	10	0.0638	15.7	44.4	696.1
35	Mouhoun	Kosso	4,537	14.5	313	10	0.0320	31.3	44.4	1,389.3
36	Mouhoun	Ouakara	2,740	11.4	240	10	0.0416	24.0	44.4	1,067.2
37	Mouhoun	Tia	1,903	11.8	161	10	0.0620	16.1	44.4	716.0
38	Mouhoun	Tikan	3,469	10.1	343	10	0.0291	34.3	44.4	1,525.0
39	Sanguie	Goundi	5,177	6.9	750	10	0.0133	75.0	27.0	2,025.8
40	Sanguie	Koukouldi	6,055	7.7	786	10	0.0127	78.6	27.0	2,123.2
41	Sanguie	Kyon	9,806	14.3	686	10	0.0146	68.6	27.0	1,851.5
42	Sanguie	Villy-Bongou	1,225	12.9	95	10	0.1053	9.5	27.0	256.4
43	Sanguie	Zawara	1,734	9.3	186	10	0.0536	18.6	27.0	503.4
44	Sanguie	Zoula	8,847	9.4	941	10	0.0106	94.1	27.0	2,541.2
45	Bazega	Doulougou	661	6.8	97	10	0.1029	9.7	43.8	425.8
46	Bazega	Gaongo	591	7.7	77	10	0.1303	7.7	43.8	336.2
47	Bazega	Guirgo	1,909	11.2	170	10	0.0587	17.0	43.8	746.6
48	Bazega	Ipelce	2,221	12.2	182	10	0.0549	18.2	43.8	797.4
49	Bazega	Kombissiri	23,460	13.5	1,738	10	0.0058	173.8	43.8	7,611.5
50	Bazega	Sapone	2,556	7.4	345	10	0.0290	34.5	43.8	1,512.9
51	Ganzourgou	Guingo	1,672	12.0	139	10	0.0718	13.9	40.6	565.7
52	Ganzourgou	Mankarga v6	2,116	23.1	92	10	0.1092	9.2	40.6	371.9
53	Ganzourgou	Nedogo	1,716	15.2	113	10	0.0886	11.3	40.6	458.4
54	Ganzourgou	Rapadama v4	175	14.3	12	10	0.8171	1.2	40.6	49.7
55	Ganzourgou	Rapadama v9 [3]	102	15.6	10	10	1.0000	1.0	40.6	40.6
56	Ganzourgou	Zoungou	1,489	17.5	85	10	0.1175	8.5	40.6	345.4

[1] Source: Burkina Faso National Statistical Institute (INSD), data provided by Malick Ba, INERA.

[2] Household size estimated from the CRSP Baseline Survey on Management of Field Insect Pests of Cowpea, Burkina Faso, 2012.

[3] For Rapadama v9, (C) was assumed to equal 10, since estimating (C) = (A) / (B) would give less than 10 households.
(C) = (A) / (B); (E) = (D) / (C); (F) = 1 / (E); (H) = (F) * (G).

Table A4. Village-level characteristics, by bio-area and province. Burkina Faso, 2011.

	Bio-area/Province													
	South						North							
Characteristics	**Houet**	**Tuy**	**Ioba**	**Zound-weogo**	**Boulgou**	**Total South**	**Banwa**	**Mouhoun**	**Sanguie**	**Bazega**	**Ganzor-gou**	**Total North**	**t-test[1]**	**Total**
Location-specific														
Distance from village to main commercial town (km)	33.8	54.2	18.0	12.2	13.7	22.8	41.0	60.6	33.2	0.0	20.2	28.5		25.3
Distance from village to paved road (km)	6.0	7.0	7.8	8.0	4.5	6.3	48.5	14.2	13.0	7.5	18.8	14.9	***	9.9
Most common way to get to above town (%):														
Bus service	0	20	0	20	50	22	33	40	0	0	0	13	--	18
Truck/car	0	0	0	0	0	0	17	20	0	0	0	6	--	3
Motorcycle/tricycle	0	20	0	80	33	27	50	40	50	50	67	52	--	38
Bicycle	0	0	80	0	17	19	0	0	50	50	0	21	--	20
By foot	0	0	20	0	0	3	0	0	0	0	0	0	--	2
Other	100	60	0	0	0	28	0	0	0	0	33	8	--	19
Road condition between village and town (%):														
Dirt + damaged sections	50	40	20	20	33	33	100	40	67	0	67	48	--	40
Dirt in good shape	0	0	40	60	17	23	0	0	17	0	0	3	--	14
Asphalt + damaged sections	0	20	0	0	33	13	0	0	0	0	0	0	--	7
Asphalt in good shape	50	40	20	20	17	28	0	60	17	0	17	20	--	24
Not applicable (village and town are the same)	0	0	20	0	0	3	0	0	0	100	17	30	--	15
Bus service in village (% yes)	67	60	20	40	17	37	50	40	17	0	50	30		34
Access to Basic services (% yes)														
Electricity	33	40	40	20	0	22	17	0	50	0	0	10		17
Water service network	17	0	0	0	0	4	17	0	0	0	0	2		3
Cell phone network	100	100	100	100	100	100	67	100	83	100	100	93		97
Health Center	67	80	80	100	33	66	67	80	83	100	83	85		74
Private bank	17	20	20	0	0	9	50	0	17	50	0	22		15
Community/rural bank	33	40	40	80	0	33	50	0	17	33	0	18		26
Primary school	100	100	100	100	100	100	100	100	100	100	100	100	--	100
Secondary school	50	80	40	80	0	41	33	40	33	100	33	52		46
Gov't ag. extension office	67	80	60	80	0	48	67	0	67	100	83	65		55
NGOs providing ag. services	17	20	80	60	17	36	83	0	100	50	33	47		41
Video viewing facilities	50	80	40	80	33	52	67	20	83	17	67	46		49

Table A4 (cont'd).

Characteristics	Bio-area/Province: South: Houet	Tuy	Ioba	Zound-weogo	Boulgou	Total South	North: Banwa	Mouhoun	Sanguie	Bazega	Ganzor-gou	Total North	t-test[1]	Total
Agriculture-related														
Do ag. extension officers regularly visit village? (% yes)	83	80	100	80	83	85	83	100	83	83	100	91		88
Is there a permanent input dealer in village? (% yes)	33	20	0	20	0	13	100	0	0	83	50	46	***	28
Rainfall in 2011, compared to a normal year (%):														
Lower	100	80	80	100	67	84	100	100	100	100	100	100	--	91
The same	0	20	20	0	17	11	0	0	0	0	0	0	--	6
Higher	0	0	0	0	17	5	0	0	0	0	0	0	--	3
Insect damage in 2011, compared to a normal year (%):														
Lower	100	80	20	100	17	57	0	40	0	83	50	42	--	50
The same	0	20	20	0	50	22	0	0	33	0	17	9	--	16
Higher	0	0	60	0	17	16	100	40	67	17	33	44	--	28
Don't know	0	0	0	0	17	5	0	20	0	0	0	4	--	5
Villages receiving training between 2009-2011 on (%):														
Pesticide use	67	60	80	60	67	67	17	40	50	83	17	44	*	57
Integrated Pest Management	33	20	60	20	50	39	17	0	50	0	17	14	**	28
Post-harvest/storage techniques	67	60	100	60	67	71	17	60	83	83	17	54		63
Cowpea yield in normal year (kg/ha)	642	590	325	790	340	528	920	840	1,350	358	950	832	***	667
Place of cowpea grain sales (% yes):														
Intermediaries in village	100	100	100	0	83	77	100	40	33	67	100	68		73
Other villages/towns	100	100	60	40	100	82	100	80	100	67	100	87		84
Grain price in 2011 at beginning of season (CFA/kg)	442	335	470	580	410	450	402	380	359	453	430	410		432
Grain price in 2011 at harvest (CFA/kg)	175	200	205	278	283	236	199	230	200	217	253	223		231
Number of observations	6	5	5	5	6	27	6	5	6	6	6	29	--	56

[1] Test of difference between means of households in the South and North bio-areas: *significant at 10%; **significant at 5%; ***significant at 1%; -- not tested. Estimates weighted to reflect population (except number of observations).

Source: CRSP Baseline Survey on Management of Field Insect Pests of Cowpea, Burkina Faso, 2012.

Table A5. Work sources, use of agricultural credit, and sources of income, by bio-area and province. Burkina Faso, 2011.

	Bio-area/Province													
	South						North							
Detail	**Houet**	**Tuy**	**Ioba**	**Zound-weogo**	**Boulgou**	**Total South**	**Banwa**	**Mouhoun**	**Sanguie**	**Bazega**	**Ganzor-gou**	**Total North**	**t-test[1]**	**Total**
Source of work & use of credit in 2011														
No. members >17 yr. working on farm	4.2	4.8	5.7	5.2	4.4	4.7	8.2	5.4	4.1	3.6	6.2	4.7		4.7
No. members >17 yr. working off farm	0.2	0	0.3	0.2	0.1	0.1	0.1	0.4	0.1	0.8	1.4	0.5	***	0.3
No. members >17 yr. working with livestock	2.7	3.1	2.5	3.8	1.8	2.8	0.5	1.8	3.8	2.8	4.2	2.8		2.8
HH used agricultural credit for cowpea production (% yes)	2.3	3.1	1.6	0	1.3	2.0	0	9.2	0.5	7.3	0.5	4.4	*	3.1
Sources of income in 2011 (% yes)														
HH received cash remittances	21	35	13	35	10	24	0	11	14	11	5	10	***	18
HH had non-crop income:	100	97	92	97	29	90	18	100	100	100	46	88		89
Main source was livestock	41	21	60	38	26	38	55	30	2	79	21	41		39
Main source was commerce	24	28	12	56	19	29	43	60	91	19	16	52	***	39
Number of observations	60	50	50	49	60	269	60	50	60	60	60	290	--	559

[1] Test of difference between means of households in the South and North bio-areas: *significant at 10%; **significant at 5%; ***significant at 1%; -- not tested.
Estimates weighted to reflect population (except number of observations).
Source: CRSP Baseline Survey on Management of Field Insect Pests of Cowpea, Burkina Faso, 2012.

Table A6. Home and farm infrastructure, by bio-area and province. Burkina Faso, 2011.

	Bio-area/Province													
	South						North							
Detail	**Houet**	**Tuy**	**Ioba**	**Zound-weogo**	**Boulgou**	**Total South**	**Banwa**	**Mouhoun**	**Sanguie**	**Bazega**	**Ganzor-gou**	**Total North**	**t-test[1]**	**Total**
Home infrastructure (% yes)														
Well	94	91	17	35	13	66	82	58	38	22	0	38	***	53
Latrine (outside)	40	51	54	34	29	42	73	45	27	62	82	51	**	46
Bathroom (inside)	0	3	0	0	0	1	5	17	3	7	2	7	***	3
Water service	0	0	0	0	0	0	0	0	0	0	0	0	--	0
Electricity service	0	3	7	0	0	1	0	0	24	0	0	7	***	4
Farm infrastructure (% yes)														
Well for irrigation	5	11	2	9	0	6	0	0	82	0	18	25	***	15
Dam for irrigation	0	2	0	0	0	0.3	0	0	18	33	19	18	***	9
Flood irrigation equipment	18	5	0	2	0	9	0	0	9	33	0	15	**	11
Sprinkler irrigation equipment	0	8	0	3	0	2	0	3	0	0	0	0.4	*	1
Drip irrigation equipment	0	0	0	0	0	0	0	0	0	0	0	0	--	0
Access to water (river, lake)	24	11	44	39	11	24	0.5	6	92	4	17	31	*	27
Infrastructure age and improvements														
Average age (yrs) of:														
Home infrastructure [2]	11	9	9	11	5	10	13	9	9	10	4	10		10
Farm infrastructure [3]	7	10	10	20	0	10	0	1	13	16	22	14	**	13
Major improvements made to at least one (% yes):														
Home infrastructure [4]	39	43	37	36	17	38	60	66	8	45	39	42		40
Farm infrastructure [5]	42	87	0	16	0	48	0	100	13	83	91	40		42
Number of observations	60	50	50	50	60	270	60	50	60	60	60	290	--	560

[1] Test of difference between means of households in the South and North bio-areas: *significant at 10%; **significant at 5%; ***significant at 1%; -- not tested.

[2,3] Refer to the average (across assets and households) number of years owning/having these infrastructure/services.

[3,5] Excludes access to water sources (river, lake) for irrigation.

[4] Excludes water and electricity services.

Estimates weighted to reflect population (except number of observations).

Source: CRSP Baseline Survey on Management of Field Insect Pests of Cowpea, Burkina Faso, 2012.

Table A7. Farmers' timing of cowpea grain sales and reasons for that timing, by bio-area. Burkina Faso, 2011.

	Reason for selling in this month (% of farmers)			
Month of sales[1]	**Good price**	**Lack of storage**	**Other[2]**	**Total**
South	55	3	42	100
May 2011	1.4	0	0.4	2
June	8.4	0	0	8
July	1.0	0	0	1
August	0.5	0	0	1
September	0	0	3.3	3
October	0	0	11.5	12
November	0	0	12.0	12
December	0	1.5	9.5	11
January 2012	3.6	0.4	2.2	6
February	14.5	0.7	2.5	18
March	18.3	0.4	0.6	19
April	7.1	0	0.3	7
Number of observations	77	6	59	142
North	18	6	76	100
May 2011	0.7	0.0	0.0	1
June	3.1	0.0	0.0	3
July	0	0	0	0
August	0	0	0	0
September	0.6	0.85	1.13	3
October	0.8	0.04	16.76	18
November	0.36	0.28	4.51	5
December	4.68	2.28	18.19	25
January 2012	1.1	1.3	8.7	11
February	2.5	1.26	18.6	22
March	3.5	0.0	8.3	12
April	0.3	0.0	0.1	0
Number of observations	36	11	78	125
Total	40	4	55	100
Number of observations	113	17	137	267

Note: Each farmer was asked to indicate only the main reason for choice.

[1] Farmers reported planting as early as May. Thus, this month was listed first.

[2] Main 'other reasons' include: school-related expenses, cash constraints, and health problems. While school- and health-related expenses were common in both bio-areas, cash constraint was more common in the North bio-area.

Estimates weighted to reflect population (except number of observations).

Source: CRSP Baseline Survey on Management of Field Insect Pests of Cowpea, Burkina Faso, 2012.

Table A8. Farmers' location of cowpea grain sales and main reasons for that choice, by bio-area. Burkina Faso, 2011.

	Reason for selecting this location (% of farmers)					
Location of sales	**Easily accessible**	**Good price**	**Lack of transport**	**Good relation with traders**	**Other**	**Total**
South	62	18	0	20	0	100
Farm/home	9	4	0	19	0	32
Local market (village)	51	6	0	0.7	0	57
Other market (nearby village)	2	8	0	0.3	0	10
Other location	0.3	0	0	0.7	0	1
Number of observations	83	40	0	19	0	142
North	43	33	7	14	3	100
Farm/home	5	0	0	2	1	8
Local market (village)	35	29	6	7	1	79
Other market (nearby village)	3	4	0	5	0	12
Other location	0.3	0	1	0	0	1
Number of observations	70	22	2	28	3	125
Total	55	24	3	18	1	100
Number of observations	153	62	2	47	3	267

Note: Each farmer was asked to indicate only the main reason for choice.
Estimates weighted to reflect population (except number of observations).
Source: CRSP Baseline Survey on Management of Field Insect Pests of Cowpea, Burkina Faso, 2012.

Table A9. Crops on which chemical insecticides were applied the most during the 2011 season, by bio-area and province. Burkina Faso.

	Bio-area/Province													
	South						North							
Detail	Houet	Tuy	Ioba	Zound-weogo	Boulgou	Total South	Banwa	Mouhoun	Sanguie	Bazega	Ganzor-gou	Total North	t-test[1]	Total sample
Among households (HH) applying insecticides, HH applying the most amount on (%):														
Cereals [2]	0	3	0	3	2	2	1	5	7	9	7	7	***	4
Cotton	0	80	66	28	2	36	47	50	0	0	11	17	***	27
Cowpea	93	17	33	63	96	59	52	29	93	91	71	73	***	66
Number of observations	38	48	46	44	41	270	59	50	46	27	50	232	--	449

[1] Test of difference between means of households in the South and North bio-areas: *significant at 10%; **significant at 5%; ***significant at 1%; -- not tested.

[2] Cereals only include maize, sorghum, and millet.

Estimates weighted to reflect population (except number of observations).

Source: CRSP Baseline Survey on Management of Field Insect Pests of Cowpea, Burkina Faso, 2012.

Annex Figures

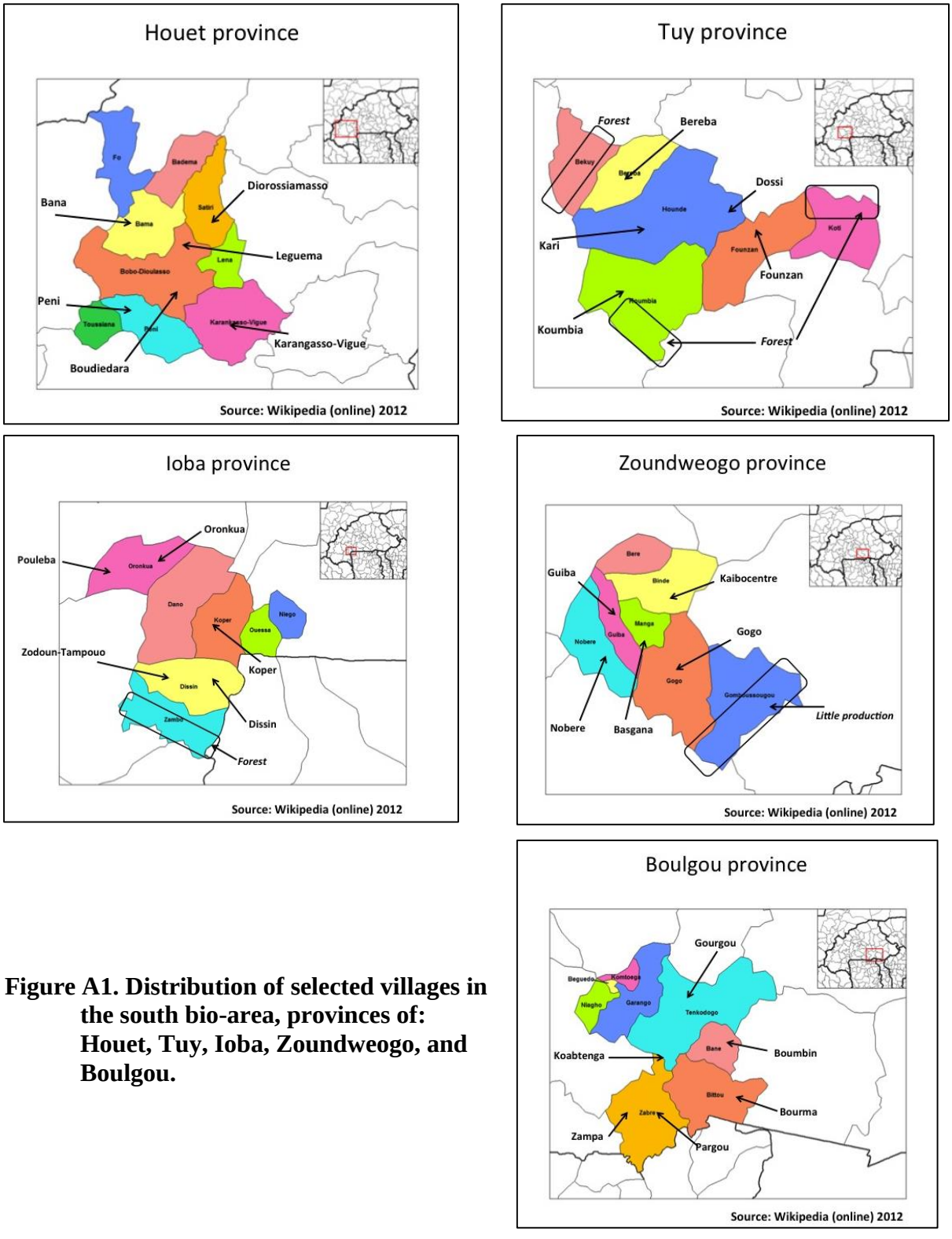
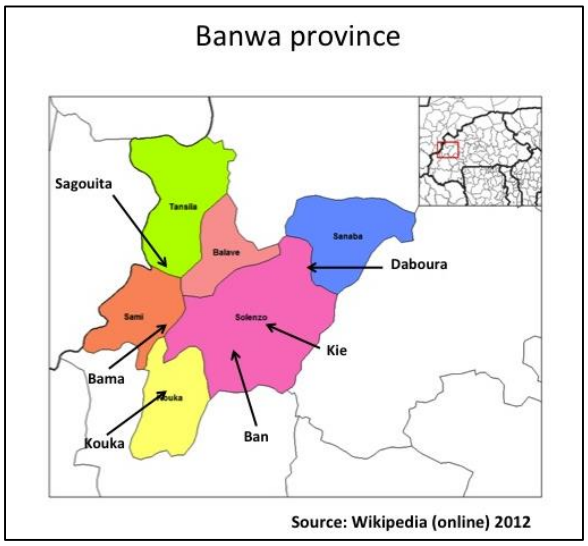
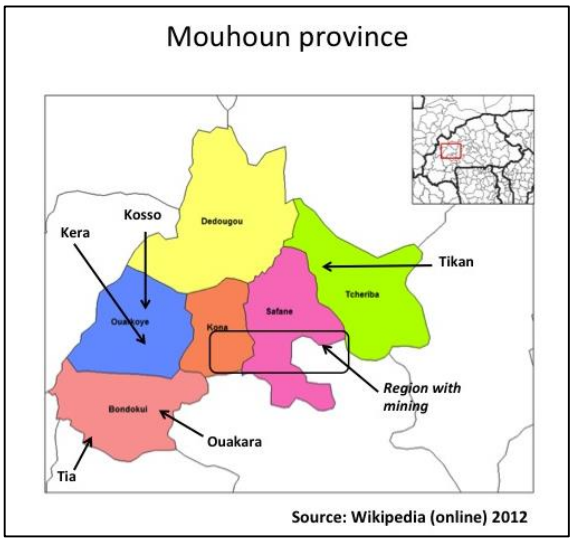
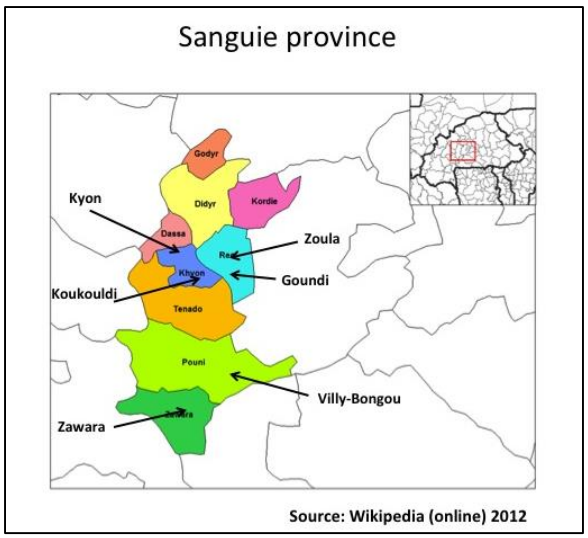
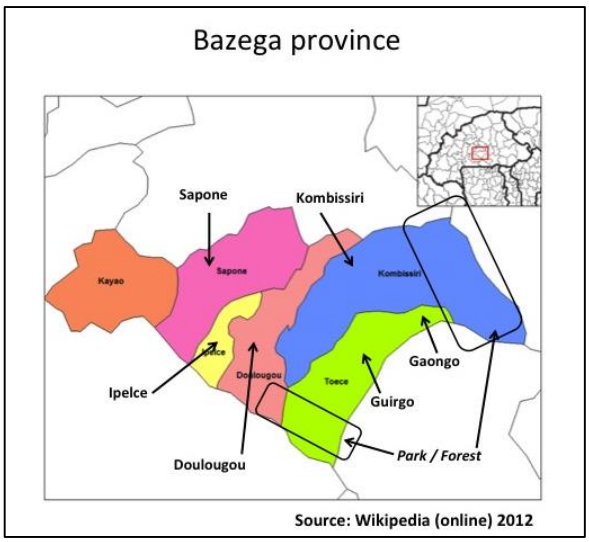


Figure A1. Distribution of selected villages in the south bio-area, provinces of: Houet, Tuy, Ioba, Zoundweogo, and Boulgou.









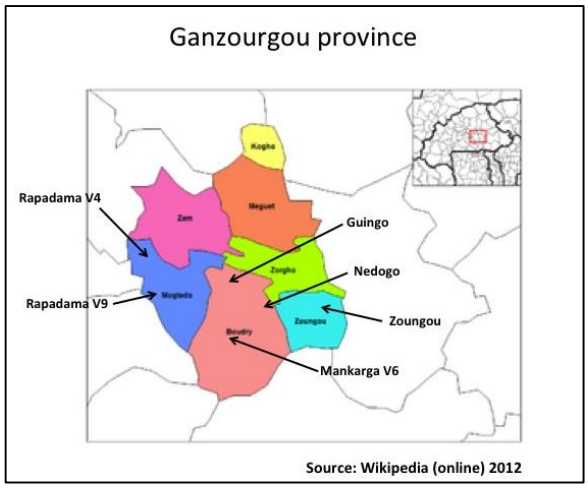


Figure A2. Distribution of selected villages in the north bio-area, provinces of: Banwa, Mouhoun, Sanguie, Bazega, and Ganzourgou.

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