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حائزة على دكتوراه في الكيمياء البيئية
أستاذ مساعد في الجامعة اللبنانية – كلية الزراعة والعلوم
البيطرية





Faculty of Agronomy



Biochar : A sustainable approach for a Healthy Life and Environment

**PhD May ISSA
Beirut 2/7/2024**

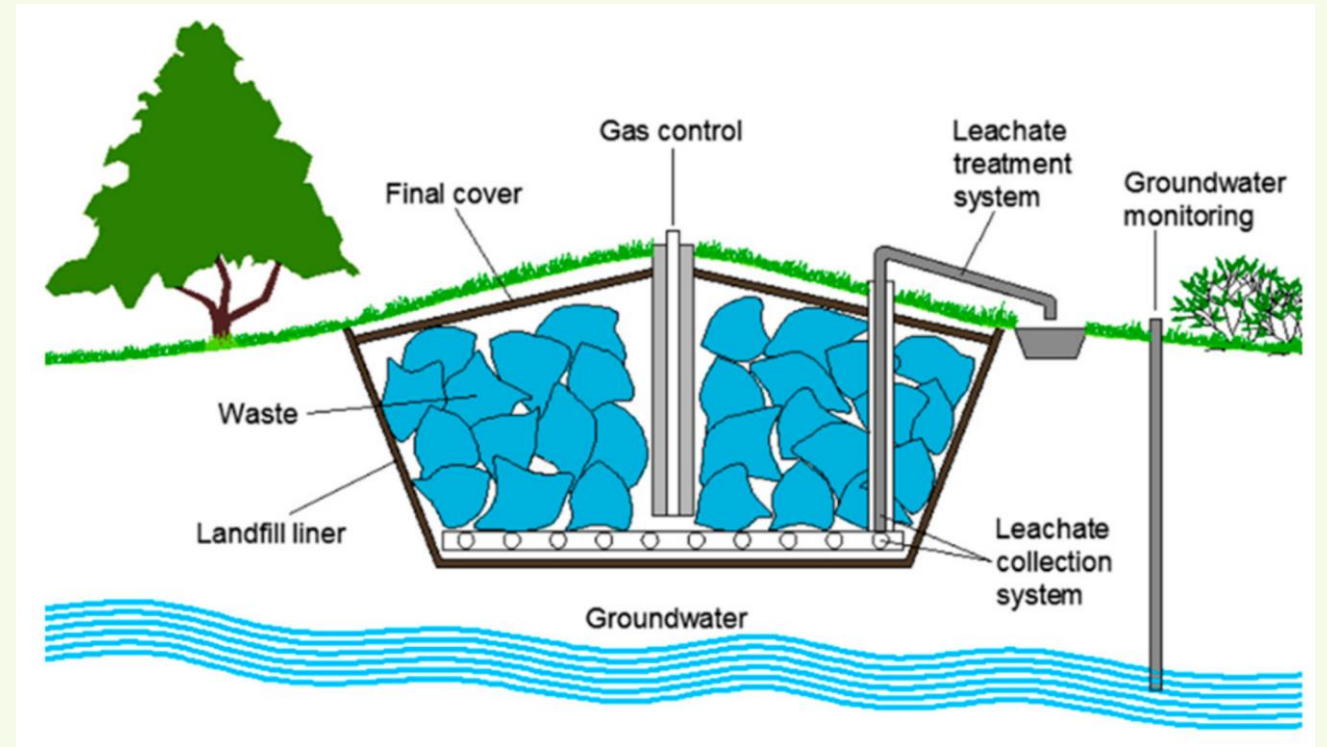
Problem

- **Waste Crisis**



Problem

Sanitary Landfills

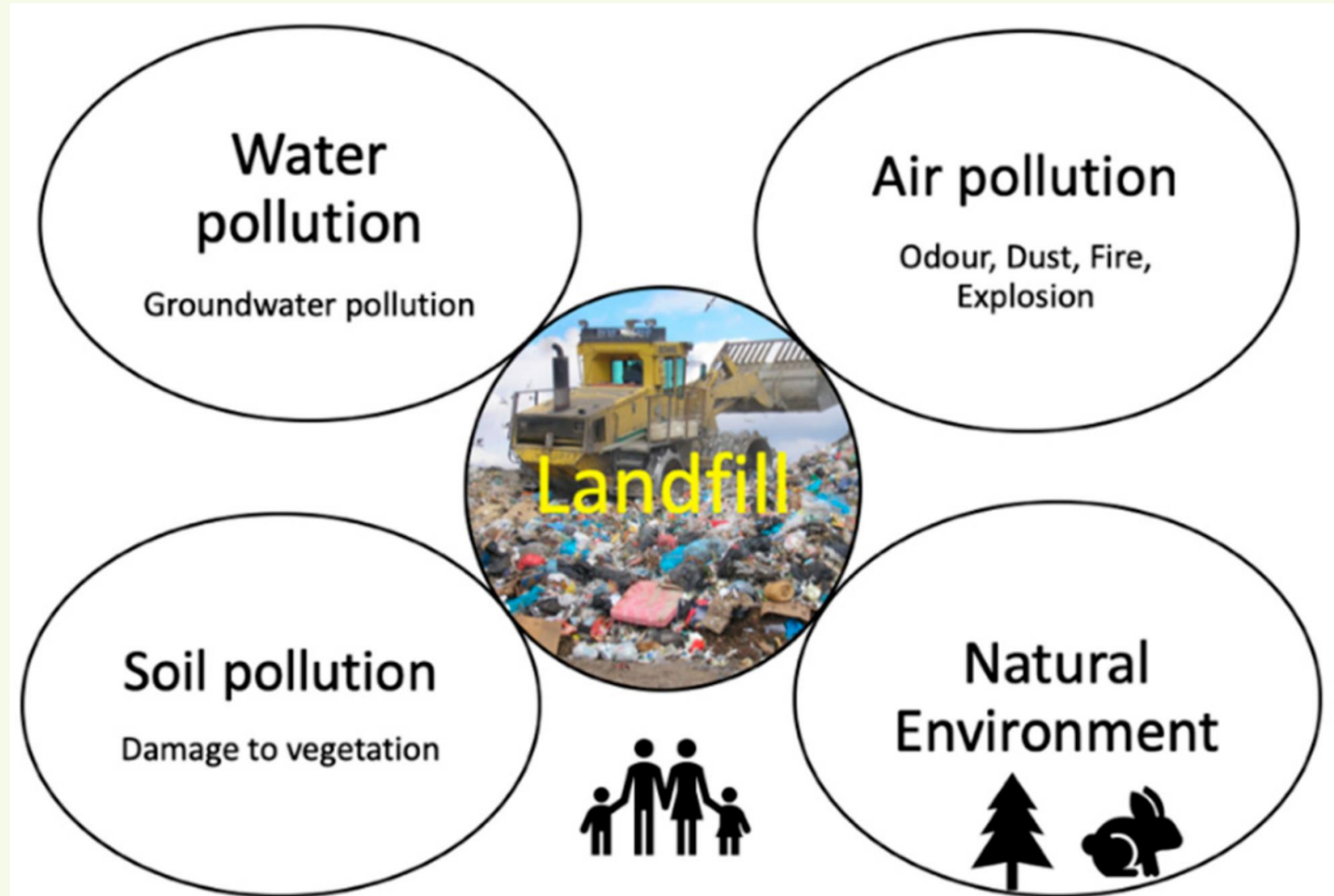


Problem

Open Dumps



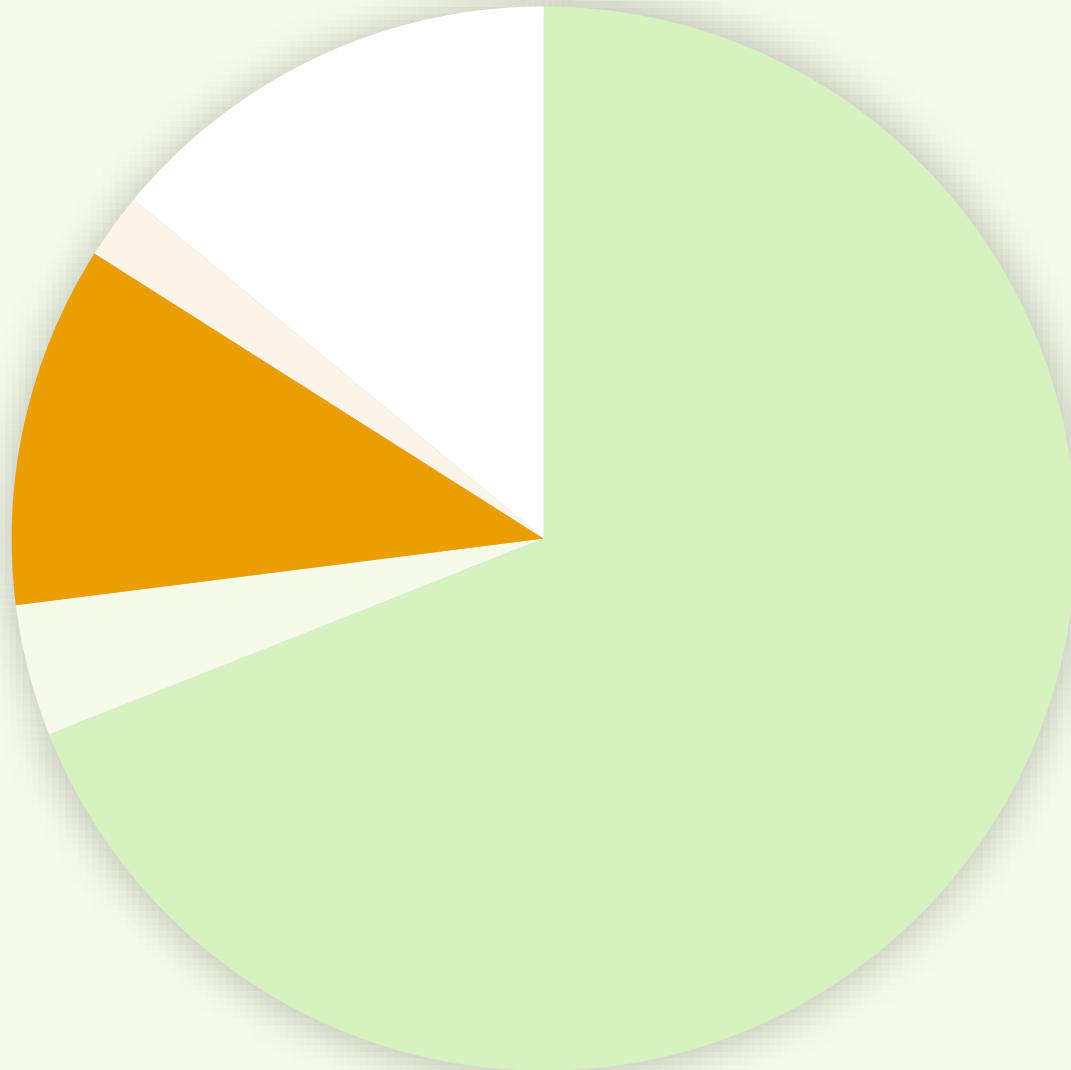
Open Dumps (Landfills)



Waste Composition

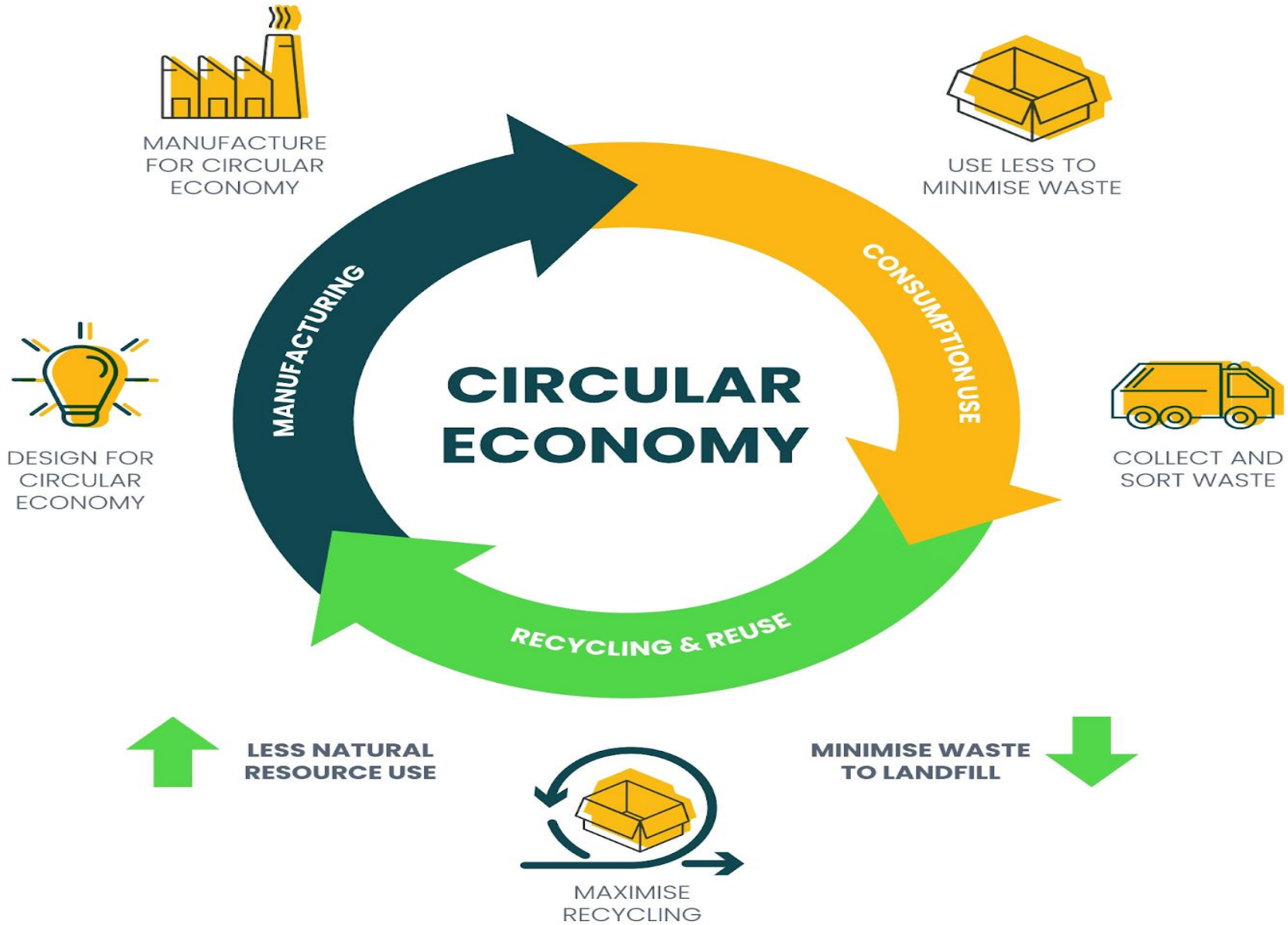
Waste	2017 (%)	2021 (%)
Organic	50-55	69-72
Paper/Carton	15-17	4-5
Plastic	10-13	11-14
Metals	5-6	2
Glass	3-4	3-4
Other	10-12	3-11

Waste Composition



Composting 9%

- ORGANIC
- PAPER
- PLASTIC
- METALS
- OTHER



Solution

Valorization of Organic Waste of various resources (agriculture residues, wood, animal manure)

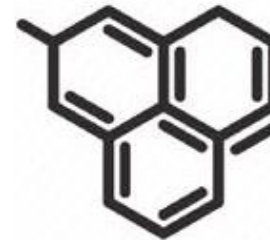
**Transforming it into High Value Added Product
Via Pyrolysis (Thermo Chemical Conversion under
Oxygen deficient Atmosphere)**



Bio-oil



Bio gaz



Biochar

Solution

**Biochar : Carbon rich solid
High specific area
Porous structure
Surface functional groups**

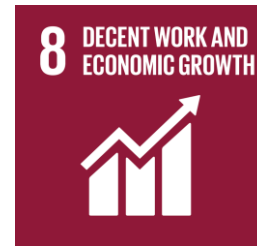
**Biochar a Renewable Source,
with a Low Cost, Various Applications**



Applications



Fulfilled SDGs



Wastewater Treatment

الصرف غير الصّحي يهدّد بصيف أصفى: 62 من أصل 67 محطة تكرير معظلة بالكامل

سعدى علوه
6 mins | 2023-05-03



التلوث يجتاح مياه لبنان بأنهاره وآبارهِ: محطات التكرير "عاجزة"

فرح منصور | الأحد 2023/03/05



Wastewater Treatment

67 WWTP, only 5 WWTP working

Lebanon's domestic and urban wastewater in 2019 reached 250 millions m³

Direct discharge into surface waters or the sea without treatment

Water is highly polluted : Organic Pollutants

Heavy metals

Pharmaceuticals Products

Polluted water has resulted in disease outbreaks and is also affecting the daily lives of people affecting their overall health.

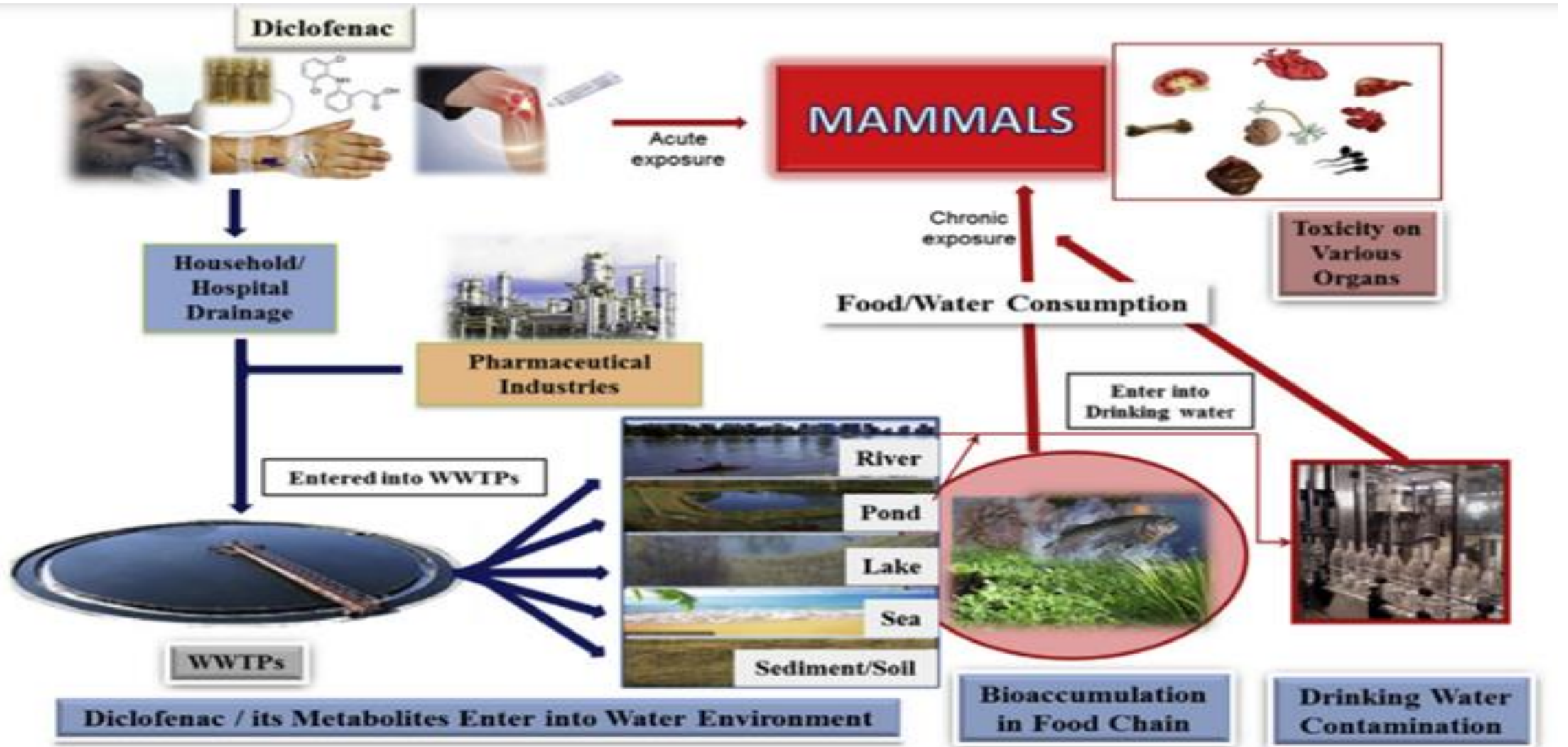
Wastewater Treatment

Removal of Pharmaceutical Products

Amoxicillin (AMX), Diclofenac

Metabolic degradation rate of AMX is low that is why it has greater chances to be found in wastewater (Bano *et al.*, 2023).

Diclofenac, considered a “contaminant of emerging concern” and included in the Watch List of EU Decision 2015/495 (Barbosa *et al.*, 2016).



Environmental distribution, bioaccumulation, biomagnifications and ecological risk of diclofenac towards mammals (Sathishkumar et al., 2020).

Biochar for Wastewater Treatment

Tea is a very famous beverage

1,830 Tonnes imported in 2023 in Lebanon

➔ Spent Tea Leaves derived Biochar

➔ Removal of pharmaceutical products

Amoxicillin (AMX), Diclofenac

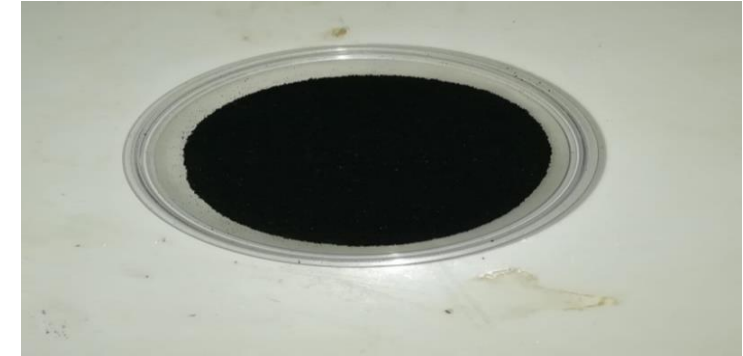
Biochar for Wastewater treatment



Dried Spent Tea Leaves

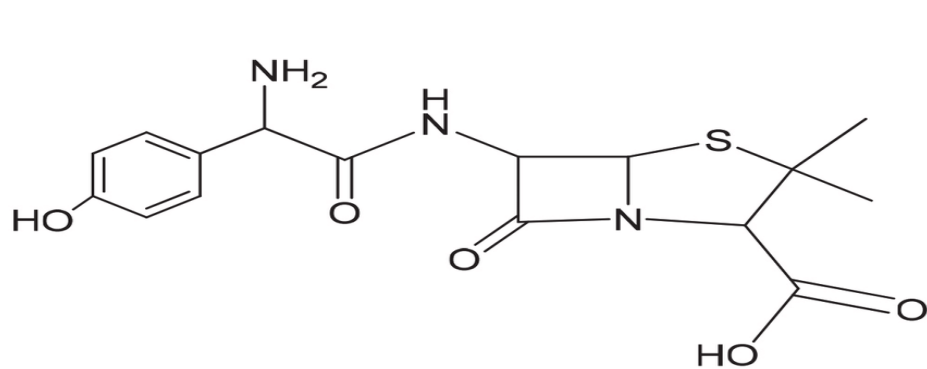
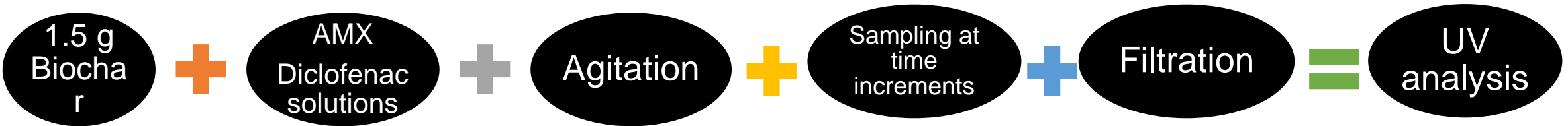


Pyrolysis

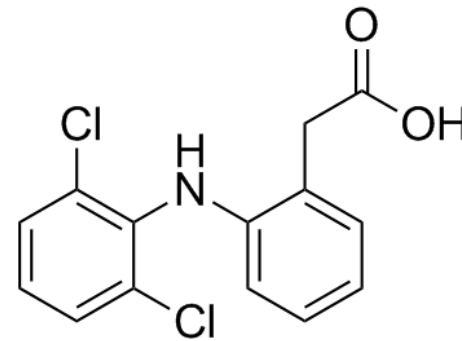


Derived Biochar

Biochar for Wastewater treatment

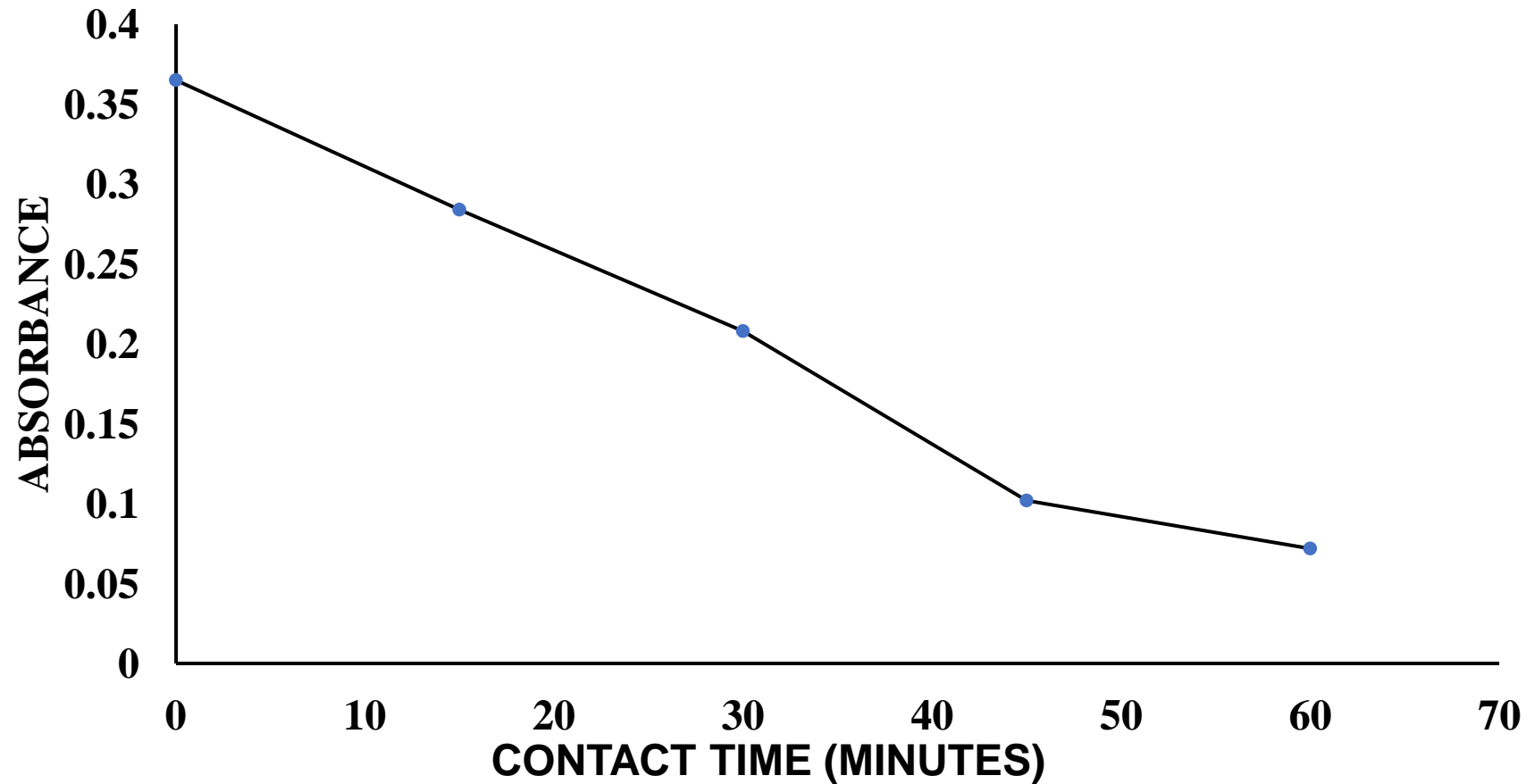


AMX



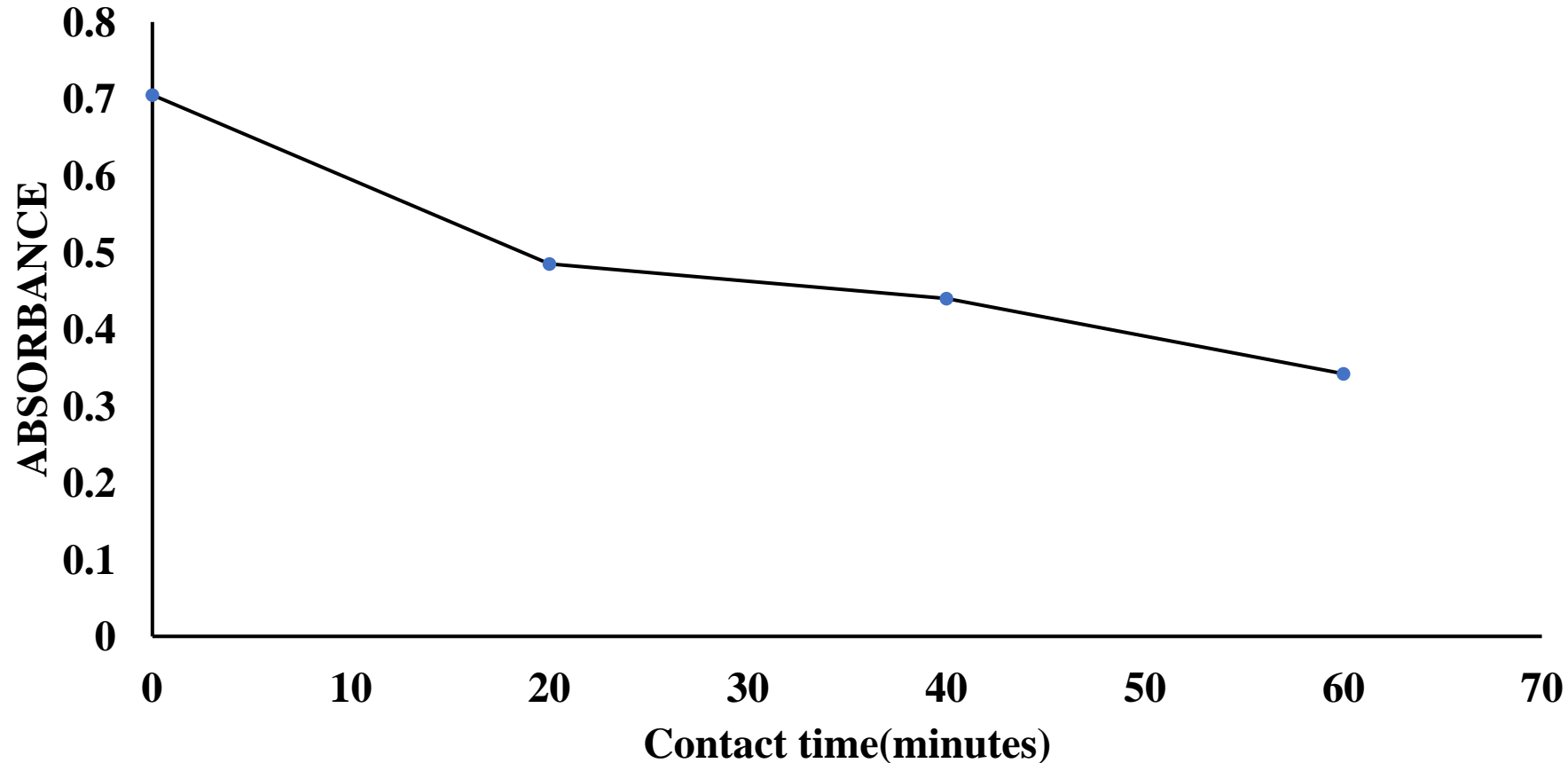
Diclofenac

Biochar for Wastewater treatment



Biochar is able to adsorb about 80% of AMX after 1 hour

Biochar for Wastewater treatment



Biochar is able to adsorb about 53% of Diclofenac after 1 hour

Biochar for Wastewater treatment



In 2021, citrus production in Lebanon was 304,883 tons.
The weight of O.P 30-40 % of the fruit weight



Lebanon produced 659481.06 tons in 2021.
potato peel can make up to 10% of the total potato



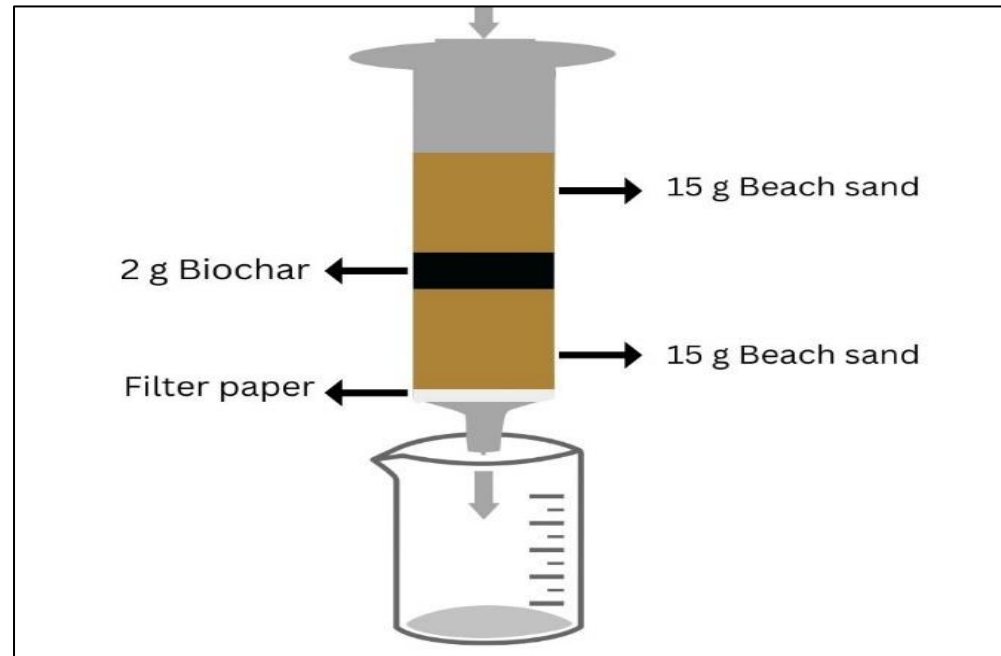
In 2018, Lebanon imported 78,588 tonnes of coffee
1 kg of instant coffee produce 2 kg coffee grounds waste



In 2021, banana production in Lebanon reached 83,501 tonnes
weight of B.P approx. 36 %

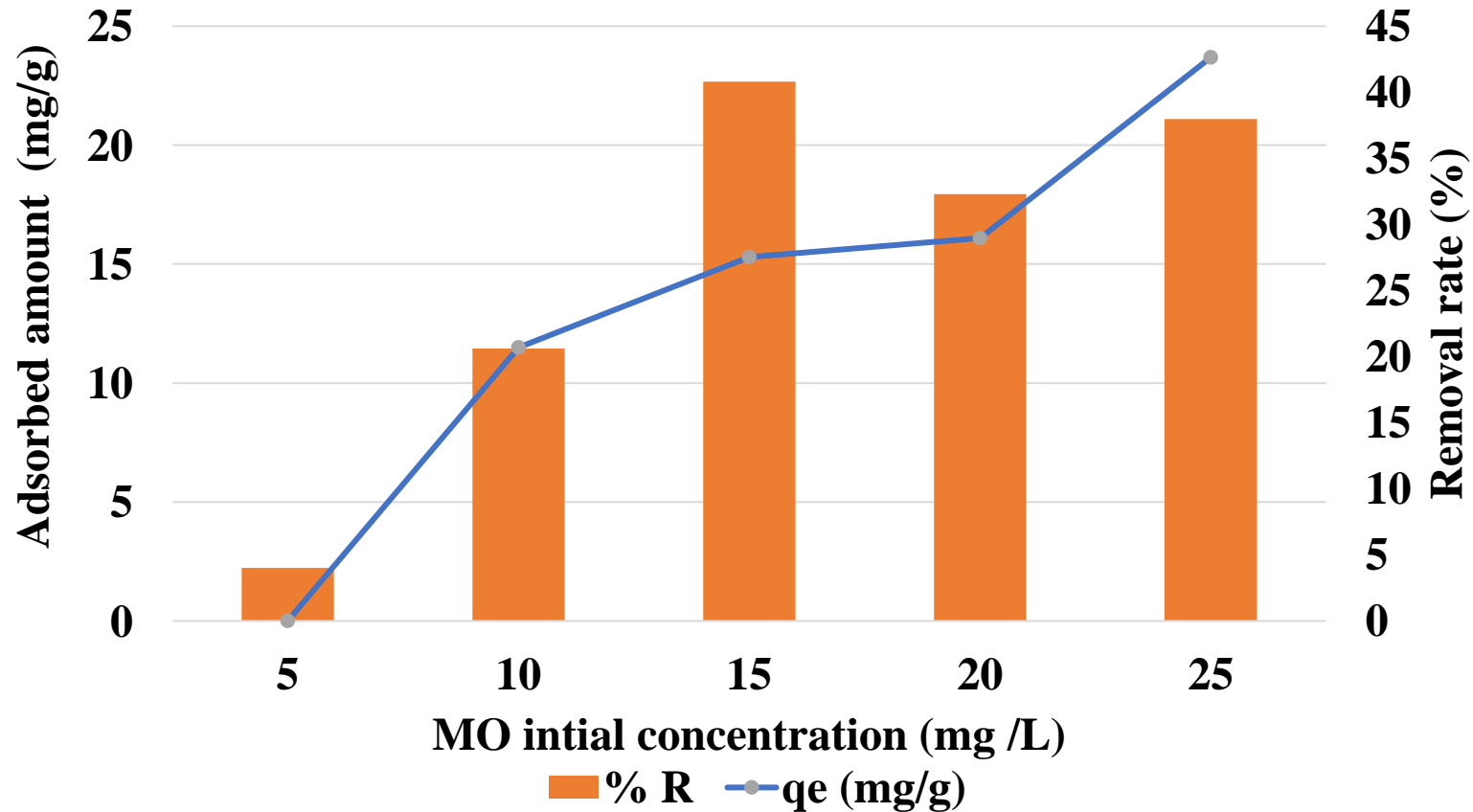
Biochar Filter for Wastewater treatment

**Kitchen Waste Derived Biochar (mixture of PP,OP, BP,CR) (KWDB) :
Methyl Orange (MO), Methylene Blue (MB) Removal**



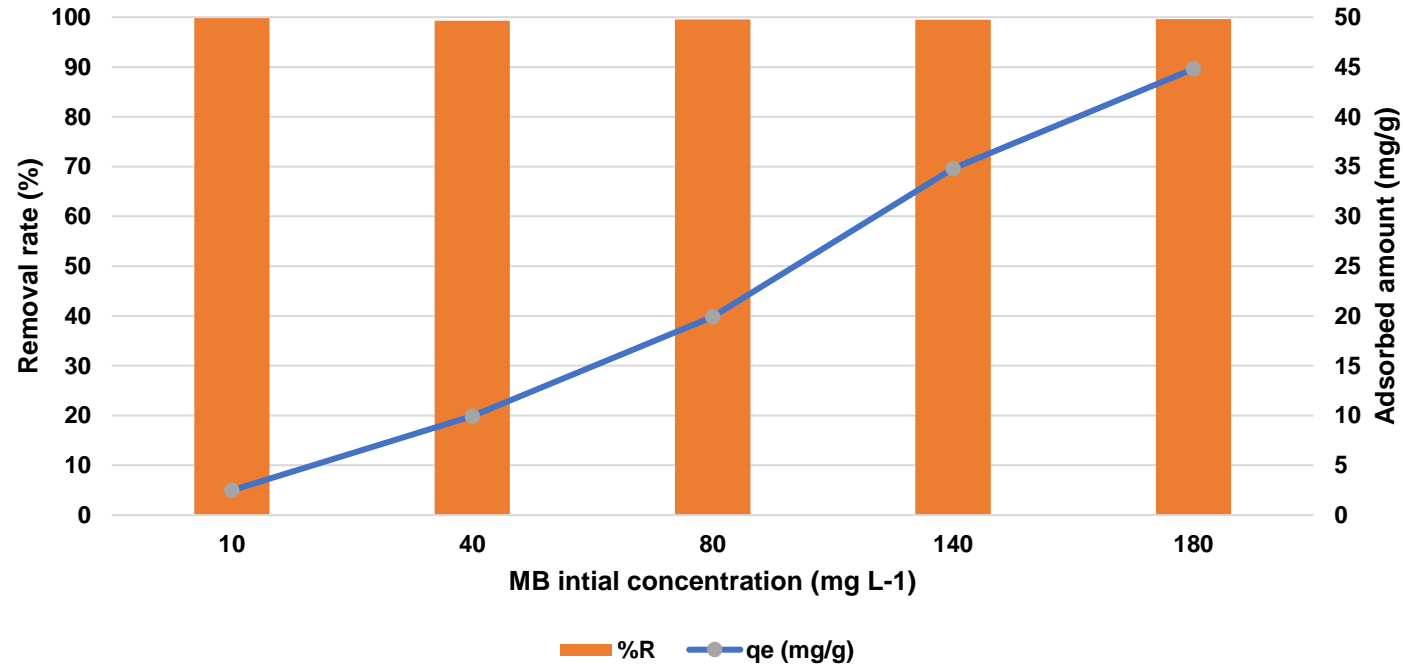
Graphical illustration of the biofilter

Biochar Filter for Wastewater treatment



Maximum adsorption capacity is 25.15 mg/g for MO
Highest removal rate is 38% for MO

Biochar Filter for Wastewater treatment



Maximum adsorption capacity is 30.39 mg/g for MB

Highest removal rate is 99.9% for MB

Variable effectiveness in removing MO and MB

Biochar As Soil Amendment



+97% Yield Improvement



+30% save nutrient



+50% save water



+39% Crop quality



Wheat germination in sandy soil after 7 days

Biochar As Soil Amendment

Production of Radish (*Raphanus sativus* L.) in Clayey soil for a period of 1.5 months (August - October 2023)

Control

1% of KWDB (mixture of PP,OP, BP,CR),

Compost,

Fertilizer,

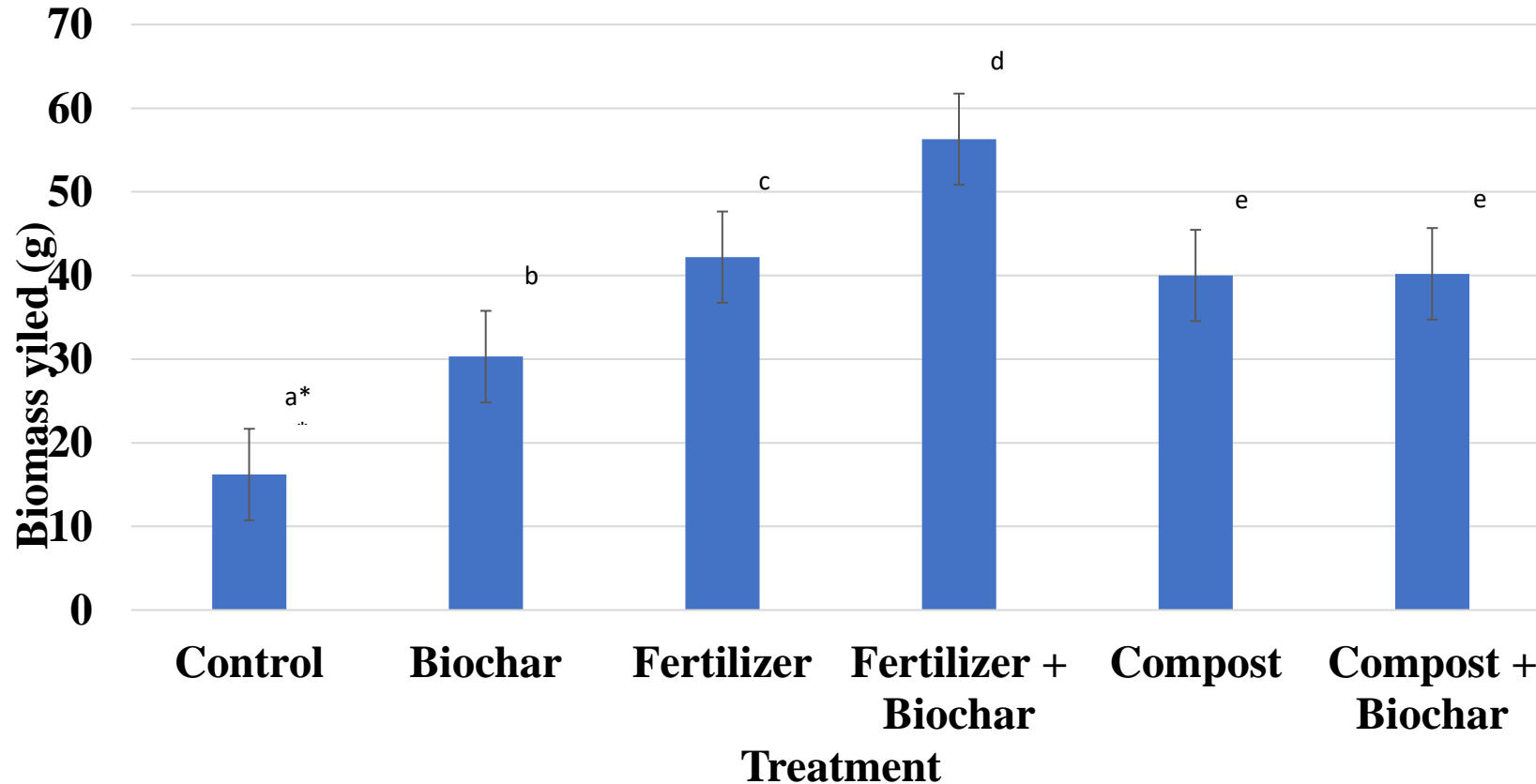
Combination of KWDB and fertilizer

Combination of KWDB and compost

Measured Parameters :

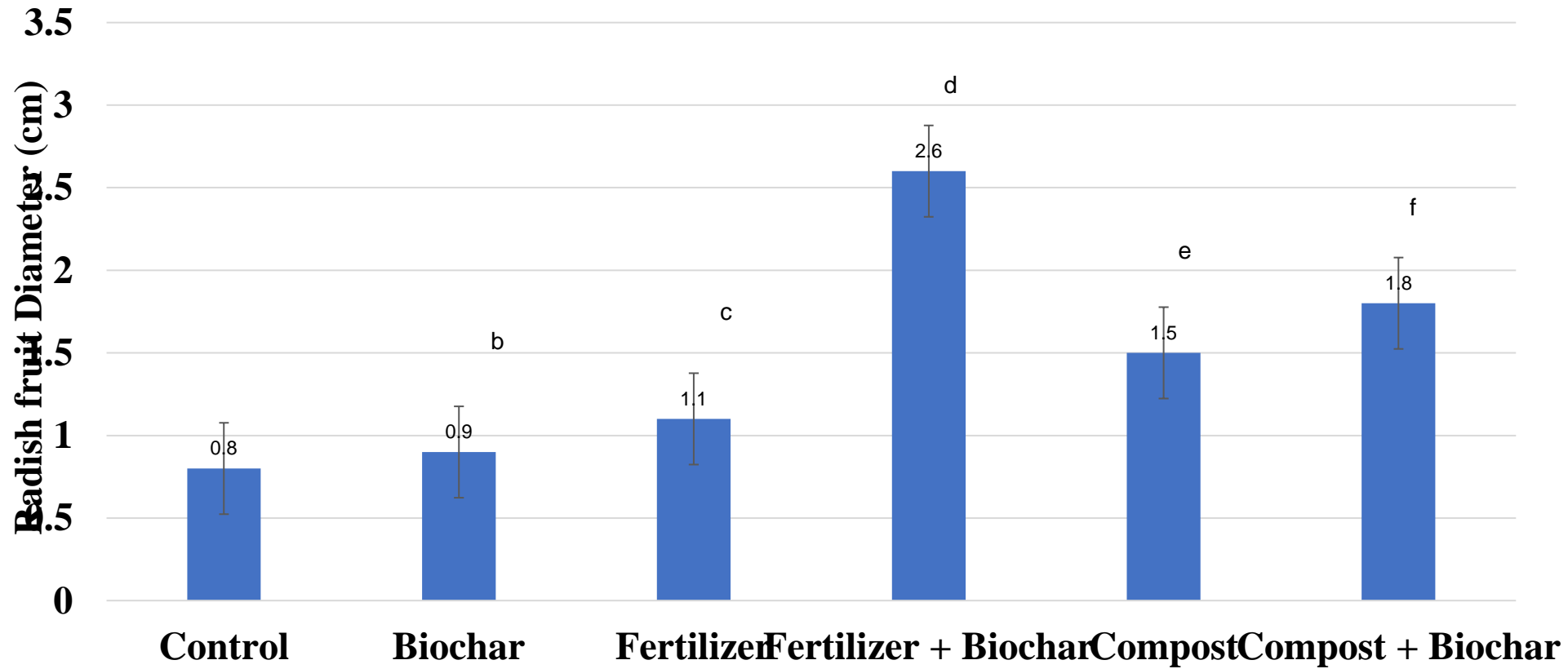
- Fresh Yield,**
- Radish fruit Diameter,**
- Number of Leaves per plant and**
- Chlorophyll content.**

Biochar As Soil Amendment



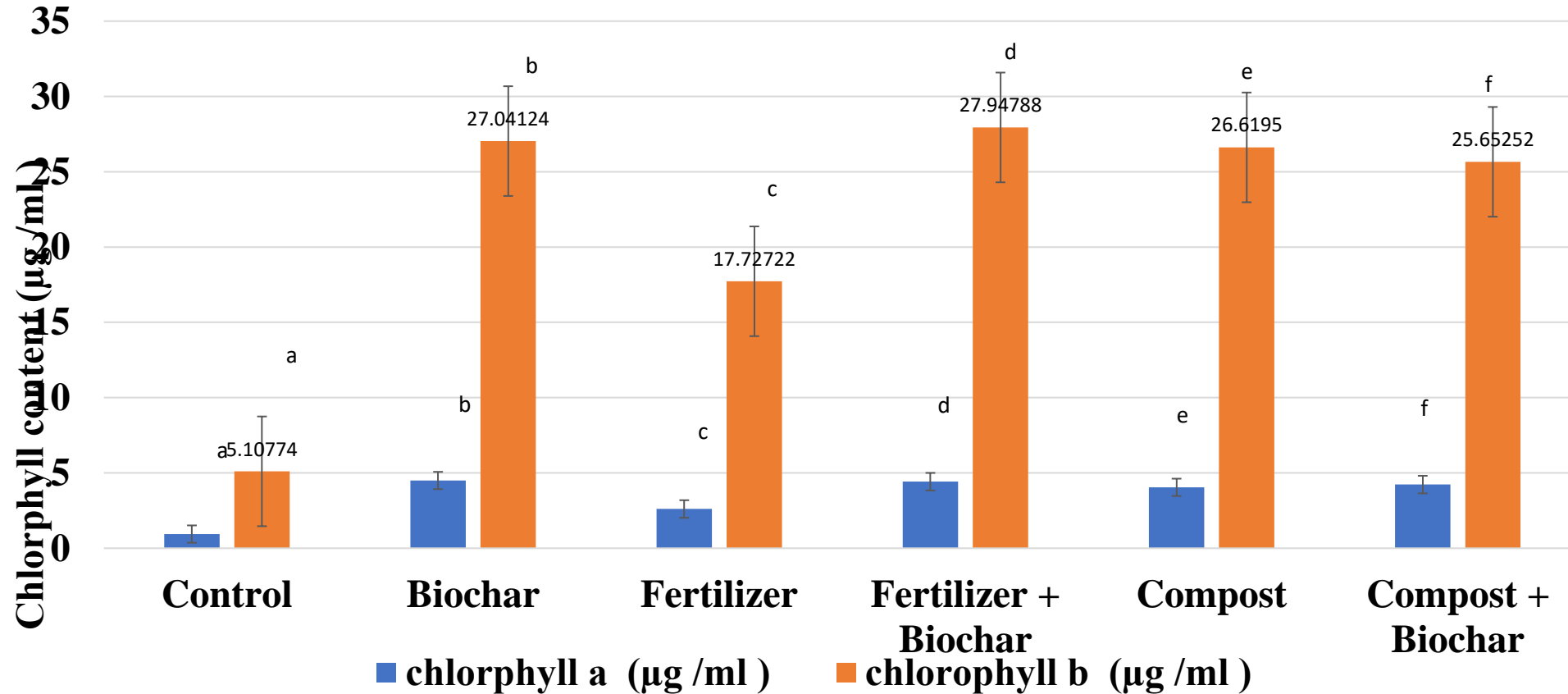
Use of KWDB as a soil amendment results in significant improvements in radish yield, notably increasing it by 87.04%

Biochar As Soil Amendment



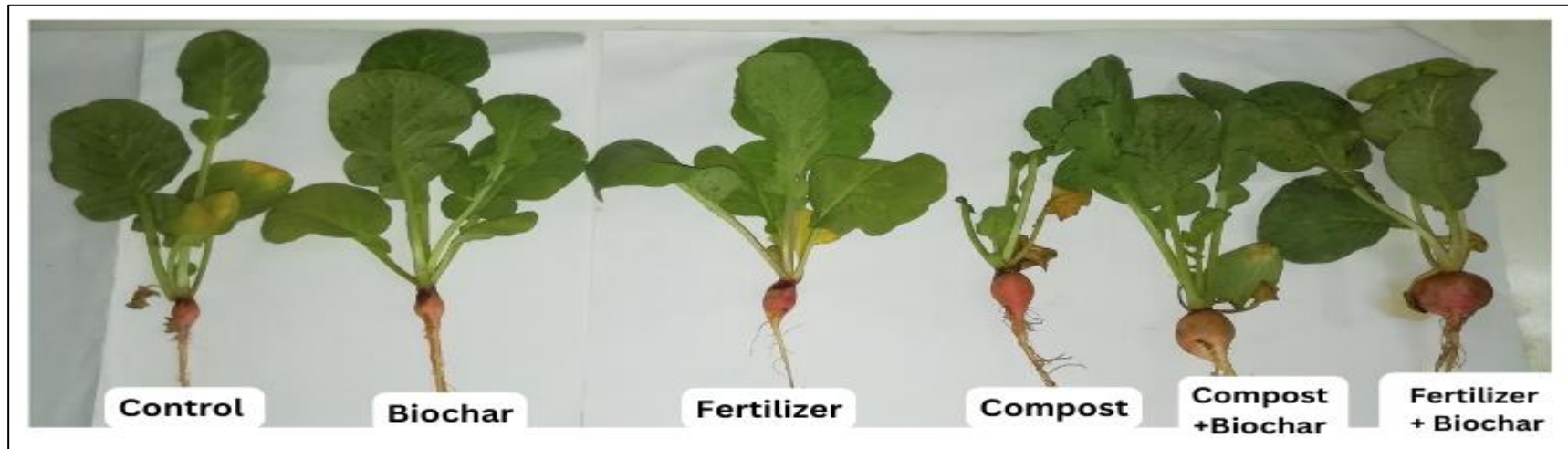
Combination of KWDB and fertilizer increases the radish 225%

Biochar As Soil Amendment

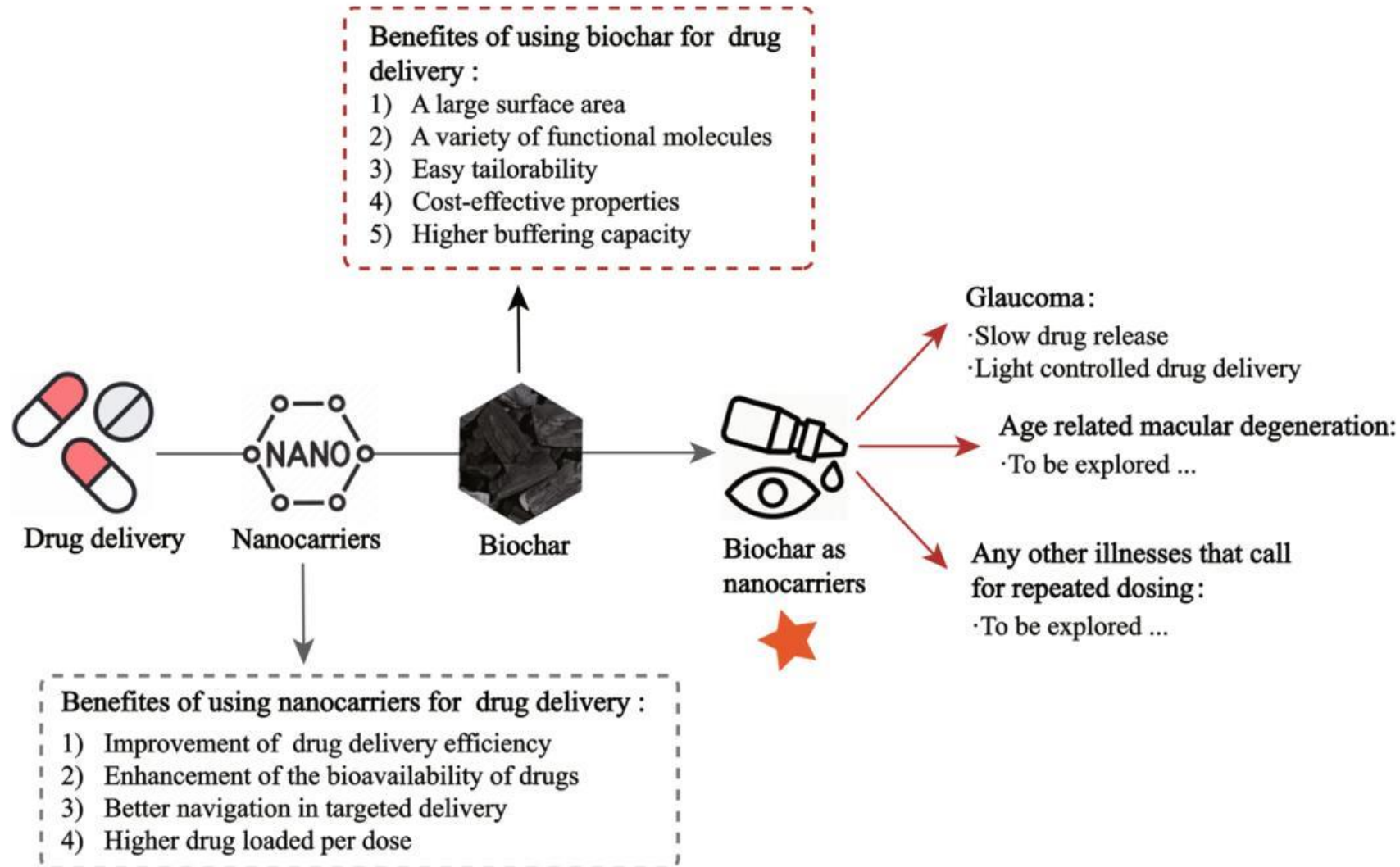


When biochar was used independently, it demonstrated a remarkable 430.39% increase in chlorophyll A content

Biochar As Soil Amendment



Biochar As Drug Carriers



Support



PHC Project

**Lebanese University
University of Upper Alsace-
Strasbourg, France**



**“There can be no life
without soil and no soil
without life; they have
evolved together”**

– Charles E. Kellogg.

THANK YOU !