

SAFE USE OF WASTEWATER IN AGRICULTURE: EXCHANGING KNOWLEDGE IN COLOMBIA

PROCEEDINGS

Bogotá, Colombia, 27–28 November 2018



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Safe Use of Wastewater in Agriculture: Exchanging Knowledge in Colombia

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Bogotá, Colombia

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Ministry of Environment and Sustainable Development of Colombia



**GOBIERNO
DE COLOMBIA**



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The presenters are responsible for ensuring that all figures, tables, text, and supporting materials are properly cited and necessary permissions were obtained.

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Background

The UNU-FLORES initiative on the Safe Use of Wastewater in Agriculture (SUWA) aims to support United Nations (UN) Member States in the development of their national capacities and strategic policy implementation actions in priority areas that promote the safe and productive use of wastewater.

For its part, the Ministry of Environment and Sustainable Development of Colombia, through the Division of Integrated Management of Water Resources, has been promoting within the framework of the Policy for the Integrated Management of Water Resources (2010–2022) and Resolution 1207/2014, the use of treated wastewater for irrigation and defined industrial uses, as a strategy of efficient use and saving of water and pollution prevention.

The unequal spatial and temporal distribution of water supply in the Colombian territory and the stress that climate change and variability is causing to this resource in the country makes SUWA a promising tool to cushion the impact of pressure from the demand for water resources. SUWA can reduce the demand for water from natural sources for agricultural uses and simultaneously increase the productivity and resilience of the agricultural sector. If handled properly, SUWA can function as a measure to prevent contamination from wastewater in the water and on the ground.

Within the framework of the Policy for the Integrated Management of Water Resources and the Green Growth Policy (2018), Colombia is currently in the process of promoting the use of treated wastewater through the adjustment of the Wastewater Use Regulation (1207/2014) for irrigation and defined industrial uses and with the compilation of good reuse practices. It is in this context that UNU-FLORES and the Ministry of Environment and Sustainable Development came together to organise this workshop. The main objective was to create a space for the exchange of knowledge to jointly identify better strategies to promote SUWA in Colombia.

At UNU-FLORES, we hope that the results of this workshop will serve as an input for the government of Colombia in its process of regulatory developments in relation to SUWA and that it will also be a starting point for a possible collaboration of mutual benefit, and above all, for the natural resources of the country.



Participants of the workshop (Image: Ministry of Environment and Sustainable Development of Colombia)

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Section 1: Setting the Scene

1.1 Introduction

For over 50 years, agricultural irrigation with industrial and domestic wastewater has been carried out in Colombia without any treatment or control by environmental authorities. It was estimated that in 2002, 1,230,193 hectares of agricultural land were irrigated with wastewater, of which 27% was irrigated with treated wastewater and the remaining 73% with untreated wastewater. This has generated an environmental problem in the country with regard to groundwater and soil pollution. For this reason and to control wastewater reuse activities, the Ministry of Environment and Sustainable Development in Colombia has recognised that Safe Use of Wastewater in Agriculture (SUWA) is a decisive strategy for reducing the pressure on water resources and its contamination. In 2014, this institution issued criteria, quality standards, and other requirements to be met for SUWA so that the population's health and the country's natural resources are not affected.

However, despite attempts by the Colombian government to stimulate SUWA, there are several weaknesses with the legislation established in 2014 and the local reality is thus inconsistent with its intended vision. As a result, farmers fail to use wastewater and thus keep drawing freshwater from natural sources, while the municipalities continue dumping their wastewater into waterbodies or soil.

1.2 Workshop Overview

Over 40 participants got together to share and exchange knowledge about Safe Use of Wastewater in Agriculture (SUWA). Representatives from the regional environmental authorities, Ministry of Environment and Sustainable Development (MADS), Ministry of Housing and Territorial Development, Ministry of Agriculture and Rural Development, Institute of Hydrology, Meteorology and Environmental Studies (IDEAM) attended the workshop on the invitation of MADS and UNU-FLORES for developing constructive ideas on the best pathway for implementing SUWA in Colombia.

The workshop spanned two days. In the opening session, the Director of the Water Resources Division (DGIRH), **Mr Nelson Mauricio Anillo**, and the Coordinator of the DGIRH, **Ms Diana Marcela Moreno**, both as representative officials of MADS gave welcome remarks.

On Day 1, the water specialist of MADS, **Mr Carlos Andrés Palacio**, presented the results of the implementation of wastewater practices following the issuance of the current regulation. This included the problems for implementing the regulation as well as the proposal to modify some aspects of this regulatory tool. The modifications proposed are related to the conceptual framework, administrative process, and uses and quality criteria for using wastewater. This was followed by a discussion, where the participants had the opportunity to share their views and ideas related to the suitability of the modifications proposed by MADS.

Day 2 was dedicated to the topic of SUWA. The Head of the Waste Management unit of UNU-FLORES, **Prof. Hiroshan Hettiarachchi**, introduced SUWA and shared some international experiences. This generated a lively discussion on how to apply some of these international SUWA practices in Colombia. Later, **Dr Serena Caucci** and **Ms Natalia Jiménez** presented the bottlenecks that are most likely blocking SUWA implementation in Colombia as well as possible solutions that can help to overcome these issues from the UNU-FLORES perspective. These interventions generated also interesting discussions among participants and UNU-FLORES staff.

Concluding the workshop on Day 2, a meeting took place under the moderation of the Coordinator of the DGIRH, **Ms Diana Marcela Moreno**. In this meeting, the representatives of the Ministry of Environment and Sustainable Development, Ministry of Housing and Territorial Development, Ministry of Agriculture and Rural Development, and Institute of Hydrology, Meteorology and Environmental Studies, defined the next steps for promoting SUWA in Colombia, inviting UNU-FLORES to be part of this process.

Section 2: Country Context and Recent Findings of the Ministry

2.1 Presentation

Mr Carlos Andrés Palacio (MADS), began his talk by pointing out the importance of wastewater use in Colombia as a strategy for the efficient use of water, decreasing also the wastewater discharges into waterbodies and the soil. He presented a timeline (see Figure 1) on the monitoring of the implementation of the wastewater use regulation issued in 2014. The MADS has conducted two surveys – one in 2016 and another in 2017 – among the regional environmental authorities and nine workshops in different regions of the country.

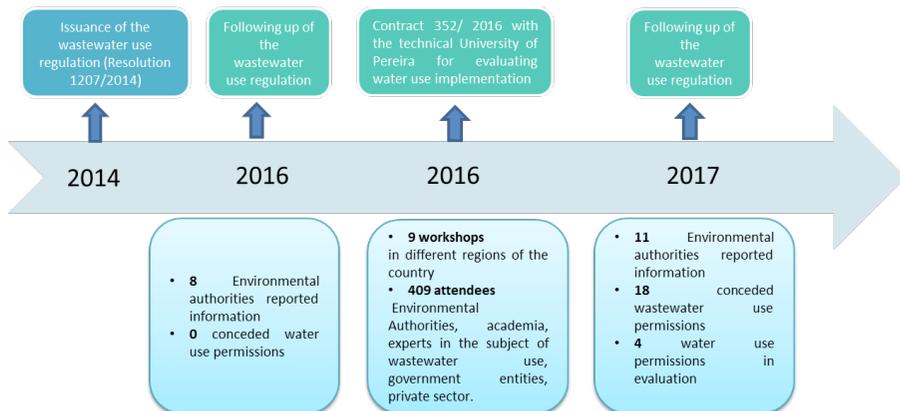


Figure 1: Timeline of the monitoring activities of the Ministry of Environment and Sustainable Development (MADS).

He pointed out that according to the surveys conducted in 2016, there was no wastewater use implementation. In 2017, there was just a small increase in the implementation as just three out of 42 regional environmental authorities reported having granted wastewater use permits. However, none of them are for the use of domestic wastewater in agriculture. Mr Palacio also indicated that MADS, together with the Technical University of Pereira, developed nine workshops in different regions of the country for evaluating the implementation of the regulation. Attendees of these workshops included representatives of environmental authorities, the private sector, academia, and other governmental institutions. These actors discussed the status of wastewater use practices in their fields and the concerns they had about this topic.



As a result of the stakeholder consultation in the two previously mentioned surveys and the nine workshops, Mr Palacio explained that stakeholders highlighted the following obstacles for applying the wastewater use regulation:

- › Difficulties in interpreting regulation
- › Lack of clarity in the administrative process
- › Demanding procedure due to the high levels of technical knowledge required
- › Restrictive and decontextualised uses and their associated quality criteria established
- › Difficulties in establishing obligations and responsibilities as cooperation between the wastewater producer and end users are based on free will
- › Greater costs incurred by the end user than wastewater producer in relation to the water tax use and to guarantee compliance with the quality criteria for the approved concession
- › Unknown quality for irrigation since there is no clarity about sanitary and agricultural regulations



Mr Palacio also explained that according to the issues presented, MADS proposed to make some modifications to the current regulation related to:

- i. Improving the conceptual framework by including and adjusting concepts and definitions in the regulation
- ii. Softening the administrative process by adjusting or creating a new instrument of control
- iii. Facilitating compliance of the quality criteria by adapting a previous regulation established in 1984

2.2 Discussion

After the presentation, MADS conducted an interactive activity using the World Café methodology. Participants from environmental authorities rotated between three tables, discussing the previous mentioned modification proposal from MADS related to: conceptual framework, administrative process, and wastewater uses and quality criteria.



In general, the participants agreed on the need for adjusting the conceptual framework of the regulation for a better understanding of the concepts and scope of wastewater use. In particular, participants supported the idea of including the “safety” concept in the regulatory framework to ensure that there are no negative impacts on health and the environment.

In relation to the administrative process, the attendees highlighted the importance of defining clear procedures and tools for using wastewater. In this way, end users can more easily access treated wastewater, and the environmental authorities can do a better job giving wastewater use permissions and monitoring the activities.

Finally, the participants agreed on the need for the establishment of quality criteria and uses that are technically and economically feasible. This refers also to the water quality corresponding to the specific use where this water is going to end up.

Section 3: International SUWA Experiences and Perspectives

3.1 Presentation

Prof. Hiroshan Hettiarachchi began his talk by enlightening the audience about the amount of water being used by the agricultural sector around the world, and that it is estimated that 89% of the total water demand will be used for irrigation by 2050. He pointed out that water used for irrigation does not always have to be of a drinking-water quality and that treated domestic wastewater is a proven source of water for irrigation. He stressed that the use of wastewater in agriculture also enables us to make use of the nutrients in it.



In his presentation, Prof. Hettiarachchi said that 330km³ of wastewater is produced each year in the world. To provide context, he compared this volume with 170 times the volume of the Colombian Dam Betania. However, he argued that unfortunately, not a big percentage of this wastewater is being used, except for in Israel and in a few more countries.

Prof. Hettiarachchi also reflected that safety is a concern, by arguing that globally 80–90% of the wastewater is not treated and 10% of food is grown with it, which could suggest that we are probably consuming food irrigated with untreated wastewater. He emphasised that compromising safety is not acceptable.

Later, he provided background information on the SUWA initiative that UNU-FLORES has been spearheading for a few years now. UNU-FLORES has the mandate to promote the integrated management of water, soil, and waste and SUWA is one of the best examples of such. He explained also how SUWA, as a sustainable practice of managing waste, can alleviate some of the resources in other sectors. In the case of wastewater, it can help the water sector, food sector as well as the energy sector. SUWA also helps to achieve some of the UN Sustainable Development Goals (SDGs) set to be achieved by 2030. SDGs 6 and 2 are some examples.

Prof. Hettiarachchi emphasised that challenges for implementing SUWA are not only related to cost and technology but also to the contexts in which it is applied. He illustrated this point with three international examples. In Tepeji, Mexico, farmers were against using treated wastewater for misplaced fears of nutrient loss and, thus, future costs they would have to bear for fertilisers. In Tabriz, Iran, some actors do not support SUWA due to religious convictions. Finally, in Tunis, Tunisia, representatives from different ministries were not able to agree on who should take which responsibility.

Prof. Hettiarachchi highlighted the need to bring all the players to the same table because nothing gets implemented until the policy sector is convinced. He also explained how UNU-FLORES has addressed some critical issues in its work promoting SUWA. This includes the involvement of the policy sector and other stakeholders, awareness raising, and education.

In the last part of his presentation, he shared some lessons from a few countries where UNU-FLORES has had collaboration partners. First, he underscored the 2006 WHO Guidelines that focused on the “Cumulative risk management interventions through a multiple-barrier approach”. These Guidelines provide a very practical message, “Do not discourage the recycling of water and nutrients. Instead use multiple barriers to reduce the risk.” He expressed his delight seeing many countries following these Guidelines to the best of their ability.

On the international lessons for applying SUWA, he mentioned Israel as the “leading nation” in water recycling thanks to the policies that embrace water reuse and support research and development. Also, he highlighted Jordan as one of the best examples of policy integration where wastewater treatment and use is a national priority. Then, he mentioned that despite the fact that Mexico has been irrigating with untreated wastewater for over a century, policymakers are motivated to address this, and it is possible to highlight some positive aspects. Among them is the launch of a certification programme for training, involvement of community associations, and willingness of universities and local governments to find solutions. Finally, he explained that even though in Tunisia the treatment capacity and SUWA practices are still low, the country has accomplished much by introducing the right guidelines. Moreover, he highlighted that Tunisia has recently developed studies on public acceptance to identify ways to promote SUWA.

Lastly, Prof. Hettiarachchi pointed out that, from the perspective of UNU-FLORES, SUWA practices in Colombia are indirectly hampered by the policies currently put in place, which possibly explains why farmers lose their motivation. It is difficult to see the opportunity to be sustainable when they do not see that they are able to benefit from the nutrients yet still have to pay a user fee/tax. He also highlighted that another discouraging factor is the mixing of domestic wastewater with industrial wastewater that is happening in Colombia – this increases health and environmental risks when used for irrigation.

3.2 Discussion

Prof. Hiroshan Hettiarachchi's presentation sparked a 30-minute discussion. The main points of discussion are summarised in the paragraphs that follow.

Several participants were interested in the types of treatment and related costs that have been used internationally, without polluting natural resources and affecting public health. UNU-FLORES staff explained that every country is a unique case, but it is very important not to encourage the use of untreated wastewater. It was also highlighted that countries with a SUWA policy structure are doing better in this regard. The cases of Israel and Jordan that are using mainly secondary or tertiary treatment are some examples. Some large cities are using centralised wastewater treatment plants, but there are also examples such as the Hidalgo area in Mexico where they opted for small-scale treatment plants. Where advanced treatments are expensive, modular treatments can be considered. Nature can be used as a solution for treatment. This depends on the local conditions. There are ways to start wastewater use in agriculture with advanced secondary treatment. In relation to the associated costs, UNU-FLORES staff mentioned that in some cases, international funding support such projects.

Another topic that attendees brought up was the types of crops that are being irrigated with wastewater internationally. UNU-FLORES staff stressed upon the importance of the "safe use" of wastewater. Reducing risk barriers such as the ones suggested by the WHO Guidelines can be used depending on what is cultivated and the wastewater quality. The multi-barrier approach offers a variety of options. It includes, among others, the use of safe irrigation techniques and retention periods to allow the elimination of pathogens, the use of personal protective equipment, good food handling practices, washing, disinfection, and cooking.

Attendees were also very interested in the agreements between farmers as end users and the wastewater producers. UNU-FLORES staff highlighted again that the mechanisms vary from place to place. In Iran, for example, water is managed by the National Water and Wastewater Engineering Company. They own the water and charge some money when they release it. In some other examples, like the Mezquital Valley in Mexico, and even in Tunisia, there is a collection process. They collect some nominal amount and farmers' associations are responsible for managing that part. So, there is no one solution that fits all criteria.



In the Mezquital Valley, there are Private-Public Partnerships for decentralised wastewater treatment plants. If there are farmers' associations or individuals that want to use wastewater for irrigation, the municipality pays for the construction of the micro wastewater treatment plant. The operation and maintenance are in the charge of the farmers' associations. Therefore, the costs here are reduced. For the municipality, the costs are ten times less for using wastewater than using groundwater, so, for them there is also an economic incentive. There are farmers' associations that monitor the quality of the wastewater outflow from the treatment plants. The Ministry of Environment oversees the technological developments for treating wastewater and the Ministry of Agriculture supervises the quality monitoring done by farmers. As such, this is not the responsibility of only one entity since we are dealing with security in various aspects – health, environmental, and agriculture – and accordingly, the work has to be performed by different institutions. The knowledge and expertise of one entity is not the same as that of another; different entities have to share the tasks to arrive at a joint solution for the crucial management and monitoring of the process.

To close the session, Prof. Hettiarachchi restated that wastewater is a resource. He reflected that it is unfortunate that globally, wastewater is not being treated as a resource. He mentioned that this is mostly about the comfort zone and a lack of knowledge on its proper use. Prof. Hettiarachchi concluded by illustrating kerosene and fire as examples of two elements that we were afraid to use some decades ago, just as we are afraid of using wastewater now. Similarly, "wastewater is not your enemy, it is actually a friend".

Section 4: Bottlenecks and Suggestions

4.1 Presentation

Dr Serena Caucci (UNU-FLORES) centred her presentation on the bottlenecks blocking SUWA application in Colombia, from the UNU-FLORES perspective. She started her presentation by mentioning that in line with the information presented by MADS, in Colombia, despite the benefits that SUWA could generate in water-scarce areas of the country, it has not been applied to a substantial extent, or even worse applied in an unsafe way. This is in spite of the efforts of MADS that had intended to promote and control wastewater use activities through the regulation issued in 2014.

Dr Caucci explained that the bottlenecks were identified from the farmer's perspective as end users of wastewater. The main areas of these bottlenecks correspond to the following themes: awareness, technical feasibility, administrative process, economic feasibility, and intersectoral cooperation (see Figure 2).

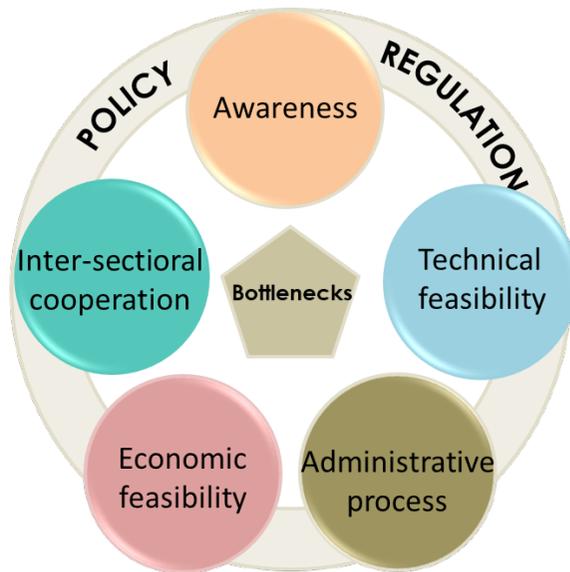


Figure 2: Identified bottlenecks.

Dr Caucci detailed these bottlenecks as identified by UNU-FLORES as follows:

1. The policy and regulatory frameworks ignore both the potential of domestic treated wastewater as a resource and farmers as end users.
2. According to the current regulation, the nutrients present in wastewater cannot be used by farmers for soil conditioning. This discourages SUWA since one of its main benefits is the possibility of using nutrients in the wastewater in a controlled way.
3. There is a lack of awareness of benefits and risks of using domestic wastewater in agriculture as there are no awareness-raising activities reaching the farmers. This is also reflected in the regulation which does not include important aspects of the benefits and risks of SUWA.
4. The regulation is stringent and not practical. There is, therefore, a lack of technical and financial capacity of the farmers for complying with all the regulation requirements.
5. There is a lack of economic incentives for farmers as it is not possible to avoid the use of artificial fertilisers; in addition, they have to pay a water use fee.
6. Sectoral thinking is dominant, which means that there is no intersectoral cooperation between stakeholders for promoting SUWA from the health, environmental, agricultural, and water and sanitation sectors.

Dr Caucci concluded by mentioning that for promoting SUWA in Colombia, there is an important need to promote cost effectiveness of wastewater use in agriculture, while protecting health and the environment.



Ms Natalia Jiménez (UNU-FLORES) illustrated the potential of SUWA in Colombia, a country that is a perfect example of one facing scarcity in the middle of abundance. It is also where the agriculture sector is growing and with it, the water demand for irrigation. Ms Jiménez asserted that wastewater use is a key alternative to increase water and nutrients availability for agriculture in Colombia.

Later, she presented several suggestions that can be possible solutions for overcoming the bottlenecks that are blocking SUWA in Colombia (see Figure 3), from the UNU-FLORES perspective, as follows:

- › Use of multi-barrier approach (2006 WHO Guidelines) for making the regulation more practical and controlling health risks in each step of the process
- › Allowing the controlled use of nutrients present in wastewater for soil conditioning – this will favour the decrease in the use of artificial fertilisers and therefore, serve as an economic incentive for farmers
- › Balancing the responsibilities between the wastewater producer and the end user – this will increase economic and technical feasibility
- › Development of a guideline of good practices that complements the regulation, with legal, administrative, and technical clarifications
- › Awareness and training programmes could be implemented for sharing knowledge and training the different stakeholders from the agriculture, health, environment and water and sanitation sectors
- › Development of SUWA pilot scale projects with a co-participatory approach at the interinstitutional level with the involvement of different sectors (health, water sanitation, agriculture, and environment)
- › Promotion of stakeholder cooperation for boosting SUWA implementation

Summary

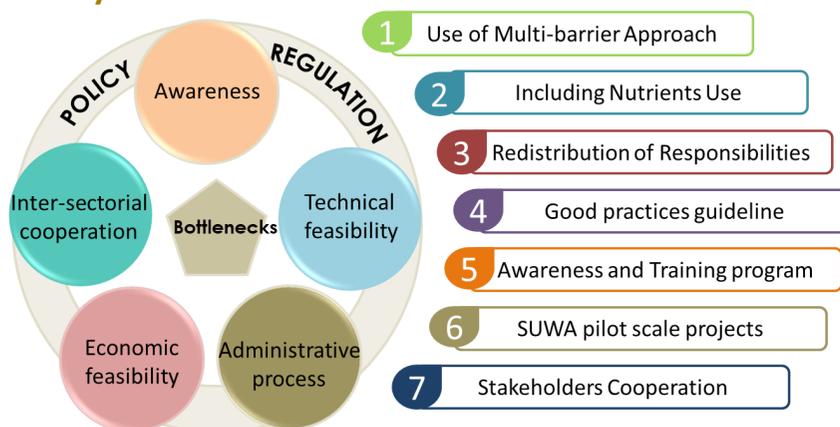


Figure 3: Summary of bottlenecks and possible solutions for overcoming them.

4.2 Discussion

The presentation of Dr Caucci and Ms Jiménez inspired vigorous discussion. Some of the important points discussed are presented in the following paragraphs.

The participants agreed that according to the facts provided by both MADS and UNU-FLORES, the implementation of domestic wastewater use in agriculture in Colombia is considerably low according to its potential. This is with consideration that the regulation was established already in 2014 and to date, there has not been major implementation of such activities.

They also agreed that the wastewater use regulation is not the only tool for promoting SUWA despite being an important one. However, it is discouraging SUWA activities in Colombia at the moment. One of the major bottlenecks is that the regulation is stringent, and the requirements are not administratively, economically, and technically feasible for the farmers and municipalities. Furthermore, the regional environmental authorities have problems monitoring and evaluating these requirements.

Participants discussed that one possible cause of the inoperability of the regulation is that in its construction did not include the participation of all the actors of interest. The Ministries of Health, Agriculture, and Housing, did not have an important involvement in the development of the regulation.



The participants concluded that implementing SUWA in Colombia is a process. The regulation has to be modified but it is also necessary to work on other tools for promoting these activities. The participants also considered it important to:

- i. Smoothen the administrative process
- ii. Adjust the regulation based on an analysis of costs for making SUWA economically attractive, taking into account that most of the farmers are smallholder farmers that do not have the economic and technical capacities for complying with stringent regulations
- iii. Raise awareness, taking into account that there are regions of the country where there is water availability and farmers would prefer to use freshwater to wastewater
- iv. Take into consideration the useful aspects of the international cases and build upon these experiences
- v. Facilitate communication between entities – this workshop opened up one such opportunity; the participation of all the actors is needed; involvement of health, agriculture, water and sanitation, and environment sectors is crucial for promoting SUWA; it is also important to include stakeholders like farmers, farmers' associations, academia, and the private sector in the process
- vi. Include the multi-barrier approach from the 2006 WHO Guidelines to protect health, the environment, and agriculture, while making the regulation more feasible and practical to implement

Section 5: Closing

Officials of the three ministries – Ministry of Environment and Sustainable Development, Ministry of Housing and Territorial Development, and Ministry of Agriculture and Rural Development – were inspired by the knowledge exchange resulting from the workshop. With the aim of continuing the promotion of wastewater use in Colombia including SUWA, they conducted a meeting to discuss the possible collaborations and road map that could be developed for promoting SUWA together.

MADS proposed the possibility of jointly developing a SUWA pilot project for four sectors of interest such as agriculture, water and sanitation, health, and environment, taking into consideration that an important mandate would be to modify the regulation in 2019. According to them, this pilot can serve as technical support for the wastewater use promotion and the modification of the regulation.

UNU-FLORES staff welcomed the idea of the interinstitutional work for promoting SUWA but also recommended that the Ministries establish a road map with feasible timelines and clear objectives.

The representatives from the Ministries proposed then two possible pathways:

1. To advance the SUWA pilot and in parallel start the modification of the wastewater use regulation
2. To carry out the adjustment by phases; the first phase would cover simple adjustments for unblocking the administrative issues and then develop the pilot exercise for further updating the regulation in the more technical issues at a later point

UNU-FLORES highlighted the importance of using the pilot also for unblocking and solving the administrative issues.

In view of these proposals, the Ministries expressed the intention of developing the SUWA pilot project. They partially agree on developing the adjustments in the first half of 2019 and in the second half starting the pilot. They will evaluate this idea within each entity.

The main aim of this pilot project would be to produce information that serves as technical support for the modification of the policy and regulation related to the use of treated wastewater in agriculture. They also invited UNU-FLORES's participation in this pilot project.

The need to include the participation of the Ministry of Health and Social Protection – which was absent from the workshop – was highlighted.

Appendix 1: Programme Highlights

DAY 1 TUESDAY, 27 NOVEMBER 2018

14:30–14:50	Registration
14:50–17:00	Latest regulatory developments in the use of treated wastewater in Colombia

DAY 2 WEDNESDAY, 28 NOVEMBER 2018

08:00–08:30	Registration
08:30–09:00	Welcome
09:00–09:45	Presentation of UNU-FLORES on international experiences of the Safe Use of Wastewater in Agriculture (SUWA)
09:45–10:00	Group picture
10:00–10:30	Coffee break
10:30–11:30	UNU-FLORES analysis of the state of wastewater use in agriculture in Colombia
11:30–13:00	Feedback from participants on the Safe Use of Wastewater in Agriculture (SUWA) in Colombia
13:00–15:00	Lunch
15:00–16:30	Internal meeting

Appendix 2: Speakers

In alphabetical order



Ms Diana Marcela Moreno Barco

*Coordinator of the Water Resources Management Group –
Division of Integrated Management of Water Resources, Ministry
of Environment and Sustainable Development*

Bogota, Colombia

Ms Diana Marcela Moreno Barco currently serves as the Coordinator of the Water Resources Management Group of the Division of Integrated Management of Water Resources of the Ministry of Environment and Sustainable Development. An environmental and sanitation engineer, Ms Moreno Barco has 15 years of experience in the environmental sector related to the management, administration, and management of natural resources and control of pollution generated by different economic activities. She has also led in the development of plans, programmes, and projects in the environmental and health areas.



Dr Serena Caucci

United Nations University (UNU-FLORES)

Dresden, Germany

As a Research Associate at UNU-FLORES, Dr Serena Caucci works in the field of capacity development in multi-stakeholder projects, such as the Safe Use of Wastewater in Agriculture (SUWA) and sludge management. Dr Caucci has closely worked with transdisciplinary partners and has developed international collaborations in the field of microbiological risk assessment related to sanitation processes and environmental pollution management. Before joining UNU-FLORES, she worked at the Institute of Hydrobiology of Technische Universität Dresden and at the Helmholtz Center for the Environment (UFZ) on issues of water sanitation and antibiotic resistance in anthropogenic environments.



Prof. Hiroshan Hettiarachchi

United Nations University (UNU-FLORES)

Dresden, Germany

Prof. Hiroshan Hettiarachchi is a civil engineering professor, waste management expert, and an advocate for circular economy. His recent work primarily focuses on the sustainable utilisation of waste as a resource, giving emphasis on wastewater recycling, organic waste composting, and their contribution to enhance nexus thinking in environmental resources management.



Ms Natalia Jiménez Contento

*Alexander von Humboldt Climate Protection Fellow
United Nations University (UNU-FLORES)*

Dresden, Germany

As a grant holder of the Alexander von Humboldt Foundation, Ms Natalia Jiménez Contento, together with Prof. Hiroshan Hettiarachchi and Dr Serena Caucci of the UNU-FLORES Waste Management Unit are currently analysing the challenges and benefits of multiple regulatory frameworks for SUWA, including in Colombia. Before joining UNU-FLORES, Ms Jiménez founded Lumbilá, an NGO that works on research, education, and environmental consulting. She has also worked in companies designing wastewater treatment plants as well as in the Ministry of Environment and Sustainable Development of Colombia, supporting processes in regulatory development of efficient water resources use.

Appendix 3: List of Participants

Day 1

FIRST NAME	LAST NAME	DESIGNATION	AFFILIATION
Nelson Mauricio	Anillo	Director	Ministry of Environment and Sustainable Development
Héctor Fabio	Aristizabal	Environmental Technical Director	Regional Autonomous Corporation of Valle del Cauca (CVC)
Iván Darío	Bautista	Specialist	Regional Autonomous Corporation of Boyacá (CORPOBOYACA)
Alexnaider	Benjumea	Specialist	Regional Autonomous Corporation of La Guajira (CORPOGUAJIRA)
Gustavo	Calderón	Specialist	Regional Autonomous Corporation of the Canal del Dique (CARDIQUE)
Cristhian Camilo	Castro	Professional	Autonomous Regional Corporation of the Orinoquia (CORPORINOQUIA)
Serena	Caucci	Officer	United Nations University Institute for Integrated Management of Material Fluxes and of Resources (UNU-FLORES)
Carolina	Cruz	Specialist	Ministry of Environment and Sustainable Development - Water Management Division
Carlos	Díaz	Professional	Ministry of Environment and Sustainable Development - Sustainable Business Office
Andrea	Fonseca	Specialist	Regional Autonomous Corporation of Boyacá (CORPOBOYACA)
Yolanda	Gallego	Professional	Regional Autonomous Corporation of Risaralda (CARDER)
Martha Liliana	Gomez	Consultant	Regional Autonomous Corporation of Cundinamarca (CAR)
Juan Diego	González	Consultant	Ministry of Environment and Sustainable Development - Water Management Division

FIRST NAME	LAST NAME	DESIGNATION	AFFILIATION
Diana	Herrera	Environmental Engineer	Regional Autonomous Corporation of Guavio (CORPOGUAVIO)
Hiroshan	Hettiarachchi	Professor	United Nations University Institute for Integrated Management of Material Fluxes and of Resources (UNU-FLORES)
German	Isaza	Consultant	Regional Autonomous Corporation of Cundinamarca (CAR)
Natalia	Jiménez Contento	Researcher/ Visiting Scholar	United Nations University Institute for Integrated Management of Material Fluxes and of Resources (UNU-FLORES)
Blanca Nubia	León	Specialist	Regional Autonomous Corporation of Cundinamarca (CAR)
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Day 2

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UNU-FLORES develops strategies to resolve pressing challenges in the area of sustainable use and integrated management of environmental resources such as water, soil, and waste. Focusing on the needs of the UN and its Member States, particularly developing countries and emerging economies, the Institute engages in research, capacity development, advanced teaching and training, as well as dissemination of knowledge. In all activities, UNU-FLORES advances a Nexus Approach to the sustainable management of environmental resources.

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ADVANCING A NEXUS APPROACH TO THE SUSTAINABLE
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