IMPLICATIONS OF REFORMING THE AGRICULTURAL SUBSIDIES POLICY IN ECUADOR – THE CASE OF RICE

Ana María Díaz González

Cristian Morales-Opazo

Ana.DiazGonzalez@fao.org

Cristian.MoralesOpazo@fao.org

Agricultural Development Economics (ESA)

Economic and Social Development Department

Food and Agriculture Organization of the United Nations (FAO)

Rome, Italy

2020

***Paper prepared for presentation at the 60th annual conference of the GEWISOLA** (German Association of Agricultural Economics)*

„Challenges for rural development – economic and social perspectives“
Halle (Saale), Germany, September 23th – 25th, 2020

IMPLICATIONS OF REFORMING THE AGRICULTURAL SUBSIDIES POLICY IN ECUADOR – THE CASE OF RICE

Summary

Considering the current and future dynamics of the agricultural sector, Ecuador's national agricultural policy is in a process of adjustment in order to structurally strengthen the sector. One of the policies being analyse is the technological kit given under the framework of the subsidies program Plan Semillas. Reforming the agricultural subsidies policy into a decoupled farm program will have tremendous impacts on production decisions and farmers' income. This paper identifies three main possible scenarios for Ecuador to reform its support policy and analyses the impact for each scenario on rice crops' productivity and farmer's well-being. We use an ex-ante analysis in the form of a static microsimulation approach and farm-level data from an agricultural household survey of rice growers. The results show that the use of certified seed and technical agrochemicals increase the yield of rice crops up to 4.8ton/ha and the average additional income for farmers is USD19.26.

Keywords

Microsimulation, subsidies, rice productivity, farmer's well-being, agricultural policy.

1 Introduction

The framework of Ecuador's national agricultural policy entered a process of revision and reforms with the last changes of government. Moreover, in 2012, the Ministry of Agriculture and Livestock (MAGAP by its initials in Spanish) started an analysis of its policies in order to progressively adjust them to the current dynamics of the agricultural sector, both at the regional and international level. One of the main conclusions is the importance of strengthening the presence of small and medium producers along the productive chains, so that productivity levels and well-being of farmers increase (MAGAP, 2016).

The international context and trends demand the introduction of important changes in agricultural policies in order to face current and future challenges. On one hand, these reforms should aim to improve productivity and competitiveness of commodities to not only fulfil the increasing demand of food, but also to make food systems more efficient, sustainable, inclusive and resilient. On the other hand, these policies should also support small-scale agriculture and family farming so that rural poverty and inequality can be reduced, and income-earning opportunities in rural areas improve (FAO, 2017; MAGAP, 2016).

The traditional way of facing these challenges is by designing and implementing subsidies and support policies. The Organization for Economic Co-operation and Development (OECD), in its annual Agricultural Policy Monitoring and Evaluation report of 2019, identifies two trends of support policies within the framework of each country's national agricultural policy. In some countries this support has become more decoupled from production and has been replaced by a support that targets environmental outcomes, while in others, especially in developed countries and emerging economies (e.g. Argentina, Colombia, Costa Rica, Philippines, South Africa and Vietnam), the support is still high and remains linked to production by policy interventions that distort production decisions (OECD, 2019).

The agricultural sector in Ecuador contributes, in average, with 10% of the country's GDP and employs more than two thirds of the rural labour force. However, some of the challenges the sector faces include accentuated rural poverty, low agricultural productivity, low diversification of the export basket and vulnerability to climate change (EGAS YEROVI ET AL., 2018; MAGAP, 2016). There are two mechanisms by which the government of Ecuador supports the sector: protection of market prices and public spending. The former includes focalized policy instruments, such as Minimum Support Prices for rice and maize, and tariff and non-tariff barriers for imported products, while the latter consists of direct subsidies and investment in public goods. For the specific case of direct subsidies, about 46% of public spending was mainly allocated to input subsidies between 2014 and 2016 (EGAS YEROVI, 2019).

One of the strategies implemented by the government of Ecuador to strengthen the agri-food chains of rice and maize, specifically, is the input subsidies program *Proyecto Nacional de Semillas para Agrocadenas Estratégicas (Plan Semillas)*. The main objective of this program is to achieve higher levels of productivity by providing subsidized technological packages to small-scale farmers, which contain certified seed, fertilizers and agricultural inputs. The productivity, according to the conception of the program, is guaranteed by the availability of high yield seed. Another objective is to promote the good use of certified seed at affordable prices in order to improve the income of producers, promote environmental sustainability and reduce production costs (all this while seeking to achieve optimum yields) (MAG, 2017).

The purpose of this study is to provide a quantitative assessment on the implications of reforming Ecuador's agricultural subsidies policy on productivity, specifically for the case of rice, and to evaluate likely consequences of possible future developments. The findings from these analyses will not only provide useful insights and key points into designing the new reforms to the agricultural subsidies policy of the government of Ecuador, but also new evidence regarding the effectiveness of decoupled direct payments programs in LAC.

The quantitative exercises are conducted within a microsimulation modelling framework that allows us to do an ex-ante analysis of the effects of changes in the actual Ecuador's subsidies program *Plan Semillas*. Three main alternative scenarios are specified and analysed under this framework using data from an agricultural household survey of rice growers.

The paper proceeds as follows. Section 2 provides background of the national agricultural policy in Ecuador, explains in detail the current subsidies program *Plan Semillas*. Section 3 presents the methodology, namely the model structure, its application to the particular purpose of the paper, and specifies the proposed scenarios for the microsimulation modelling. Section 4 describe the database and presents descriptive statistics. Section 5 reports the results obtained from simulating the different policy scenarios and discuss policy implications of estimated impacts.

2 Agricultural Policy in Ecuador

In this section, we describe briefly the current agricultural policy in Ecuador and the program of subsidies that has been implemented. Furthermore, we describe the possible scenarios that Ecuador could adopt in order to reform the agricultural subsidies. These scenarios are also going to be the ones that are analysed in our microsimulation model.

2.1 National Agricultural Policy

Since 2012, the MAGAP started a process of progressively adjust the national agricultural policies to the international dynamics of the sector and demands of global agri-food markets. However, it was not until 2016 that the government of Ecuador and the MAGAP consolidate this process in the document "La Política Agropecuaria Ecuatoriana. Hacia el desarrollo territorial rural sostenible 2015 – 2025". In general terms, the proposals made in this document aim to strengthen the main productive chains, develop more sustainable agroecosystems and provide more technical support to small and medium-scale producers. The main idea behind these new approaches, among many other reasons, is to change the agricultural policy from a traditional excluding agricultural model, towards another more inclusive and innovative, so that farmers achieve a decent standard of living (MAGAP, 2016).

The proposed new scheme focuses on four strategic objectives: (i) improve the contribution of agriculture to guarantee food security and sovereignty of the Ecuadorian population (now and in the future); (ii) enhance the contribution of agriculture to rural development and national economic growth with social inclusion; (iii) contribute to reduce poverty and socioeconomic inequality in rural areas, particularly, improve the social inclusion of small and medium-scale farmers; and (iv) support the change of the national productive matrix, regarding specifically the substitution of primary and agro-industrial imports, diversification of the exportable supply, and generation of the primary base for agro-industrial development (MAGAP, 2016).

The government of Ecuador has prioritized certain areas and focuses of policies in order to develop an agricultural production system that offers producers a variety of socioeconomic and environmental benefits, specifically those related to productivity and cost effectiveness. Direct support programs are one of the strategies implemented by the government to reduce production costs for farmers, improve competitiveness, rise productivity and increase domestic food supply. These programs include subsidies to farmers, delivery of subsidized inputs such as fertilizers or certified seeds, technical assistance, access to agricultural insurance, and endowment of machinery, equipment and infrastructure for certain stages of the productive cycle.

2.2 Proyecto Nacional de Semillas para Agrocadenas Estratégicas (Plan Semillas)

The main support program for the provision of subsidized inputs is *Plan Semillas*, whose implementation began in 2013. The purpose of this program is to increase productivity of small and medium-scale producers using certified seed, the application of integral agronomic solutions (fertilization, phytosanitary control, crop management), and technical assistance. All these components are part of a technological package or "kit" given by the Ministry of Agriculture and to which any farmer can access. The key point of *Plan Semillas* is to increase access to quality inputs (and thus enhance crops' yield), by subsidizing part of the total value of these technological packages per hectare.[1]

This subsidy only applies for corn, rice, potato, cotton, bean, red onion, soy and broccoli, and its value depends on the type of crop. Between 2013 and 2015, for example, the average value of the subsidy per kit was USD 214 for corn, USD 224 for cotton, USD 662 for potato and USD 256 for rice (MAG, 2017). The project is executed only during summer or the rainy seasons, commonly known as intervention cycles. Usually, the summer in Ecuador is from May to November, and the rainy season from December to April (see Table 1). For each cycle it is verified that the producers meet certain requirements in order to be a beneficiary of the program and receive the subsidy, for example not having more than 10 declared hectares for sowing.

Table 1: Intervention cycles

Year	Season	Dates	
2013	Winter (rainy season)	02-Dec-12	21-May-13
	Summer	22-May-13	10-Nov-13
2014	Winter (rainy season)	11-Nov-13	13-May-14
	Summer	14-May-14	11-Nov-14

[1] In this sense, all kits have the benefit of the subsidy. Thus, the kits go hand in hand with the subsidy: there is no kit without subsidy nor the opposite case, a subsidy without a kit. This is framed under the *Proyecto Nacional de Semillas* program

2015	Winter (rainy season)	12-Nov-14	17-May-15
	Summer	18-May-15	17-Nov-15

Source: Ministerio de Agricultura y Pesca, 2017

Although the general objective of the program is to give small farmers the opportunity to access a high-performance technology package through a partial subsidy, it also becomes an instrument to achieve other public policy objectives. At a micro level, the policies aim to strengthen the agri-food chains of maize and rice specifically, increase the income of small-scale farmers, and encourage the permanent use of certified seed and better quality inputs among the producers to achieve higher yields and have lower environmental impact. At a macro level, on the contrary, these policies focus more on strengthen the development of the sector, promote more competitive exports and reduce imports of products.

3. Methodology

Microsimulation is an *ex-ante* tool that helps policymakers in the design of new policies and assessing the repercussions of proposed reforms to actual ones on different social welfare aspects, such as distribution of income, levels of inequality and poverty. Furthermore, it can be used by governments and different stakeholders to show how alternatives approaches of a specific policy (or group of policies) could result in better outcomes for a targeted population. This tool also helps policymakers from a practical perspective, since with microsimulation modelling it is possible to measure the approximate budgetary cost of a new policy or reform given its objectives and allows to evaluate the viability of its implementation (ABSALÓN and URZÚA, 2012; FIGARI, PAULUS and SUTHERLAND, 2015).

Given the importance of aligning the national agricultural policy of Ecuador with the international context, the use microsimulation modelling allows us to evaluate and analyse the implications of different scenarios of reforming the agricultural subsidies policy on the yield of rice crops. This analysis includes three main scenarios: with kit, without kit and only certified seeds.

Our static model is at household-level and it considers a Cobb-Douglas production function as the basis for decomposing inputs of rice production (see equation 1). Additionally, we use a log transformation convenient for econometric estimations (see equations 2 and 3), which allows us to define our econometric model (equation 4).

The Cobb-Douglas production function form is as follows:

(1) $Y = AK^{\alpha}L^{\beta}$

where Y denotes total output; K and L are total capital and labour inputs, respectively; A denotes Total Factor Productivity (TFP)2; and α and β represent the elasticity of capital and labour, respectively.

Applying the log transformation to (1):

(2) $\ln(Y) = \ln\left(AK^{\alpha}L^{\beta}\right) = \ln A + \alpha \ln K + \beta \ln L$

Then in the econometric form, (2) becomes:

(3) $\ln Y_i = \beta_0 + \beta_1 \ln K_i + \beta_2 \ln L_i + \varepsilon_i$

[2] Total Factor Productivity "is the part of output not explained by the amount of inputs used in production. As such, its level is determined by how efficiently and intensely the inputs are utilized in production" (COMIN, 2008)

Having in mind that (3) is the base formula of econometric modelling for applying microsimulation methods, our model is specified as below:

$$(4)\ \ln yield_i = \beta_0 + \delta_1 Benef_i + \beta_j' X_{TechPack}' + \beta_j' X_{AgTech}' + \beta_j' X_{Land}' + \beta_j' FS_i + \beta_j' X_{Poverty}' + \beta_j' X_{Constraints}' + \beta_j' X_{HeadHH}' + \alpha_i + \varepsilon_i$$

in which $yield$ is tons of rice produced per hectare sown (a proxy of productivity) and it is our dependent variable; $Benef$ is a dummy that indicates if the household is beneficiary of the subsidy program; $X_{TechPack}'$ is a set of variables regarding the inputs given in the technological package[3]; X_{AgTech}' is a vector of variables related to the technology used in the production process[4]; X_{Land}' is a vector that represents a set of variables related to the type of land (owned or rented), farm size and type of rice producer (small, medium or large); FS is a dummy that indicates if the household is food secured or not[5]; $X_{Poverty}'$ is a vector of variables that indicates if the household is deprived or not of roof material and sanitation[6]; $X_{Constraints}'$ is a set of dummies regarding the perception that producers have on variables that influence the production of rice[7]; X_{HeadHH}' is a vector that represents variables that characterizes the head of the household[8]; α_i and ε_i denote the unobserved province effect and the error term, respectively.

In the specific case of rice production and its determinants, the literature is divided into two principal lines of analysis: one regarding the adoption of improved rice varieties (also known as new technologies) and the other focused on crop productivity. The general framework for the development and choice of our model is based on the latter, mainly because the most used production function in these types of analysis is a Cobb Douglas (KEA, LI and PICH, 2016; NAKANO ET AL., 2011; SHAIKH ET AL., 2016).

The scenarios proposed for our analysis are describe in Table 2. As seen, there are three main scenarios (plus the base line): with technological package, only certified seed and without the kit. The idea behind these proposed scenarios is to analyse the implications of reforming the subsidy program and making some changes in the structure and components of the kit (certified seed, fertilizers and pesticides). Hence, the first scenario is divided into four different combinations: (i) a technological package with all the initial components defined in the guidelines of *Plan Semillas* by the Ministry of Agriculture, (ii) another one with certified seed and fertilizers but no pesticides, (iii) one option with certified seed and pesticides but no fertilizers, and (iv) a last one with both agrochemicals but no high quality seed. The second and third proposed scenarios are, respectively, a kit consisting only of certified seed and without any technological support (no kit).

Table 2: Description of scenarios

Scenario	Description
0	Base
1	With technological package
1.1	Certified seed and fertilizer
1.2	Certified seed and pesticides
1.3	Fertilizer and pesticides

[3] Specifically type of seed, use of fertilizer (dummy) and use of pesticides (dummy)
[4] Irrigation system (dummy), technical assistance (dummy) and harvest method (manual or machinery)
[5] In the survey, the questions asked to each household regarding food security is "*During the last year, was there a month in which the food did not reach to meet the needs of the home?*"
[6] These variables are constructed based on the Multidimensional Poverty Index standards
[7] The dummy equals to 1 if they feel it is a limitation, 0 otherwise. There are 12 different categories: shortage of quality seed, low seed quality, fertilizer shortage, high price of fertilizers, difficult access to credit, droughts, floods, plagues, diseases, soil infertility, soil erosion and low brightness
[8] Mainly focusing on years of experience as a rice producer (quadratic form included) and years of education

2	Only certified seed
3	Without technological package

Note: the beneficiaries of the program have access to a technological package that includes certified seed, fertilizers and pesticides (instead of a traditional package that contains recycled seed and some complementary inputs)

4. Data

The main data used in the analysis are derived from an agricultural household survey data of rice growers collected in Ecuador by the International Centre for Tropical Agriculture (CIAT) and the National Agricultural Research Institute of Ecuador (INIAP).

The survey was collected in the coastal region of Ecuador between November 2014 and April 2015. It provides information at household and plot level for the provinces of Guayas, Los Ríos, Manabí and El Oro, which are the main rice production areas of Ecuador (representing near 97% of total rice production in the country). The dataset consists of information of 1,021 rice growers and provide information about household socio-demographic characteristics, farm features, rice management practices and production, other crops farmed and socio-economic context variables (ORREGO-VARÓN ET AL., 2016).

The main variables used from this dataset are summarized in tables A1 and A2 (see Appendix A). Table A1 shows that in total there are 1557 parcels containing 1730 plots, of which 1454 are rice crop plots and that an average household of rice growers in Ecuador has 1.5 arable plots, which represent 5.8 hectares, of which 4.8 hectares are sown with rice. Also, it shows that the production yield of rice by household is, on average, 4.55 ton/ha (see Figure A5 for more detail about the data's distribution). Regarding production characteristics, specifically for rice crops, more than 95% of households use fertilizers and perform both pests and weeds controls with agrochemicals, 80% has an irrigation system and nearly 42% receive technical assistance from the government. In terms of food security and poverty, 70% of the households are food secured, 4% are deprived of roof material and 54% are deprived of sanitation. Lastly, the average years of experience as a rice producer in the coastal region is 27 years.

Table A2 describes other main variables that are only available at rice plot level, like type of seed used, harvest method and type of land. On one side, 46% of the rice crop plots were sown with certified seed and the harvest method was mainly mechanized (98%). On the other side, almost 70% of the rice plots are owned (and no rented) by the household. Also, it shows that the average years of education of the person in charge of production in each plot is 6 years, which in terms of highest level of education reached by an individual is primary.

In order to define categories of producers according to their size, households were divided into quintiles, according to the extent of land destined for rice planting. The households were distributed into three categories: small producers (between 0.176 and 2.117 hectares); medium producers (between 2.25 and 7 hectares); and, large producers (more than 7 hectares). Based on this classification, Table A3 (Appendix A) shows that most rice producers can be considered small and medium, where 81% do not exceed a sown area of 7 hectares.

Regarding the subsidy program, tables B1 – B3 (see Appendix B) summarize the main variables related to the technological package and its use by the benefited households. One key aspect of the program is that the cost of each kit varies according to the inputs it contains; yet, and according to ORREGO-VARÓN ET AL. (2016), the average value of a kit of inputs in 2014 was around USD300. From the data, it is possible to observe that the average cost of the kit for benefited households was USD136 (see Table A1). It is also important to state that participation or non-participation in the program would depend on several factors, including the interest of producers in participating. Tables B1 and B3 shows, for example, that approximately 7% of the beneficiaries did not use the kit – 33 out of 450 households.

About 44% of the households surveyed were beneficiaries of the subsidy program and received the technological package during the winter intervention cycle of 2015. However, the distribution of participation in this program varied among the different provinces. Table B2 shows that in El Oro and Manabí (which are the provinces with the lowest level of rice production within Ecuador), the percentage of beneficiaries was the highest: 67% and 83%, respectively; while in Guayas and Los Ríos (the first and second more important regions for rice production, respectively), the percentage of participants slightly exceeded 50% of the provinces' sample.

In terms of the type of seed used by households for rice crops, Figure B4 shows that nearly 54% of rice plots were sown with recycled seed. Finally, the perception of the beneficiaries regarding the effectiveness of the kit is mostly negative: more than 70% of the households perceive the technological packages as bad or very bad, while 25% think that is regular and less than 5% say is good or very good (Figure B5).

5. Results and Discussion

The microsimulation estimates are summarized in Table 3. These results show that if all the households benefit of the program and incorporate the inputs of the technological package into their rice crops, the average yield would increase up to 4.76 ton/ha. Comparing this value with the baseline (4.56 ton/ha), the difference is almost 0.2 ton/ha more of rice. On the contrary, a kit that only includes certified seed as an input (without technical agrochemicals to support the production of rice) relates to an average yield of 3.83 ton/ha; and the results are even lower when there is no use of any of the technological inputs: the average yield for rice crops is nearly 3.58 ton/ha.

Table 3. Microsimulation results

Scenario	Mean (of yield)	Standard deviation
0 - Base	4.563	2.218
1 - With technological package	4.757	2.270
1.1 – Certified seed + Fertilizer	4.320	2.099
1.2 – Certified seed + Pesticides	4.194	2.058
1.3 - Fertilizers + Pesticides	4.418	2.133
2 - Only certified seed	3.828	1.966
3 - Without	3.581	1.929

Another relevant and important result is the increase in the income of the benefited households as a result of the variation in productivity (compared to the increase in income of the not benefited households). Table 4 shows that the average additional income for those households that were beneficiaries of the program, during the winter campaign of 2015, is USD 19.26, while for the no beneficiaries is USD13.13. This difference of approximately USD 6 shows that the technological kit not only has a positive impact on crop yield (0.25 ton/ha), but also results in an additional income for the rice producers.

Table 4. Additional income per household

	Beneficiaries	No beneficiaries
Productivity (ton/ha)	4.69	4.44
Difference in productivity	0.25	0
Production (ton)	22.46	19.43
Producer Price (USD/ton) *	385.9	385.9

Value of production (USD)	8667.02	7499.716
Number of households	450	571
Additional income (USD/HH)	19.26	13.13

*We assume the producer price is the same for both, beneficiaries and no beneficiaries, since there are no economic reasons for a price discrimination by type of producer. Source: FAOSTAT.

Overall, we can conclude that the subsidy program *Plan Semillas* is well oriented and meets its objectives of increasing productivity. However, best results are achieved in the scenario of using a technological package than the scenario without it: the difference is almost of 1 ton/ha, on average. In terms of reducing the package to only certified seed, we can conclude that is not enough and that it must be accompanied and supplemented with technical agrochemicals. Results on additional income are significant and important for farmers (specially for their well-being and the future of agriculture in the region). The additional income shows that rice cultivation (in this specific case) can be a good alternative to incentive farmers to remain in the agricultural sector (as it can be seen as a profitable activity), as long as there is a technical handling and certified seed is used. Moreover, these results could motivate younger generations to be more involved in farming activities and adopt and applied technical strategies to improve their crop production and productivity

Literature

ABSALÓN, C. and URZÚA, C.M. (2012). Modelos de microsimulación para el análisis de las políticas públicas. Gestion y Politica Publica 21(1): 87–106.

COMIN, D. (2008). Total Factor Productivity. In S.N. Durlauf & L.E. Blume (eds). The New Palgrave Dictionary of Economics. London, Palgrave Macmillan, 6685–6687.

EGAS YEROVI, J.J. (2019). Monitoring agricultural policies for policy design: the case of Ecuador. In: IDB Blog [online]. [Cited 23 July 2019]. https://blogs.iadb.org/sostenibilidad/en/monitoring-agricultural-policies-for-policy-design-the-case-of-ecuador/

EGAS YEROVI, J.J., SHIK, O., INURRITEGUI, M. and DE SALVO, C.P. (2018). Análisis de Políticas Agropecuarias en Ecuador. Informes de política agropecuaria. Quito.

FAO. (2017). The future of food and agriculture: trends and challenges. The future of food and agriculture: trends and challenges.

FIGARI, F., PAULUS, A. and SUTHERLAND, H. (2015). Microsimulation and Policy Analysis. Handbook of Income Distribution. ISER Working Paper 2014(23): 2141–2221.

KEA, S., LI, H. and PICH, L. (2016). Technical Efficiency and Its Determinants of Rice Production in Cambodia. Economies, 4(4): 22.

MAG. (2017). Proyecto Nacional de Semillas para Agrocadenas Estratégicas (PNSAE). Quito.

MAGAP. (2016). El sector agropecuario ecuatoriano: análisis histórico y prospectiva a 2025. Quito.

NAKANO, Y., IBRAHIM, B., ALIOU, D., KEIJIRO, O. and KEI, K. (2011). The Possibility of a Rice Green Revolution in Large-scale Irrigation Schemes in Sub-Saharan Africa. Policy Research Working Paper 5560. The World Bank.

OECD. (2019). Agricultural Policy Monitoring and Evaluation 2019. Paris.

ORREGO-VARÓN, M., MARÍN, D., GARCÍA, M., YÁÑEZ, F., MENDOZA, L., TWYMAN, J. and LABARTA, R. (2016). Estudio de adopción de variedades modernas y prácticas agronómicas mejoradas de Arroz en Ecuador. Reporte de Investigación. CIAT-INIAP.

SHAIKH, S.A., HONGBING, O., KHAN, K. and AHMED, M. (2016). Determinants of Rice Productivity: An Analysis of Jaffarabad District–Balochistan (Pakistan). European Scientific Journal 12(13): 41.

A Data and descriptive statistics

Table A1. Description of variables at household level

Variables	Description	N	Mean	SD	Min	Max
Dependent variable						
Yield	Production yield of rice (ton/ha)	1017	4.55	2.09	0.12	16.71
Independent variables						
Subsidy program						
Beneficiary	1 if household is beneficiary of the subsidy program, 0 otherwise	1021	0.441	0.497	0	1
Kit use	1 if household uses kit, 0 otherwise	1021	0.409	0.492	0	1
Average cost	Average cost of the kit	404	136.73	88.802	40	812.88
Farm characteristics						
Farm size	Total hectares	1021	6.518	11.568	0.176	180
Arable plot	Number of arable plots	1021	1.525	0.824	1	7
Arable area	Total arable hectares	1021	5.869	9.157	0.176	135
Rice crops						
Rice crop plots	Number of rice crop plots	1021	1.424	0.734	1	6
Sown area	Total sown hectares of rice	1021	4.819	7.763	0.176	135
Harvested area	Total harvested hectares of rice	1021	4.734	7.735	0	134.5
Production characteristics (specifically for rice crops)						
Irrigation system	1 if HH has an irrigation system, 0 otherwise	1021	0.854	0.353	0	1
Technical assistance	1 if HH receives technical assistance, 0 otherwise	1021	0.424	0.494	0	1
Fertilization	1 if HH uses fertilizer, 0 otherwise	1021	0.993	0.083	0	1
Pest control	1 if HH performs pest control, 0 otherwise	1021	0.975	0.158	0	1
Weeds control	1 if HH performs weeds control, 0 otherwise	1021	0.982	0.132	0	1
Food security and poverty						
Food security	1 if HH is food secured, 0 otherwise	1016	0.649	0.478	0	1
Roof material	1 if HH is deprived, 0 otherwise	1017	0.038	0.192	0	1
Sanitation	1 if HH is deprived, 0 otherwise	1018	0.539	0.499	0	1
Head of HH						
Years of experience	Years of experience as a rice producer	1008	26.928	15.237	1	73
Total						
Kits	Number of kits		2101			
Parcels	Number of parcels		1557			
Plot	Number of plots		1730			
Rice plots	Number of rice plots		1454			

Note: HH = household

Table A2. Description of variables at rice plot level

Variables	Description	N	Mean	SD	Min	Max
Dependent variable						
Yield	Production yield of rice (ton/ha)	1425	4.626	2.234	0.092	16.982
Independent variables						
Production characteristics and human capital (specifically for rice crops)						
Seed	1 if uses certified seed, 0 if recycled	1380	0.461	0.499	0	1
Harvest method	1 if mechanized, 0 if manual	1089	0.979	0.144	0	1
Years of education	Years of education of person in charge of production	1367	6.233	3.850	0	20
Rice crops						
Sown area	Planted hectares of rice	1425	3.148	3.245	0.071	21.168
Harvested area	Harvested hectares of rice	1425	3.104	3.230	0.071	21.168
Production	Tons of rice produced	1425	13.535	16.199	0.191	147
Land						
Type of land	1 if owned, 0 if rented	1380	0.667	0.471	0	1

Table A3. Number of households and sown hectares by type of rice producer

Type of rice producer	Sown hectares of rice			Number of households (%)
	Mean	Min	Max	
Small	1.34	0.176	2.117	437 (42.8%)
Medium	4.14	2.25	7	389 (38.1%)
Large	13.97	7.056	135	195 (19.1%)

B Subsidy program

Table B1. Beneficiaries of subsidy program and use of kit

Use of kit	Beneficiary		Total
	No	Yes	
No	570	33	603 [59%]
Yes	1	417	418 [41%]
Total households	571 [56%]	450 [44%]	1021

Table B2. Households that received the technological package in the last campaign (2014) by province

Beneficiary	El Oro	Guayas	Los Ríos	Manabí	Total
Yes	16 [66.7%]	281 [38.6%]	113 [51.1%]	40 [83.3%]	450
No	8 [33.3%]	447 [61.4%]	108 [48.9%]	8 [16.7%]	571
Total households	24	728	221	48	1021

Table B3. Benefited households that used the kit in the last campaign (2014) by province

Use of kit	El Oro	Guayas	Los Ríos	Manabí	Total
Yes	15 [93.7%]	258 [91.8%]	105 [92.9%]	39 [97.5%]	417
No	1 [6.3%]	23 [8.2%]	8 [7.1%]	1 [2.5%]	33
Total benefited households	16	281	113	40	450

Figure B4: Type of seed used

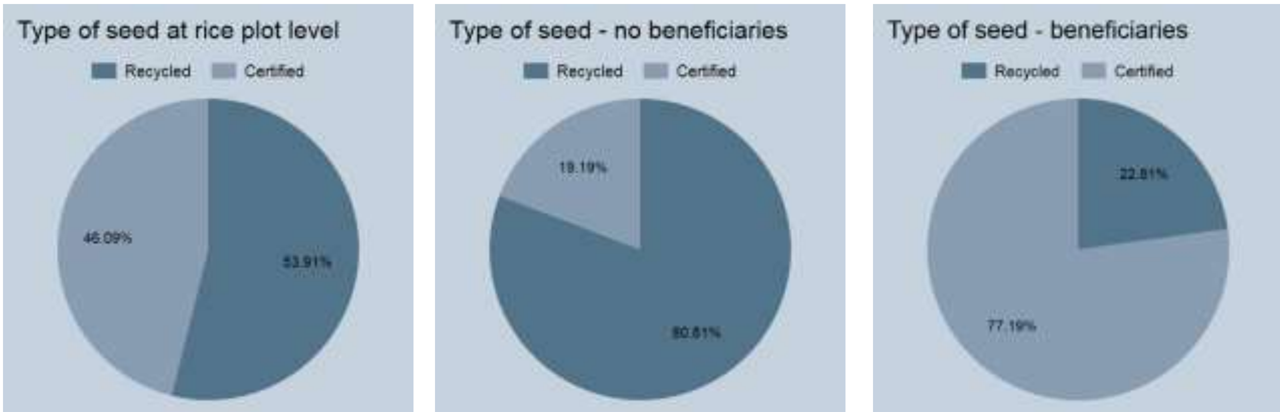
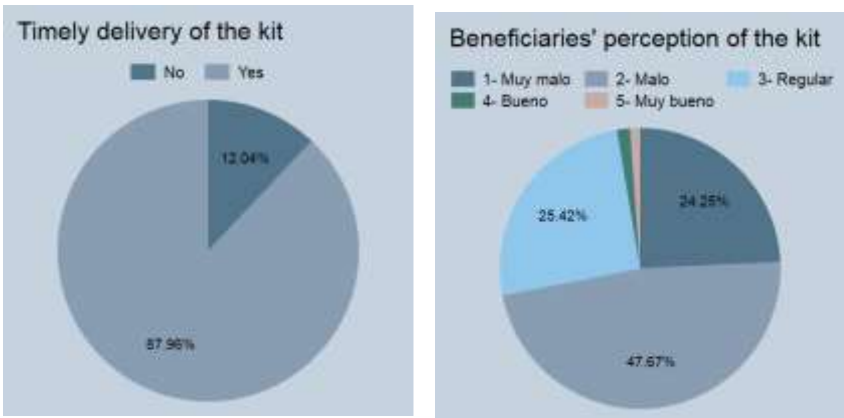


Figure B5: Effectiveness of the technological package



Note: some of the reasons why the beneficiaries have these perceptions of the kit include improve production, increase access to certified seed and inputs, kit unavailability in a timely manner, the kit did not have what I needed, cheap, incomplete, seed