

From bags for bunches to corner boards for pallets: recycling banana plastic in Peru

L. Clercx¹, D. Balarezo Camminati², M. Carreño Zapata³, R. Voerman^{4 a}.

¹AgroFair, Barendrecht, Netherlands, ²Clúster de Banano del Perú, Piura, Perú, ³Grupo ECOBAN S.R.L., Sullana, Perú, ⁴Triple Benefit, Enschede, Netherlands

Abstract

In banana cultivation for export, plastic bags are hung around the young bunch. This way, a microclimate is created inside the bag, which makes the bananas in the bunch grow better. The bag also protects the bunch from birds and insects. These do not affect the eating quality of the fruit, but feed, scrape or oviposit on the peel, leaving behind small superficial scratches, spots or scars. However, the supermarkets pursue what is called ‘cosmetic quality’: with the iconic perfect yellow banana as example, and handle ‘zero tolerance’ for these defects. But this beauty comes with a price: the massive use of plastic bunch bags; and, in the conventional, non-organic banana production, the use of bunch bags impregnated with insecticides. Not many consumers know this. In Peru’s small export banana sector alone, some 20 million bunch bags are used annually, totalling 400 tons of plastic. The bag can only be used once, after which it becomes waste. Recycling of this plastic is practice in some banana countries (such as in Costa Rica), but in most cases and in Peru, these bunch bags are thrown away (ending in landfills), buried, burned or just left behind in plantations or along roads, with a high risk of cumulative pollution of land-based ecosystems with (micro)plastics. Together with banana producer organizations and the Banana Cluster in Peru, AgroFair founded the company ‘Grupo ECOBAN S.R.L.’, that started to recycle banana plastic to manufacture corner boards for pallets, early 2022. We will explore the challenges of collecting and processing used banana bunch bags, the business model of the factory and the perspectives to extend its operations, to make organic banana production for export more sustainable.

Key words: Bunch bags, Recycling banana plastic, Small scale, Peru

INTRODUCTION

Pollution by plastics: some data

Climate change, loss of biodiversity and pollution are considered as the three main planetary environmental crises, undermining 80 percent of the SDG efforts. Given their interconnected nature, these problems should be tackled together. (UNEP 2021b). Pollution by plastics is a major component. The movement and accumulation of plastic waste occur over decades. Approximately 7.000 million of 9.200 million tons of cumulative plastic production between 1950 and 2017 became plastic waste, 75% of which became part of uncontrolled and mismanaged waste streams, was dumped or abandoned. The level of greenhouse gas emissions related to production, use and disposal of fossil fuel-based plastics will grow to 19 percent of the global carbon budget by 2040. At this moment, the recycling rate of plastics is less than 10 per cent. (UNEP 2021a). (Fig 1).

^a Mail: rikvoerman@triplebenefit.nl

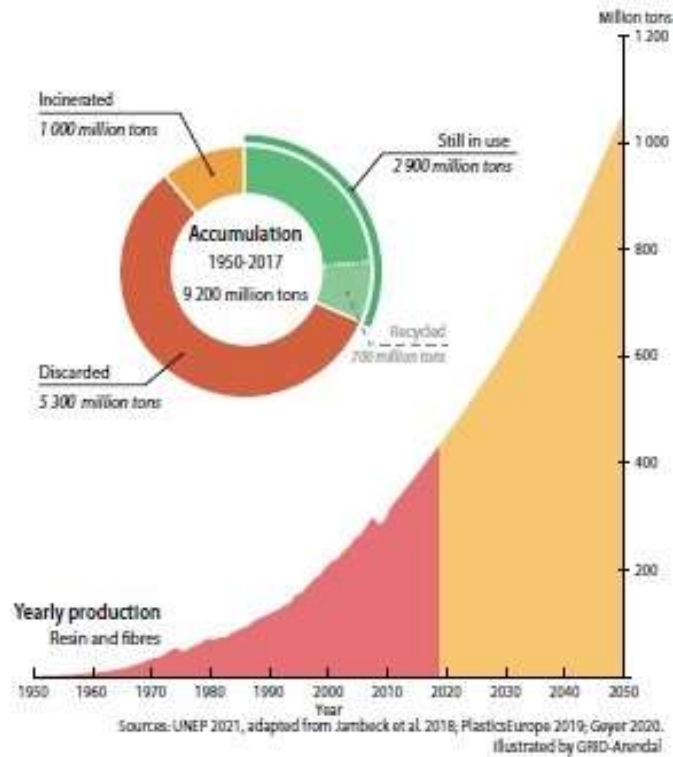


Figure 1. Global plastic production, accumulation and future trends (UNEP 2021a, p. 17)

The use and unsustainable management of plastics in agriculture

In 2019, annual plastic production was 359 million tons approximately. In the same year, agricultural value chains used 12,5 million tons of plastic products in crops, livestock, aquaculture, fisheries and forestry and 37,3 million tons in food packaging, nearly 14 per cent of total plastic production. The majority of the products are single use with a life span of less than 12 months. Of the agricultural plastics, approximately 60% are films (such as plastic storage bags, banana bunch bags, greenhouse, mulching and silage films); the rest are fishing gear, pesticide containers, tree guards (forestry) and other plastic (non-film). (Fig. 2).

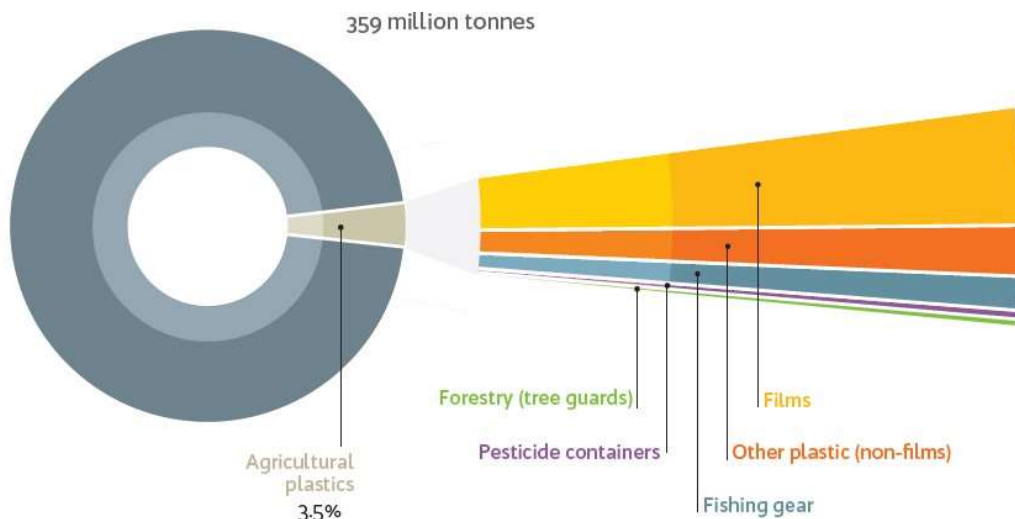


Figure 2: Composition of types of plastic products used in agriculture (does not include packing material downstream, which is mostly film).(FAO 2021, p. 17).

There are many benefits related to the use of agricultural plastics, but these also pose a serious risk of pollution and health of terrestrial, freshwater and marine ecosystems when degraded or discarded in the environment. Agriculture and livestock are the largest users (over 81%); and soil is the predominant receptor of agricultural plastics. In the qualitative risk assessment of 13 main plastic products, plastic banana bunch bags received a very high risk score. (FAO 2021).

The use of plastics in the banana export sector: overview

In all stages of the banana value chain (planting, cultivation, post-harvest processing, ripening, retail, consumption), plastic products are used. The main plastic products are containers, (insecticide impregnated) bunch bags, pads to protect banana hands during cultivation and harvest; and in the post-harvest stage, plastic bags inside the banana boxes and corner boards used for palletizing. (Fig. 3).

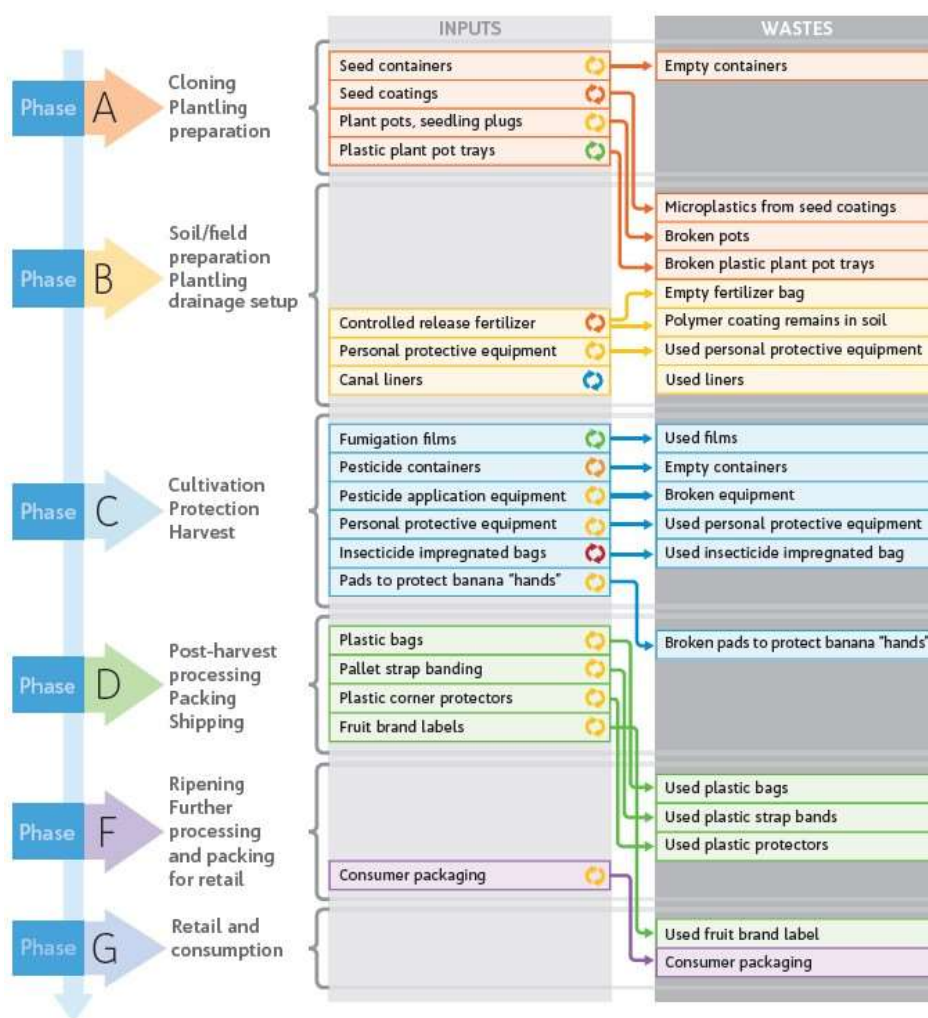


Figure 3. Use of plastics in the export banana value chain (FAO 2021, p. 139)

Approximately 500.000 ha worldwide are dedicated to the cultivation of export banana. It is estimated that per hectare 40 kg of bunch bags are used per year, each between 20 – 25 grams, totalling 20.000 tons, which represents 800 million - 1 billion bunch bags. If all these bunch bags would be put in a row, supposing a length of 1.50 m each bunch bag, this

would be 30 – 40 times around the world, *each year*. Annual import of banana, only in Europe, is 500 million boxes approximately, and an equal number of plastic bags inside. There are no reliable data yet on how much of this enormous volume of ‘banana plastics’ is recycled. Thin-walled plastic LDPE (Low-Density Polyethylene) or HDPE (High-Density Polyethylene) foils are one of the most difficult types of plastic to recycle, especially when part of household garbage. It is contaminated, mixed with other types of plastic, weighs almost nothing, and therefore, spreads easily into terrestrial and aquatic ecosystems, and is difficult and costly to collect and separate. Therefore, the best possible treatments (or should we say, the less worst) are the landfill and the oven. This becomes a different story when recycling processes are set up in a decentralized way, as close as possible to the places where many of the same types of waste are generated. (Voerman, 2020). This is the case with banana plastic. Separate this plastic from landfills is an impossible job and too costly. It should and can be done earlier.

TOWARDS RECYCLING OF BANANA PLASTIC IN PERU

Setting up a recycling facility in Peru

Peru has a relatively young and small banana export sector of 15.000 ha approximately. There is a dozen of medium sized banana farms, but the majority of the Peruvian banana export sector is made up of 9.000 small farmers approximately, organized in around 35 producer associations and cooperatives, with average plot sizes of between 0,5 and 1,0 ha per farmer. It is estimated that Peru supplied 25% of the organic banana market in 2021. (Willer et al. 2021). Each year approximately 20 million bunch bags are used, an estimated 400 tons. The production of ‘sustainable organic and Fairtrade banana’ in Peru contrasted sharply with the *unsustainable* management of plastic waste. It ended on landfills, was buried, burned or just left behind. In 2014 AgroFair commissioned a feasibility study for the recycling of banana plastic (WASTE, 2015) which was the start of a series of initiatives and trials, that culminated in close collaboration between AgroFair, the organisation Plastic Fantastic in the Netherlands and the Clúster de Banano del Perú in 2019 and the joint implementation of the project ‘From bunch bags to corner boards – recycling banana plastic’ from January 2000 onwards.

Organizing the company ‘Grupo ECOBAN S.R.L.’ and its recycling plant

The project was partially inspired by the recycling plant RECYPLAST in Costa Rica, founded in 1993: a joint venture of the banana companies DOLE, Del Monte and the plastic industry Grupo Montecristo, recycling agricultural plastics from the banana, pineapple and melon sector. (<https://www.recyplast.cr/>). All waste plastic is recycled into one single product: corner boards, used in the palletization of mainly banana and pineapple boxes. The current production capacity of RECYPLAST is 35.000 corner boards per day, sufficient for 437 reefer containers each day (with 20 pallets and 80 corner boards).

The initiative in Peru has similar goals (recycle banana plastic to manufacture corner boards) but at a far smaller scale. A joint venture was formed early 2021 between Tulipán Naranja, subsidiary of AgroFair in Peru, the Clúster de Banano del Perú (a sector platform actually grouping 8 producer organisations), and the banana producer organisations APPBOSA, AVACH, Río y Valle and APOQ, which was legally constituted as ‘Grupo ECOBAN S.R.L.’. An agglomerator and two recycling lines were ordered from a manufacturer in Qingdao, China, which arrived in September 2021 in the port of Paita. Building of the plant, located on the terrain of APPBOSA in Saman, part of the Marcavelica district, with a production hall, a storage for plastic bunch bags, a storage for corner boards and a small office (all together 578 m²), started in June 2021 and was completed in November. Starting capital for these investments and for technical assistance was subsidized by the Netherlands Enterprise Agency RVO, the CACTUS supermarket in Luxembourg and the Peruvian

governmental program INNOVATE. In December staff and workers were selected and appointed, and in January 2022 trials could start. The plant was officially inaugurated by AgroFair and regional authorities on February 3 in a festive ceremony. (Fig. 4).



Figure 4. The recycling plant of ECOBAN, viewed from outside and inside (February 2022)

RESULTS AND DISCUSSION

Overcoming start-up problems in production and logistics

Producing corner boards from recycled bunch bags starts with the quality of the prime material of the whole process, the bunch bags. In the packing stations, before dehanding, bunches are cleaned with water, still with bunch bags attached, and these are still wet when they arrive at the plant. Plastic foil must be transformed into granulate first. This is done in the agglomerator, a rotating barrel with knives that shreds the plastic bags into small pieces under a temperature of +/- 100 degrees Celsius. After 12 - 15 minutes a small amount of water is poured into the barrel, which suddenly brings down temperature and makes the tiny warm foil pieces agglomerate to small granules. Experience learned that wet bunch bags produced a granulate of bad quality, that is, insufficiently agglomerated. This caused excessive water vapour inside the extruder, jamming of the screw and a corner board with a very rough surface, due to the emergence of bubbles in the melted plastic inside the extruder. The quality of the corner boards improved drying the plastic before agglomerating, and was enhanced lowering the temperature of the heaters in the feed zone, melting zone and die. (Fig. 5).

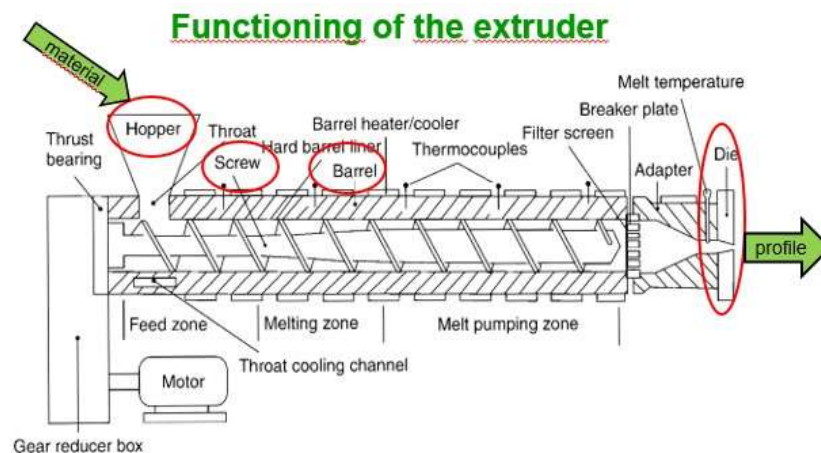


Figure 5. Working of the extruder.

Once these lessons were learned, ECOBAN started to produce corner boards of acceptable quality that could be used for shipments of banana boxes.

The logistics to collect plastic bunch bags are a bit more complicated. Especially the sector of small producer associations is highly fragmented, with hundreds of small packing stations that on harvesting days (once every 10 – 14 days) do not pack more than several hundred boxes. These are transported on small trucks to logistic palletizing centers where they are consolidated to fill one or more reefer containers containing 1.080 boxes each, on 20 pallets. The corner boards are delivered to the palletizing centers, and ideally, plastic bunch bags are taken back to the plant. This supposes separation of bunch bags in hundreds of packing stations and their delivery to these palletizing centers as intermediate recollection hubs. In practice, this requires training of workers in the packing stations, extra trips to the palletizing centre and a certain routine to become part of a normal every day practice. For ECOBAN it is easier to collect plastic from packing stations of bigger banana companies. However, this overlooks one of the main objectives of ECOBAN: the sustainable disposal of banana plastic, starting with small producer organizations.

Recycling banana plastic: the metrics of ECOBAN

The metrics of ECOBAN are quite simple. Each corner board weighs 0,5 kg, and on average it takes between 20 - 25 bunch bags (20 grams each approximately) to produce 1 corner board. The two recycling lines together have a capacity of producing 600 - 700 corner boards per working day, = 3.000 - 3.500 corner boards each week, sufficient for 37 - 43 containers; on an annual basis, 1.950 - 2.250 containers, roughly 20% of the total number of 11.000 exported banana containers from Peru in 2020, equipped with 880.000 corner boards. That implies that each day, ECOBAN needs 300 - 350 kg dry plastic. The nice thing is that in order to produce 80 corner boards (40 kg of recycled plastic), roughly the number of plastic bags are processed that were used to produce the banana to fill one container: an almost perfect match that creates an interesting piece of circular economy. Initial projections showed that with current production capacity and selling corner boards at competitive prices, operational costs (salaries and energy) would be covered with a break-even volume of 8.000 corner boards per month, and a little more to cover depreciation costs of the machines and building and other fixed costs as well, which looks quite promising. A mid-term review (to take place in July) should reveal real and more precise data on the profitability and the capacity to expand operations with investments financed from net profits.

Perspectives: towards a more sustainable banana sector, free from plastic waste

After two months operating, the demand for corner boards from recycled plastic is growing, and ECOBAN decided to introduce a second shift (4:00 PM – 12:00 PM), which almost doubles its production capacity. In the project, the acquisition of two more recycling lines is foreseen. With four lines, operating in two shifts, sufficient capacity would be in place to collect almost all used bunch bags plastic from the banana sector in Peru and to serve the whole sector with ECOBAN corner boards. Apart from the banana sector, other products are exported from Piura: grapes, avocado, mango and lemon, all together another 10.000 containers. (Solidaridad, 2020). If ECOBAN starts recollecting plastic from other sources, it could expand its market of corner boards from recycled plastics. Other products are also possible. In 2020, the banana company BANANICA installed a small recycling plant of their own to make corner boards as well; in 2022 another line was installed in their plant with support from the University of Piura, to produce plastic building blocks.

The publication of the FAO assessment on agricultural plastics in December 2021 was an important motive to put this issue on the sustainability agenda of the World Banana Forum

(WBF, a multi-stakeholder platform of the banana industry (<https://www.fao.org/wbf>)). The assessment calls for a code of conduct on the use of agricultural plastics. (FAO, 2021). Since the sector is very broad (includes many agriculture subsectors, livestock, fisheries, aquaculture, forestry), a separate code of conduct for the banana sector could be promoted by the WBF. The new GlobalGAP standard for fruits and vegetables puts a stronger emphasis on sustainability criteria, including the sustainable disposal of plastic waste, and recycling where possible. (GlobalGAP, 2022). All banana producers that produce for the European market have GlobalGAP certification.

The fifth General Assembly of the United Nations Environmental Program (UNEP), held early March 2022 in Nairobi, adopted a resolution presented by Rwanda and Peru, to submit a draft for an international binding treaty by the end of 2024, covering the whole life cycle of plastics (including production), to reduce the use of virgin plastic and put an end to pollution of aquatic and terrestrial ecosystems. The treaty should encourage action also by the private sector and all stakeholders, and promote voluntary approaches. (UNEP 2022). The banana sector can anticipate this and take responsibility. RECYPLAST and ECOBAN are examples of how banana plastic disposal by recycling is possible and even can be a profitable business. There is no excuse to do nothing.

CONCLUDING REMARKS

Anyone who eats the banana peel?

The focus of plastic pollution reduction strategies can be partitioned into upstream (pre-consumption, such as reducing demand) and downstream measures (post-consumption, such as collection and recycling) (Lau et al. 2020). Pocasangre et al. (2005) observe that the export banana market demands a fruit with a perfect cosmetic appearance, in part endorsed by the EU marketing regulation on banana (European Commission, 2011). In conventional banana, large amounts of pesticides are used to meet these standards, including in bunch bags impregnated with insecticides. Roughly 85% of edible bananas and plantains are sold on local markets in Asia, Africa and Latin America, and *nobody* complains about scratches, dark spots or scars on the peel – these do not affect the fruit itself. Usually, no bunch bags are used for the production of bananas for local markets. Pocasangre et al. call for education of consumers and marketeers to generate acceptance of bananas ‘with less than perfect cosmetic appearance but with an overall better environmental pedigree’ (*Op. cit*, p. 363). This is true for the use of insecticides, and also, to a great extent, for the use of plastic bunch bags. How many consumers know how much insecticide and plastic is used for a perfect yellow banana?

The pursuit of cosmetic quality was one of the reasons why the precursors of the actual big banana companies started to produce banana themselves to exert full control in integrated chains. The perception of what the consumer calls a ‘banana’ goes back to that period and is part of the ‘banana culture’. (Soluri, 2005). It will not be easy to change that culture - but we are drowning in pesticides and plastics. Will it be possible someday to phase out the plastic bunch bag in banana cultivation and ban it from a new kind of banana culture that is more sustainable? Until that day, many ECOBANs and RECYPLASTs are needed to free the banana sector and its surroundings from pollution by plastics. And if that day comes, these recycling facilities can be used to transform other single use plastic products to manufacture corner boards.

ACKNOWLEDGEMENTS

The authors want to thank all institutions that contributed with co-finance to the realization of the recycling plant ECOBAN: the Netherlands Enterprise Agency RVO, the supermarket chain CACTUS from Luxembourg, the Peruvian Governmental Program INNOVATE and the German Corporation for International Cooperation GIZ. Thanks to Plastic Fantastic for their technical assistance and enthusiasm. Thanks also to Eliana Noe for the pictures of the ECOBAN plant.

Citations and literature cited

European Commission. 2011. Commission Implementing Regulation (EU) No 1333/2011 of 19 December 2011 laying down marketing standards for bananas, rules on the verification of compliance with those marketing standards and requirements for notifications in the banana sector (codification) <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32011R1333>.

FAO. 2021. Assessment of agricultural plastics and their sustainability. A call for action. Rome. <https://doi.org/10.4060/cb7856en>.

FAO / Solidaridad / AgroFair. 2022. Plastics in the banana industry. Strategies to address and reduce the use of plastics in the banana industry. Thursday 21 April. Presentation for Working Group 1 Thematic Session, in preparation of the World Banana Forum Steering Committee Session 22. Rome. WBF.

GlobalGAP. 2022. Integrated Farm Assurance Smart. Principles and Criteria for Fruit and Vegetables. V6. Valid from 26 April 2022. https://www.globalgap.org/uk_en/for-producers/globalg.a.p/integrated-farm-assurance-ifa/versions-overview/.

Lau, W.W.Y et al. 2020. Plastic pollution. Evaluating scenarios toward zero plastic pollution. Science 368, 1455-1461 (2020), 18 September 2020. <https://www.science.org/doi/epdf/10.1126/science.aba9475>.

Pocasangre, L. et al. 2015. Organic Banana Disease Management. In: Plant Diseases and Their Management in Organic Agriculture. M.R. Finckh, A.H.C. vanBruggen and L. Ta., (eds). The American Phytopathological Society – APS Publications. Published online 22 Aug 2017. <https://doi.org/10.1094/9780890544785.026>.

Solidaridad. 2020. Estudio integral para el tratamiento de los residuos sólidos plásticos de la cadena de valor del banana orgánico del Departamento de Piura. Piura.

Soluri, J. Banana Cultures. 2005. Agriculture, Consumption & Environmental Change in Honduras & the United States. Austin. University of Texas Press.

United Nations Environment Programme (UNEP) (2021a). From Pollution to Solution: A global assessment of marine litter and plastic pollution. Nairobi. <https://wedocs.unep.org/bitstream/handle/20.500.11822/36963/POLSOL.pdf>

United Nations Environment Programme (UNEP) (2021b). Making Peace with Nature: A scientific blueprint to tackle the climate, biodiversity and pollution emergencies. Nairobi. <https://www.unep.org/resources/making-peace-nature>

United Nations Environmental Programme (UNEP) (2022). Draft resolution, 2 March. End plastic pollution: Towards an international legally binding instrument. Nairobi. https://wedocs.unep.org/bitstream/handle/20.500.11822/38522/k2200647 - unep-ea-5-l-23-rev-1 - _advance.pdf?sequence=1&isAllowed=y

WASTE. 2015. Reciclaje de fudas plásticas del sector banero en Perú. Feasibility study commissioned by AgroFair.

Willer, H. et al. (Eds.). 2021. The World of Organic Agriculture. Statistics and Emerging Trends 2021. Research Institute of Organic Agriculture FiBL, Frick, and IFOAM – Organics International, Bonn. <https://www.fibl.org/fileadmin/documents/shop/1150-organic-world-2021.pdf>