STDF Standards and Trade Development Facility

PROJECT: STDF/PG/460[1]

Mozambique regional report

Implementation of the International Standard on Phytosanitary Measures, ISPM 15 (Regulation of wood packaging material in international trade): An empirical analysis of how the regulation affects the economy of a group of countries in Africa

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08/09/2017

[1] www.standardsfacility.org/PG-460

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1. Introduction to the Mozambique report

The NPPO is the organization in charge of implementing the ISPM 15. It receives help –in terms of knowledge and resources- by the Plant Protection department, Ministry of Agriculture.

There are currently 4 WPM treating facilities in the country. Fumigation Internacional Lda –which is the first facility to be registered- is based in Beira; at the time of the first registration it used MB. This company showed the NPPO inspectors to have the necessary knowledge necessary to handle MB and it was, hence, given the license to operate as an official WPM treating facility.

The second company registered was Chazeira de Moçambique based in Gurue, province of Zambézia. This is a tea producer and exporting company; in order to reduce the costs of purchasing already treated WPMs, it decided to manufacture and to treat their own WPMs. The facility does sell treated WPM to third companies if requested.

The third company –ITFC- is based in Gurue, province of Zambézia. This is a forest company, whose chore business is to cut trees and sell the timber. The company later decided to manufacture and to treat WPMs too, as the initial investment cost was not too high. In the history of Mozambique, ITFC represents the first facility to treat WPMs only for other companies' use. As they are located far from Maputo, its main customers are exporters located in the north of the country. The company is planning to extend its business by selling the treated WPM in the neighbour Malawi.

The 4th company is based on Maputo and it serves all the exporting companies located in and around the capital.

The NPPO has been recently contacted by 2 potential facilities –both of them located in Beira- and the process of registration will soon start.

The registration process formally starts with the facility filling a form and sending it to the local NPPO; the form has to be accompanies by the official license released by the Ministry of Trade and Industry, and by the design of the facility, which includes a description of the available equipment and an explanation of all the processes needed for treating WPMs. A NPPO team composed by one technician from the quarantine sector and one from the agrochemicals registration and control sector visits the facility and conduct an inspection aimed at verifying that the ISPM 15s is observed. If the facility passes the inspection, it is then granted the use of the ISPM 15 mark.

One of the main challenges the country is currently facing in terms of ISPM 15 is the notification of non-compliance from other countries; the NPPO is working on the actions to take in order to improve the inspection process.

The Mozambique report looks specifically at the implementation of the ISPM 15, its effect at the trade level and the costs and the benefits of the standard implementation at the WPM treating facilities point of view. The report is organized in the following way; next section sets out the context of the analysis by describing the effects –both at the economic and non-economic level- of standards for trade. Section 3 deals with the description of the qualitative component of the research. It reports the content of a number of qualitative interviews with private and public stakeholders and it highlights the main implementation challenges the country faced. Section 4 describe the macroeconomic analysis to see whether the standard implementation has had any effects at the trade level. The analysis points out

which economic sectors have gained and which have lost in the international markets in the aftermath of the standard implementation. Section 5 looks at the viability –i.e. it compares the costs and the benefits- of the standard implementation from the point of view of the WPM treating facilities. The section looks at the costs and at the revenues the treating facilities face when treating WPMs.

2. Context and Framework of the Analysis

There are many environmental measures nowadays that help us regulate the impact of a diverse range of human activities on the environment. In many domains of environmental protection (such as air and water quality, provision of ecosystem services, climate stability), markets are not sufficient alone to regulate the extent of environmental degradation that affects welfare in a non-excludable and non-rival manner. In other words, market mechanisms cannot reduce the extent of "public bads", since it is often prohibitively expensive to exclude certain individuals alone from the welfare costs of environmental damage, while the disutility and displeasure experienced by any individual is independent of the one experienced by others. These are typically referred to as the case of "missing markets", where those contributing to environmental damage and those demanding a reduction of it do not physically meet to negotiate solutions to the problem, in the form of appropriate compensation mechanisms or other implicit pricing. In such cases, negative environmental externalities often affect other individuals than the ones generating them and policymakers need to intervene in order to limit environmental degradation.

On many occasions, policymakers resort to market-based instruments to control for the levels of environmental pollution and degradation (Pirard, 2012). This rather heterogeneous group of policy instruments incorporate a price component that aims at incentivizing (or disincentivizing) certain behaviors through the provision of financial rewards and penalties. Charges and taxes on pollution or environmentally-destructive activities increase the price of goods and services that result in pollution or excessive resource use. These can be applied per item (e.g. plastic bag levies) or based on measurable environmental parameters (e.g. a tax linked to the carbon intensity of fuels). Using financial penalties is a similar mechanism that goes a step further by implicitly "criminalizing" certain unsustainable behaviors and imposing monetary penalties to those deviating from the pre-defined "status quo". Instead of imposing charges that limit but nevertheless legitimize a certain activity, financial penalties treat non-compliant behavior as an environmental offence (e.g. a fine imposed on those discharging waste in a water source or engaging in hunting during certain periods of the year). Tradable permits is a form of policy mechanism that allows one to sell some entitled environmental rights that are not exercised, such as carbon permits in the EU emission trading scheme where environmentally-conscious companies may sell unused carbon allowances to firms that exceed their own quota (at a price determined by the overall supply and demand of total carbon allowances).

Naturally, market-based instruments can also reward certain types of behavior, as in the case of subsidies and fiscal incentives. For instance, several energy-saving technologies are subsidized at their initial stages of development and adoption (e.g. solar panel technologies). Fiscal incentives can render certain types of behavior more attractive to tax payers, for instance by exempting from income tax accrued revenues from "green" investments. Policymakers, and increasingly so also private companies and large investment funds, may also use positive discrimination in favor of public investment projects and contracts that have a positive environmental impact.

On many occasions, governments resort to policy measures that restrict pollution more directly, rather than through market price signals. These types of instruments are often referred to as command and control regulatory measures (Engel *et al*., 2008) or, alternatively, as non-tariff or non-market barriers to

trade when the measures apply specifically to imports and exports of goods and services. Again, there is a wide range of policy instruments that aim to directly influence the level of unsustainable activities (rather than indirectly via distorting relative prices). Licenses and quotas regulate the level of trade transactions (and hence amount of imports of certain commodities) through the issuance of permits and quantitative restrictions. In extreme cases, embargoes can be imposed on the entire amount of a particular commodity before reaching a destination market. Standards fall in this latter category of command and control instruments that restrict the production or trade of certain commodities as they often prescribe certain conditions that products need to meet in order to minimize health risks and enhance consumer protection. Environmental standards specifically aim at products complying with predefined processes that minimize or eliminate certain types of environmental damage. ISPM 15 addresses the need to treat wood packaging material thicker than 6 mm (to prevent the spread of pests and resulting damage to the ecosystems of importing countries) and falls into this category of standards.

There are some important issues that need to be recalled when discussing the distinction between the market-based and the command and control type of instruments (as in the case of phytosanitary environmental standards; see Harrington and Morgenstern, 2007). First, command-and-control measures directly regulate the extent of environmentally damage, rather than attempting to achieve this indirectly by influencing relative prices across traded commodities. Taxes and charges, instead, try to limit environmental damage by making environmentally-polluting products more expensive. While, in practice, taxes and charges may achieve similar results as command and control measures, their success depends on the underlying price elasticity. In other words, the decline in demand for an environmentally-damaging commodity will depend on how consumers and firms respond to price changes with respect to the initial level of prices. First, setting a tax at a very low level may result in a minimal adjustment of behavior; similarly, setting a tax at a very high level may achieve the exact same result that a more modest tax could have achieved. Second, charges and taxes do not only discourage behavior that damages the environment (when fulfilling their role as a price signal) but also generate public revenues. These additional public revenues can have multiple purposes. Governments, for example, can decide to make use of them to finance green public investment that further improves environmental quality. Thus, they can dedicate financial resources for the same purpose that the original environmental tax was adopted in the first place. Alternatively, governments can view these additional public revenues as a substitute for existing unpopular taxes. For example, environmental taxes could allow governments to reduce income taxes, particularly for those economies suffering from high unemployment rates. Environmental standards (and command and control measures more broadly) have, in general, a neutral fiscal effect, although governments can still collect some fees through issuing permits to those firms that are allowed to implement the standards. Historically, market-based instruments (such as tariffs) played a much more important role in generating public revenues, but the increasing prominence of other sources of taxable income (e.g. through sales or income taxes), accompanied by the development of a sophisticated system to collect these, supported a gradual transition towards non-trade barriers (and a gradual elimination of tariffs).

2.1 Implementation of Environmental or Trade Standards – Key Issues

There is a wide range of criteria policymakers need to have in mind when designing appropriate instruments, including environmental or trade standards. Effectiveness is naturally a key criterion to consider when selecting and designing policy instruments, which should grasp the extent to which the desired outcome has been achieved (e.g. preventing the spread of plant pests and diseases in the context of ISPM 15). In practice, policymakers and governments face multiple constraints when deciding the appropriate policy (or policy-mix) response to an environmental problem and as a result of this, multiple criteria are normally applied simultaneously. Efficiency is another critical factor that influences decisions behind the optimal response and policy instrument to tackle some environmental concerns this and primarily focuses on how well resources (public funds, human resources, etc.) have been utilized to achieve a specific (environmental) objective. This is also where cost-benefit analyses (similar to the one presented in Chapter 6) become handy, as they provide estimates on the country-specific net benefits (associated with a specific instrument) translated in monetary terms.

Policy instruments can rank differently when assessed in effectiveness and efficiency terms (Oosterhuis et al., 2014). While an instrument can be very effective in environmental protection, it may at the same time be very costly (and inefficient), leaving few other resources available for other uses. Efficiency becomes a more meaningful concept when trying to take into account any indirect (positive or negative and often unintentional) effect that the policy instrument is likely to induce. Environmental standards, for example, increase the cost of exports and may, hence, result in a considerable loss of competitiveness. This effect is likely to be sector-specific (and is the focus of Chapter 5), depending on the final change in consumer prices and producer profits, as well as the intensity of competition in international markets. Some sectors, such an environmental improvement can, for this reason, come at the expense of output loss and increased unemployment for the local population. For other sectors, there can be an increase in employment and demand by allowing local firms to export to new markets with more stringent environmental regulations. Furthermore, the increase in demand for environmentally compliant materials could, for instance, also create additional employment for treatment facilities, inspection agencies, and so forth.

Implementation costs of standards or other policy instruments are naturally an integral part of efficiency. Some obvious direct costs of implementation (e.g. related to acquiring specialised equipment to manage the standard, or training personnel) are straightforward to calculate in monetary terms. Trade and environmental standards often involve multiple other, less direct, transaction costs that would also need to be taken into consideration. These include:

i. Information costs. These relate to the information that is required to implement effectively the standard. For example, awareness raising campaigns to sensitize the public or firms to the necessity of the standard and its environmental benefits, or surveys to capture the expected responsiveness of target groups to a change in price as a result of the implementation.

ii. Administrative costs. These can be substantial costs (both for the government and target groups) when the standard entails detailed bureaucratic procedures with large numbers of individual firms or households involved (e.g. processing and evaluation of forms, or sampling costs). For the government,

the costs also often involve planning and decision-making costs; for instance staff costs in policy-making departments, as well as the cost of stakeholder consultations.

iii. Monitoring and enforcement costs. These depend on the complexity of the requirements and the efforts involved in verifying compliance with the standard. These costs can be borne either by the government or by the target groups. Corruption is often one of the key constraining factors (particularly in developing countries) behind enforcement of standards and it is often perceived as a separate cost itself.

iv. Judicial procedures. A standard will be less costly in this respect if its provisions and conditions are clearly specified and unambiguous. Nevertheless, legislative amendments, required to support implementation, can involve substantial costs and may delay implementation.

In addition to these costs, a number of other situation-specific considerations play a role in terms of identifying how successfully a trade or environmental standard is implemented:

i. The scale and nature of associated environmental benefits. It is likely that the legitimacy and social acceptance of a standard will be higher (as a means to ensure some environmental benefits, such as pest control in the case of ISPM 15) when the public sees a close link between the standard's implementation and its intended environmental services.

ii. The number of actors involved. The larger the number of government departments and companies involved, the higher the associated transaction costs described above are likely to be. The spatial distribution of actors can also be relevant; costs are for instance likely to be higher when the monitoring and enforcement process of a standard takes place in multiple locations.

iii. Financial constraints of the local government or institutions. This is particularly relevant in the case of developing countries where the successful implementation of the standard might be hindered by the availability of resources. Even when these resources become available, they might come at the expense of the provision of another public good.

iv. Social and cultural conditions. Customs, habits and traditions can affect the acceptance of a specific standard. Misconceptions and the spread of inaccurate information can hinder the acceptance and enforceability of a standard. This is also likely to happen when the standard is at odds with established social norms and common practices. In such cases, there is often much resistance to change, when a new (potentially beneficial) instrument is introduced. Consequently, low social acceptance will typically lead to infringements and this, in turn, to reduced effectiveness and high enforcement costs.

2.2 Economic and Non-Economic Impacts of Standards

Any thoroughly conducted cost-benefit analysis needs to take into consideration all these additional socio-economic side effects (positive or negative) that are associated with the implementation of a standard. Many of these, often indirect, side effects might not be evident at first sight. The implementation of a standard, for example, can create employment gains or losses in associated economic sectors and changes in competitiveness as a result of price distortions.

In the case of trade standards with an environmental objective (as ISPM 15), the expected environmental benefits associated with the standard's implementation also need to be monetized and contrasted against costs. There is a wide array of benefits that need to be incorporated into such an analysis (Born *et al*., 2005), specifically:

i. Direct use values, which can for instance be (a) consumptive use values when the standard aims to preserve an environmental asset that will be consumed in the future (timber, food, etc.); (b) recreational use values, which indicate the environmental asset preserved (e.g. forest) that is valuable to individuals for recreational purposes (for walks, camping, etc.); (c) aesthetic use values, as evident from the price premium associated property in the vicinity of the environmental assets. In addition, for specific (often indigenous) communities, environmental assets can also provide significant spiritual values and fulfillment.

ii. Indirect use values, which include preserving an environmental asset (e.g. forest) through which also additional environmental services are safeguarded. For example, forests provide ancillary ecosystem services to local communities in the form of flood protection, improved erosion control, protection of water resources and biodiversity, and more, as well as benefits in the form of carbon sequestration for the global community.

iii. Option values, which relate to the value of potential (i.e. as of yet an undiscovered potential for use in the future). For example, the preservation of a particular species may allow the development of some future medical breakthroughs.

iv. Non-use existence values, which concern the satisfaction of continued existence of an environmental asset, even when there are no immediate tangible benefits associated. People might value the continued existence of a particular tropical forest or natural habitat, even if they never visited or intend to visit it in the future.

v. Non-use bequest values, which relate to the satisfaction one receives by ensuring that the environmental assets remain available to future generations. This is an issue of intergenerational equity and fairness where current individuals wish to safeguard the possible (yet unknown) satisfaction of future generations.

vi. Non-use altruistic values, which are those attached to a resource being available to others in the current generation. This captures the issues associated with intragenerational equity and fairness; although we might not be directly affected by a certain loss of an environmental asset, we value that this environmental asset is available for other communities and individuals (many of whom might have limited opportunities to substitute such an environmental asset with another one).

Any comprehensive cost-benefit analysis associated with a trade standard with an environmental objective should attempt to incorporate as many of these values as possible. Naturally, attaching monetary values to all the benefits discussed above is a formidable task that, in most cases, allows us only to approximate the real value of a particular environmental asset. Furthermore, this largely remains an anthropocentric approach to the benefits of environmental assets, given that the latter are directly or indirectly measured through human preferences.

2.3 Standards and Issues of Fairness

Fairness is another important dimension that policymakers should consider when designing a new standard (Gross, 2007). Environmental standards, for instance, are often designed with an emphasis on the attainment of certain environmental targets, with little consideration given to how certain groups (e.g. low income groups, women, indigenous people, small-scale firms) may be disadvantaged or proportionately less favoured in the process. Small firms may be unintentionally excluded from the implementation of a new standard because of budget constraints due to initial transaction costs, or simply through informational barriers. Much literature points to multiple barriers (financial, informational, discriminatory) that particularly women often disproportionately face when they attempt to engage in new business practices (Brindley, 2005; Pehrsson, 2009). There is also evidence pointing to a lower participation of small firms in many new environmental initiatives, often as a result of limited access to capital and skills or due to higher transaction costs compared to their income. Small firms may also be less willing to align their production methods to a new standard, when this adjustment entails uncertain financial returns given their high discount rates and relatively high risk aversion. This also concerns perceptions of typically disadvantaged groups regarding whether they feel that their voice is heard in the design and implementation of a standard. This type of fairness is often referred to as "procedural justice".

Another important aspect of fairness relates to the so-called "distributive justice"; the distribution of benefits (and costs) when the standard is implemented. Distributional justice can be examined at multiple levels. It might be that the costs of implementation of a particular standard affect small-scale firms disproportionately negatively (that subsequently struggle to maintain a positive profit margin and hence remain in production), or that firms that comply with the standard experience little improvement in the demand they face (and, hence, lose competitiveness with non-compliant producers). Fairness also relates to the distributional aspects of any anticipated benefits. It may be, for example, that any additional employment opportunities stemming from the implementation of the standard, only benefit specific groups of employees. In the case of trade standards with an environmental objective, the associated environmental benefits might largely accrue to others than those paying for the costs of implementation, and in many cases the beneficiaries might be located in other areas or even countries compared to those who bear the costs of implementation.

There are multiple ways to address issues of distributive injustice. In some cases, it might be possible that the additional cost initially borne by the implementing actor of the standard can be passed on to the ones ultimately enjoying the benefits accruing from the standard. This is not always easy, given that even in the case of agreed higher prices (e.g. passed to the final consumer), depending on the price elasticity of demand, those implementing the standard can face a substantially lower demand for their product and consequently a drastic reduction in profits. In other instances, the government or an international agency can compensate those who lose out from the implementation of the standard.

Perceptions of fairness, as to participation and distribution of benefits and costs, are often instrumental in the success of the implementation of and compliance with a standard. The legitimacy of new standards can, for this reason, depend on the following factors: (a) how involved actors are approached and how actively they become engaged in the process; and (b) the distribution of involved costs and

benefits, and compensatory schemes. In this sense, fairness perceptions are likely to relate to how involved actors reflect on the entire implementation process, from the beginning when the standard is designed extending to the stage when it is advertised, administered and monitored.

3. ISPM 15: findings based on qualitative interviews

This chapter will describe and critically analyse all the procedures put in place by the Mozambique NPPO to implement and comply with ISPM 15. The material used in this section derives from qualitative interviews with a number of stakeholders involved in the ISPM 15 implementation and compliance, such as exporters and importers, inspectors, and WPM treatment facility personnel. Through our descriptions of the field research in Mozambique, we will highlight the malpractices adopted by the ISPM 15 implementing agencies. Malpractices put in place by other agencies or organizations, either public or private, and that affect the correct implementation of ISPM 15, will be discussed too. Some of the malpractices are country-specific –i.e. are peculiar to the Mozambique case- but in most cases the same challenge and mal-practises highlighted in Mozambique can be detected in other countries too.

The rest of the chapter is organized in the following way. The next section will describe the field research undertaken in Mozambique; first we introduce the missions followed by a brief description of the interviews carried out with the stakeholders and an elaboration of the main findings. The policy implications of our findings and the main recommendations are summarized and discussed in the last section, whereas the appendix shows photos taken during the missions to help illustrate the issues discussed in this chapter.

3.1 Field research

The mission to Maputo, Mozambique, took place from 31 January and 5 February 2016. A complete list of the interviewed stakeholders can be consulted in Table 2.

Mozambique is located in the South-East part of Africa. Its location is strategic in terms of trade, as its ports are used by neighbouring and land-locked countries –Malawi, Zambia and Zimbabwe- to import and export goods. The implementation of the ISPM 15 in the country has been advertised in the national gazette. Despite that, there are several stakeholders –both private and public- whose knowledge of the international standard is still limited. The NPPO has prepared a manual for the import inspection, which is lacking in the other countries part of the project. The major challenge is represented by the fact that there is a limited number of WPM treating facilities; out of the existing 4 companies, only one is located in the Maputo area which is the one where most of the exporting businesses are concentrated and where the main commercial port is.

Interviews with the stakeholders

The Director of the NPPO, Ms Mangana, explained that the country started to implement ISPM 15 in 2007 (Figure 4 shows the first page of the official gazette where information about the implementation of ISPM 15 was given). The first WPM treatment company was officially registered during the same year, and there are currently three authorized WPM treatment facilities, all located in the northern part of the country, and one that has applied for authorization, located just outside Maputo. The application process foresees alone a request letter from the company and a visit from the NPPO to verify that the

company has all the necessary equipment needed to treat WPM. No further paperwork is needed (e.g. regards training of employees, status of the workers in the company and of the company). Both the license and the renewal are free of charge. The NPPO audits all the facilities once a year, mainly to check the treatment records. The NPPO is considering increasing the inspections to two per year. The NPPO is currently not offering any training to the facilities.

Ms Mangana pointed out several challenges that the NPPO is struggling to address, such as the inadequate flow of communication (partly due to the absence of awareness policies) between the NPPO on one side and customs, several ministries and exporters on the other. This lack of communication may lead to some inefficiencies in the short and long term and often mean that no entry inspections are carried out for the WPM used to transport non-fruit or non-vegetable products. Lack of awareness about the existence of ISPM 15 is reflected in the fact that there is no WPM treatment facility in Maputo, where most of the industries are located and where the port is.

Regarding capacity development, the NPPO took part in a quarantine course organized by the FAO-IPPC in Zambia in 2015, and one NPPO representative participated in an ISPM 15 workshop in Vancouver in 2005[3]. IAPSC used to organize some training workshops on phytosanitary measures but has reduced its activities in the last years.

Mr Luis and Ms Francisco work for the pesticide registration unit within the Ministry of Agriculture. Part of the Ministry's mandate is to register the use of MB, which can now be used only for quarantine purposes. Despite the fact that MB is allowed for treating WPM, there are no WPM treatment facilities using this chemical as it is common knowledge in the country that the use of MB has been phased out for all uses. As a result, Mozambique is not importing any MB at the moment. Neither Mr Luis nor Ms Francisco is aware of the international standard. Mr Sulila, who is the country focal point for compliance with the Montreal protocol, confirmed that the use of MB stopped in 2015. United Nations Industrial Development Organization (UNIDO) has the mandate to gradually reduce, with the purpose of eliminating, the use of MB at an international level, as UNIDO promotes industrialization in developing and transition economies, and helps the central governments to comply with the Montreal protocol. Also the UNIDO representative, Mr Comiche, pointed out that the relation between the international organizations and the central government is not very strong and the communication between them lacks. As an example, Mr Comiche highlighted that the agricultural production in Mozambique decreased when the ban to use MB for agricultural-related purposes was issued, but the Ministry of Agriculture never contacted UNIDO to find possible alternatives to MB in agriculture.

The meeting with the Agriculture Forest Resources Department, represented by Ms Alves, was useful to understand that this research division has recently started to take actions regarding pest control. Specifically, they recently launched a survey with the aim to record all the different types of pests in the country. The emphasis of the survey is on pests such as the Lue gum chalcid wasp (*Leptocybe invasa*), Gum lerp psyllid (*Glycaspis brimblecombei*) and Bronze bug (*Thausmastocoris peregrinus*), and when the

[3] For more information about the workshop held in Vancouver, see https://www.ippc.int/en/core-activities/capacity-development/ippc-workshop-practical-application-ispm-no-15vancouver-canada-28-february-4-march-2005/ (last accessed: 22/06/2017).

pests have been recorded, there will be an effort to identify the pests' natural enemies, which can be used to eliminate or control them. As to ISPM 15, Ms Alves said that her team is not aware of this international standard.

The lack of awareness on matters related to ISPM 15 is shared with the Ministry of Trade, represented by Mr Mavila, head of the Market Division. Despite the fact that his team daily deals with issues related to exports and they help exporting companies in accessing new foreign markets, he has never come across ISPM 15.

Mr Uamusse, head of Maputo Phytosanitary Inspection Division, receives directions from the NPPO. Mr Uamusse is aware of ISPM 15 and he and his team inspect the imported agriculture goods coming by sea – about 40 percent of the total imports. Inspections are also carried out on exported goods to make sure that the WPM used by the exporting companies in Mozambique is complying with the international standard.

Inspections are conducted following the guidelines given by the NPPO and reported in a booklet (Error! Reference source not found.Figure 4). The share of the WPM inspected by the phytosanitary inspection division is reported in Table 1. No record is kept of cases of ISPM 15 non-compliance. Similarly to what has been reported in other countries, non-agricultural imported consignments are not inspected for compliance with IPSM 15. Those consignments are inspected by customs to verify that taxes have been paid. Mr Uamusse also stressed that Mozambique's neighbouring landlocked countries (Malawi, Zambia and Zimbabwe) use the port of Maputo for importing and exporting goods. The volume of the goods entering into Mozambique via the port (imported by and exported to three mentioned countries) is too high for the inspectors to be able to conduct the necessary inspections.[4] The NPPO has requested the central government to supply additional 72 inspectors (Figure 5).

Table 1: Share of imported WPM that the phytosanity inspectors should inspect

Number of imported WPM	Share of imported WPM to be inspected
>10	Inspect all the units
11–100	10% or 5 units minimum
101–1000	2% or 10 units minimum
>1000	1% or 20 units minimum

Notes: This summary table constitutes an extract of the "Manual Pratico para Inspector Fitossanitario".

Mr Macuacua, representative of customs, confirmed that the organization is aware of ISPM 15. Contrary to what the NPPO inspectors had said, Mr Macuacua highlighted that customs inspectors have the duty to call the NPPO inspectors every time they are about to inspect a consignment that is transported on WPM; failure to do so may result in the withdrawal of the permission to import. Nevertheless, Mr Macuacua suggested that there is some confusion as to which institution is supposed to conduct the inspections and that clearer areas of responsibility between them would ease the process. He also

[4] According to the transit standard (ISPM 25) consignments in transit are subject to the same requirements as imports.

stressed the need for awareness campaigns on ISPM 15, as many stakeholders are not familiar with the standard.

One of the major issues the NPPO is currently facing relates to the non-authorized WPM treatment facility called IMMOGROUP. This facility, which opened in 2013, has requested the license to treat WPM in accordance with ISPM 15 but the NPPO has not granted the license yet because it is not satisfied that the scheme IMMOGROUP will adopt is in accordance with ISPM 15; IMMOGROUP wishes to purchase treated timber from Swaziland, manufacture the WPM and stamp it with the ISPM 15 mark without treating it further. This impasse is deleterious for a number of stakeholders; the IMMOGROUP cannot start its treatment business, the NPPO is struggling to find a suitable solution, and all the exporting companies located in Maputo and its surroundings are forced to buy treated WPM from other countries.[5]

Woodland is a WPM manufacturer with eight full-time staff and a production of approximately 300 pieces of WPM per day. The eucalyptus timber used by this company comes from South Africa as the timber reserves in Mozambique are too far from Maputo and it would be too costly to transport timber from the north of the country. Its main customers are beer exporters, which use the WPM for both the national and international movement.

As for the other countries, also Mozambique has the problem of WPM repairer facilities. Just outside of Maputo a number of WPM repairers are located (Figure 6). The main threat these facilities pose in relation to ISPM 15, is the same as in the other countries, namely that treated WPM is repaired using non-treated wood and resold as treated WPM. The price of repaired WPM is between 150 and 300 MZN, which is half the price of what a newly manufactured WPM would cost. The NPPO is aware of the problem but is not monitoring the facilities' activities.

The research team also visited two banana producers that export internationally. Rioverde has branches in four districts of Mozambique – Maputo (the one the research team visited), Boane, Moamba and Namacha. The company buys treated WPM from South Africa and uses it for both national and international movement. The company has tried to buy treated WPM from Mozambique-based facilities, but the cost was higher than that offered by their counterparts in South Africa. The WPM they use for transporting bananas returns to the company, which then repairs it if necessary – but no additional treatment will be applied – or displaces it. None of the WPM has had pest interceptions. However, the fact that the WPM is marked with a South African mark, repaired with untreated WPM in Mozambique and then re-shipped, means that any non-compliance notification would go to South Africa and not to Mozambique.

A similar story was told by Beluzi, another banana producer and exporter, that buys treated WPM from South African. The company purchased about 17,000 treated pieces of WPM in 2013 and about 25,000

[5] ISPM 15 refers to "producers" who are those manufacturing the WPM and that may apply the mark to appropriately treated WPM), and to "treatment providers" who are those applying the approved treatments and that may apply the mark to appropriately treated wood packaging material. WPM subjected to the approved measures shall be identified by application of an official mark in accordance with Annex 2.

in 2014. There are several other banana exporting companies in the area and they seem to all purchase treated WPM from South Africa.

Table 2: List of activities for the mission to Mozambique

Name of the Company / Organization / Institution	Contact person	Main activity
NPPO	Armand Come	NPPO representative
NPPO	Serafina Mangana	NPPO director
MASA/DINas	Luis Francisco	Treat wood pallet materials using MB
UNIDO	Leonildo Munguambe and jaime Comiche	United Nations
Ministry of Forestry	Darlindo	Government
Ministry of Agriculture	Alves	Government
Custom Organization	Macuacua	Customs
Port Inspectors	Lucas Uamusse	Phytosanitary inspectorate
MITADER	Leonardo Manuel Sulila	Ministry of Land, Environment and Rural Development
IMMOGROUP	Nicola Francescon	WPM producer and treating facility
Agrifocus	Lizi Mabate Marrengula	Company importing pesticides
Ministry of trade	Mavila	Government
WPM repairer	n/a	WPM manufacturer
Woodland	Colla Sono	WPM manufacturer
Rioverde banana exporter	Jose' Maluana	Exporter
Beluzi banana exporter	Paulo Nogueira	Exporter

Note: Transcripts of the interviews are available upon request.

Main findings

Through the interviews with the stakeholders involved in the implementation of ISPM 15 at both the import and export levels, a number of interesting key points have emerged. These are summarized in the text that follows and translated into policy recommendations in Chapter 7, where the results of the qualitative interviews will be combined with the macro- and microeconomic analysis.

Figure 1 shows how the country as a whole and the NPPO in particular have organized the implementation process.

i) ISPM 15 awareness

The NPPO would need support to increase stakeholder awareness about ISPM 15; currently, there are several representatives of various ministries of relevance to the implementation of the standard that are not aware of it and this hinders coordination of activities. In addition, the Ministry of Agriculture is not aware of the possibility of using MB for WPM treatment purposes.

ii) Inspections of imported goods

Similarly to what has been concluded in the other countries involved in the project, also in Mozambique the NPPO inspectors inspect only WPM used to import fruit and vegetables. Other imports are inspected by customs and they do not check WPM for compliance with ISPM 15.

iii) Inspections for goods to and from neighboring countries

Related to the point raised above, the NPPO is aware of a high volume of traffic of informal or unofficial exports from Mozambique to neighboring and land-locked countries but the NPPO is not able to address this problem due to lack of resources.

iv) Land-locked neighboring countries and their exports

The land-locked neighboring countries (Malawi, Zambia and Zimbabwe) all use the port in Maputo to import and export commodities. The consignments that are imported by these countries are regularly inspected, whereas those exported are not. The main reason for this is the lack of inspectors to see the number of available inspectors operating in Mozambique and the number of inspectors the country needs).

v) Lack of WPM treatment facilities in Mozambique

There are only four operating WPM treatment facilities in Mozambique and all of them are located in the North of the country, wherefore most of the Maputo-based export companies have to buy treated WPM from South Africa or Swaziland as less costly. This may represent a loss for the national economy. One WPM treatment facility located in Maputo area has requested authorization to treat WPM for two years but the license has not yet been granted.

vi) WPM repair facilities

There is an area of Maputo where there are approximately 50 small companies repairing broken WPM, where the WPM is reassembled by using parts of treated and un-treated WPM. The NPPO is aware of these businesses but is not addressing the risk this WPM represents.

vii) Is one treatment better than the other?

One exporting company stated that some importing countries refused WPM that had been treated using heat.

viii) More about the perceived efficacy of the two treatments

Related to the point raised above, WPM treatment facilities are skeptical about stopping the use of MB in favor of HT, as exporting companies fear that importers may refuse their consignment when moved on heat treated WPM. This idea clashes with the understanding several stakeholders have, namely that the Montreal protocol has banned MB for all purposes.

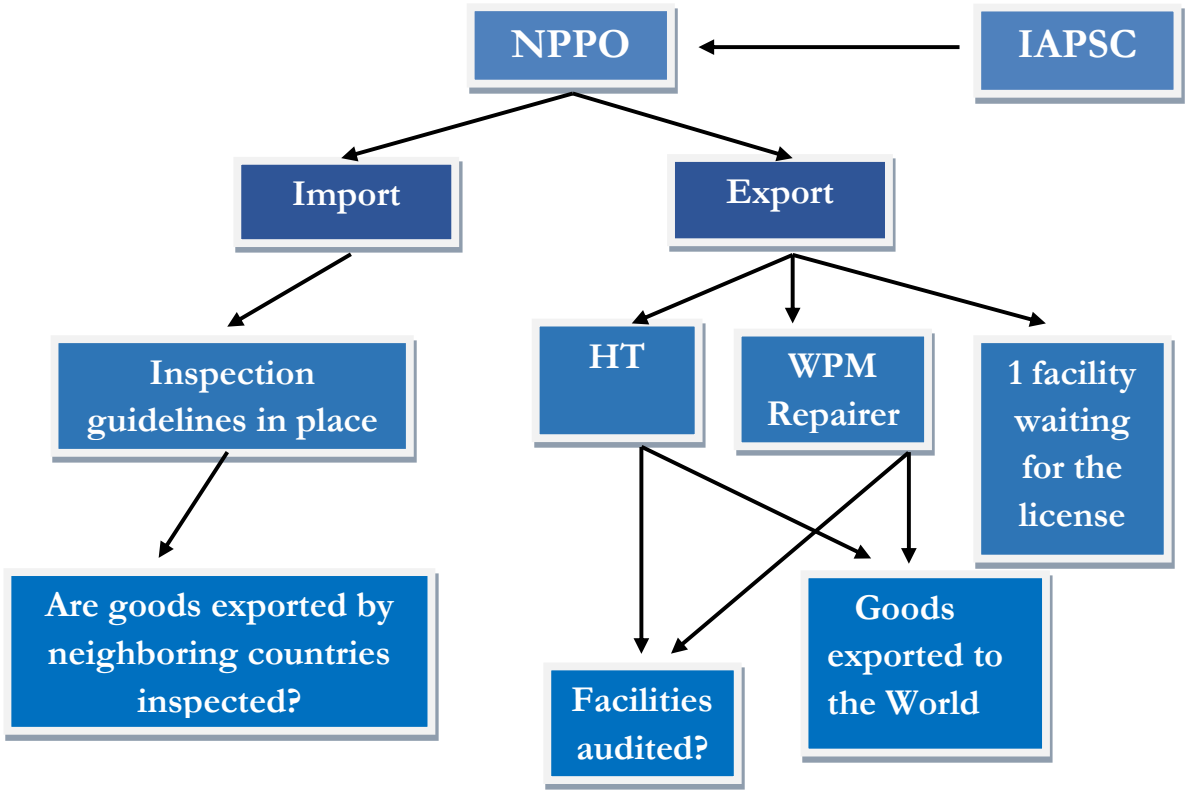
ix) Training and capacity building

The NPPO has not offered any type of ISPM 15 training to the representatives of treatment facilities based in Mozambique. Likewise, IAPSC has not offered training to the NPPO despite the common perception that IAPSC should have a stronger impact on the NPPO. NPPO representatives did receive training from FAO-IPPC in 2008.

x) Solar energy?

The NPPO has never thought of designing or using an HT chamber that runs on solar energy, although the average temperature in many areas of Mozambique is 38–39 °C, with temperatures reaching also 47 °C in December.

Figure 1: Flow chart of the ISPM 15 implementation process in Mozambique



Note: Authors' elaboration

3.2 Policy implications and policy advice

Through the country missions and the stakeholder interviews, a number of malpractices were highlighted in relation to the working procedures of NPPOs and other organizations when implementing ISPM 15 (see Table 3). In some cases, these malpractices were generated from a misunderstanding of the standard. In other cases, the NPPOs are aware of the malpractice but they do not have the necessary resources or an adequate level of know-how to address it. It may also be that the NPPO is not aware of the specific issue.

Improvements in how ISPM 15 should be implemented should come from several directions. In the text that follows we propose possible solutions to the identified malpractices out. These proposals all stem from ISPM 15 or from procedures adopted by other NPPOs in other areas of the world. Some of these proposals will be discussed in more details in Chapter 6, where qualitative results will be merged with the macroeconomic evidence and with the results stemming from the microeconomic analysis.

Table 3: Overview of the malpractices observed when implementing the ISPM 15 in the four case-study countries

Malpractice	Mozambique
Auditing the WPM treatment facility	V
Lack of inspections for imported goods	V
WPM repairers	V
Awareness of ISPM 15	V

Source: Authors' elaboration.
Note: "V" indicates that the malpractice is present in the country; whereas "X" indicates that it is not present

Regulation

An NPPO that needs to implement a standard should first develop a legislative and regulatory framework that will help explain it, to support delegation of functions as needed, and support auditing activities and inspections. In other words, each country should develop a number of laws to ensure that the standard is well described in its entireness and all the stakeholders are well aware of its existence. Efforts should be made to inform all stakeholders whose activities may be affected by the standard of its existence.

In Mozambique, the legislative base exists but covers only a part of the needed information (i.e. only a manual on how to conduct inspections on imported goods). The legislative support should explain all the steps needed to implement and to comply with the standard, and should therefore, among others, explain the approved treatments adopted and how to certify their uses, how WPM treatment facilities obtain license to operate, how to carry out audits, how to inspect imported consignments and how to disincentive fraud.

In what follows we try to enumerate all the information the legislative tool should have and we propose interactions and exchange of information between the public and the private sector.

Coordination

Awareness campaigns should be organized and informative brochures be prepared to promote the existence of the standard. As it stands several important stakeholders are still not aware of ISPM 15, including ministries regulating trade, agricultural activities, or in charge of safeguarding the environment.

It should be clear that the correct implementation of and compliance with the standard is not the responsibility of the NPPO alone, but a joint effort of all the stakeholders, both public and private.

Import control

Since WPM is associated with almost all shipments, including those that are not the target of phytosanitary inspections, cooperation with custom agencies is a *sine-qua-non* requirement for a correct implementation of the standard. The way inspections for imported goods are organized are similar in the four countries; the NPPO inspect plant-related imports, while customs inspect all imports for tax purposes. As there is no exchange of information between these organizations as to the arrival of consignments, which are not plant related, the WPM associated with these consignments are rarely inspected. Cooperation between customs and NPPO should be reviewed to ensure effectiveness in detecting potential non-compliance of WPM.

In this chapter we mentioned that other countries overcome this challenge by establishing a database of commodities that are most likely to be associated with WPM. Customs then targets these commodities and the NPPO inspects the WPM. Overall, an inspection manual should be prepared to inform inspectors on the share of imports to be inspected and based on what principle, and which actions should be taken when cases of non-compliance occur. It should for instance be decided whether to inspect randomly or according to assessment of risks based on the exporting country or type of consignment.

Continuous training of all staff (customs and NPPO inspectors, port employees) should be organized. A number of countries rely on paper documentations to track consignments. This challenges sharing of knowledge and the identification of pest risks, as the data is not easily analysed. All steps of the implement process should be computerized (lessons should be drawn from the ePhyto system).[6]

Definition of all those measures related to the non-compliance at the point of entry

Where WPM does not carry the required mark, action should be taken unless other bilateral arrangements between countries have been put in place. This action may take the form of treatment, disposal or refused entry, and the NPPO of the exporting country should be notified (ISPM 13 *Guidelines on notification of non-compliance and emergency action*). However, the authors did not find evidence of NPPOs having set up guidelines for non-compliance situations.

Treatments used

The treatments should be monitored extremely well by the NPPOs. Treatments different from those approved in ISPM 15 should not be used for treating WPM. One of the main objectives of the audits should be whether the length of the HT are appropriate (see also *Contents of the audits*).

Content of the audits

Does the chamber used for the HT meet the prescribed operating conditions? Is the HT chamber properly loaded to allow the heated air to move through the entire load? Is the chamber equipment properly calibrated? Will the starting temperature of the wood – e.g. frozen wood – affect the treatment duration? Is the chamber appropriately sealed? Such questions highlight the fact that appropriate auditing would help improve implementation of the standard. Many interviewees stressed that audits need to be more accurate more frequent and unexpected, and records of the treatment

[6] For more information on the ePhyto project see http://www.standardsfacility.org/PG-504 (last accessed: 28/06/2017).

operations need to be seen and studied. The auditor needs to be able to answer questions related to the mark application, and if the mark is in line with the ISPM 15.

All this information is necessary to gather a complete view on different phases of the implementation process. As we have seen, malpractices can occur for a number of reasons; it is possible that WPM treatment facilities attempt to treat WPM according to ISPM 15 but that the treatment is not applied properly. This may be because the minimum required dose of fumigant or heat, or the time of the treatment are not adequate. The malpractices that may lead to non-compliance can be unintentional. As an example, a WPM treatment facility may follow the treatment schedules correctly based on sensors within the chamber, but because of cold pockets or uneven distribution of the fumigant not all wood is treated equally.

For heat treatments, ISPM 15 specifies that temperature probes need to be carefully inserted to the core of the largest wood pieces present in the chamber during each treatment cycle. If the probes do not reach the centre of the wood or if a probe is not well sealed from the ambient air then the target temperature of 56 °C will be indicated sooner than it should. To obtain accurate readings all equipment must be calibrated and working properly. In addition, fans are often needed in chambers to help circulate the fumigant or heated air, and the individual pieces of WPM should be properly stacked to ensure good airflow. Each of these factors, as many others (e.g. presence of bark, cross-sectional size of wood pieces), could result in reduced mortality of the pests during treatment and in the subsequent non-compliance.

Understanding how the WPM treatment facilities apply MB or HT is as important as defining what happens if inspections of those facilities find non-compliance. Is the facility interdict from operating for a limited period of time? Is it inspected more frequently? What happens to its stamp if the facility is suspended for some months? The NPPOs should take punitive action against the non-compliant companies and this information should be made public. NPPOs in other countries often take such action to incentivize other facilities to comply. As an example, Canada publishes the information of non-compliant facilities, thereby creating a deterrent for other producers. In our understanding, such actions are not being taken in the four case-study countries.

Fraud

Episodes of intentional ISPM 15 non-compliance or fraud can occur. This happens when the ISPM 15 stamp is knowingly applied to WPM that has not been treated, or not properly treated. Widespread usage of WPM with fraudulent marks, especially if infested, would reduce the apparent impact that the ISPM 15 has on reducing WPM infestation rates.

While we were not made aware of any intentional case of non-compliance, the issue of WPM repair facilities remain serious. These facilities repair broken WPM with an end result that appears to be treated WPM, as it has the ISPM 15 stamp. However, the repaired WPM may not necessarily comply with the ISPM 15; this is only the case when the repaired part is maximum a third of the total wood.

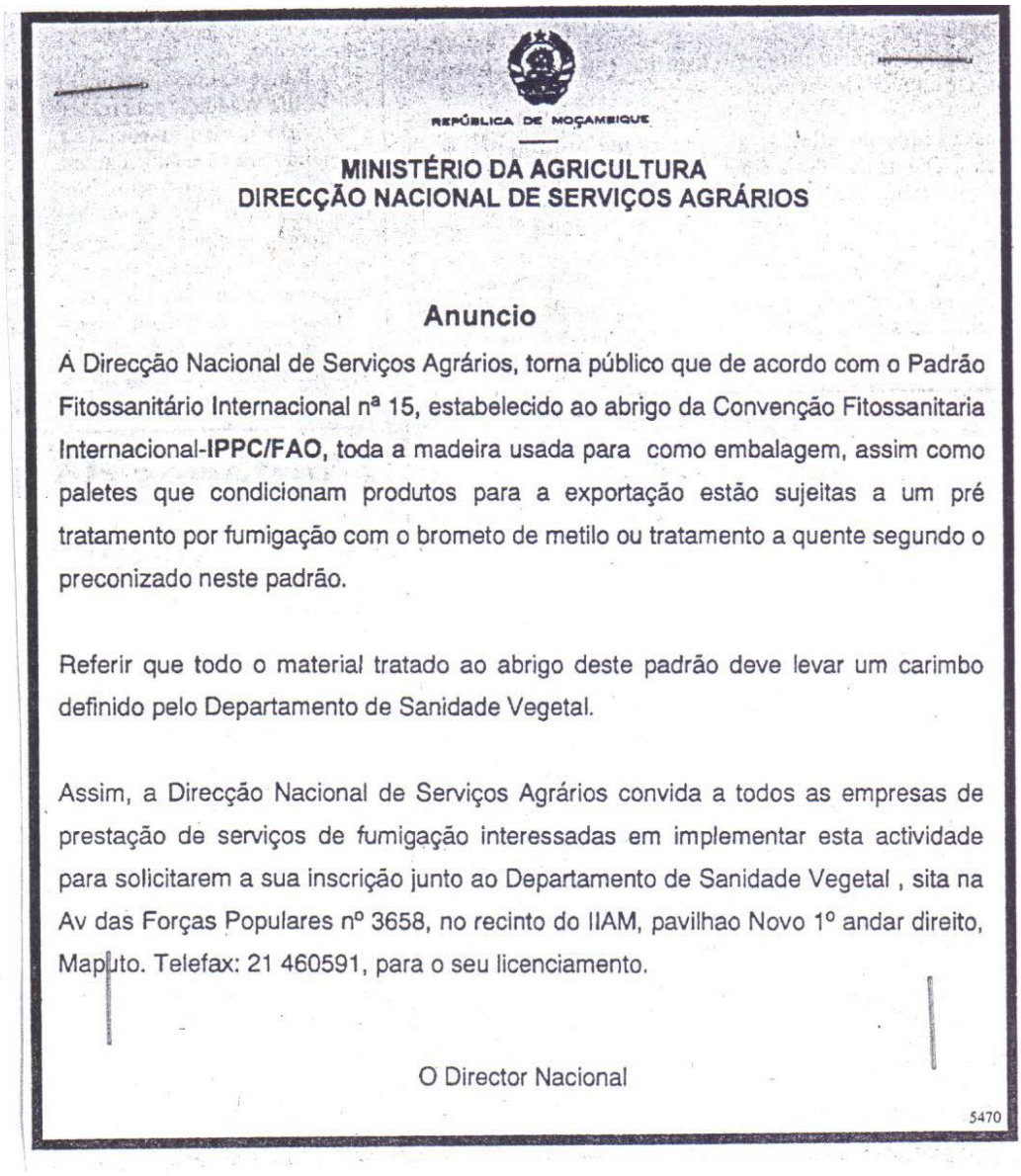
Database on pest interceptions

Several countries maintain databases of pests that are intercepted at their points of entry. Long-term pest interception databases have been developed by governments and NPPOs in Australia, Canada, Chile, Europe and North Africa (developed by the EPPO), Mexico, New Zealand, and the US. Typically, inspectors target high-risk products, countries of import or pathways, rather than conducting completely random inspections. In addition, interception records are usually included in a country's database only when pests are found although there are exceptions.

This type of database is not present in ether of the four countries. A centralised database including all the 55 countries under the umbrella of IAPSC would be advisable, as it would offer a comprehensive picture of the impact of the standard.

3.3 Appendix

Figure 2: NPPO official communication of the introduction of the ISPM 15 in the country



REPÚBLICA DE MOÇAMBIQUE

MINISTÉRIO DA AGRICULTURA
DIRECÇÃO NACIONAL DE SERVIÇOS AGRÁRIOS

Anuncio

A Direcção Nacional de Serviços Agrários, torna público que de acordo com o Padrão Fitossanitário Internacional nª 15, estabelecido ao abrigo da Convenção Fitossanitaria Internacional-**IPPC/FAO**, toda a madeira usada para como embalagem, assim como paletes que condicionam produtos para a exportação estão sujeitas a um pré tratamento por fumigação com o brometo de metilo ou tratamento a quente segundo o preconizado neste padrão.

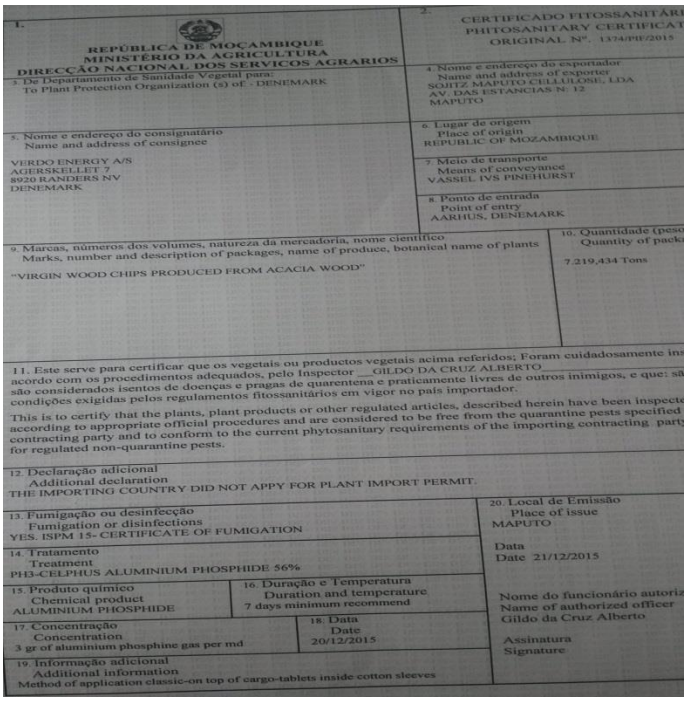
Referir que todo o material tratado ao abrigo deste padrão deve levar um carimbo definido pelo Departamento de Sanidade Vegetal.

Assim, a Direcção Nacional de Serviços Agrários convida a todos as empresas de prestação de serviços de fumigação interessadas em implementar esta actividade para solicitarem a sua inscrição junto ao Departamento de Sanidade Vegetal , sita na Av das Forças Populares nº 3658, no recinto do IIAM, pavilhao Novo 1º andar direito, Maputo. Telefax: 21 460591, para o seu licenciamento.

O Director Nacional

5470

Figure 3: Copy of the NPPO phytosanitary certificate for wood chips being exported in Denmark



1.
REPÚBLICA DE MOÇAMBIQUE
MINISTÉRIO DA AGRICULTURA
DIRECÇÃO NACIONAL DOS SERVICOS AGRARIOS
3. De Departamento de Sanidade Vegetal para:
To Plant Protection Organization (s) of: - DENEMARK

2.
CERTIFICADO FITOSSANITÁRI
PHITOSANITARY CERTIFICAT
ORIGINAL Nº. 1374/PIE/2015

4. Nome e endereço do exportador
Name and address of exporter
SOJITZ MAPUTO CELLULOSE, LDA
AV. DAS ESTANCIAS N. 12
MAPUTO

5. Nome e endereço do consignatário
Name and address of consignee
VERDO ENERGY A/S
AGERSKELLET 7
8920 RANDERS NV
DENEMARK

6. Lugar de origem
Place of origin
REPUBLIC OF MOZAMBIQUE

7. Meio de transporte
Means of conveyance
VASSEL IVS PINEHURST

8. Ponto de entrada
Point of entry
AARHUS, DENEMARK

9. Marcas, números dos volumes, natureza da mercadoria, nome científico
Marks, number and description of packages, name of produce, botanical name of plants
"VIRGIN WOOD CHIPS PRODUCED FROM ACACIA WOOD"

10. Quantidade (pesu
Quantity of packa
7.219,434 Tons

11. Este serve para certificar que os vegetais ou productos vegetais acima referidos; Foram cuidadosamente ins
acordo com os procedimentos adequados, pelo Inspector GILDO DA CRUZ ALBERTO
são considerados isentos de doenças e pragas de quarentena e praticamente livres de outros inimigos, e que: sã
condições exigidas pelos regulamentos fitossanitários em vigor no país importador.
This is to certify that the plants, plant products or other regulated articles, described herein have been inspecte
according to appropriate official procedures and are considered to be free from the quarantine pests specified
contracting party and to conform to the current phytosanitary requirements of the importing contracting party
for regulated non-quarantine pests.

12. Declaração adicional
Additional declaration
THE IMPORTING COUNTRY DID NOT APPY FOR PLANT IMPORT PERMIT.

13. Fumigação ou desinfecção
Fumigation or disinfections
YES. ISPM 15- CERTIFICATE OF FUMIGATION

14. Tratamento
Treatment
PH3-CELPHUS ALUMINIUM PHOSPHIDE 56%

15. Produto químico
Chemical product
ALUMINIUM PHOSPHIDE

16. Duração e Temperatura
Duration and temperature
7 days minimum recommend

17. Concentração
Concentration
3 gr of aluminium phosphine gas per md

18. Data
Date
20/12/2015

19. Informação adicional
Additional information
Method of application classic-on top of cargo-tablets inside cotton sleeves

20. Local de Emissão
Place of issue
MAPUTO

Data
Date 21/12/2015

Nome do funcionário autori
Name of authorized officer
Gildo da Cruz Alberto

Assinatura
Signature

Note: the certificate report that wood chips have been treated according to the ISPM 15 while it would be very unlikely that the wood chips the certificate is referring to have undergone the HT or MB treatment and then stamped.

Figure 4: First page of the inspection manual prepared by the NPPO

Note: the manual is prepared by the NPPO and distributed to all the 38 inspectors present in Mozambique.

Figure 5: Number and geographical distribution of NPPO inspectors in Mozambique

Província	PIFs/POSTOS			Inspectores fitossanitarios		
	Funcionais	Não Funcionais	Total	Existentes	Necessários	Total
Maputo cidade	3	1	4	7	6	13
Maputo	6	2	8	11	15	26
Gaza	0	2	2	0	4	4
Inhambane	1	1	2	1	1	2
Sofala	2	1	3	4	3	7
Manica	1	2	3	2	4	6
Tete	3	6	9	3	15	18
Zambézia	3	1	4	3	5	8
Nampula	1	1	2	4	2	6
Cabo Delgado	0	4	4	0	8	8
Niassa	3	3	6	3	9	12
TOTAL GERAL	**23**	**24**	**47**	**38**	**72**	**110**

Figure 6: Informal WPM repairer in Maputo

Figure 7: WPM used by the Rioverde 4 to export bananas

Figure 8: WPM used by the Beluzi to export bananas

4 Description of Macroeconomic Analysis

The macroeconomic analysis employs econometric methods to assess changes in trade volumes (for a wide range of sectors) after the implementation of ISPM 15. We follow the conventional methodological approach used for such purposes in the empirical trade literature, which is the estimation of trade gravity models (see Clougherty and Grajek, 2014; De Santis, 2012). These allow estimating simultaneously the statistical correlation (association) of these bilateral trade flows with several socio-economic and geographical factors. Three gravity models were estimated for 86 different types of commodities:

1. A parsimonious (simple) "fixed effects" model, which can be summarized by the following specification:

$$V_{ijkt} = b0 + b1\ Income_{ijt} + b2\ ISPM\ 15_{it} + \varepsilon_{ijt}\ , \qquad \textbf{(1)}$$

where V_{ijkt} refers to the value of trade (imports/exports) in product type *k* from/to our case-study country (Botswana) *i* to/from any trade partner country *j* at time *t*, $Income_{ijt}$ captures the real GDP size of both trading partners *i* and *j* (which, hence, controls for the fact that trade tends to expand in accordance with the increasing size of both exporting and importing economies), and $ISPM\ 15_{it}$ is a time dummy taking the value of 1 for the years corresponding to the year Botswana implemented the standard. ε_{ijt} captures the unexplained component of the estimated statistical relationship (i.e. the part of the variation in the dependent variable, the sector-specific trade volume, that cannot be explained by either). All the *b*'s correspond to the estimated coefficients that capture the size of the correlation between trade flows and other explanatory variables. Fixed effect estimators control for the effects of time invariant variables (in other words, fixed effects models impose time independent effects for each entity, i.e. country combination, that are possibly correlated with the explanatory variables) and are typically the preferred analytical tool in econometric analysis, since they are able to control for often important (but often unobservable and hence omitted) time invariant factors (e.g. cultural characteristics).

Particular attention will be given to the coefficient *b2*, which measures changes in trade volumes during the periods before and after implementation of ISPM 15. We hypothesize that the sign of this coefficient can be either positive or negative, dependent on a number of factors. Implementation of ISPM 15 can harm some exporting sectors, assuming that compliance increases the costs of pallets and, hence, of exported products, rendering them less competitive in international markets. It can also be the case that the implementation has the opposite effect, for instance by creating opportunities for an increase in export volumes by allowing access to markets with stringent plant protection regulations. It can also reduce the volume of imports for specific commodities by permitting imports only from a reduced number of ISPM 15-compliant trading partners. Such a reduction in imports can be the combined result of reduced competition and higher import prices, of fewer trading partners to meet demands, of the higher WPM costs passed on to the price of the final product, or due to higher administrative (e.g. inspection) costs of the importing country. All trade volumes will be measured in a natural logarithmic

scale, and, therefore, the *b2* coefficient will capture the percentage change between the periods before and after ISPM 15 implementation.

2. A richer "fixed effects" model, which includes a more sophisticated specification with additional explanatory factors:

$$V_{ijkt} = b0 + b1\ Income_{ijt} + b2\ ISPM\ 15_{it} + b3\ X_{jt} + \varepsilon_{ijt}\ , \qquad \textbf{(2)}$$

where again, the volume of bilateral trade will depend on (a) the size of economic activity (*Income*); (b) ISPM 15 implementation of Botswana and a vector *X* of additional control variables. These additional explanatory factors include: (c) an interaction variable that examines how non-implementation of ISPM 15 in Botswana can interact with ISPM 15 implementation in the export country to potentially reduce export volumes (variable: *ISPM 15 partner*). For the case of exports, this variable takes a value of 1 for the years when the trading partner implemented ISPM 15 but Botswana had not done so. For the case of imports, the corresponding variable takes a value of 1 when Botswana implemented ISPM 15 but the trading partner had not done so. Last, this richer model includes an institutional variable that relates to the extent of corruption in the export country (*Transparency*). The institutional variable aims to capture whether Botswana prefers to trade with countries characterized by higher levels of transparency in transactions (see Anderson and Marcouiller, 2002). Again, the fixed effect estimators control for the effects of time invariant variables (in other words, fixed effects models impose time independent effects for each entity (country combination) that are possibly correlated with the explanatory variables).

3. A random effects model, that includes, in addition to the variables of Model 2, an additional set of time-invariant factors:

$$V_{ijkt} = b0 + b1\ Income_{ijt} + b2\ ISPM\ 15_{it} + b3\ X_{jt} + b4\ Z_{ijt} + \varepsilon_{ijt}\ , \qquad \textbf{(3)}$$

where the vector *Z* captures the additional time-invariant variables, namely: (a) *Distance* which is a variable capturing distance between countries (distance between capital cities in km) – we expect distance to correlate negatively with trade flows, as a result of larger transportation costs; (b) a dummy variable taking a value of 1 when Botswana and each trade partner share borders (variable *Borders*) (we expect countries with common borders to trade more with one another, other things equal); (c) a dummy variable taking a value of 1 when trade partners share a common language as this may facilitate trade (variable *Language*); and (d) a dummy variable taking a value of 1 in cases of historical links between colonies and colonial powers, which may increase trade for involved parties (variable *Colony*). For gravity models using similar geographical variables see the papers by Gómez-Herrera (2013) and Lohmann (2013). All the other explanatory variables appearing in Model 2 (fixed effects richer model) are also included in the random effects model. Contrary to fixed effects estimators, random effects models do not impose time-independent effects for each entity (country combination) that are possibly correlated with the explanatory variables. In other words, we assume that variation in the explanatory

variables arises from random causes and is not systematically related to the country-combinations over time.

The second model (fixed effects richer specification) provides the most reliable estimators (although results are shown also for the more parsimonious fixed effects and random effects specifications for key export and import commodities). Random effects estimations are based on the assumption that individual-specific effects are uncorrelated with independent variables, an assumption that is often violated in panel data settings (in other words, the corresponding Hausman tests conducted are in favour of the fixed effects estimators). The first model is likely to provide biased estimators as a result of an omitted variable bias (i.e. a restricted model with few variables is likely to omit key explanatory factors and, hence, bias either downwards or upwards of the estimated coefficients of the included variables). All models make use of robust standard errors that correct for any heteroscedasticity effects on statistical significance.

4.1 Description of Macroeconomic Data

The research team has compiled data from multiple sources such as UN Comtrade dataset, World Development Indicators, and World Governance Indicators. Below is a detailed description of all variables used in the macroeconomic analysis.

Trade flows: These have been captured by the value of imports and exports across 86 commodity categories from/to Botswana and to/from any trade partner country. These bilateral annual trade flows are expressed in a natural logarithmic scale and are available for the years 2000–2013. All data are available from the UN International Trade Statistics Database, commonly known as the Comtrade website (https://comtrade.un.org).

ISPM 15: Data on ISPM 15 implementation for all countries. The *ISPM 15* variable is a time dummy taking the value of 1 for the years corresponding to the implementation year of the standard by Botswana. The variable *ISPM 15(partner)* is an interaction variable that examines how non-implementation of ISPM 15 in Botswana can interact with ISPM 15 implementation in the export country to potentially reduce export volumes. For the case of exports, this variable takes a value of 1 for the years when the trading partner implemented ISPM 15 but Botswana had not done so. For the case of imports, the corresponding variable takes a value of 1 when Botswana adopted ISPM 15 standard but the trading partner had not done so.

Income: Data on real GDP in 2010 constant prices. In all regressions, the natural logarithm of the product of the GDP size (of pairs of trading partners) has been used. Data are available from the World Development Indicators (http://data.worldbank.org/data-catalog/world-development-indicators).

Transparency: An institutional variable that relates to the extent of corrupt practices in the export partner economy. This is a control of corruption index that captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" (appropriation) of the state by elites and private interests. It is measured in a −2.5 to 2.5 scale

where 2.5 corresponds to the lowest level of corruption and −2.5 corresponds to the highest level of corruption. Data are available from the Worldwide Governance Indicators (www.govindicators.org).

Borders: A dummy variable taking a value of 1 when Botswana and each trading partner share borders.

Language: A dummy variable taking a value of 1 when the trading partners share a common language.

Distance: A variable capturing distance between the capital cities of partner countries (expressed in km and logarithmic scale).

Colony: A dummy variable taking a value of 1 in cases of historical links between colonies and colonial powers.

The descriptive statistics for all variables are available in Table 4.

Table 4: Descriptive statistics – Botswana

Variable	Mean	Standard Deviation	Minimum	Maximum
Trade flows (exports)	8.37	3.84	0	22.03
Trade flows (imports)	8.89	3.67	0	20.97
ISPM 15	0.47	0.50	0	1
ISPM 15 (export partner)	0.17	0.37	0	1
ISPM 15 (import partner)	0.01	0.09	0	1
Income	48.81	2.42	41.52	53.68
Transparency	0.41	1.13	−1.83	2.50
Borders	0.11	0.32	0	1
Language	0.53	0.50	0	1
Distance	8.65	0.87	6.56	9.59
Colony	0.05	0.21	0	1

4.2 Empirical Analysis

A total of 516 models were estimated (i.e. 86 sectors × 2 trade categories (imports/exports) × 3 model specifications). Results are presented below.

Exports

Tables 34 and 35 present detailed results for the two most important export sectors of Mozambique (in terms of export value); aluminium articles (

Table 5) and tobacco products (

Table 6). We present estimates for all three empirical models (column 1 for the parsimonious fixed effects specification, column 2 for our preferred richer fixed effects specification and column 3 for the random effects specification).

According to

Table 5 (Model 2), there was a non-statistically significant decline by 64% in the exports of aluminium articles during the period after ISPM 15 implementation (−86% and −5% according to Models 1 and 3). For the case of tobacco (

Table 6, Model 2), there was a non-statistically significant increase by 144% during the same period (3% and 232% according to Models 1 and 3).

Table 5: Exports of aluminum articles - Mozambique

Dependent variable:	FE	FE	RE
	(1)	(2)	(3)
Constant	−61.37	−49.70	1.35
Income	1.47	1.23	0.40
	(1.62)	(1.34)	(0.29)
ISPM 15	−0.86	−0.64	−0.05
	(1.01)	(0.97)	(0.63)
ISPM 15 (partner)		0.37	0.51
		(0.72)	(0.70)
Transparency		0.69	0.94
		(2.48)	(0.78)
Borders			−1.24
			(1.63)
Language			−0.06
			(0.72)
Distance			−1.40
			(0.91)
Colony			−2.81**
			(1.20)
R^2 overall	0.06	0.13	0.26
(within; between)	(0.02; 0.05)	(0.02; 0.08)	(0.02; 0.11)
Countries	46	43	41
N	124	116	113

*Note: Robust standard errors of coefficients in parentheses. Superscripts *, **, *** correspond to a 10, 5 and 1% level of significance.*

Table 6: Exports of tobacco - Mozambique

Dependent variable:	FE	FE	RE
	(1)	(2)	(3)
Constant	−96.46	−63.58	7.55
Income	2.26***	1.56**	0.42***
	(0.47)	(0.64)	(0.15)
ISPM 15	0.03	1.44	2.32**
	(0.27)	(1.24)	(1.12)
ISPM 15 (partner)		1.57	2.24**
		(1.23)	(1.13)
Transparency		−0.80	−0.22
		(0.99)	(0.25)
Borders			−1.83
			(1.40)
Language			−0.23
			(0.61)
Distance			−1.88***
			(0.59)
Colony			−0.02
			(0.64)
R^2 overall	0.01	0.02	0.15
(within; between)	(0.18; 0.05)	(0.19; 0.08)	(0.18; 0.25)
Countries	70	70	64
N	328	312	296

*Note: Robust standard errors of coefficients in parentheses. Superscripts *, **, *** correspond to a 10, 5 and 1% level of significance.*

Figure 9 provides in graphical form the distribution of the size of effect of ISPM 15 implementation (b2) across all export sectors (based on the estimates of our preferred Model 2). Effects are presented in descending order, with the sectors experiencing the largest increases in export volumes during the post-ISPM 15 period appearing at the top. The majority of the sectors experienced an increase in export volumes. The largest increases were in bamboo and plaiting materials (+561%) and footwear (+444%), while the largest decreases were in chemical products (−399%) and photographic/cinematographic goods (−347%).

Figure 9: Distribution of ISPM 15 effects across all exporting sectors

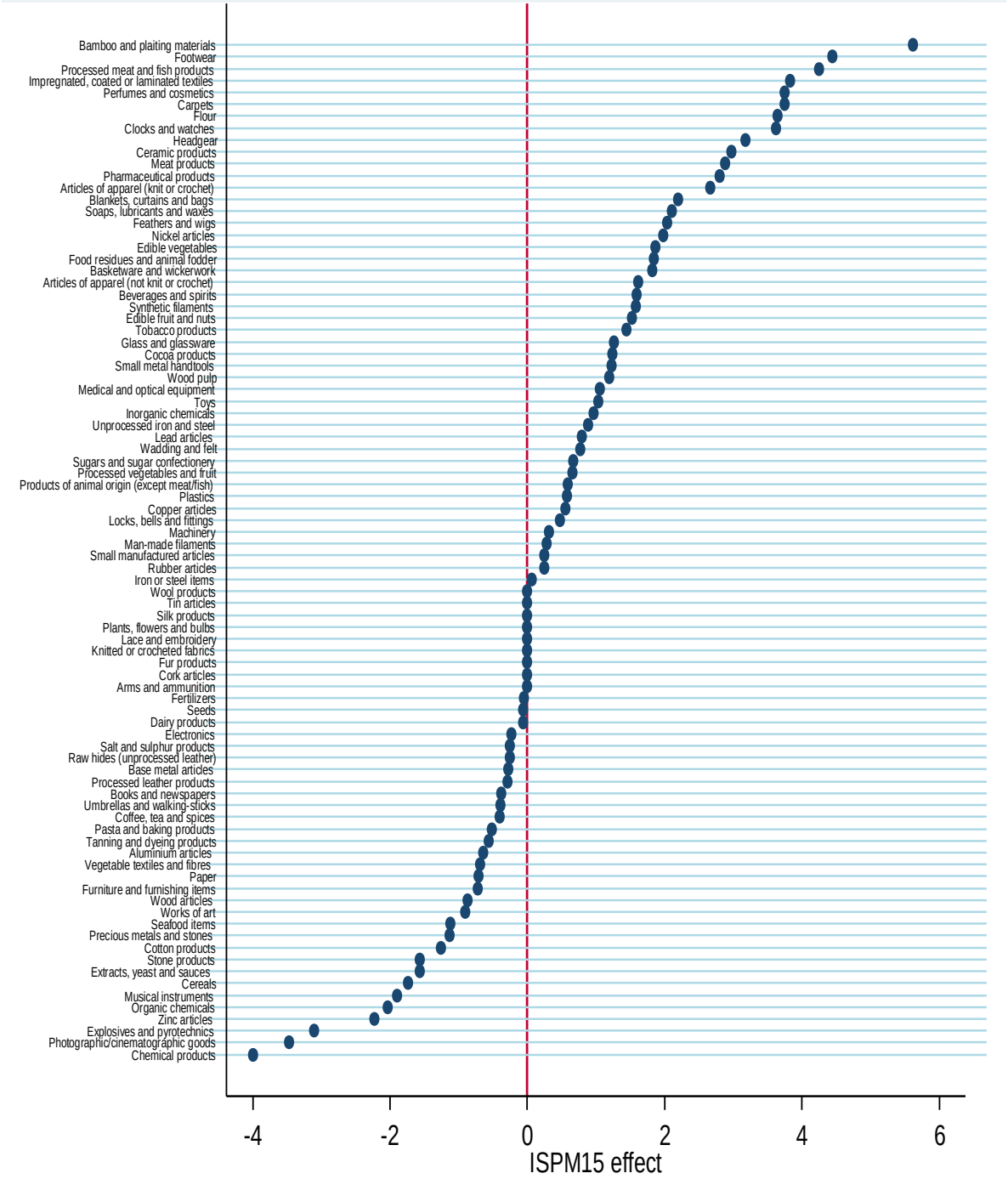
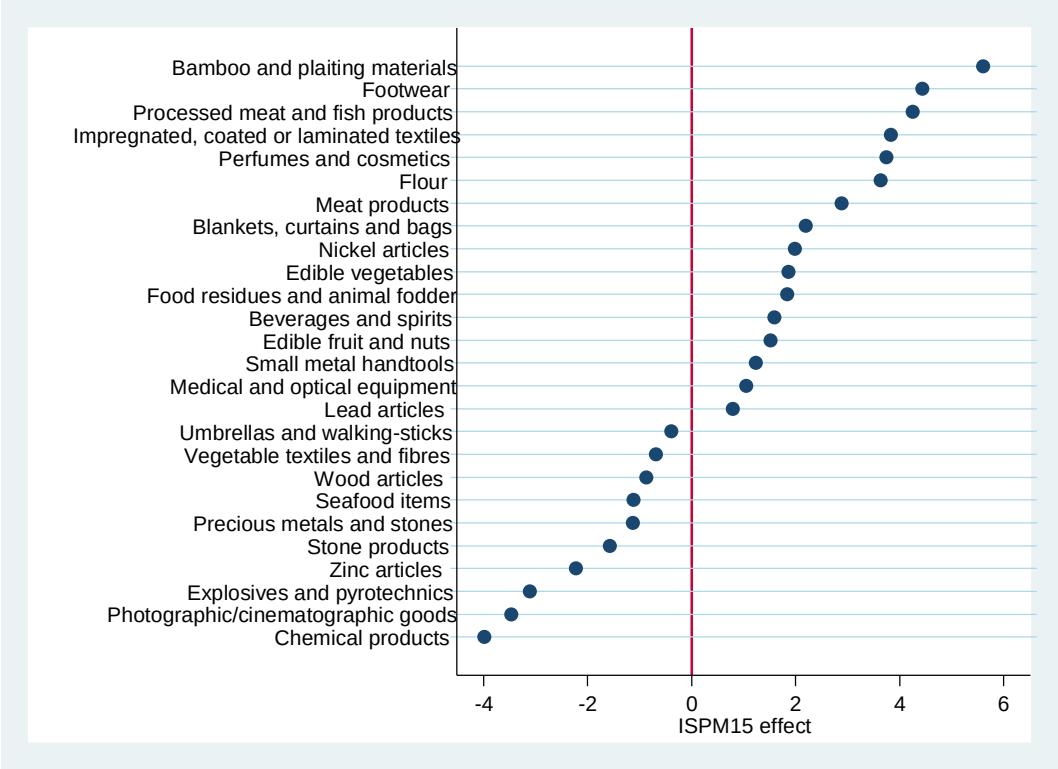


Figure 10 provides in graphical form the distribution of the size of effect of ISPM 15 implementation (b2; Model 2) only for those export sectors where the effect was found to be statistically significant (at least at the 10% level of significance). The majority of sectors experienced an increase in export volumes. The largest increases in the period after the implementation of ISPM 15 were in bamboo and planting materials (+561%) and footwear (+444%), while the largest decreases were in chemical products (−399%) and photographic/cinematographic goods (−347%).

Figure 10: Distribution of only statistically significant ISPM 15 effects (exports)



Imports

Tables 36 and 37 present detailed results for the two most important import sectors in Mozambique (in terms of import value); medical and optical equipment (Table 7) and machinery (Table 8). We present estimates for all three empirical models (column 1 for the parsimonious fixed effects specification, column 2 for our preferred richer fixed effects specification and column 3 for the random effects specification).

According to Table 7 (Model 2), there was a (non-statistically significant) decline by 1% in the imports of medical and optical equipment during the period after ISPM 15 implementation (10% and 3% increase according to Models 1 and 3). For the case of machinery (Table 8, Model 2), there was a non-statistically significant increase in export value by 18% during the same period (19% and 38% according to Models 1 and 3).

Table 7: Imports and medical and optical equipment - Mozambique

Dependent variable:	FE (1)	FE (2)	RE (3)
Constant	−22.55	−34.58	−17.90
Income	0.68***	0.92***	0.81***
	(0.22)	(0.31)	(0.11)
ISPM 15	0.10	−0.01	0.03
	(0.18)	(0.21)	(0.16)
ISPM 15 (partner)		−0.47	−0.95
		(1.32)	(1.43)
Transparency		0.42	0.52***
		(0.43)	(0.17)
Borders			−0.06
			(1.32)
Language			1.15
			(0.79)
Distance			−1.32***
			(0.40)
Colony			3.61***
			(0.77)
R^2 overall	0.29	0.32	0.43
(within; between)	(0.04; 0.30)	(0.05; 0.31)	(0.05; 0.47)
Countries	128	124	103
N	882	785	725

*Note: Robust standard errors of coefficients in parentheses. Superscripts *, **, *** correspond to a 10, 5 and 1% level of significance.*

Table 8: Imports of machinery - Mozambique

Dependent variable:	FE (1)	FE (2)	RE (3)
Constant	−42.66	−46.06	−23.10
Income	1.13***	1.20***	0.92***
	(0.15)	(0.20)	(0.08)
ISPM 15	0.19	0.18	0.38***
	(0.14)	(0.15)	(0.13)
ISPM 15 (partner)		−0.28	−1.04
		(1.22)	(1.23)
Transparency		0.51	0.64***
		(0.40)	(0.16)
Borders			2.71***
			(0.86)
Language			1.00***
			(0.36)
Distance			−1.17***
			(0.38)
Colony			3.78***
			(0.38)
R^2 overall	0.33	0.34	0.50
(within; between)	(0.14; 0.37)	(0.12; 0.42)	(0.13; 0.58)
Countries	169	166	138
N	1315	1165	1037

*Note: Robust standard errors of coefficients in parentheses. Superscripts *, **, *** correspond to a 10, 5 and 1% level of significance.*

Error! Not a valid bookmark self-reference. provides in graphical form the distribution of the size of effect of ISPM 15 implementation (b2) across all import sectors (based on the estimates of our preferred Model 2). Effects are presented in descending order, with the sectors experiencing the largest increases in import volumes during the period after ISPM 15 implementation appearing at the top. The majority of the sectors experienced an increase in import volumes. The largest increases were in knitted or

crocheted fabrics (+142%) and carpets (+136%), while the largest decreases were in fruit and nuts (−161%) and edible vegetables (−135%).

Figure 11: Distribution of ISPM 15 effects across all exporting sectors

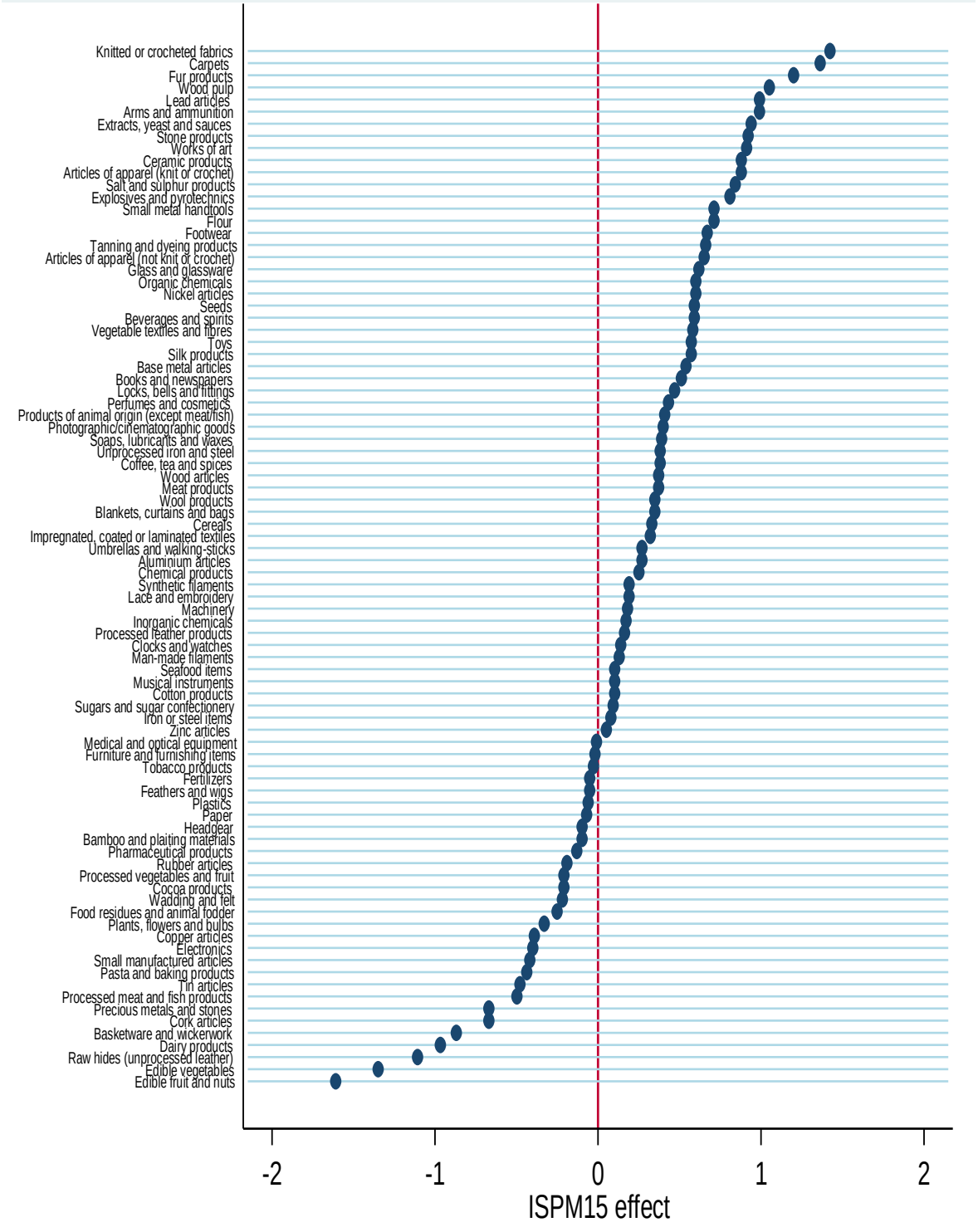
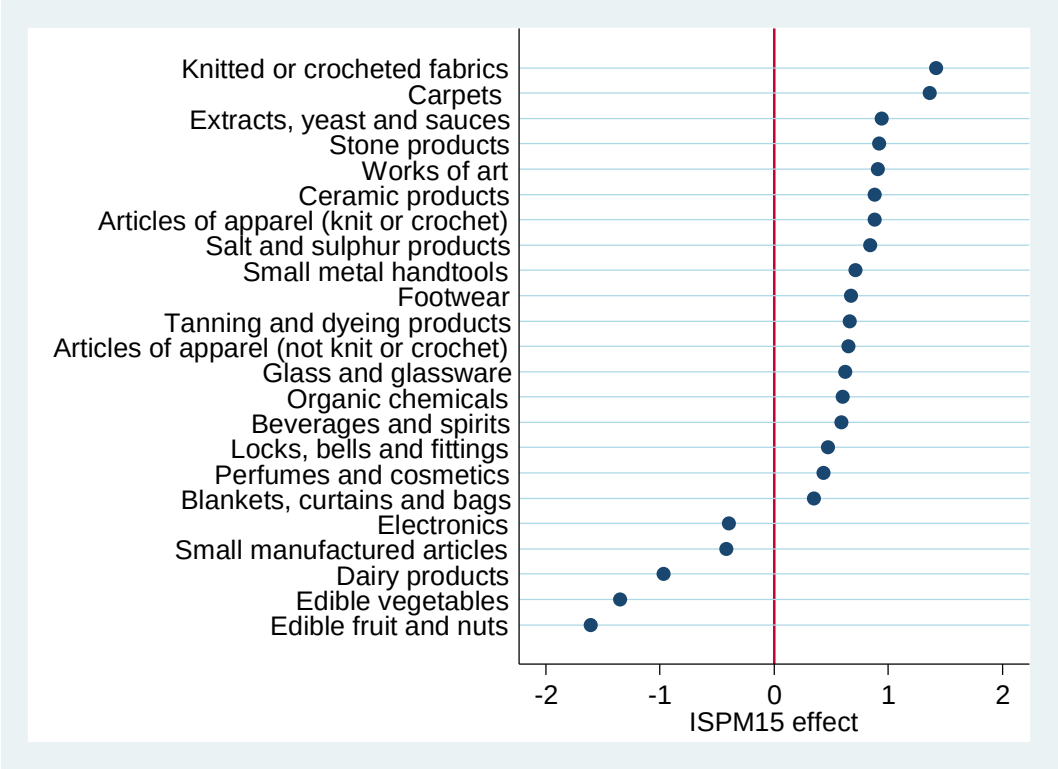


Figure 12 provides in graphical form the distribution of the size of effect of ISPM 15 implementation (b2; Model 2) only for those import sectors where the effect was found to be statistically significant (at least at the 10% level of significance). The vast majority of the sectors experienced an increase in import volumes. The largest increases in the aftermath of ISPM 15 implementation were in knitted or crocheted fabrics (+142%) and carpets (+136%), while the largest decreases were in fruit and nuts (−161%) and edible vegetables (−135%).

Figure 12: Distribution of only statistically significant ISPM 15 effects (imports)



Change in trade balance

Multiplying the sector-specific coefficient of the ISPM 15 with the value of the corresponding sector (2013 values) provides an estimate of the change in value for the particular exporting/importing sector between the periods before and after ISPM 15 implementation (after controlling for other determining factors, such as the size of economic activity, transparency levels, etc.). We do this for all sectors where the ISPM 15 effect is statistically significant (i.e. those listed in Figure 10 for exports and Figure 12 for imports). Tables Table 9 and

Table 10 display the change in export and import value (in million USD) per sector. The largest drop in export values were in chemical products (USD −211.47 million) and seafood items (USD −47.04 million).

The largest drop in import values were in electronics (USD −216 million) and dairy products (USD −45.59 million).

Aggregating these values across all these exporting and importing sectors provides the overall change in value for all exports and imports (in the pre- and post-ISPM 15 adoption period). Overall, exports decreased by USD 47,287,000, while imports increased by USD 165,542,000. As a result of this, the trade balance deteriorated by USD 212,829,000 (Figure 13).

Table 9: Change in export values per sector (in million USD)

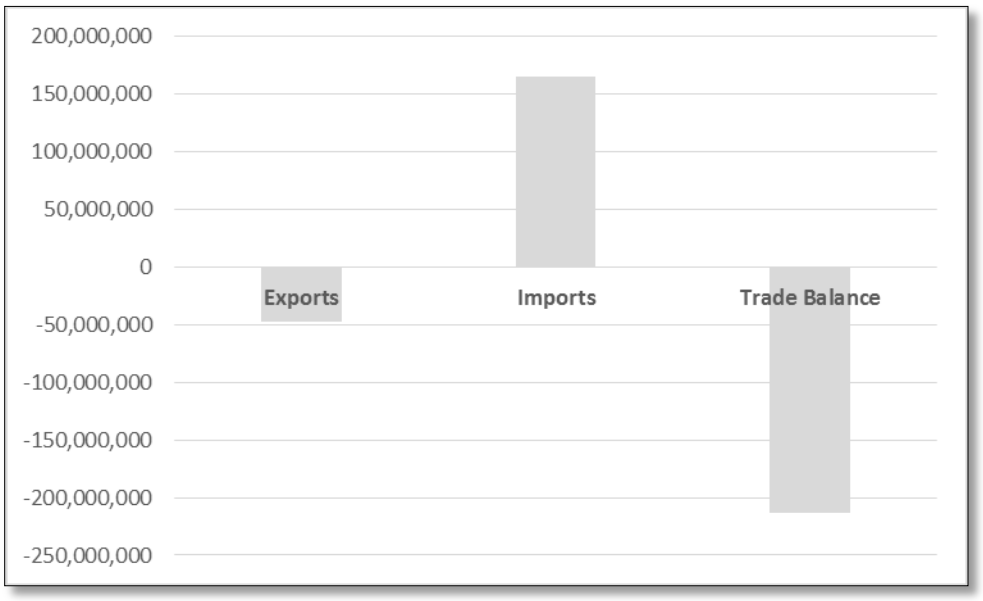
Chemical products	−211.47
Seafood items	−47.04
Wood articles	−43.50
Precious metals and stones	−1.36
Vegetable textiles and fibres	−0.76
Explosives and pyrotechnics	−0.41
Zinc articles	−0.06
Stone products	−0.02
Umbrellas and walking-sticks	0.00
Impregnated, coated or laminated textiles	0.04
Processed meat and fish products	0.05
Meat products	0.16
Footwear	0.29
Lead articles	1.66
Blankets, curtains and bags	1.80
Perfumes and cosmetics	2.10
Small metal handtools	5.29
Beverages and spirits	8.27
Flour	16.74
Food residues and animal fodder	20.24
Edible vegetables	48.36
Medical and optical equipment	67.20

Edible fruit and nuts	85.12

Table 10: Change in import values per sector (in million USD)

Electronics	−216.00
Dairy products	−45.59
Edible vegetables	−27.00
Edible fruit and nuts	−13.20
Small manufactured articles	−8.82
Works of art	0.18
Knitted or crocheted fabrics	0.75
Carpets	2.99
Organic chemicals	9.60
Locks, bells and fittings	10.34
Articles of apparel (not knit or crochet)	13.00
Articles of apparel (knit or crochet)	16.72
Perfumes and cosmetics	18.06
Footwear	19.43
Tanning and dyeing products	20.46
Stone products	23.92
Glass and glassware	25.42
Small metal handtools	26.98
Blankets, curtains and bags	29.75
Extracts, yeast and sauces	36.66
Beverages and spirits	46.61
Ceramic products	49.28
Salt and sulphur products	126.00

Figure 13: Changes in values of exports/ imports/ trade balance in Mozambique (USD)



Summary of Findings

The purpose of this macroeconomic analysis is to estimate changes in trade volumes (exports/imports) during the periods before and after the ISPM 15 implementation across multiple commodity sectors. We followed the conventional methodological approach used for such purposes in the empirical trade literature, which is the estimation of trade gravity models. These allow estimating simultaneously the statistical correlation (association) of these bilateral trade flows with several socio-economic and geographical factors. Overall, we found that:

- The majority of sectors experienced an increase in export volumes. The largest increases in the aftermath of ISPM 15 implementation were in bamboo and plaiting materials (+561%) and footwear (+444%), while the largest decreases were in chemical products (−399%) and photographic/cinematographic goods (−347%).
- The vast majority of the sectors experienced an increase in import volumes. The largest increases in the aftermath of ISPM 15 implementation were in knitted or crocheted fabrics (+142%) and carpets (+136%), while the largest decreases were in fruit and nuts (−161%) and edible vegetables (−135%).
- Overall, exports decreased by USD 47,287,000, while imports increased by USD 165,542,000. As a result of this, the trade balance deteriorated by USD 212,829,000.

Policy Recommendations

Given the unequal distribution of effects across sectors, the authorities in Mozambique should pay attention to those sectors that experienced an economic contraction in the aftermath of the ISPM 15 implementation. The export sectors with the largest percentage decreases were: chemical products (−399%) and photographic/cinematographic goods (−347%). In total, ten export sectors experienced a statistically significant drop in export revenues (Figure 10). A more qualitative-based analysis per sector needs to identify the extent to which the drop in export revenues for each sector has been associated with the administrative burden and costs associated with the implementation of ISPM 15 in combination with other underlying internal and external factors (e.g. changes in prices locally and globally, emergence of new competitors, constraints in domestic productive capacity, or exchange rate volatility). The same should also apply in the context of import sectors.

In Mozambique, the implementation of ISPM 15 appears to be associated with a decrease in overall exports and an increase in overall imports. Overall, exports decreased by USD 47,287,000, while imports increased by USD 165,542,000. As a result of this, the trade balance deteriorated by USD 212,829,000. This is an issue of concern, given that Mozambique has been running an overall trade deficit since 2008. Supporting those exporting industries that experienced a contraction in the aftermath of ISPM 15 implementation could at least partly offset these persistent trade deficits. Alternatively the government could support those sectors that grew substantially after the implementation of ISPM 15, as long as these industries can expand further and compensate for the value and employment loss that other contracting sectors experienced.

5. ISPM 15: findings based on microdata

The precise assessment of the costs and the benefits related to implementation of ISPM 15 does not constitute an easy task. Available studies on the subject have not been able to go beyond rough estimates, as a number of hypothetical and sometimes unquantifiable factors are often involved. There are no studies, to our understanding, trying to quantify the costs and the benefits related to the implementation of ISPM 15 in developing countries, which makes the present research of particular importance for its contribution to the subject matter.

The available evidence – mostly based on country case studies and regional assessments conducted in developed areas of the world – suggests that:

- **i.** The burden of the compliance cost is imposed on exporting countries.
- **ii.** WPM treatment facilities (i.e. private businesses) have to bear the implementation costs. Those costs are later transferred to the exporters and to the final consumers via the importers.
- **iii.** The cost of compliance is relatively high if put in relation to the income level of the low income and least developed countries.
- **iv.** While the cost of compliance is high, the short- and long-term costs related to the lack of compliance is enormous, in terms of potential foregone export, income and employment.
- **v.** The cost and efficiency of the compliance depend, *inter alia*, on the organization of the supply chain.

Although the implementation and compliance costs relate to both imports and exports, the majority of the costs burden the exporter. For this reason, this chapter will assess the costs and the burden of compliance from the perspective of the WPM treatment facilities, which were very likely to experience a number of new fixed and variable costs and benefits since implementation of ISPM 15 became compulsory in the country.

Implementation of and compliance with ISPM 15 may, however, also generate costs on stakeholders other than the WPM treatment facilities. For instance, the NPPO may incur additional costs related to the organization of training courses, or there may be the need for additional phytosanitary inspectors (Table 11).

Table 11: Costs and benefits related to the ISPM 15 implementation

Implementation at the export level		**Implementation at the import level**
Costs	*Benefits*	*Costs*
Fixed costs for the WPM treatment facilities Inspections/audits costs for the WPM treatment facilities Variable costs for the WPM treatment facilities Validation checks	Revenues from the sale of treated WPM	Legislative changes Hiring of inspectors and inspections Training inspectors Adminstrative costs Purchase of the necessary equipment
Overall benefits for the country	Being able to export Reduction in the introduction and spread of economically devastating pests Agricultural yields not affected by economically devastating pests	

Source: Authors' elaboration.

Those costs are not taken into account here when computing the overall costs that compliance with the standard may have generated. In this chapter we limit our analysis to estimating the costs the WPM treatment facilities are facing and comparing them to the revenues. For the time being we will disregard all the costs related to organizing the import inspections.

From the perspective of the WPM treatment facilities, the compliance costs can be high in absolute and relative terms, especially for those developing countries lacking the know-how, resources and specific competencies related to ISPM 15. According to the available literature on this issue, the cost of compliance is the sum of all expenses that are directly and indirectly related to the standard's implementation. Those costs include the funds disbursed for purchasing components of the supply chain (fixed costs) for instance to purchase a heat chamber or the necessary equipment to apply MB. In addition, the cost analysis should take into account a number of variable costs too; costs related to hiring workers with the necessary technical expertise of the treatment, to carrying out inspections, to obtaining the license to operate, and so forth.

The revenue benefits for the WPM treatment facilities relate to the mark-up price WPM treatment facilities can charge for their treated WPMs. If there is a positive difference between the benefits and the costs it would indicate that the WPM treatment facilities are economically viable entities. In addition, it would indicate that the whole system created ad-hoc for implementing and complying with the standard is generating revenues and that there is enough demand for treated WPM. However, if the costs are higher than the financial benefits this may indicate that the overall chain is not profitable enough. In this case, it would be important to understand which are the system bottlenecks, why a loss exists and which potential remedies could be put in place.

The cost-benefit analysis of ISPM 15 cannot be limited to the assessment of the economic profitability of the WPM treatment facilities. There are a number of other direct and indirect economic consequences the implementation of the standard may generate. For the sake of completeness, we have supported the results of the cost-benefit analysis with the analysis of the procedures put in place by the NPPOs (i.e. the agencies responsible for implementing ISPM 15), and with a macroeconomic analysis of the trade

position of the country. The first type of analysis, referred to as the qualitative analysis (Section 3), will assist the NPPOs to implement ISPM 15 better. The second type of analysis, the macroeconomic analysis (Section 4), looks at how the trade position of each of the four case-study countries has evolved after the implementation of ISPM 15, and which sectors have benefited the most. The third, the microeconomic analysis, will be discussed in this section.

The stakeholders of ISPM 15 implementation, and especially the NPPOs, should take the results of the three types of analysis into consideration to increase their understanding of the effects the standard has generated. Therefore, the three analyses may be read as stand-alone or as three different components of the same phenomena.

The rest of this section is organized in the following way. The next section introduces and describes the survey tool used for the data collection process. The questionnaire was given to all the WPM treatment facilities operating in the country, and the rate of responsiveness, any missing data problems as well as data quality will be discussed too. The presentation of the descriptive statistics and the costs and benefits analysis is presented in Section 5.3, followed by the conclusions.

5.1 Description of the survey tool

There are many ways to conduct a cost-benefit analysis related to the implementation of ISPM 15. One way could be to examine all the expenditures the central government faced to guarantee the correct implementation of the standard. Those costs may relate to the research needed to understand and correctly apply the treatments, to the change in the regulation adopted by the country in matters related to trade and in the management of the "new" supply chain, or to the hiring of phytosanitary inspectors. Another strategy could be to assess the aforementioned costs and compare them with the number of pests that have been introduced in the country before and after the standard was implemented; this comparison would help quantifying the funds saved as a consequence of the reduction of such pests. This analysis would also help understanding the impact the standard has had at the phytosanitary level and, possibly, on the agricultural yield and productivity. Data for assessing these costs and impacts are scarce, if not completely lacking.[7] As previously discussed, the activity of keeping up-to-date records of pests in the country is not conducted in any of the four case-study countries.

In what follows, we will assess the costs WPM treatment facilities have faced, and if the costs will outcast the benefits coming from the sale of the treated WPM. For this purpose, we prepared a survey tool consisting of a detailed questionnaire directed at the WPM treatment facilities operating in each of the four case-study countries. The questionnaire comprises several different sections, each of which relates to different aspects of the WPM treatment facilities' business cycle.[8] The seven sections the questionnaire are composed as following:

[7] The lack of data is related to the fact that it is extremely difficult to know, with a high degree of certainty, that a particular species was introduced by a particular commodity. Usually, such information is largely based on assumptions. Furthermore, it is computationally complicated to assess the economic and environmental impact of the pest in a particular region.

[8] The questionnaires used in the four countries differ slightly to reflect country-specific situations. However, the content of the four questionnaires, as well as the data collected, are in any case comparable. A copy of the master questionnaire, which was

i. Section 1: Questions regarding the wood treatment facility

ii. Section 2: Wood treatment facility: general information

iii. Section 3: Wood treatment information

iv. Section 4: Wood treatment training

v. Section 5: Costs related to the wood treatment

vi. Section 6: Benefits related to the wood treatment

vii. Section 7: General comments.

Section 1 includes general questions about the respondent and its role within the facility, the year the facility started to operate as a treatment facility, and all the requirements needed to obtain the license to operate. The section also queries the number of employees and whether there was an increase in the number of employees following the implementation of the standard.

The second section, investigates the main activities performed by the facility. For instance, whether the facility also manufactures the WPM it will later treat, or if it repairs broken WPM. Given some types of packaging material is made of different materials, the section also queries if the facility only produces WPM or also other packaging material. Also the capacity of the facility in terms of number of treated WPM per year is queried, as are details as to potential repetition of treatments, and which companies buy the final product and for what purpose. In other words, the section aims at understanding the core businesses of the facilities and their capacity.

The third section poses questions regarding the wood treatments used. We query which treatment the facility uses and the main reasons for choosing that instead of another treatment. We also query whether the facility is planning to invest in another treatment and the reasons behind that choice. Lastly, we inquire about any cases where their ISPM 15 mark has been used by other facilities without them knowing.

Section 4 outlines questions regarding the training received by the WPM treatment facility. In this section, we gather information about the type of training received and the organization offering the training, to understand if guidelines have been given to the treatment facility. Furthermore, we ask whether the treatment facilities receive updates on how to comply with ISPM 15 considering its various revisions. The section also seeks information on the time the facility spent purchasing new equipment or adapting old equipment for implementing the international standard. This part tries to assess whether the implementation process is time consuming, for instance in terms of permits required. The section then moves on to gather information on the audits the NPPO does of the facility; the frequency and the type of audit, whether they are done unexpected, and the result of the audits.

Section 5 gathers a series of financial data related to the costs the facility has to cover every year in order to run the treatment business. These are the fixed costs (e.g. investment costs, costs for

developed before the country missions, is attached to this study. Copies of the four country-specific questionnaires are available upon request.

equipment, license cost) and the variable costs (costs of labour, energy, maintenance, timber, and administration). We also query if the company received any Government subsidy.

Section 6 examines the sources of revenues of the facilities. In this section we gather data on the pieces of treated WPM sold, the unit price and the amount of the unit price for each WPM before ISPM 15 was implemented. The respondent is also asked to indicate the overall economic benefits and costs of ISPM 15 at the facility level.

Section 7 deals with perceptions and gathers data on the knowledge the interviewee has on the possible costs and benefits of the ISPM 15. Here, we try to differentiate between socio-economic impacts (both positive and negative), the main implementation challenges, and the main environmental consequences of the implementation.

5.2 Description of the respondents

Table 12 lists all the WPM treatment facilities currently operating in the four case-study countries and that have answered the questionnaire. The collection of the data was delegated to a team of enumerators working for the NPPO of the given country. The connection between the enumerators and the NPPO served to make sure that the enumerators were knowledgeable about ISPM 15 and to help ensure that the respondents (the WPM treatment facility employees) would trust the enumerators when providing any type of data, especially those pertaining to financial aspects. This strategy was successful in many cases, but failed in a few.

Table 12: List of WPM treatment facilities for which microdata have been collected, divided by country

Progressive number	Name of the WPM treatment facility	District	City
	Mozambique		
1	Fumigation International	Sofala Province	Gurue
2	ITFC	Zambezia Province	Gurue
3	Chazeira de Mozambique	Zambezia Province	Gurue
4	Maputo Province	Maputo Province	Matola

Note: Some of the above-mentioned WPM treatment facilities are also WPM manufacturers.

For what concerns the data collection process, the following should be noted.
It took the research team about three months to receive the lists of the WPM treatment facilities from the local NPPOs. For some European countries, such as Italy and the Netherlands, this list is published online, and only the WPM treatment facilities that have a valid license to operate are included (the list is updated regularly). Having an online list available to anyone is beneficial for several reasons, for instance exporters can check that the WPM treatment facility they buy treated WPM from has been authorized by the NPPO.

When designing the data collection process, we aimed at interviewing all the WPM treatment facilities operating in Mozambique (and not a sample of them) to get a complete and exhaustive picture of that specific business. This approach has worked relatively well in Mozambique.

It is also crucial to highlight a few things about the quality of the data collected by the enumerators. The overall rate of responsiveness was relatively good. The questionnaires were well compiled by the enumerators and well answered by the respondents. However, the section, aimed at gathering data on

the financial disbursements of the facilities, presented some issues, as in some cases respondents were not willing to disclose their costs and their revenues.

Some of the questions in the survey presented missing values where the respondents did not give an answer. In those situations we have not imputed the missing value but continued the analysis without that particular data point. In several cases the information gathered via the survey tool has been triangulated with the qualitative information collected during the country missions or with other information or data coming from third sources. This check has been necessary to verify the correctness of some of the microdata, and in some cases, the data collected tell a different story than that told in the qualitative interviews. As an example, the manager of the WPM treatment facility located in Botswana, mentioned that he had never been audited by the NPPO whereas the data collected using the questionnaire reports that he is audited once a year. We cannot always determine which version reflects the reality, and can therefore only make the reader aware of such inconsistency. However, most of the data collected is in line with data collected by third parties and published in academic publications, which underpins the quality of the data and of the analysis presented here.

5.3 Descriptive statistics

Each NPPO, at its own discretion, sets a number of requirements each of the applicant facilities should present to obtain authorization as a legitimate WPM treatment facility. These requirements, as stressed in Chapter 3 when discussing how to make all the stakeholders aware of the international standard, are not well communicated to the facilities. The respondents' answers within each country highlight that there is no consistency in the type of requirements requested from the facilities, even within the same country (Table 13). In Mozambique, all the four facilities interviewed stated that the application form constitutes one of the requirements for being officially authorized by the NPPO, and some believed that an NPPO inspection would be part of the authorization process. The other requirements set in Mozambique range from documents stating the legality of the firm, the presence of a business plan and a license to trade.

Generally, the NPPOs should have clear requirements that apply to all applicants for WPM treatment authorization, and they should communicate these publicly. The NPPO could achieve this by preparing a document to be published in the country's official gazette or on its official website. This issue will be discussed more in details in the next concluding chapter.

Table 13: Requirements for becoming a legit WPM treating facility

# of facilities	Requirement	Req.	Req.	Req.
1	Application form	Proof of legality of company	Business plan	Site inspection
2	Application form			
3	Application form	Inspection		

Source: Microeconomic data gathered from WPM treatment facilities. Authors' elaboration.

Generally speaking, the facilities operating in Mozambique are relatively small, with the average number of paid and permanent employees being equal to 18 (Table 14). The implementation of ISPM 15 has influenced the number of employees hired. This is particularly true in Mozambique, where all the facilities interviewed showed an increase in the number of employees after the implementation of ISPM 15 (Table 14). This shows, albeit at a very low level, that the implementation of the standard has caused an increase in the employment rate.

Most of the interviewed WPM treatment facilities were already in the WPM business before ISPM 15 was implemented and, as there was no requirements for treatments, they all were manufacturing WPM and selling it to export companies. With the implementation of the standard, some of them became, in addition to being WPM manufacturers, treatment facilities too. Those facilities that were not in business before the implementation of ISPM 15, opened their facilities because they believed it would be a profitable business. In Mozambique, all the treatment facilities also manufacture WPM, and in some cases they repair WPM (both treated and not treated).

Table 14: Size and employees number of the WPM treating facilities and type of business

Average number of employees working in the WPM treating facility	Share of WPM treating facility which had an increase in the number of employees after ISPM 15 implementation (in %)	Average increase in the number of employees	Share of WPM treating facilities manufacturing WPM (in %)	Share of WPM treating facilities repairing WPM (in %)	Share of WPM treating facilities repairing treated WPM (in %)	Share of the WPM produced/ treated in the facility made of wood (in %)
19	100	12	100	66	33	100

Source: Microeconomic data gathered from WPM treatment facilities. Authors' elaboration.

Table 15 presents the amount of WPM treated monthly by the treatment facilities, and at the use and destination of the treated WPM. The amount of WPM being treated by each facility varies; it is of particular interest that the facilities in Mozambique do not treat a very high number of WPM. This may be explained by the lack of facilities in those areas where most of the industries are located (i.e. Maputo), and with the fact that most of the export companies prefer to buy treated WPM from South Africa. As previously noted, there is one WPM treatment facility in the outskirts of Maputo but it has yet to obtain the treatment authorization, requested about two years ago. In addition, it has to be noted that these numbers may be inflated; Kenyan facilities believe that already treated WPM needs to be re-treated after a month, if not used. This clearly contradicts ISPM 15 that instead provides that "[…] a unit of wood packaging material that has been treated and marked in accordance with this standard and that has not been repaired, remanufactured or otherwise altered does not require re-treatment or reapplication of the mark throughout the service life of the unit".
The treated WPM is in most cases used for exports (India and South Africa), although some are used for internal purposes, where treatment is actually unnecessary.

When it comes to the treatment used, the facilities use only the HT treatment (Table 15). All facilities have chosen the treatment method based on the same reasons (whether HT or MR); lower costs, easier implementation, and effectiveness of treatment the WPM.
The share of facilities considering using other treatments is practically zero, which makes sense as it is very rare for a WPM treating facility to move away from HT to start treating WPMs by using MB.

Table 15: Number of WPM treated, their use and type of treatment

Average number of WPM being treated per month	Internal or international customers	Use of the treated WPM	Treatment used	Reason for choosing that treatment	Share of facilities thinking of adopting a new treatment (in %)
251	Internal India South Africa	Agricultural Manufactured Tea Drinks	HT (100%)	1. Less expensive 2. Easier to implement 3. More effective	0

Source: Microeconomic data gathered from WPM treatment facilities. Authors' elaboration.

One of the main activities the NPPOs have had to organize when the country decided to implement ISPM 15 was training of stakeholders. In Mozambique, an initial training was offered to two third of those WPM treatment facilities which answered to the question (Table 16). It is also crucial that the NPPOs notify all stakeholders, and particularly the WPM treatment facilities, on matters related to compliance with the standard. According to the data collected, only 33 percent of the facilities in Mozambique are aware of changes adopted to ISPM 15.

Table 16: Types of training received and inspections being made

Share of WPM treating facilities which have received training	Agency which organized the training	Share of WPM treating facilities which are receiving updates about the standard	Share of WPM treating facilities having random inspection (in %)	Organization in charge of organizing the random inspection	Number of random inspection per year
67	Ministry of Agr. (50%) University (50%)	33	100	NPPO (100%)	1 (67%) Ad-hoc visit (33%)

Source: Microeconomic data gathered from WPM treatment facilities. Authors' elaboration.

The last section of the questionnaire refers to the consequences, at many different levels, the implementation of ISPM 15 may have had in the country. This section has the objective to understand the knowledge of the interviewees have of the standard and its spillover effects. The first question sought details on the effects on the small wood processing facilities (Table 17). The respondents agreed that the implementation of ISPM 15 has had and will have positive consequences for wood processing facilities, mainly in terms of job creation. This matches the findings presented earlier one, namely that the implementation of standard has increased the employment rate.

Table 17 presents the positive and negative environmental effects caused by the implementation of the standard. The answers given by the respondents are all correctly related to ISPM 15. The positive environmental impacts the implementation of standard may generate are related to the improvement of the overall phytosanitary situation of the country, which is incidentally the reason why the standard was developed in the first case, and in an improved pest management, which has not actually been dealt with so far in Mozambique.

The last part of Table 17, focuses on more general impacts of the implementation of the standard in the short and in the long run. The respondents did not mention any negative impacts of the ISPM 15; positive aspects range from increased employment to skills development of employees, because they are challenged to comply with an international standard. From a more macroeconomic perspective, the respondents mention the increase in the credibility of the country, translating into trade opportunities, as its exports should not be banned by other countries, and hereto connected the overall economic growth of the country.

Table 17: Main social, environmental and overall impacts of the ISPM 15

Main social impacts
Job creation
Environmental impacts
Protection of plants
Better pest management
Improve human health
Positive (p) and negative (n) impacts of the ISPM 15
Employment generation (p)
Skill development (p)
Major credibility of the country (p)

Source: Microeconomic data gathered from WPM treatment facilities. Authors' elaboration.

Table 18 lists the types of costs borne by WPM treatment facilities. The costs, which were originally measured in the local currency of the country, are expressed in USD in the table.[9] First, we query the amount spent for all the equipment and the number of years that equipment should be used for. The life expectancy of the equipment will serve to discount the amount spent for the equipment and allocate a share of those expenses to the next years. Equipment and license costs constitute the fixed costs each facility has every year.

Table 18: Average annual cost –in USD- for the WPM treating facilities, disaggregated by the source

Cost	Mozambique
Equipment cost	2,197
(Life expectancy of the equipment)	(15)
License	446
Costs for repairing equipment	125
Administrative cost	706
Timber costs	884
Salaries	n/a
External costs	707
Energy related costs	884
Other material cost	402
Other cost	0
Total	**6,366**

Source: Microeconomic data gathered from WPM treatment facilities. Authors' elaboration.

The process of estimating the costs related to the implementation of and compliance with ISPM 15 should consider the time needed to set up a WPM treatment facility This period relates to the time needed for the facility to purchase or update equipment, present all the necessary documentation, be inspected by the NPPO, and obtain authorization to operate. In the questionnaire, this was tackled through two questions; the first pertained to the time needed to purchase any equipment needed for treating the WPM, and whether the facility needed to update existing machines; the second related to the number of months needed to become fully operational.

[9] The costs, as well as the revenues, refer to the year before the year when the interview has taken place. The interviews took place in 2016, hence the financial data refer to 2015.

There is not so much variation among the four different facilities which have been interviewed (Table 19). The responses coming from the facilities indicate a waiting time of about seven to eight months to update the facility and for the authorization to arrive. In the case of Mozambique, the numbers would be higher if we had considered the facility, which has been waiting about two years to receive the authorization (see Chapter 3, section on the country mission to Mozambique for further details on this issue).

The questionnaire also queried the revenues the WPM treatment facilities have realized in the current year. In order to compute this figure, we first queried the maximum capacity of the facility, (i.e. the maximum number of WPM the facility is able to treat per year). In Mozambique the maximum capacity amounts to about 12,000 WPM per year; the actual number of WPM the facilities treat every year is lower than the maximum number. The facilities' capacity are used up to one fourth; those statistics are in line with the information gathered during the qualitative interviews. Mozambique has a fairly active export market but it lacks WPM treatment facilities close to where the exporters are located and most exporters prefer to buy treated WPM from South African facilities, which are closer by.

The last part of Table 19 gathers all the different data previously analysed to assess whether the WPM treatment business is a profitable one.
The first column presents the estimated annual cost each WPM treatment facility will bear to be operational. These costs are average, meaning that some of the facilities may face higher costs than those expressed. The second column indicates the number of WPM the facility treats every year. Based on the price each treated WPM is sold for, we can infer what would be the ideal amount of WPM to be treated and sold every year for the revenues to cover the total costs. This information is in the third column.
Results indicate that costs are higher than the revenues for the facilities located in Mozambique, and that to reach the breakeven point these facilities should treat an additional 700 pieces of WPM each year.

Table 19: Time needed for updating/purchasing equipment, total WPM capacity and total costs

Average number of months needed to update/buy machineries	Average number of months needed to become operational	Share of WPM treating facilities undergoing a verification process (in %)	Maximum number of WPM the facility can treat, per year	Number of WPM being treated in the current year	Number of WPM being treated in the previous year
6.3	1.3	100	14,700	3,597	3,164
Total cost	# of WPM treated	# of WPM treated for to break even			
6,366	3,597	4,465			

Source: Microeconomic data gathered from WPM treatment facilities. Authors' elaboration.

After having investigated whether the facilities operate in a loss or in a surplus, we will now examine whether it would be more profitable to close the facility and instead invest the money. To answer this, we need to know the current interest rates on savings in the four countries. Table 20 shows two different interest rates in each of the four countries, one that is more conservative with lesser return, and the other less conservative with higher potential return on the investment. The interest rates relate to a deposit investment for a period of 24 months. The last two rows of the table show that -in either

case- the revenues coming from the investments would be positive, whereas the Mozambique WPM treating facilities are currently operating with a deficit.

Table 20: Cost-benefit analysis for the WPM treatment facilities

	Mozambique
Costs	6,366
Revenues	3,488
Surplus/deficit	- 843
Interest rate (lower band)	8.94
Interest rate (higher band)	12.81
Revenues with no investments in WPM (lower band)	269
Revenues with no investments in WPM (higher band)	386

Source: Microeconomic data gathered from WPM treatment facilities. Authors' elaboration.
Regarding the interest rate part, data on Botswana interest rate come from Barclays and Stanbic bank.

5.4 Conclusions

Is implementing ISPM 15 sustainable for the WPM treatment facilities? Does it offer a good return on the investments disbursed by the facility? Is it necessary for the central government to subsidize the facilities? Would it be better to disinvest from the WPM treatment business and invest in a 24-months bank deposit?

This chapter has tried to answer these questions by using the microeconomic data gathered from the WPM treatment facilities located in the four case-study countries.

The objective of this chapter goes beyond the mere measurement of the costs and the revenues of the facilities. Instead it examines the implementation of the standard by looking at it from the perspective of the facilities. To do this, the facilities were studied with a magnifying glass to understand how they are organized, which have been their choices of treatments and why, and what is the demand of treated WPM. Furthermore, we wished to understand whether the information the facility gets from the NPPO is clear, if any training is provided and what the overall level of knowledge the facilities have of ISPM 15 is.

With this in mind, we designed a facility-level questionnaire with questions ranging from the documentation needed to be presented when requesting authorization from the NPPO to operate in the WPM business, the employment rate of those facilities, the treatments the facilities use, to the training organized to instruct the facility appropriate in how to comply with ISPM 15. In addition, we asked the respondents to elaborate on possible effects – environmental, social and economic – they feel ISPM 15 may have caused. Lastly, an entire section of the survey tool looked at the financial costs the facilities bear when operating, and at their annual revenues. We looked at all the costs related to the treatment

process, both fixed and variable costs, and after assessing the costs related to the equipment, to obtaining authorization, and to salaries and energy, we compared them with the revenues from the sale of the treated WPM.

The analysis highlighted a number of interesting key points. First, there is no homogenous approach to what is requested from applicants wishing to obtain authorization as a WPM treatment facility. While ISPM 15 does not set requirements around this, there should be clarity within the country on the documentation requested from the applicant facilities to provide for transparency, equality and efficiency, and help ensure that the facilities meet all the requirements for operating the treatments set out in ISPM 15.

The authorization process is rather fast; overall the process from purchasing all the necessary equipment to receiving the license may take up to two months. The NPPOs should improve the process by providing clearer indications and ad-hoc training.

On the financial side, the content of this chapter, discussed in combination with the qualitative evidence and the macroeconomic analysis, will help understand the overall costs and benefits of implementing the standard. There has recently been controversy over whether it is economically viable to implement and comply with the standard. Those in disagreement with the standard presents the argument that most introduced pests are innocuous whereas ISPM 15 implementation is costly and usually only delays pest introductions, rather than eliminating them.

This chapter demonstrates that the WPM treatment facilities operating on Mozambique are not self-sustainable and that the revenues are not high enough to cover the total costs.