EPD®
THE INTERNATIONAL EPD® SYSTEM

Southeast Asia EPD

Environmental Product Declaration

In accordance with ISO 14025:2006 for

Herbicide Reductants (WEED Solut-ioN®)

From

PANDAWA AGRI INDONESIA

PT Pandawa Agri Indonesia

Jalan Raya No.5 RT.01/RW.01, Krajan,
Benelanlor, Kabat, Banyuwangi, East Java,
Indonesia - 68461

Programme
The International EPD® System,
www.environdec.com

EPD registered through the fully aligned regional hub
EPD Southeast Asia,
https://www.epd-southeastasia.com/

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General Information

Programme information

Programme	**The International EPD® System** EPD registered through the fully aligned regional hub: EPD Southeast Asia
Address	**EPD International AB** Box 210 60, SE-100 31 Stockholm, Sweden **EPD Southeast Asia** Kencana Tower Level M, Business Park Kebon Jeruk Jl. Raya Meruya Ilir No. 89, Jakarta Barat 11620, Indonesia Website: www.environdec.com www.epd-southeastasia.com Email: info@environdec.com

Accountabilities for PCR, LCA and independent, third-party verification
Product category rules (PCR): PCR: 2021:03 of Basic Chemicals, version 1.1.1. UN CPC: 34240
PCR review was conducted by: The Technical Committee of the International EPD® System. **Review chair:** Lars-Gunnar Lindfors The review panel may be contacted via the Secretariat www.environdec.com/contact.
Life Cycle Assessment (LCA) LCA accountability: PT. Life Cycle Indonesia
Third-party verification
Independent third-party verification of the declaration and data, according to ISO 14025:2006: ☑ EPD verification by individual verifier **Third party verifier:** Niels Jungbluth, ESU-services Ltd., Switzerland **Approved by:** The International EPD® System Technical Committee, supported by the Secretariat
Procedure for follow-up of data during EPD validity involves third party verifier: ☐ Yes ☑ No

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EPDs within the same product category but registered in different EPD programmes, or not compliant with EN 15804, may not be comparable. For two EPDs to be comparable, they must be based on the same PCR (including the same version number) or be based on fully-aligned PCRs or versions of PCRs; cover products with identical functions, technical performances and use (e.g. identical declared/functional units); have equivalent system boundaries and descriptions of data; apply equivalent data quality requirements, methods of data collection, and allocation methods; apply identical cut-off rules and impact assessment methods (including the same version of characterisation factors); have equivalent content declarations; and be valid at the time of comparison. For further information about comparability, see EN 15804 and ISO 14025.

Company Information

Owner of the EPD

PT Pandawa Agri Indonesia
Jalan Raya No.5 RT.01/RW.01, Krajan, Benelanlor, Kabat, Banyuwangi, East Java, Indonesia - 68461

Name and location of production site

1 site of herbicide reductants (WEED Solut-ioN®) production plant located in Banyuwangi, East Java, Indonesia.

Description of the organisation

Pandawa Agri Indonesia is the first life science-based company from Indonesia and currently the only one company that has innovation in the development of herbicide reduction products (herbicide reductant). Starting from this innovation, Pandawa Agri Indonesia is committed to helping agricultural businesses to create agricultural practices that are sustainable, environmentally responsible, and also cost-efficient.

Product Information

Product name

WEED Solut-ioN®

Product identification

Herbicide Reductant

UN CPC code

34240 - Phosphates of triammonium; salts and peroxy salts of inorganic acids and metals n.e.c.

Product description

WEED Solut-ioN® is an innovative product invented by Pandawa Agri Indonesia that incorporates agricultural waste as one of its key ingredients. It serves as a herbicide reductant, a specialized formula designed to reduce herbicide dosage by up to 50%[1], allowing users to significantly decrease the amount of herbicide used and realize substantial cost savings.

Reductants act as carriers for the active ingredients of herbicide. The active ingredients in WEED Solut-ioN® (WS), which consist of mineral salts, amplify the effectiveness of the herbicide constituents. These mineral salts play a significant role in stopping weeds from absorbing water and nutrients, resulting in a discernible weakening effect on the targeted weeds. Additionally, the mineral salts contribute to a gradual withering of the weeds, facilitating the optimized transference of active herbicidal components.

Technical Information

Product Name	Dimension	Density	Weight	Picture
WEED Solut-ioN®	30x30x42 cm	1.12 g/ml	24 kg	

[1] Putri, P. H., & Guntoro, D. (2018). *Effectiveness of Weed Solut-Ion as herbicide adjuvant to control weeds in oil palm plantations*. IOP Conference Series: Earth and Environmental Science, 183, 012022.

The technical standard properties of WEED Solut-ioN® are as follows[2]:

Properties	UoM	Data	Standards	Country
Physical state	-	Liquid	Pandawa Agri Indonesia	Indonesia
Color	-	Blue (light-cyan)	Pandawa Agri Indonesia	Indonesia
Odor	-	Product specific	Pandawa Agri Indonesia	Indonesia
pH	-	5.9 – 9.1	Pandawa Agri Indonesia	Indonesia
Solubility	-	Soluble	Pandawa Agri Indonesia	Indonesia
Density	g/ml	1.12 – 1.13	Pandawa Agri Indonesia	Indonesia
Viscosity	cP	<7	Pandawa Agri Indonesia	Indonesia
Acute oral toxicity (LD50), rat	mg/kg	>15,000 [relatively harmless]	Regulation of Government of The Republic of Indonesia no.74/2001	Indonesia
Acute aquatic toxicity (LC5096 hours)	ppm	592.53 (Poecilia reticulata); 4,073.01 (Cyprinus caprio); 2,932.33 (Oreochromis niloticus) [Practically non-toxic]	US EPA	USA
Eye irritancy	-	Non-irritant	Regulation of the Head of the Indonesian Food and Drug Authority no.7/2014	Indonesia
Skin irritancy	-	Non-irritant		
Biodegradability	-	Readily biodegradable	OECD 301D	Globally
Bioaccumulation potential (K_{ow})	-	0.36 [bioconcentration is extremely unlikely to be significant]	OECD 107	Globally

Geographical Scope

Manufactured in Indonesia, supplied to Indonesia and Malaysia

[2] Pandawa Agri Indonesia. (2023). WEED Solut-ioN® Safety Data Sheet: FM.RND.0114. Banyuwangi.

LCA Information

Declared unit

1 (one) kg of herbicide reductants plus its packaging ready for delivery (the weight of the packaging shall not be included in the 1 kg declared unit)

Time representativeness

1st January – 31st December 2022

Reference service life

Not applicable

Database(s) and LCA software used

Generic data for upstream and downstream processes, using Ecoinvent Database 3.9.1. Manufacturer-specific data used for core processes. All data and modelled by using SimaPro Developer software version 9.5.0.0. No datasets older than 10 years were used.

Description of system boundaries

The system boundary was chosen based on the goal and scope of the study and in accordance with Product Category Rules (PCR) 2021:03 Basic chemicals 1.1.1, i.e. "cradle-to-grave" excluding the use stage and the end-of-life treatment of chemical products. The processes below are included in the product system to be studied:

The processes below are included in the product system to be studied:

1 Upstream

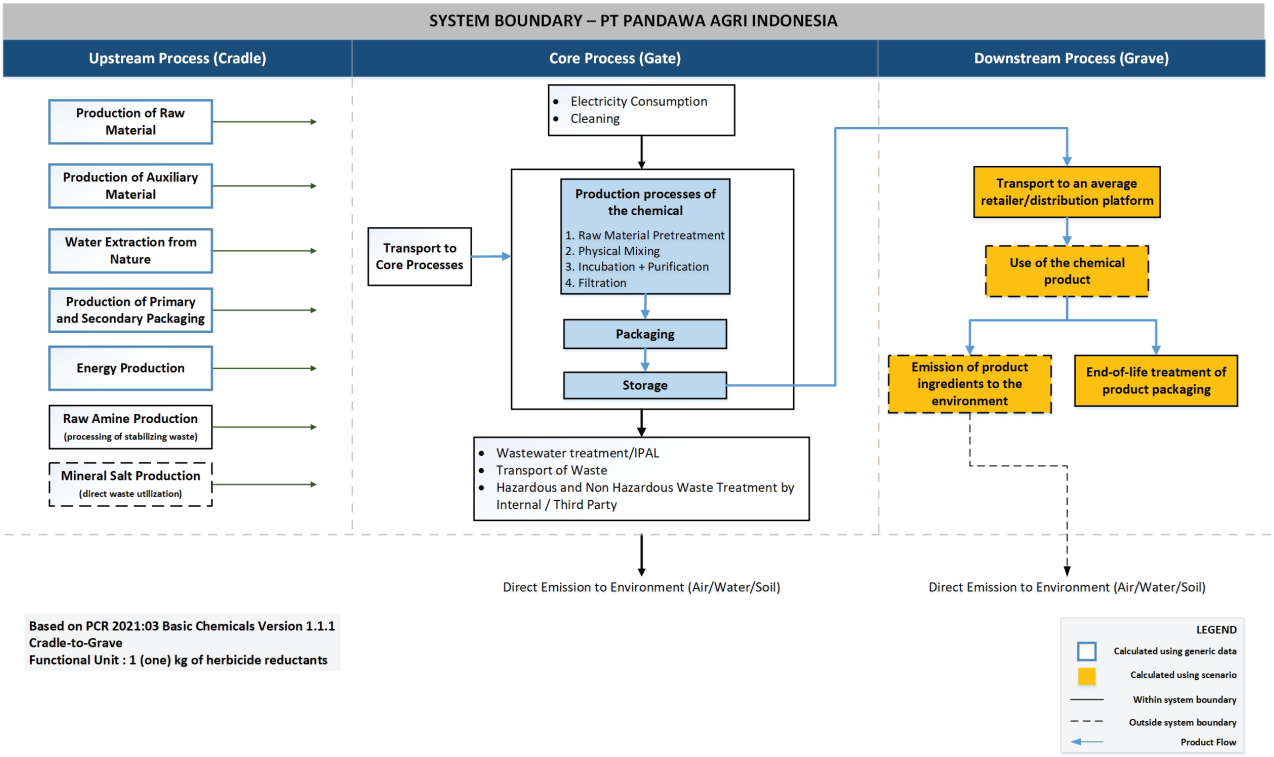
a. Production of raw materials (e.g., raw additives sodium, mineral salt, raw amine, inert materials, etc.)
b. Production of auxiliary materials (e.g., mask, rubber gloves, tissue, etc.)
c. Production of packaging (e.g., jerrycan HDPE, label, etc.)
d. Production of energy (i.e., electricity)
e. Tap water

2 Core

a. Transportation of raw/auxiliary materials from the supplier to production plant
b. Production and packaging process of the chemical:
    i. Raw material pretreatment
    ii. Physical Mixing
    iii. Incubation + Purification
    iv. Filtration
    v. Filling and Packaging (with labelling)
c. Warehouses
d. Maintenance process (e.g. lubricating oil, fine filter, sponge filter)
e. Machine cleaning
f. Waste and wastewater treatment by the company

3 Downstream

a. Transportation from production plant to customer (e.g. Kalimantan, Banten, Sumatera, Riau, and Malaysia).
b. End-of-life treatment of packaging waste.



Excluded lifecycle stage

- Environmental impact from use stage and end-of-life treatment of the chemical product that are physically integrated with other product are not accounted for in the LCI.
- Personnel-related impacts, such as transportation to and from work, are also not accounted for in the LCI.

More information

Relevant websites for more information regarding the process in manufacturing: https://pandawaid.com/

Key Assumptions and Limitations

- Production process of materials in the upstream process taken from the Ecoinvent Database 3.9.1 which have been modified mainly for electricity and water according to the supply country to make it more representative reflects average or generic production and therefore does not correspond to actual suppliers.
- Chemical and supporting material data for which there is no specific Material Safety Data Sheet (MSDS) available will use general data composition or generic data.
- The cartridge mask composition consists of 70% filter media and 30% housing/case materials.
- Sulfur water uses a generic H2S content of 7.621 mg/L which comes from a local crater in East Java (Hidayat, 2019).
- Water usage data for machine cleaning is cumulative for all process machines.
- Energy consumption and emissions from transportation processes are assumed to be similar to data available in the Ecoinvent Database 3.9.1, considering the type of transportation (truck, train, and sea freight) and distance travelled.
- Product transportation to markets is estimated based on Google Maps distance data, including transportation to warehouses using a weighted average. Both truck and train transportation modes are considered. The transportation data includes transportation to the warehouse, which is calculated using weighted average. The total land distance includes both truck and train modes of transportation used to distribute the products.
- Transportation waste of WEED Solut-ioN® to waste processing units is estimated based on average distance traveled by truck in Indonesia, 300 km (BPS, 2021) and Malaysia 191.78 km (Briggs, 2016).
- The measurement of emission to water is conducted before the wastewater enters the treatment plant. Therefore, the amount of liquid waste materials released into the environment is determined based on the maximum levels permitted by local government regulations (Banyuwangi Local Government Regulations, 2017).
- Amount of sediment and colloid produced from the production process is cumulative for all process machines (Incubation and Purification, also Filtration process).
- In 2022, Pandawa Agri collected hazardous waste in storage, therefore, the hazardous waste treatment in this study is assumed to use incineration as the common practices.
- In 2022, Pandawa Agri retained the used HDPE drums utilized for packaging raw materials due to their ongoing internal use. In the future, the drums will be sold to third parties so that in this study the waste drums do not carry the burden of waste treatment.
- Waste treatment methods for HDPE jerrycans, plywood boards, and ropes are based on general municipal solid waste treatment methods in Indonesia and modelled using generic data from Ecoinvent Database 3.9.1.
- In Indonesia, the prevailing methods for municipal solid waste treatment typically involve 10% recycling/reuse, 17.1% landfilling, and 72.9% open dumping (Keesman, 2019).

Cut-off rules

At each unit process within the system boundary, all data will be included, unless those that meet the cut-off criteria, i.e.:

- Data for elementary flows to and from the product system contributing to a minimum of 99% of the declared environmental impacts shall be included (not including processes that are explicitly outside the system boundary as described in system boundary).
- The check for cut-off rules is through the combination of expert judgement based on experience of similar product systems and a sensitivity analysis in which it is possible to understand how the un-investigated input or output could affect the final results.
- Pandawa's main inputs, mineral salt and raw amine, are sourced from waste generated by other systems. While mineral salt is used directly without any processing, raw amine undergoes processing before being received by Pandawa. Pandawa only bears the environmental impact from the processing of raw amine. However, for mineral salt, which is used directly without any processing, Pandawa does not bear any environmental impact from the earlier life cycles of the waste.

If there is missing primary data, proxy data or extrapolation or secondary data from the database or literature will be used.

Data Quality

- Time related coverage: specific data were collected from 2022-01-01 to 2022-12-31, and generic data are representative of the year 2021.
- Geographic coverage: specific data were collected from the area under study, i.e., Banyuwangi, West Java, Indonesia. Generic data were collected from global average data.
- Technological coverage: specific data were collected from the current production process under study at a specific site.

Data quality for both specific and generic data were sufficient to conduct life cycle assessment in accordance with the defined goal and scope.

Allocation

In this study, allocation is not applied in the manufacturing phase since no by-products exist. In the end-of-life stage for the processing/scenario for waste packaging, allocation by mass may be used.

LCA scenarios and additional technical information

- The study only included products in 20 L jerrycan packaging, excluding other bottled products that constituted less than 1% of the total distribution.
- The mass of the WEED Solut-ioN® product uses the product density conversion, which is 1.12 g/ml.
- The mass of the plywood board uses the density conversion, which is 768.6 kg/m^3 according to Ecoinvent Database 3.9.1.
- Electricity grid in the production process of WEED Solut-ioN® was based on the Ecoinvent Database 3.9.1 for Indonesia that was modified to represent the JAMALI (Java-Madura-Bali) electricity network. The composition of electricity mixed for JAMALI and the amount of electricity losses were adjusted based on Statistic from Directorate General of Electricity (2019) which is highly reliant on coal (66%), gas fired (27.5%), hydropower (4%), geothermal (2%), and diesel (<1%). The climate impact of the electricity is 1.2 kg CO_2 eq./kWh.
- The characterization factor (CF) for water use is modified to describe the watershed level where the unit process withdraws water, i.e., Banyuwangi, Indonesia. The CF data is documented by AWARE through a Google Layer Document that provides CF up to watershed level in the region. The CF ranges from 0.1 up to 100 with the annual average is 9.5. Therefore, the CF for water is modified to 9.5 m^3/m^3 from average Indonesia 23.6 m^3/m^3.
- Transportation using trucks in customer countries adjusted to its EURO level to represent the current condition. In Indonesia and Malaysia, EURO III is used.
- WEED Solut-ioN® will be mixed with herbicide at a volume ratio in liter of 1:1 or 50% of the herbicide dose.

Content Declaration

Product

Product components[a]	%	Environmental / hazardous properties
Water	57-59	Not categorized as hazardous in any GHS hazard class
Nitrogen[b]	16-18	
Salt[c]	1.5-2	
Others	21-25.5	
Total	100	

[a] This detailed content is protected by copyright, and all associated content is confidential, intended solely for the use of authorized personnel within the Pandawa Agri Indonesia organization.

[b] Nitrogen based on agricultural waste

[c] Salt containing Natrium and other components

Packaging

Distribution packaging:
WEED Solut-ioN® is distributed with rope and plywood boards.

Consumer packaging:
WEED Solut-ioN® is packed using HDPE jerrycan 20 L and label.

Recycled material

Provenience of recycled materials (pre-consumer or post-consumer) in the product:
N/A

Results of the Environmental Performance Indicators

Impact category indicators - 1 kg of WEED Solut-ioN® without its packaging

Parameter		Unit	Upstream	Core	Downstream	TOTAL
Global warming potential (GWP)	Fossil fuel (GWP-fossil)	kg CO_2 eq.	3.54E-01	1.14E-01	1.86E-01	6.54E-01
	Biogenic (GWP-biogenic)	kg CO_2 eq.	8.96E-04	6.48E-05	-4.28E-04	5.33E-04
	land use and land use change (GWP-luluc)	kg CO_2 eq.	1.98E-04	7.92E-05	1.18E-04	3.95E-04
	TOTAL (GWP-total)	kg CO_2 eq.	3.55E-01	1.14E-01	1.85E-01	6.55E-01
Ozone layer depletion (ODP)		kg CFC_{11} eq.	7.26E-09	1.78E-09	2.61E-09	1.16E-08
Acidification potential (AP)		mol H^+ eq.	2.70E-03	5.75E-04	1.29E-03	4.57E-03
Eutrophication potential - freshwater (EP-freshwater)		kg P eq.	1.87E-05	3.87E-06	2.65E-06	2.52E-05
Eutrophication potential - marine (EP-marine)		kg N eq.	5.67E-04	1.98E-04	4.73E-04	1.24E-03
Eutrophication potential - terrestrial (EP-terrestrial)		mol N eq.	5.32E-03	2.15E-03	5.15E-03	1.26E-02
Photochemical oxidant creation potential (POCP)		kg NMVOC eq.	1.20E-03	8.76E-04	1.57E-03	3.65E-03
Abiotic depletion potential (ADP)	non-fossil resources (ADPE)*	kg Sb eq.	8.55E-06	4.89E-07	6.49E-07	9.68E-06
	Fossil resources (ADPF)*	MJ, net calorific value	5.10E+00	1.47E+00	2.52E+00	9.09E+00
Water deprivation potential (WDP)*		m^3 world eq. deprived	8.83E-03	8.59E-04	4.73E-04	1.02E-02

* The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

Resource use indicators - 1 kg of WEED Solut-ioN® without its packaging

Parameter		Unit	Upstream	Core	Downstream	TOTAL
Primary energy resources – Renewable	Use as energy carrier (PERE)	MJ, net calorific value	2.69E-01	2.99E-02	4.24E-02	3.41E-01
	Used as raw materials (PERM)	MJ, net calorific value	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Total (PERT)	MJ, net calorific value	2.69E-01	2.99E-02	4.24E-02	3.41E-01
Primary energy resources – Non-renewable	Use as energy carrier (PENRE)	MJ, net calorific value	9.86E-01	1.57E+00	2.69E+00	5.25E+00
	Used as raw materials (PENRM)	MJ, net calorific value	4.54E+00	0.00E+00	0.00E+00	4.54E+00
	Total (PENRT)	MJ, net calorific value	5.53E+00	1.57E+00	2.69E+00	9.79E+00
Secondary material (SM)		kg	7.39E-01	0.00E+00	0.00E+00	0.00E+00
Renewable secondary fuels (RSF)		MJ, net calorific value	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Non-renewable secondary fuels (NRSF)		MJ, net calorific value	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Net use of fresh water (FW)		m^3	4.11E-02	2.27E-03	2.72E-03	4.60E-02

Waste indicators - 1 kg of WEED Solut-ioN® without its packaging

Parameter	Unit	Upstream	Core	Downstream	TOTAL
Hazardous waste disposed (HWD)	kg	4.04E-07	1.80E-03	0.00E+00	1.80E-03
Non-hazardous waste disposed (NHWD)	kg	1.80E-03	2.32E-03	9.46E-06	4.13E-03
Radioactive waste disposed (RWD)	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Other environmental performance indicators - 1 kg of WEED Solut-ioN® without its packaging

Parameter	Unit	Upstream	Core	Downstream	TOTAL
Components for re-use (CRU)	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling (MFR)	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for energy recovery (MER)	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported electrical energy (EEE)	MJ per energy carrier	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported thermal energy (EET)	MJ per energy carrier	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Impact category indicators - 1 kg of packaging for one kg of WEED Solut-ioN®

Parameter		Unit	Upstream	Core	Downstream	TOTAL
Global warming potential (GWP)	Fossil fuel (GWP-fossil)	kg CO_2 eq.	1.66E-01	8.35E-03	8.27E-03	1.83E-01
	Biogenic (GWP-biogenic)	kg CO_2 eq.	-1.22E-04	9.61E-06	8.11E-03	8.00E-03
	land use and land use change (GWP-luluc)	kg CO_2 eq.	1.30E-04	5.34E-06	8.08E-07	1.36E-04
	TOTAL (GWP-total)	kg CO_2 eq.	1.66E-01	8.37E-03	1.64E-02	1.91E-01
Ozone layer depletion (ODP)		kg CFC_{11} eq.	8.36E-10	1.21E-10	1.85E-11	9.76E-10
Acidification potential (AP)		mol H^+ eq.	7.44E-04	4.63E-05	7.27E-06	7.98E-04
Eutrophication potential - freshwater (EP-freshwater)		kg P eq.	1.21E-05	8.23E-08	1.30E-07	1.23E-05
Eutrophication potential - marine (EP-marine)		kg N eq.	1.62E-04	1.80E-05	9.42E-06	1.89E-04
Eutrophication potential - terrestrial (EP-terrestrial)		mol N eq.	1.79E-03	1.95E-04	2.85E-05	2.01E-03
Photochemical oxidant creation potential (POCP)		kg NMVOC eq.	6.81E-04	6.18E-05	1.41E-05	7.57E-04
Abiotic depletion potential (ADP)	non-fossil resources (ADPE)*	kg Sb eq.	5.46E-07	3.54E-08	4.77E-09	5.86E-07
	Fossil resources (ADPF)*	MJ, net calorific value	4.56E+00	1.16E-01	1.76E-02	4.69E+00
Water deprivation potential (WDP)*		m^3 world eq. deprived	5.98E-04	2.16E-05	1.03E-04	7.23E-04

* The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

Resource use indicators - 1 kg of packaging for one kg of WEED Solut-ioN®

Parameter		Unit	Upstream	Core	Downstream	TOTAL
Primary energy resources – Renewable	Use as energy carrier (PERE)	MJ, net calorific value	1.39E-01	2.87E-03	4.75E-04	1.43E-01
	Used as raw materials (PERM)	MJ, net calorific value	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Total (PERT)	MJ, net calorific value	1.39E-01	2.87E-03	4.75E-04	1.43E-01
Primary energy resources – Non-renewable	Use as energy carrier (PENRE)	MJ, net calorific value	4.92E+00	1.24E-01	1.88E-02	5.06E+00
	Used as raw materials (PENRM)	MJ, net calorific value	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Total (PENRT)	MJ, net calorific value	4.92E+00	1.24E-01	1.88E-02	5.06E+00
Secondary material (SM)		kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Renewable secondary fuels (RSF)		MJ, net calorific value	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Non-renewable secondary fuels (NRSF)		MJ, net calorific value	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Net use of fresh water (FW)		m^3	7.72E-03	1.15E-04	2.07E-05	7.86E-03

Waste indicators - 1 kg of packaging for one kg of WEED Solut-ioN®

Parameter	Unit	Upstream	Core	Downstream	TOTAL
Hazardous waste disposed (HWD)	kg	6.18E-05	3.87E-05	1.18E-11	1.00E-04
Non-hazardous waste disposed (NHWD)	kg	2.69E-04	7.21E-04	7.76E-08	9.91E-04
Radioactive waste disposed (RWD)	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Other environmental performance indicators - 1 kg of packaging for one kg of WEED Solut-ioN®

Parameter	Unit	Upstream	Core	Downstream	TOTAL
Components for re-use (CRU)	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling (MFR)	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for energy recovery (MER)	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported electrical energy (EEE)	MJ per energy carrier	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported thermal energy (EET)	MJ per energy carrier	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Interpretation of Results

1. From overall life cycle stages, **upstream module** has given the most significant impact that generated by the whole life cycle.

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2. The **production of raw amine** emerges as the primary contributor, impacting 12 out of 13 total categories. This signifies its broad influence across impact categories. Transportation, specifically via medium-duty trucks, affects 11 categories, while the production of high-density polyethylene jerrycans and transportation using heavy-duty trucks contribute to 10 and 8 categories, respectively. Other hotspot processes impact 3 or fewer categories.

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3. In the transportation aspect, various modes of transport have been identified as significant contributors in this study. These include medium-duty truck, heavy-duty truck, motor scooter, train, and ship. **Medium-duty truck** and **heavy-duty truck** for transportation products to customer are the main contributors which have a substantial impact to eleven and eight out of 13 impact categories, respectively.

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4. Production activities in the study area highlight that the **incineration treatment of hazardous waste** and the **generation of electricity** from the regional supply mix as significant hotspots throughout the entire production process (core module). Specifically, hazardous waste treatment is a hotspot in the Water Scarcity Footprint (WSF), while electricity production stands out as a hotspot in the Freshwater Eutrophication Potential impact categories.

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5. The largest contributor in the end-of-life treatment of product packaging and distribution packaging is the **open dumping** and **landfilling treatment of plywood board waste**, which only contribute as hotspot in one impact category, GWP-Biogenic.

Additional environmental information

The Herbicide Reductants are biodegradable[3] according to the OECD 301D method. They are made from locally sourced ingredients and non-toxic minerals. Based on toxicity assessment, they have been proven to be non-toxic to mammals, non-irritating for skin and oral exposure, do not bioaccumulate, and are harmless to aquatic life. They are also compatible with a wide range of herbicides, allowing farmers and plantations to reduce herbicide usage by 50%, thereby reducing residue levels in end products.

Directions for Use

1. Mix well WEED Solut-ioN® with herbicides with volume ratio of 1:1 or 50% utilized doses.
2. The dosage or concentration of the mixed solution (WEED Solut-ioN® and herbicide) should follow the recommended dosage or concentration of the herbicide being used.
3. WEED Solut-ioN® can be used with all types of herbicide active ingredients available in the market.
4. WEED Solut-ioN® cannot be applied alone as it is not a herbicide. The use of WEED Solut-ioN® must be combined with a herbicide.

Example of application

If the recommended herbicide dosage per hectare used is 2 L/ha, then the combined usage with WEED Solut-ioN® would be: 1 L/ha of WEED Solut-ioN® + 1 L/ha of herbicide

Storage and Disposal

Store the product in a cool and dry place, away from direct sunlight. Always ensure the lid is tightly closed when not in use to prevent spills. The container cannot be recycled or refilled. Dispose of any empty product packaging in accordance with local government requirements or regulations.

- Complete degradation within 14 days, meeting the criteria of OECD 301D testing[3], and earning the classification of "readily biodegradable" due to achieving ≥60% degradation within 28 days.
- This substance is not listed among materials that can contaminate aquatic environments and is labeled as "virtually non-toxic" according to the US EPA. It does not tend to accumulate within organisms and poses no harm to aquatic life.
- The bioconcentration of this material is extremely unlikely to be significant. The product underwent OECD 107 testing[4] and was classified as "readily biodegradable" per the Annex 6 Harmonised Offshore Chemical Notification Format (HOCNF) from March 10-14, 2003. When an ample quantity of undiluted 100% product is introduced into water, there may be a slight increase in pH.
- Expected to exhibit non-persistence in soil, water, and the atmosphere.
- Non-toxic. This product is harmless to aquatic life, biodegradable and has no potential to accumulate in organisms. Nevertheless, a substantial spill could potentially impact the environment.
- Non-irritant to eyes and skin during prolonged exposure.

[3] Institut Pertanian Bogor. (2020). Laboratory Test Report Adjuvan Pandawa Agri Indonesia: Lt-10-19-1351.

[4] Institut Pertanian Bogor. (2022). Laboratory Test Report WS Pandawa Agri Indonesia: Lt-10-22-0354.

Potential Environmental Impact

Weed Solution is released 100% into the environment during the use stage. Therefore, the environmental impact of the products to air, soil, and water during both the use and end-of-life stages are as follows:

1. During Use Stage*:

- Marginal parts of the products may reach field crops, which in some cases can volatilize back into the air, while other parts could reach the soil through wash-off, and some small parts might end up inside the crops as residues or degrade.
- While the product's salt content may influence soil salinity, it constitutes only 0.75-1% of the mixture when combined with herbicide for application. Furthermore, Weed Solution contains nitrogen, which might contribute to enhanced agricultural productivity.
- Air: During the product application, there is a risk of drift, where tiny droplets or particles can be carried by wind and dispersed into the air. This can result in unintended contamination of the atmosphere.
- Soil: Herbicide reductants can be absorbed by the soil after application and potentially affect groundwater. The extent of soil contamination depends on factors like the type of soil and application rate.
- Water: Runoff from treated areas can carry herbicides and reductants into nearby surface water bodies, such as rivers, streams, and ponds.

*Estimating the exact amount of these impacts is not possible due to the variability in wind and soil conditions.

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2. End-of-Life:

- WEED Solut-ioN® Residual: If the containers are not properly cleaned and recycled, residual herbicide reductants can remain in containers and potentially leach into the soil or water when the containers degrade in landfills.
- Unused WEED Solut-ioN®: Improper disposal of unused products, such as pouring them down the drain or into the soil, can lead to direct contamination of water sources and soil.
- Product Degradation: Some herbicide reductants can persist in the environment for extended periods, potentially leading to long-term emissions to air, soil, and water as they break down.

To mitigate these potential emissions, it's crucial to follow recommended WEED Solut-ioN® application practices, including using appropriate equipment, adhering to label instructions, and avoiding application in adverse weather conditions. Additionally, proper disposal and recycling of the containers and unused products are essential to minimize environmental impacts by following the local government regulations.

Additional social and economic information

In addition to reductants, Pandawa Agri Indonesia also establishes an end-to-end smallholders ecosystem, where farmers are fully assisted with good agricultural practices (GAP) from the beginning of the planting to the harvesting time. Pandawa Agri Indonesia provides farmers with PPAI (Plant and soil health, Productivity, Assistance, and Innovation) technology.

The PPAI technology has been purposefully engineered to serve multifaceted purposes, encompassing not only the augmentation of agricultural productivity but also the enhancement of environmental quality and bolstering plant resilience in the face of climate change.

With PPAI technology, farmers have witnessed an increased productivity to up to four times higher than before. Pandawa Agri Indonesia's focus on sustainable agriculture has also resulted in a 25% higher productivity compared to conventional farming methods, further improving farmers' financial stability and economic well-being. Aside from the rise in both agricultural productivity and farmers' income, the farmers also reported a heightened state of health in their agricultural lands. Pandawa Agri Indonesia also collaborates with financial institutions to give farmers access to affordable financing, so they have the resources to further implement GAP. The company also facilitates farmers with market access to their harvest at competitive prices, allowing farmers to earn additional income. Pandawa Agri Indonesia's smallholder ecosystem developments were established in South Sumatra (coffee plantation), East Nusa Tenggara (rice farming), and in East Java (chili farming).

Since 2021, Pandawa Agri Indonesia has successfully integrated more than 400 farmers, with over 340 hectares of land, into its ecosystem.

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Environmental Product Declaration

EPD®

THE INTERNATIONAL EPD® SYSTEM

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