2ND ANNUAL REGIONAL WORKSHOP ON

Conservation Agriculture and Sustainable Intensifcation

28-29 September 2021

Virtual Webinar | 14:00-17:00 GMT+7

CASIC · UNITED NATIONS ESCAP Economic and Social Commission for Asia and the Pacific · CSAM · ASEA Agroecology in SouthEast Asia · cirad · swisscontact

Session 2: Addressing Technical Challenges Related to CA/SI Broad-Scale Adoption

Facilitator

Dr. Pascal Lienhard, Researcher of CIRAD

3:40 PM – 4:40PM
(60 mins)

Speakers

Dr. Florent Tivet, Researcher of CIRAD and Technical Advisor of Department of Agricultural Land Resources Management (DALRM)

Mr. Madhusudan Singh Basnyat, Independent Consultant, Agricultural Mechanization Specialist for TCP/FAO-Nepal

Dr. Lionel Moulin, microbial plant ecologist and research director at IRD (French National Research Institute for Sustainable Development)

Session 2: Addressing Technical Challenges Related to CA/SI Broad-Scale Adoption

3:40 PM – 3:50PM
(10 mins)

Cambodia Experience on Plant Material

Dr. Florent Tivet, Researcher of CIRAD and Technical Advisor of Department of Agricultural Land Resources Management (DALRM)

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CAMBODIA

Cambodia Experience on Plant Material

Florent TIVET (CIRAD)
Vira LENG (DALRM/CASC)
Vang SENG (DALRM)

OVERVIEW

1. Session
2. Contents
3. Key Takeaways


1
Session

OUTLINE

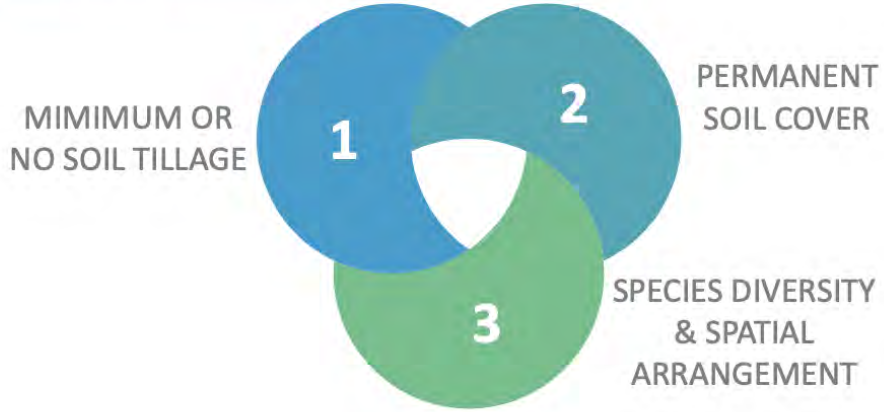
- Main functions of cover crops
- Example of cropping systems
- A genetic bank of cover crops
- Steps forward to foster the uptake of cover crops and plant diversity

2

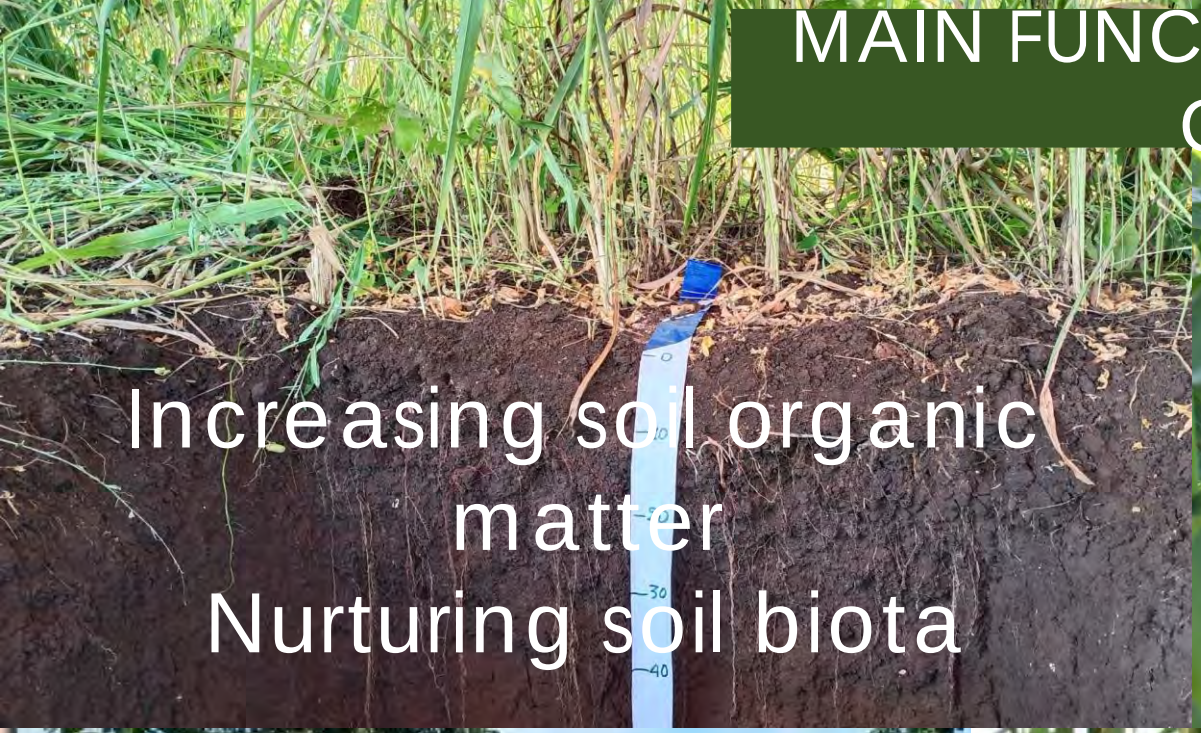
Content

Conservation Agriculture
The 3 pillars

THREE PILLARS OF CONSERVATION AGRICULTURE

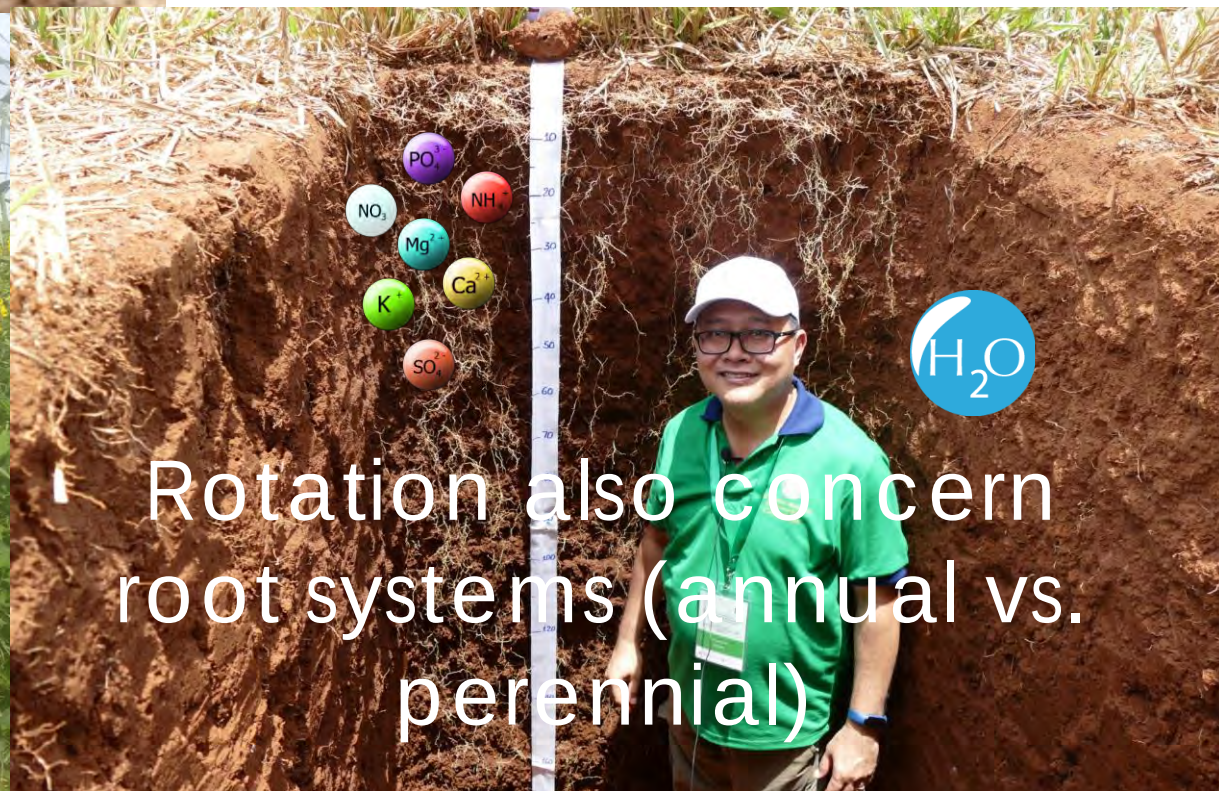


MAIN FUNCTIONS OF COVER CROPS



NEED TO RESTORE AND INVEST IN SOIL CARBON, BIODIVERSITY OF AGRICULTURAL

Biomass inputs, plant diversity and nutrient cycling as a decision-making tool



Rotation also concern root systems (annual vs. perennial)

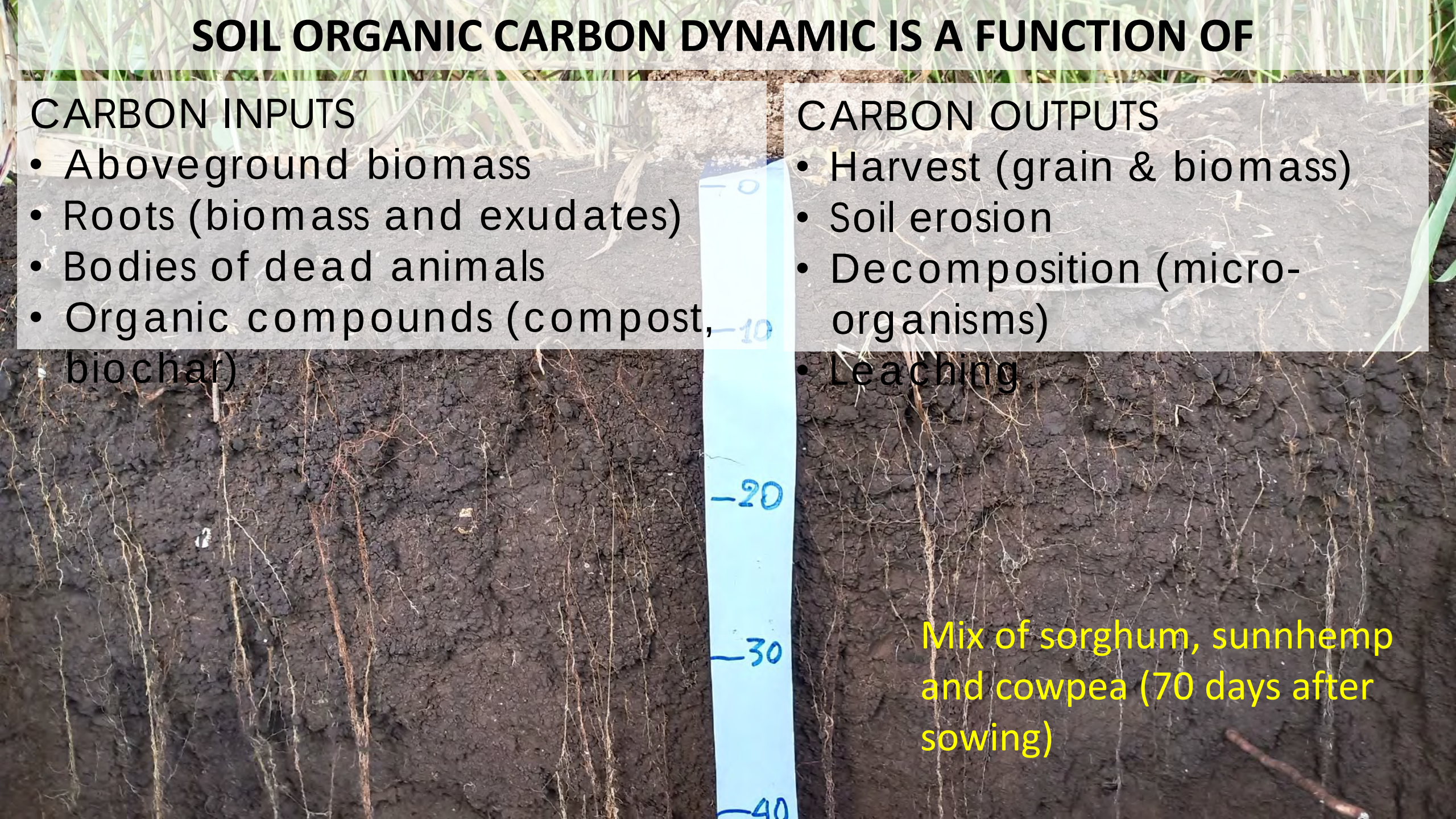
SOIL ORGANIC CARBON DYNAMIC IS A FUNCTION OF

CARBON INPUTS

- Aboveground biomass
- Roots (biomass and exudates)
- Bodies of dead animals
- Organic compounds (compost, biochar)

CARBON OUTPUTS

- Harvest (grain & biomass)
- Soil erosion
- Decomposition (micro-organisms)
- Leaching



Mix of sorghum, sunnhemp and cowpea (70 days after sowing)

IMPACTS OF NO-TILL AND COVER CROPS ON SOIL FUNCTIONS

- **Increase in soil C** (+ 500 kg C/ha/year) and N (+ 45 kg C/ha/year) → better plant nutrition

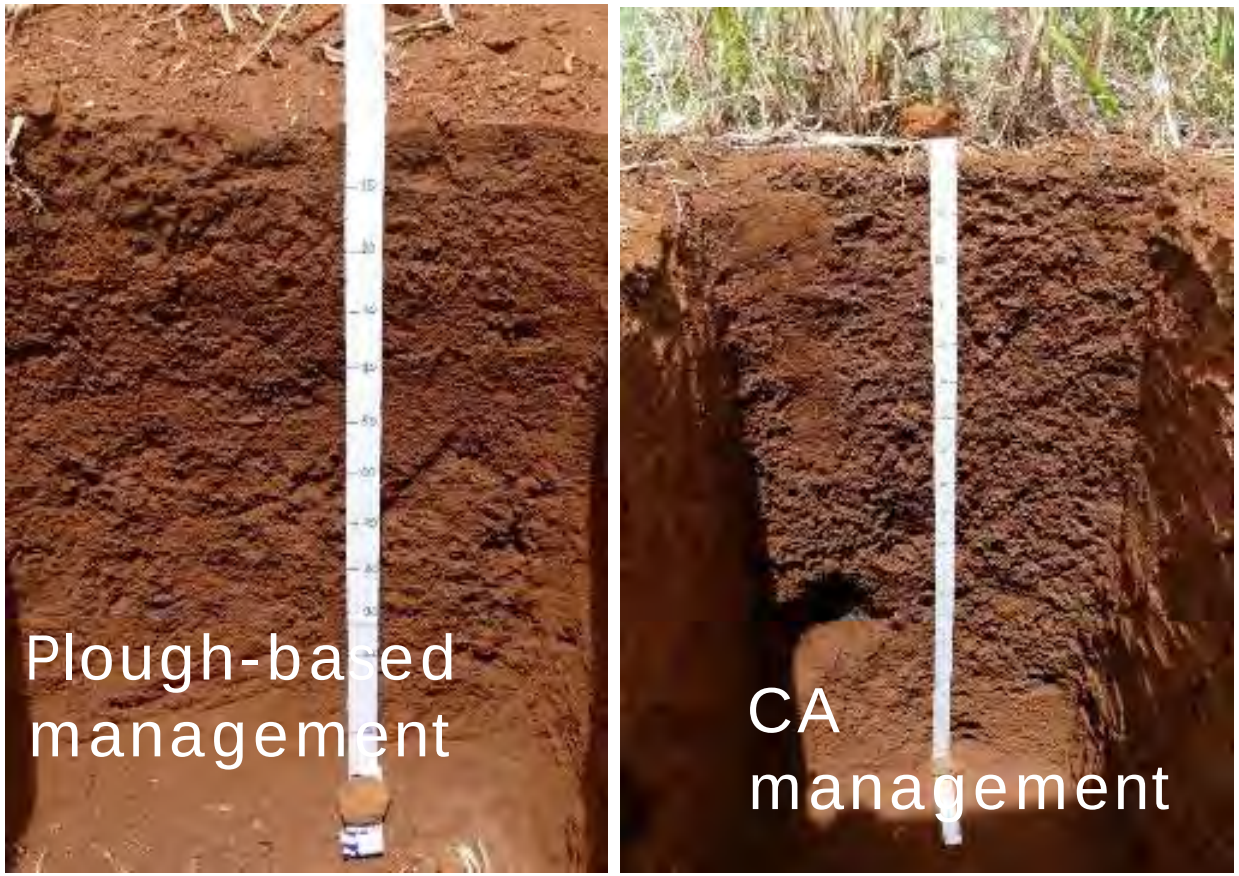
- **Water infiltration 2 times higher under CA**

Conventional = 125 ml/min
CA = 264 ml/min

- **Increase of soil respiration** (microbial communities, 2 times higher when compared with plough-based management)

- **Increase of available N** (NO_3^-, NH_4^+)

- **Soil structure is improved** with higher soil aggregation



Hok et al., 2015 Agriculture Ecosystems and Environm
Pheap, Lefèvre et al., 2019 Soil & Tillage Research

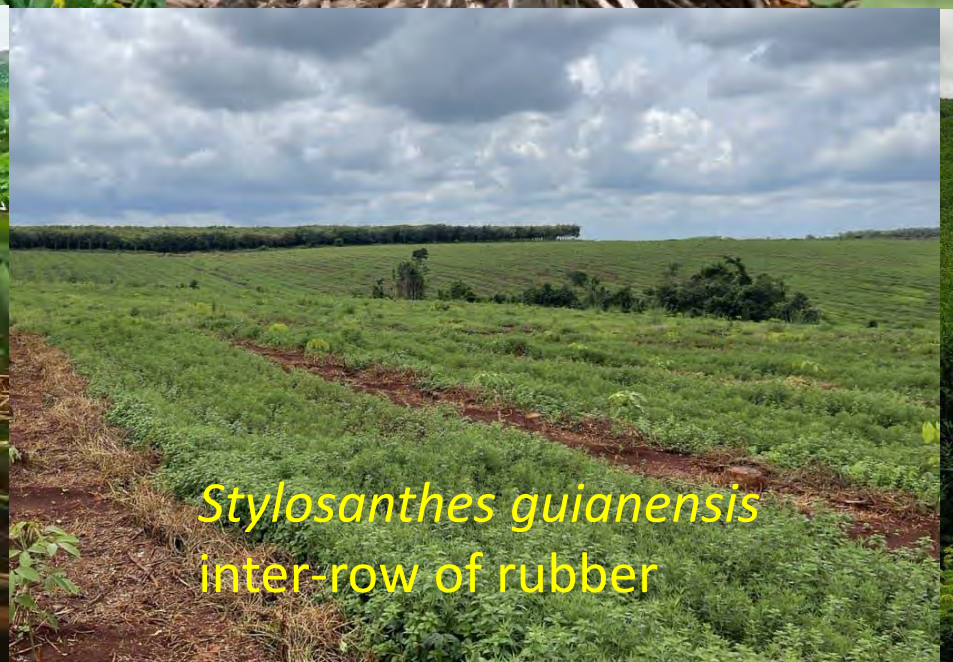
A DIVERSITY OF USE OF COVER CROPS: ANNUAL AND PERENNIAL CROPPING SYSTEMS


Rolling sunnhemp & sowing maize


Soybean on mulch of sorghum


Maize after sunnhemp


Cassava after early maize


Stylosanthes guianensis inter-row of rubber


Crotalaria ochroleuca inter-row of new rubber planting

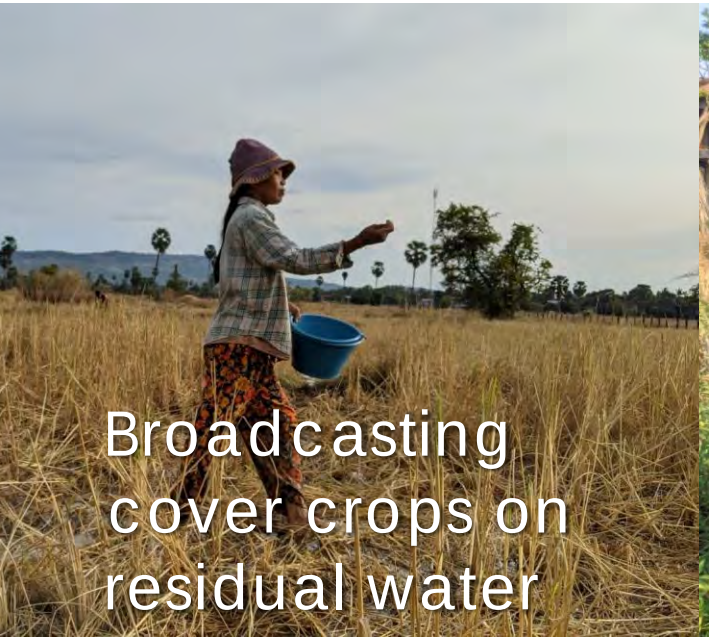
AN UNIQUE GENETIC BANK OF COVER CROPS (BOS KHNOR STATION)

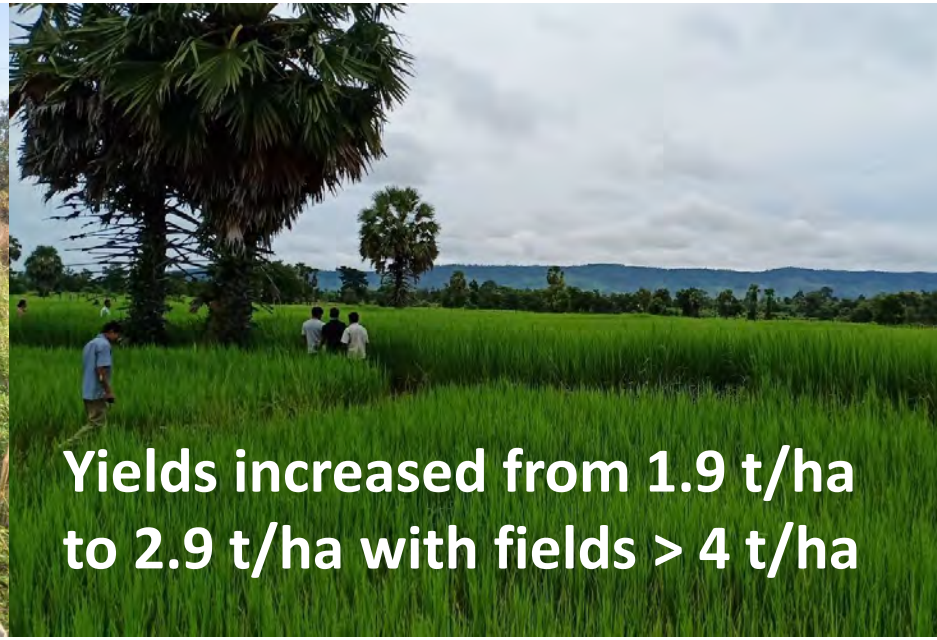
- Germplasm preservation and sharing
- Seed production to support farmers during 1st steps
- > 7.5 tons of seeds produced annually; > 65% of legumes
- Connection with private company (SmartAgro) and

Grasses	1	Brachiaria brizantha
	2	Brachiaria decumbens
	3	Brachiaria humidicola
	4	Brachiaria ruziziensis
	5	Brachiaria mullato
	6	Brachiaria mutica
	7	Eleusine coracana
	8	Zea mays
	9	Panicum maximum
	10	Pennisetum typhoides
	11	Pennisetum purpureum
	12	Sorghum bicolor
	13	Tripsacum laxum
Others	38	Amaranthus cruentus
	39	Corchorus capsularis
	40	Hibuscus cannabinus
	41	Hibiscus sabdariffa
	42	Sesamum indicum
	43	Helianthus annuus

Legumes	14	Arachis pintoi
	15	Arachis repens
	16	Cajanus cajan
	17	Canavalia ensiformis
	18	Centrosema pascuorum
	19	Crotalaria juncea
	20	Crotalaria ochroleuca
	21	Crotalaria atrorubens
	22	Crotalaria zanzibarica
	23	Desmodium intortum
	24	Desmodium ovalifolium
	25	Dolichos lablab
	26	Gylcine max
	27	Macroptilium bracteatum
	28	Macrotyloma axillare
	29	Mucuna pruriens
	30	Neonotonia wigthii
	31	Pueraria phaseoloides
	32	Sesbania grandiflora
	33	Sesbania rostrata
	34	Stylosanthes guianensis
	35	Vigna radiata
	36	Vigna umbellata
	37	Vigna unguiculata

USE OF LEGUME COVER CROPS FOR ORGANIC RICE





- Increase of rice yield but also grade/quality under an organic value-chain
- Need high quality seeds of cover crops, mix of species at affordable cost per ha to move forward with a sustainable soil management and higher plant diversity
- Seed producer groups on specific agroecosystems are required to ensure the needs at local level and through connection with private sector

WHAT DOES IT MEANS IN TERMS OF ADAPTATION AND MITIGATION

STEPS FORWARD TO FOSTER THE UPTAKE OF COVER CROPS

- Long term use of cover crops in Cambodia
- The law on ***Seed Management and Plant Breeder's Rights*** was approved by Parliament on 08 April 2008 and by the Senate on 29 April 2008
- But no specific categories for cover crops
- Need of a recognition within a national portfolio to facilitate the establishment of seed producers groups and the engagement of private sector

3

Key Takeaways

Key take-aways

- Take advantage of a diversity of species with large adaptability to drought, flood, acidic and alkaline soils
- Keep in mind that deep root systems, use of perennial species are key for a sustainable land management
- Generate additional incomes through seed production, biomass/fodder production
- NT along with use of cover crops represent among the best options to adapt farming systems to climate change while mitigating its impacts
- Need to recognize a portofolio of cover crops to support seed producer groups, ensure investment of private sector, seed quality and affordability

Pueraria phaseloides in association with maize

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Soil is Life

Thank You

Session 2: Addressing Technical Challenges Related to CA/SI Broad-Scale Adoption

3:50 PM – 4:00PM
(10 mins)

Nepal Experience promoting on Mechanization for conservation agriculture

Mr. Madhusudan Singh Basnyat, Independent Consultant, Agricultural Mechanization Specialist for TCP/FAO-Nepal

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Nepalese Experience In Promoting Mechanization For Conservation Agriculture And Sustainable Intensification

Er. Madhusudan S. Basnyat
Independent Consultant
Agricultural Mechanization Specialist (TCP/FAO-Nepal)
Former Deputy Director General, Department of Agriculture

OVERVIEW

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1
Session

Objectives of the Session

- **Addressing technical challenges related to CA/SI broad-scale adoption.**
- **Experience of Conservation Agriculture Activities by Different Organization**
- **Challenges and Constrain Promoting CA/SI mechanization**

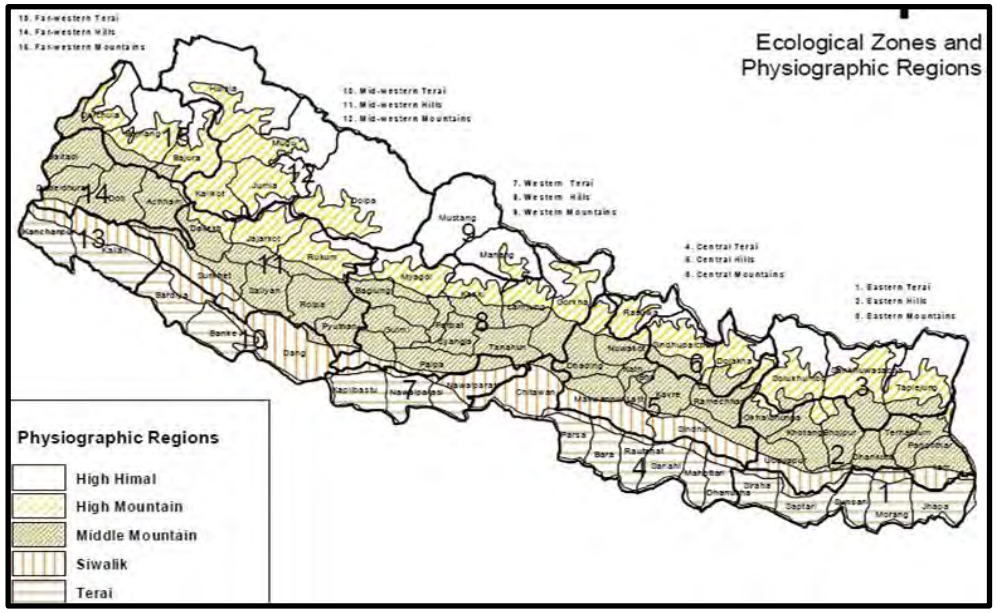
Topics to be covered in the session

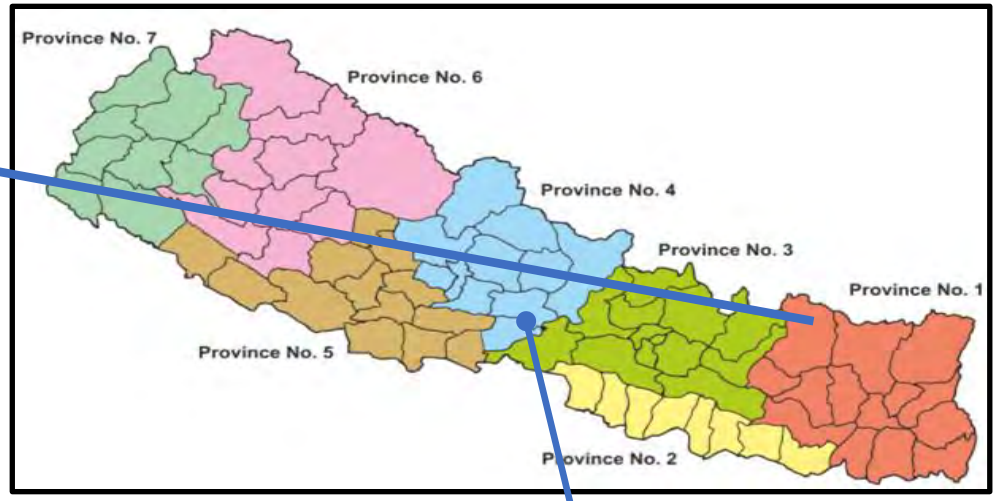
- Brief Introduction of the Country
- Policies and Strategies Promoting Mechanization for CA/SI
- Technology used in different agro ecological Zone
- Nepalese Experience Promoting CA/SI
- Constraints and Challenges Adopting and Promoting CA/SI Mechanization
- Key Take-Away
- Conclusion

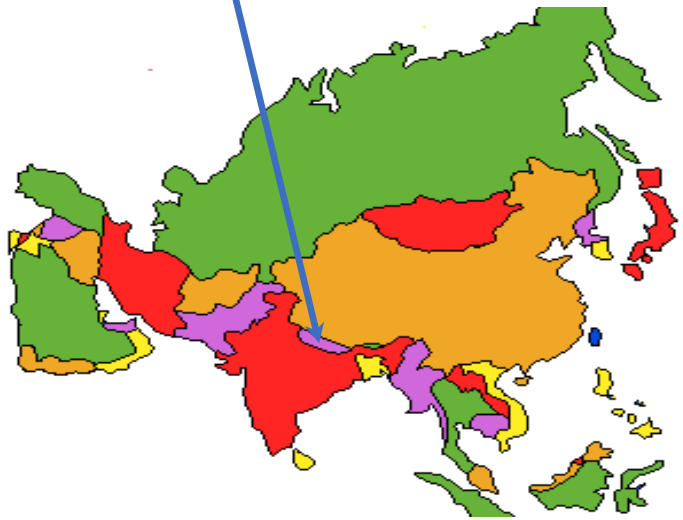
2

Content

Federal Democratic Republic of Nepal







- Total land area -147,181 sq. km, Only 0.1% of total land mass of earth (EW-885 km, NS-193 km)
- Three geographical region Terai, Hill & Mountain
- Elevation ranges from 70 m to 8848 m
- Climate temperate to sub tropical
- Rugged terrain and diversity (in all sense) the typical feature
- CA was introduced sometime around 1996-97

Policies and Strategies Promoting Mechanization for CA/SI

Agricultural Development Strategy (ADS)

20 years strategic planning 2015-2035

Vision

A self-reliant, sustainable, competitive, and inclusive agricultural sector that drives economic growth, and contributes to improved livelihoods and food and nutrition security leading to food sovereignty

4 STRATEGIC FRAMEWORK

4.4.1 Food and Nutrition Security

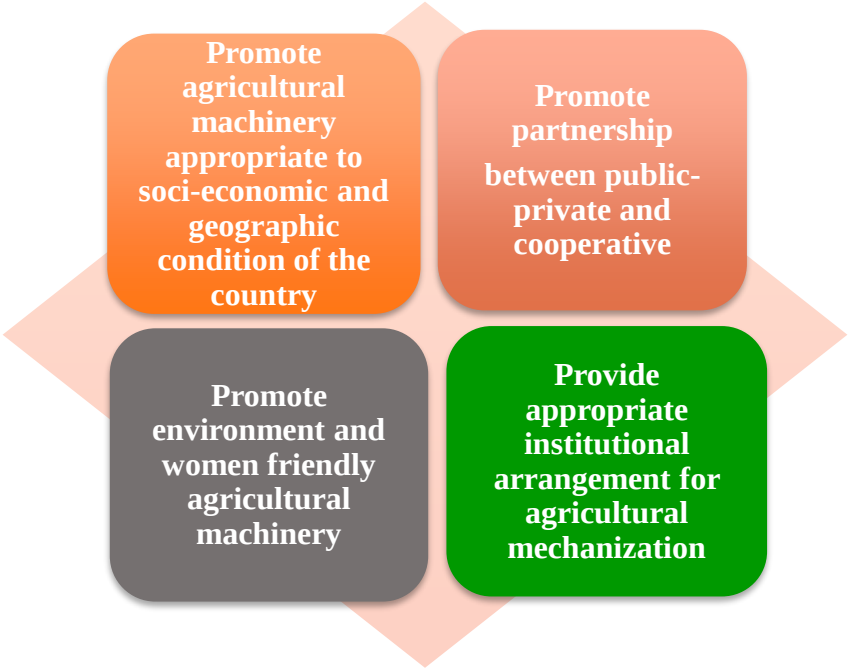
184. Component 2 of the ADS on Productivity has an impact of food and nutrition security by (i) increasing the volume of food production in Nepal in a sustainable way through higher productivity and sustainable use of natural resources; and (ii) reducing vulnerability of farmers through improved food/feed/seed reserves, improved preparedness and response to emergencies, and climate smart agricultural practices.

Policies and Strategies Promoting Mechanization for CA/SI

Agricultural Mechanization Promotion Policy, 2071 (2014)

Approved on 29th August 2014

4 Main Objectives



- To identify and promote women and environment friendly agriculture machineries.
  - Promotion of environment friendly and fuel efficient machines will be encouraged
  - Promotion of agricultural machines appropriate for sustainable agriculture and resource conservation technology will be encouraged
  - Promotion of agricultural machines and equipments for production of organic fertilizer, organic and bio-pesticides and Integrated Pest Management (IPM), Integrated Nutrition Management (INM), Good Veterinary Practices (GVP), Good Livestock Practices (GLP), Good Agricultural Practices (GAP) and Good Fishery Practices will be encouraged

Technology used in different agro ecological Zone

Terai- (Plain Land)

- Minimum tillage (power tiller operated seed drill): for wheat, rice,

lentil, mung bean etc.

- Zero-tillage (4 wheel tractor operated zero till machine): for wheat,

rice, maize, rajma, lentil, mung gram, and peas etc

- Reduced tillage (Animal- drawn harrows, 4 WT harrows): for wheat
- Surface seeding / Relay seeding: for wheat, mung bean and lentil
- Bed planting: for wheat, rice , maize, mung bean
- Land Laser Leveler (LLL)
- Happy turbo seeder
- Manual seed broadcaster
- strip till maize and wheat
- DRS in rice

Technology used in different agro ecological Zone

Mid Hill and Valley

- Promoting planting with supplementary irrigation, short-duration cultivars
- Minimum tillage using a strip-till, intercropping with leguminous crops,
- Use of cover crops
- Strip till maize and wheat
- Contour farming
- Terrace farming
- Seed Drills driven by power tiller and mini tiller
- Jab planter, hoe, etc

High Hill

- Contour farming
- Terrace farming
- Seed Drills driven mini tiller
- Jab planter, hoe,

Nepalese Experience Promoting CA/SI

Government Organization in CA

Former-Directorate of Agricultural Engineering (DoAEngg), Now Center for Agricultural Infrastructure Development and Mechanization Promotion(CAIDMP) -Department of Agriculture

Resource Conservation Technology (RCT) since 2005/06

- Demonstration of Power Tiller driven Seed cum Fertilizer seed drill-Validation with Traditional Practice
- More than 30 location of Terai and Mid Hill districts.
- Average Result compare with traditional practice:
  - Cost reduction by 30%
  - Production increase by 25 %
  - Net Income increase by 27.5%

Former-Crop Development Directorate, Now Center for Crop Development and Agro Bio-Diversity Conservation (CCDABC) - Department of Agriculture

Has allocated budget to Local Government for the promotional activities on CASI, results yet to come.

Nepalese Experience Promoting CA/SI

Research Organization in CA

Nepal Agriculture Research Council (NARC)

National Agricultural Engineering Research Centre Previously it was Agricultural Engineering Division (AED)

- Minimum Tillage by Power tiller driven seed cum fertilizer drill
- No-Tillage by 4-wheel tractor driven seed cum fertilizer drill & Happy seeder
- Residue Management
- Direct Seeded Rice
- Green Maturing
- Dry and wet weeders
- Developed Jab Seeder for maize and fertilizer

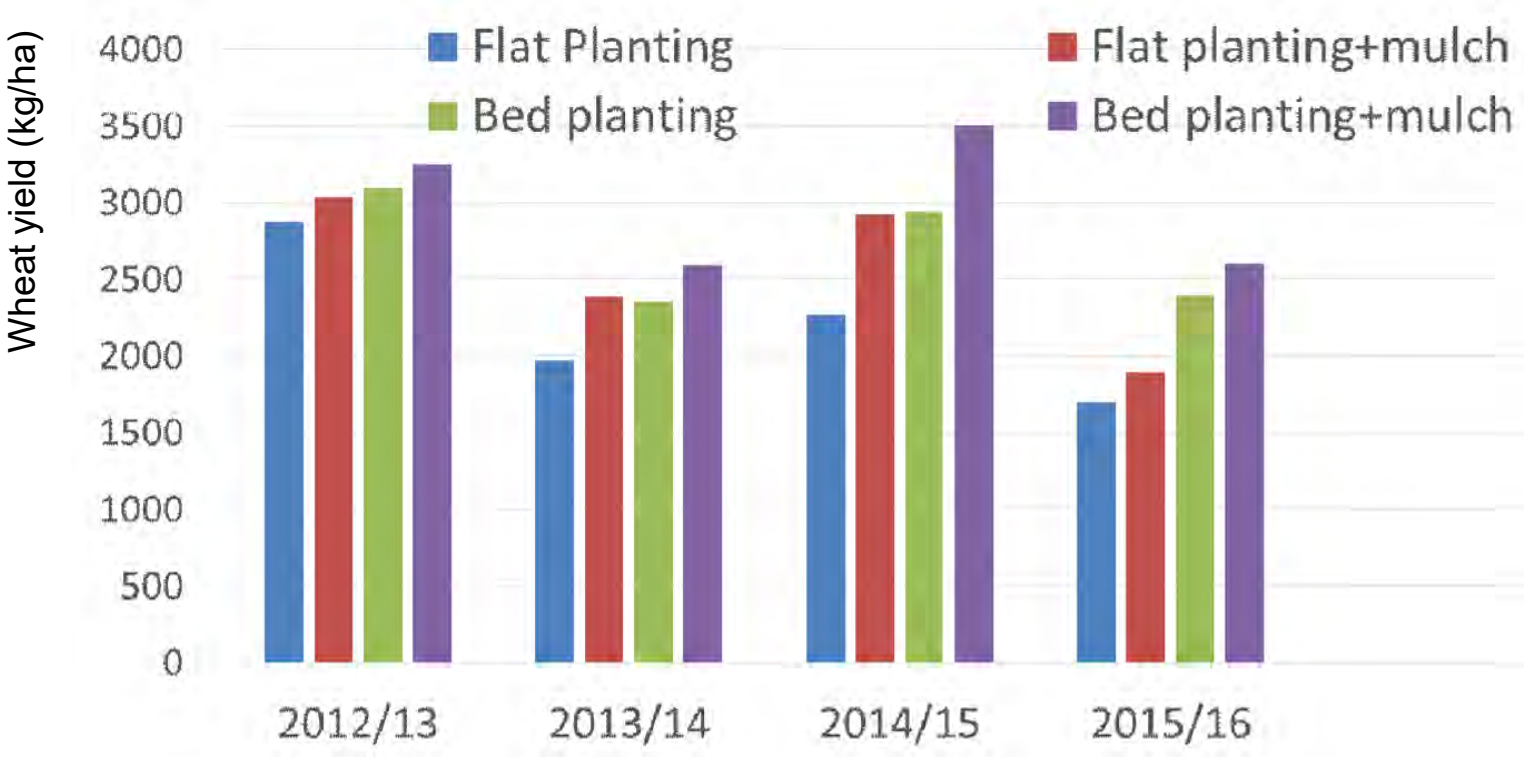
Nepalese Experience Promoting CA/SI

Research Organization in CA/SI

Agricultural Implement Research Station (AIRC) - Birgunj- TERAI

On Farm and out reach sites of Terai District on CA Practices

Example of On Farm-Wheat yield under permanent bed planting



Source: PPT on Current Status and Scope of Conservation Agriculture in Nepal
by Dr. Baida Nath Mahato, Former ED, NARC

Nepalese Experience Promoting CA/SI

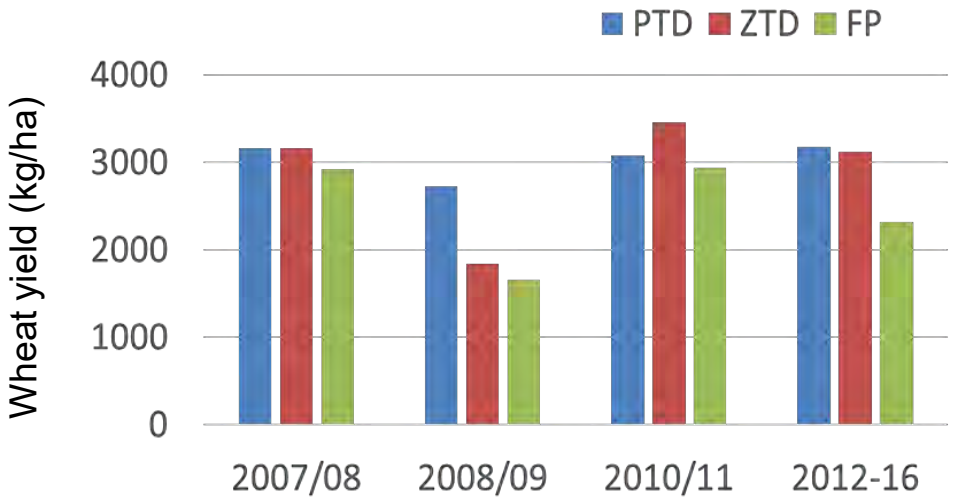
Research Organization in CA/SI

Example of Out Reach Program by AIRS

Wheat area coverage (ha) under different CA practice in Parsa & Bara districts

Wheat area (ha)

Year	PTD	ZTD	ADH
2007/08	192	133	56
2008/09	165	80	69
2009/10	4	139	458
2010/11	10	64.3	572
2012-16	31	133	134



PTD- Power till drill
ZTD- Zero till drill
ADH- Animal Drawn Harrow
FP- Farmer's Practice

Source: PPT on Current Status and Scope of Conservation Agriculture in Nepal by Dr. Baida Nath Mahato, Former ED, NARC

Nepalese Experience Promoting CA/SI

Research Organization in CA/SI

Example of Out Reach Program by AIRS

Adoption of Laser Land leveling Technology

Area under LLL			
Year	No of Beneficiaries	Area leveled (ha)	Remarks
2008/09	12	33	Bara,Parsa
2009/10	14	101	Bara,Parsa
2010/11	8	33	Parsa
2012-2016	31	77	Parsa

Source: PPT on Current Status and Scope of Conservation Agriculture in Nepal by Dr. Baida Nath Mahato, Former ED, NARC

Wheat yield (kg ha^{-1}) under laser leveled and unleveled field at AIRS, 2015/16			
	Laser Leveled	Unleveled	Water saving %
PTD	3112	2900	23
ZTD	3250	3025	38

Nepalese Experience Promoting CA/SI

Research Organization in CA/SI

National Maize Research Program (NMRP)

Maize yield (kg/ha) under different CA practices at NMRP, Chitwan

- Permanent bed (PB) with or without mulch saved about 29-33% irrigation water
- PB increased maize grain yield by 61-106%
- PB recorded highest (2.03) Irrigation water use efficiency

Source: PPT on Current Status and Scope of Conservation Agriculture in Nepal by Dr. Baida Nath Mahato, Former ED, NARC

Nepalese Experience Promoting CA/SI
Private Sector in CA/SI

Custom Hiring Center (CHS)

- **Hakim Ansari, Kauwa Bankatya, Parsa**

Different types of Combine harvestor, Tractor, Straw Chopper, Ridger, Cultivator, trolly etc.

- **Abhay Kumar Yadav, Bijabaniya, Parsa**

Tractor, Combine harvestor, Laser land leveler, Zero till drill, reaper, rice transplanter, trolly

Nepalese Experience Promoting CA/SI
Private Sector in CA/SI

Custom Hiring Center (CHS)

- **Nemi Lal Sah, Sugauli, Parsa**
  Power Tiller Drawn Seed Drill
- **Mukund Bahadur Chhetri, Simara, Bara**
  Tractor, Cultivator, **Zero-till Drill,** Disc harrow, Hadamba thresher of rice & wheat, trolly
- **Nawal Kishor Yadav, Pattarhati, Bara**
  Tractor, Cultivator, **Zero-till Drill,** Disc harrow, Rotavator, Hadamba thresher of rice & wheat,
- **Rajeshwer Pd. Chaurasiya, Pakadiya, Bara**
  Tractor, Cultivator, Disc harrow, Rotavator, Hadamba thresher of rice & wheat, Corn thresher, trolly

Nepalese Experience Promoting CA/SI

Development Organization in CA/SI

FAO-*Reducing Vulnerability and Increasing Adaptive Capacity to Respond to Impacts of Climate Change*

- *Climate Change Adaptation and Disaster Reduction Management*
- *Period –September 2015 -August 2019*
- *4 districts*- Argakhanchi, Kapilbastu, Siraha and Udayapur

Outcome:

- a participatory learning and doing approach through farmer field schools
- Beneficiaries of the project are 120 farmer groups (~3000 farmers-more than 60% women)
- Community Based Adaptation (CBA) to strengthen livelihood strategies and transfer of adaptation technology
- 20 Zero tillage seed drill had been distributed and used in last wheat season.

Nepalese Experience Promoting CA/SI

Development Organization in CA/SI

CEREAL SYSTEMS INITIATIVE FOR SOUTH ASIA CSISA's Mechanization and Irrigation (MI) programs

- increase the adoption of sustainable intensification technologies
- intensification and diversification of pulses (lentil and mung bean)
- Promoting scale-appropriate mechanization and irrigation
- Machine-sown dry direct seeded rice (DSR) into non-puddled fields can also be practiced under zero-tillage
- produced a FM radio jingle to spread awareness of the benefits of DSR Organize linkage workshopamong linkages between farmers, dealers, importers and public organizations and visit to zero tillage wheat and strip till lentil planted by the new machinery
- inkages between District Agriculture Development Offices, local machinery suppliers and service providers leading to the establishment of DSR
  - more than 200 hectares in the districts of Rupandehi and Nawalparasi of Western Districts
  - More than 105 hectares in the districts of Banke and Bardiya of Mid-West Districts during the monsoon season
  - a 90 percent increase over last year

Nepalese Experience Promoting CA/SI

Development Organization in CA/SI

Sustainable and Resilient Farming Systems Intensification (SRFSI)

Project in the Eastern Gangetic Plains

- Regional four-years project (May 2014 - June 2018 {extended till Sept 2021})
  - Bangladesh (Rajshahi and Rangpur)
  - India (Malda, Cooch Behar, Madhubani and Purnea)
  - Nepal (Dhanusha and Sunsari)and
- So many funding partner

Australian Centre for International Agricultural Research (ACIAR) and implanted by the International Maize and Wheat Improvement Center (CIMMYT)

- More than 20 partners representing research, development and educational sectors

OBJECTIVE: These partners are expected to answer two questions:

i) can farm management practices based on the principles of CA system intensification (CASI) increase smallholder crop productivity and resilience?

ii) can institutional innovations that strengthen adaptive capacity and link farmers to markets and support services for both women and men farmers accelerate change processes

Of the total beneficiaries (34,658), female farmers' participation was 31.9%

Nepalese Experience Promoting CA/SI Development Organization in CA/SI

SRFSI sites

Nepalese Experience Promoting CA/SI

Development Organization in CA/SI

SRFSI-NARC

Some Major Finding

Direct Seeded Rice

- matured 7-10 days early, timely planting of the succeeding crop, possibility of crop intensification
- low cost of production of ZT than TPR (26-72% less tillage cost, 10-21% less water)

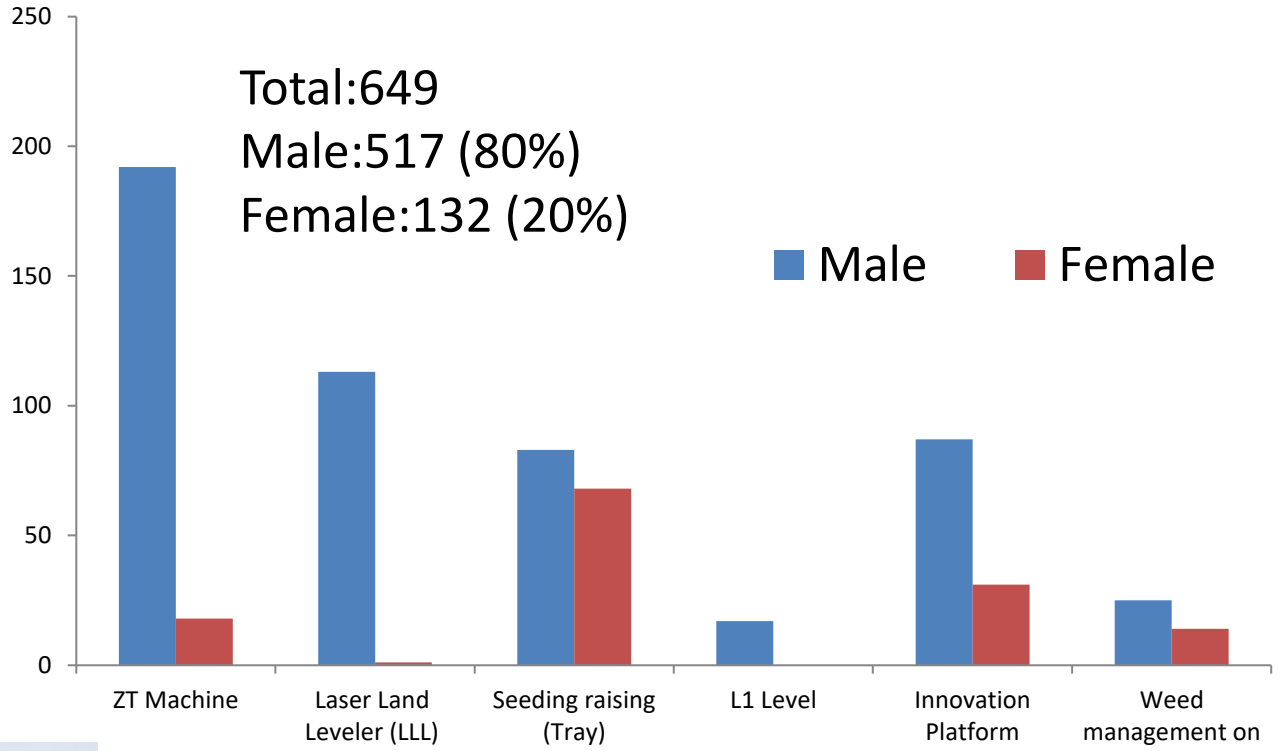
Maize

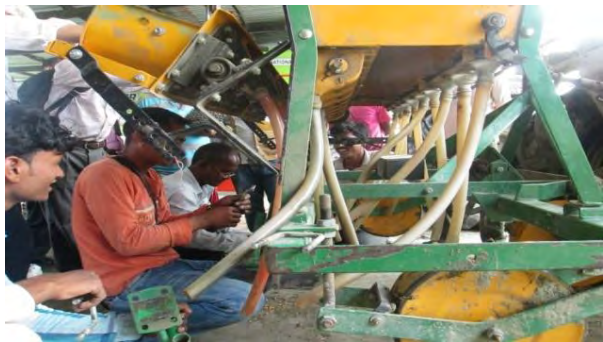
- Cost of production reduced by 25-30 % in ZT than Conventional tilled (CT)
- 35% less tillage cost, 14% less water

Nepalese Experience Promoting CA/SI Development Organization in CA/SI

SRFSI-NARC

Awareness activities (2014 to 2018)



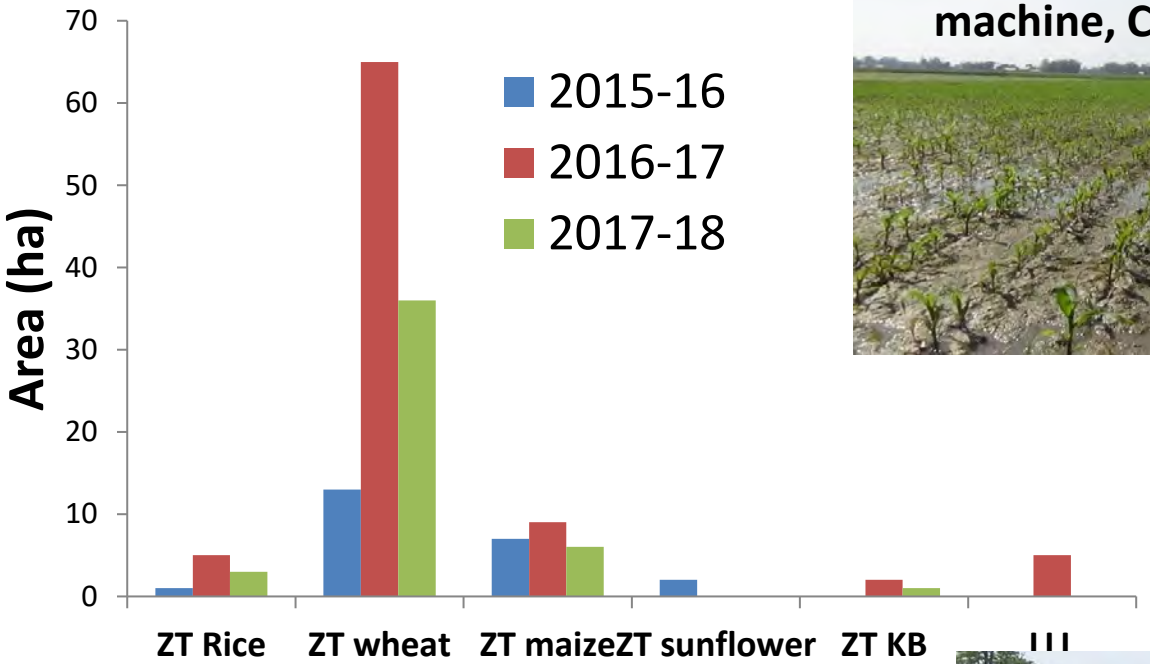


Nepalese Experience Promoting CA/SI

Development Organization in CA/SI

SRFSI-NARC

Area under ZT crops/ LLL in project implemented districts



ZT maize, Saalbani

Nepalese Experience Promoting CA/SI

Development Organization in CA/SI

Capacity Building

SRFSI-DoA

- **Training on Conservation Agriculture for JT/JTAs and Service Providers**

- **Training on Conservation Agriculture for farmers**

Farmers and IP members Visit to West Bengal, India

Major observations	Participants	Category of participants
1. Satmile Satish Club (SSC), Coochbehar: 2. UBKV and KVK, Coochbehar: on-going activities 3. ZT wheat and maize demos and out scaling fields 4. Seedling factory run by SSC 5. CASI based small-scale business model run by a women farmers group	18 (female-2)	• Leaders farmers from PMAMP Super Zone and Zone-9 • Farmers conducting Wheat demo-2 • DoA Service providers/Operator-4 • DoA staff-3

Constraints and Challenges Adopting and Promoting CA/SI Mechanization

Policy

- Inconsistencies in Government program support
- Weak in multi-sectoral linkage in coordination and cooperation
- Land fragmentation, and the conversion of agricultural lands into other uses.
- Less governmental willingness in financially supporting and promoting CA
- Low levels of research funding available for addressing CA issues.
- *Low public sector investment in agriculture*
- *No control of excessive use of fertilizers and pesticides*
- Lack of Recognition of Farm Machinery Custom Hiring Enterprise

Environmental and agro ecology

- Physical constraints of rugged and steep topography, narrow terraces in Hills and Mountains discouraged use of machineries.
- Less knowledge about suitability of different production methods under the climate change scenario across a wide array of ecological
- *Limited capacity for adaptation to climate change effects*

Constraints and Challenges Adopting and Promoting CA/SI Mechanization

Socioeconomic

- Change over to CA requires a change in mindset as well as a whole range of new management approaches
- Farmers' inability to take risks and invest in new technologies
- Poor knowledge of best agricultural management practices
- Competing uses of crop residues mainly for animal fodder
- Subsistence farming, small farm size,
- Gender constraints are another major factor that we need to consider in CA promotion and adoption
- External environmental issues (produce markets, value addition, and climate change variability)
- Farmers often lack knowledge on safe and integrated weed management practices (IWM)
- Capital and financial

Constraints and Challenges Adopting and Promoting CA/SI Mechanization

Technological

- small-scale farmers has been limited to access to specialized equipment and machinery, such as no-till planters
- concept of CA is relatively new and constitutes a big departure from conventional practices
- unavailability of manual or bullock drawn portable machineries for levelling land, sowing and harvesting crops in the sloppy terraces,
- need appropriate machinery for small-holders
- knowledge intensive as opposed to power intensive conventional farming
- new ways of crop management and lack of cover crops
- use of farm yard manure (FYM) and compost is the most difficult task in practicing CA
- requires state-of-the-art technologies and technical know-how on non-chemical pest control and use of manures
- easy availability of inputs and CA machinery
- less capacity of local agricultural machinery fabricators

Constraints and Challenges Adopting and Promoting CA/SI Mechanization

Institutional

- Less skilled human resources
- Lack of access to information and updates
- Poor Ag. Machinery Extension System
- Poor Ag. Machinery Research System
- Lack of Awareness of Improved Ag. Machinery

General

- Very time-consuming, and measurement is often ambiguous
- Crop diversification, crop rotation, mulching, organic recycling and soil-water conservation require 5 to 10 years of implementation before the results are visible or measurable
- without solving the problems of poverty and population pressure on the land is impossible to adopt CA
- Smallholders having marginal lands

3

Key Takeaways

Key Take-Away

- A shift to the approach of CA often involves combining traditional wisdom with modern technology that is acceptable, adoptable, profitable and environment-friendly
- CA should survive in the changing climate and work with nature's biological cycle
- Generating knowledge through on-station research and verification through wide-scale participatory research in farmer's fields are the basic pathways of promoting CA based practices
- Developing effective linkages and working in partnership with a range of stakeholders, including private machinery manufacturers, agrovets, and development officials is the key to accelerated generation and adoption of CA practices
- Three principles: 1. Minimum soil disturbance. eg. zero tillage 2. Year-round soil cover. eg. maintaining crop residues on soil surfaces. 3. Crop rotation. eg. agroforestry. These principles, when adopted together with appropriate land preparation (precision leveling using laser equipment, planting in bed and furrow systems, etc.) form the basis for a shift from conventional to CA
- Need champions/role models to Change of mindset of Farmer
- Crop-livestock integration, to keep the Crop residues for soil covered

Key Take-Away

- Researching & contextualizing options for weed control
- Adaption of CA to suit local conditions and needs
- Reduced tillage could be an option to tackle Conventional tillage practices on steep and fragile landscape, which can check fertility depletion and significant loss of top soil of the hills.
- Farmer Field School (FFS) is a participatory approach to educating and empowering farmers. Successful in disseminating information, handing over technology and fostering CA
- Wide acceptance of CA will require governmental support to the farmers not only in the beginning to sustainability but also in maintaining it once it has been achieved.
- Not only subsidising inputs but formulation and implementation of policies that instigate farmers towards the trajectory of CA confidently.
- Investing in women and empowering them through new techniques and access to agricultural inputs is essential to yield better incomes and improved quality of life for rural families
- CA related Machinery should be subsidies and make compulsory at Custom Hiring Center to encourage CA/SI

Key Take-Away

About 4-7 % of revenue have to sacrifice for more than 5 years to adopt CA, Hence, Government should Subsidies for 5 years to adopt CA technologies.

Regional Level

- Technology transfer
- Exchange of commercially available equipment
- Study visits for planners/scientists/technical officers in regional countries
- Exchange of information and publications
- Skill development training for existing man power
- Joint Action Research Project Development
- Strengthening R & D Institutes
- Collaboration with national and international institutions for technology transfer

Conclusion

There is a strong need for a working group to advocate CA and it's three pillars, and working with farmers, scientists and private actors to enhance, to share information and results in order to scale-up adaptation of CA/SI

Hence

ASIAN ALLIANCE on CONSERVATION AGRICULTURE (CA) or SO

Is

NEEDED

CASIC 2nd Annual CA & SI and Agroecology Regional Workshop

28-29 September 2021
Virtually Workshop
CAMBODIA

Email: basnyatms@ymail.com
Cell: +977 9851022899

Thank You

Session 2: Addressing Technical Challenges Related to CA/SI Broad-Scale Adoption

4:00 PM – 4:10PM
(30 mins)

Regional Experience on Bio-Product

Dr. Lionel Moulin, microbial plant ecologist and research director at IRD (French National Research Institute for Sustainable Development)

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Lionel Moulin,
Biofertilizers for agroecology in South-East Asia

Institute of Research for Development (IRD)
Plant Heath Institute of Montpellier
Referee for JEAI HealthyRice consortium (Cambodia)

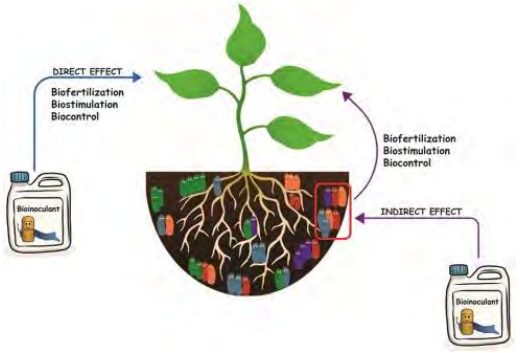
OVERVIEW

1. Session
2. Contents
3. Key Takeaways


1
Session

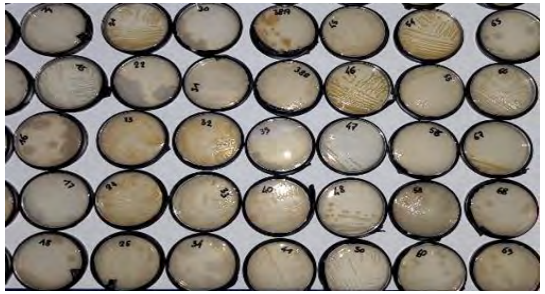
Objectives of the Topic “Bioproducts”

- Bioproducts & their interest for sustainable agriculture



- Bioproducts and their regulations in Cambodia

- HealthyRice program in Cambodia on bioproducts



2

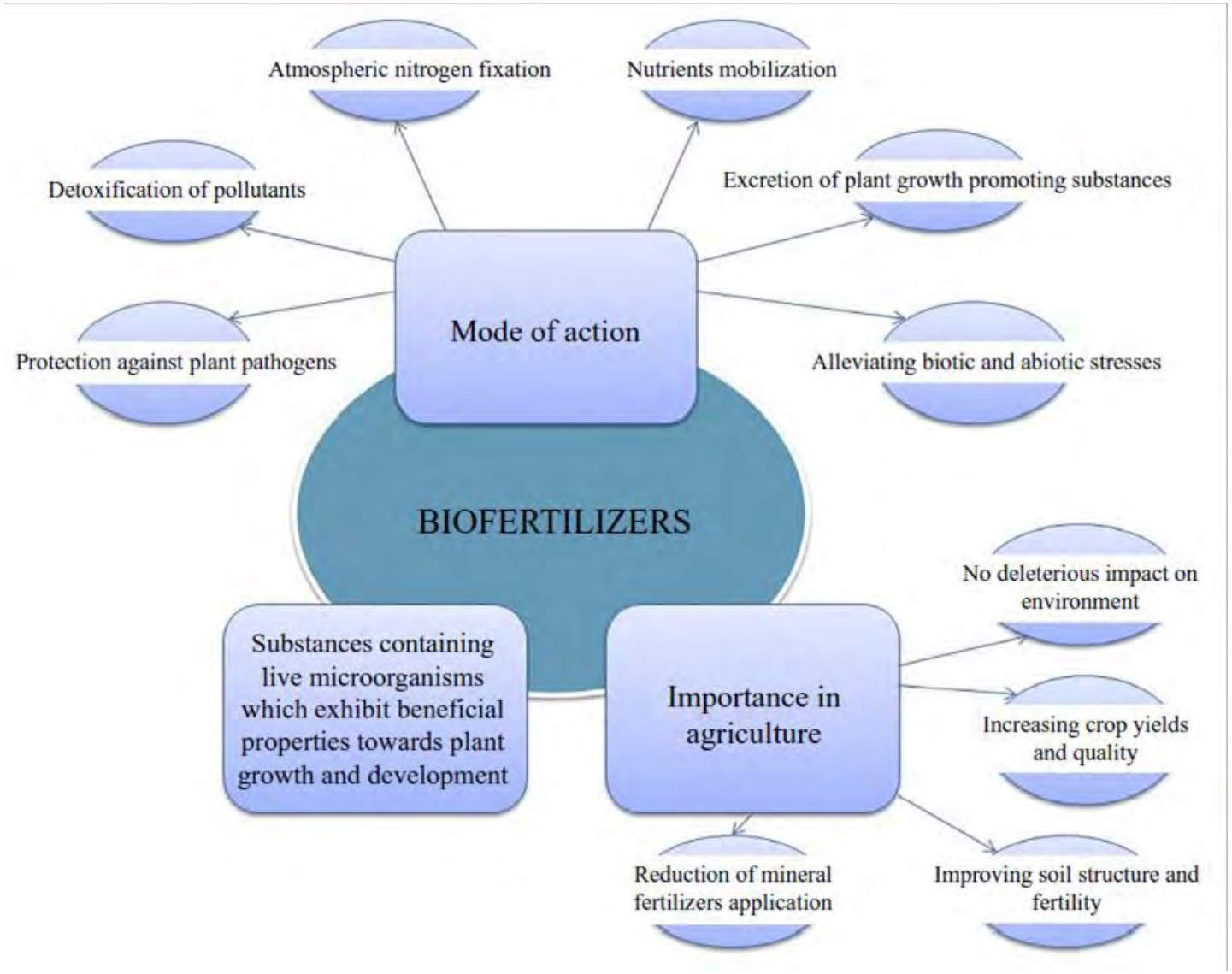
Content

What are bioproducts?

- Biofertilizers
- Biocontrol agent (BCA)

- Living micro-organisms
- Microbe-derived compounds
- Plant-derived compounds

Mode of action of bioproducts



Formulations of bioproducts

- Trapped in a solid sustrate (mainly alginate beads)
- Liquid (for spraying)

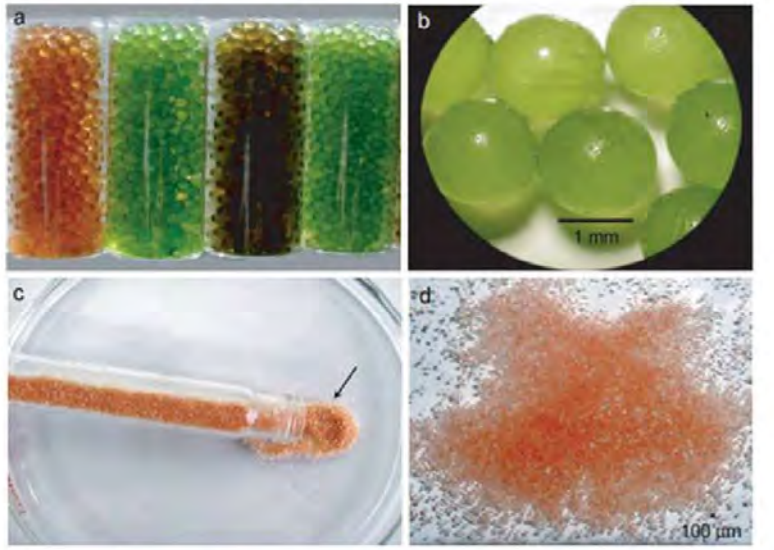


Fig. 2.1 Immobilization of microorganisms in alginate inoculants. (**a**, **b**) Wet macrobead inoculant and (**c**, **d**) dry microbead inoculant. (**a**) Inoculants of (from *left*) *Azospirillum brasilense*, *Chlorella vulgaris*, *C. vulgaris* (in alginate obtained from *Sargassum*), *C. sorokiniana*. (**b**) Macrobeads containing an association between *A. brasilense and C. sorokiniana*. (**c**, **d**) Dry alginate microbeads of *A. brasilense* (*arrow*)

Strategies for microbial inoculants

- **Inoculation of a single strain (most classic approach)**
  - Plant-Growth Promoting rhizobacteria (PGPR), Microbial-based fertilizers: N fixers, P solubizers
  - Bio-control microorganisms for pest and pathogen management
  - Under development: inoculation of core or hub taxa from microbiota studies

- **Inoculation of a microbial consortium (mainly under development)**
  - Challenging to obtain registration for each microbial strain

- **Inoculation of an entire soil microbiome or mixture of soil inocula: « Microbiome Therapy »**
  - Mainly used for soil restoration (Wubs et al. 2016 Nature Plants)
  - Inoculate microbiomes from suppressive soils (Gopal et al. 2013)

Limitations of microbial inoculants: Inoculum does not colonize the soil/plant – biosecurity issues
Solution -> Increasing use of native microbes

Regulation of bioproducts in Cambodia

- Biocontrol agents (BCA) : lack of regulation until 2017:

"the Department of Agricultural Legislation (DAL) with assistance of GIZ ASEAN Sustainable Agrifood Systems project developed the Cambodian registration form of Biocontrol Agents which is aligned with the ASEAN Guideline on Regulation, Use and Trade of BCA. On 11 of September 2017, the Minister of of agriculture, forestry and fishery (MAFF) approved the Prakas No.526 on Imposing Usage of Sample Documents for Commercial Biological Control Agents (BCA)"

KHMER TIMES

Insight into Cambodia

Business

December 22, 2017

Biological pest control agents given green light by government

Sok Chan / Khmer Times

A vegetable farmer waters plants at plantation in the countryside. KT/Chor Sokunthea

Cambodia has just launched a new registry for companies that wish to import biological control agents (BCA), effectively allowing the importation of these organisms which are widely used in other countries for pest control.

BCA are natural organisms that are used to fight pests, such as the larva of certain flies which are used to combat insects that kill crops. Controlling pests ¬– whether they are insects, mites, weeds or plant diseases – through this method is known as biological control.

Speaking at a workshop on the subject yesterday, Phum Ra, the director of the department of agricultural legislation at the Ministry of Agriculture, said his

Guidelines from ASEAN Regional BCA Expert Groups on Regulation and Application

BCA have been grouped into four product categories:

- Microbial control agents (microbials or MCA)
- Macro-organisms (macrobials)
- Semiochemicals (mostly pheromones, kairomones, etc.)
- Natural products (plant extracts or 'botanicals', fermentation and other products

Each category has specific regulations

Registered BCA products in ASEAN

Categories of BCA[6] and number of products available in ASEAN (Source: ABC database)

BCA category	Indonesia	Lao PDR	Malaysia	Philippines	Singapore	Thailand	Vietnam	Total
Attractant	9						9	18
Botanical	16	1	8		3	2	60	90
Growth stimulator		2					47	49
Microbial	31	6	35	9	7	23	62	173
Natural product		2	2		1		79	84
Other	1	7				1		9
Product Mix	4	3	1				39	47
Semiochemical	1							1
Grand Total	62	21	46	9	11	26	296	471

In Cambodia?

Trichoderma (#fungi)
Beauveria (#insect)
Metarhizium (#insect)

What about rice BCA?

Conclusions of ASEAN guidelines for BCA in rice production

During discussions with regional experts, the role and use of BCA in rice is predicated on:

- Relieving rice farmers from continuous synthetic pesticide use.
- Disavowing farmers of the belief that pesticide use necessarily increases yield.
- Avoidance of broad-spectrum insecticide use within the first 40 days after transplanting.
- Promoting the combination of cultural measures and **BCA use**, **especially for seed treatment and against early stages of pest insects**.
- Observing the actual relevance of pests, weeds, diseases, rodents, *etc.*, and take **appropriate measures** only when necessary

What about plant fortification microbes?

- BCA are biocontrol agents directly targetting the pathogen / bioagressor

But there are others phytobenefical microbes:

- Some plant associated microbes are known to stimulate plant growth, nutrient use efficiency and immunity
- These can be bacteria (PGPR) or fungi (PGPF as mycorrhizal fungi or fungal endophytes as Trichoderma spp.), naturally present in the microbiome of plants.

On-going initiatives in Cambodia

- Search rice beneficial micro-organisms from Cambodia to make easier registration (bacteria from soil or plant in Cambodia)
- Find microbes that stimulates plant growth, yield and immunity, rather than direct biocontrol agents (= biofertilizers)
- Develop formulation and market in Cambodia with local companies (or farmers themselves)

→ HealthyRice consortium & project

The HealthyRice consortium

JEAI HealthyRice (Jeunes Equipes Associées à l'IRD) =

* ITC: Institute of Technology of Cambodia (F. Kuok, M. S
* RUA: Royal University of Agronomy (L. Hok, S. Phea
* NUBB: National University of Battam Bang (P. Srean,

With support from

* MAFF: Ministry of Agriculture, Forestry and Fisheries
* GDA: General Directorate of Agriculture
* DALRM: Agricultural Land Resources Management

French partners

* IRD: UMR PHIM (S. Bellafiore, L. Moulin, P. Czernic),
  UMR Eco&Sol (A. Brauman)
* CIRAD: UPR AIDA (F. Tivet, M. Sesters)Collaborations v

(Buyung Hadi) & CRP RICE

The HealthyRice project

- Our main working hypothesis is that **diversified rice-based cropping systems** with no/low chemical inputs can be **a sustainable alternative to the current conventional rice cropping.** We hypothesize that better rice quality and farmer's livelihood are based on an improving quality continuum from soil to plants and needs a decrease in chemical inputs (fertilizers, pesticides). This can be facilitated by using **bioproducts** for rice production & health.

The HealthyRice project

Task 1.
Diversified rice Cropping systems

- No or reduced tillage
- Crop diversification
- Use of cover/relay crops
- Vermicompost
- Organic fertilizers
- No/low pesticides use

VS

Conventional

Pao Srean (UBB)

Task 2. Plant health

- Disease monitoring
- Parasites (nematodes)
- Plant Microbiomes
- Plant Phenotyping

M. Suong (ITC)

Bioproducts for rice

Task 3. Soil health

- Organic matter transformation
- Maintenance of soil structure
- Nutrient cycling
- Soil functional biodiversity

Lyda Hok (RUA)

Task 4. Rice quality

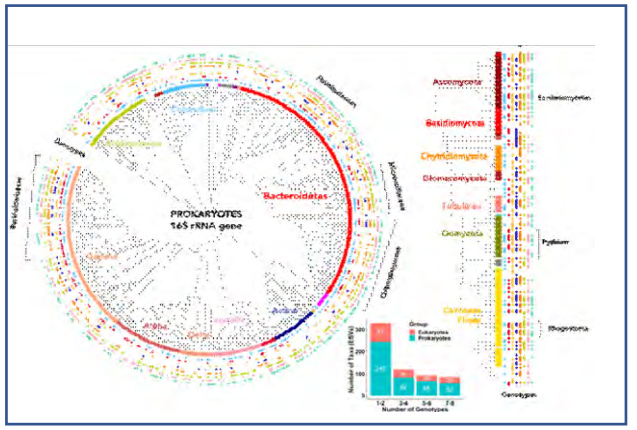
- Protein content
- Pesticides residues
- Farmer livelihood

Fidero Kuok (ITC)

On-going work on bioproducts in HealthyRice (Cambodia)

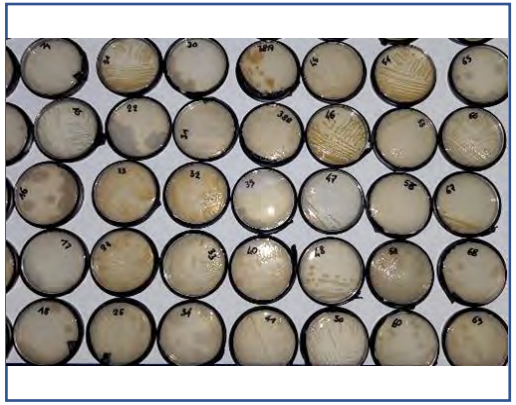
- Conservation agriculture systems

- Rice root microbiomes



Identify health-related microbes in rice microbiomes

- Collections of root-associated bacteria & evaluation of phytobeneficial traits



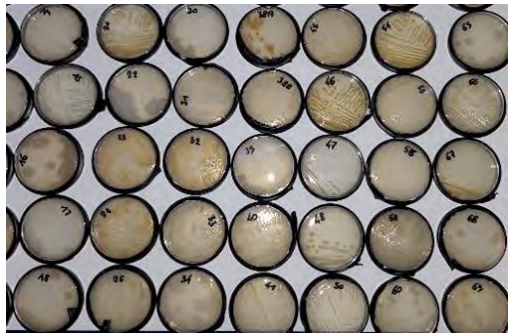
Isolate health-related microbes and evaluate their phytobeneficial capacities

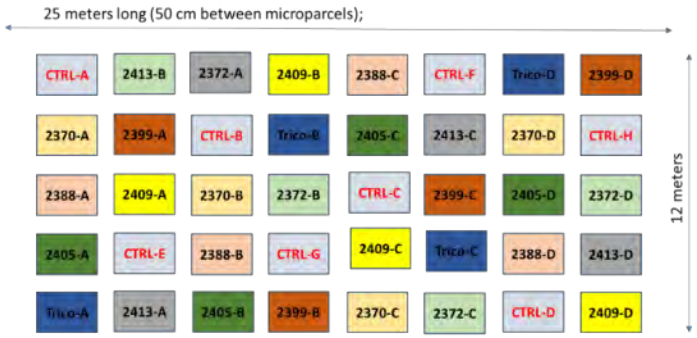
Bioproducts evaluated

- 6 bacteria isolated from rice roots in Stung Chinit.
  - Bacillus aryabhattai (2370)
  - Bacillus flexus (2372)
  - Enterobacter ludwigii (2388)
  - Kosakonia sp. (2399)
  - Microbacterium sp. (2405)
  - Paenibacillus sp. (2409)
  - Pseudomonas sp. (2413)

- 1 fungi: Trichoderma harzianum (provider Cambodia)

- 4 plot replicates per bioproduct; 5 m x 2 m.





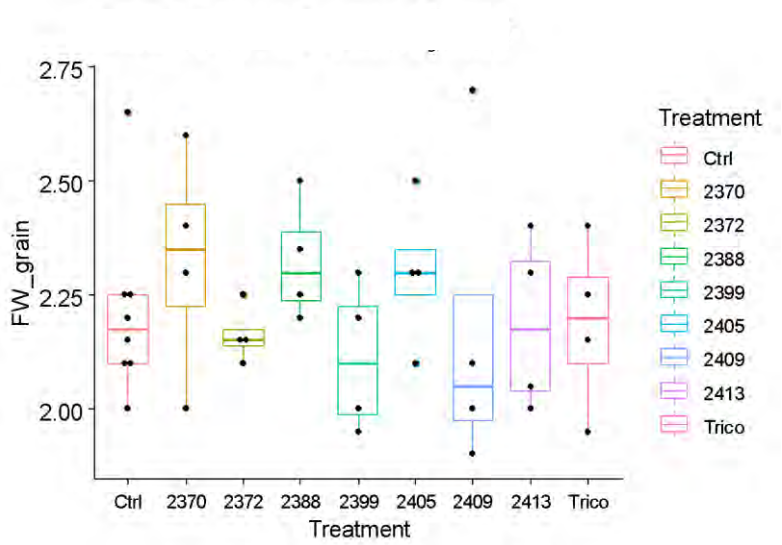
Two bacteria as promising yield enhancers

Control

Best bacteria

Trichoderma

Yield



Need more field experiments, but promising results

On-going & future work

- Increase the collection of rice-associated bacteria and screening for yield increase and biocontrol capacities (PhD Kakada Oeum at ITC)
- Produce rice root microbiome in different CA-based systems to identify key health-related microbes in rice microbiomes
- Other biofertilizers: fungi = mycorrhizal fungi as biofertilizers for rice

3

Key Takeaways

Take-home message

- BCA and biofertilizers have high potential to increase yield and reduce the use of pesticides
- Need specific regulations as living microorganisms biofertilizers are not BCA and are not chemicals
- Need to develop local market on biofertilizers
- Need to better inform farmers on their use of biofertilizers and BCA
- Active on-going research on this topic in Cambodia with ITC, NUBB, RUA, GDA-DALRM, CIRAD and IRD.

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Thank You

Q&A for Session 2

Facilitator

Dr. Pascal Lienhard, Researcher of CIRAD

4:10 PM – 4:40PM
(30 mins)

Speakers

Dr. Florent Tivet, Researcher of CIRAD and Technical Advisor of Department of Agricultural Land Resources Management (DALRM)

Mr. Madhusudan Singh Basnyat, Independent Consultant, Agricultural Mechanization Specialist for TCP/FAO-Nepal

Dr. Lionel Moulin, microbial plant ecologist and research director at IRD (French National Research Institute for Sustainable Development)

Recap & Closing of Day 1

Dr. Pascal Lienhard, Researcher of CIRAD

Workshop Agenda

Day 1

- Opening Session
- Session 1: CA/SI Status in Asia
- Session 2: Addressing Technical Challenges Related to CA/SI Broad-Scale Adoption

Day 2

- Session 3: Managing Diversity in CA/SI Systems
- Session 4: Driving CA/SI Dissemination Process
- Session 5: Support by Development Partners on Enabling CA Environment
- Consultative Discussion on the Workshop
- Closing Session

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Thank You

See you tomorrow with the same time and link!