N2Africa Early Impact Survey, Phase I

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N2Africa

Putting nitrogen fixation to work for smallholder farmers in Africa

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Summary

N2Africa aims to contribute to increasing biological nitrogen fixation (BNF) and the productivity of grain legumes among African smallholder farmers; in turn this helps to enhance soil fertility, improve household nutrition, and increase the income of smallholder farmers. Today, the project is implemented in five Core countries (Ghana, Nigeria, Tanzania, Uganda, and Ethiopia) and six Tier-1 countries (DR Congo, Malawi, Rwanda, Mozambique, Kenya, and Zimbabwe).

This N2Africa early impact survey report provides a comparison across eight N2Africa countries, that were involved in the first phase. The results of the baseline survey (2011) and the early impact survey (2013) were both used to compare farmers practices and to assess the impact of input packages delivered to N2Africa farmers. The surveys were carried out DR Congo, Ghana, Kenya, Malawi, Mozambique, Nigeria, Rwanda and Zimbabwe. The assessment consisted of a structured baseline and early impact survey among randomly sampled households. According to the design of the baseline survey, a total of 400 households per country were interviewed. All households that were interviewed for the early impact survey (300 households in each country) had participated in N2Africa dissemination trials. Through these trials and the provision of legume input packages and/or training, farmers became familiar with legume technologies. The input package contained legume seed (common bean, cowpea, soyabean, groundnut), mineral fertilizer and/or inoculants.

In the analyses in this report, we first compared the results of the baseline survey with the results of what farmers reported to cultivate four years ago in the early impact survey (before they received a N2Africa input package). Secondly, we compared results of the early impact survey before households received an input package with the results of the early impact survey: How did farmers cultivate legumes before and after they received a legume input package? These comparisons provided insights in what has changed and the impact of N2Africa activities, reported by farmers who received input packages. The insights and understandings in farming practices and impact on livelihood strategies allowed better priority setting for future project activities, draw lessons learned and provided recommendations for future impact studies.

Results

Changes in legume area, production and amount sold
Farmers reported changes in area, yield and amounts sold. Overall, farmers reported an average increase in legume area per farm of 0.10 ha. Per country the change in legume area ranged from a 0.05 ha decrease in Zimbabwe to a 0.37 ha increase in Nigeria. Many farmers reported large production (yield farm^{-1}). In addition, the difference between yield (kg ha^{-1}) and farm production (kg farm^{-1}) was not always clear. The average amount of legumes sold increased with 124 kg farm^{-1}. The change ranged from a 10 kg farm^{-1} increase in Rwanda to a 739 kg farm^{-1} increase in Nigeria.

Legume cultivation
The data suggests that impact survey farmers (before they received an input package) already cultivated legumes more often than baseline farmers. This is particularly the case in DR Congo, Nigeria and Mozambique. This suggests that N2Africa targeted farmers that already cultivated legumes in these countries, to ensure the successful use of legume input packages. In the other countries the difference between the baseline survey and what impact survey farmers did before they received an input package did not differ much. The proportion of farmers cultivating legumes increased by 4% (in Malawi, Rwanda) to 26% (in Kenya). The proportion of farmers cultivating legumes after they received a legume input package varied from 91% in Nigeria to 100% in DR Congo, Rwanda and Mozambique. Whereas farmers from Zimbabwe, Malawi, Kenya and Rwanda in the baseline survey usually cultivated legumes as intercrops, the farmers of the early impact survey more often cultivated legumes as monocrops.

Use of inputs in legumes
In Ghana, Kenya, Malawi and Mozambique input use in all legumes (except for groundnut in Mozambique) increased after they received an input package. In DR Congo, Rwanda and Zimbabwe, the past input use among impact survey farmers was higher than the baseline farmers' input use. In Nigeria, the input use in the baseline survey was higher than the past input use from the impact survey farmers.

Stratifying the results by the type of package received indicated that in all countries except for DR Congo the proportion of farmers that used P-fertilizer and/or inoculants increased after having received a package (as compared with farmers reported for 'four years before'). The use of P-fertilizer on groundnut increased after having received a groundnut package in Nigeria and Malawi. The use of P-fertilizer on cowpea increased after having received a cowpea package in Nigeria and Zimbabwe. In Rwanda the use of P-fertilizer and/or inoculants in both bush and climbing bean had increased. For the other legume-country combinations the use of inputs had not increased as compared with what farmers reported for 'four years before'.

Sources of inputs
A relatively large part (50-78%) of the impact survey farmers obtained fertiliser (NPK, DAP or compound fertilizer) from agro-dealers or markets (except for DR Congo and Mozambique) (Figure 1.1). SSP, TSP and Sympal fertilizers, mainly used in Nigeria and Kenya, were usually obtained through NGOs or agricultural projects rather than bought on the market. Legume seed was supplied by projects and NGO's more often than it was bought on the market. In a few cases, neighbours or relatives provided farmers with legume seed. Only in Rwanda more than 60% of the farmers bought legume seed from the market (Figure 1.1). Ghana and Zimbabwe were the only two counties where part of the farmers bought inoculants from agro-dealers or the market. In Ghana, it is possible that inoculants appeared on the 'market' through IFDC or from Benin. In the other counties all the inoculants were supplied by projects and NGO's.

Lessons learned and suggestions for N2Africa impact studies

The results showed farmers most often obtained legume seeds and inoculants through implementing partners, such as NGOs or governmental programs. One possible explanation is that input supply markets are not working effectively. When inputs are not obtained independently (i.e. without project or governmental support) it is difficult to imply lasting impact. Farmers interviewed in the baseline survey were a random sample within the target areas, whereas farmers interviewed for the early impact survey were intentionally selected as a sample of farmers who had participated in N2Africa. The aim was to see whether the farmers who had received a demonstration package continued to use, or expanded the use of the N2Africa technology. Consequently, farmers who participated in N2Africa had a different background in legume cultivation than the random sample surveyed in the baseline (notably in DR Congo, Nigeria and Mozambique). Therefore, farmers in the baseline survey cannot serve as counterfactuals for the farmers in the early impact survey and the results cannot be extrapolated to the wider population.

The aim of the N2Africa impact studies planned for the end of the project is to assess changes in living conditions of the target group, including intended and unintended social, economic and ecological outcomes. The impact studies will also consider changes in the role of farmers' organisations (collective marketing, farmer groups, amongst others), public—private partnerships and institutional arrangements. Furthermore, the studies will evaluate qualitatively the 'delivery and dissemination' strategy (D&D approach) and its learning aspects, since learning through research and dissemination activities are key to N2Africa's approach. The impact assessment for N2Africa will be conducted in selected project areas in different ecological zones across all countries. The design will focus on specific expected effects/areas (called impact domains) and consider changes in those areas. Household surveys, case studies and project outcome data will be used to assess the impact at the end of the project.

Data collected by household surveys can be used to measure impact questions at household level. It provides insights related to questions such as: How do current activities relate to activities reported by farmers who participated in the baseline study? Particularly parameters related to changes in legume and crop production (kg farm^{-1}), legume use, input use per legume, legume area (ha farm^{-1}), income earned from increased legume production, livestock ownership, land holding and land use can be measured. Also changes in legume area (kg farm^{-1}) in relation to changes in livestock ownership, welfare and legume consumption patterns can be assessed by using household surveys. Household surveys and the standard difference-in-differences method (DiD) could be used to study changes in farmers' practices and measure the causal effect of project interventions on social, economic and project outcomes.

Due to the way that N2Africa has been implemented through partnerships, inevitably we have no experimental design with counterfactuals to measure D&D approaches, best fit business models, accessibility of input requirements, gender inclusion, farmers' organisation and bargaining power, and so on. In-depth case studies (focus groups meeting, semi-structured interviews, amongst others) can be used to assess these impacts. Annually collected M&E data provide insights in changes in institutional, partners and individuals (farmers' capacity) capacity building and the sustainability of input supply and market systems (volume of seeds, fertilizers and inoculants used, % households using inputs and volume of input types sold by agro-dealers), amongst others.

Exploring sample variations at spatial (at household, regional and country level) and temporal scales offer insights in the N2Africa impact with regard to legume and rhizobia genotypes (G_L * G_R), environment (E) and/or management practices (M). Analysis of the N2Africa early impact survey has allowed us to explore the potential and limitations of these surveys within the constraints of project implementation. The final two years of the project will be used to design and implement a range of studies using quantitative and qualitative methods to examine the impact of N2Africa and maximise our learning.

Keywords
N2Africa Phase I, Early impact survey, Baseline survey, performance evaluation, legumes, lessons learned, difference-in-difference method, DR Congo, Ghana, Kenya, Malawi, Mozambique, Nigeria, Rwanda and Zimbabwe

1 Introduction

N2Africa aims to contribute to increasing biological nitrogen fixation (BNF) and the productivity of grain legumes among African smallholder farmers; in turn this helps to enhance soil fertility, improve household nutrition, and increase the income of smallholder farmers. Today, the project is implemented in five Core countries (Ghana, Nigeria, Tanzania, Uganda, and Ethiopia) and six Tier 1 countries (DR Congo, Malawi, Rwanda, Mozambique, Kenya, and Zimbabwe).

This report provides a comparison among the eight N2Africa countries, that were involved in the first phase. The results of the baseline survey (2011) and the early impact survey (2013) are both used to compare farmers practices and to assess the impact of input packages delivered to N2Africa farmers. The surveys were carried out DR Congo (DRC), Ghana, Kenya, Malawi, Mozambique, Nigeria, Rwanda, Zimbabwe. The households that were involved in the baseline survey were randomly sampled. According to the design of the baseline survey, a total of 400 households per country were to be interviewed. All households that were interviewed for the early impact survey (300 households in each country) had participated in N2Africa dissemination trials. Through these trials and the provision of legume input packages and/or training, farmers became familiar with legume technologies.

Households in the baseline survey were a representative sample of the population in the N2Africa target areas, whereas households in the early impact survey all participated in N2Africa. This means we cannot draw conclusions on the impact of N2Africa on the population in the target areas. In some cases, the sites where the baseline survey and early impact surveys were carried out also differed. The impact survey examined the impact of N2Africa on farmers who participated in the project. This is also why it was called the 'early' impact survey – real project impact will be established a few years after the project has finished. To establish the early impact, we asked farmers questions on how they cultivated legumes four years ago, and how they currently cultivate legumes. These comparisons are used to determine the early impact. The baseline survey is used to compare the farmers that participated in the project with a wider population sample.

1.1 Baseline survey

The N2Africa baseline survey was conducted in 2011 and implemented in eight countries. The aim was to establish the current status of livelihoods, through the assessment of household characteristics (education, occupations, sources of income, amongst others). The N2Africa baseline report provides a detailed description of each country with its specific regions (Franke and de Wolf, 2011). This description will be used to facilitate monitoring progress over time and to assess the impact at the end of the project.

The questionnaire consisted of nine sections (Franke and de Wolf, 2011):

A. Demographic information: composition of household, affiliation to (community) organisations, education, involvement in on- and off-farm activities
B. Income: source of income, importance of farming
C. Labour: hiring of labour, for which crops, cost
D. Household assets and resources (wealth indicators)
E. Livestock ownership
F. Land holding and crops cultivated
G. Production activities: cultivation of legumes and to a lesser extent of other crops
H. Nutrition and legume utilization: consumption in general and of legumes, used of haulms
I. Markets: availability, distance, frequency, distance

A total of 400 households per country were randomly selected and interviewed. The baseline report (Franke *et al.*, 2011) provides more country-specific descriptions and maps of the homesteads and villages where baseline interviews were conducted. In the analyses some

cases had to be dropped due to problems with the data collected. Consequently, the sample size differs per table.

1.2 Early impact survey

The early impact survey was conducted in 2013. Its main aim was to establish progress made towards achieving the Vision of Success. N2Africa defined its Vision of Success for Phase I as follows:

> To raise average grain legumes yields by 954 kg ha^{-1} in four legumes (groundnut, cowpea, soyabean, and common bean), increase average biological nitrogen fixation (BNF) by 46 kg ha^{-1}, and increase average household income by $465, directly benefiting 225,000 households (1,800,000 individuals) in eight countries in sub-Saharan Africa (DR Congo, Ghana, Kenya, Malawi, Mozambique, Nigeria, Rwanda, Zimbabwe).

The second goal of the early impact survey was to collect information about factors determining success or failure to use of the promoted legume technologies. Consequently, the early impact survey (EIS) has been built upon the following three main questions:

1. What is the impact of the N2Africa project on agricultural practices? Do farmers still use N2Africa technologies?
2. Have they changed their crop practices?
3. Why do certain farmers adopt the N2Africa technologies and others do not, as well as to measure and quantify the impact of the N2Africa project?

The survey was carried out DR Congo (DRC), Ghana, Kenya, Malawi, Mozambique, Nigeria, Rwanda, Zimbabwe, amongst households who received input package(s) and/or training from N2Africa (Huising and Franke, 2013). The provided type of input packages for legume cultivation differed among the farmers. The input package contained legume seed (common bean, cowpea, soyabean, groundnut), mineral fertilizer and/or inoculants. All farmers participated in N2Africa dissemination trials between 2009/2010 and 2012. Farmers who received inputs and/or training in 2013 were excluded from the analyses. As the interviewed farmers were a sample of farmers who participated in N2Africa, they do not represent a random sample of farmers in the different action sites. In the analyses some cases had to be dropped due to missing data. Consequently, the reported sample sizes differ per table.

The early impact questionnaire was developed with participation of project staff in the different countries. It was agreed to use a relatively brief instrument, focussing on the key indicators for the project to ensure reliable data collection and avoid interviewee fatigue. The household survey was conducted 1-2 month after harvest and consisted of six sections (Appendix II):

A. General information: composition of household, education, source of income, importance of farming, livestock ownership
B. Inputs and training received from N2Africa
C. Land holding and current crop management
D. Crop production and use
E. Changes in crop production and use: farming practices, yield, crop areas, crop use
F. Nutrition: legume consumption, dietary diversity

1.3 **Reading guidelines**

In the first part of this report specific sites, socio-economic characteristics of households and general cropping patterns are described. In the second part we examine legume cultivation. In the third part we look at changes reported by the farmers interviewed for the early impact survey. Farmers indicated if and how areas under legumes, yields of legumes and quantities sold changed, as compared to four years before the impact survey was carried out. In the fourth part we look at input use. We discuss how farmers obtained which inputs and from which source. Subsequently, we show input use for the different legumes. In the final part of this report we segregate results by type of input package. We assess whether use of legume technology has changed after having received a certain package. We also assess past use of inputs for the specific legumes among farmers who received an input legume package with a certain legume. Subsequently, key results are compared across the eight countries and lessons learned and suggestions for impact studies at the end of the project are presented in the last chapter.

2 General information

2.1 Sites

The regions targeted by N2Africa correspond to three different zones of sub-Saharan Africa. The regions have a high potential for agriculture, including legume production. Figure 2.1 gives an overview of the eight countries and approximate locations of action sites where N2Africa conducted activities during the first phase of the project. The actions sites for project intervention have been classified according to agro-ecological potential and market access (Franke and de Wolf, 2011).

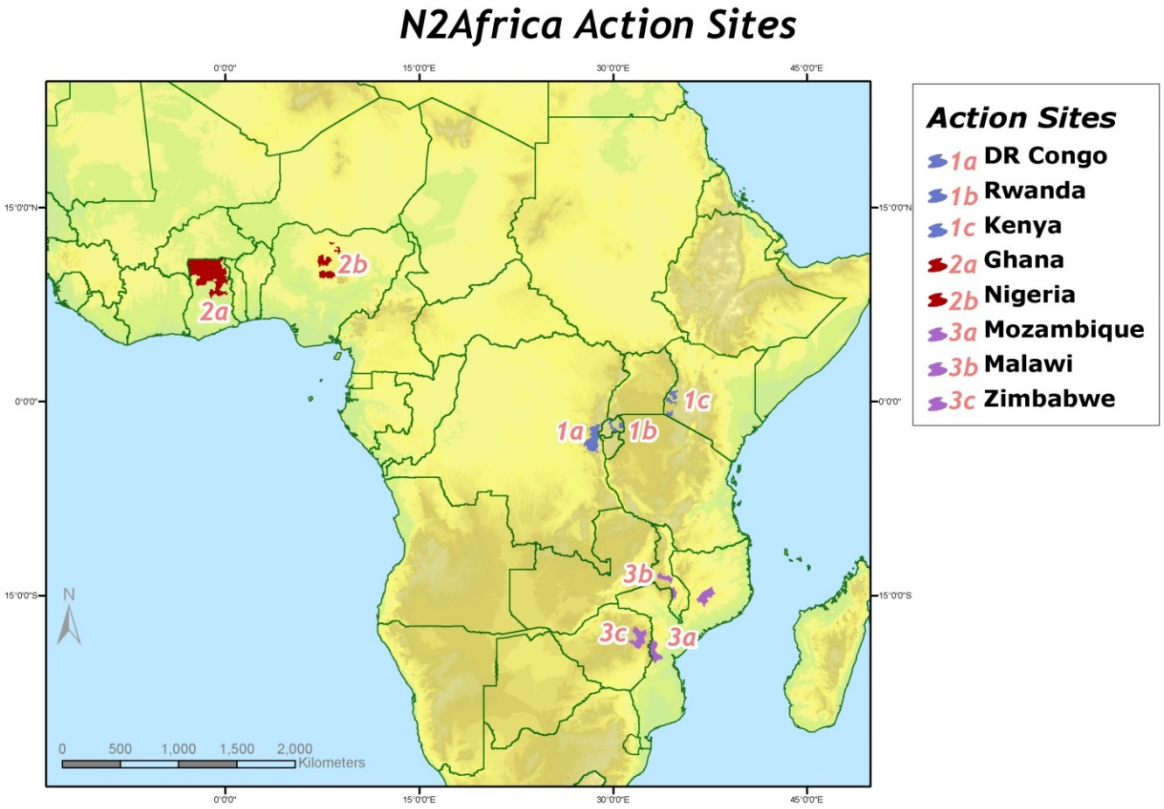


Figure 2.1. Map of Africa depicting the eight countries and the approximate locations of action sites where N2Africa conducts activities (Franke *et al.*, 2011).

In each country, a number of contrasting zones have been identified. Franke *et al.* (2011) provide detailed descriptions of the different countries and their zones in terms of agro-ecological aspects (rainfall, temperature, wind, altitude, growing season), population density and market accessibility. Generally, in East and Central Africa (e.g. DR Congo, Kenya and Rwanda), the temperatures are relatively cool. Rainfall is relatively high and the length of the growing season is long with two growing seasons. West Africa (e.g. Ghana and Nigeria) is generally characterised as a zone with relatively high temperatures, urban market accessibility in less than three hours and one growing season. Southern Africa (e.g. Malawi, Mozambique and Zimbabwe) also has one growing season. Furthermore, it is characterised by a low population density (exception in some action sites in Mozambique and Zimbabwe) and long travel times to urban markets.

The different action sites per country, in which the baseline survey and the early impact survey were conducted are presented in Table 2.1. Note that the sites differed in the two studies. Consequently, the analysis and comparison between the two surveys are made at country level.

Table 2.1. Number of households interviewed in the early impact survey and the baseline survey and action sites per country.

Country	Early impact survey		Baseline survey	
	Action sites	**Number of households interviewed** (n = 2,667)	**Action sites**	**Number of households interviewed** (n = 3,403)
DR Congo	Kabare, Kalehe, Mwenga, Walungu	300	Kabare, Kalehe, Walungu	381
Ghana	Bawku West, Chereponi, Karaga, Savelugu/Nanton	292	Bawku West, Kassena Nankana East, Chereponi, Tolon-Kumbungu, Savelugu/Nanton, Nadowli, Wa East	400
Kenya	Bondo, Bungoma, Busia, Butula, Kakamega, Kisumu, Migori, Rarieda, Siaya, Tese North, Vihiga	291	Bondo, Kisumu West, Masigolo, Mudete, North Sakwa, Rarieda, South Gem, Wamuluma, Kanyamkago	400
Malawi	Dedza, Dowa, Ntcheu, Salima	310	Dowa, Lilongwe, Ntcheu, Salima	394
Mozambique	Angonia, Chimbuwa, Chindeque, Gondola, Gurue, Mogovolas, Sussendenga, Tsangano	352	Gurue, Mandimba, Sussundenga	247
Nigeria	Bichi, Bunkure, Kachia, Kurmin Gwaza, Soba	376	Bunkure, Dawakin Kudu, Garko, Tudu Wada, Giwa, Igabi, Kachia, Zangon Kataf	781
Rwanda	Bugesera, Burera, Gakenke, Kamonyi, Kayonza	300	Kioni, Cyabingo, Nemba, Rukara, Musambira, Nyamiyaga, Musenyi	400
Zimbabwe	Chegutu, Goromonzi, Guruve, Makoni, Mudzi	331	Chegutu, Guruve, Makoni, Mudzi	40

2.2 **Households interviewed**

The households that were involved in the baseline survey were randomly sampled. According to the design of the baseline survey, a total of 400 households were to be interviewed. This was achieved in most countries, except for Mozambique (Table 2.1). This was due to budgetary constraints, mainly resulting from the large distances and poor infrastructure (Franke and de Wolf, 2011).

All households that were interviewed for the early impact study had participated in N2Africa dissemination trials. Through demonstrations on farmers' fields (demonstration trials) and the provision of legume input packages to test on their own fields (adaptation trials), farmers became familiar with legume technologies. The aim was to interview 300 households in DR Congo, Ghana, Kenya, Malawi, Mozambique, Nigeria, Rwanda and Zimbabwe. These target numbers were attained in nearly all eight countries (Table 2.1). In Nigeria and Mozambique, a total of respectively 491 and 352 interviews were conducted. The interviews for the early impact study were held from February to July in 2013.

2.3 Socio-economic characteristics of interviewed households

Table 2.2 provides an overview of socio-economic characteristics of the households participating in the early impact survey and in the baseline survey. Household size, farm size and livestock ownership varied per study and country. Generally, average household sizes were larger in those households participating in the early impact survey than in the baseline survey. Except for Kenya and Rwanda, the average and median farm size (ha) highly varied among the countries and participating households. Livestock ownership was generally a little higher among households participating in the early impact survey, than among households sampled for the baseline survey. However in DR Congo, the average and median Tropical Livestock Unit (TLU) per farm was slightly higher for farmers who participated in the baseline survey. Except for Mozambique and Nigeria, almost or more than half of the farmers participating in the early impact survey were female. The percentage of farmers that were interviewed for the early impact survey that had a previous role in N2Africa as Lead farmer varied between 8% (Rwanda) and 39% (Ghana).

Table 2.2. Socio-economic characteristics of households interviewed during the early impact survey and baseline survey per country.

Country	Early impact survey								Baseline survey					
	Sample size (n)	Female farmer (%)	Lead farmer (%)	Average household size (# of people)	Average farm size (ha)	Median farm size (ha)	Average TLU	Median TLU	Sample size (n)	Average household size (# of people)	Average farm size (ha)	Median farm size (ha)	Average TLU	Median TLU
DR Congo	300	57%	32%	8.7	1.41	1.00	0.38	0.21	381	7.0	1.87	1.87	0.53	0.53
Ghana	292	46%	39%	11.4	4.16	3.64	4.81	3.10	400	8.8	3.91	2.83	3.77	1.75
Kenya	291	57%	18%	6.8	0.93	0.61	2.06	1.56	400	4.8	1.15	0.81	2.02	1.50
Malawi	310	58%	32%	5.7	1.46	1.21	0.74	0.40	394	4.7	1.39	1.20	0.49	0.13
Mozambique	352	36%	21%	6.1	4.50	4.00	1.47	0.46	246	5.5	2.85	2.25	0.73	0.04
Nigeria	491	24%	30%	13.3	2.38	2.00	3.90	1.80	781	11.0	4.96	3.00	3.75	1.80
Rwanda	300	50%	8%	5.4	0.84	0.50	0.81	0.70	400	4.9	0.72	0.38	0.78	0.70
Zimbabwe	331	59%	31%	5.3	2.40	2.00	2.82	2.10	400	5.2	1.86	1.50	2.27	1.30

2.4 General cropping patterns

We compared general cropping patterns among farmers interviewed during the baseline survey to general cropping patterns among farmers interviewed during the early impact survey (Figure 2.2). Comparisons were not always straightforward, because many fields were intercropped. In Nigeria, it was not clear whether fields for which multiple crops were mentioned were indeed intercropped with those crops, or that the different crops pointed to rotations used on that field. The results for Nigeria should therefore be interpreted with care. Whereas farmers from Zimbabwe, Malawi, Kenya and Rwanda in the baseline survey usually cultivated legumes as intercrops, the EIS-farmers more often cultivated legumes as monocrops. In all countries, except for Nigeria and Mozambique, the area cropped with soyabean was larger among the farmers from the early impact survey than among the farmers in the baseline survey. In Mozambique, the difference in soyabean area (among baseline and EIS-farmers) coincides with a change in cereal and bean area. In other countries this is not very clear, due to larger intercropped areas.

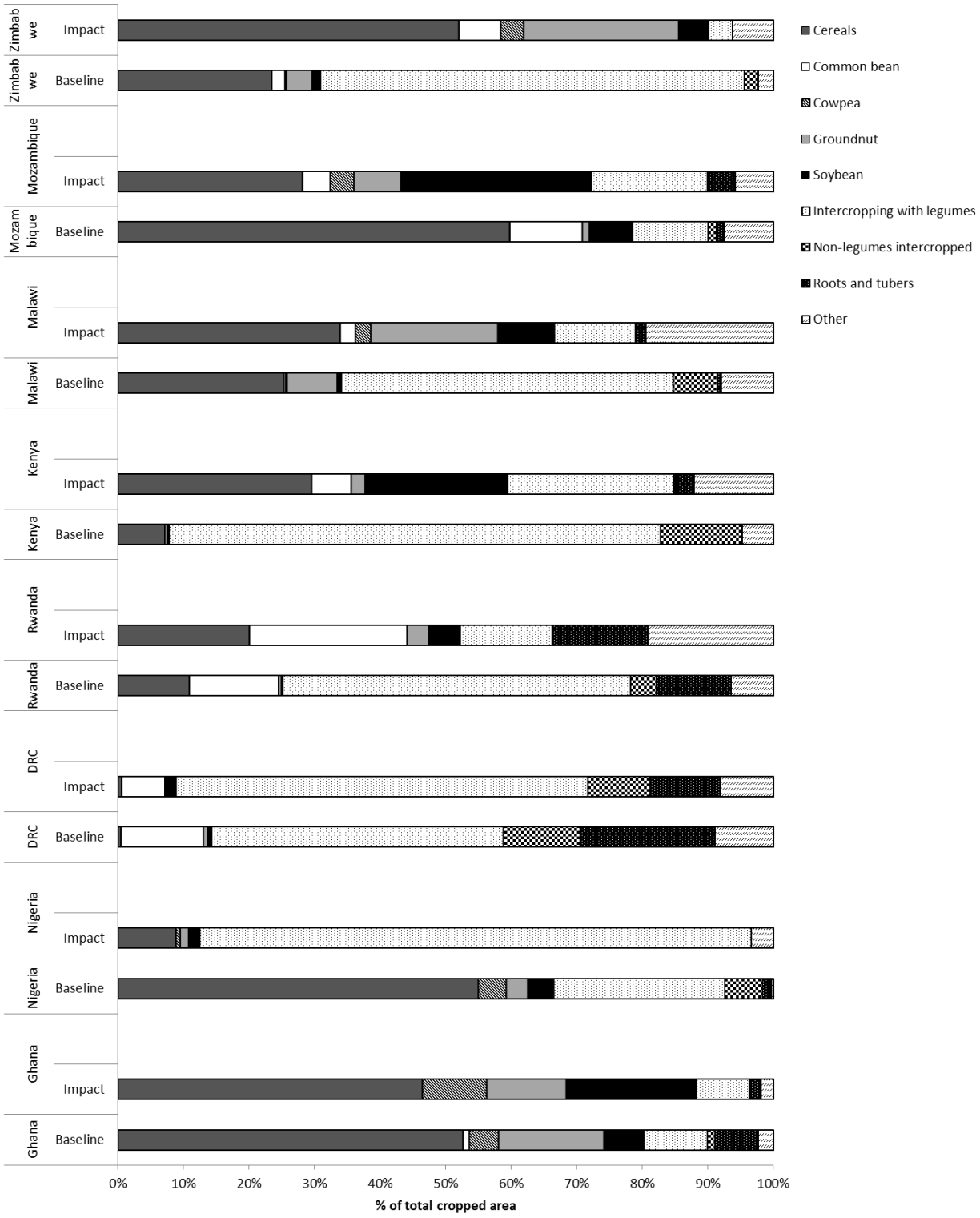


Figure 2.2. General cropping patterns of households per survey and country. Cereals include maize, rice, sorghum, millet and wheat. Roots and tubers include cassava, sweet potato, Irish potato and yam. Other includes vegetables, Bambara groundnut, pigeon pea and cash crops such as tobacco, cotton, sunflower or sesame.

3 Changes in legume area, yield, production and amount sold per country

Households that participated in the early impact survey were asked to describe changes over the last four years in legume production (area and yield) and amount of produce used for sale. Figure 3.1, 3.2, 3.4 and Figure 3.5 show how farmers recalled changes in their legume area, yields and amounts sold over the past four years. Figure 3.3 shows the distribution of change in legume area per farm (ha). The changes reflect the results of the early impact survey before households received an input package and compare it with results of the early impact survey after households received an input package. As the reported changes vary per country and legume, the results are discussed per country. We did not quantify the changes in yield, since the data did not allow a separation by yield (kg ha^{-1}) or production (kg $farm^{-1}$).

3.1 DR Congo

The majority of farmers from DR Congo did not mention a difference in their legume areas. When they reported a change it was more often an increase than a decrease (kg ha^{-1}). In addition, relatively large numbers of farmers mentioned increases in yield (kg ha^{-1}) or production (kg $farm^{-1}$) and amounts sold, for all legumes. The impact survey did not identify radical changes compared to the baseline survey. The main reason is that legumes, particularly beans, already were principal crops and constituted an important part of the diet. Nevertheless, more than half of the farmers increased their cultivated area with beans during the last four years. The same accounts for 15% of the soyabean farmers. In addition, the percentage of farmers growing soybean has increased to reach almost half of the surveyed farmers as compared to 14% in the baseline.

3.2 Ghana

The yield (kg ha^{-1}), production (kg $farm^{-1}$) and amount sold of groundnut seemed to have decreased for Ghanaian groundnut farmers. However, exactly equal numbers of farmers mentioned a decrease, increase, or no difference in groundnut area. For cowpea, slightly more farmers reported that their cowpea area had increased than decreased. In addition, more farmers reported increases in yield (kg ha^{-1}) or production (kg $farm^{-1}$) and amounts sold than decreases. For soyabean, relatively many farmers mentioned an increase in area, accompanied by increases in yield/production and amounts sold.

3.3 Kenya

Whereas the majority of Kenyan bean and groundnut farmers did not report a difference for their areas under bean and groundnut, relatively many farmers had increased the area under soyabean. For soyabean, 81% reported that yield (kg ha^{-1}) or production (kg $farm^{-1}$) had increased. Similarly, 60% mentioned that the amounts of soyabean sold had increased. Although the difference was less spectacular than for soyabean, groundnut and bean farmers also reported more often that yields and amounts sold had increased than decreased.

3.4 Malawi

The majority of Malawian farmers reported no difference in legume area for any of the four legumes. Yet, the majority also reported an increase in yield (kg ha^{-1}) or production (kg $farm^{-1}$) for all four legumes. Especially for groundnut and soyabean, farmers also experienced increased amounts sold.

3.5 **Mozambique**

The majority of bean, cowpea and soyabean farmers reported no difference for the area under cultivation. The groundnut farmers equally reported an increase and a 'no difference'. Few farmers mentioned decreases in area. In terms of yield (kg ha^{-1}) or production (kg $farm^{-1}$), the majority of bean and cowpea farmers reported no difference. For groundnut and soyabean, the number of farmers reporting no difference and an increase in yield (kg ha^{-1}) or production (kg $farm^{-1}$) were more or less equal. The majority of groundnut farmers reported an increase in amount sold. However, between 31% and 58% (depending on legume type) reported no difference in amount sold.

3.6 **Nigeria**

The results from Nigeria stand out compared to the other countries. For all legumes, the vast majority of farmers mentioned an increase in area under cultivation, in yield (kg ha^{-1}), production (kg $farm^{-1}$) and amounts sold. Very few farmers mentioned decreases or reported no difference. Most soyabean processors, who are potential off-takers in Nigeria, import soyabean to meet the need of their factory. Locally produced soyabean are mainly sold on open markets and middle men often interfere to make unattractive price arrangements to both farmers and off-takers. The middle men interference can be cut off, once farmers are linked directly to off-takers. Public sector agricultural extension service within the country is another driver of technology dissemination and information sharing. Nigerian farmers have age long history of cultural practice that facilitates information sharing within the community. Developing business opportunities for the soyabean value chain is recommended to guarantee sustainability and planning for specific activities for output marketing and delivery systems are needed.

3.7 **Rwanda**

The majority of Rwandan legume farmers reported no change in the area under bean, groundnut and soyabean. However, the majority of bean and soyabean farmers had increased yields (kg ha^{-1}) or production (kg $farm^{-1}$). For groundnut, the changes in yield were more or less equally divided among increase, decrease and no difference. Relatively large parts of the groundnut, soyabean and common bean farmers mentioned no change in amounts sold. However, many climbing bean farmers reported larger amounts of produce being sold.

3.8 **Zimbabwe**

More than 50% of the farmers stated that the area under groundnut and cowpea had not changed during the last four years. The majority of cowpea farmers mentioned an increase in cowpea yield (kg ha^{-1}) or production (kg $farm^{-1}$). For groundnut, the number of farmers that reported a yield increase or decrease were equal. The amounts of groundnut and cowpea sold had not changed for the majority of farmers. Although few farmers had an increase in bean area, the majority of farmers thought that bean yield (kg ha^{-1}) or production (kg $farm^{-1}$) had increased. Yet, fewer farmers reported that the amounts of bean sold had increased. For soyabean, the majority of farmers reported that the area had increased and that yield (kg ha^{-1}) or production (kg $farm^{-1}$) had increased. Again, fewer farmers reported that the amounts sold had increased.

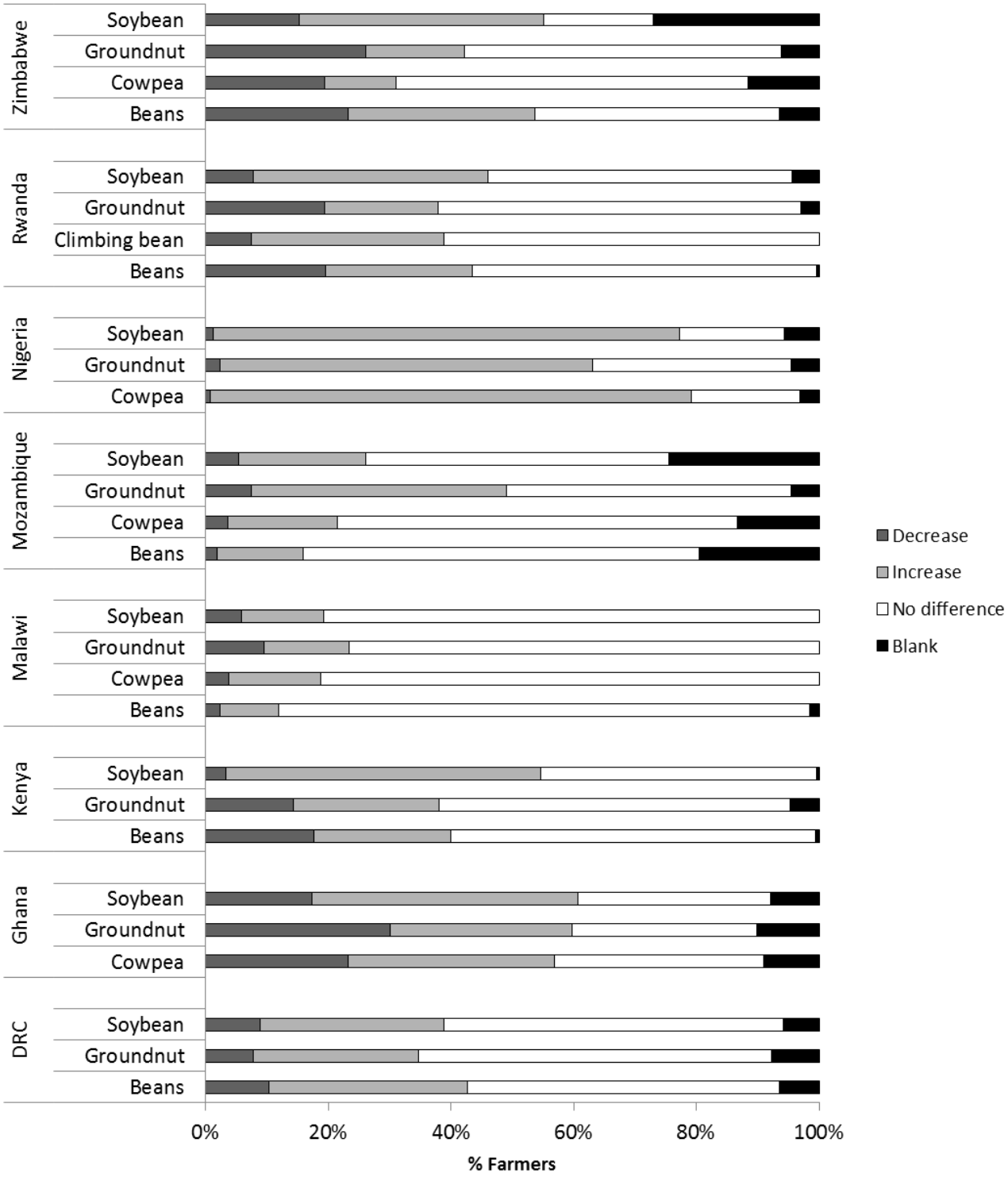


Figure 3.1. Change in legume area reported by farmers per legume and country (%). Farmers were asked to compare their current legume cultivation with four years ago (i.e. before farmers received an input package).

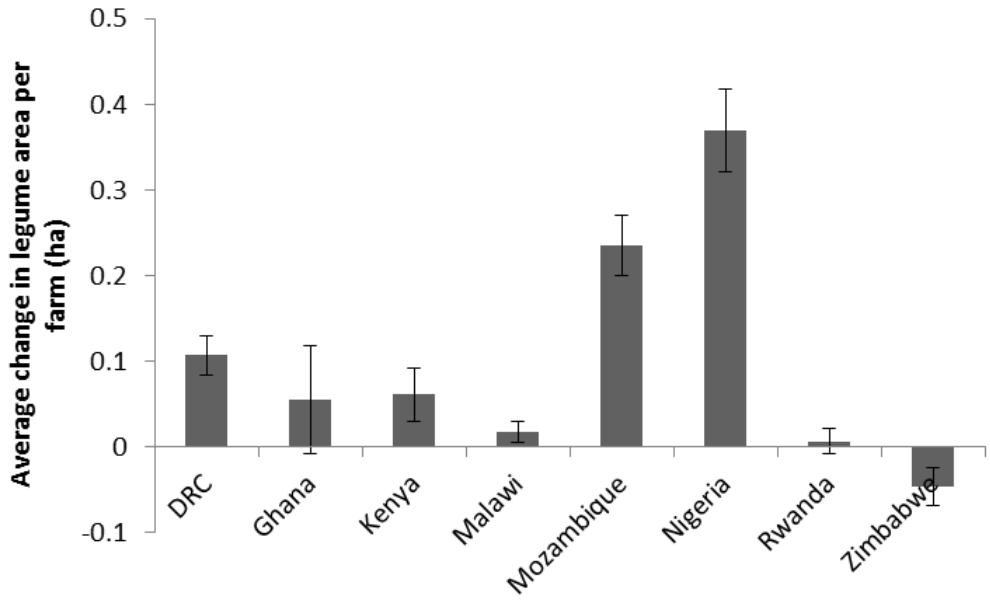


Figure 3.2. Average change in total legume (bean, cowpea, groundnut and soyabean) area per farm (ha) per country. Change = area now – area '4 years ago'. Error bars represent standard errors of means. Excluded from the analysis are: 295 cases where legume area now > farm size with > 0.1 ha per farm and 55 additional cases where legume area 'four years ago' > farm size > 0.1 ha per farm.

Figure 3.3 shows the distribution of change in legume area per farm (ha). In total 1,719 cases were taken into account. The distribution shows that more households reported a positive change or increase than a decrease in total legume area per farm (ha). However, most households mentioned that the legume area per farm (ha) did not change.

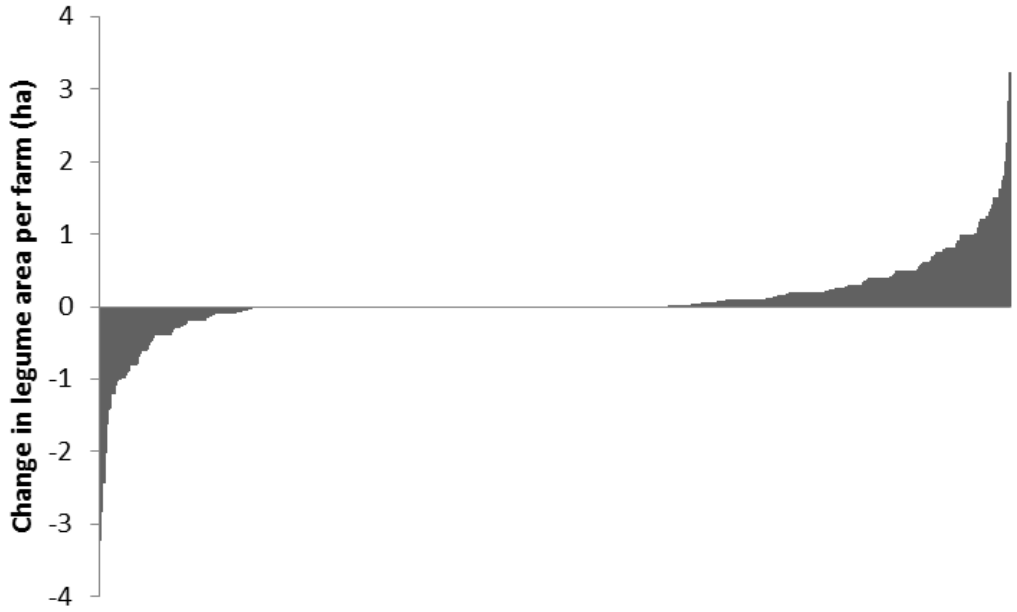


Figure 3.3. Distribution of change in legume area per farm (1,719 cases) (ha).

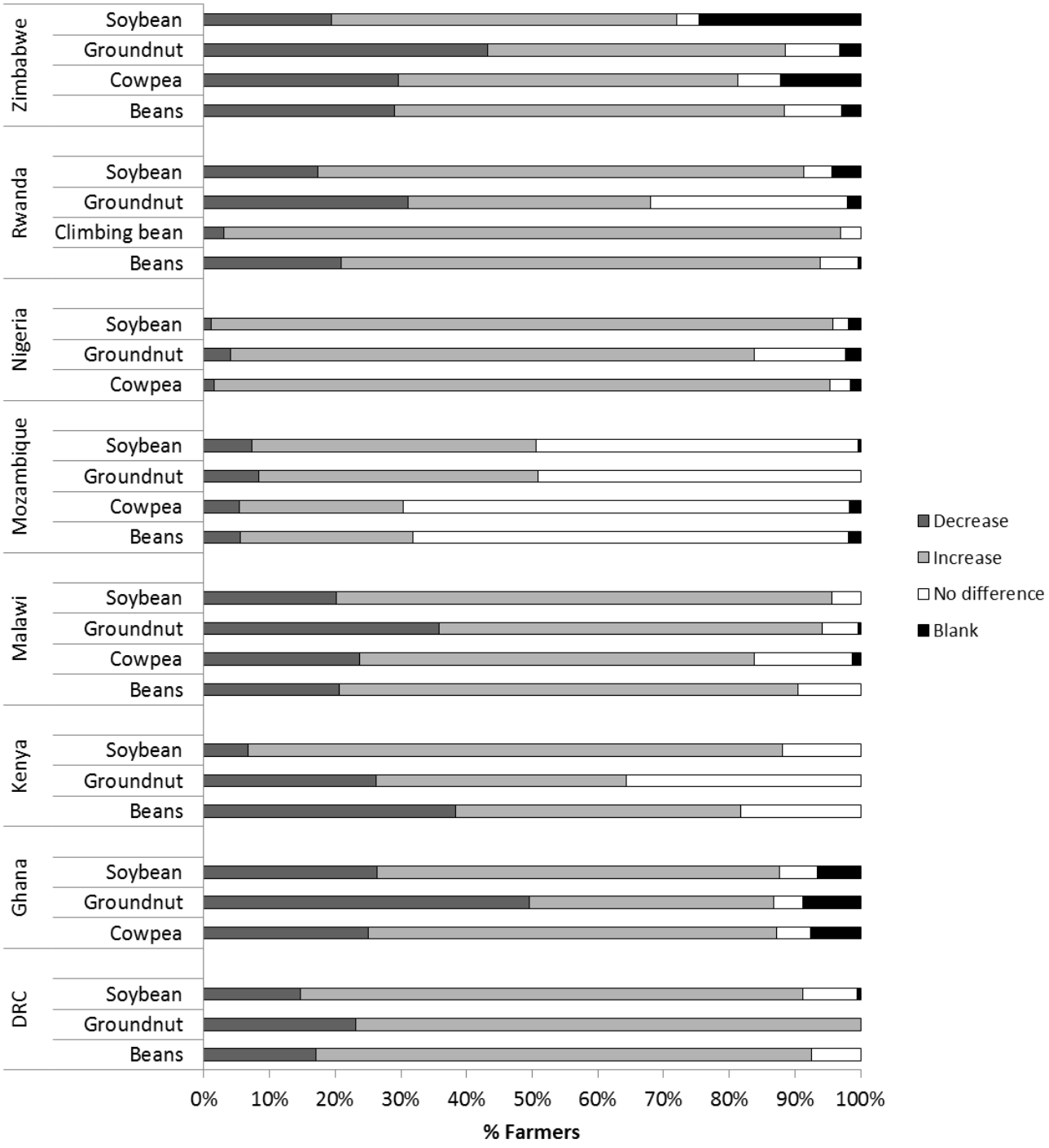


Figure 3.4. Change in yield (kg ha^{-1}) or production (kg farm^{-1}) per legume crop reported by farmers per country (%). Farmers were asked to compare their current legume cultivation with four years ago (i.e. before farmers received an input package).

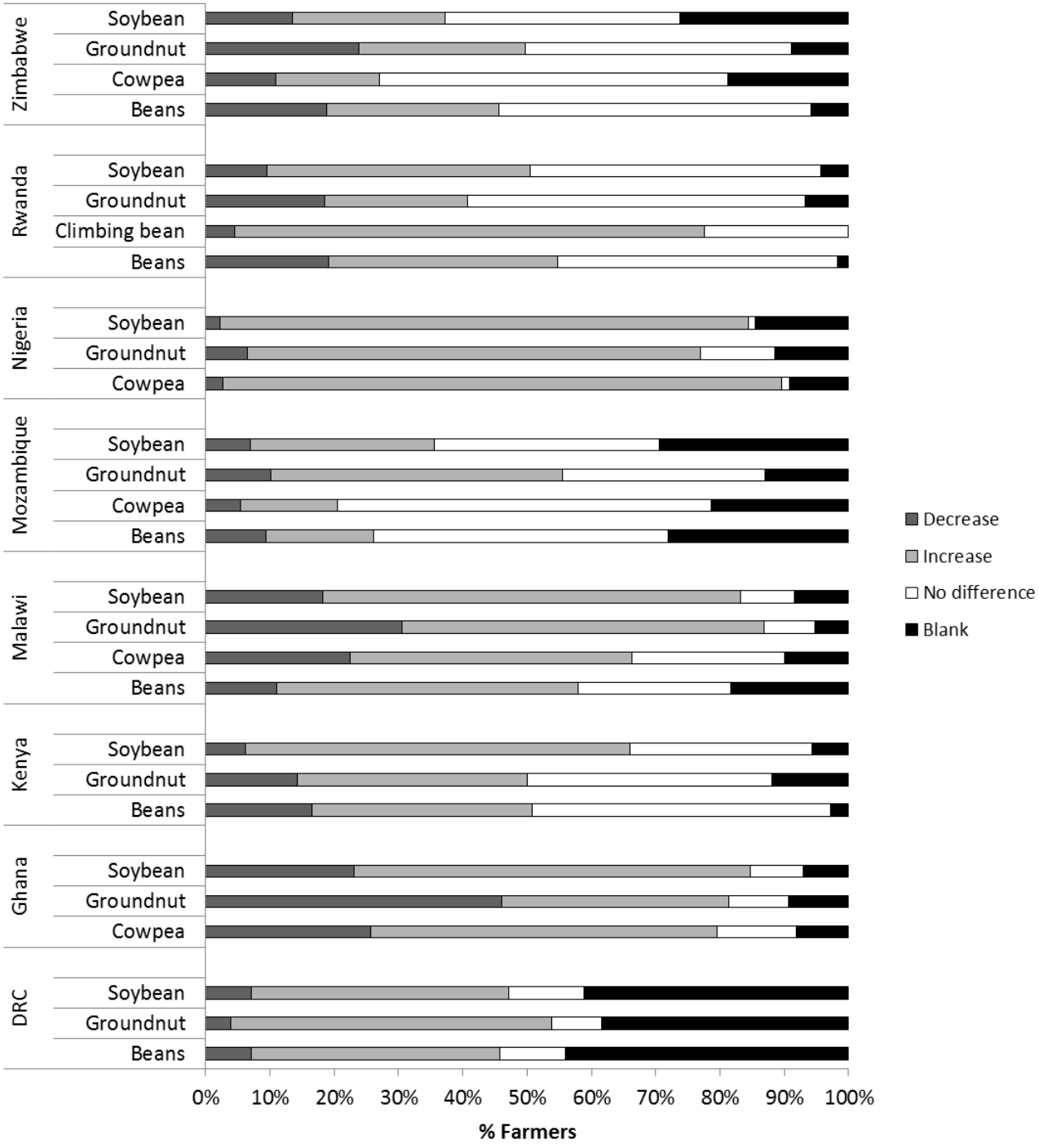


Figure 3.5. Change in amounts sold per legume crop as mentioned by farmers per country (%). Farmers were asked to compare their current legume cultivation with 'four years ago' (i.e. before farmers received an input package). Amounts sold >10,000 from areas <2 ha were excluded from analyses.

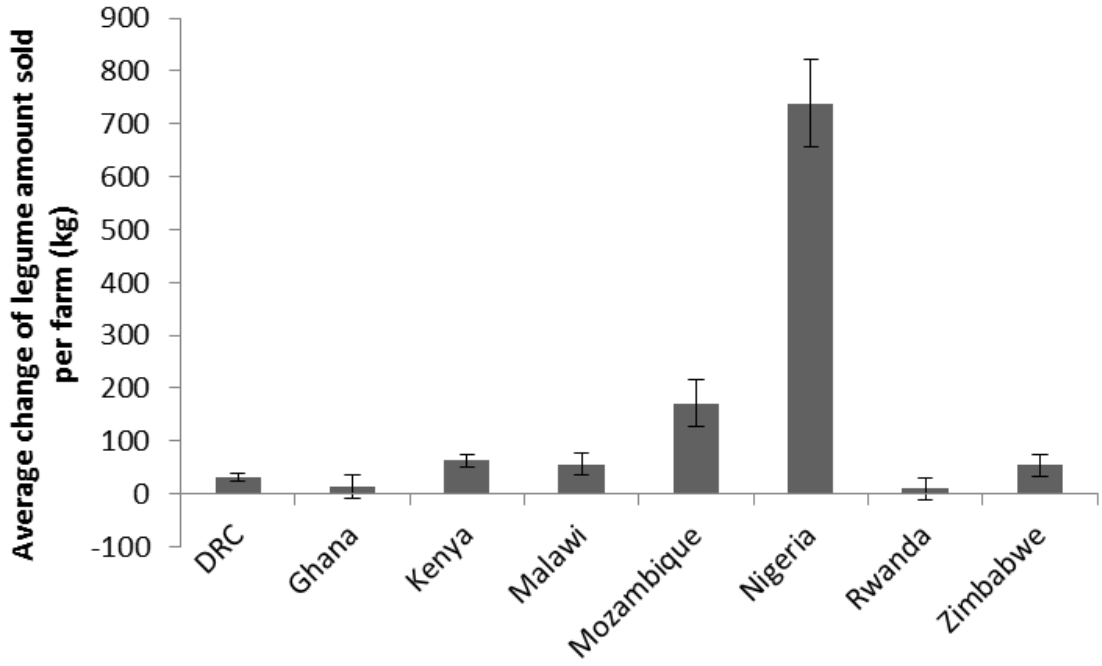


Figure 3.6. Average change in the amount of legumes sold (total amount of bean, cowpea, groundnut and soyabean sold) per country (kg). Change = amounts sold – amounts sold 'four years ago'. Error bars represent standard errors of means. Excluded from this analysis: 65 cases were the amount sold now/legume area now > 5,000 kg ha^{-1} and five additional cases where the amount sold where the amount sold past/legume area four years ago > 5,000 kg ha^{-1}.

Figure 3.7 shows the distribution of change in amount of legumes sold per farm (kg). In total 2,346 cases were taken into account. The distribution shows that most households reported a positive change or increase in amount of legumes sold per farm. However, there is still a number of households who mentioned that the amount of legumes sold per farm decreased or did not change.

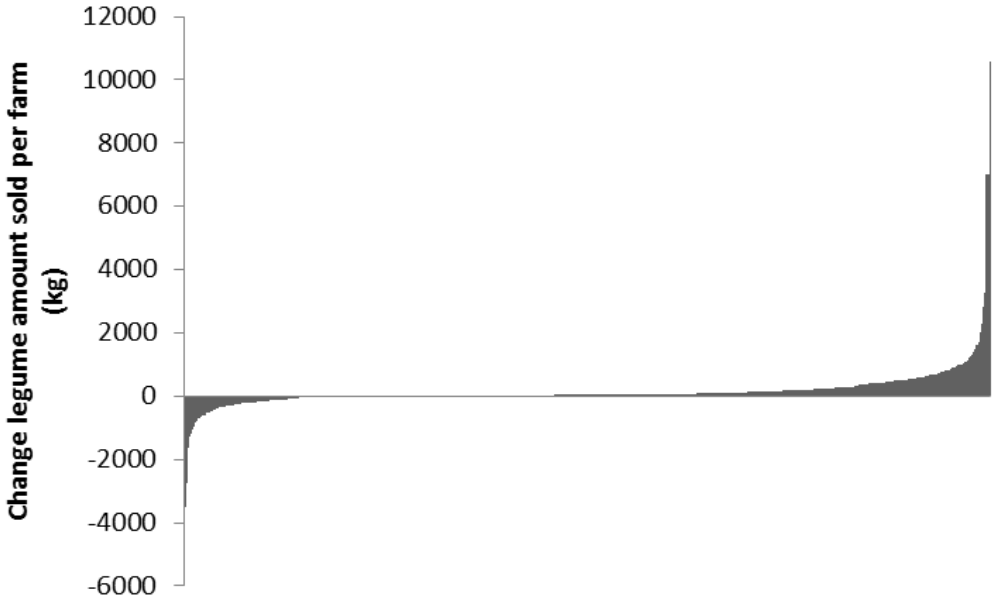


Figure 3.7. Distribution of change in amount of legumes sold per farm (2,346 cases) (kg).

4 Legume cultivation and use

4.1 Households cultivating legumes

Figure 4.1 shows the proportion of farmers interviewed for the baseline survey and the early impact survey (e.g. before and after farmers received an input package) cultivating legumes per country (%). The data suggests that impact survey farmers (before they received an input package) already cultivated legumes more often than baseline farmers. This is particularly the case in Nigeria and Mozambique. This suggests that N2Africa targeted farmers that already cultivated legumes in these countries, to ensure the successful use of legume input packages. In the other countries the difference between the baseline survey and what impact survey farmers did before they received an input package did not differ much.

Figure 4.1 also shows the results of the early impact survey before households received an input package and the results of the early impact survey after households received an input package. The proportion of farmers cultivating legumes (after they had received an input package) varied from 91% in Nigeria to 100% in DR Congo, Rwanda and Mozambique (Figure 4.1). Except for Nigeria, the proportion of farmers cultivating legumes increased after they had received an legume input package or training. The increase ranged from 4% (in Malawi, Rwanda) to 26% (in Kenya).

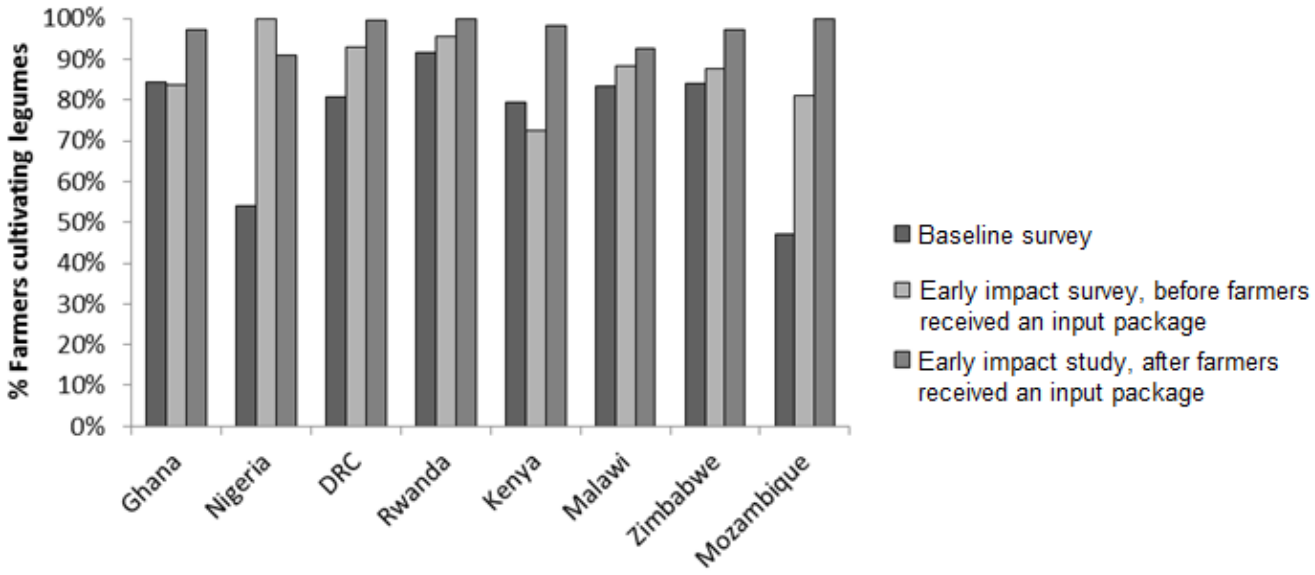


Figure 4.1. Proportion of farmers from the baseline survey cultivating any legume compared to proportion of farmers from early impact survey (e.g. before and after farmers received an input package) cultivating any legume per country (%).

4.2 Cultivated legume species

4.2.1 Common bean

Figure 4.2 shows that in Malawi, Zimbabwe and DR Congo, common bean was cultivated more often among farmers that were involved in the early impact study as compared to baseline survey farmers. However, the number of farmers that cultivated common bean did not change after they received an input package. Figure 4.2 suggests that between 70% (Zimbabwe), 99% (Rwanda) and 98% (DR Congo) of the current bean farmers also cultivated bean before they received an input package. In Kenya and Mozambique, cultivation of common bean declined compared with both the baseline survey and what impact survey farmers recalled from what they cultivated four years ago (before they received an input package).

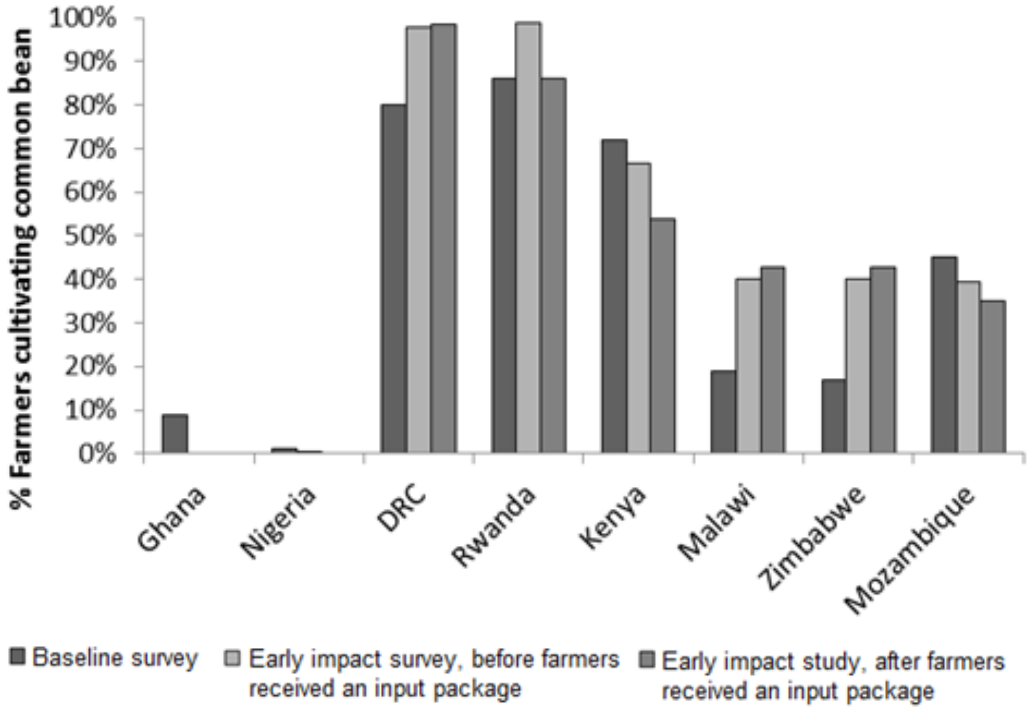


Figure 4.2. Proportion of farmers from the baseline survey (darkest grey) and the impact survey cultivating common bean. Farmers from the early impact survey recalled what they did 'four years ago' (lightest grey) and reported what they did in 2013 (medium grey) per country.

4.2.2 Cowpea

In Ghana, Nigeria, Malawi and Zimbabwe, the percentage of farmers that cultivated cowpea and were interviewed for the early impact survey was larger than the percentage cowpea farmers in the baseline survey. However, compared with what the early impact survey farmers did 'four years ago' (e.g. before they received an input package), the proportion of farmers cultivating cowpea often declined (except for Mozambique, where it remained stable) (Figure 4.3).

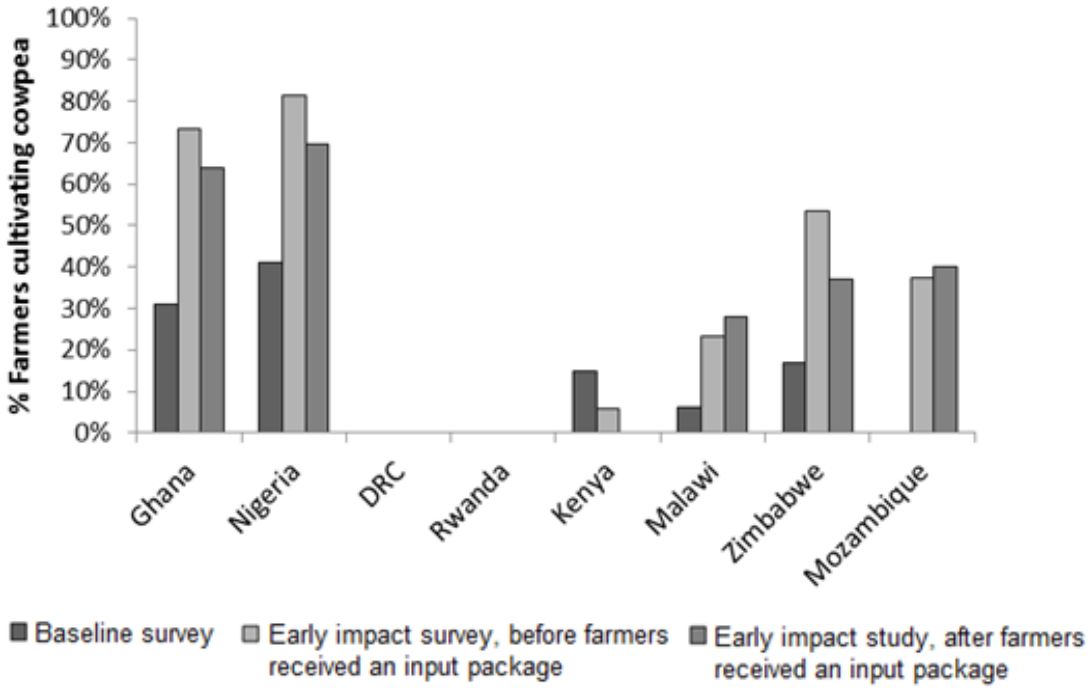


Figure 4.3. Proportion of farmers from the baseline survey (darkest grey) and the impact survey cultivating cowpea. The farmers from the early impact survey recalled what they did 'four years ago' (lightest grey) and reported what they did in 2013 (medium grey) per country.

4.2.3 **Groundnut**

The story for groundnut is mixed (Figure 4.4). In Ghana and Rwanda, the proportion of groundnut farmers interviewed in the baseline survey and the early impact survey were more or less similar (Figure 4.4). The figure also shows the results of the early impact survey before households received an input package and the results of the early impact survey after households received an input package. The results indicate that, the proportion of groundnut farmers declined in Ghana, Nigeria and Rwanda. In Malawi and Zimbabwe on the other hand, the proportion of groundnut farmers remained stable.

In addition, Figure 4.6 suggests that the number of 'new' groundnut farmers in the impact survey ranged from 3% (Malawi) to 18% (Mozambique). At the same time, Table 5.3 suggests that 88% (Zimbabwe) to 100% (Mozambique, Nigeria) of the farmers who had received a groundnut package already cultivated groundnut before.

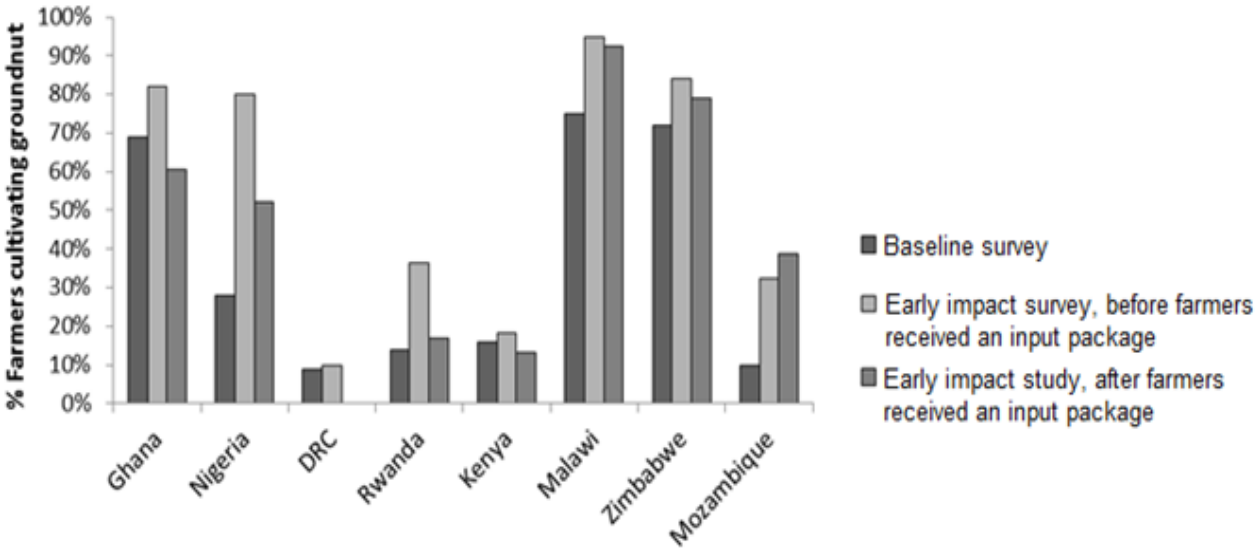


Figure 4.4. Proportion of farmers from the baseline survey (darkest grey) and the impact survey cultivating groundnut. The farmers from the early impact survey recalled what they did 'four years ago' (e.g. 2009) (lightest grey) and reported what they did in 2013 (medium grey) per country.

4.2.4 **Soyabean**

For soyabean we see large increases in the number of farmers that cultivated soyabean in the early impact survey before households received an input package when compared to the baseline survey (Figure 4.5). However, only in Kenya and Zimbabwe we also see increases in soyabean farmers when compared with what the impact survey farmers did four years before.

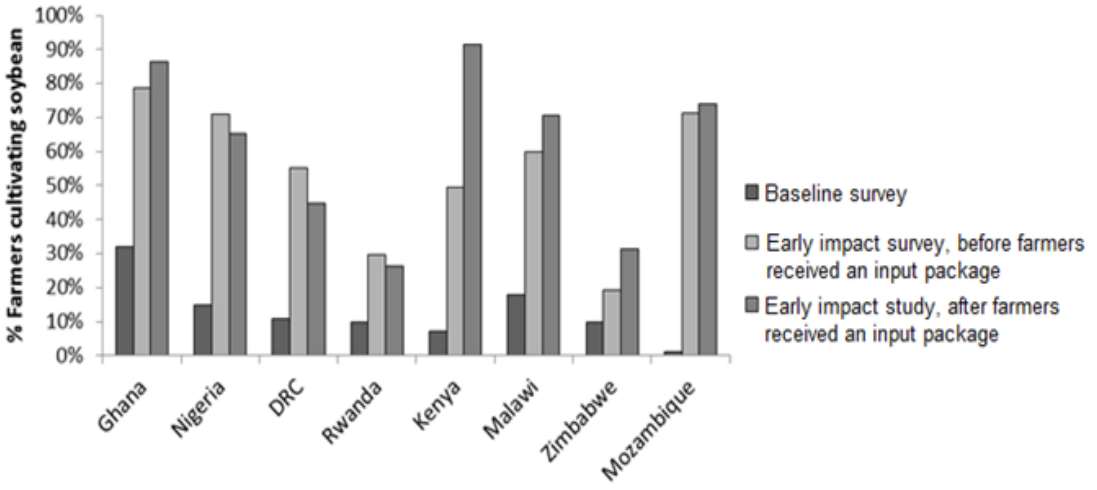


Figure 4.5. Proportion of farmers from the baseline survey (darkest grey) and the impact survey cultivating soyabean. The farmers from the early impact survey recalled what they did 'four years ago' (e.g. 2009) (lightest grey) and reported what they did in 2013 (medium grey) per country.

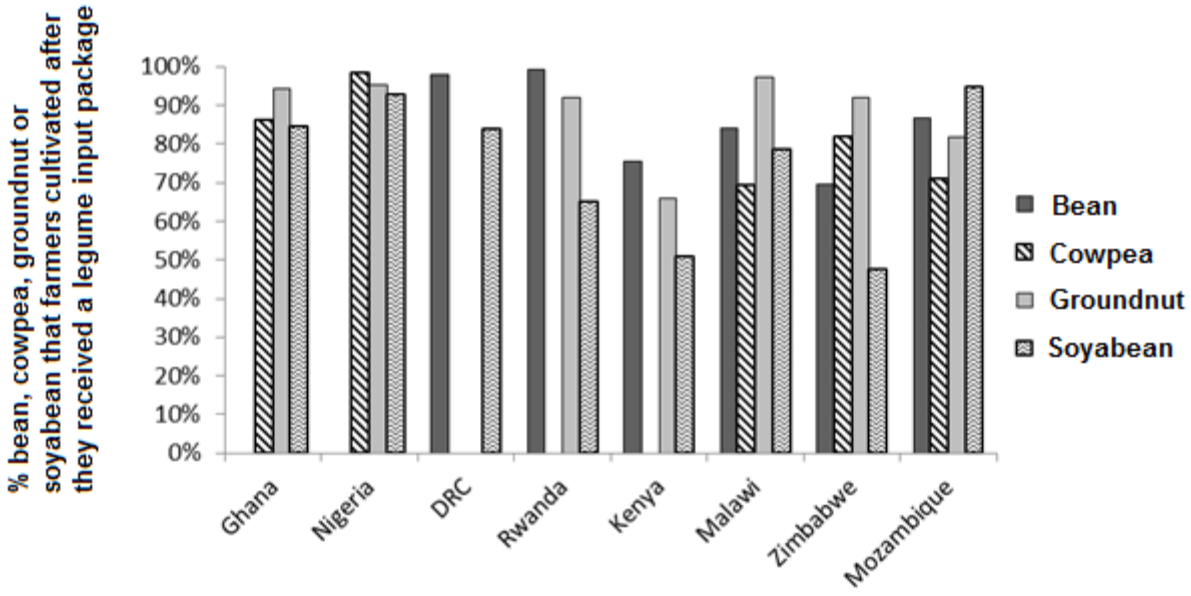
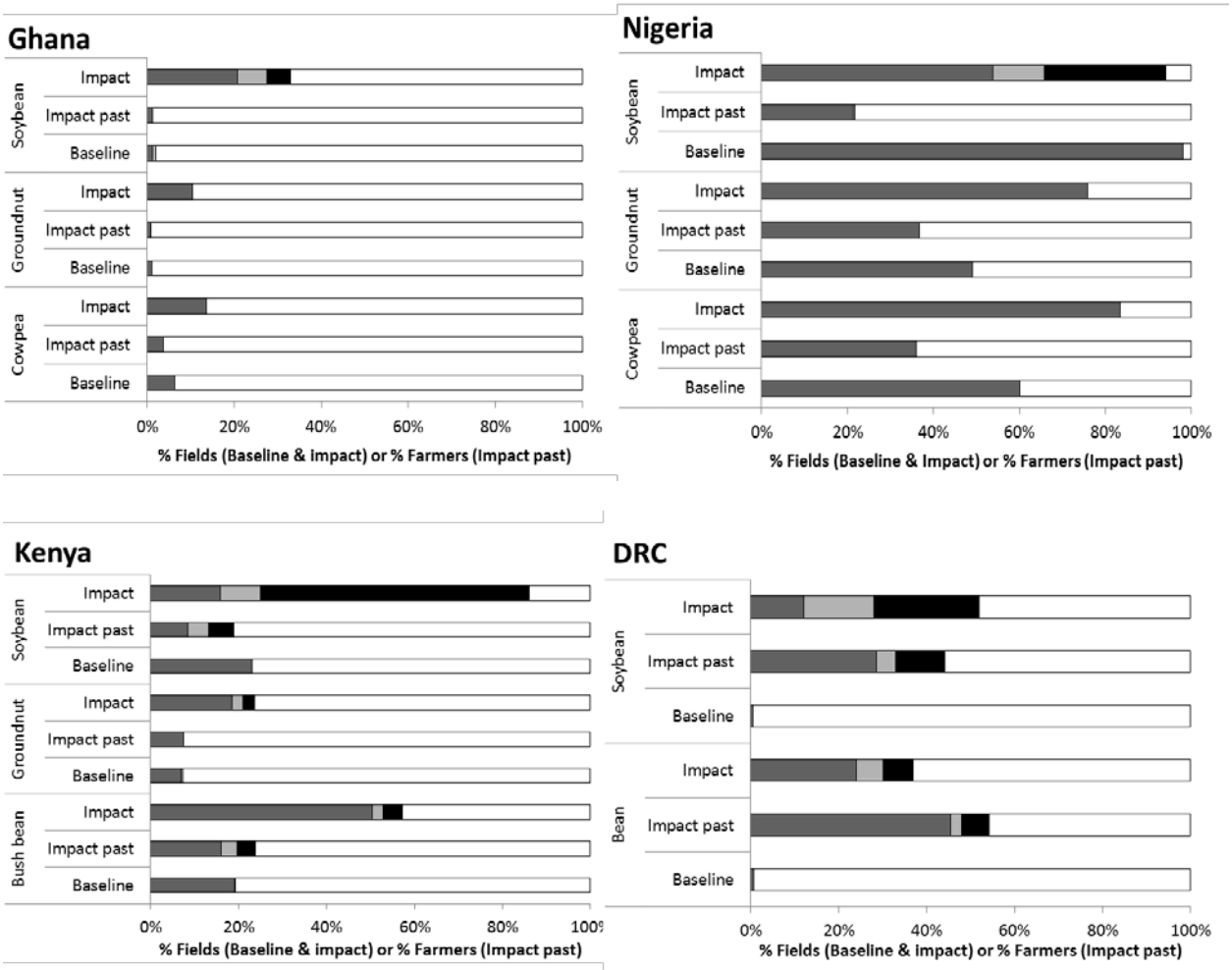


Figure 4.6. Percentage of legume cultivating farmers (2013) that also cultivated those legumes before they received an input package.

4.3 Use of inputs in legumes

4.3.1 Use of fertilizer and inoculants per country

Figure 4.7 shows that Nigerian famers that participated in the baseline survey used more inputs as compared with farmers of the early impact survey (before households received an input package). Furthermore, the results show that it was the other way around in DR Congo, Rwanda and Zimbabwe. At the start of the project, farmers in DR Congo virtually did not use mineral fertilizer or inoculant in any legume crop. Farmers that participated in the early impact study used substantially more inputs: 35% of beans fields and 38% of soybean fields received mineral fertilizer. Farmers also used more inputs (inoculant and mineral fertilizer) after receiving an input package. In Ghana, Kenya and Malawi the input use increased in all legumes after farmers received an input package. In Mozambique the input use of famers that participated in early impact survey (before households received an input package and/or training) was higher as compared to the results of the baseline survey. This was particularly the case for soyabean farmers, since this legume was introduced along with inputs such as P-fertiliser and inoculants. Note however, that in Mozambique the dataset contained cases where farmers used inoculants in groundnut. These cases were removed.



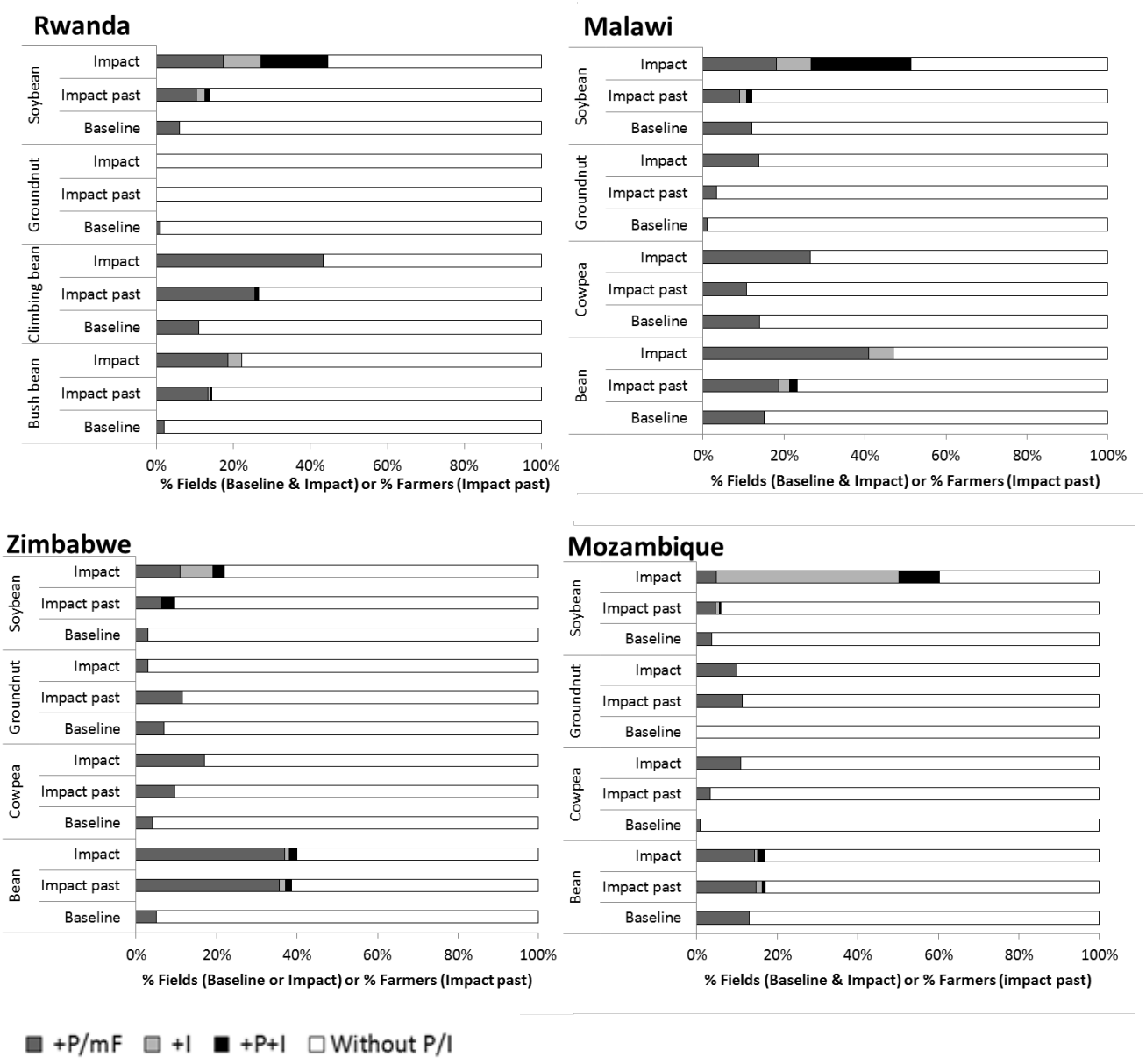


Figure 4.7. Use of mineral P-fertilizer[1] and inoculants in legumes (baseline survey and the early impact survey). P=Phosphorus fertilizer, mF=mineral fertilizer, I=inoculant[2].

4.4 Use of input types

4.4.1 P-fertilizer

In Ghana, Nigeria, Kenya, Malawi and Zimbabwe the majority of impact survey farmers obtained P-containing fertilizer (Figure 4.8), mostly in the form of NPK/DAP/Compound D (N:P:K:S 7:14:7:4). In Nigeria and Kenya, farmers also obtained more legume specific fertilizers such SSP, TSP or Sympal. Note that the fertilizers obtained refer to the farm level

[1] Only P-fertilizer was included for the baseline survey and the impact survey season, but for the recall in the impact survey, fertilizer type was not always known. In the recall, we therefore refer to mineral fertilizer in general. However, the data that are available suggest that it refers mainly to P-containing fertilizers such as DAP, NPK or SSP.
[2] The use of inputs in the baseline and impact survey is on a field basis, whereas the use of inputs for the recall to the past is on a household basis.

meaning that not all fertilizers obtained were used on legumes. Yet, the large proportion of Nigerian farmers obtaining fertilizers corresponds with the high use of inputs in legumes in Nigeria. For Ghana, however, we assume that part of the P-containing fertilizer obtained was not used on legumes (Figure 4.8). In Rwanda, approximately 40% obtained P-fertilizers. In Mozambique and DR Congo the proportion was smaller. The results for Mozambique can partly be explained by a fertilizer market that is still incipient and high fertilizer prices, amongst others.

4.4.2 Legume seed

Legume seed was obtained by a large proportion of farmers in Ghana, Nigeria, Kenya and Mozambique (Figure 4.8). In Malawi about half of the farmers obtained legume seeds. In DR Congo, Rwanda and Zimbabwe the proportions of farmers obtaining legume seed were small. Farmers in these countries could have used more saved seeds.

4.4.3 Inoculants

Inoculants were obtained mostly in Nigeria and Kenya (Figure 4.8). However, in Kenya the impact survey only targeted farmers, who had received a soyabean package. This can partly explain why the proportion of farmers that obtained inoculants in Kenya is higher than in other countries, as inoculants were mostly disseminated with soyabean and less often with the other legumes. Surprisingly, about 25% of farmers in Mozambique also mentioned that they obtained inoculants. Yet, Figure 4.9 shows that only farmers in Ghana and Zimbabwe bought their inoculants. In the other countries, all inoculants were supplied by projects.

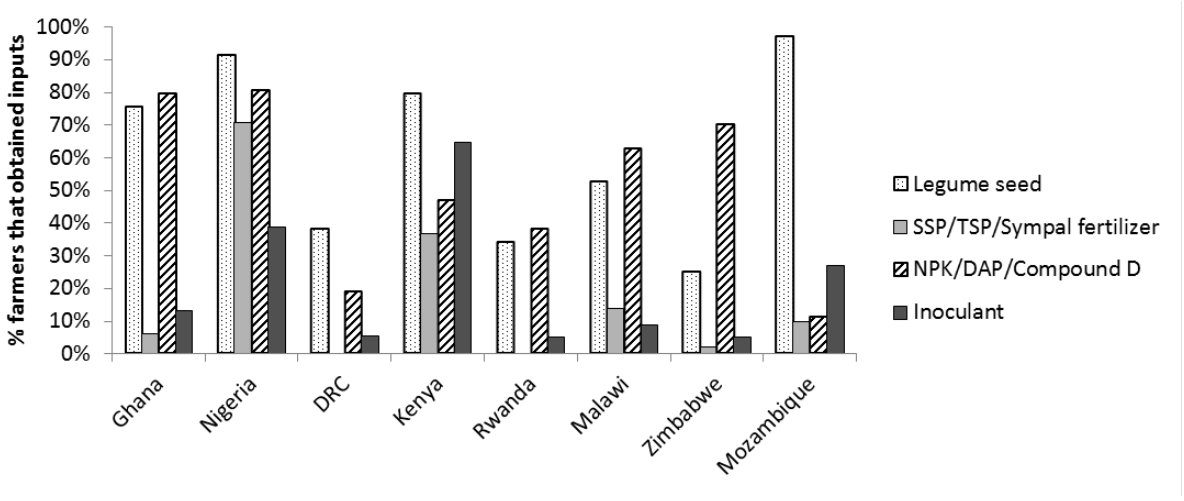


Figure 4.8. Percentage farmers that obtained an input package with legume seed, P-fertilizer[3] and/or inoculants per country.

4.5 Sources of inputs

A relatively large part (50%-78%) of the farmers, who received an input package, acquired NPK, DAP or compound fertilizers from agro-dealers or markets (Figure 4.9). However, this was not the case for DR Congo and Mozambique. SSP, TSP and Sympal fertilizers, mainly used in Nigeria and Kenya (Figure 4.8), were usually obtained through NGOs or agricultural projects rather than bought on the market (data not shown). Legume seed was supplied by

[3] Mineral fertilizer in Rwanda mainly included DAP and NPK, and some urea. Urea was never distributed in the dissemination package, DAP was distributed in the soyabean –maize system, NPK was distributed in dissemination package for bush bean and cassava cropping system (which means that if urea was obtained, it is included here under P-fertilizer, which is not correct).

projects and NGO's more often than it was bought on the market. In a few cases, neighbours or relatives provided farmers with legume seed. Only in Rwanda more than 60% of the farmers bought legume seed from the market (Figure 4.9). Ghana and Zimbabwe were the only two counties where part of the farmers bought inoculants from agro-dealers or the market. In Ghana, it is possible that inoculants appeared on the 'market' through IFDC or from Benin. In the other counties all the inoculants were supplied by projects and NGO's. Note that the proportion of farmers that obtained inoculants in Ghana and Zimbabwe was small in the first place (Figure 4.8).

Urea was never distributed in the dissemination package, only DAP was distributed in the Soybean/Maize system, NPK was distributed in dissemination package for Bush bean and Cassava cropping system

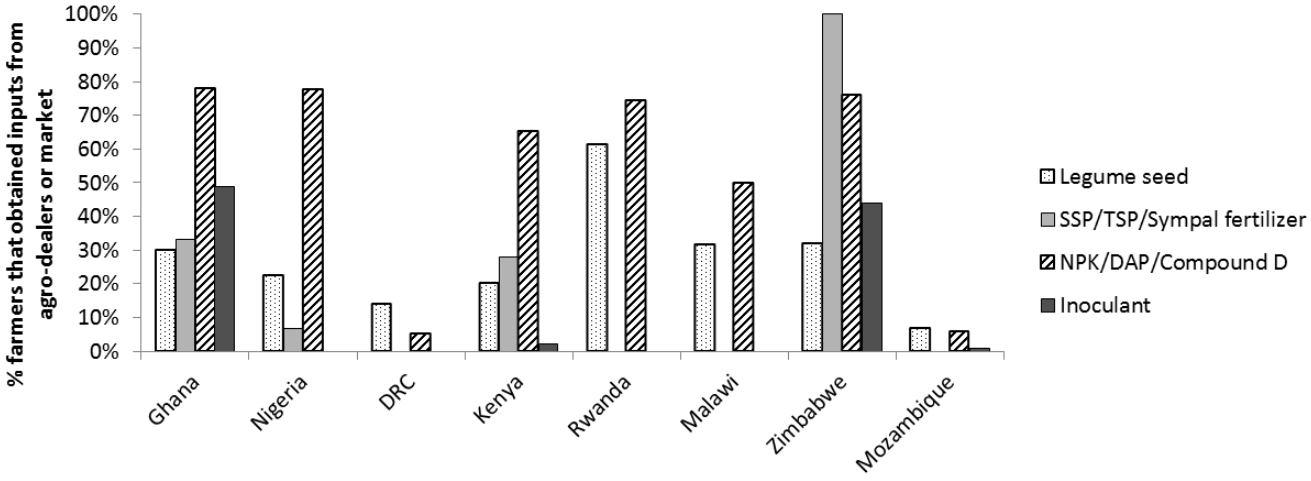


Figure 4.9. Proportion of early impact farmers who obtained inputs from agro-dealers or the market[4] per country.

[4] When farmers did not acquire inputs from agro-dealers or markets, the largest other suppliers were NGOs and agricultural projects (among which N2Africa was also mentioned).

5 Use of legume input packages

5.1 Legume input packages received

Farmers interviewed in the impact survey had all participated in N2Africa dissemination trials with different target legumes. Some farmers had received multiple legume input packages. They either received these packages in the same season or in consecutive years. Except for Rwanda and DR Congo, the majority of farmers received a soyabean input package (Table 5.1).

Table 5.1. Number of farmers who received an input package and number of packages per type received by farmers per country (note that farmers could have received multiple input packages).

Country	# farmers	# bean packages	# cowpea packages	# groundnut packages	# soyabean packages	Total # of packages
DR Congo	296	261			207	468
Ghana	292		84	49	165	298
Kenya	291	70			288	358
Malawi	310	61	30	120	153	364
Mozambique	352		5	66	259	330
Nigeria	376		143	42	219	404
Rwanda	300	229			85	314
Zimbabwe	331	69	57	83	122	331
Total	**2,548**	**690**	**319**	**360**	**1,498**	**2,867**

Table 5.2 shows in which year farmers had received input packages. In DR Congo, the majority of farmers had received their package in 2010 or 2011. In Ghana and Nigeria, the majority had received their package in 2011 and 2012, in Kenya and Rwanda in 2011, and in Malawi, Mozambique and Zimbabwe in 2012. Farmers who received a N2Africa package in 2013 were excluded from analyses.

Table 5.2. Years in which farmers received an legume input package per country.

Country	2010	2011	2012	2013	Total number of packages
DR Congo	146	123	15	1	285
Ghana	30	131	112		273
Kenya	67	112	36	1	216
Malawi[a]	3	95	179	31	308
Mozambique[a]	1	30	274	26	331
Nigeria	25	127	124		276
Rwanda	36	184	62	9[b]	282
Zimbabwe[a]			330	1	331
Total	**308**	**802**	**1,132**	**60**	**2,302**

[a] In Malawi, Mozambique and Zimbabwe, 2010 refers to the 2009/2010 growing season.
[b] Five out of nine farmers in Rwanda received the package in the 2013A season and are included in further analyses.

5.2 Cultivated legume types

Table 5.3 provides further insight in the number of early impact farmers who received a package per type followed by the percentage of farmers that already cultivated this legume before they received the package and the percentage of farmers that also cultivated this legume after they received the input package. In DR Congo, almost all farmers that received a bean input package cultivated beans before and after they had received the package. The results furthermore show that fewer farmers cultivated soyabean, after they received a soyabean package. In Ghana the number of farmers cultivating cowpea remained approximately equal after having received a cowpea package, the number groundnut farmers declined after having received a groundnut package, and the number of soyabean farmers increased after having received a package. In Kenya, fewer farmers cultivated common bean after they received a package than before. However, Kenyan farmers often received multiple packages and the number of farmers growing soyabean increased after having received a package. In Malawi, slightly more farmers cultivated beans after they received a bean package, the number of cowpea farmers decreased, the number of groundnut farmers stayed the same and the number of soyabean farmers increased. In Mozambique and Nigeria there was not much change in the number of groundnut and soyabean farmers after having received a specific package. In Rwanda, the number of bean farmers declined, the number of cowpea and groundnut farmers stayed more or less equal and the number of soyabean farmers increased.

Table 5.3. Number of early impact farmers who received an input package followed by the percentage of farmers that already cultivated this legume before they received the package and the percentage of farmers that cultivated this legume after they received an input package per legume and country.

Country	Bean package			Cowpea package			Groundnut package			Soyabean package		
	n	Before (%)	After (%)	n	Before (%)	After (%)	n	Before (%)	After (%)	n	Before (%)	After (%)
DR Congo	259	98%	98%	0	0%	0%	0	0%	0%	204	72%	61%
Ghana	0	0%	0%	84	85%	82%	49	98%	69%	165	76%	89%
Kenya	68	75%	57%	0	0%	0%	0	0%	0%	250	50%	90%
Malawi	56	46%	52%	26	19%	15%	99	94%	94%	135	72%	85%
Mozambique	0	0%	0%	0	0%	0%	64	100%	100%	235	95%	98%
Nigeria	0	0%	0%	141	94%	94%	42	100%	100%	218	89%	82%
Rwanda	227	97%	85%	0	0%	0%	0	0%	0%	82	50%	59%
Zimbabwe	69	68%	80%	57	79%	79%	83	88%	86%	122	34%	58%
Total	**679**			**308**			**337**			**1,411**		

5.3 Used input packages per country

5.3.1 DR Congo

The majority of farmers who had received a soyabean package reported that they already cultivated soyabean before they received the package (four years ago) (Figure 5.1). Fewer farmers reported that they cultivated soyabean after they received an input package. Common bean was cultivated by almost all farmers who had received a common bean package, both before and after they received a package. The use of P-fertilizer on common bean increased after farmers received an input package.

5.3.2 **Ghana**

The majority of farmers who received a soyabean package reported that they already cultivated soyabean before. Yet, the proportion of farmers that continued to cultivate soyabean after having received a package was larger after they had received a package. In addition, more farmers used P-fertilizer and/or inoculants after they received a package (Figure 5.1). Although the proportion of groundnut farmers decreased - even after having received a groundnut package - the proportion of farmers using P-fertilizer in groundnut increased after having received a groundnut package. The cultivation and use of inputs on cowpea did not change much.

5.3.3 **Kenya**

Both the proportion of farmers cultivating soyabean and the proportion of farmers using P-fertilizer and/or inoculants increased after having received a soyabean package (Table 5.3 and Figure 5.1). The proportion of farmers who cultivated climbing bean before they had received a package and the proportion that cultivated climbing bean after receiving a package were both small. The input use on climbing bean did not change.

5.3.4 **Malawi**

Both the proportion of farmers cultivating soyabean and the proportion of farmers using P-fertilizer and/or inoculants increased after having received a soyabean package. Although the proportion of farmers cultivating groundnut has remained more or less equal, the use of P-fertilizer has increased after farmers had received a groundnut package. Differences related to the cultivation of cowpea or common bean were minimal.

5.3.5 **Mozambique**

Both the proportion of farmers cultivating soyabean and the proportion of farmers using P-fertilizer and/or inoculants increased somewhat after having received a soyabean package (Table 5.3 and Figure 5.1). However, a large proportion of farmers who had received a soyabean package reported that they already cultivated soyabean before they received the package. All farmers who had received a groundnut package already cultivated groundnut before and continued to cultivate groundnut. It is remarkable that about 15% of farmers reported that they used inoculants on groundnut.

5.3.6 **Nigeria**

Although the proportion of soyabean farmers decreased after having received a package, the proportion of farmers using P-fertilizers and/or inoculants increased (Table 5.3 and Figure 5.1). Almost all farmers who had received a groundnut package used P-fertilizer on groundnut. The use of P-fertilizer on cowpea also increased after having received a cowpea package. Majority of soyabean farmers in Nigeria want to see ready market and off-takers before they go into soyabean production, as soyabean is considered to be a commercial crop. It is an axiomatic fact, not unconnected with those just enumerated, that there is limited use of grain soyabean for food at household level as compared to groundnut and cowpea. Cowpea is considered as food crop and groundnut as food and commercial crop. More training on utilization, especially for soyabean, is needed.

5.3.7 **Rwanda**

Soyabean cultivation increased somewhat among farmers who had received a soyabean package. Use of inputs in soyabean clearly increased after having received a package (Figure 5.1). Whereas the proportion of farmers who cultivated bush or climbing bean decreased somewhat after they received an input package. However, the use of P-fertilizer and/or inoculants had increased.

5.3.8 **Zimbabwe**

Both the proportion of farmers cultivating soyabean and the proportion of farmers using P-fertilizer and/or inoculants increased after having received a soyabean package (Figure 5.1). Differences related to groundnut cultivation were minimal. Although the proportion of farmers cultivating cowpea had not increased after they received a cowpea package, the input use had. For common bean it was the other way around: the proportion of farmers cultivating common bean had increased whereas the use of inputs had not. Yet, a few more farmers used inoculants on common bean after they had received a common bean package.

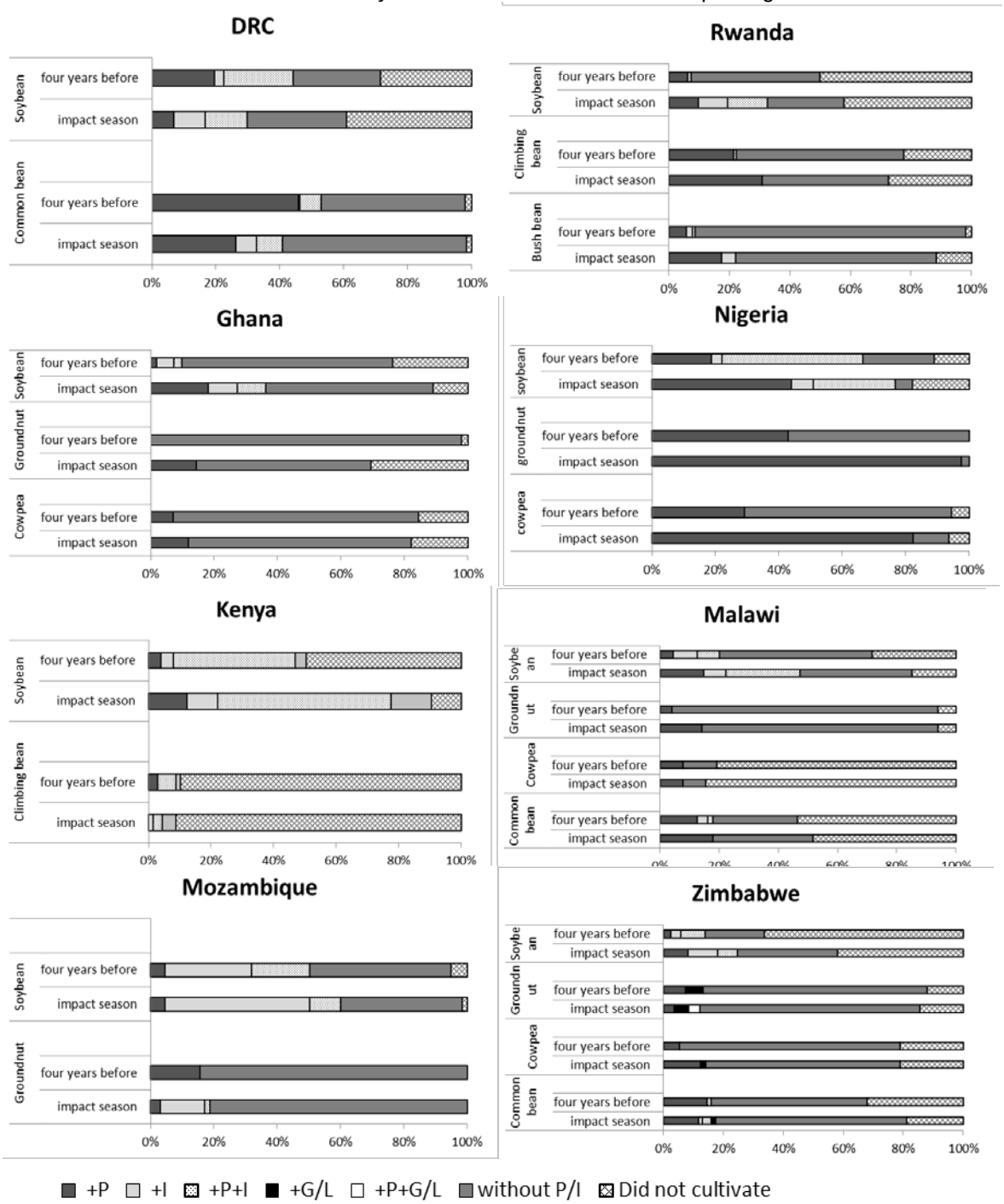


Figure 5.1. Use of input packages before ('four years before') and after ('impact season') farmers received a legume input package per country. P=mineral fertilizer containing phosphorus, I=inoculant, G=gypsum, L=lime.

5.4 Past use of inputs

Table 5.4, 5.5, 5.6 and 5.7 show the past use of inputs per legume by farmers who used phosphorus fertilizer (P) and/or inoculant (I), after they received a legume input package. Between 30 and 72% of the farmers who used P-fertilizer in common bean, already used P-fertilizer on bean before they received the bean package (Table 5.4). In Rwanda, 44% of the common bean farmers used mineral P-fertilizer before they received the input package. This number corresponds with the increase in fertilizer use shown in Figure 5.1. The same counts for the large increase in P-fertilizer use on groundnut and cowpea in Nigeria (Figure 5.1) and the relatively small proportion of farmers that used P-fertilizer on groundnut or cowpea before they received the input package (Table 5.6 and Table 5.7).

The case for soyabean in DR Congo is slightly different. Figure 5.1 shows that fewer farmers in DR Congo used P-fertilizer and/or inoculants in soyabean, after they had received a soyabean package. However, only about half of the farmers who used these inputs after they received the package had used them before (Table 5.5). This means that many farmers who used P-fertilizer and/or inoculants before had abandoned using them.

Table 5.4. Past use of inputs in common bean by farmers who used phosphorus fertilizer (P) and/or inoculant (I), after they received a common bean package per country.

Country	Package bean + P-fertilizer (n)	Past use mineral P-fertilizer (%)	Package bean + inoculant (n)	Past use inoculant (%)
DR Congo	89	72%	38	21%
Kenya	2	50%	3	67%
Malawi	10	40%	0	0%
Rwanda	62	44%	0	0%
Zimbabwe	10	30%	0	0%

Table 5.5. Past use of inputs in soyabean by farmers who used phosphorus fertilizer (P) and/or inoculant (I), after they received a soyabean package per country.

Country	Package soyabean + P-fertilizer (n)	Past use mineral P-fertilizer (%)	Package soyabean + inoculant (n)	Past use inoculant (%)
DR Congo	41	54%	47	49%
Ghana	45	9%	30	7%
Kenya	170	52%	163	53%
Malawi	54	24%	44	23%
Mozambique	34	65%	130	58%
Nigeria	152	64%	71	65%
Rwanda	19	5%	19	5%
Zimbabwe	18	33%	20	30%

Table 5.6. Past use of mineral P-fertilizer in groundnut by those farmers who used P-fertilizer, after they received a groundnut package per country.

Country	Package groundnut + P-fertilizer (n)	Past use mineral P-fertilizer (%)
Ghana	7	0%
Malawi	14	7%
Mozambique	3	33%
Nigeria	41	41%
Zimbabwe	6	33%

Table 5.7. Past use of mineral P-fertilizer in cowpea by those farmers who used P-fertilizer, after they received a cowpea package per country.

Country	Package cowpea + P-fertilizer (n)	Past use mineral P-fertilizer (%)
Ghana	10	10%
Malawi	2	50%
Nigeria	116	23%

6 Lessons learned and suggestions for impact studies based on household surveys

6.1 Lessons learned

The results showed farmers most often obtained legume seeds and inoculants through implementing partners, such as NGOs or governmental programs. One possible explanation is that input supply markets are not working effectively. When inputs are not obtained independently (i.e. without project or governmental support) it is difficult to imply lasting impact. Farmers interviewed in the baseline survey were a random sample within the target areas, whereas farmers interviewed for the early impact survey were intentionally selected as a sample of farmers who had participated in N2Africa. The aim was to see whether the farmers who had received a demonstration package continued to use, or expanded the use of the N2Africa technology. Consequently, farmers who participated in N2Africa had a different background in legume cultivation than the random sample surveyed in the baseline (notably in DR Congo, Nigeria and Mozambique). Therefore, farmers in the baseline survey cannot serve as counterfactuals for the farmers in the early impact survey and the results cannot be extrapolated to the wider population.

6.2 N2Africa impact studies

The aim of the N2Africa impact studies planned for the end of the project is to assess changes in living conditions of the target group, including intended and unintended social, economic and ecological outcomes (Ampadu-Boakye *et al.*, 2016). The impact studies will also consider changes in the role of farmers' organisations (collective marketing, farmer groups, amongst others), public—private partnerships and institutional arrangements. Furthermore, the studies will evaluate qualitatively the 'delivery and dissemination' strategy (D&D approach) and its learning aspects, since learning through research and dissemination activities are key to N2Africa's approach. The impact assessment for N2Africa will be conducted in selected project areas in different ecological zones across all countries. The design will focus on specific expected effects/areas (called impact domains) and consider changes in those areas (Ampadu-Boakye *et al.*, 2016). Household surveys, case studies and project outcome data will be used to assess the impact domains at the end of the project.

The specific impact domains and learning areas are outlined below:

- Change in income earned from increased legume production and use of such additional income;
- Gender inclusion and empowerment: Changes in gender disparities in targeted value chains;
- Sustainability of interventions related to marketing (Does collaboration with private sector continues after project ends?);
- Best-fit business models (What kind of business models work?; Under what circumstances?);
- Soil fertility and other benefits to other crops (What are the rotational effects and/or broader benefits of legume crops in farming system?);
- Benefits/value generated to male and female farmers including health and nutritional benefits specifically change in nutritional aspects of selected women and children benefiting from project interventions;
- Sustainability of input supply and market systems;
- Best-fit D&D approaches in terms of effectiveness and efficiency;
- Sustainability of national institutions to lead and develop improved legume technologies; capacity of partners to take up dissemination after project ends and capacity of households to adopt technologies introduced. (To what extent has the project contributed to institutional, partners and individuals (farmers' capacity) capacity building?).

An overarching question relevant across all aspects of N2Africa work is "*What works where, when, why and for whom?*" – understanding the role of conditioning factors in the agro-ecological and socioeconomic and political realms that govern success at all levels. Additional research questions could be:

- What are best-fit technology for households in terms of closing legume yield gaps?
- What needs and constraints have been addressed by the N2Africa technologies?
- What is the adoption intensity (use of N2Africa technologies in the total farm area (%))?
- What performance characteristics of the N2Africa technologies (usability, ease of management, profitability, reliability, compatibility with other household activities or culturally embeddedness) have been appreciated?
- What household characteristics (gender, resource endowment, farm area, amongst others) foster change and adaptation of N2Africa technologies?
- What are target areas (adoption domains) for future project interventions?
- What fostered or hindered project learning, questioning the current way of working and searching for new strategies and learning about our theory of change?
- What are the best-fit configurations of public-private partnerships?

Due to the way that N2Africa has been implemented through partnerships, inevitably we have no experimental design with counterfactuals to measure impact domains, such as D&D approaches, best fit business models, accessibility of input requirements, gender inclusion, farmers' organisation and bargaining power, amongst others. In-depth case studies (focus groups meeting, semi-structured interviews, amongst others) can be used to assess these impacts. Annually collected M&E data provide insights in changes in institutional, partners and individuals (farmers' capacity) capacity building and the sustainability of input supply and market systems (volume of seeds, fertilizers and inoculants used, % households using inputs and volume of input types sold by agro-dealers), amongst others. In the remainder of this conclusion we reflect on the possibilities for a survey to measure impact at household level at the end of the project, based on the lessons learned with the early impact survey.

6.2.1 Impact studies based on household surveys

Data collected by household surveys can be used to measure impact questions at household level. It provides insights related to questions such as: How do current activities relate to activities reported by farmers who participated in the baseline study? Particularly parameters related to changes in legume and crop production (kg farm^{-1}), legume use, input use per legume, legume area (ha farm^{-1}), income earned from increased legume production, livestock ownership, land holding and land use can be measured. Also changes in legume area (kg farm^{-1}) in relation to changes in livestock ownership, welfare and legume consumption patterns can be assessed by using household surveys.

6.2.2 Difference-in-difference method

The standard difference-in-differences method (DiD) can be used to study changes in living conditions at household level and measure the social, economic and ecological impact of N2Africa's technologies (Ampadu-Boakye *et al.*, 2016). The DiD approach estimates the causal effect of project interventions on outcome measures. The approach assumes that the N2Africa project is the only factor that affects trends in the outcomes between the intervention and control groups (e.g. counterfactual groups), as it excludes changes that are related to wealth–based sample selection (Ruben, 2008). A second important assumption of the DiD model is that the outcome trend in the control group represents a good approximation of what the outcome trend in the intervention group would have been in the absence of the project intervention (McKinnon *et al.,* 2015).
The method is a statistical technique that mimics an experimental research design. It studies the differential effect of an intervention by comparing the average change over time at outcome level for a 'treatment group' versus a 'çontrol group'. The comparative quantitative assessment requires measurements of project outcomes at two moments in time for the two different groups (Table 6.1).

Table 6.1. Schematic representation of difference-in-difference method.

Data collection	Control group	Treatment group	Statistical analysis
Pre-test of outcomes (t=0)	C_0	T_0	Inter-group difference – $T_0 - C_0$
Post-test of outcomes (t=1)	C_1	T_1	Inter-group difference – $T_1 - C_1$
Statistical analysis	**Intra-group difference (C_1 - C_0)**	**Intra-group difference ($T_1 - T_0$)**	**Difference in difference $T_1 - (T_0-C_0)$**

The treatment group (N2Africa users) is exposed to an intervention during the project (t=1), the control group (non-users) is during both periods not exposed to any treatment. Based on these four measurements, both inter-group and intra-group differences can be analysed. These analyses compare observed changes at project outcome level around treated groups (T_1-T_0) with observed changes around control groups (C_1-C_0) (Figure 6.1). Furthermore, DiD calculates the "normal" difference in the project outcome between the two groups (the difference that would still exist if neither group experienced the treatment = normal outcome). Consequently, the treatment effect is the difference between the observed outcome and the "normal" outcome (T_1-$Normal_{outcome}$ or $T_1 - (T_0-C_0)$) (Figure 6.1). Since the approach relies on direct 'before' and 'after' measures at the same site, it provides a more direct value attributable to project interventions (Heckert and Mennis, 2012).

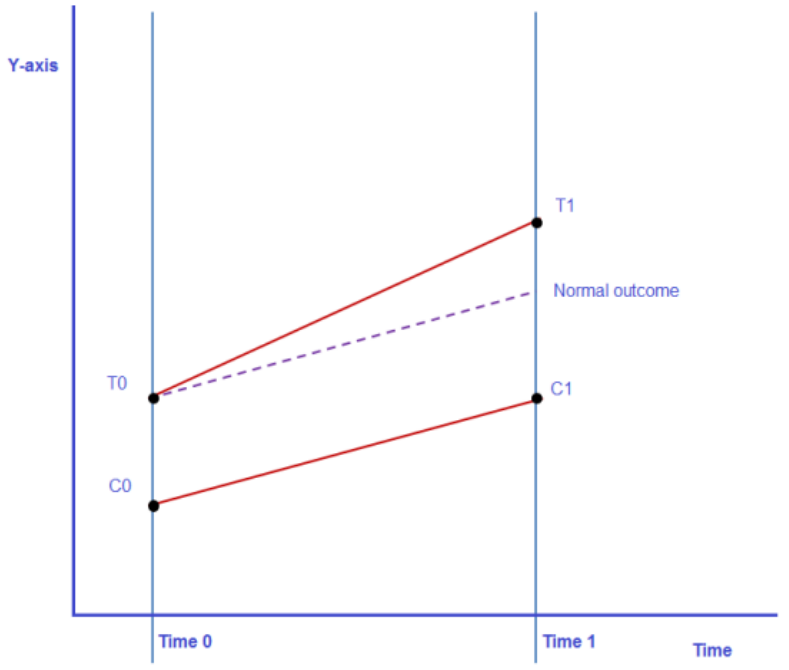


Figure 6.1. Schematic representation of difference-in-difference method.

Applying the DiD approach pre-requisites that the targeted sample for the impact study consists of farmers that participated in the baseline study (2011 and 2013). Only those geographical areas will have to be selected where project activities actually took place. Baseline data collected in 2011 and 2013 can be used to define C_0 and T_0 (Figure 6.1) by asking baseline farmers if they did not (C_0) or did (T_0) participate in the project. Baseline farmers that did not participate in the N2africa project are used to determine C_1. Baseline farmers that did participate in the N2africa project are used to determine T_1.

6.2.3 **Conclusion**

Exploring sample variations at spatial (at household, regional and country level) and temporal scales offer insights in the N2Africa impact with regard to legume and rhizobia genotypes (G_L * G_R), environment (E) and/or management practices (M). Analysis of the N2Africa early impact survey has allowed us to explore the potential and limitations of these surveys within the constraints of project implementation. The final two years of the project will be used to design and implement a range of studies using quantitative and qualitative methods to examine the impact of N2Africa and maximise our learning.

7 Literature

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Appendix I Early impact survey N2Africa project

Name of the interviewer:_____

Date of interview: _____/_____/2013

Country: _____ Sector / State:_____

Action site (District/County/LGA/…): _____

Village: _____

GPS coordinates homestead (decimal degrees) North/South:_____
East/West: _____ Altitude: _____(meter)

Part A: General information

A.1. Name of the N2Africa farmer: _____

A.2. Sex of farmer: Male ___ /Female ___ Age: _____

A.3. Is farmer head of the household: Yes ___ / No ___

A.4. If no, head of household is Male ___ /Female ___ and Age _____ years

A.5. Members of the household

Total number of people in the household:_____

Age	**No. of all children**	
0 – 16 years		
	No. of females	**No. of males**
17 – 35 years		
35-60 years		
Over 60 years		

A.6. Highest education level completed in the household: _____

A.7. Highest education level completed by the household head: _____

A.8. Role of farmer in the N2Africa project (please tick):
Lead Farmer ____
Satellite farmer ____
Other role (Specify): _____
No role at all in N2Africa_____

A.9. Importance of agriculture in the household

	What are the main sources of cash income in the household? (please tick)	Estimated proportion of total income (in %, make sure the total equals 100%)
Cropping		
Livestock		
Casual labour		
Trade		
Other business		
Salaried job		
Pension		
Remittances		
Other_____		

A.10. What are the three most valuable goods in your household?

1._____

2._____

3._____

A.11. Number of valuable livestock species owned of by the household

Cattle (no.):_____ Sheep (no.):_____ Goats (no.):_____

Pigs (no.):_____

Other valuable livestock, type: _____ no: _____

type: _____ no: _____

A.12. Do you hire labour from outside the household to work in your fields? Yes___/No____

A.13. Do you or your household members work on other people's fields for food or cash (as hired labour)? Yes___/No____

Part B. Inputs / training received from N2Africa

B.1 Did you receive inputs and/or training from N2Africa in the past?

1. Yes:____ 2. No:_____ If yes, proceed with B.2. If no, continue with B.4.

B.2. Please give the name of the organisation that disseminated N2Africa technologies:

_____

B.3. If you did receive inputs and/or training **from N2Africa**, please specify what you received and in which year/season. If inputs or training were received over more than one season, please split the column.

	Specify the type of input received, leave blank if not received
Season(s) in which you received the inputs	
Legume crop & Variety/ies	
Legume crop & Variety/ies	
Seed / planting material from non-legume crops	
Mineral Fertiliser	
Organic inputs	
Inoculants	
Biocides	
Training 1 (specify areas of training provided)	
Training 2	
Other	

B.4. Did you receive inputs or training for **legume cultivation** from sources **other than N2Africa** (such as other projects, government extension, NGOs, etc.) in the last four years?

Yes: _____ No: _____

If Yes, Specify type of inputs/training, source and timing

Type of input/training	**Source**	**Which season was it received?**
1.		
2.		
3.		
4.		
5.		
6.		

Part C. Land holding and current crop management

C.1. How much arable land do you have available for crop farming (incl. fallow land)? _____ha or ____acres

C.2. Can you describe the most common crop rotation(s) on your farm?

	Crop rotation 1	Crop rotation 2
Season 1		
Season 2		
Season 3		
Season 4		

C.3. Do you leave land fallow during the cropping season?

1) Yes:____ 2) No:_____

If yes, how long is a field typically left fallow between crops (seasons): _____

C.4. In the last cropping season, which of the following inputs did you acquire (i.e. not saved from last season)?

	Tick if obtained	If yes, please specify	If yes, specify from who you obtained it (e.g. agro-dealer, NGO, relative, government)
Legume seed			
Non-legume seed / planting material			
P-based fertiliser			
Other mineral fertiliser			
Inoculant			

C.5. *Crop management.* Fill in the table below for each field (or the 7 main fields) cropped in the last season. Please pay attention to units.

Field	Size (indicate ha, ac or m^2)	Crop(s) grown (if intercropped, mention all crops and indicate relative shares, e.g. 80% maize / 20% beans)	Indicate variety/ies (ensure variety names for all legumes are noted)	Mineral fertiliser applied? (If yes, specify type and amount If none, leave blank) Type:	Amount+unit	Organic inputs applied? (Tick if yes)	Inoculant applied? (Tick if yes)	Total harvest from this field (give unit, e.g. in kg or 50 kg bags)
1.								
2.								
3.								
4.								
5.								
6.								
7.								

D. Crop production and use

D.1 Indicate for each crop the total production from last season for the entire farm and the amounts for sale, kept in the household for food, for payment / food of hired labour, and the amount for seed. The table refers to the division of crop production directly after harvest. Make sure that the sum of the amounts for sale and kept within the household for food, payment of labour, or seed equals total production.

Crop	Total production at the farm Indicate units, e.g. kg, 50 kg bags. Total production should correspond with the yields given in the last column of C.5.	Amount for sale	Amount for food in the household	Amount used as payment / food for hired labour	Amount kept as seed / planting material

E. Changes in crop production and use

E.1. In the last 4 years, did the total amount of cultivated land in the household (Tick): 1. Increase_____ 2. Decrease_____ 3. Stay the same_____

If the area changed, can you indicate how much it changed and why it changed:

from_____ ha or ____acres 4 years ago to _____ha or _____acres now.

Why: _____

_____

E.2. Which crops *increased* in area on your farm in the last 4 years?

1._____ 2._____ 3._____

E.3. Which crops *decreased* in area on your farm in the last 4 years?

1._____ 2._____ 3._____

E.4. Did you cultivate grain legumes before you came in contact with the N2Africa project?
Yes_____ No:_____
If yes, proceed with questions E.5.-E.7. If no, please proceed with question E.8.

E.5. Describe how legume cultivation in the field has changed in the last 4 years, and what the reason was for this change. Think about changes in crop management, improved varieties, intercropping, crop rotation, area, yield, etc.

_____

_____

_____

_____

_____

E.6. Describe how you typically cultivated grain legumes 4 years ago by filling in the table below:

	Legume 1: _____	Legume 2: _____	Legume 3: _____
Variety/ies (Specify)			
Mineral fertiliser applied? (If yes, specify type)			
Organic inputs applied? (If yes, specify type)			
Inoculant applied? (Tick if yes)			
Pesticides applied (Tick if yes)			

E.7. Describe for each legume crop how grain production, area, and amount of produce used for sale changed over the last four years by filling in the table below. Please pay attention to units.

Legume crop	In the last 4 years, how did grain yield change (per ha or per field)?	Can you give the typical yield 4 years ago and current yield per unit area, e.g. kg per ha?	In the last 4 years, did the area with this legume on your farm change? (tick)	Can you give the area under this legume 4 years ago and in the current season?	In the last 4 years, did the amount of legume grain (raw or processed) sold change (tick)	How much did the sale change? (Give the amount sold 4 years ago and the amount currently sold)
	Increase_____ Decrease____ No difference____	4 years ago: _____ Current: _____	Increase_____ Decrease____ No difference____	4 years ago: _____ Current: _____	Increase_____ Decrease____ No difference____	4 years ago: _____ _ Current: _____ _
	Increase_____ Decrease____ No difference____	4 years ago: _____ Current: _____	Increase_____ Decrease____ No difference____	4 years ago: _____ Current: _____	Increase_____ Decrease____ No difference____	4 years ago: _____ _ Current: _____ _

	Increase_____ Decrease____ No difference____	4 years ago: _____ Current: _____	Increase_____ Decrease____ No difference____	4 years ago: _____ Current: _____	Increase_____ Decrease____ No difference____	4 years ago: _____ _ Current: _____ _
	Increase_____ Decrease____ No difference____	4 years ago: _____ Current: _____	Increase_____ Decrease____ No difference____	4 years ago: _____ Current: _____	Increase_____ Decrease____ No difference____	4 years ago: _____ _ Current: _____ _

E.8. Do you process legume grain at home? Yes:_____ No:_____
If yes, how do you currently process legume grain (e.g. grinding into soya flour)?
Did the way of processing change compared with 4 years ago?

	Type of legume grain	Specify current processing of legume grain	Specify processing of legume grain in the past (if any different)
1.			
2.			
3.			

E.9. Do you use **legume haulms**? Yes:_____ No:_____
If yes, how do you currently use legume haulms? Did the use of legume haulms change in the last 4 years?

	Type of legume haulm	Specify current use of haulms (e.g. for sale, animal feed)	Specify use of haulms in the past (if any different)
1.			
2.			
3.			

F. Nutrition

F.1. In a normal year (not a drought year for instance), which months of the year do you struggle to find sufficient food to feed everyone in the household?
Tick the box(es).

	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Tick the months when you struggle												

F.2. In a normal year, which months does the food consumed in the household **mainly** comes from your own farm and which months mainly from other sources?
Tick the box(es).

	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Tick the months when food comes from the farm												
Tick the months when food comes from other sources												

F.3. How often do you eat grain legumes and legume leaves in your household? (which kinds, number of times per week, main or side dish)

	Which grain legume?	Number of times per week		How eaten? Main or side dish?
		Peak season	Low season	
1.				
2.				
3.				
4.				
	Which legume leaves?			
1.				
2.				

F.4. Individual dietary diversity score (proxy for nutritional adequacy of the diet)
Please describe the foods (meals and snacks) that you ate or drank yesterday, at home or outside the

home. Start with the first food or drink of the morning. Write down all foods and drinks mentioned. When composite dishes are mentioned, write down the ingredients.

	Dish	Ingredients
Breakfast		
Snack		
Lunch		
Snack		
Dinner		
Snack		

Was yesterday a celebration or feast day where you ate special foods or where you ate more, or less than usual? Yes:_____ No:_____

Did you consume red palm oil or palm nuts yesterday? Yes:_____ No:_____

Do you have any questions / comments for us?

_____

Thank you for your time and cooperation.

List of project reports

1. N2Africa Steering Committee Terms of Reference
2. Policy on advanced training grants
3. Rhizobia Strain Isolation and Characterisation Protocol
4. Detailed country-by-country access plan for P and other agro-minerals
5. Workshop Report: Training of Master Trainers on Legume and Inoculant Technologies (Kisumu Hotel, Kisumu, Kenya-24-28 May 2010)
6. Plans for interaction with the Tropical Legumes II project (TLII) and for seed increase on a country-by-country basis
7. Implementation Plan for collaboration between N2Africa and the Soil Health and Market Access Programs of the Alliance for a Green Revolution in Africa (AGRA) plan
8. General approaches and country specific dissemination plans
9. Selected soyabeans, common beans, cowpeas and groundnuts varieties with proven high BNF potential and sufficient seed availability in target impact zones of N2Africa Project
10. Project launch and workshop report
11. Advancing technical skills in rhizobiology: training report
12. Characterisation of the impact zones and mandate areas in the N2Africa project
13. Production and use of rhizobial inoculants in Africa
18. Adaptive research in N2Africa impact zones: Principles, guidelines and implemented research campaigns
19. Quality assurance (QA) protocols based on African capacities and international existing standards developed
20. Collection and maintenance of elite rhizobial strains
21. MSc and PhD status report
22. Production of seed for local distribution by farming communities engaged in the project
23. A report documenting the involvement of women in at least 50% of all farmer-related activities
24. Participatory development of indicators for monitoring and evaluating progress with project activities and their impact
25. Suitable multi-purpose forage and tree legumes for intensive smallholder meat and dairy industries in East and Central Africa N2Africa mandate areas
26. A revised manual for rhizobium methods and standard protocols available on the project website
27. Update on Inoculant production by cooperating laboratories
28. Legume Seed Acquired for Dissemination in the Project Impact Zones
29. Advanced technical skills in rhizobiology: East and Central African, West African and South African Hub
30. Memoranda of Understanding are formalized with key partners along the legume value chains in the impact zones
31. Existing rhizobiology laboratories upgraded
32. N2Africa Baseline report
33. N2Africa Annual country reports 2011

34. Facilitating large-scale dissemination of Biological Nitrogen Fixation
35. Dissemination tools produced
36. Linking legume farmers to markets
37. The role of AGRA and other partners in the project defined and co-funding/financing options for scale-up of inoculum (banks, AGRA, industry) identified
38. Progress Towards Achieving the Vision of Success of N2Africa
39. Quantifying the impact of the N2Africa project on Biological Nitrogen Fixation
40. Training agro-dealers in accessing, managing and distributing information on inoculant use
41. Opportunities for N2Africa in Ethiopia
42. N2Africa Project Progress Report Month 30
43. Review & Planning meeting Zimbabwe
44. Howard G. Buffett Foundation – N2Africa June 2012 Interim Report
45. Number of Extension Events Organized per Season per Country
46. N2Africa narrative reports Month 30
47. Background information on agronomy, farming systems and ongoing projects on grain legumes in Uganda
48. Opportunities for N2Africa in Tanzania
49. Background information on agronomy, farming systems and ongoing projects on grain legumes in Ethiopia
50. Special Events on the Role of Legumes in Household Nutrition and Value-Added Processing
51. Value chain analyses of grain legumes in N2Africa: Kenya, Rwanda, eastern DRC, Ghana, Nigeria, Mozambique, Malawi and Zimbabwe
52. Background information on agronomy, farming systems and ongoing projects on grain legumes in Tanzania
53. Nutritional benefits of legume consumption at household level in rural sub-Saharan Africa: Literature study
54. N2Africa Project Progress Report Month 42
55. Market Analysis of Inoculant Production and Use
56. Identified soyabean, common bean, cowpea and groundnut varieties with high Biological Nitrogen Fixation potential identified in N2Africa impact zones
57. A N2Africa universal logo representing inoculant quality assurance
58. M&E Workstream report
59. Improving legume inoculants and developing strategic alliances for their advancement
60. Rhizobium collection, testing and the identification of candidate elite strains
61. Evaluation of the progress made towards achieving the Vision of Success in N2Africa
62. Policy recommendation related to inoculant regulation and cross border trade
63. Satellite sites and activities in the impact zones of the N2Africa project
64. Linking communities to legume processing initiatives
65. Special events on the role of legumes in household nutrition and value-added processing

66. Media Events in the N2Africa project
67. Launch N2Africa Phase II – Report Uganda
68. Review of conditioning factors and constraints to legume adoption and their management in Phase II of N2Africa
69. Report on the milestones in the Supplementary N2Africa grant
70. N2Africa Phase II Launch in Tanzania
71. N2Africa Phase II 6 months report
72. Involvement of women in at least 50% of all farmer related activities
73. N2Africa Final Report of the First Phase: 2009-2013
74. Managing factors that affect the adoption of grain legumes in Uganda in the N2Africa project
75. Managing factors that affect the adoption of grain legumes in Ethiopia in the N2Africa project
76. Managing factors that affect the adoption of grain legumes in Tanzania in the N2Africa project
77. N2Africa Action Areas in Ethiopia, Ghana, Nigeria, Tanzania and Uganda in 2014
78. N2Africa Annual report Phase II Year 1
79. N2Africa: Taking Stock and Moving Forward. Workshop report
80. N2Africa Kenya Country Report 2015
81. N2Africa Annual Report 2015
82. Value Chain Analysis of Grain Legumes in Borno State, Nigeria
83. Baseline report Borno State
84. N2Africa Annual Report 2015 DR Congo
85. N2Africa Annual Report 2015 Rwanda
86. N2Africa Annual Report 2015 Malawi
87. Contract Sprayer in Borno State, Nigeria
88. N2Africa Baseline Report II Ethiopia, Tanzania, Uganda, version 2.1
89. N2Africa rhizobial isolates in Kenya
90. N2Africa Early Impact Survey, Rwanda
91. N2Africa Early Impact Survey, Ghana
92. Tracing seed diffusion from introduced legume seeds through N2Africa demonstration trials and seed-input packages
93. The role of legumes in sustainable intensification – priority areas for research in northern Ghana
94. The role of legumes in sustainable intensification – priority areas for research in western Kenya
95. N2Africa Early Impact Survey, Phase I

Partners involved in the N2Africa project

A2N

Bayero University Kano (BUK)

Caritas Rwanda

Diobass

Eglise Presbyterienne Rwanda

Ethiopian Institute of Agricultural Research

Kwame Nkrumah University of science and Technology

MIRCEN
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Resource Projects-Kenya

Sasakawa Global; 2000

Université Catholique de Bukavu

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