Impact assessment case study of phytosanitary measures for the risk mitigation system against the spread of fruit fly in Argentina

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CONTENT

ACRONYMS

ABP	Low Prevalence Area
ALMF	Fruit Fly Free Area
BAS	Health Barriers
COSAVE	Southern Cone Plant Protection Committee (COSAVE by its acronym in Spanish)
DGSA	Dirección General de Servicios Agrícolas from Uruguay
IDR	Instituto de Desarrollo Rural de Mendoza
IICA	Inter-American Institute for Cooperation on Agriculture
INDEC	Instituto Nacional de Estadística y Censos de Argentina
IPPC	International Plant Protection Convention
ISCAMEN	Instituto de Sanidad y Calidad Agropecuaria Mendoza
MAPA	Ministério da Agricultura, Pecuária e Abastecimento from Brasil
MEIS	Socioeconomic Impact Assessment Methodology (MEIS by its acronym in Spanish)
NPPO	National Organization for Phytosanitary Protection
SAG	Servicio Agrícola y Ganadero from Chile
SDF	Secretaria de Defensa Agropecuaria from Brasil
SENASA	Servicio Nacional de Sanidad y Calidad Agroalimentaria from Argentina
SENASA	Servicio Nacional de Sanidad Agraria from Perú
SENASAG	Servicio Nacional de Sanidad Agropecuaria e Inocuidad Alimentaria from Bolivia
SENAVE	Servicio Nacional de Calidad, Sanidad Vegetal y de Semillas from Paraguay
SMR	Risk Mitigation System
STDF	Standards and Trade Development Facility
TIE	Sterile Insect Technique

LIST OF TABLES AND GRAPHS

I. INTRODUCTION

This case study presents the results of impact assessment of phytosanitary measures of the risk mitigation system as a preventive measure against the propagation of the fruit fly in Argentina. This follows the Socioeconomic Impact Assessment Methodology developed in the framework of Project STDF / PG / 502 "COSAVE: regional strengthening of the implementation of phytosanitary measures and access to markets"

Fruit flies are considered one of the most economically important pests in the production of fruits and fruits in Argentina and in the world. Fruit flies, within the group Diptera, belong to the Tephritidae family, and among the 481 different types belonging to this family, only five are economically important. They are: *Anastrepha, Ceratitis, Bactrocera, Rhagoletis* and *Toxotrypana*. In Argentina the most important species present are *Ceratitis capitata* (Mediterranean Fly) and Anastrepha fraterculus (South American Fly) (Silva & Batista, 2018).

Fruit flies have a broad geographical distribution with greater predominance in the Neotropical region.

The annual losses caused by the pest are high, reaching about 5 billion dollars worldwide. The damages can be considered direct, since the larvae feed from the pulp causing the rotting and the fall of the fruits. For commercialization, the damages are caused by the fall in productivity and the depreciation of quality, making fruits unsuitable for both *in natura* consumption and for industrialization (juices, jams, jams, jams). Other damages caused by the presence of the pest include the restriction of imports by the imposition of phytosanitary requirements, since fruit flies are pests of quarantine importance in many regions of the world (Silva & Batista, 2018).

The male releases pheromones that attract females for intercourse. A female fruit fly can ovulate 500 to 1000 eggs and this ovulation is influenced by the temperature, luminosity and characteristics of the fruit, such as shape, size and bark properties, but it ovulates preferably in mature fruits or in growing fruits. Although females deposit pheromone in the fruits after ovulation, other females may also ovulate in the same fruit.

The use of traps allows monitoring of the presence, location and population level of the flies in the orchard, thus allowing a more effective decision making process. Different types of traps, such as the Jackson and Mc Phail types, which contain different attractants, are used to attract and capture the adult form of fruit flies. Control is usually done by applying chemicals to the elimination of adults. Cultural control measures are also used, such as the collection and buring of fallen fruits in the soil, bagging of fruits, and elimination of host plants neighboring the orchard. Biological control through the sterile insect technique (TIE) has also been used to aid in control and as an alternative to chemical control.

As the fruit fly in its various species is regulated as a quarantine pest in several countries and in order to meet the phytosanitary requirements of these importing countries, one of the alternatives is the application of measures under a Mitigation System Risk (SMR). By defining the International Plant Protection Convention, risk

mitigation systems, which incorporate measures for pest risk management as specific norms, it can provide an alternative to individual measures to achieve the appropriate level of plant protection in an importing country. They can also be developed to provide phytosanitary protection in situations where no single measure is available. A risk mitigation system requires the integration of different measures, at least two of which act independently, with a cumulative effect.

International Standard for Phytosanitary Measures (ISPM) No. 35 "Systems approach for pest risk management of fruit flies (Tephritidae)" (IPPC, 2012) provides guidelines for the development, implementation and verification of integrated measures in a systems approach such as an option for risk management of economically important fruit fly (Tephritidae) pests. In order to avoid a ban, which is considered the strictest phytosanitary measure, and to facilitate the movement and importation of fruit products, in this case mainly fruits and fruits, to the endangered areas, the application of a Risk Mitigation System has been used as an alternative where the National Plant Protection Organizations (NPPOs) recognize SMR as equivalent to a single measure.

Argentina offers a great diversity of fruits throughout the year. It occupies the first place in the world in exports of lemon and pear and it has been prioritizing supplier of berries, cherry and grapes. It is one of the sectors that employs more permanent labor in agriculture, with a strong increase of job position during harvest times. The presence of the fruit fly in the country represents a loss for fruit growers and restrictions on exports. Thus, the implementation of a Risk Mitigation System for Fruit Fly is a key support tool for the control of the pest and for the competitiveness of the Argentine fruit sector in the world market.

II. METHODOLOGY

The methodology used for this case study was the MEIS (Socioeconomic Impact Assessment Methodology, MEIS by its acronym in Spanish) and followed its implementation guide.

Based on scientific principles, MEIS is an impact assessment methodology, created by JS/Brazil ((company responsible for the coordination of this case study) and adapted to the needs of the COSAVE project. The MEIS provides a wide and innovative assessment of social programs and policies, analyzing three aspects of measures performance: cost-efficacy, cost-benefit, and equity.

The methodology incorporates different internationally recognized valuation techniques, and incorporates different elements of economic valuation methods from development banks, such as the World Bank. The measurement of impacts on social indexes is also incorporated and based on several Equity Analysis metrics (for example, Hoover index).

Therefore, this case study used all the phases established in the guide for the implementation of the socioeconomic impact assessment methodology: definition of the logical framework for assessment; elaboration of form for data collection; collection of endogenous and exogenous data; and cost-efficacy, cost-benefit analysis and social equity.

As it is described later, the case study also included the active participation of representatives of the Ministries of Agriculture of all members of COSAVE. This participation was promoted during the definition of the logical framework matrix and indicators, data collection and recommendations on other factors to be incorporated into the various formulas applied in each of the impact assessment analyzes.

III. RESULTS

The results of the application of the Socioeconomic Impact Assessment Methodology are subdivided according to their respective stages.

STAGE 1: ELABORATION OF THE LOGICAL FRAMEWORK

For the definition of the logical assessment framework, a workshop was held with representatives of all COSAVE members. Following the MEIS implementation guide, the workshop focused on the consensus building of the overall objective, specific objectives, goals and indicators for impact assessment.

Initially, participants were invited to bring inputs on their perspectives in relation to the overall objective of measuring the impact of SMR for fruit flies. Several suggestions were made and a first list of possible narratives were elaborated, as shown below (Table 1):

Table 1. Individual narrative suggestion for the general objective of participants in the logical framework workshop

General objective (SMR - fruit fly)
Access markets with phytosanitary restrictions competitively with products from fruit fly low prevalence areas (ABP).
1. Viabilize / access marketing of products to competitive restrictive markets from the ABP to markets located in areas fresh fly free (ALMF).
2. Accessing restrictive markets (ALMF) competitively with products from ABP.
3. Marketing competitive products from the ABP to markets located in ALMF both nationals as international, existing or potential.
4. Maintain the marketing of competitive products from the ABP to markets located in the ALMF.
5. Obtain differentiated quality and health products that allow access to restrictive markets.
6. Generate higher profitability for products with a destination in natura industry and consumption.
7. Provide an equivalent and alternative measure to quarantineary treatments favoring the traceability of production.
8. Decrease the likelihood of plague dispersion.
9. Improve the health and quality of the products.

Based on these suggestions, participants were then asked to have the suggestions consolidated into a single overall impact objective. During the discussions, arguments were made about the importance of establishing a general goal that was

not only within the control of the measure, but which established broader impact aspects, such as the economic and social dimensions.

In this sense, aspects that were limited to issues of implementation of the measure, (such as "offering an equivalent and alternative measure to quarantennial treatments favoring traceability of production") were used during a more specific discussion within the scope of the specific objectives. Thus, after several group discussions, the overall objective of the impact assessment was established as: Access markets with phytosanitary restrictions in a competitive way, with products from areas of low prevalence of fruit flies**.**

With the definition of the general impact objective, specific targets were assigned for their better quantification. Five specific targets were established:

1_ Maintain access to fruit fly free area markets

2_ Increase the volumes sold by SMR low prevalence areas

3_ Generate greater profitability of fruit production under SMR

4_ Maintain the lifeshelf of the merchandised product

5_ Increase the number of fruit species from pulp, that are allowed to access free fruit fly areas

These goals were then used not only to define quantitative aspects to be assessed based on the overall objective, but it also contributed to the definition of quantifiable indicators.

The Table 2 shows the list of indicators defined in consensus for the impact assessment of the measures.

Table 2. **Consolidation of the narrative of the general objective of impact, its goals and indicators**

GENERAL OBJECTIVE (SMR)	TARGETS	INDICATORS	FORMULA
ACCESS MARKETS WITH PHYTOSANITARY RESTRICTIONS COMPETITIVELY WITH FRUIT FLY ABP PRODUCTS.	1) MAINTAIN ACCESS TO MARKETS IN ALMF	RATE OF ALMF INHABITANTS ACCESSING ABP PRODUCTS	N ° of inhabitants of ALMF that have access with SMR / Total number of inhabitants of the country
	2) INCREASE THE VOLUMES MARKETED UNDER SMB OF FRESH FLY ABP	RATE OF SMR PRODUCTS THAT PRODUCE IN ABP	Kg of host products commercialized under SMR / kg of hosts produced in the ABP
	3) GENERATE HIGHER PROFITABILITY OF FRUIT PRODUCTION UNDER SMR	RATE OF INCREASE IN THE PRICE OF FLAX HOST PRODUCTS OF FRUITS FROM SMR	Average price of product with traditional quarantine treatments / Average price per kg of product produced under SMR in the market
	4) MAINTAIN THE USEFUL LIFE OF THE MERCHANDISED PRODUCT FROM SMR	INCREMENTAL DURATION RATE IN THE MARKET OF SMR PRODUCTS	Duration (days) on the market of the product that has undergone traditional quarantine treatment / Duration (days) on the SMR product market
	5) INCREASE THE NUMBER OF PRODUCES IMPLEMENTING SMR, ACCESSING THE ALMF	RATE OF INCREASE OF ABP FITOSANITARY PRODUCTS THAT CAN ACCESS THE ALMF	Quantity of species that can access the ALMF with SMR / Quantity of species that can access the ALMF with traditional quarantine treatment (based on the installed capacity in the ABP)

It is interesting to note that after the definition of the goals, it was possible to establish specific indicators of impact assessment of the fruit flies risk mitigation measures.

After defining the overall objective, its goals and indicators, the working group defined the specific objectives of the Logical Framework. As mentioned earlier, the specific objectives relate directly to specific actions related to the implementation of the measure. In this sense, the specific objectives were established by consensus:

1_ Promoting the adoption of the SMR as an alternative measure to traditional quarantenary treatments

2_ Control the traceability of production

3_ Decrease the likelihood of plague dispersion

In addition, specific targets and indicators were suggested for the quantification of these specific objectives, as shown below:

Table 3. Consolidation of the narrative of the specific objectives, their goals and indicators

SPECIFIC OBJECTIVES	TARGETS	INDICATORS	FORMULA
1) PROMOTING THE ADOPTION OF THE SMR AS AN ALTERNATIVE MEASURE TO TRADITIONAL QUARANTENARY TREATMENTS	1.1) DISSEMINATE TO 100% OF THE PRODUCERS THE ADVANTAGES OF THE SMR	RATE OF PRODUCERS WHO KNOW THE MEASURE	Number of BPA producers who are aware of the measure / Total number of BPA producers
	1.2) INCREASE IN 40% THE NUMBER OF PRODUCERS WHO ADOPT THE SMR	RATE OF PRODUCERS THAT ADOPT THE MEASURE	Number of producers of BPA producers who register and adopt the measure / Total number of BPA producers
2) CONTROL THE TRACEABILITY OF PRODUCTION	2.1) VERIFY THAT 100% OF THE SHIPMENTS ACCESSING THE ALMF WITH OFFICIAL DOCUMENTATION	SPECIES INTERCEPTION RATE WITHOUT FRUIT TRANSIT DOCUMENT (DTV)	Number of shipments intercepted without official documentation / Total shipments accessing ALMF
3) DECREASE THE LIKELIHOOD OF PLAGUE DISPERSION	3.1) TO ENSURE THAT 80% OF THE PRODUCTION UNITS HAVE BEEN REGISTERED IN THE SMR	SMR MAINTENANCE RATE	Number of SMR units that have discharged / Total number of SMR units
	3.2) REVIEW 100% OF SMR TRAPS	TRAPS REVIEW RATE	N ° of traps reviewed / N ° of traps placed
	3.3) VERIFY THAT 100% OF SHIPMENTS COMPLY WITH ISOLATION AND FREE PLAGUE CONDITIONS	INTERCEPTATION RATE OF LARGE SAMPLES	Number of intercepts of larval samples from the SMR at control points located at the entrance to ALMF / Total of inspected shipments

STAGE 2: ELABORATION OF THE DATA COLLECTION FORM

Based on the definition of all the indicators of the logical framework, a form was generated with the decoupling of the indicators to list the data needed to be obtained in the field for their respective calculations. It also included exogenous data to be collected, which were used in the economic and social analyzes.

Next, the form (Table 4) generated for the data collection is presented based on all the indicators established in the evaluative logical framework for two different periods.

Table 4. Data collection form

Assessment of SMR					
DATA COLLECTION FORM					
Targets of the general objective according to the numbering in the matrix of the logical framework (ACCESS MARKETS WITH PHYTOSANITARY RESTRICTIONS COMPETITIVELY, WITH PRODUCTS ARISING FROM LOW PREVAILING AREAS -ABP- FRUIT FLY)	Indicators (2016/2017)	Numeric Unit	Data (2016/2017)	Data (2017/2018)	Sources Used
1.1) MAINTAIN ACCESS TO FRUIT FLY FREE AREAS MARKETS	No. of individuals that have access to free area with SMR	Habitants			Projections prepared based on the National Population, Housing and Housing Census 2010. Instituto Nacional de Estadística y Censos de Argentina (INDEC).
	NUMBER OF COUNTRY INHABITANTS	Habitants			Projections prepared based on the National Population, Housing and Housing Census 2010. (INDEC)
1.2) INCREASE VOLUMES SOLD OUT OF THE SMR FROM THE LOW PREVALENCE AREA	VOLUME OF HOST PRODUCTS ALLOWED TO BE COMMERCIALIZED UNDER SMR	Kilograms			SMR Database
	VOLUME OF PRODUCTS PRODUCED IN THE ABP	Kilograms			IDR, effective host production data 2017-2018.
1.3) GENERATE HIGHER PROFITABILITY OF FRUIT PRODUCTION UNDER SMR	PRODUCT MARKET PRICE UNDER SMR ($)	Average price per kg.			IDR, data of the second week of February 2016. (wholesale market price)
	PRICE OF PRODUCT MARKET WITH QUARANTENARY TREATMENT ($)	Estimated average price			Estimated

1.4) MAINTAIN THE USEFUL LIFE OF THE MERCHANDISED PRODUCT	SHELFLIFE OF PRODUCTS UNDER SMR (average days)	Days			Estimation for sweet pepper (which receives treatment as an alternative)
	SHELFLIFE OF PRODUCTS SUBMITTED TO QUARANTENARY TREATMENT (average days)	Days			Estimation for sweet pepper (which receives treatment as an alternative)
1.5) INCREASE THE NUMBER OF FRUIT SPECIES FROM PULP, THAT ACCESS INTO THE FREE AREA OF FRUIT FLY	QUANTITY OF HOSTING SPECIES THAT MAY ACCESS INTO THE FREE AREA WITH SMR (n °)	Number			SMR database. (Pear, apple, peach, plum, nectarine, grape, pepper, quince, apricot, cherry)
	QUANTITY OF HOSTING SPECIES THAT CAN ACCESS THE FREE AREA WITH QUARANTENARY TREATMENT MADE WITHIN THE ABP (WITHIN THE FUNCTION OF THE INSTALLED CAPACITY) (n °)	Number			Regulation and SMR database (grapes and quince)
SMR Assessment					
DATA COLLECTION FORM					
Targets of the specific objectives according to the numbering in the logical framework matrix (by cost center)	Indicators (2016/2017)	Numerical unit (to be considered for inclusion of data)	Data (2016/2017)	Data (2017/2018)	Sources Used
1) PROMOTING THE ADOPTION OF THE SMR AS AN ALTERNATIVE MEASURE TO QUARANTENARY TREATMENTS	PRODUCERS WHO KNOW THE MEASURE (n °)	Producers	without data / research proposal.	without data / research proposal.	Conduct a telephone survey on a representative sample of BPA producers.
GOAL 1.1: DISTRIBUTE TO 100% OF THE PRODUCERS THE ADVANTAGES OF THE SMR	TOTAL ABP PRODUCERS (n °)	Producers			IDR, host-only properties.

META 1.2: INCREASE SMR ADOPTION BY 40%	PRODUCERS REGISTERED AND ADOPTED TO MEASURE (n °)	Producers			SMR Database
2) CONTROL THE TRACEABILITY OF PRODUCTION	SHIPMENTS INTERCEPTED WITHOUT OFFICIAL DOCUMENTATION (DTV OR GUIDE) (n °)	Interception of documents			BAS (Sanitary barriers)
GOAL 2.1: CHECK BARRIERS AND ROUTES IN 90% OF THE CONSIGNMENTS THAT ACCESS THE FREE AREA	TOTAL SHIPMENTS FOR FREE AREAS (n °)	Shipping			BAS – SMR CERTIFICATES
3) DECREASE THE LIKELIHOOD OF PLAGUE DISPERSION	INTERCEPTIONS OF LARVE SAMPLES FROM SMR TO CONTROL POINTS LOCATED IN THE REGISTRATION OF FREE AREAS (n °)	Intercepts of larval samples			BAS
GOAL 3.1: VERIFY THAT 100% OF SHIPMENTS COMPLY WITH ISOLATION AND FREE PLAGUE CONDITIONS	TOTAL INSPECTED SHIPMENTS (n °)	Shipping			BAS – SMR CERTIFICATES
GOAL 3.2: TO ENSURE THAT 80% OF PRODUCTIVE UNITS HAVE BEEN REGISTERED NOT SMR	NUMBER OF DISCARDED UNITS	Units discarded			Data base SMR
	NUMBER OF INSCRITED UNITS	SMR units			Data base SMR
GOAL 3.3: REVIEW 100% OF THE SMR'S PLANNED TRAITS	NUMBER OF REVISED TRAPS	Number of revised traps			Data base SMR
	N ° OF TRAPS INSTALLED	Number of traps			Data base SMR

	Data 2016/2017	Data 2017/2018
Costs of SMR for ISCAMEN ($)		
1) Staff		
2) Inputs		
3) Transportation		
Costs of SMR for SENASA ($)		
1) Staff		
2) Transportation and per diem		
3) Information Systems		
Costs of SMR for its beneficiaries		
SMR costs for producers ($)		Provincial tax law. It is a collection scale per hectare. Values are the total collection for this item.
Costs of SMR for other actors (packers / distributors / markets) ($)		Provincial tax law.
Economic and Social Profile Indicators		
Departments involved in SMR / Total ABP departments		
Rate of agricultural units under SMR per affected municipality		

As shown above, for each indicator, the data is decomposed into numerators (data cells to be filled in red) and denominators (data cells to be filled in yellow). The fields at the bottom of the form with blue header are the data required for economic and social analysis but are not part of any indicator defined in the logical framework.

STAGE 3: DATA COLLECTION

At the data collection stage, consultations were held with the managers of the localities affected by fly fruits in Mendoza, Argentina. The data collection form was sent to the organizations responsible for implementing the measures. The data were requested for two different periods of implementation of the measure 2016-2017 and 2017-2018 for a time comparison of their efficacy rates.

At the end, three types of data were sent by local managers: impact; management; inputs.

The impact data are observed in Table 5.

Table 5. Data on the impact of the fruit fly in Mendoza

Assessment of SMR					
DATA COLLECTION FORM					
Targets of the general objective according to the numbering in the matrix of the logical framework (ACCESS MARKETS WITH PHYTOSANITARY RESTRICTIONS COMPETITIVELY, WITH PRODUCTS ARISING FROM LOW PREVAILING AREAS -ABP- FRUIT FLY)	Indicators (2016/2017)	Numeric Unit	Data (2016/2017)	Data (2017-2018)	Sources Used
1.1) MAINTAIN ACCESS TO FRUIT FLY FREE AREAS MARKETS	No. of individuals that have access to free area with SMR	Habitants	3.920.471	3.978.468	Projections prepared based on the National Population, Housing and Housing Census 2010. (INDEC)
	NUMBER OF COUNTRY INHABITANTS	Habitants	43.967.679	44.416.530	INDEC. Projections prepared based on the National Population, Housing and Housing Census 2010. (INDEC)
1.2) INCREASE VOLUMES SOLD OUT OF THE SMR FROM THE LOW PREVALENCE AREA	VOLUME OF HOST PRODUCTS ALLOWED TO BE COMMERCIALIZED UNDER SMR	Kilograms	13.942.020	12.592.270	SMR Database
	VOLUME OF PRODUCTS PRODUCED IN THE ABP	Kilograms	91.469.212	97.856.876	IDR, effective host production data 2017-2018.

1.3) GENERATE HIGHER PROFITABILITY OF FRUIT PRODUCTION UNDER SMR	PRODUCT MARKET PRICE UNDER SMR ($)	Average price per kg.	26,2	28	IDR. The price variable is an average of the maximum prices (optimistic scenario) of Mendoza production products in the Concentrator Market of Guaymallen. The following products were taken as reference: pepper, cherry, plum, damask, peach, nectarine, pear and grape.
	PRICE OF PRODUCT MARKET WITH QUARANTENARY TREATMENT ($)	Estimated average price	21.35	22.82	Estimated
1.4) MAINTAIN THE USEFUL LIFE OF THE MERCHANDISED PRODUCT	SHELFLIFE OF PRODUCTS UNDER SMR (average days)	Days	10	10	Estimation for sweet pepper (which receives treatment as an alternative)
	SHELFLIFE OF PRODUCTS SUBMITTED TO QUARANTENARY TREATMENT (average days)	Days	4	4	Estimation for sweet pepper (which receives treatment as an alternative)
1.5) INCREASE THE NUMBER OF FRUIT SPECIES FROM PULP, THAT ACCESS INTO THE FREE AREA OF FRUIT FLY	QUANTITY OF HOSTING SPECIES THAT MAY ACCESS INTO THE FREE AREA WITH SMR (n °)	Number	10	10	SMR database. (Pear, apple, peach, plum, nectarine, grape, pepper, quince, apricot, cherry)
	QUANTITY OF HOSTING SPECIES THAT CAN ACCESS THE FREE AREA WITH QUARANTENARY TREATMENT MADE WITHIN THE ABP (WITHIN THE FUNCTION OF THE INSTALLED CAPACITY) (n °)	Number	3	3	Regulation and SMR database (grapes and quince)

Management data for specific efficacy objectives are given in the Table 6.

Table 6. Measurement management data

SMR Assessment					
DATA COLLECTION FORM					
Targets of the specific objectives according to the numbering in the logical framework matrix, by cost center	Indicators (2016/2017)	Numerical unit (to be considered for inclusion of data)	Data (2016/2017)	Data (2017/2018)	Sources Used
1) PROMOTING THE ADOPTION OF THE SMR AS AN ALTERNATIVE MEASURE TO QUARANTENARY TREATMENTS	PRODUCERS WHO KNOW THE MEASURE (n °)	Producers	without data / research proposal.	without data / research proposal.	Conduct a telephone survey on a representative sample of BPA producers.
GOAL 1.1: DISTRIBUTE TO 100% OF THE PRODUCERS THE ADVANTAGES OF THE SMR	TOTAL ABP PRODUCERS (n °)	Producers	1.789	1.789	IDR, host-only properties.
GOAL 1.2: Increase SMR adoption by 40%	PRODUCERS REGISTERED AND ADOPTED TO MEASURE (n °)	Producers	156	182	SMR Database
2) CONTROL THE TRACEABILITY OF PRODUCTION	SHIPMENTS INTERCEPTED WITHOUT OFFICIAL DOCUMENTATION (DTV OR GUIDE) (n °)	Interception of documents	41	7	BAS (Sanitary barriers)
GOAL 2.1: Check barriers and routes in 90% of the consignments that access the free area	TOTAL SHIPMENTS FOR FREE AREAS (n °)	Shipping	1.877	2.561	BAS – SMR CERTIFICATES
3) DECREASE THE LIKELIHOOD OF PLAGUE DISPERSION	INTERCEPTIONS OF LARVE SAMPLES FROM SMR TO CONTROL POINTS LOCATED IN THE REGISTRATION OF FREE AREAS (n °)	Intercepts of larval samples	1	2	BAS
GOAL 3.1: VERIFY THAT 100% OF SHIPMENTS COMPLY WITH ISOLATION AND FREE PLAGUE CONDITIONS	TOTAL INSPECTED SHIPMENTS (n °)	Shipping	1.877	2.561	BAS – SMR CERTIFICATES
GOAL 3.2: TO ENSURE THAT 80% OF PRODUCTIVE UNITS HAVE BEEN REGISTERED NOT SMR	NUMBER OF DISCARDED UNITS	Units discarded	32	26	Data base SMR
	NUMBER OF INSCRITED UNITS	SMR units	156	182	Data base SMR
GOAL 3.3: REVIEW 100% OF THE SMR'S PLANNED TRAITS	NUMBER OF REVISED TRAPS	NUMBER OF REVISED TRAPS	664	702	Data base SMR
	N ° OF TRAPS INSTALLED	Number of traps	664	702	Data base SMR

Finally, the input data were observed in table 7.

Table 7. Data on inputs used to implement the measure

	Data 2016/2017	2017/2018
Costs of SMR for ISCAMEN ($)	$ 4.090.235	$ 4.886.584
1) Staff	$ 1.900.000	$ 2.276.200
2) Inputs	$ 290.235	$ 334.184
3) Transportation	$ 1.900.000	$ 2.276.200
Costs of SMR for SENASA ($)	$ 656.160	$ 775.392
1) Staff	$ 360.000	$ 414.000
2) Transportation and perdiem	$ 176.160	$ 211.392
3) Information Systems	$ 120.000	$ 150.000
Costs of SMR for its beneficiaries	$ 416.305	
SMR costs for producers ($)	$ 65.910	Provincial tax law. It is a collection scale per hectare. Values are the total collection for this item.
Costs of SMR for other actors (packers / distributors / markets) ($)	$ 350.395	Provincial tax law.
Economic and Social Profile Indicators		
Departments involved in SMR / Total ABP departments	67%	
Rate of agricultural units under SMR per affected municipality	NO INFORMATION	

STAGE 4: FINANCIAL, ECONOMIC AND SOCIAL ANALYSIS

Financial analysis (cost-efficacy)

Using the indicators of the specific objectives and defining the two periods of analysis of cost-efficacy, the data referring to this level of analysis were used from the data collection form sent by local managers, as shown below in Table 8.

Table 8. Efficacy Data

SMR Assessment					
DATA COLLECTION FORM					
Goals of the specific objectives according to the numbering in the Logical Framework matrix (by Cost Center)	Indicators (2016/2017)	Numerical unit (to be considered for inclusion of data)	Data (2016/2017)	Data (2017/2018)	Sources Used
1) PROMOTING THE ADOPTION OF THE SMR AS AN ALTERNATIVE MEASURE TO QUARANTENARY TREATMENTS	PRODUCERS WHO KNOW THE MEASURE (n °)	Producers	without data / research proposal.	without data / research proposal.	Conduct a telephone survey on a representative sample of BPA producers.
GOAL 1.1: DISTRIBUTE TO 100% OF THE PRODUCERS THE ADVANTAGES OF THE SMR	TOTAL ABP PRODUCERS (n °)	Producers	1.789	1.789	IDR, host-only properties.
GOAL 1.2: INCREASE SMR ADOPTION BY 40%	PRODUCERS REGISTERED AND ADOPTED TO MEASURE (n °)	Producers	156	182	SMR Database
2) CONTROL THE TRACEABILITY OF PRODUCTION	SHIPMENTS INTERCEPTED WITHOUT OFFICIAL DOCUMENTATION (DTV OR GUIDE) (n °)	Interception of documents	41	7	BAS (Sanitary barriers)
GOAL 2.1: CHECK BARRIERS AND ROUTES IN 90% OF THE CONSIGNMENTS THAT ACCESS THE FREE AREA	TOTAL SHIPMENTS TO FREE AREAS (n °)	Shipping	1.877	2.561	BAS – SMR CERTIFICATES
3) DECREASE THE LIKELIHOOD OF PLAGUE DISPERSION	INTERCEPTIONS OF LARVE SAMPLES FROM SMR TO CONTROL POINTS LOCATED IN THE REGISTRATION OF FREE AREAS (n °)	Intercepts of larval samples	1	2	BAS
GOAL 3.1: VERIFY THAT 100% OF SHIPMENTS COMPLY WITH ISOLATION AND FREE PLAGUE CONDITIONS	TOTAL INSPECTED SHIPMENTS (n °)	Shipping	1.877	2.561	BAS – SMR CERTIFICATES
GOAL 3.2: TO ENSURE THAT 80% OF PRODUCTIVE UNITS HAVE BEEN REGISTERED AS SMR	NUMBER OF DISCARDED UNITS	units discarded	32	26	Data base SMR
	NUMBER OF INSCRITED UNITS	SMR units	156	182	Data base SMR
GOAL 3.3: REVIEW 100% OF THE SMR'S PLANNED TRAITS	NUMBER OF REVISED TRAPS	NUMBER OF REVISED TRAPS	664	702	Data base SMR
	N ° OF TRAPS INSTALLED	number of traps	664	702	Data base SMR

The previous analysis was made based on the period of application of the measure in the only cost center identified in the study (province of Mendoza). In this case, the efficacy data are compared between these two periods to verify the average efficiency and its corresponding levels.

As has been demonstrated, these data must be analyzed based on a specific universe of action. For example, in the period 2016/2017, 156 producers adopted the measure, but this does not represent the universe of producers in the province. As the universe of producers is 1789, 8.7% of gross efficacy was reached in the adoption of the measure.

This relationship was made for all indicators established for the analysis of efficacy for each of the time periods, as shown in the table below:

Table 9. Rates of efficacy indicators

Targets	Indicators of specific objectives according to numbering in the logical framework matrix	Goal limit for efficacy calculation	Data (2016/2017)	Data (2017/2018)	total
1) PROMOTING THE ADOPTION OF THE SMR AS AN ALTERNATIVE MEASURE TO QUARANTENARY TREATMENTS *GOAL 1.2: INCREASE THE SMR'S ADOPTION BY 40%*	Number of producers of ABP producers who register and adopt the measure / Total number of ABP producers	9.4%	8.7%	10.2%	9.4%
2) CONTROL THE TRACEABILITY OF PRODUCTION *GOAL 2.2: CHECK IN BARRIERS AND ROUTES 90% OF SUBMISSIONS THAT ACCESS INTO THE FREE AREA*	Number of shipments intercepted without official documentation / Total shipments accessing the ALMF	1.2%	2.2%	0.3%	1.2%
3) DECREASE THE LIKELIHOOD OF PLAGUE DISPERSION *GOAL 3.1: VERIFY THAT 100% OF SHIPMENTS COMPLY WITH ISOLATION AND FREE PLAGUE CONDITIONS*	Number of intercepts of larval samples from the SMR at control points located at the entrance to the ALMF / Total of shipments inspected	0.07%	0.05%	0.08%	0.07%
GOAL 3.2: TO ENSURE THAT 80% OF PRODUCTIVE UNITS HAVE BEEN REGISTERED NOT SMR	Nr. of units of the SMR that have dropped-out / Total of units registered in the SMR	17.4%	20.5%	14.3%	17.4%
GOAL 3.3: REVIEW 100% OF THE SMR'S PLANNED TRAPS	N ° of traps reviewed / N ° of traps placed	100%	100.0%	100.0%	100.0%
AVERAGE FOR ALL INDICATORS			26%	25%	

However, it should be noted that the gross efficacy rates above can only be considered after adjusting them to the targets established for each indicator. In this case, the average gross efficiency in the two periods was used to arrive at a baseline of the targets. For example, as the gross efficacy average for SMR promotion reached 9%, this value was used as an efficacy benchmark for the final calculation

of overall efficacy. That is, in the period 2017/218, 100% of the referential target was actually achieved.

In order to make an adjustment of the efficacy indicators in relation to the goals established, the values in the above table were recalculated according to these targets, as shown below in Table 10.

Table 10. Efficacy rates

Indicators of specific objectives according to the numbering of the logical framework matrix	Data (2016/2017)	Data (2017/2018)	Average Indicator
Average	95%	81%	
1.2 INCREASE THE SMR'S ADOPTION BY 40%	92%	100%	96%
2.2 REGISTER 100% OF USERS ADOPTING THE SMR	100%	22%	61%
3.1 VERIFY THAT 100% OF SHIPMENTS COMPLY WITH ISOLATION AND PLAGUE-FREE CONDITIONS	81%	100%	91%
3.1 GUARANTEE THAT 80% OF PRODUCTIVE UNITS HAVE BEEN REGISTERED AS SMR	100%	82%	91%
3.3 REVIEW 100% OF THE SMR'S PLANNED TRAPS	100%	100%	100%

As goals are set only as minimal benchmarks, values that exceed 100% have been adjusted. For example, as in the 2016/2017 period 10.2% of the SMR adoption rate was reached, the use of the minimum reference target of 9% made the period reach 108% of the minimum referential target. Therefore, this efficacy indicator was at a maximum of 100% target reaching value.

As shown above, the period with the most significant efficacy value was 2016/2017 which averaged 95% of the established management targets for the phytosanitary measure. The period 2017/2018 follows with an average of 81%.

Regarding the specific efficacy indicators, all the indicators reached more than 90%, except for the interception rate of species without plant transit document (DTV).

For a comparison of these rates of efficacy with the financial amounts used by each period for implementing the measures, an analysis of the financial resources used was carried out.

The following table shows the specific budgets used in the cost center during 2016/2017 and 2017/2018 and their proportion to the total values used.

Table 11. Final budget of the measure for the two study periods

UNIT OF ANALYSIS (2017)	Data (2016/2017)	Data (2017/2018)
SMR COST FOR ISCAMEN ($) (CC)	$ 4.090.235,00	$ 4.886.584,00
% IN RELATION TO TOTAL COUNTRY BUDGET	16%	16%
SMR COSTS FOR SENASA ($)	$ 656.160,00	$ 775.392,00
TOTAL FINANCIAL COST	$ 4.746.395,00	$ 5.661.976,00
NUMBER OF PRODUCERS APPLYING THE MEASURE	156	182
COST BY PRODUCER UNDER SMR	$ 30.425,61	$ 31.109,76
COST BY PRODUCER APPLYING THE MEASURE (MONTHLY)	$ 2.535,47	$ 2.592,48
TOTAL NUMBER OF PRODUCERS OF THE AFFECTED REGION	1.789	1.789
COST BY TOTAL NUMBER OF PRODUCERS	$ 2.653,10	$ 3.164,88
COST BY TOTAL NUMBER OF PRODUCERS (MONTHLY)	$ 221,09	$ 263,74

Based on these proportions, It was made an apportionment of the values used at the central level for the coordination of the measures in the two periods. Thus, even in the period 2017-2018, when ISCAMEN directly applied 4.8 million pesos in the implementation of the phytosanitary measures, the pro rata value of 775 thousand pesos of the budget used by SENASA was added (16% of the value of the direct costs). The total financial cost was 5 million and 575 thousand pesos. That is, 4.8 million plus 775 thousand, for a total of $ 5,575,000.00.

Taking into account the cost analysis the two time periods, the definition of the cost of the measure per producer was applied to the total cost. Thus, even having the period 2016-2017 with the lowest absolute cost, the cost per SMR producer was very similar to 2017-2018 or ($ 30,425.61 per producer). Therefore, based on the increase in the number of SMR producers in the second period, even with the increase in the total budget, the average cost per SMR producer also reached a similar cost at $ 31,109.00.

The cost analysis also shows that the monthly cost of the measure in 2016-2017 was $ 2,500.00 per month per producer, a value very similar to that of the 2017-2018 period.

The costs per producer (SMR and without SMR) were also identified. However, the SMR producer analysis unit appears to be the best unit of analysis for a final assessment of the impact assessment of the measures.

From the results of the efficiency analysis and the average costs per unit of analysis, a correlation of these indicators was performed. The Table 12 presents the financial costs per producer applying the measure incorporating the efficacy rates:

Table 12. Final cost-efficacy analysis of the two periods

UNIT OF ANALYSIS (2017)	Data (2016/2017)	Data (2017/2018)
COST BY PRODUCER APPLYING THE MEASURE (MONTHLY)	$ 2.535,47	$ 2.592,48
INSTITUTIONAL EFFICACY RATE	95%	81%
COST EFFICACY (YEAR)	$ 32.134,10	$ 38.469,00
COST EFFICACY (MONTH)	$ 2.677,84	$ 3.205,75

It is interesting to note that in this case there is a difference in cost-efficacy from the first period to the other period of analysis. In 2016-2017, the cost-efficacy per producer adopting SMR was $ 2,677.84 and in 2017-2018, there was an increase of 19.7% or $ 3,205.75 per producer.

A combined analysis of the two periods was also performed to jointly verify the levels of profitability of the measure, as shown below in Table 13.

Table 13. Combined cost-efficacy analysis of the two periods

Total producers applying the measure	338
Total invested (2016-2018)	$ 10.408.371,00
Cost by producer applying the measure (year)	$ 30.794,00
Cost by producer applying the measure (month)	$ 2.566,17
Average efficacy rate	88%
Cost-efficacy by producer applying the measure (month)	$ 2.923,52

In this case, considering that there were 338 SMR producers in the two periods and an overall investment total of 10.4 million pesos, the average cost per SMR producer per year was $ 30,794.00. This corresponds to a monthly value of $ 2,566.17. Taking into account the average rate of efficacy for all indicators and analysis periods of 88%, a final adjustment was made in relation to the monthly value, totaling $ 2,923.52 per month.

ECONOMIC ANALYSIS (COST-BENEFIT)

For the economic analysis, adjustments were made in the financial cost to incorporate other inputs used during the implementation of the measure by the cost centers, to verify possible distortions of the price practiced in the use of financial resources by the cost center in relation to market prices, and to incorporate costs incurred by producers for the actual implementation of the measure (SMR).

Therefore, the data in Table 14 was used.

Table 14. Economic costs for producers and other actors

Costs of SMR for its beneficiaries	$ 416.305	
SMR costs for producers	$ 65.910	Provincial tax law. It is a collection scale per hectare. Values are the total collection for this item.
Costs of SMR for other actors (packers / distributors / markets)	$ 350.395	Provincial tax law. Values are the total collection for this item.

As indicated earlier, other non-financial costs with the implementation of the measure have been identified. Therefore, $ 416,305 was invested based on the total cost of the measure by producers. $ 65,910 of SMR costs for producers adopting the measure and $ 350,395 pesos of SMR costs for other stakeholders (packers / distributors / sellers). However, this adjustment had no final implications on the total cost of the financial cost because this amount was already included in ISCAMEN financial data.

In addition, a distortion in the average price paid for specific inputs by the core cost was set at 5.00% lower than the market prices. Therefore, the total economic cost of the measure in the period 2016/2017 was 5.00% higher than the financial cost, $ 4.74 million. This same amount was used for projecting investments in the measure for the following 10 years.

On the benefit side, two figures were found for a projected gain in the next 10 years. An incremental gain per fruit price of the SMR (Year) and a price gain per fruit shelflife under SMR. Total proven benefit is over $ 41 million per year.

Table 15. Price distortion analysis

Fresh fruit	2.845.578 t
Fruit for industry	11.096.442 t
Market price concentrator of Guaymallen - Mendoza	26.2
Price differential% in ALM - more than in ABP - 2016-	18.5%
Price differential $ in ALM - more than in ABP - 2016-	4.85

Based on these values, a cost-benefit economic projection model was developed for the calculation of the cost-benefit ratio, net present value and internal rate of return of the phytosanitary measure.

Table 16. Calculation of economic cost-benefit

Year	Gross Cost	Gross Benefit	BL Incremental	Factor (25%)	Net Present Value (25%)
1	$ 4.746.395,00	$ -	$ (4.746.395,00)	0,800	$ (3.797.116,00)
2	$ 4.746.395,00	$ 41.626.703,66	$ 36.880.308,66	0,640	$ 23.603.397,54
3	$ 4.746.395,00	$ 41.626.703,66	$ 36.880.308,66	0,512	$ 18.882.718,03
4	$ 4.746.395,00	$ 41.626.703,66	$ 36.880.308,66	0,410	$ 15.106.174,43
5	$ 4.746.395,00	$ 41.626.703,66	$ 36.880.308,66	0,328	$ 12.084.939,54
6	$ 4.746.395,00	$ 41.626.703,66	$ 36.880.308,66	0,262	$ 9.667.951,63
7-10	$ 4.746.395,00	$ 41.626.703,66	$ 36.880.308,66	0,619	$ 22.831.834,58
NPV (25%)				$ 98.379.899,75	

In sum, based on a discount factor of 25% (official interest rate in Argentina in 2017), it is calculated that, over 10 years of implementation of SMR, for each $ invested in the measure, the return is $ 6.81. In addition, the net present value of the measure reaches more than $ 98 million.

Finally, the internal rate of return of the measure is 225%. That is to say, even if Argentina does not have a budget available for the implementation of the measures, it justifies negotiating loans with credit organizations up to this level of interest. Thus, it justifies the implementation of the measure even in a context of high inflation.

SOCIAL ANALYSIS (EQUITY)

For the social analysis, the main unit of analysis was the adoption of the SMR measure in the properties that are the most vulnerable to fruit flies. In addition, the number of host species that can access the free area with SMR was identified. Thus, the Hoover index of equitable distribution was calculated with and without SMR. This is to say that indexes that reach closer to one, it means extreme concentration of access to markets and zero means equitable distribution of access to free areas over the years.

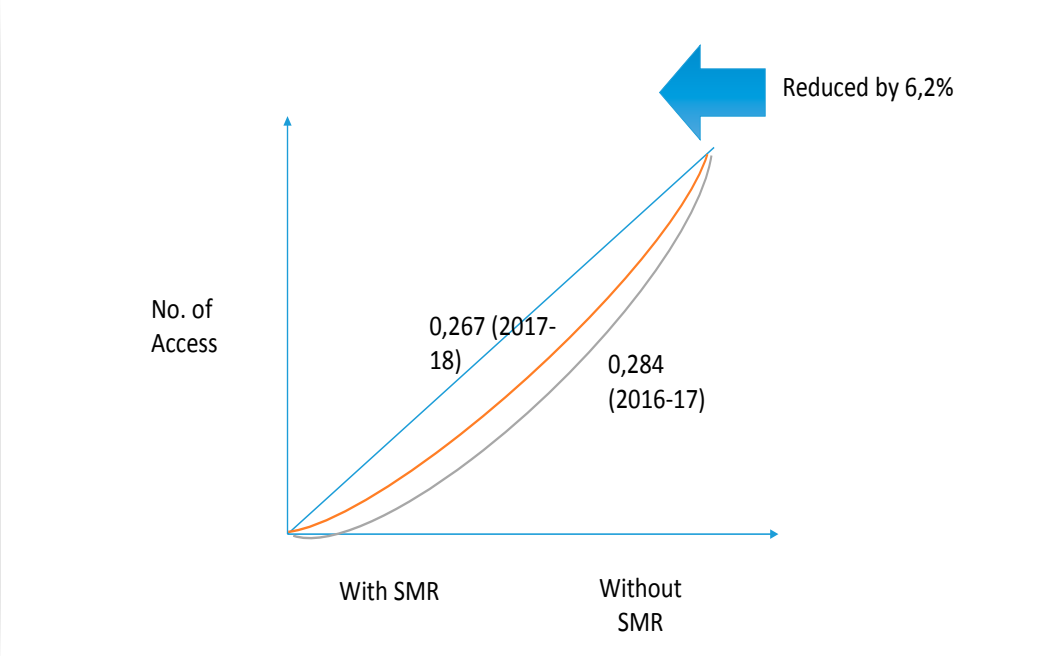
The data collected refer to the number of properties that adopt the SMR and the total of properties that are interested in adopting the measure (20% of total properties).

Table 17. Analysis of concentration of host species that can access the free area with SMR

PROVINCE OF MENDOZA	PRODUCERS REGISTERED AND ADOPTED TO MEASURE (n °)	PRODUCERS NOT ADOPTING THE MEASURE (n °)	TOTAL ABP PRODUCERS (n °)	PROPORTION PRODUCERS REGISTERED AND ADOPTED TO MEASURE (n °)	TOTAL PROPORTION OF PRODUCERS NOT ADOPTING THE MEASURE (n °)	QUANTITY OF HOSTING SPECIES THAT MAY ACCESS INTO THE FREE AREA WITH SMR (n °)	QUANTITY OF HOSTING SPECIES THAT MAY ACCESS INTO THE FREE AREA WITH QUARANTENARY TREATMENT MADE WITHIN THE ABP (IN FUNCTION OF THE INSTALLED CAPACITY) (n °)
2016-2017	156	202	358	0.436	0.564	10.00	3.00
2017-2018	182	176	358	0.508	0.491	10.00	3.00

A1	A2	(A1+A2)	E1	E2	(E1+E2)	D1	D2	H1	H2	HOOVER	
156	202	358	1.560.000	605.400	2.165.400	- 0.284	0.284	0.284	0.284	0.284	
182	176	358	1.820.000	527.400	2.347.400	- 0.267	0.267	0.267	0.267	0.267	6.2%

As shown above, the type of property with the highest number of host species that can access the free area are the properties that adopt the SMR. However, this number and proportion between the periods 2016-2017 and 2017-2018 increased and the number of species remained unchanged. It was found that the Hoover index of 2016-2017 (0.284) decreased in the period 2017-2018 to 0.267. That is, a reduction in the inequality in the distribution of the number of host species that can access the free area reached 6.2%. This change can also be seen in the following graph:



Graph 1. Hoover index for the two groups of social analysis

IV. CONCLUSION

The phytosanitary measure of SMR represents an important investment for the Argentine agricultural sector. This is true given that in the province affected by the measure, the economic projection value of return was almost $ 6.81 per $ 1.00 invested. This is also very significant considering that the measure requires a series of interventions that initially increase costs for the private and public sectors.

In addition, the measure has a high internal rate of return. This means that a lack of public and/or private budget cannot be used as an excuse for its non-implementation. The resources must be mobilized by the governmental budget or even by national or international credit lines that include the payment of interest.

With regard to the management of the measures, a good level of efficacy was reached with 85% of the targets achieved in two different periods. Also, the cost per producer that adopts the SMR is about $ 2,923.52 a month, taking into account the financial amounts invested by the cost center in two different periods and compensation for loss of efficacy.

In addition, the cost-efficacy analysis brings an interesting comparison between the two implementation periods for their respective efficacy rates, financial figures and cost-efficacy ratio. It would be important to define an implementation model on how these values can best be standardized and good practices passed on to those directly involved in the implementation of the measure.

The social analysis also represents an important component of the assessment, since it has demonstrated that the properties that adopt SMR are having more access to the free zone markets. Therefore, the transition of more properties for adoption of SMR is fundamental, considering that it is not only a small proportion of the total of properties that are currently adopting SMR. Moreover, if most of the properties adopt the measure, this will contribute to improve the conditions of production of the properties and consequently their access into the free areas, reducing inequity.

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ANNEX: COMPLEMENTARY ANALYSIS OF THE SOCIAL IMPACT OF THE APPLICATION OF THE SMR MEASURE APPLIED TO THE FRUIT PRODUCTION OF PEACHES IN THE PROVINCE OF MENDOZA

OBJECTIVES AND SCOPE OF THE ANALYSIS

The objective of this analysis is to conduct an approximation of the effects of non-application of the risk mitigation system (SMR) on employment for the peach sector in the province of Mendoza, Argentina.

To that effect, the contributions of local counterparts at the federal and provincial levels were obtained, as well as IDR-Mendoza, which produced the largest amount of primary information for this sector. It has also been validated by national counterparts in an attempt to account for the social dimension of the Impact Assessment Methodology proposed by JS/Brazil within the framework of Project STDF / PG / 502 "COSAVE: regional strengthening of the implementation of phytosanitary measures and access to markets".

CHARACTERIZATION OF EMPLOYMENT IN MENDOZA, IN PARTICULAR RURAL

According to the 2010 National Population, Household and Housing Census, the population of the province of Mendoza is 1,738,929 inhabitants. The population is distributed in the 17 departments in which the province is subdivided as follows:

Table 1. Mendoza Population per Department

DEPARTMENT	POPULATION	%
Capital	115041	6.62
General Alvear	46429	2.67
Godoy Cruz	191903	11.04
Guaymallén	283803	16.32
Junín	37859	2.18
La Paz	10012	0.58
Las Heras	203666	11.71
Lavalle	36738	2.11
Luján de Cuyo	119888	6.89
Maipú	172332	9.91
Malargüe	27660	1.59
Rivadavia	56373	3.24
San Carlos	32631	1.88
San Martín	118220	6.80
San Rafael	188018	10.81
Santa Rosa	16374	0.94
Tunuyán	49458	2.84
Tupungato	32524	1.87
Total	1738929	100

Source: Own elaboration based on INDEC. National Census of Population, Houses and Houses 2010

Out of the total population of the province, 1,406,283 is urban population and 332,646 is rural population, corresponding to almost 81% and 19%, respectively, according to census data.

Before considering the fruit sector and in particular the peach sector, it is necessary to characterize the rural population for its main social indicators, representing those directly involved in peach production. Therefore, this study utilizes the survey of Condition of life performed by the Government of Mendoza (Government of Mendoza, 2018). The latest data available correspond to the 2017 survey.

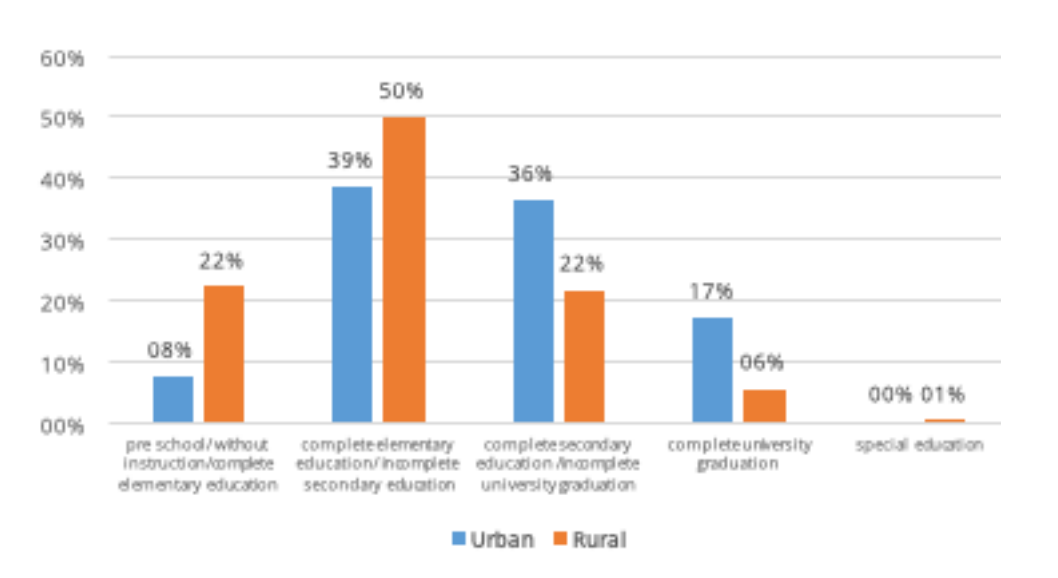
The rural population has a number of distinct characteristics of the urban population. In general, the rural population is exposed to a larger set of vulnerabilities, which expose themselves to worse performance in most social indicators. Therefore, the loss of jobs will impact differently if it is a deteriorated social structure like the rural one, or an urban one, where people have greater means for survival.

At the housing level, the differences between rural and urban environments are important. Only 12.2% of the rural households have satisfactory life quality standards, while the remaining 89.6% are in a survival condition (39.2%) or even insufficient life quality standards (48.6%). Also the distance to basic services such as health, education, security is greater than for the urban population.

In terms of health, the rural population has a lower level of coverage than the urban population, which is 47%, while for the urban population is 66.2%. The dependence on public services to ensure the health of people is more relevant in rural than in urban areas. More than 71% of the rural population is served in public hospitals and health centers, while this percentage reaches only 41% among the urban population.

At the educational level, the performances are also different between rural and urban people. While the literacy rate of 10 or more years for the urban environment reaches 98.7%, for the rural population is 95.2%.

The educational level reached for both groups is also different with the rural population reaching 72.2% of the population with incomplete basic or secondary studies. The most educated people are thus in urban areas according to the following graph.



Graph 1. **Population of 15 years or more by maximum educational level reached by area of residence. Mendoza. Year 2017. Own elaboration based on data from the State of Life Research Report, 2017.**

In the labor market, the rural population also has some characteristics that make them even more vulnerable when compared to the urban population. However, in the general economic indicators, these differences were not so extreme in 2017 although there is a slight difference between the two areas of residence.

Table 2. **Main indicators of the labor market by area of residence. Year 2017**

Indicator	Total	Rural	Urban
Activity Rate	43.6%	42.4%	44.0%
Employment Rate	41.3%	39.9%	41.7%
Unemployment rate	5.3%	5.8%	5.1%

Source: DEIE based on Life Condition Survey. Mendoza. Year 2017

In any case, if we analyze these numbers more carefully, one will see that there are important differences, particularly among rural and urban men and women, showing more significant gender gaps within the rural population and among the rural and urban population. For the year 2017, the activity rate of men in rural areas reached 55.5% while for women it was only 29.6%. This gap of 26 percentage points in rural areas reaches only 16.2 percentage points in the case of the urban population.

It is also possible to observe these differences in employment. The occupation rate is higher in the urban areas when compared to rural area, being 41.7% among urban population and 40% among the rural area. However, a major gender gap is identified between urban and rural areas. While the occupancy rate of men in rural areas is 53.6% for women is only 26.6%.

In terms of unemployment, the rural population of Mendoza has an unemployment rate of 5.8%, while in urban areas it was 5.1%. Again there is a gap between men and women, being 3.5% for men and 10.1% for women. For the urban population it is 4.1 for men and 6.5 for women.

According to the 2017 Condition of Life Survey, the number of people employed in the Province of Mendoza is 770,166 people, equivalent to 44.2% of the population[1]. Of this percentage, only 24% of the population is from rural areas, while 75.8% are in urban areas. The regions with the highest rural occupation rates are located in the Northeast of the province, with a percentage of 70.1% followed by the Uco Valley region, to the east and finally Greater Mendoza. Even so, the level of informality is very high, reaching almost, in all regions, 50% of the population.

1 Information of Annual Report Survey of condition of life. Mendoza. Year 2017. See calculation of Occupancy Rate on p. 48

Table 3. Population Occupied by economic activity performed, according to region of residence. Mendoza. Year 2017.

Region	Total employed persons		Primary Activity		Secondary Activity	
	People	%	People	%	People	%
Total	770166	100%	79944	10.4%	156110	69.3%
Gran Mendoza	497927	100%	22284	45.0%	106046	74.2%
East	88805	100%	20008	22.5%	14480	61.2%
Northeast	26705	100%	6944	26.0%	4745	56.2%
Uco Valley	50168	100%	16205	32.3%	7008	53.7%
South	106560	100%	14504	13.6%	23832	64.0%

Source: Own elaboration based on the Annual Report Survey of condition of life. Mendoza. Year 2017

Primary activities represent 10.4% of the total employed persons. The regions with the highest number of occupants are the Uco Valley, the eastern and northwest regions.

In rural areas, 80% of the population is engaged in primary activities, equivalent to 64,220 people. Also in the rural area is where the largest number of unregistered workers is recorded, that is, working informally. Of the total number of registered workers, only 17.6% is in rural areas, while 31.1% of the total is not in rural areas.

Finally, the Condition of Life Survey for 2017 does not present poverty data for rural and urban areas. However, this number is significant, in 2017, 35% of the population was living in poverty and 7.8% were living in extreme poverty. The development of employment and, in particular, of the productive sector will be key for avoiding further vulnerability, in particular, among populations living in rural areas.

IMPORTANCE OF THE FRUIT SECTOR TO THE PROVINCIAL ECONOMY, MAIN CHARACTERISTICS, VOLUME, INCOME, EXPORTS

In Argentina, stone fruits represent 10% of the total national fruit production. Primary production of peaches represents 1.3% of the world total, ranking 9th. Canned peaches for the year 2015 reached 10.1 million dollars. Total canned peach in Argentina accounts for 1% of world production in 2014 (Ministry of Finance and Public Finance (2016).

The activity is mainly concentrated in the province of Mendoza (83%), since its climatic characteristics - low humidity, significant thermal amplitude and high hours of sun - make it a favorable environment for the development of this type of fruit.

The production of stone fruit shares many characteristics in relation to the processes that involve both its production and its processing. Among them, plums, apricots and peaches are the most representative in terms of provincial production.

The fresh fruit represents only 26% of the peach and plum cultivation in the province of Mendoza. Of these 26%, 73% correspond to peaches and 27% to plums.

The following is a description of the value chain for this sector, from which we will specifically analyze the case of the peach in each of its production stages in order to carry out the estimation of employment and its impact by not applying SMR.

PRODUCTIVE CHAIN OF THE STONE FRUIT IN MENDOZA

Mendoza has three productive areas for the harvesting of peaches: the northwestern zone, the central zone and the south zone or the Uco Valley. These are considered as the "productive activities" that in the following map are highlighted in dark green.

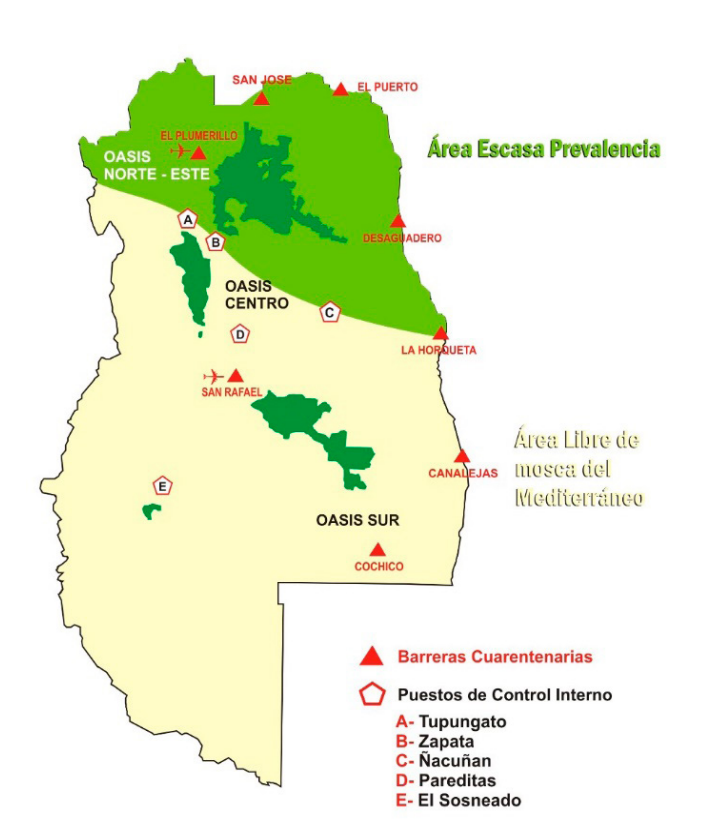


Image 1. Province of Mendoza. Phytosanitary surveillance

Source: ISCAMEN
NOTE: Original image in Spanish

At the production level, the process begins with the nurseries that are in charge of producing the seedlings that soon will become part of the fruit plantations, in this case, peaches.

Thus, in the production process it is possible to identify a series of common tasks to arrive at the fruits. There are two main destinations for the fruit: fresh fruit and for industry. All primary production tasks are similar. The primary production involves a set of tasks including fertilization, pruning, thinning and culminating in the harvesting of the fruits. At the industrial and commercial level, the activities are distinguished by the generation of an industrial chain around fruit processing, where two products are mainly obtained: canned peaches and peach pulp for jellies, juices, etc. These end products are intended for both domestic and export markets.

In the first case, the fruit follows the fresh fruit chain (conservation - packaging - marketing) until reaching the distribution markets (wholesale or retail), however, the industry phase by phase involves the industrial processing of the fruit, for its later commercialization.

The packaging of the fresh fruit for consumption area also located in establishments that are used for packaging of other fruits[2].

According to data from the Census of Cold Packing Sheds held in the province of Mendoza[3] in 2008, it was established that there are 242 establishments, 127 correspond to packing sheds with refrigerators, 99 only serve the job of packing, 14 only have a cold room and two are fridges associated with other fruit chains.

However, the data provided by ISCAMEN indicates that in Mendoza, the number of establishments authorized by SENASA and belonging to the SMR are 26. They are distributed as follows:

Companies	Total
Wrapping	7
Refrigerators & Freezers Establishment	1
Distribution centers	3
Stocks	0
Industries	15
Total	26

Table 4. Number of establishments authorized by SENASA of 2017

Source: ISCAMEN

INDUSTRY

Almost 90% of industry peaches are intended for preserves or pulps. The domestic market is the main destination of production, although - as from 2002 - significant increases in external sales have been experienced.

During operation of the product production, the factories are classified as: canners, they produce, mainly, peach in halves in syrup; pulp factory, produce concentrated pulps; and mixed, make both canned and pulped. A product of lesser importance is the dehydrated, which reaches only 2 or 3% of the annual volume processed.

COMMERCIALIZATION

The main destination of fresh fruit is the domestic market through wholesale markets throughout the country (mainly, the Central Market of Buenos Aires). In the case of peaches, the share of the internal market is 95%

Regarding the marketing channels of canned peach production, the focus is central or internal markets, since a very small portion of the total processed fruit is exported. In the case of peaches in halves, the different supermarket chains account for 42% of sales made directly through the processing industries. The second important destination is wholesalers that, in many cases, are companies that market these types of products through their own brands and that, after

2 In Mendoza, in general, a fruit mix is sold per season: 40% pear, 24% apple, 24% peach and 12% fresh plum.

3 Baroni, A. *Censo de galpones de empaque frutícola y frigoríficos, provincia de Mendoza*. Consejo Federal de Inversiones – Instituto de Desarrollo Rural, Mendoza, 2008.

re-labeling them, market them through supermarkets, increasing their participation as marketing channels.

ESTIMATION OF EMPLOYMENT FOR THE PEACH SECTOR IN THE PROVINCE OF MENDOZA

To estimate the employment in the peach sector, a theoretical model based on the one proposed by Baroni and Cantaloube (2013) was used. Based on this model, it was estimated the employment for the industry peach sector.

For this study, the employment for the 2017/2018 season of the peaches sector was calculated for industry and fresh fruit, adapting the present model and validating it with the ISCAMEN technical team and the Rural Development Institute. To all the people who collaborated in these calculations, thank you very much for your valuable contributions.

The next section describes each of the components of the chain, ending with the theoretical estimation of employment for the peach sector for the province of Mendoza. The same is divided into permanent and transitional stations for both destinations: fresh fruit and industry. Each of these components breaks down into the main tasks involved.

PERMANENT EMPLOYMENT IN FRUIT FARMS FOR PEACHES

In the model proposed by the IDR, the estimation of the permanent stations is made from a stratification of the properties according to their sizes. The last calculation was made for the peach industry sector in the year 2013. The last data to estimate fresh peach is from the 2010 fruit census. A number of assumptions will be made to address a number that is as realistic as possible, considering the limitations on the basis of the RDI estimate for the industries. The projected surface quantities for this crop will be used. In the case of the peach for the industry, it represents 22.3% less than the area for 2013. Therefore, it is assumed that the surface area between the producers is maintained. The second hypothesis is that the size of farms destined for fresh peach is the same as peach for industry. The area estimated for the 2017/2018 season is 16% lower than that of the peach industry. Therefore, permanent posts would also be reduced by this percentage[4].

4 This data is consistent with that calculated in the stone fruit value chain report for the peaches sector

Table 5. Approach to permanent employment in the peach sector for industry and fresh fruit production. Season 2017/2018

Permanent positions for industry in report 2013		Estimation of permanent positions industry and fresh fruit 2017-2018		
Harvested surface (ha)	8160	For season 2017/2018	6339 ha Ind (-22.3%)	1944
		For season 2017/2018	5335 ha fres (-16%)	1633
Permanent positions for industry	2377	Total permanent posts peach 2017-2018		3577

Fuente: own elaboration based on IDR data.

ESTIMATION OF TEMPORARY EMPLOYMENT FOR THE PEACH SECTOR FOR INDUSTRY AND FRESH FRUIT

Primary production

Although most of the tasks for producing industrial peaches and fresh fruits are the same, they require different work forces. This is why together with the IDR technical team weightings and multipliers have been established and updated for each number of tasks, either in terms of the tonnes produced, as well as the areas planted.

Table 6. Primary production of peaches for industry

Task	Ratio wage/kg	Job positions
Harvest	1 Salary/1.100 kg	70 days of harvest/year
Projection 2017/2018		
Total kg produced (industry)	Number of wages	Number of jobs
140.280.000	127.527	**1.822**
Pruning	13 salaries/ha	70 days of proning/year
Projection 2017/2018		
Total Ha harvested	Number of wages	Number of jobs
6339	82.407	**1.177**
Thinning	18 salaries/ha	30 days per year
Projection 2017/2018		
Toral Ha harvested	Number of wages	Number of jobs
6339	114.102	**3803**
Total temporary peach jobs for industry		**6802**

Source: own elaboration based on data Census 2017, IDR and ISCAMEN

Primary production with destination fresh fruit

Table 7. Primary production for consumption fresh peaches

Task	Ratio wage/kg	Job positions
Harvest	1 Salary/1.100 kg	70 days of harvest/year
Projection 2017/2018		
Total kg produced (industry)	Number of wages	Number of jobs
85.899.000	85.899	**1227**
Pruning	13 salaries/ha	70 days of pruning/year
Projection 2017/2018		
Total Ha harvested	Number of wages	Number of jobs
5335	69.355	**991**
Thinning	18 salaries/ha	30 days per year
Projection 2017/2018		
Total Ha harvested	Number of wages	Number of jobs
5335	69.355	**2312**
Total temporary employment of peaches, primary production for fresh consumption		**4530**

Industry secondary activity

The two main products produced by the industry for the peach sector are canning and pulp production. According to the IDR (2013) the processing of the peach pulp represents 39% of the volume of peaches for the industry.

However, we do not have a wage assumption required by volume to estimate the posts in the pulp, so the industry data is presented, which includes robust assumptions. For the number of temporary positions in a canning industry, we will estimate 39% additional workers for a pulp industry.

Table 8. Estimation of jobs in the Industry (canned and pulped)

Canned		
0.5 minutes/can		1 position= 8 hs during 80 days
Number of cans of peach	Number of minutes	Number of jobs
120.000.000	60000000	1563
Total employment canned		927
Total employment pulp processing		609
Total Employment Industry		1563

Source: own elaboration based on IDR data

Secondary activity of peach destined for fresh consumption

Table 9. Estimation of jobs in packaging and storage

11 establishments in Mendoza (ISCAMEN)				
	Establishments	Fresh peach production volume	Quantity of transitory wages	Total stands for peaches
7	Packing sheds	85899	56693	1503
1	Refrigerators & Freezers	85899	56693	215
3	Distribution centers	85899	56693	644
Total transitory packaging and storage jobs				2362

Source: own elaboration based on data IDR and ISCAMEN

Therefore, given that each component of the sector was calculated for both industry and in nature consumption, it is possible to affirm that the total number of workers linked to the sector is close to 19,754 people. 55% of the total posts belong to production destined to the industry while 44.8% of production destined to fresh fruit.

The permanent posts for both destinations represent 18.1% of the total estimated number of posts. This is an important component, since the transitional positions oscillate between 2 and 3 months during the period of pruning, thinning and harvesting for both destinations. In the case of the industry, the transitory positions of the canned sector were estimated for 12 months, according to the parameter of the Ministry of Labor, through the Minimum Index of Employment for packaging. As no available parameter was available for the processed volume or pulp processing, a percentage of pulp volume was used, which was 39%.

The summary of each of the components is described below.

Table 10. Summary jobs Industry and fresh

Total permanent jobs peach industry	1944
Total permanent peach fresh job	1633
Total employment transitional peach industry	8974
Primary activity	6802
Harvest	1822
Pruning	1177
Thinning	3803
Industrial Activity	2172
Canning factories	1563
Pulp processing plants.	609
Total transitional peach fresh peach	6892
Primary activity	4530
Harvest	1227
Pruning	991
Thinning	2312
Industrial activity	2362
Packaging and storage	2362
Total peach employment for fresh consumption	8836
Total peach industry employment	10918
Total employment for the sector peach season 2017/2018	19.754

Source: own elaboration

Considering that the number of people employed in the primary activity of Mendoza for the rural area is 64,220 people, the permanent posts of the peach sector represent 5.6% of the total employed. The transitory posts of primary production for both destinations represent 17.6% of the total employed in rural primary activities.

Therefore peach activity should be considered a relevant activity in terms of occupation of the province either by its permanent posts as transitory. In addition, for properties with less than 30 ha according to the peach census for industry, people employed in permanent posts are usually resident of the same properties, which has demographic implications for the rural and urban environments because they are internal migration recipients.

IMPLEMENTATION OF SMR PHYTOSANITARY MEASURES

As mentioned in the first part of the report, there are two complementary programs for the phytosanitary protection of fruit fly in Mendoza. On the one hand, a program to eradicate the fruit fly "Procem Mendoza" that carries out activities and actions to reduce the incidence of this pest. This program is supported by a bio-factory of sterile male fruit fly insects and sanitary barriers. On the other hand, the SMR, which is a system of certification of producers that was described in the introduction of this study [5].

The phytosanitary status of the province of Mendoza is divided into two, coinciding with the distribution of the three productive oases. On the one hand, to the north-east of the province, which contains one of the oases. This area has a phytosanitary status of low fruit fly prevalence. On the other hand, to the south zone where the oasis center and the south oasis are located, this zone has the phytosanitary status of Fruit Fly Free Area.

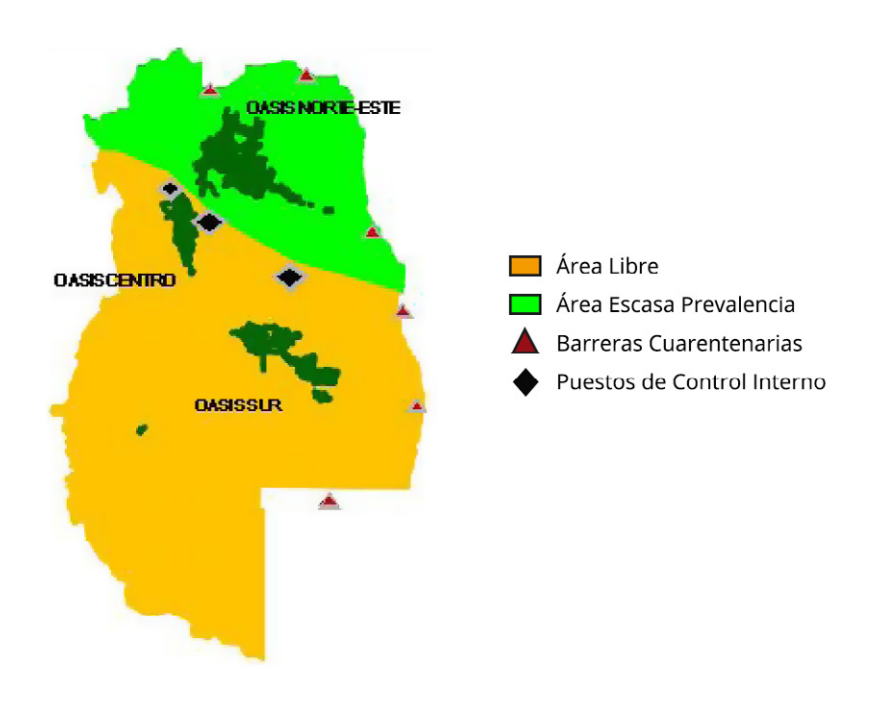


Image 2: **Phytosanitary measures in Mendoza**

Source: ISCAMEN

NOTE: Original image in Spanish

There are 1,789 fruit producing properties in the northern and eastern zones (SMR influence zone). Of these, 590 properties produce peaches (industry and fresh) which represents 33% [6].

If the producers are not in the SMR or they cannot sell to the south zone (Fly Free Area). It cannot also sell to wholesale markets in Patagonia, whose prices are higher than those paid in other wholesale markets, such as Buenos Aires. According to ISCAMEN estimates, there could be a difference in the wholesale price of 18.5% (last date of 2016), without discounting the freight costs involved to reach that market.

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5 The SMR is a program that producers are free to adopt.

6 This value is approximate, since there are establishments that produce several fruits, but the estimation was made from data of the IDR based on census and declaration of producers.

However, if fresh fruit producers are not in the SMR, this does not mean that their production is destroyed, but that they are placed in other markets at a lower price or their production is sold to the industry for processing such as canned or pulp.

For the 2017/2018 harvest there were a total of 182 properties registered in the SMR. Of this total number of producers, 26 were dropped and 4 of these 26 were discharged due to production of contaminated peaches.

The total fruit volume produced in the northern and eastern areas for the 2017/2018 harvest was 86,357,000 kg. The total volume of peaches produced in both zones (industrial and fresh) was 43,261,000 kg.

For the 2017/2018, peach volume produced within the SMR was 3,203,892 kg (industry and fresh)[7].

Therefore, only 7.4% of the production of peach (industry and fresh) used SMR out of the total volume of peaches produced in the north and east.

Similarly, considering SMR domestic production, it is possible to notice that for the referred harvest, the total fruit produced by producers within the SMR was 12,984,685 kg[8]. Therefore, the production of peaches (industry and fresh) reached only 24.7%.

Finally, the circulation of products from the primary production of industrial production takes place in greater quantity from the Free Area of Fruit Fly to the northern zone where the largest number of processing industries are located. For the 2017/2018 crop, the circulation of peaches from the low prevalence zone to the Fruit Fly Free Area was only 1%.

This can be observed by the evolution of the planted area and by a graphical representation of the product circulation. Both estimates were made by IDR.

7 This data comes from data provided by ISCAMEN in your POA. For the calculation of the kilograms of fresh fruit sold by SMR producers, the parameter of 18 kg per package was used, according to the IDR. For packages of other fruits, the parameter is 13kg.

8 ISCAMEN, POA

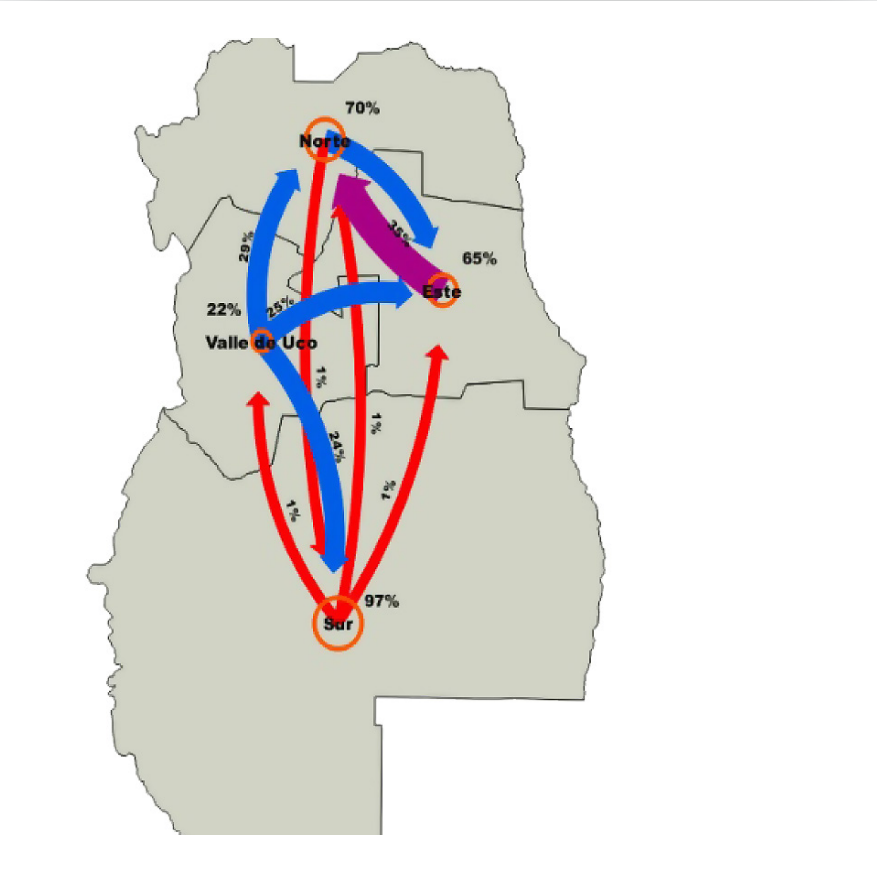

Image 3.
Commercial circulation routes of fresh peaches and industry

Source: IDR.
Reference: red color, peach industry circulation.

IMPACT OF NON-APPLICATION OF THE PHYTOSANITARY MEASURE ON EMPLOYMENT IN MENDOZA

The hypotheses for estimating the impact of the SMR phytosanitary measure on rural employment were as follows:

1_ That the phytosanitary measure means a guarantee not to lose the harvest of producers. Therefore, one cannot work with the assumption that if contaminated production was detected, it would be destroyed. This is not the case, since other types of production can be placed in other markets at a lower price, or it is delivered to industries in areas outside ALMF.

2_ The expected impact on production would reach primary production, in particular temporary posts linked to pruning.

3_ SMR as a phytosanitary measure to allow the circulation of goods to fly free area would ensure that producers had available markets (either for industry) or for fresh fruit destination in the south of the country. However, the production of peaches for fresh fruit is produced in large quantities in a fly free area and not in an area of low prevalence.

4_ Peaches only represent 24% of the fruit processed by producers within the SMR.

5_ We did not work with the assumption that the properties that belong to the SMR are more labor-intensive than the properties that are not. This assumption was discarded when analyzing the productivity of SMR properties and those that were not SMR. Therefore, a greater intensity of production would imply a substitution of labor in some chain components (in particular in the harvest) by mechanization.

According to the data analyzed previously, it is not possible to identify the impact due to the non-application of SMR in the low prevalence zone due to its scarce circulation from this zone to the fruit fly free zone.

In addition, peaches represent only 25% of the total fruit processed by SMR producers.

Although no direct effect on labor issues was found, it was possible to identify that, in the case of crop eradication by market decisions (price and quantities), the properties that would first fail to perform the primary activity would be those that are not in the SMR. Therefore, the less productive ones would be the most vulnerable to production impacts in the regional economy.

It is recommended to examine another phytosanitary measure that implies the destruction of crops, as well as a historical analysis of the sectors for a determination of the sector that is more relevant/determinant at the level of production (e.g plums).

SIMULATION OF EFFECTS ON THE ACTIVITY RATE FROM CHANGES IN QUANTITIES HARVESTED AND PLANTED AREA OF PEACHES.

In order to illustrate the usefulness of the model previously developed, three scenarios of loss of production and/or surface caused by the hypothetical effect of a pest for the non-implementation of a phytosanitary measure.

Table 11. Loss of permanent posts

		Number of jobs lost	Percentage of occupation in primary activities
Scenario 1	15% surface	467	0.73
Scenario 2	30% surface	825	1.29
Scenario 3	50% surface	1192	1.86

Source: own elaboration

Table 12. Loss of temporary posts

It is estimated that the main impact is on primary activities, in particular pruning.			
		Number of jobs lost	Percentage of occupation in primary activities
Scenario 1	15% volumen	283	0.44
Scenario 2	30% volumen	500	0.78
Scenario 3	50% volumen	723	1.13

Source: own elaboration

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