

Climate Resilient and Agroecological Farming Practices

Compendium of Good Practices



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Acknowledgement

The Improving Livelihoods of Poor and Marginalised Farmers through Building Capacity of Local Partners and Cooperatives in Promoting Agriculture Value Chains through Adopting Climate Resilient and Agroecological Farming Methods and Practices (ILM-DCA) Project was initiated in August 2017 with an aim of improving food and nutrition security, income and resilience of small and marginal farm families. It has been implemented in five districts namely Bardiya, Kanchanpur, Doti, Achham and Dailekh of Nepal since 2017 in partnership with local implementing partners namely Tharu Women Upliftment Center (TWUC), Nepal National Social Welfare Association (NNSWA), Equity Development Center (EDC), Malika Development Organization (MDO) and Social Service Center (SOSEC). With the financial support from Dan Church Aid (DCA) Nepal, Local Initiatives for Biodiversity, Research and Development (LI-BIRD) provided technical support to this project.

During the implementation of this programme, a variety of good practices and lessons were learned. To document them and make them available to the community, stakeholders and interested parties, the project team has prepared this compendium of 'Climate Resilient and Agro-Ecological Farming Practices'. 'Climate adaptation' is one aspect of tackling climate vulnerabilities while eco-agriculture is another aspect of environmental protection, ensuring sustainable renewal of natural resources (water, soil, biodiversity, etc.) required for production, reducing the use of non-renewable and chemical resources. It is about improving the health of farmers and consumers. This publication contains similar empirical thematic learning. Its use is expected to have an impact on climate change adaptation and ecological agriculture as well as the sustainable livelihood of smallholder farmers. In order to implement climate adaptation and agro-ecological technologies and practices effectively, the staff of the project, cooperatives and local partner organizations, social workers, leading farmers have gathered the small farmers who benefited from the project and exchanged knowledge on a weekly or monthly basis as required.

We express our sincere thanks to the thematic experts of LI-BIRD who played a key role in editing and publishing this compendium. Furthermore, we are grateful to the DCA Nepal team for providing guidance and suggestions on a regular basis to enhance the quality of the programme and this publication. Looking forward to hearing from you all.

Project Team

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Interlock block industry for easy access to eco-friendly construction materials at local level

Good Practices 1



Mira Shrestha, NNSWA

Introduction

As Nepal experiences natural disasters such as earthquakes, floods, landslides, and droughts frequently, the Government of Nepal aims to adopt emergency and disaster response plans and programs, establish green funds, and adopt climate-friendly technologies. These plans and programs have emphasized maintaining or following the standard building construction guidelines. This provision has been put forward to encourage earthquake-resistant construction structures and adhere to mandatory standards, after the catastrophic earthquake of 2072 BS. Accordingly, various national and international organizations, including the Government of Nepal, seem to be promoting the use of climate-friendly compressed stabilized interlocking blocks (CSEB) as the building and structure building materials that play a major role in earthquake-resistant construction structures. According to a study on the state of the brick industry in South Asia, the brick industry ranks sixth among the sectors that play an

important role in Nepal's economy, contributing 10 to 11% to Nepal's gross domestic product, which is also a challenge for the emerging brick industry. The Government of Nepal, in collaboration with DFID/ICIMOD, has a five-year plan for the establishment of a climate-friendly brick industry, which demonstrates the importance and potential of CSEB.

Community Impact Nepal (CIN), formerly known as Build Up Nepal, and DCA Nepal promote the CSEB brick industry in Nepal. CIN and DCA Nepal are currently providing training, materials support, and advice to interested entrepreneurs who wish to start brick businesses. At the same time, these organizations have taken steps to promote and introduce these industries to various organizations within their association. The Nepal Rashtriya Samaj Kalyan Sangh, a leading organization in Kanchanpur district, is among them. To date, CIN has established nine interlocking block industries with this organization in Belauri Municipality and Laljhadi Village in the southern part of the



district. Additionally, other projects are planned for 2021. The brick is marketed as a climate-friendly alternative to bricks made from sand and cement, even though industrialists produce bricks using these materials. This reduces the number of carbon emissions. As it is earthquake resistant, climate-friendly and also cost-friendly, this brick is of significant importance for building a sustainable community in Nepal.

Benefits

The benefits of CSEB are listed below:

- It reduces air pollution.
 - It is earthquake resistant.
 - Due to its low cost and low investment, it can be consumed and raw materials can be collected locally.
 - No plastering is required, less cement is used even in complex joints and even with less human resources the physical structure can be constructed in a short time, so its use will be up to 25% less than other bricks.
- According to the users' experience, the rooms of the house made of CSEB brick in winter will be warm and cool in summer. Furthermore, mental health will be in good condition.
 - According to the ICIMOD, its use helps to reduce carbon emissions by about 7 to 8 tons per brick compared to other bricks per house construction, which is a great help in fulfilling Nepal's commitment and goal of emitting green gas globally.
 - According to CIN, the cost of building a two-room house with a tin roof from the use of CSEB bricks is Rs. 614,027 (Depending on the number of bricks, labour and raw material) but if the bricks made from the chimney are used, it will cost around Rs. 727,342.
 - To compare the strength of the bricks made from the traditional chimney and CSEB, both the bricks were thrown down from the same height, as a result, the bricks made from the chimney were broken or cracked, but the interlocked bricks were not damaged.
 - Each interlocking block can cost up to Rs. 40-50.

Table 1: Comparison of CSEB and normal brick

S.N.	Interlock Brick	Normal Brick
1	It reduces greenhouse gas emissions.	It emits carbon dioxide gas.
2	It reduces 7 to 8 tons of carbon dioxide emissions per house.	According to the World Bank, the chimney brick industry emits 37% of carbon dioxide.
3	Raw materials will be available locally.	You have to bring coal from India.
4	Do not break even when transporting long distances.	If you have to transport it for a long distance, it is likely to crack or break.
5	Earthquake-resistant	Earthquake friendly
6	No need to plaster.	The plaster will be required.
7	Can be painted directly on the wall.	Can only be painted after plaster.
8	Any structure can be built in a duration of time and in a small number.	A long duration of time is needed and a large number of bricks will be required.
9	Climate-friendly as it is cool in summer and warm in winter.	It is not climate-friendly as it is very hot in summer and very cold in winter.
10	Due to its inclusive nature, even women, people from backward or minority communities can also run their industries.	Only caditchalists can do the business of chimney bricks.
11	Positive mental health is derived from feeling safe in a safe house.	Feeling insecure and having weak psychology.
12	The workers are over 18 years old.	According to major newspapers such as The Guardian and The Himalayan Times, child labour has also been used.

Implementation

Interlock block brick production mainly requires clay, cement and stone dust. Some manufacturers even use sand. In addition, the land needed for the operation of the industry, coordination with the market and access, as well as other necessary materials, have to be well secured. Thus, for the establishment of the interlock block industry, the following things need to be taken into consideration:

Table 2: Aspects required for the establishment and operation of interlock block industry

S.N.	Actions	Activities
1	Selection of land	A minimum of 2.5 Katha to 3 Katha of land is required. With the use of metal stands, many blocks can be stored in one room.
2	Machine	<p>Types of machine:</p> <p>The machine with CIN has a hand interlocking single mould machine which costs around Rs. 235,000. This machine produces 300x150x100 mm interlocking bricks. About one ton of bricks is produced daily from one machine and four workers are required and the production cost of a block is Rs. 11. This brick unit is suitable for house building as well as easy to operate and cheap. It has a press capacity of 12 tons and weighs 200 kg.</p> <p>Multi mould machine:</p> <p>It produces two bricks of 00x150x100 mm or one brick of 245x245x100 mm. This machine is very useful for commercial production as it can be used to make bricks of both sizes by changing the mould. Which can also make bricks of normal size and paver. Large bricks are suitable for the construction of public buildings and two-storey houses. The cost of this machine is Rs. 365,000. It has a press capacity of 12 tons and weighs 365 kg. It can produce 800 pieces of bricks daily and the production cost of a block is Rs. 9.</p>

		<p>Similarly, 800 pieces of 300x150x100 mm are produced daily from a multi-mould machine + 150-litre mixture machine. This small industry has a double mould and a 150 litre Pan Mixer. This reduces labour costs and saves Rs. 2.5 per brick. It is considered to be the best machine for commercial production at a low cost. It also has a press capacity of 12 tons and costs only Rs. 7 per brick. Similarly, up to Rs. 35,000 per month can be saved from the mixture. The cost of this machine alone is Rs. 365,000, while a Pan Mixer, weighing 150 kg, is Rs. 100,000 extra, and transportation and training cost around 800,000 rupees.</p> <p>The most efficient machine for commercial production with low labour costs is the semi-automatic hydraulic machine. In a single phase, this machine can produce 1600 bricks daily with a press capacity of 24 tons and 1500 bricks with a press capacity of 18 tons with a capacity of 24 tons. It produces two bricks at a time and can operate in one or three phases. Its mould can be changed and bricks and pavers can be made in different shapes. The machine costs approximately 1100,000 rupees.</p>
3	Brick production house	The production of bricks requires a building with a roof. The cost depends on the type of roof and the type of roofing to be made.
4	Raw and other materials	Manufacturers make bricks by combining clay, stone particles, cement, sand, and cement. For quality bricks, the proportions of soil, sand, and cement must be 60-30-10. Furthermore, there are machines for measuring the quality and quantity of raw materials, such as clay, sand, mortar, and cement.
5	Workers	If there are 2-4 skilled workers who can handle all manufacturing procedures, a business can be started with 12-15 employees.

Brick production process:

The mixture for brick production must consist of 60% stone particles/sand, 30% clay, and 10% sand, depending on the quality of raw material. When you pour water on one bag of sand and leave it for a while, the soil becomes loose and the sand settles. The mixture of all these materials (stone particles/sand, clay and sand) is poured into the mould of the machine. After pressing well

on the machine with the help of hands or feet, the prepared bricks are placed in a tray and placed in a safe place or stand. Bricks should be kept in a safe place for 24 hours. Water should be kept in the bricks for 21 days to maintain moisture, which is understandable considering the bricks are cooked. After 21 days, the bricks are ready for use in any construction project.

Cost

Interlock block production in 3 Katha land: Investment and return analysis

Entrepreneurs need to keep records of their costs and turnover so that they can analyze their costs, income and profits well and become successful entrepreneurs by adopting additional marketing mechanisms in the coming days.

Below is the example of a business plan adopted by Prabin Bista and Dal B. Karki of Belauri Municipality Ward No. 6 and 3, respectively, who are doing business with the help of DCA Nepal, CIN and NNSWA to run an interlock block industry in 3 Katha land:

Description (Materials Needed)	Initial cost for operating the interlock block industry
Expenses for constructing room or a tent	Rs. 50,000 (Prices can vary depending on the construction of the room or tent)
Iron stand for laying or storing bricks (since bricks are 4 inches, each room of the stand should be 7 inches long / height for laying bricks)	Rs. 25,000 (Prices may vary as required)
Reda	Rs. 4,000
Tray (waterproof)	Rs. 60,000
Tray (normal)	Rs. 22,500
Soil 4 trolley (4 cubic meters)	Rs. 6,000 (Prices may vary depending on the distance between the place of delivery and the place where the industry is located)
Cement (15 lbs)	Rs. 12,000 (approximately)
Sand (6 cubic meters)	Rs. 5,500 (approximately)
Double mold machine	Rs. 365,000 (approximately)
Workers (12 person)	Rs.1,00,000 (approximately)
Other (electricity, water)	Rs.5,000 (approximately)
Total Expenses	Rs. 6,55,500

Contribution and Impact

Interlock blocks or bricks are manufactured without fire, which reduces carbon dioxide emissions. When compared to bricks produced with chimneys, this reduces carbon dioxide emissions by 6 to 8 tons per brick. Locally available raw materials like clay, mortar, and cement are used to make it strong. Essentially, the interlock brick itself has an interlocking feature. That is why it is also known as earthquake-resistant due to its preparation by filling its holes with cement. A house made of interlocking bricks will feel cool in summer and warm in winter. This brick is therefore climate-friendly, and its promotion does not have a significant impact on our commitment to reducing greenhouse gas emissions worldwide, including our Sustainable Development Goals by 2030.

Sustainability

The use of interlock brick is likely to increase in the coming days as it is eco-friendly, earthquake resistant and low cost. After being recognized by the provincial government, this brick has received widespread local recognition across the country. As the central government recognized this importance and included it in its guideline for building construction, local governments need to also include it in their guidelines in the near future.

Strengths, Challenges and Feedback

By creating employment opportunities for middle-income entrepreneurs and locals, the compulsion to go for foreign employment has been reduced. It is possible to construct safe housing both economically and environmentally. The number of brick users has been increasing in recent times as the house constructed using this brick is cool in summer and warm in winter. With attractive designs of houses and structures that can be built, its market potential is very good. Currently, the interlock entrepreneurs of Belauri Municipality and Laljhad Village Municipality have joined the state level interlock block union and have been taking the initiative to recommend the use of bricks at the local level by informing the municipalities about the importance, benefits and uses of this brick.

Limitation

In order to establish an interlock block industry, it is necessary to have a proper study about its potential. Then there is the need for effective capacity building. It is necessary to coordinate with all the concerned parties by considering where to bring the required raw materials and how to oversee the market. It can be difficult to use this brick in case of emergency, as only quality bricks are produced after 24 hours after production of bricks without stirring for 21 days. This brick seems to be useful everywhere in the Terai, hills and valleys.



Success story

Dal Bahadur Karki, a 35-year-old resident of Belaury Municipality Ward No. 3, Balmi, is satisfied and happy running an interlocking block industry.

Previously, he worked as an auto driver. Before, he struggled to pay for the needs of his family of five, including his wife and three children. He has now started his own business of manufacturing interlocking bricks. His enthusiasm has grown with each order that comes in. DCA Nepal helped him get a double mould machine worth approximately 300,000 rupees with the technical assistance of CIN/LI-BIRD and the coordination of NNSWA. He has been operating the industry on his own land of 3 Katha for 7-8 months. In the meantime, he has built five houses. He has been charging 45 rupees per brick including delivery but says that there is no uniformity in the rate of bricks in the market.

As a result of the industry's acceptance by the federal and provincial governments, the local level should also recognize its importance. Since the employees are from the surrounding municipalities, the industry has also contributed to creating jobs at the local level.

Mr Karki has been producing bricks from a mixture of crusher dust, clay and cement in the range of 60-30-10. "As per my experience using crusher dust or instead of sand will make the bricks stronger." he expressed honestly. He started with a small production, but after training, he has been able to increase the output.

"While working as an auto driver, it was difficult for me to meet him (husband) regularly and discuss household matters." Dal Bahadur's wife ?? spoke about her past experiences. These days, she also helps her husband with brick production. She learns business skills from her husband.

Dal Bahadur has managed to sell 1.5 lakh bricks in the initial phase. He collects the raw materials from the crushers in Mahendranagar. Although, he faces difficulty collecting raw materials due to the lockdown imposed by COVID 19. Now he plans to increase the scale of interlock brick production by purchasing a multi-moulded machine. Despite the midst of a global pandemic, an auto driver became an entrepreneur and created opportunities for others as well.

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Integrated Rice Duck Farming: An eco-friendly practice appropriate for Terai and inner Madesh

Good Practices 2



Rima Khanal, NNSWA

Introduction

Rice duck farming is an eco-friendly and integrated farming technique. It is a suitable technology to produce organic paddy at a low cost and small farmers can also adopt this technology very easily. Rice duck farming is considered to be a successful farming technique in many countries like Japan, the Philippines, Vietnam, and Bangladesh. It has begun in the Belauri Municipality of Kanchanpur district of Nepal since 2020 BC. In the Terai districts of Nepal, especially in the Tharu communities and also in some hilly communities, this type of farming practice has been found to be useful. It seems that this type of integrated and eco-friendly farming technology would be more appropriate for poultry farms. Rice duck farmers avoid pesticides on their farms and grow vegetables and pulses organically. The farmers use duck manure in their home gardens.

Malnutrition is a major health problem in Nepal. About half of the children under the age of five are found to be severely malnourished at an early stage. In Nepal, the nutritional status of pregnant women and lactating mothers is very poor. That is why the Government of Nepal has given high priority to improving the nutritional status of women and children. With funding support from DCA, the NNSWA in Kanchanpur trained ten farmers of Belauri Municipality to practice rice duck farming starting in 2020. The farmers of Belauri Municipality's Wards 3, 5 and 6 adopted this technology in their home gardens and it is continued even today.

Benefits

Both ducks and paddy have benefited from this practice. By eating the harmful insects and weeds in the paddy field, the ducks prevent the farmers from using pesticides and chemicals in

the paddy. The ducks ate insects and weeds, which provided them with nutrition. The dung of ducks provides natural fertilizer to the paddy crop, thus no chemical fertilizer is required. During the time that ducks graze in the paddy fields, nutrients such as nitrogen, phosphorus, and potash became available to the paddy.

This technology reduces the production cost compared to the traditional method. It is also considered an eco-friendly technique that increases the production of paddy as well as generates income from duck meat and eggs. Additionally, those who have practised this technology have increased net profits per unit of land by 40%. Three quintals of paddy were produced on one Katha of land. In addition, by keeping ducks at home, the family has been able to get the nutrition they require. Because duck meat is high in protein and vitamins and contributes to food security and nutrition.

Implementation

Farmers who used this technology last year plan to continue using it this year as well. This kind of farming technique will be very beneficial even though it takes a bit more effort. Several things have to be taken into consideration when raising rice ducks. These include the management of paddy fields, management of ducks and maintenance and inspection of ducks in paddy crops.

The technology is developed as a package (field selection, duckling management, improvement of cattle shed, planting of pulses and vegetables, use of duck manure, etc.) and implemented in cooperation with the local stakeholders, like agriculture and livestock service centres, women groups and farmers groups. The agricultural technicians of the Agriculture Service Center and NNSWA selected marginalized farmers with high water content and low nutritional value for the implementation of this technology.

Table 1: Aspects required for the establishment and operation of the interlock block industry

S. N.	Actions	Activities
1	Selection of field and management of ducklings	Management of paddy fields, management of ducks, management of diseases in ducks as well as maintenance and inspection of ducks in paddy fields have been completed.
2	Use of duck manure	Duck manure collected from the cage has been used in the home garden.
3	Field Management and Selection of Paddy Varieties	In order to cultivate paddy in paddy farming, first of all, a suitable field and variety of paddy should be selected. For this, a field with a loamy pinch type or soil with water holding capacity was selected. As the ducks grazed in the paddy field all day long, it was a field that was constantly watered. The field near the house has been selected. Paddy was planted differently from the traditional method. The paddy field was surrounded by nets. Ducks were reared in the Radha 4 variety of paddy field where bunds (edge of terraces) were managed from all sides of the field to minimize water leakage.

4	Plantation of paddy	Organic manure (collected from cowshed) was applied at the rate of 17.5 kg per hectare without using any chemical fertilizers and pesticides in the field. When planting paddy in the prepared field, the distance from one line to another was at least 40 cm and the plant to plant distance was 25 cm. The paddy field was watered continuously.
5	Cage construction and duckling management	<p>A total of 100 ducklings were raised on five Katha land. Cages were constructed according to the number of ducks. Cross-breed ducklings were also selected. Through agricultural technicians, farmers learned about duck diseases and vaccinations. Antibiotics and vitamins were also used to reduce the mortality rate of artificially produced ducklings.</p> <p>The ducks were only placed in the cage in the morning and in the evening, so a large cage was not needed. 1 sq.m. area was allocated for 5-6 ducks. The cage was located in the east-west direction. Ducks weigh about 2.5 kg in 8-10 weeks. When the paddy was ripe, the duck was ready to sell. Electricity and clean drinking water were provided to keep the ducks warm.</p> <p>The ducks were left in the paddy field for six hours a day. Thus grazing in the paddy field did not require much supplementary grain. As it was not possible to go to the field during the heavy rains, it was done by mixing locally available rice bran, wheat, maize flour and weed. Before starting to graze in the paddy field, a balanced grain feeding was done for 1 to 10 days. After starting to graze in the paddy field (from 15 to 18 days) they started to eat the larvae, insects and weeds available in the field.</p>

Cost

During the project, NNSWA provided ducklings and fencing to ten farmers of Belauri Municipality to protect their paddy fields for rearing ducks in their 5-5 Katha lands. Irrigation, harvesting and processing of paddy are done by the farmers themselves. Farmers have earned 35 to 40 thousand rupees by reducing the entire investment. The grains in the house were bought with maize husk and some amount was fed to the duck. Since the duck gets most of the nutrients it needs directly from the paddy, there is no need to invest much in extra food. There was also no need to invest in chemical fertilizers and pesticides.



Table 2: Expenditure incurred while rearing paddy in 5 Katha fields

Description (Materials Needed)	Initial cost for operating the interlock block industry (Costs in NPR.)
Construction of the cage	90,000
Fences for the paddy field	6,800
Ducklings (At the rate of 160/duckling)	16,000
Chicken feed	12,500
Medicine, care and other expenses	15,000
Paddy seeds	750
Land preparation and paddy planting	5,000
Irrigation	1,000
Paddy harvesting and processing	5,000
Total Expenses	Rs. 241,950

Contribution and Impact

Compared to traditional farming methods, this technology has reduced production costs. It has increased the production of green rice as well as income from duck meat and eggs. The farmers have been eager to keep using this type of farming practice since it has increased paddy production by about 35 percent. 100 to 150 grams of seed is sufficient for each Katha of land. The use of organic manure has reduced the use of chemical fertilizers and chemicals. Therefore, this type of farming technology contributes to adapting to climatic conditions. Even smallholder farmers can also adapt to this technology because it tends to cost less and increase income. In addition, it has become easier to meet the nutritional needs of 5-year-old children and lactating mothers of 1000 days. The use of this technology has improved the livelihoods of smallholder farmers in the villages

who cannot cultivate their land through heavy investments. The income generated from selling rice, duck eggs and duck meat the farmers have been able to purchase household items as well as stationery and school dresses for the children.

Sustainability

In coordination with the agriculture unit of the municipality, the NNSWA has been monitoring and overseeing the technology of rice duck farming. They have also urged that farmers would benefit from this technology every year. In addition, in order to effectively implement rice duck farming, a proper strategy has been carried out by the social mobilizers and the leading farmers to impart this knowledge to the smallholder farmers as per their needs.

Strengths, Challenges and Feedback

It was observed that even smallholder farmers who could not invest much could also improve their income by using this eco-friendly technology.

The big challenges of this technology are not visible. Even though this technology is useful, it is necessary to raise awareness among farmers about its importance. Additionally, the municipality has made posters and pamphlets about the need, importance, purpose and benefits of rice duck farming and distributed them to concerned farmers and stakeholders on the occasion of National Paddy Day and Outstanding Farmer Award, Agricultural Fair Exhibition, Animal Health Camp and Agricultural School Operation Program.

Limitation

In rice duck farming, agriculture and livestock technicians are required to orient farmers on planting paddy, planting of pulses and vegetables in the bund, management and selection of ducklings and selection of suitable fields for cultivation. This technology has been more successful in the Tharu communities of the Terai region than in other communities.

Success Story

My name is Asare Wadayak. I am 36 years old. My house is in Velauri Municipality-6, Elephant Load. I have a family of 7 in my house. My family members also help me with the My name is Asare Wadayak. I am 36 years old. My house is in Belbari Municipality-6, Hattibojha. I have a family of seven in my house. My family members also help me with farming. I have been cultivating sugarcane, vegetables and paddy and this is the first time I have adopted rice duck farming technology. As part of the SAFAL project implemented with the support of DCA Nepal in 2020, I received an orientation about this technology. I received support from the agricultural technicians of NNSWA regarding the method of planting paddy, maintaining the amount of water, and the importance of rice duck farming. In the first year, I raised 100 ducklings on five Katha of land. Chemical fertilizers were used in the past but I no longer use them. I was also satisfied with the paddy.

Ducks were raised in 5 Katha paddy fields. This year, paddy production has increased compared to previous years. Ducklings and wire for the fence were provided by the organization, but all other investments are mine. After deducting the investment, the net income was 40,000. I have been selling each duck at the rate of 500 rupees. My neighbours also like this technology and they have also shown interest in starting rice duck farming this year. This year, three neighbouring farmers are also adopting this technology. I did rice duck farming in the Radha 4 paddy field last year. This year I plan to expand it to 10 Katha fields of Bahuguni paddy. The technology has supplemented meat and eggs, therefore I found it to be very beneficial in terms of nutrition and income as well. I will continue this technology from now on. I would like to thank the NNSWA for its support in adopting this technology.

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(Climate Change Adaptation and Mitigation Toolbox)

जलवायुमैत्री कृषि पुस्तिका, वि.सं. २०७३, नेपाल सरकार कृषि मन्त्रालयको जलवायु प्रकोप समुत्थान
निर्माण आयोजना, कृषि व्यवस्थापन सूचना प्रणाली

भुसाल, आस्था; जि.सी., सागर; मिश्र, सुजन; भट्ट, लक्ष्मीप्रसाद; मण्डल, इन्देश्वर; बस्नेत, शम्भु; खत्री, लक्ष्मण;
वि.सं. २०७७, जलवायुमैत्री कृषि प्रविधि तथा असल अभ्यासहरूको सङ्ग्रालो; 'जैविक विविधता,
अनुसन्धान तथा विकासका लागि स्थानीय पहल (ली-बर्ड)' र भूमि व्यवस्था, कृषि तथा सहकारी
मन्त्रालय; गण्डकी प्रदेश

Sukkha Paddy: Drought Tolerant Rice Varieties

Good Practices 3



Rima Khanal, NNSWA

Introduction

In Nepal, paddy is cultivated from 60 meters to 3,050 meters above sea level. Sukkha-2 and Sukkha-3 varieties of paddy have been introduced in Nepal since 2011 and Sukkha-6 varieties of paddy were introduced in 2014. In 2014-2015, it was cultivated as a trial in Dang, Kailali, Baki and Bardiya. Sukkha- 2 varieties of paddy are grown in both the Terai and hills which mature in 120 to 125 days. Sukkha- 3 varieties of paddy are available in both the Terai and hills and mature in 122 to 125 days. Sukkha- 6 varieties have been started from 2014 and this paddy is available in both the Terai and hills and matures in 125 days.

Climate-friendly agricultural technology is not a completely new method but a practice based on the best practices practised even in the present situation which has included climate change adaptation and mitigation as a major agenda for sustainable agricultural development. Prolonged drought or heavy rainfall at any time is the effect

of climate change. This has a negative impact on paddies. Various drought-tolerant rice varieties are available to mitigate such effects. As the Kanchanpur district of Nepal is in the Terai, it is a suitable place in terms of paddy production. In the absence of an easy irrigation system, in the case of non-production of the paddy, with the financial assistance of the European Union, the DCA Nepal with the technical assistance of LI-BIRD and NNSWA under the UTHAN project distributed drought-tolerant paddy varieties to the local farmers. Out of ten farmers in Belauri Municipality, five were given Sukkha- 2, and five were provided with Sukkha- 3 varieties of rice seeds for the trial. Similarly, Sukkha- 6 seeds were distributed to six farmers of Laljhadi village municipality for the trial.

Benefits

Sukkha paddy seeds are new to farmers, but they have the experience of producing better than other traditional paddy seeds. Compared to last year, the income was up by 40 percent,

while the net profit was Rs. 7,319 this year. The variety of characteristics of Sukkha paddy has made it popular among farmers within a short period of time. The rice gives high yields without using chemical fertilizers or pesticides and can be planted in dry or low-water areas, gives high yields in both hilly areas and lowlands; matures in less time and offers higher yields than other rice varieties, and is tastier than other traditional rice.

Implementation

Farmers who have sown paddy seeds at the rate of 2 kg per Katha and planted them in 3 Katha fields in the first year are preparing to cultivate on 1 bigha in the next year. In addition, they share the

paddy seeds with their neighbours. The farmers and the location were selected after discussing with the farmers about the type of paddy they previously planted and consulting with the ward office's people's representative. The technology of growing paddy is the same as that employed by farmers. In the presence of representatives of the Agriculture Service Centre, Chief Ward Member of Belauri Municipality and agricultural technicians of the organization working in the field of paddy research. The work of measuring paddy plants, measuring sand and weighing straw was done in coordination and cooperation during seed distribution. It was distributed in the presence of ward members in coordination and cooperation with the ward office.

Table 1: Activities performed while sowing dry paddy

S. N.	Actions	Activities
1	Field Selection and Fertilizer Management	Paddy Field Management, Fertilizer Management, Approximately 1000 to 1500 kilograms of dung and manure are used.
2	Sowing of seeds and transplanting management	Paddy was sown within 20 to 22 days of sowing and at a distance of 25 to 30 cm and 15 to 20 cm of seedlings.
3	Taken rice research protocol	As it is hard to get data on the number of paddy plants, the number of tillers, and the weight of paddy and straw per square meter, the trail was built on one square meter plot from the same field of farmers and 5-10 plants were chosen. While collecting data, plant height, panicle length, and seed size were taken into account.

Cost

Out of the 16 farmers including 10 farmers of Belaury Municipality and six farmers of Laljhadi Rural Municipality, one farmer was provided with the assistance of Rs. 2,500 while the rest was borne by the farmers themselves. Farmers have been able to earn more even with a small investment. Since this year, farmers have been planning to plant their own paddy seeds. This paddy has benefited twice than the production of traditional paddy.

Table 2: Cost for Sukkha paddy in 3 Katha fields

S. N.	Description (Materials Needed)	Initial cost for operating the interlock block industry (Costs in NPR.)
1	Potash	219
2	Nutrition plus	422
3	Zinc	254
4	DAP	557
5	Urea	304
6	Paddy seed	504
7	Land preparation and paddy plantation	1500
8	Irrigation	500
9	Paddy harvesting and processing	1000
	Total Expenses	Rs. 4,756

Contribution and Impact

In one Katha field, Sukkha-2 and Sukkha-3 paddy yielded 1 quintal 15 kg rice, while Radha-4 paddy produced 60 kg. The farmers sold Sukkha paddy rice at the rate of 30 to 35 rupees per kilogram. They have earned Rs. 3450 to 4025 per Katha. A farmer cultivated this paddy in three Katha plots. According to him, his income increased from 10350 to 12075. This technology is less labour-intensive than other types of paddy, does not require much tilling, does not require much financial investment and is also effective from an ecological perspective. The straw of this paddy is tall and useful for making traditional-style mattresses (Gundri). Furthermore, the husk from the paddy was used by the farmers to feed their livestock. Thus, farmers were found to be attracted to this paddy.

Sustainability

The Agriculture Unit of the local municipality and Caritas Nepal had conducted a farmer's school on Sukkha paddy. In coordination with the Agriculture Unit, NNSWA monitored the distribution of the paddy crops and provided necessary technical inputs and support. Farmers were also informed that it would be beneficial to cultivate this paddy every year. The social mobilizers and the leading farmers have carried out strategic interventions by imparting knowledge to the smallholder farmers as per their needs so that the Sukkha paddy can be put to effective use.

Strengths, Challenges and Feedback

It was also seen to be beneficial for farmers who have less land. It was learned that this paddy would be suitable for small farmers and also in areas with less water. The challenges of this technology are

not obvious.

Although this technology is useful, there is a lack of publicity among farmers. Since farmers are attracted to the paddy they are already using, it seems necessary to spread public awareness about the need, importance and purpose of this paddy. In addition, dry paddy can be disseminated on the occasion of National Paddy Day and Best Farmer Respect Program, Agriculture Fair Exhibition and Krishi Pathshala program being celebrated by the municipality.

Limitation

In rice duck farming, agriculture and livestock technicians are required to orient farmers on planting paddy, planting of pulses and vegetables in the bund, management and selection of ducklings and selection of suitable fields for cultivation. This technology has been more successful in the Tharu communities of the Terai region than in other communities.

Success Story

My name is Asare Wadayak. I am 36 years old. My house is in Velaury Municipality-6, Elephant Load. I have a family of 7 in my house. My family members also help me with the My name is Asare Wadayak. I am 36 years old. My house is in Belbari Municipality-6, Hattibojha. I have a family of seven in my house. My family members also help me with farming. I have been cultivating sugarcane, vegetables and paddy and this is the first time I have adopted rice duck farming technology. As part of the SAFAL project implemented with the support of DCA Nepal in 2020, I received an orientation about this technology. I received support from the agricultural technicians of NNSWA regarding the method of planting paddy, maintaining the amount of water, and the importance of rice duck farming. In the first year, I raised 100 ducklings on five Katha of land. Chemical fertilizers were used in the past but I no longer use them. I was also satisfied with the paddy.

Ducks were raised in 5 Katha paddy fields. This year, paddy production has increased compared to previous years. Ducklings and wire for the fence were provided by the organization, but all other investments are mine. After deducting the investment, the net income was 40,000. I have been selling each duck at the rate of 500 rupees. My neighbours also like this technology and they have also shown interest in starting rice duck farming this year. This year, three neighbouring farmers are also adopting this technology. I did rice duck farming in the Radha 4 paddy field last year. This year I plan to expand it to 10 Katha fields of Bahuguni paddy. The technology has supplemented meat and eggs, therefore I found it to be very beneficial in terms of nutrition and income as well. I will continue this technology from now on. I would like to thank the NNSWA for its support in adopting this technology.

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जैविक विविधता अनुसन्धान तथा विकासका लागि स्थानीय पहल (ली-बर्ड) को वि.सं. २०७७ सालको क्यालेण्डर

कृषि तथा पशुपन्छी डायरी, वि.सं. २०७८, नेपाल सरकार, कृषि तथा पशुपन्छी विकास मन्त्रालय, कृषि सूचना तथा प्रसार शिक्षण केन्द्र, हरिहर भवन, ललितपुर

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Bio-dyke for controlling river erosion

Good Practices 4



Roshan Rana, NNSWA

Introduction

According to UNDP, 2004, Nepal ranks 11th in the world in terms of earthquake risk, followed by water-prone disasters (flood and landslide) and climate change. Disasters in Nepal are causing a loss of over Rs 1.20 billion every year. There are 6,000 major rivers and streams in Nepal. There are 14 small and big rivers and streams in Kanchanpur. Up to 200 people are being affected by the annual floods and landslides caused by climate change. Moreover, in the case of the Terai, bigha-bigha land is being harvested, watered and submerged every year. Some villages have been displaced due to deforestation. Due to regular flooding and deforestation in the Terai and the consequent change in the course of the river, the river flow in the Terai is less than in the hills. A change in appearance can be seen. In order to minimize the risk of such a situation, the biological embankment also known as bio-dyke is an effective method of controlling river erosion in the Terai at low cost

with the active participation of local people using local resources. This method involves making spurs from bamboo culms and building dams out of sand or soil in those spurs. This work is done at the place where the river is being cut or at the place where it is likely to be cut.

In the case of Terai, where there are medium rivers, embankment construction using this technology has been found to be very popular and effective. The source of such medium rivers is the Chure and Mahabharat mountain ranges. This bio-dyke technology was introduced by various NGOs working in flood-prone areas in coordination and collaboration with the local community to control erosion.

Benefits

Since this type of bioengineering technology will control river erosion, riverside settlements and fertile lands will also be prevented from erosion. Currently, there is a project called 'People's

Embankment' under the multi-year plan of the Government of Nepal for the prevention of river degradation. However, due to slow and weak implementation, thousands of acres of land are being turned into bogs every year. In this context, alternatively, if embankments are constructed with this technology in time, hundreds of acres of land can be saved from being eroded.

This technology can be adopted economically and reliably in the community. Because it:

- Assists in preventing the river from being cut off,
- As the cost is less, embankment work can be done with less investment using local resources,
- As it is a biological method, trees can be planted in the area where the embankment has been constructed. The environment will be green in the area where it is harvested in a few years.

Implementation

While constructing the bio-dyke, various things should be taken into consideration and preparation should be done accordingly. The bio-dyke should be constructed considering the area that can be degraded rather than the area that is being eroded. Construction must be completed by the end of June at the latest. If it is later than that, the bamboo poles, the constructed spurs, and the bags inside may not be settled. As a result, the embankment could be washed away in the heavy flood of the monsoon season. Bamboo, plastic bags, and sand are commonly used to construct dams. The taller the bamboo, the more durable it is.

Selection of bio-dyke construction site

Bio-dykes should be built on rivers or streams

especially in low flow areas. The river is considered to be suitable for the place where it is being cut or can be cut. It is necessary to construct the embankment on the opposite side of the embankment. This is because the shape of the river is often irregular. If the embankment is built a short distance ahead of the main erosion site, the speed of water will be reduced when the spur reaches the main erosion area by reducing the flow of water and soil will start eroding in the empty space between the spurs.

Building an embankment

While measuring the place for building an embankment, the length of two to four meters extra area should be taken into consideration. Because of this, water does not get stuck in the main degradation area and the bio-embankment will also be strong and durable. The length of bamboo to be buried as a pillar should be nine feet tall. Spurs should be made every 15 to 20 meters. The length of the spur should be two to three meters and the spur should be constructed in the same way as the main embankment. When making spurs, the main embankment should be made 60 degrees or horizontal. Its primary function is to control the flow of water and to protect the main embankment. More specifically, it helps in eroding the soil between the main embankment and the spur. The four feet extending from the pole buried at a distance of one meter should be woven from bamboo bamboo culms and the empty space in the middle of the weave should be filled with a plastic bag or sacks filled with sand or soil. After that, the surface of the embankment should be leveled from the mound to the embankment with a slope of 60 degrees. Plants that spread or grow quickly, like bamboo and reem 'Amlewswor', should be planted to prevent the soil from spreading.

Cost

Table1: Cost and materials needed to construct 100 meters of bio-dyke

S.N.	Description (Materials Needed)	Quantity	Unit	Rate	Total	Remark
1	Bamboo	250	Pcs	400	100,000	
2	Load and unload 250 Pcs of bamboos	2	Trips	7,000	14,000	
3	Sack	4,000	Pcs	10	40,000	
4	G. I. bending wire	13	KG	160	2,080	20 gauge
5	Cutting and sawing bamboos	250	Pcs	50	12,500	
6	Pump set	12	Hrs	200	2,400	
7	Diesel (Fuel)	15	Ltr	115	1,725	
8	10 workers to fill sacks	10	Workers	500	5,000	
9	Cutting and sawing bamboos, bamboo culms	40	Workers	500	20,000	
Total amount					1,97,905	

Contribution and Impact

This kind of bioengineering technology will not only protect the land from erosion but will also protect the plants planted along the embankment. Which makes the surrounding green and helps in enhancing the environment. It directly or indirectly helps to reduce greenhouse gas emissions to some extent in embankment areas. In Belauri and Laljhadi villages, the embankments have been transformed into a community forest.

Learnings, Challenges and Feedback

Earlier, the lands along the river were gradually turning into bogs. In this context, this technology has an instrumental role in controlling erosion and keeping the environment green. In addition, essential timber raw materials are also being produced. As the nearby community is environmentally friendly, this year, Belauri and Laljhadi Municipalities constructed about six kilometers of biological embankment this year in different places along the banks of the Doda River with the coordination and cooperation of local level and NGOs and the local communities.

Limitation

Using this technology to build an embankment is very suitable for the Terai region. For the banks of slow-moving rivers and streams, this technology is very effective. However, this technology is not suitable for large and fast-flowing rivers and streams.

Success Story

The 'Udaypur Community' is located in the Belauri Municipality, Ward No 5, the southern part of Kanchanpur district. Mr Ram Rana, a local resident, said that this place was considered suitable for settlement as there is fertile land for farming, forest for grazing cattle and the Doda river nearby. There were only 60 households in the beginning, but now there are 65 households in this place, of which 60 are Janjati and 5 are other households.

Initially, this river was like a stream, according to Ram. During the spring, the river would dry up. Later, when the other two rivers, Silahi and Banara Machheli mixed with the Doda river, it turned into a big river. After that, this river started causing a lot of damage to the Udaypur community and other communities. Floods in 2064 and 2065 caused the most damage. When the two children were trying to reach a safe place, they drowned in a river. Some survived by staying in a tall tree for two days, unable to reach a safe place at night.

Due to the frequent floods, it was not possible to stay in this place. Therefore, since 2065 BS, this community has moved to the Raniban community for stay. Since they have only a plot of land to live in this new place, they have to go to the same old place about a kilometer away for farming. During the monsoon season, it is sometimes submerged as well as flooded. The production of

other seasonal crops is fine. As it is not possible to produce the main crop in this place, some people have gone elsewhere and most of the men have moved to India for employment.

Ram's house is 200 meters away from the river. He says, "Even though there has not been much flooding in the last few years, there is rapid erosion in some places. To get support to protect the place and to build a dam on the river, we visited various ministries of the Government of Nepal. The government representatives tried to make us feel assured because there was a plan to construct stone walls on both sides of the river through the 'People's embankment' initiative. But it's not the same as being committed by them." He further stated, "There is a fear that the remaining few houses will be washed away by the flood of this monsoon. I have sown grass for buffaloes in the field instead of cultivating paddy. I am happy, however, that the CBLSF project of the NNSWA and the municipality is helping to build the embankment. But I was a bit upset when I learned that the dam will be made from bamboo. A huge mango tree had been swept away by the flood, and I wondered what would happen to the bamboo dam. However, I had helped the communities build the dam. Even with the heavy floods, the dam is still strong. I regularly visit there. Thanks to the support organization and the team."

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Goat as a gift to enhance livelihood of poor and marginalized

Good Practices 5



Anita Tharu, TWUC and Indeshowr Mandal, LI-BIRD

Introduction

The goat gift scheme is a scheme where the recipient farmer receives goat as gift and returns the goat without reducing the quantity and quality to needy and interested poor and marginalized (disadvantaged groups including Dalit and indigenous groups) and families with similar background. Goat gifting programmes have contributed for the enhancement of livelihood in both Terai and hilly regions. The goat gift programme aims to uplift livelihood of poor, Dalit and disadvantaged groups. Under this scheme, an operational guideline has been developed for effectively managing goat gift procedures including farmers selection process. Farmers are selected in the first step and each of the selected farmers receives five goats. The goat farming is done as per the instructions set out in operational guidelines. The key points included in the guideline are: the selected families (disadvantaged groups including Dalit, indigenous groups, single women, orphan

and differently abled) should have their own feed and fodder to suffice for at least 3 to 6 months. In addition to these, the settlement of the community should be well harmonized, should have grazing land, concerned farmers should have strong interest to do goat farming, should be involved in the groups (newly formed or reformed) and should provide commitment to return kid goats in the group.

Benefits

- Increment in annual income and livelihood enhancement
- Creation of employment opportunities
- Development of family harmony and social harmony
- Supply of meat, milk and manures strengthened and contribution in nutrition supply
- Can be initiated with small investment
- Wasted terraces and sloppy land can also be

utilized.

- Goats can be easily marketed.
- Goats are required to perform certain religious rituals and worship as well.
- Goats provide us with milk which is regarded as one of the most nutritious foods.
- We can prepare various materials from the bones of goats.

Implementation

Farmers are selected as per the guideline prepared by the project in coordination with municipal government's livestock division and concerned cooperatives. Training is provided to selected farmers. After receiving training, farmers prepare goat climate smart goat sheds. Goats required for the goat farming are purchased by mobilizing cooperative and farmer group committees adhering to the project's procurement guidelines. The procured goats are provided to farmers after signing the agreement. Farmers need to return the same number of goats received as goats to the members of the group after the defined time. In every goat farming group 5 to 10 farmers are selected. In year 1, amongst all groups, 50 members receive 5 goats each. The remaining 50 farmers shall receive the goat as a gift on year 2 after the batch 1 farmers return the goats as a gift. The decision on which farmers will receive the goat in year 1 is made based on the consultation between goat farming groups, concerned farmers' households, cooperative's representatives and representatives from municipal government. The breed of the goat is identified in consultation with farmers and suggestions from the concerned livestock division of the municipal government. The project provides technical support for the orientation of goat farming and goat shed

management. Each group also receives a buck of improved breed. The buck should be managed by the farmer group themselves. This involves providing grass, fodder, feed and treating buck in time. The cost of the treatment of goats shall be borne by the concerned livestock division of the respective municipal government. The project shall carry out monitoring and evaluation of the goat farm management in coordination with respective municipal governments. All of the goats provided under this programme are insured by the insurance company at the rate of NPR 300 per goat. The household head is responsible for taking care of goats. If the sick goat could not be treated during treatment and are dead, concerned farmers can give an application to the organization and penalty may be waived based on Muchulka after joint decision from organization and municipal government authorities. The concerned household head needs to claim for the insurance from the company. Once the claim amount is received, the amount shall be utilized to purchase goats for the same family. If the goat/goats are lost because of the negligence of farmers, the concerned family is responsible. Cooperative provides necessary support for the marketing of goats.

The following technical aspects need to be taken care while doing goat farming

Suitable breed: Selecting appropriate breed as per the local climate is key for goat farming. We cannot raise mountain goats in Terai and Terai goats in Mountains and hills as they cannot acclimatize well in the changed environment.

Identifying productive breed: While identifying breed for certain region, it is essential to select productive doe and buck as well. The following are the basis of selection of mother and buck.

Basis for selection of buck for breeding

- Healthy and energetic
- The one with best growth in the batch should be selected as buck
- Buck should be successor of parent bearing twins
- It should not have any kind of defect in sex organ
- It should have no relation with doe for at least 5 generations.

Basis of doe goat selection

- Healthy and energetic
- Healthy body
- Having all four feet equally strong
- Able to raise babies
- Having tendency to give birth to twins
- Able to give birth three times in two years.
- Having clear udder and proper nipples so that mammary glands are properly developed.

Shed management

- Goat shed needs to be in a sunny, heighty space
- When making goat sheds in Terai and hills, it should be built in raised space so that the lower space can be utilized to collect manure. The goat shed needs to be high so that the smell from the manure does not harm goats.
- Proper ventilation needs to be ensured in the shed.
- Goat shed should be made ensuring it can be properly cleaned afterwards.
- Goats should be managed as per the group. If different groups of goats are kept in the same place, they need to be properly bonded.
- Grass rack (Separate allocated section for keeping grass and fodder/feed) should be made in a goat shed.
- Goat shed needs to be cleaned on a routine basis.

Feed and Water Management

- As feed affects production directly, managing feed for goats is crucial.
- The wasted land needs to be utilized to produce nourishing grass so that goats get green grass throughout the year.
- Expecting mother goats, breastfeeding goats and buck needs to be provided with additional feed in addition to grass.
- Balanced feed can be made at home as well. For this, three parts (different varieties of crops like maize, wheat, bran, wheat millet rice) and one part of pulses (leguminous) or wastages from oilseeds (bi products) can be used to prepare balanced feed for goats.
- Mineral blocks can be made at villages as well. For this five shells of egg can be dry roasted and grinded. Take 250 gm red clay (should be in dust form) and take 250 gm of iodine salt. Mix it properly by adding water, it should not be too thin, otherwise it will be difficult to prepare the block/cake. Now mould it as a cake/block of different size and dry properly. It needs to be dried for 4-5 days. Once dried, hang the mineral block in the place where goats can reach to lick. It should be provided once a day.

Livestock Health management

- Provide medication on a regular and timely basis to save from internal and external parasites.
- To make goats safe from fatal diseases like PPR, ensure timely vaccination.
- To reduce the probability of diseases, ensure proper sanitation and ventilation in the goat shed and take care of the feed as well.
- Report to concerned authorities whenever there is communicable disease or fatal diseases reported.
- Isolate the ailing goats from the rest of the goats.

Breeding management

- Wait till the babies get to seven eight months before doe is taken to buck.
- Buck needs to be at least 10 month and shouldn't be used for mating when it is above 5 years.
- Buck should not be too fat or too thin.
- The ratio of buck to doe should be 1:20.
- To avoid breeding, bucks should be changed each year.
- Once the doe is noticed of getting heat, buck should be brought within 24 hours.
- To avoid uncontrolled mating, buck should be kept separately.
- The sex organ of buck of doe should not have any problem.
- In order to ensure no compromise in productivity, breeding should be managed by ensuring no in-breeding.

- While selecting doe and buck, attempts should always be made to those who have a history of being in a family producing twins.
- The mating should be managed so that parturition does not occur in the month of extreme winter and rainy season as it will be extremely difficult for the newborns. (Avoid December/January and July August)

Problems of inbreeding

- Higher mortality of kids
- Decrement in the production capacity, decline in milk and meat
- Prone to diseases
- Kids are thin and cannot gain weight.
- The age to reproduce gets longer in every next generation.

Cost

The details of the cost while providing 5 goats to a farmer is as per the table below.

S.N	Particles	Rate (NPR)	Number	Amount (NPR)
1	Training	2000/-	1	2,000/-
2	Goats	8,000/-	5	40,000/-
3	Insurance cost	500/-	5f	2,500/-
4	Vaccination and medicine	500/-	5	2,500/-
5	Nutrient Management	2,000/-	5	10,000/-
6	Goatshed Construction	20,000/-	1	20,000/-
Total				77,000/-

Contribution and Impact

Goat farming enhances annual income and contributes to livelihood upliftment. Goat manure can be used as an organic method for increasing vegetable cultivation. Goat farming also contributes to increasing the supply of meat and milk in the family thereby contributing to the improvement in family nutrition. Goat gift programmes can be used without external support to enhance the livelihood of the communities.

Sustainability

This practice is sustainable in itself. For further sustainability, this programme should be prioritized by the local government and implemented strategically. Local government, cooperatives and groups can coordinate and extend this practice so that this is sustainable and scaled up further.

Learnings, challenges and Suggestions

- Goat gift programme helps to enhance livelihood of poor and marginalized families and contributes for sustainable economic development. It also helps to make them self dependent and contributes to enhancing family nutrition.
- If the goat received a gift dies due to some reason, farmers have difficulty returning the goat as a gift.
- This practice is sustainable only when it's done in proper coordination with concerned municipal authorities' livestock division.

Limitation

This practice is effective for the marginalized communities dwelling in Terai and Hills.

Success Story

Sharada Thapa (41 year)'s family, residents of Bar Bardiya Municipality Ward No 5 Bankasi, Bardiya are making good earnings from goat farming. She was engaged with a women farmers group created by the initiative of 'Climate smart livelihood enhancement and good governance' project from 2017 onwards. She received basic training on goat farming through the same group. Before joining this group, she had only two goats. Later on, she received the support of two goats through the project. This helped her to double her goats, now she has 6 doe goats. Her annual income is 50,000 from goat farming. She has also returned two kids to her group members. She runs home from the earnings received from goat farming and also manages the educational expenses of her son. She also saves some of her earnings. She aims to continue goat farming as an enterprise in future.



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Solar Irrigation: Appropriate Climate Smart Technology to Irrigate River Basin of Terai and Hill

Good Practices 6



Munnaram Tharu and Chyamata Gurung, TWUC

Introduction

Solar irrigation based vegetable farming is clear cost effective and climate smart technology. This technology converts energy to electrical energy and draws water from surface area or ground area and is used to irrigate vegetable farming. This technology is effective even in the areas where electricity is not available or electricity voltage is not enough. This technology can be used for storing water in a tank and used in a Multi Use System. This system is also used as a source of drinking water in the Hilly and Terai area. This technology helps to produce vegetables at a relatively smaller cost and contributes to the savings from the earning.

Advantages:

- This is green technology which
- Since solar irrigation is run by solar energy, it doesn't require additional cost after it is installed.
- It does not use fossil fuels like petrol, diesel and kerosene.

- It is more of a one time investment rather than continuous investment.
- This contributes significantly to enhance farmers' livelihood

Implementation

Solar irrigation system works by accumulating solar energy in a solar panel which is later converted to current. The converted current goes to the control box and is transformed as energy which helps to run the pump enclosed. This system draws water directly when it's sunny. But On a foggy morning, evenings and non sunny days, the water extraction is lower. Thus, a battery is also required as an alternative backup so that water irrigation is not disrupted.

For the installation of solar based irrigation the following steps need to be taken.

Selection of area: Solar panel installation area needs to be fixed by ensuring the availability of

undisrupted sunlight from morning to evening.

Solar system size and budget estimation:

Solar system budget will vary as per the size of the system. Thus, it is essential to calculate the size of the solar panel to be installed so that budget estimation is more realistic.

Identifying water source or underground boring:

On this step, situation analysis needs to be done whether the source will be underground boring or river water. After this step, a necessary machine is used to take the water from the sources to the farmer's field.

Connection of tools: Solar tools eg Solar panel, pump, earthing, Controlbox etc are connected

as per the area for fixing solar irrigation system. Once the system is installed, water supply is tested. The water can be utilized by farmers as per their requirement.

Water tank construction and mini irrigation facility installation:

In this step, a water tank needs to be constructed to store the water collected from solar energy. The collected water can then be supplied to the field from Drip Irrigation technology. Drip irrigation technology ensures the efficient use of water and also enhances the production.

Solar based irrigation system requires various materials eg. Solar Panel, Controller box, Submersible Pump, Earthing stand etc.

Table 1: Details of the materials required for the solar irrigation technology installation.

S. N.	Required Items	Details
1	Solar Panel	Solar panel converts the solar energy to electrical energy. The number of solar panels is determined as per the requirement, place and capacity.
2	Pump	Solar irrigation technology can be used to draw water from surface level, underground water. In Terai, water is extracted from ponds and borings. Whereas, in the hill water is extracted from flowing river, water tanks. When water is to be generated from Boring, a submersible pump needs to be kept, and where water is to be generated from the surface, the surface pump is kept. The pumps are installed as per the availability of water sources.
3	Earthing	Earthing needs to be done to ensure safety mechanisms, especially to avoid short circuits and to remain safe from lightning.
4	Controller Box	Controller box converts the current generated from the solar panel to the Submergible or surface pump and such current runs the motor of the pump.
5	Wire	Wire is used to connect solar panels to the Controller and Controller to the Pump

Cost

The solar system is quite diverse. The cost of Solar irrigation technology varies on the area of irrigation and requirements. Though the initial installation cost is significant, the operational cost afterwards is nominal for the solar technology. The cost of the technology will largely depend on the area that needs to be irrigated, the height of the water source and the height of the place to be irrigated. For example, the cost will be 20 to 25 lakh if the height of the place to be irrigated is 50 to 100 meter high. But the cost will be only 5 lakh if it is to be done from 5 to 10 meter. While generating water from boring, if the water source is 100 feet deep boring, it will cost 5 to 7 lakh.

Contribution and impact

Though the initial cost of the solar irrigation technology is higher, it has a very minimal cost of running. Which makes the compound cost less and irrigation becomes less costly in a longer run. This technology can ensure the availability of water throughout the year which contributes to making the production more commercial and is also helpful for off-season farming which will help farmers to increase income and uplift livelihood.

Sustainability

The solar based irrigation technology has been implemented based on tripartite agreement

between project, municipal government and local communities. Thus, this technology is sustainable and will be operated in longer run.

Learnings, Challenges and Feedback

During summer, the water demand is high and supplying irrigation facilities to all farmers is difficult. During winter the temperature is low and energy is also less thus irrigation is challenged. Solar irrigation technology is a costly technology and thus this has been a major limitation to resource poor farmers. In order to make this technology work at night as well, battery backup and tank is required which adds the cost making it more expensive.

Limitations

Solar panels need to be cleaned on a periodic basis otherwise it will be filled with dust which will limit the solar energy reception thereby limiting water supply. This technology is quite costly as compared to other technologies during installation. This initial setup cost is quite high. If the battery backup is not kept, this technology does not work especially at night, foggy time and hazy weather. Thus, water collection tanks and batteries also need to be installed. This technology is useful for both hilly and Terai areas.

Success Story

The farmers of Satkhaluwa Farmers group, Barbardiya Municipality, Ward No. 9, Bardiya are attracted towards commercial vegetable farming because of solar irrigation technology. The farmers group members have been able to increase their production area and production each year because of solar irrigation. The vegetable farming land of Stkhaluwa farmers group has increased by 1 Bigha 5 Katha after the starting of a solar irrigation facility.

The electricity used to be disrupted because of storms and the availability of petroleum fuels was uncertain so they could not irrigate the land earlier. But now, they are not worried about irrigation and their time and resources are saved. Before the installation of solar technology, they used to pay 500 rupees for a diesel pumpset. Now, they save that cost. They are cultivating in groups and marketing jointly. They are growing vegetables at low cost and are quite motivated with the production and earnings and are expanding their production.



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Improved animal shed for enhancing quality farm yard manure at household level

Good Practices 7



Nirmala Rijal, TWUC and Indeshowr Mandal, LI-BIRD

Introduction

Animal shed is required to provide safe and healthy space to animals and also to increase production and provide a quality environment for breeding. Depending on the age and the condition of the animal, the shed needs to be spacious with ample air circulation, well ventilated, have natural light and appropriate temperature so that production is assured. To enhance farm yard manure (FYM), one of the most commonly used organic fertilizers in Nepal and manage livestock, traditional animal sheds are improved so that cows, buffalos and pigs etc can stay comfortably in safe and healthy space. The arrangement to collect animal dung effectively in the animal shed is farm yard manure improvement. This includes improving the animal shed in a way that the space is safe and the animal dung does not make the shed dirty but is rather collected efficiently in a pit or pot to make the space clean and healthy. Enhancement of farm yard manure helps to improve the quality of manure

thereby contributing to the crop production. Animal urine has more nitrogen than dung, which in general is destroyed. Amongst the grass and feed eaten by animals, only 20% nitrogen is utilized as nutrition by the animal, the rest i.e 80% nitrogen converts to dung or urine, 28 percent in dung and 58% in urine. Thus, urine has significant nitrogen. Similarly, 61 to 87 percent phosphorus and 82 to 92 percent Potas is extracted via dung and urine. Additionally, dung and urine have other micro nutrients helpful for ensuring minerals and nutritions for plants.

Benefits

- The requirement of Nitrogen and potassium is supplied by farm yard manure and this will help to decrease the cost to purchase chemical fertilizers.
- The organic manure from the animals helps to fulfill micro nutrient requirements of the plants.
- As the cost of chemical fertilizer is reduced, the cost of production will also be decreased.
- It helps to improve the overall environment,

including sanitation around the periphery of animals which will also contribute to lessen the disease thereby increasing production of milk.

- It also helps to provide irrigation to the farm.
- The healthy animal produces low methane gas, it contributes to low emission of methane gas in the atmosphere. This is helpful while using biogas.
- It helps to increase the quality and quantity of manure and nutrients due to controlled leaching, evaporation and runoff with flood.
- Through animal shed and FYM Improvement, it is easy and time-saving to clean the shed floor as the floor is dry. It is healthier for animals.
- Improved FYM releases its nutrient content slowly hence supplies nutrients to the growing crops and helps in overall growth and development of crops.
- It ensures proper aeration and improves water holding capacity of soil and improves physical, chemical and biological properties of soil and increases soil fertility.
- Animal Shed can be kept dry and clean and the overall environment will be clear. This will also save time for households spent in livestock management.
- The improved farmyard manure is light in weight. It is easy for women to carry and reduces the drudgery of the women.

Implementation

This practice can be implemented in close coordination and partnership of farmers and municipal level agriculture sections. For the implementation of this practice, farmers need to manage items which are available locally on their own. Whereas items to be purchased from external agencies eg. Cement can be contributed by the project and technical support is provided by the agriculture division. The animal shed should be made open during summer and should have flexibility to be closed during winter. Shed's front space needs to face south or east in the hill and north facing in Terai.

Floor of the animal shed: The floor of the animal shed should be strong, should not absorb water and should be dry and healthy. The floor should be at least 25 cm above the ground and should not be slippery. The floor should have a soling of brick and stone and cement can be used to prepare a permanent structure. As the brick connections have small pores, it can be affected by bacteria and it can absorb water, thus the use of concrete cement is recommended. In order to make the floor non slippery, draw cross lines every one meter. Make the end part at least 2 cm lower than the upper part so that the liquid is not retained in the floor.

Urine Canals in the animal shed: While making canals in the shed, it should be made 30 cm wide, 7.5 cm deep and the corners should be made round. If the canal is too narrow or too deep, cleaning it will be extremely difficult. Urine canal should have one cm sloopy in each one meter so that urine can pass easily. The urine collection should be at least 50 cm deep.

Living space for Animal: Cows will need 1.6 meter long and 1.1 meter wide space (5¼'x3½') and buffalo will need 2.25 meter long and 1.35 meter wide space (7¼'x4½'). In order to keep the shed clean and make it easy for milking, keeping a gap of 1.1 meter between two animals and keeping 1 meter long wood or Pipe as a divider is recommended. The ground should have a ring enclosed to fix the rope for binding animals.

Feeding space: Animal sheds should have concrete feeding space. The front part of the space should be 40 cm high and the later part should be 60 cm high. Inner breadth of the space should be 60 cm and depth should be 20 cm. One animal will require 60 cm long space for feeding. While making space for two animals. 60 cm long, 50 cm wide and 20 cm deep feeding space can accommodate both.

Animal Shed's roof: The shortest pole of the animal should be 2 meter (6½') and the highest part should be 3.5 meter (11½'). For making roof, metallic roof, thatched roof can be used. Floor should cover the walls of the shed and also reach upto 60 cm (2') outside the walls at minimum. When the roof is facing both ends, sun and air can pass properly and the shed is not much hot during summer. In order to protect the roof from being excessively hot, the metallic roof can be covered with straw. Trees can be planted nearby to provide fresh air and shade. The animal shed should also be protected from storms.

Wall and pillar of Animal shed: The animal shed should have the walls of at least 20 cm. For every 3 to 4 meter concrete cement pillar of 20x20cm or 30x30 cm brick pillar should be made. While placing iron pillar or wooden pillar, 30 cm tall concrete cement structure should be kept (refer to picture) for the support so that it's not destroyed by storm.

Air circulation in animal shed: Proper air circulation is must in the animal shed so that animals get fresh air and are well ventilated otherwise the animals will be affected by the gas produced by their urine and dung. To make the air circulation effective, The animal shed can be made by making wall upto one third of the height of the animal shed and making the two third as open. If the animal shed has proper air circulation, the floor of the shed shall be dry, healthy, free from bad odors and dampness. This also helps to enhance the milk production. During winter the open space needs to be covered by thick plastic or tent or temporary partition.

Farm Yard Manure management: When the animal shed is improved, a pit should be made to collect the urine and dung of the animal

to prepare farm yard manure. The size of the pit should be determined based on the number of animals. The pit should be at least 2 meter deep and should have length and breadth as per the requirement. The pit should have at least two or more than two sections. If there are more than two sections it is easy to shift the manure in between the pit so that the quality of farm yard manure is enhanced by proper decomposition. If the pit is properly covered, the temperature increases and micro bacteria will work effectively contributing to prepare the manure fast. The dung and leaf filter, crop residue and grasses should be placed together and the pit needs to be reshuffled in between 4 to 6 weeks. Some poles or pipes need to be placed in the middle of the pit so that it helps for the decomposition of the manure. This will help to provide air in between and contributes to enhancing the quality of manure. To save the manure from water and sun, the pit should be properly covered by a roof. The room controls the nutrients to dry by sun and washed by rain. Urine also needs to be collected separately and should be covered properly for being protected from sun and rain. The collected urine helps to supply the needed nitrogen to the plants.



Cost

The tentative estimated cost for improving animal shed for two buffalo or cow is provided below

S.N	Materials	Unit	Quantity	Price	Total
1	Cement Sac	No	6	1100	6600
2	Sand Sac	No	18	100	1800
3	Pebbles/Gravel (Sac)	No	25	100	2500
4	Stone	Cubic Meter	1	3000	3000
5	Labor (including farm yard management)	Person	10	800	8000
					21,900/-

Contribution and Impact

Improved animal shed and farm yard manure is one of the climate smart agriculture (CSA) practices. As per the experts, 18 percent of the green gas emission in the atmosphere is down by domestic animals. While managing animals from traditional methods, there are lots of problems faced and production is also compromised. Thus from a climate adaptation perspective, managing animals in a shed and improving farm yard manure not only helps to enhance animal's health and contribution in production but also helps to reduce emission of green gasses. This also helps to reduce cost of production. The improved farm yard manure helps to increase the fertility of the soil and contributes to increased income of farmers thereby enhancing farmer's livelihoods.

Sustainability

This practice is very beneficial. This makes the animal shed healthy, clean and also user friendly. The quality of manure is also enhanced and contributes to increased production overall.

Learnings, Challenges and Suggestions

The major challenge of this practice is unavailability of human resources for the construction and maintenance of this practice. Managing skilled human resources for animal shed construction is one of the ways out to address this challenge. This practice is very helpful for those who want to do commercial buffalo and cow farming as this significantly reduces health hazards and contributes for better production. To sum up, animal sheds should be constructed as per the number of animals and buffalos and.

Limitations

This practice can be practiced in all ecological regions, terai, hill and mountains

Success Story

Amita Tharu, 32 lives in Barbadiya-3, Jhandipur, Bardiya. Her major occupation is farming. Her family consists of her husband Syana Tharu, her father in law and 6 years old daughter. She is also engaged with Juneli Saving Farmers group. She got married In 2070 B.S. She has studied upto class 8. She has only three katthhas of land and her husband works on contract basis for a constructor.

Her economic status was quite poor earlier. She faced difficulty managing the educational costs of her daughter. Realizing the need to increase income, she started doing buffalo farming. Her buffalo used to give 3 liters of milk which she sold

in the nearby dairy. Now, she has 4 buffalos and sells upto 15 liter milk. Her economic status has increased significantly and she is able to provide quality education to her daughter and she also manages to save from her earnings.

She received support from Tharu Women Development Center, Bardiya under the "Improving Livelihoods of Poor and Marginalized Farmers (ILM-DCA)" project supported by Danish Church Aid and implemented by LI-BIRD. Her animal shed is managed properly which helps her to better manage her buffalos. She also uses the farm yard manure in her field. She feels happy that she does not use chemical fertilizers any more and is producing organic and nutritional vegetables. '

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Concept of Climate Smart Village and Practice

Good Practices 8



Ramesh Rawat, SOSEC and Indeshowr Mandal, LI-BIRD

Introduction

Agriculture is one of the most affected sectors from climate change. Climate change has resulted in the increment of various hazards which includes flood, landslide, short rainy seasons, prolonged droughts, extreme rain or too less rain, untimely hailstone, cold wave. The increment of disease and pest has also contributed to the significant decline of agriculture production. To minimize the loss in the agriculture sector and increase agricultural production, and to cope with the climate change amidst population growth, climate smart agriculture technologies and practices need to be adopted.

Climate smart village is an appropriate option for decreasing adverse effects of climate change by implementing climate smart agriculture tools, technologies and practices for better adaptation. Climate smart agriculture village concept helps to reduce the negative effect of climate change

through adaptation in a systematic manner and helps in the identification, testing and expansion of climate smart tools, technologies and practices for certain agro ecological zones by enhancing the resilience capacity of the communities. This concept was developed by CCAFS's programme. This concept is successfully implemented in various countries of South Asia successfully. This concept is implemented based on specific village's climate change risks by assessing the suitability of the tools, technologies and practices in the local context for increasing the resilience of the community.

For the implementation of Climate smart village, the farmers and communities can make land use plans based on climate risk, eco agriculture, social and economic status. Different tools and technologies which could contribute to climate change adaptations are identified, researched, tested, promoted and expanded in this concept. This practice also studies on the risk and effect of climate changes, traditional learnings, education, perspectives towards climate change and selection

of technologies is done on scientific basis by analyzing the above mentioned aspects as well. Overall, through the climate smart village concept, a scientific plan is implemented for the promotion of different tools and technologies for enhancing the resilience of local communities.

In Nepal's context, different ecological zones, especially higher hill, mid hills and Terai are seen as more appropriate for different types of Climate smart agriculture technologies. For high and mid hills, some relevant tools and technologies include, resilient seed and varieties, animal shed improvement and farmyard manure management, mixed cropping, home garden, water storage, drip irrigation, plastic house, community seed bank, fruit farming, agroforestry, small hand tools, insurance, agro met advisory services from mobile. For Terai, solar based irrigation, zero tillage farming, community seed bank, agroforestry, small handy agri tools, crop insurance, agro met advisory services from mobile are some of appropriate tools and technologies.

Benefit

The following are the benefits of Climate Smart Village

- Increment in productivity
- Increment in gross income
- Improvement on the usage of production input and effectiveness
- Reduction in green gas emission
- Increment of resilience
- Improvement in Gender equality and Social Inclusion

Implementation method and approach

Climate Resilient and Agroecological Farming Practices

Compendium of Good Practices

For the implementation of a climate smart village, having coordination and partnership between the province government, local government, local communities and stakeholders and organizations working in the area is a must.

Selection of location and impact groups

For the establishment of a climate smart village, site selection should be done in close coordination with the Agricultural Knowledge Center, Local government, local community and the concerned project. For this, attempts are made to implement in the places where LAPA (Local Adaptation Plan of actions) is already prepared. Amongst the different villages which are being considered as an area for the selection of site, climate risk, the scope to represent agro ecological zone, the facility of road access, feasibility to promote either one agriculture product or livestock product, contribution in the biodiversity conservation, interest and concerns of local community, climate resilience capacity, suitability from technical perspective, the presence of marginalized and resource poor community, interest from youths and women, sensitivity from vulnerability perspective and those communities who have not accessed such services before are some of the criteria for the site selection. The above criteria are considered important for the site selection.

Participatory climate risk and vulnerability assessment analysis

In the selected village, climate risk analysis needs to be done so that the possibility of climate smart agriculture technology is assessed. For this vulnerability capacity assessment or participatory capacity and vulnerability assessment method is

implemented. Climate vulnerability assessment is analyzed based on different means of vulnerability analysis, for example resource and hazard mapping hazard calendar, hazard classification, climate calendar, crop calendar, historic timeline, access to institution, tree diagram etc. can be used. Additionally the LAPA of concerned local authority can also be done as a resource for the analysis. The participation of local government and local community is essential for the vulnerability analysis. Vulnerability analysis is done based on the hazards and climate risks, challenges faced by the community. Based on the analysis of vulnerability assessment, the data of climate risks can be analyzed and suitable climate adaptation tools and technologies (Climate smart tools and technologies can be identified and selected and a plan for the implementation of Climate smart agriculture in villages is prepared.

Selection promotion and expansion of ecosystem friendly tools and technologies

For the establishment of climate smart villages, selected areas climate risks are analyzed. Based on the analysis, different climate smart agricultural tools and technologies are identified and selected. The climate smart tools and technologies are divided in five categories based on the community's need base for adaptation and resilience. 1) Weather smart, 2) Water smart, 3) Carbon/Nutrient Smart 4) Seed/Breed mar technologies and 4) Institutional/market smart technologies.

The details of the tools and technologies that can be implemented in climate smart villages are provided in annex 2. As the tools and technologies implemented in climate smart villages are selected

on the vulnerability assessment of the specific location, the tools and technologies are different as per location and the cost will also differ from place to place. The implementation of climate smart villages is costly and needs ample resources. Thus, this programme needs financial support from local government, province government and agriculture knowledge center. The programme needs local people's participation and contribution of financial resources (If not human resource, the community needs to provide contribution by being engaged as labour). The tools and technologies/practices promoted in the climate smart village needs to be recognized as a regular programme in the local government and provincial governments so that it can be expanded in other local governments as well.

Capacity Building

In order to implement climate smart village successfully, providing capacity development training on the concept of climate smart village to human resources under Province, district and local government authorities, agriculture and livestock technicians is essential. Additionally, farmers implementing this practice needs to be properly trained on the effects of climate change and the coping strategies.

Excursion visit and Workshop

Excursion tours and visits are organized to provide direct field observation opportunities to farmers and stakeholders about the different climate smart agricultural practices and technologies adopted in climate smart villages so that stakeholders and officials can directly interact with the farmers implementing this practice. This kind of excursion is targeted to the organizations and stakeholders who are keen to implement

this practice. Staff from agriculture knowledge center, livestock development directorate, forest division office, watershed management offices, forestry development directorates, agro enterprise and training center, various research stations within NARC and representatives from municipal governments, cooperatives are included in this kind of exposure visits.

Programme Implementation and Monitoring

For the regular monitoring and successful implementation of this model Agriculture knowledge center, a monitoring committee comprising representatives from Forest office's sub division, local government, project, and climate smart village needs to be formed. Though agriculture knowledge centers and local

government representatives are included in the monitoring team, having regular interactions and coordination meetings in each trimester is essential so that the progress monitoring and review is done periodically. The monitoring and evaluation shall be carried out by the monitoring committee so that the municipal government and provincial government can replicate the best tools and technologies in other areas by including them in local and provincial governments policy and programmes.

Norms for the selection of climate smart model village

For the establishment of Climate smart village, villages need to be selected where at least 30-50 households are available. The following are the norms for the selection of climate smart villages.

S.N.	Basis for Evaluation	Maximum
1.	Area with high climate risk and vulnerability (Drought, flood, landslide, disease and pest, hailstone, Extreme rain, blight, storm,	15
1.1	If it has 6 or more risks stated above	15
1.2	If it has 4 or 5 risk stated above	12
1.3	If I has less than 4 risk stated above	10
2	If majority of household have livelihood from agriculture and livestock	10
3	If there is scope of marketing at least one agriculture or livestock production from the village	5
4	If there is scope of agro biodiversity promotion, organic agriculture and agro tourism	5
5	If local government and community have commitment and concern in the area	5
6	If there is presence of marginalized community and youth and they are interested to be part of the programme	

7	Access to roads. Proposed eco agricultural village should have access to the road.	5
8	If the farmers and farmers group have not taken support in agriculture grants so far	
8.1	Not taken	5
8.2	Taken	0
	Total	60

Source: ली-बर्ड, वि.सं. २०७८, मुख्यमन्त्री एकीकृत कृषि तथा पशु विकास कार्यक्रमअन्तर्गत जलवायुमैत्री प्रविधि तथा अभ्यासहरू प्रवर्द्धनको कार्ययोजना

Cost

The cost of establishing an agro ecological village will depend on the region where it is being established and also vary based on the practices to be implemented. The estimated cost of the establishment of an agro ecological village is as below.

S. N.	Items/Technologies/Practices
1	Site selection of Climate Smart Village
2	Participatory vulnerability assessment for climate smart village
3	Capacity Building Training
4	Programme Monitoring and Evaluation
5	Exposure visit and Workshop
(A)	Weather Smart
1	Plastic Tunnel (120 gsm) 12 meter length, 6 meter width UV Plastic sheet
2	Agro Advisory Services
3	Agriculture and Livestock Insurance (50 household)
4	Integrated Home Garden (Per household)
(B)	Water Smart
1	Rainwater collection pond

2	Community recharge pond
3	Solar based irrigation
4	Drip Irrigation
5	Muddy Cement pond
6	Plastic Pond
(C)	Carbon/Nutrient Smart
1	Animal shed improvement
2	Organic manure
3	Vermicomposting manure
4	Mixed cropping with leguminous crops
5	Green manure
6	AgroForestry
(D)	Seed/Breed Smart
1	Climate resilient sees (Drought tolerant, flood tolerant, disease and pest resistant) (Per Ropani)
2	Community Seed Bank
(E)	Institution/Market Friendly
1	Farmers Group
2	Farmers' cooperative
3	Collection Center

Source: ली-बर्ड, वि.सं. २०७८, मुख्यमन्त्री एकीकृत कृषि तथा पशु विकास कार्यक्रमअन्तर्गत जलवायुमैत्री प्रविधि तथा अभ्यासहरू प्रवर्द्धनको कार्ययोजना

Contribution and Impact

Because of the climate change's adverse effect, sources of the water have dried up, the recharge pond have been source for the conservation of spring water. Farm yard manure management, drip irrigation, dish washing space have been constructed which also contributes in climate change adaptation.

Sustainability

For the implementation of Climate Smart Village, the coordination and partnership between the provincial government, federal government, local government, community and different institutions working in this sector is essential. This practice is entirely based on agro ecological farming. Thus, keeping the soil's fertility intact and enhancing production, nutrition and increasing income remains top priority for the sustainability of this practice so that the next generation also receives the benefits from the ecosystem in the same manner.

Contribution and Impact

People have received clear information about the climate smart village. Communities have properly utilized the land which used to remain fallow earlier. Organic agriculture system has been developed and expanded. Water has been properly utilized and organic vegetable farming has contributed to generate more employment opportunities. Time is better utilized and less water is consumed for irrigation purposes which is also helping to better do off season farming and manage livestock efficiently. The income of the community has increased and livelihood has been enhanced.

Limitation

For the implementation of Climate smart village having appropriate place and conditions remains key. Due to geographical and financial conditions, some communities lack ample space required which limits the minimum requirement to implement this practice. Thus, despite being sustainable, this practice might not be appropriate due to geographical location, readiness, the

settlement of community and household and other requirements. This practice is relevant in all ecological zones, mountains, hills and Terai.

Success Story

48 farmers of Dailekh district, Aathbis Municipality Ward 3, Kumalkhada are implementing climate smart agriculture and producing seasonal and off seasonal vegetable farming. SOSEC Nepal has been providing technical support and facilitation for implementing Climate Smart agriculture in the village with financial support from DCA Nepal and European Union. 48 Families are affiliated with 3 Agriculture Groups and do vegetable farming and each family on an average is earning 50,000 per year.

He has been doing vegetable farming in a plastic tunnel. He has used drip irrigation and plastic and vegetable mulching for vegetable farming. He has also prepared compost manure by using a compost pit. He has enhanced animal shed and has done farm yard manure management .He has collected catal urine and used it as fertilizer. Each family has created a water recharge pond of 2 meter length and 1.5 meter breadth.

For sanitation, space for the whole family's hand washing and dishwashing has been created. As per the expert this work will also be helpful for the reduction of climate change and help on building resilience.

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Biofertilizer (Jholmal)

Good Practices 9



Sangam Bista, SOSEC

Introduction

Jholmal is a kind of bio fertilizer which is prepared from locally available materials. This is prepared using cow dung, cow urine, locally available smelly, hot, bitter, sour kinds of plants (especially popular for their medicinal values) (leaves, roots, seeds and flowers) are used. All of the contents are mixed together and decayed to prepare this fertilizer. If this technology is used properly, farming can be done without chemical fertilizers and pesticides. The plants like Banmara, Justicia Adhatoda (asuro), Mugwort (titepati), bakaino, neem, garlic cloves, onions, Sichuan Pepper (Timmur), mint, Holy Basil, Nettle, Ketuki, Chilly, Khiro, Kanchopat, marigold are mixed together with cow dung and cow urine and stirred until a paste is formed for 15 days to one month or till they are not properly decayed. This mixture can be used in vegetables and fruits by mixing with water

in 1:4, 1:3 or 1:2 ratio. Biofertilizer (Jholmal) can be mixed together with cow urine and cow dung after decaying properly and can be used as both fertilizer or pesticide. This fertilizer is very effective for organic farming. Disease and pests are also major problems of farmers and this kind of bio fertilizer is quite useful as they can be used as an alternative against chemical fertilizer and pesticide. Bio fertilizer acts as a nutrition to the plants. Biofertilizers (Jholmal) are of three categories. Jholmal-1 is used for food nutrient management, Jholmal 2 is used for disease management and Jholmal -3 is used for pest management. This practice is useful for smallholder farmers who produce vegetables and fruits in home gardens. This technology also is helpful to produce healthy food and also contributes to the enhancement of ecological agriculture.

Benefits

The following are the benefits of biofertilizer.

- This contributes to the enhancement of soil quality and helps for the growth of plants.
- This practice is considered as climate smart technology.
- This practice helps to reduce disease and pests.
- This aids the growth of micro materials.
- This can be created by utilizing local resources and local plants.
- The application of Jeevamrut reduces the cost of pest and fertilizer.

Cost

This technology uses locally available plants, herbs and tools. Thus, this technology is not quite costly while it is prepared as per the table below. The cost will differentiate based on the availability of the resources at local level.

Implementation

For preparing Biofertilizer (Jholmal) -1

- The items required for the preparation are : 50 liter drum, 17 kg cow dung, 16 liter cow urine, 1 liter E.M liquid
- Make a one feed deep pit with 2 feet radius.
- Keep the drum in a pit in a way that one third of the drum's part is within the pit.
- Add 17 kg cow dung, 16 liter of cow urine and 16 liter water in the drum and mix it well. Now add one liter E.m and mix well.
- Seal the drum properly so that air cannot enter.
- Make sure to open the drum in a 3 days gap and stir using a stick. The Biofertilizer (Jholmal) will be ready in 15 days.
- For preparing Biofertilizer (Jholmal) -2
- The items required for the preparation are : 50 liter drum, 24.5 liter cow urine, 24.5 liter water and 1 liter E.M liquid
- Make a one feet deep pit with 2 feet radius.

Biofertilizer (Jholmal)-1					Biofertilizer (Jholmal)-2					Biofertilizer (Jholmal)-3				
Particulars	Unit	Amount	Rate	Total cost	Particulars	Unit	Amount	Rate	Total cost	Particulars	Unit	Amount	Rate	Total cost
Cow dung	Kg	17	5	85	Cow urine	liter	24.5	5	122.5	Cow dung	Kg	16	0	0
Cow urine	Liter	16	5	80	E.M.	Liter	1	140	140	Cow urine	Liter	16	5	80
E.M.	Liter	1	140	140	Drum (50 liter)	Liter	1	450	450	E.M.	Liter	1	140	140
Drum (50 Liter)	Liter	1	450	450	Water	Liter	24.5	0	0	Drum (50 liter)	Liter	1	450	450
Water	Liter	16	0	16						Water	Liter	24.5	0	0

- Keep the drum in a pit in a way that one third of the drum's part is within the pit.
- Add 24.5 liter of cow urine and 24.5 liter water in the drum and mix it well. Now add one liter E.m or Jibatu liquid and mix well.
- Seal the drum properly so that air cannot enter.
- Make sure to open the drum in a 3 days gap and stir using a stick. The Biofertilizer (Jholmal) will be ready in 15 days.

For preparing Biofertilizer (Jholmal) -3

- The items required for the preparation are : 50 liter drum, 16 liter cow urine, 16 liter water adn 1 liter E.M liquid and 16 kg weed leafs (bitter, soury, hot, stinging, itchy).
- Make a one feet deep pit with 2 feet radius.
- Keep the drum in a pit in a way that one third of the drum's part is within the pit.
- Add 16 liters of cow urine, 16 kg vegetable leafs and 16 liter water in the drum and prepare a paste by mixing it well. Now add one liter E.m or Jibatu liquid and mix well.
- Seal the drum properly so that air cannot enter.
- Make sure to open the drum in a 3 days gap and stir using a stick. The Biofertilizer (Jholmal) will be ready in 15 days.

Contribution and impact

This insecticide when used in time can manage diseases and pests resulting from climate change. This technology does not have a negative impact on the environment and human health. Local weeds can be managed with this technology. As there is no requirement to purchase chemical fertilizer and pesticides, this technology reduces the use of chemical fertilizers and pesticides and

also reduces green gas emissions as transportation is also not required for getting fertilizers.

Sustainability

This technology has been implemented with coordination support from the agriculture division of Dullu Municipality, Dailekh and material and technical support from SOSEC Dailekh. This technology is also used as part of the cleanliness campaign and awareness programmes. This practice is also implemented in Climate smart village prog. Farmers can receive sustainable benefits from this technology when this is used for the long run. The farmers currently practicing this technology share the learnings and sharings of this technology with the farmers of their community and inspire them to adapt this technology.

Contribution and impact

Chemical fertilizers and pesticides are used haphazardly in farming without proper knowledge which brings a negative impact on the environment and human health. This also results in the decline of social and economic capital. The residues of the chemical fertilizers stay in the environment for a long time. The residue fertilizers also do harm especially in the plants and animals which creates imbalance in the ecosystem and new problems are created. The application of Biofertilizer (Jholmal) s helps to reduce the above problems to some extent, thus, it is recommended.

Learnings, Challenges and Recommendations

This practice is not as easy as using chemical fertilizer for getting a positive impact as it requires lots of local resources. Farmers do not show keen

interest to adopt this technology, and they also lack the knowledge to prepare this kind of technology, farmers do not trust that biofertilizers actually work and other mechanisms like cooperative and other institutions have not lobbied much for the use of bio fertilizer and bio pesticide. Farmers need to be oriented on well managed organic farming and the positive impacts it brings to human health and environmental health and be inspired to adapt this practice. Additionally, farmers also need to be oriented on organic vegetable production and should be shared about the marketing scope of organic products and should be provided with assistance for the marketing.

Limitations

This technology is mainly targeted for marginalized communities. We can inspire agricultural groups, mother groups and youth groups to implement this technology. All families of rural villages can implement this Biofertilizer (Jholmal) technology. This technology is suitable in all agro ecological zones, for example Terai, Hill and mountains.

Success Story

Tej Bahadur Karki is a farmer from Dullu Rural Municipality Ward No. 9, Dailekh. He has been receiving support from SOSEC for almost 2 years and has received technical and material support from SOSEC for the preparation of Biofertilizer (Jholmal). He is utilizing his Biofertilizer (Jholmal) preparation skills so that he can use it effectively in vegetable farming. He is also encouraging his group members and communities to adapt this technology. The application of Biofertilizer (Jholmal) has helped him to produce fresh and organic vegetables which is also contributing to enhancing his family's nutrition.

SOSEC Nepal has been providing support to farmers like Tej Bahadur who are working in organic farming and marketing. From this project, 80 farmers including 30 members from Tej's group and 50 members from other community members have received training on the preparation of Biofertilizer (Jholmal). The application of Biofertilizer (Jholmal) has not only helped for the marketing of vegetables but it has also contributed to increase annual income of the farmers. Tej Bahadur is not only an example in his community but is also an inspiration in the cooperative and neighborhood communities as well.

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Water Recharge ponds for the revival of spring water (water sources) and the areas with less access to water

Good Practices 10



Arjun Shahi, SOSEC and Indeshowr Mandal, LI-BIRD

Introduction

Dailekh district is one of the least developed districts and is behind in terms of infrastructure. Aathbis rural municipality is back in terms of the agri enterprise development and also in the application of the tools and technologies. Because of poverty, unemployment and availability of food, the majority of households in this municipality travel to different cities of India for seasonal wage based works. Majority of farmers in this rural municipality do seasonal and off season vegetable farming. Farmers are not able to scale up in commercial farming so far because of the limited resources available.

SOSEC with technical and financial support of Danish Church Aid Nepal is working in the Aathbis Municipality and Panchdeval Binayak Municipality. SOSEC is leading social mobilization and managing resources. SOSEC has been coordinating well for the development of pocket areas and contributing for the conservation of water resources and creation

of water recharge ponds. The main objective of this technology is to ensure the water resources in the community by utilizing the available technology. When the water sources are drying, the water recharge is essential. This technology has helped to regenerate water from the springs which were almost not operational earlier.

This technology is very useful in the hilly areas where the water resources are scarce. The water recharge pond can be created by the community utilizing locally available resources, skills at low cost. The water recharge ponds are created in Aathbis Municipality Ward no. 7 Lamichhane tole, Ward no. 5 Kitu Tole, Ward no. 4 Selgaun.

Benefits

The following are the benefits of this practice.

- This technology can be done in low investment.
- This technology also helps with home garden

management and helps agriculture production.

- The waste water is properly collected and utilized.
- This technology aids the promotion of a green environment.
- The gray water is properly utilized in farms.
- Commercial fishing and farming is supported by this technology.
- This technology also helps soil erosion control.
- This maintains the moisture level of soil and recharges the water below ground.

Implementation

While preparing water recharge ponds, we need to consider the watershed. For implementing this technology, coordination needs to be done with the local government, micro watershed coordination committee, community forest user groups, mother groups, farmer groups and local stakeholders and community members. This practice needs to be implemented in close coordination and active participation of the parties mentioned above.

While making water recharge ponds in a low cost and cost effective way the size and design pattern remains the decisive factor. While making the recharge pond permanently, a permanent pond is prepared. The water recharge pond can be implemented in the following way.

- The pit needs to be dug as per the requirement. The water entrance and exit should be properly planned and prepared.
- While making a permanent pond, the floor, walls and ceilings need to be properly prepared and plastered. For the longevity of the pond, it needs to be repaired in a timely manner.
- This technology can be prepared using either private or public land.
- Public participation remains at the crux of this technology and needs to be ensured from preparation of plan, implementation, monitoring, evaluation and distribution of benefits. If the recharge pond is prepared on public land, the community's interest needs to be prioritized and if at private land, the farmer's interest needs to be prioritized.

Table 1: The activities in the package for the selection and implementation of water recharge ponds.

S. N.	Unit	Activity for implementation
1	Water recharge pond	Water recharge pond should have a circle of vegetation and there should be space to allow water flow.
2	Vegetable and fruits plantation	If there is broad space beside the recharge pond, that should be utilized for vegetable and fruits farming.
3	Fish farming, pig farming, and duck farming	If the water recharge pond has a bigger area of water, duck farming can be done.
4	Use of water for irrigation	If a water recharge pond has ample water, it can be used for vegetable farming.

Source: Field survey based on farmer experience in Dailekh, 2021.

Cost

The cost depends on the size of the pond and the resources to be used. Small recharge pond (2 meter length, 1 meter width and 1 meter depth) can be prepared in the investment of 5 to 7 thousand. When prepared using stone and mud, the cost is not much higher. The cost also depends on the size of the plastic when the plastic pond is prepared. If cement is used, the cost will be higher. While calculating water recharge ponds including human resource costs and transportation costs, it will cost upto Npr 70,000.

Contribution and impact

Water recharge pond is very useful for controlling soil erosion, recharging water below surface level, for the promotion of geenary, to retain moisture of soil and to manage water. The water in the pond is very effective for being used in agriculture, home usage, for feeding cattles.

Sustainability

As this approach requires participation of people, this approach can be sustainable. This approach has scope of being adapted by different Municipal governments and also by different institutions. For making this approach sustainable, this needs to be owned by the local government and local people.

Learnings, Challenges and Recommendations

It has been observed that a water recharge pond is effective for the hilly farmers who have faced difficulty in drinking water, managing water for livestock, and accessing water sources for irrigation. The water recharge pond helps to make the area moist, recharges the water sources and provides water sources in the dry zone. The problem of maintenance and timely repair has been reported as the major challenge. For proper management of a water recharge pond, the sedimentation of mud and sand brought off the water needs to be managed. The entrance and exit of the water canal needs to be properly cleaned and the pond's was and surface needs to be cleaned from time to time.

Limitations

Water recharge pond should not be made above the village and settlement area. Water recharge pond should not be made in sandy space and in an area with loam (domat) soil. Similarly, it also should not be made in a sloped area. If these aspects are not well taken care of, it can result in disaster. If the recharge pond is prepared by using cement, the pond won't recharge. If the pond is too deep, there are chances that children can get drawn accidentally. These kinds of ponds are also prone to mosquitoes and contribute to water pollution. If a recharge pond is made in a sloped area, the pond might get disrupted and lower belt settlement can be hampered.

Success story

In Aathbis municipality, infrastructure development activities, for example road construction using excavators, repair and maintenance of springs are done without studying the environmental impact assessments. The afforestation activities are not implemented effectively. The unmanaged deforestation is one of the major problems in the municipality.

In this context, Danish Church Aid is working in the ward 1, 2, 3, 4 of this municipality and has implemented different programmes related to agriculture, environment and implemented different technologies and practices. Social Service Center, SOSEC Dailekh is engaged in the mobilization and management works. The residents of ward no. 8 Lamichhane Tole and Ward no. 5 Kitu Tole, Ward No. 5 Sel village were facing the problem of drinking water. 30 Water

recharge ponds with one meter width, one meter height and one meter length are prepared in each ward, which means 90 ponds are prepared in total. These areas used to have ample water during summer but lacked water during winter. Farmers faced difficulty producing vegetables during the winter season, now they produce ample vegetables in their own home garden.

The water recharge ponds are prepared as per the concept in technical support and coordination of SOSEC with local people's participation. After the creation of water recharge ponds, more than 65 households have increased access to water resources and are happy. The local government authorities especially ward representatives and Municipal government authorities have expressed vote of thanks for SOSEC for ensuring water availability to local communities.

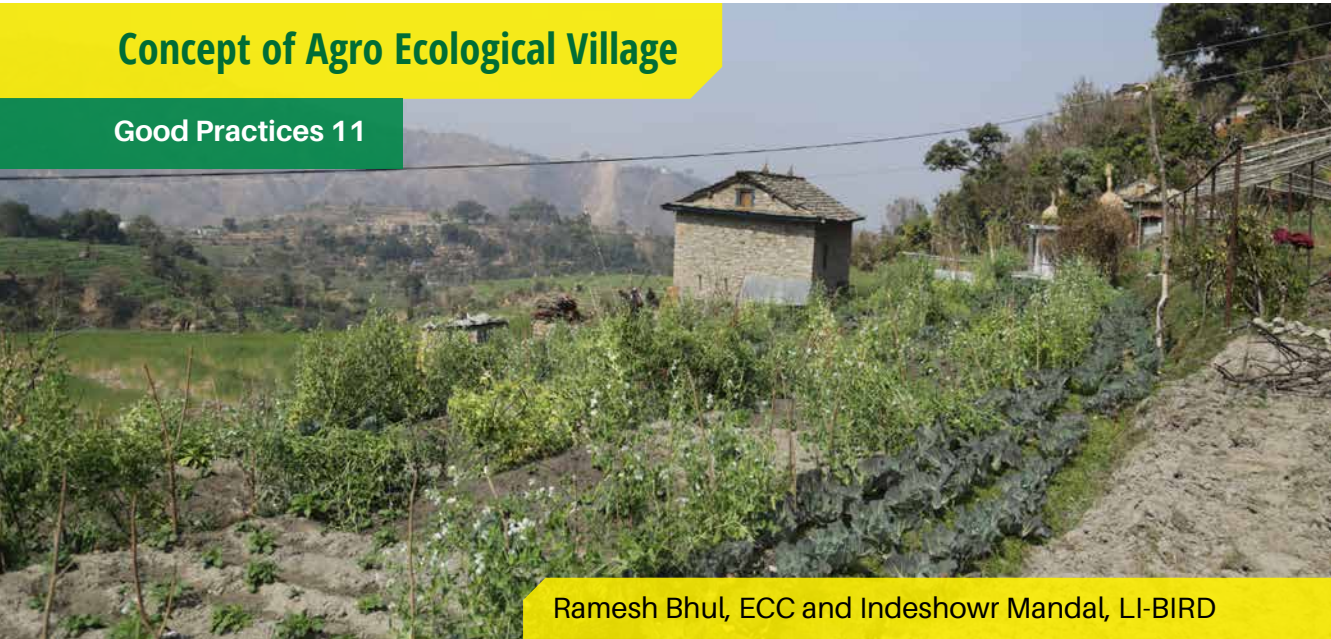
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Concept of Agro Ecological Village

Good Practices 11



Ramesh Bhul, ECC and Indeshowr Mandal, LI-BIRD

Introduction

Agro ecology is a system where soil, ecology and human health are seen together. The cycle is linked to agro biodiversity, ecological systems and systems based on local context. On ecological farming, organic practices are adopted where soil erosion is controlled, water storage is enhanced, greenhouse gas emission is controlled and attempts are made to improve ecological biodiversity so that ecosystem services are functional. Agro ecological farming promotes a sustainable food system and helps farmers to combat climate change, disease and pests. Soil, crops, animals, peest, micro organisms and humans are part of the ecosystem and knowing the interaction between them is key for maintaining a healthy ecosystem. To adopt this practice, farmers also need to know traditional knowledge, know the needs, understand the dimensions of rural social movements, farmer's rights, food sovereignty, food security and other legal and constitutional provisions. Agro ecological farming is the combination of science, sustainable system and social movement.

Agro ecological village concept has climate adaptation in rural context, disaster risk reduction, practices, tools and technologies for the sustainable farming system, extension and capacity building aspects. This concept seeks active participation from the community and stakeholder during the programme development and implementation so that the community are well aware of the climate resilient tools and technologies and adapt it by heart. Agro ecological village concept is eco friendly practice which promotes low carbon emission development in villages so that communities take development as an integrated system. Different climate adaptation technologies like organic farming, rainwater harvesting, conservation of spring waters (water sources), and animal shed improvement are implemented in this concept. The following are the advantages of implementing this system.

- Natural resources are sustainably managed.
- This helps to reduce the imbalance in the ecosystem and also contributes to reducing

Climate Resilient and Agroecological Farming Practices

Compendium of Good Practices

pollution generated by agriculture.

- The pressure on the environment and ecosystem is lessened and all creature's lives are protected.
- This decreases climate change and also reduces the green gas emission.
- This reduces the cost of chemical fertilizer purchase and also controls weed naturally.
- This promotes the use of local sources.
- Ecosystem productions get first priority in purchase and get a good price.
- This promotes agriculture production and helps in stable economic activities.
- This promotes the reduction of poverty.
- As this technology also enhances food security in terms of continuous availability and the amount of food consumed.
- Agri products are tasty and nutritious.
- The less use of chemical fertilizers contributes to enhancing the health of farmers and consumers.
- Fresh diverse and culturally suitable food and other products are available round the year which makes farmers less dependent and helps be self-sufficient.
- Local resources and skills are properly utilized.
- Seed, crops, biodiversity and natural resources are controlled by the community.

The following are the objectives set for the ecological organic village.

1. Make the agriculture sector productive and competitive by making it economically strong and promoting social justice and equity based sustainable eco agriculture practices.

2. Increased access and availability of healthy and nutritious agriculture produces free from chemical fertilizers, and other artificial chemicals.

3. Enhance institutional structures and networks, make amendments in policy provisions, invest in human resource developments and increase the access of agricultural products and expand the available services.

4. Prepare the norms for the sustainable use of agricultural lands and promote low cost technology focusing on reproduction so that local sources and needs are specialized and classify the agricultural land (zoning) for developing integrated farming systems.

5. Focus on the agriculture sector so that it acts best for the betterment of soil, ecosystem and human health.

6. Develop dedicated, aware and skilled human resources (farmers, agriculture technicians and active customers) for organic farming.

7. Extreme exploitation of natural resources has resulted in green gas emissions and has brought climate change and imbalance in nature so agro ecological farming should take actions to reduce the negative effect brought by agriculture and nature.

Implementation

For the implementation of an agri ecological village, having the coordination and partnership between the province government, local government, local communities and stakeholders and organizations working in the area is a must.

Selection of location and impact groups

For the establishment of an agro ecological village, site selection is done in coordination with the Agricultural Knowledge Center, Local government, local community and the concerned project. For this initiative, those local governments who are either promoting and supporting organic agriculture, are working to lessen chemical fertilizer or are planning to implement organic agriculture should be selected. Amongst the different villages which are being considered as an area for the selection of site, climate risk, the scope to represent agro ecological zone, the facility of road access, feasibility to promote either one agriculture product or livestock product, contribution in the biodiversity conservation, interest and concerns of local community, climate resilience capacity, appropriateness from technical perspective, the presence of marginalized community, interest from youths and womens, sensitive from vulnerability perspective and those communities who have not accessed such services before are some of the criterias for the site selection. The above criteria are considered important for the site selection.

Selection promotion and expansion of ecosystem friendly tools and technologies

For the establishment of ecological organic village, agriculture farmers group, community, cooperative, local government, project, agriculture division, livestock division, watershed management office and other organizations working in the same area including non governmental organizations and stakeholders need to discuss, interact and coordinate for the identification and selection of eco friendly tools and technologies to be promoted

in specific location. The eco-friendly tools and technologies are divided in five categories based on ecological and community's need base. 1) Water smart technologies, 2) Carbon smart/ Nutrient smart technologies, 3) Seed/Breed mar technologies and 4) Institutional/market smart technologies.

As the tools and technologies are selected as per the ecological zones and the needs of the communities, the tools and technologies will be different in various parts and the cost of the implementation will also be different. The promotion of agri ecological village implementation is quite costly and it needs ample resources. Thus, this programme needs financial support from local government, province government and agriculture knowledge center. The programme needs local people's participation and contribution of financial resources (If not human resource by engaging as labour). The tools and technologies/practices promoted in the agro ecological village needs to be recognized as a regular programme in the local government and provincial governments so that it can be expanded in other local governments as well.

Capacity Building

In order to implement agro ecological village successfully, the human resources under Province, district and local government authorities, agriculture and livestock technicians need to be provided capacity development training on the concept of agro ecological farming. Additionally, farmers implementing this concept also need to be oriented about this practice.

Excursion tour and visit

Excursion tours and visits are organized to provide direct field observation opportunities to farmers and stakeholders about the different agro ecological practices and technologies adopted in agro ecological villages so that stakeholders and officials can directly interact with the farmers implementing this practice. This kind of excursion is targeted to the organizations and stakeholders who are keen to implement this practice. Staff from agriculture knowledge center, livestock development directorate, forest division office, watershed management offices, forestry development directorates, agri enterprise and training center, various research stations within NARC and representatives from municipal governments, cooperatives are included in this kind of exposure visits.

Programme Monitoring and Evaluation

For the regular monitoring and successful implementation of this model Agriculture knowledge center, a monitoring committee comprising representatives from Forest office's subdivision, local government, project, and climate smart village needs to be formed. Though agriculture knowledge centers and local government representatives are included in the monitoring team, having regular coordination meetings in each trimester is essential so that the progress monitoring and review is done on a periodic basis. The monitoring and evaluation shall be carried out by the monitoring committee so that the local government and provincial government can replicate the best of the tools and technologies in other areas and include the programme in policy and programme of local government and provincial governments.

Norms for the selection of climate smart model village

For the establishment of agro ecological farming, villages need to be selected where at least 30-50 households are available. The following are the norms for the selection of an agro ecological farming village.

S.N.	Basis for Evaluation	Maximum
1.	Area with high climate risk and vulnerability (Drought, flood, landslide, disease and pest, hailstone, Extreme rain, blight, storm)	15
1.1	If it has 6 or more risks stated above	15
1.2	If it has 4 or 5 risk stated above	12
1.3	If it has less than 4 risk stated above	10
2	If majority of household have livelihood from agriculture and livestock	10

3	If there is scope of marketing at least one agriculture or livestock production from the village	5
4	If there is scope of agro biodiversity promotion, organic agriculture and agro tourism	5
5	If local government and community have commitment and concern in the area	5
6	If there is presence of marginalized community and youth and they are interested to be part of the programme	
7	Access to roads. Proposed eco agricultural village should have access to the road.	5
8	If the farmers and farmers group have not taken support in agriculture grants so far	
8.1	Not taken	5
8.2	Taken	0
	Total	60

Source: ली-बर्ड, वि.सं. २०७८, मुख्यमन्त्री एकीकृत कृषि तथा पशु विकास कार्यक्रमअन्तर्गत जलवायुमैत्री प्रविधि तथा अभ्यासहरू प्रवर्द्धनको कार्ययोजना

The following steps need to be followed for the selection of sites in the participation of stakeholders.

1. Form small famerholds groups and identify farmers

The farmers selected for the programme are the most important factors for the overall implementation of the agro ecological village. Thus the following aspects need to be taken care while selecting farmers.

- Farmers should be highly motivated.
- Farmers should have their own land or should have leased land.
- Farmers need to have support from family members. The role of women farmers needs to be well appreciated and acknowledged.

2. Orientation to the farmers groups

Selected farmers need to be well oriented about the sustainable agricultural practices from time to time. They should also receive on-farm practical coaching so that they can learn from the practical demonstration at the field.

3. Selection of crops and livestock

Farmers need to decide the crops they want to produce and also the livestock they want to raise. They need to select crops as per the crop calendar.

4. Major practices

The following are the major practices that farmers need to implement for the implementation of agro ecological village. They can do minor changes in their farms and fields for implementation of this concept as below:

- Farmers who are using less fertilizers or who are approaching towards implementation of organic agriculture
- Farms using biodiversity based bio fertilizer and bio pesticide so that nutrition of the plant is maintained while controlling disease and pests in organic matter.
- Farms promoting mixed farming system based on agriculture and livestock
- Farms practicing agroforestry practices
- Farms promoting Good Agricultural practices

Following methods can be used while practicing these technologies:

- Utilizing waste biodegradable products and enhancing the interaction with soil so that compost manure is well managed.

- Lessen the external and non renewable resources as input in the farm.
- Use local crops and breeds to enhance climate change adaptation.
- Protect soil's fertility by managing weeds without chemical application.
- Use chemical fertilizer as little as possible and protect the environment.
- Manager water resources properly and utilize enhanced farm yard manure properly.
- To manage disease and pest, implement appropriate technology and also practice the cover crop method.
- Practice mixed crop farming.
- Practice mulching technology
- Prepare vermicompost manure in own farm
- Implement terrace improvement
- Manage grazing land for animals
- Animal shed improvement and farm yard management
- Improve crop cycle
- Increase the use of leguminous crops

Cost

The cost of establishing an agro ecological village will depend on the region where it is being established and also vary based on the practices to be implemented. The estimated cost of the establishment of an agro ecological village is as below.

S. N.	Items/Technologies/Practices
1	Animal shed improvement and Farmyard manure Improvement
2	Compost Pit
3	Rack
4	Gloves
5	Fruit Picker
6	Corn sheller
7	Drum for bio fertilizer
8	Drip Irrigation
9	Plastic Pond
10	Multi purpose nursery establishment
11	Nursery tray
12	Fruit saplings
13	Seeds
14	Wages
15	Other costs
16	IPM Materials and other tools cost
17	Soil testing and agriculture Lime cost
18	Bee hives
19	Mixed farming
20	Mulching technology
21	Vermicompost

22	Terrace farming improvement
23	Managing grazing area
24	Managing proper cropping and technology enhancement in sloppy land
25	Plant cycle
26	Using of leguminous plants

Contribution and Impact

From the implementation of agro ecological village, the community and farmers are now well aware about ecological agriculture, its principles, its importance and various technologies about it. They are also aware about the importance of traditional knowledge. They have learnt the situation and contribution of women in agriculture. They are also able to analyze different strategies under different strategies of agro ecological farming. Farmers are also well aware about farmers rights, food security, food sovereignty and are aware of the provisions made in Nepal's constitution, policies and acts with regards to above. This has helped for the sustainable management of natural resources and helped to deduct agricultural pollution and soil erosion. It has also contributed to climate change adaptation and helped to reduce green gas emissions. The cost of farming has been reduced because of the less use of chemical fertilizers and maximum use of locally available resources which has increased food security and enhanced the livelihood in overall.]

Sustainability

The programme was run from the Sakar project with technical support from LI-BIRD Pokhara and implemented by Equity Development Centre Doti based on the working guidelines for the operation of this programme. Local governments are well

aware about this programme and convinced about its effectiveness and included it in their regular programmes and policies so that they can continue implementing this practice which will contribute to the sustainable results contributing to enhancing soil and human health. Thus, we can say that this technology is sustainable. Learnings, Challenges and Recommendations

People Social and economic changes like urbanization, changes in food habits, globalization and world trade, migration, green technologies, diversification, market's control on distribution system, quality and food standards, climate change, depletion of sources, fiscal discipline etc. are major challenges hindering agricultural transformation. More specifically, the inappropriate model of agricultural development and the rumors and misconception about organic farming are also major challenges.

Thus, it is essential to promote cooperative approach, community farming, seed and grain storage, processing, marketing and distribution in the local market and promotion of local farming. For the promotion of organic farming and food security, chemical fertilizer and imported agricultural products should be demotivated. Keeping the productive land fallow should be demotivated by policy approach. Farmers should be the owner and decision maker of farm land and land use policy should be prepared and

implemented. To address risks and uncertainties brought by climate change, a sustainable farming system should be promoted, all political parties and civil society organizations should promote local communities to actively engage in production oriented works and contribute for the enhancement of food security via agriculture. The lack of awareness in common people about climate change also remains as a challenge. As the climate smart village is a new concept, there is a lack of human resources (technical experts) to work in rural communities. Local governments also have not been able to provide resources for the capacity building of available technical staff and human resources on these aspects. A few years ago the concept of ecological farming was seldom heard. Thus, farmers were not interested in it. Communities also were unaware of organic farming thus farmers hesitated to adapt this technology which had added challenges. Thus, attempts should be made to develop basic understanding amongst farmers on climate change, organic farming and importance of farmer's role for sustainable ecological agriculture.

Limitation

The activities implemented in climate smart villages are purely based on organic agricultural farming. There is no doubt that it helps to develop sustainably thereby contributing to enhancing soil and human health. However, the community needs to know about its importance and should be well aware about it. This practice has not been able to expand as expected because of the lack of authority to certify the products and provide awareness about its importance. This technology is not being able to expand much as the community lacks minimum natural resources and environment to promote it. This technology can be implemented successfully in all ecological zones, mountains, hills and Terai.

Success Story

Kamala Joshi resides at Doti district Purbichauki Rural Municipality Ward No. 4 Sanagan Dhaulabasti with 11 member family where there are 3 men and 8 women. Before the implementation of the project, she used to do seasonal vegetable farming which was conventional and unmanaged.

Kamala has now improved from her traditional farming and implemented the organic farming approach in her farm. She has adapted pure biological agri farming technology and is making a livelihood from green enterprises. Kamala was engaged in the project implemented by LI-BIRD and has started doing vegetable farming by improving on traditional farming approach and introducing organic farming in a managed way. She has received support from project on local resources and producing seasonal and off seasonal vegetables, has managed local crops in her nursery, has used bio fertilized and also introduced BIOCHAAR technology, vermicompost manure, enhanced farmyard manure management, rotatory management for control of disease and pests and has known about value



chain approaches for effective production and marketing. Since Kamala has implemented sustainable farming approaches her livelihood has been enhanced and she has been able to introduce eco friendly sustainable, women friendly, livelihood upliftment oriented farming practices which is different in its own and which is seen as an inspiration in the community and neighborhood.

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Cooperative partnership programme for increasing community's access on resources, marketing and self employment

Good Practices 12

Ramesh Bhul, ECC

Introduction

Nepal Government is also utilizing cooperative partnership programmes for ensuring community's access to resources and to increase self employment opportunities. This programme also helps to the modernization, commercialization and diversification in agriculture. Cooperatives are a good medium to enhance leadership, develop skills and raise awareness and provide voices to the marginalized and also retain the vanishment of human resources so that community development is achieved via cooperative. Cooperatives also promote co-existence and provide services.

In order to reduce the trade loss, connecting cooperatives with the production directly could be a major breakthrough. This kind of practice also helps the cooperatives in rural settings which are struggling for growth. This concept also helps to consolidate the small capitals from farmers in an institutional setup so that it can be easily accessed as a loan for the needy farmers. Cooperatives are good means to provide essential financial and technical resources to the farmers, for increasing the skills and capacity of the cooperative members, provide assistance for the production, processing, grading, labeling, packaging, branding and marketing so that the productions are easily distributed in the market via cooperative. This process also helps in enhancing the livelihoods of the cooperative members. Cooperative can provide quality seed and fertilizes to the farmers associated with them and help them to better

access and control the resources. Amongst the different cooperatives acting as service providers in district, Khaptad Women Multipurpose Cooperative organization located in Purbichauki Rural Municipality Ward No. 3 and Janapriya Agriculture Cooperative located in Ward No. 4 and Dugadevi Women Multipurpose Cooperative and Sitaram Agri Cooperative located in K I Singh Rural Municipality Ward no. 4 and 6 respectively are implementing work as per this model.

Through the project tri- artiate agreement model has been prepared between Danish Church Aid, Equity Development Center and respective Cooperative Organization where seed money of 5 lakh 12 thousand has been kept. This fund is created on a resource leveraging approach. Amongst these funds, 75 percent is utilized on cooperative market promotion and mobilization, 25 percent is used in providing support via cooperative and also for office management of cooperative.

Benefit

- The resource poor and marginalized farmers residing in rural area can get affiliated with cooperatives and get various services and benefits provided from cooperative eg. Accessing loans at subsidized rates, getting seed, tools as grants and participating in different capacity building initiatives conducted by local governments and donor agencies.
- Resource poor and marginalized farmers can get the benefit by utilizing the services and facilities as

mentioned above and significantly enhance their livelihood.

- Cooperative members Farmers can also generate income by selling the products in nearby local markets.
- Cooperative members can invest the income received in their children’s education, health and nutrition which ultimately enhances overall quality of life.
- Cooperatives also create employment opportunities and reduce the vanishing of human resources.

Implementation

Each cooperative has a Board of Directors for the cooperative’s management, proper operation, supervision, proper coordination, partnership and networking. Board of directors continuously works in close coordination and partnership with donor agencies, local governments and representatives of stakeholders for the best interest of cooperative and cooperative members. The Board of directors

have been able to leverage resources for the capacity building of cooperative members from local governments and donor agencies. The position of Market Promoter has been arranged in the cooperative from 25 percent contribution from cooperative and 75 percent contribution from Danish Church Aid funded Sakar Programme implemented by Danish Church Aid and Equity Development Center. Similarly, grant support has been provided for the cooperative’s business promotion and relevant software support has also been provided. The cooperative has also received support on the reviewing and updating of essential policies, guidelines and also for effectively managing daily operations. The Board of Directors has taken initiatives to leverage technical and financial resources for the capacity development of the board of directors as well. In overall, the cooperative members have been able to enhance their capacity and have been able to improve their quality of life.

Cost

S. N.	Particulars	Unit	Amount	Budget		Projects Contribution (NPR)	Cooperative’s Contribution (NPR)
				Project (NPR)	Cooperative (NPR)		
1	Market Promotion (Management)	Month	13	18,750	3,750	2,43,750	48,750
2	Reviewing policy and guidelines	Number	1	12,000	3,000	12,000	3,000
3	Software for Cooperative	Number	1	25,000	0	25,000	0
4	Office Management	Frequency	1	50,000	12,500	50,000	12,500
Total						3,30,750	64,250

Contribution and Impact

The tripartite partnership arrangement has helped cooperatives to receive financial, technical, administrative and capacity development aspects. The staff recruited in cooperative have been well oriented which has helped to better record the transactions and maintain the accounts of cooperative as per the double accounting standards. This has also helped to maintain consistency, transparency and bring clarity in the overall financial transactions of the cooperative. This has helped cooperative members to develop a positive attitude towards the cooperative. The number of regular contributors for saving has significantly increased in the cooperative which has resulted in the rise of overall capital increment of the cooperative. This has also increased the capacity of the cooperative to provide access to loans to its members. The cooperative members are able to invest the loan they received from the cooperative in different enterprises and generate income successfully. This has helped to increase their social and economical status. As the cooperative provides employment opportunities as well, the staff who receive employment are able to enhance their livelihood and bring positive results in their lifestyle.

Sustainability

For the sustainability of this practice, Cooperative has been functioning in the community as per the policy provisions of the concerned local government's cooperative section's guidance.

This programme is initiated in its own capacity and cooperative members are getting continuous facility and services from the cooperative. As a cooperative organization is autonomous on its own they can continue to operate in future. As local governments and other organizations have also shown keen interest in this programme, this programme can be continued in the long run by generating support from them.

Learnings, Challenges and Recommendations

While working in partnership modality, there are several advantages. However, there are also some challenges and limitations in this modality eg. To work on this modality, the majority of the members should have a good literacy rate but the cooperative where we work has a very low literacy rate which has been a major hindrance in the implementation of this programme. The board of directors also have not been fully accountable which is also creating problems. The cost of transportation while taking the agri products from rural villages to the market is also quite high. The loan mobilized as loan to the committee members is not repaid timely which creates problems in overall loan recovery and remobilization.

Limitation

This practice is effective for all ecological areas of Nepal including mountains, hills and Terai where marginalized communities and poor are engaged in the establishment of cooperatives.

Success Story

Khaptad Women Multipurpose Cooperative was established in 2059 B.S in Purbichauki Rural Municipality Ward No. 3, Gairagaun. The cooperative was established by 25 women who were treated as second class citizens in household and family. They established the cooperation with the awareness to uplift their financial aspect based on their own capacity. More than 20 years ago, they started cooperative with strong realization 'until and unless women's economic status is not uplifted, women will continue to be denied their basic rights. This realization helped them to get organized for a cause and move ahead. This initiative contributed to increasing the 'saving' concept in the farmer members gradually. After a while, there was a project from Good Neighbour in the same community. That project provided 22 lakh rupees as a grant to the cooperative trusting the cooperative. This support was very helpful for developing the cooperative's infrastructure. From its establishment to so far, the cooperative is able to collect savings from members on a continuous basis. The collected amount is then invested as loan in agriculture, livestock, enterprise and processing industries. The cooperative defines the criteria for loan investment and also provides loans on subsidized rates in defined areas.

From the financial support of DCA Nepal, technical support of LI-BIRD and partnership with Equality Development Center, Doti, Sakar project is being implemented by this area from 2017 to till date. This work is implemented in tripartite partnership (DCA, EDC and Cooperative). The project has provided 5 lakh 12 thousand as revolving fund to the cooperative. Additionally, the project has also

provided contribution for the logistic support for office management and installation of software. The project has provided different training and orientations to the Board of Directors and cooperative members. The cooperative did not have the policies and guidelines as provisioned by Cooperatives Act 2074, the project also provided necessary support for developing policy as per Act's provision. The draft of the policy was discussed line by line in the board of director's meeting and the feedback received during discussion were incorporated and policies were finalized after that and handed over to the cooperative for the implementation.

The project has also prepared guidelines for the operationalization of the collection center which works to collect and market the agricultural products produced by the farmers. The guideline has also provisioned the formation of different committees for the functioning of the collection center, based on which committees are already functional. The members affiliated to the cooperatives have been able to access loans at subsidized rates without collateral. The 70% of the loan they receive is invested in the productive sector whereas 30% is invested in small enterprises. As a result, cooperative members are able to increase their income and positive impact is seen in cooperative member's lives.

In future, the cooperative is planning to operate an IME center so that better banking facilities and services are provided to the community members who so far are restrained from such services. The cooperative's business plan also includes establishing a small spice processing industry.

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Collective farming on barren land by young people returning from foreign employment due to COVID-19

Good Practices 13



Laxmi Bahadur Joshi and Yogendra Bahadur Oli, MCO

Introduction

Most parts of the Achham district lack irrigation facilities. Farmers here are forced to depend on rainwater for farming. As a result, there is a shortage of food and people are forced to live on food shortages. Therefore, the locals have been migrating to the nearby Terai districts. Some local youths have started cultivating soybeans on the land of Chaurpati village in Achham district which has been barren for the past 30 years. It started with the facilitation of the SAKAR project run in partnership with Malika Bikash Sangh- Nepal. The organization, in collaboration with the Chaurpati Rural Municipality, encouraged the people returning from India to cultivate vegetables in the dry and barren lands of Chaurpati by providing the necessary seeds and technical assistance. The municipality has also set up temporary collection centers in villages and sales stalls in Dhangadhi to market the millet produced here. This campaign has played a crucial role in facilitating the food

availability of families by involving people in farming in the community who have returned from foreign countries. The project has been successful in attracting people from various countries who have lost their jobs due to the Coronavirus epidemic, even if only partially, to engage in income-generating activities. Benefits

The aim of this initiative is to help migrant workers who have lost their jobs while working in India to improve their livelihoods. In addition, it helps them gain access to food, support family income and nutrition, and conserve biodiversity. The collective farming program on barren land has become even more effective with the initiative taken by the Chaurpati Rural Municipality. As a result, they have adopted a program that exchanges rice for finger millet. Finger millet produced in the village is also available for consumption by the people of the town. Barren and degraded land has become cultivable again. Landless and poor farmers have been able to get the right price for millet. This is a unique example of collective farming. This

has developed a spirit of mutual support in the community. It has also become a learning platform for farmers and cooperatives from other districts. The number of people moving to India for work all year round is reduced and people are starting to become self-employed in the villages.

Implementation

Collective farming on barren land has been implemented after a thorough discussion between Chaurpati Village Municipality and MDO Nepal. This work has been managed, supervised and inspected collectively by the farmers. Collective farming is based on the understanding that everyone will work equally and everyone will share the profit and loss equally. The Saakar project run by MDO provided seeds and technical assistance to the farmers. In addition, the ward office and the municipality had mobilized agricultural technicians for technical assistance.

Cost

The annual cost of cultivating one ropani of land is as follows. The cost of operating this practice is as follows but it may vary depending on the location and market price.

S. N.	Description	Unit	Quantity	Rate	Total
1.	Cost of leasing land	Month	12	500	6,000
2.	Labor cost (Land preparation, tilling, care etc.)	Person	12	500	6,000
3.	Seeds cost	Lump Sum	1	2,000	2,000
4.	Irrigation			0	0
				Total cost	14,000

Contribution and Impact

Finger millet is a traditional and indigenous crop. Cultivating it is not as difficult as cultivating other crops. Its seeds are readily available locally, making cultivation easy for farmers. Through its cultivation, barren land has been effectively utilized, as well as helping to protect the environment. It has also contributed to food security and nutrition. In order to continue this initiative, Chaurpati Municipality provides additional efforts and support.

Sustainability

Farmers have been continuing to carry out this work year after year. The municipality's agriculture and livestock policy also emphasize promoting such activities. Farmers and youth have directly benefited from this program, so it is continuously being improved and extended. Due to the local government and other organizations' interest in this initiative, there are many opportunities to gain support in the future. Millet and pulses produced in the village have a large scope in the local market as well as in the city. Additionally, the sustainability of this practice is guaranteed by the cooperatives and agricultural groups that plan

to build agricultural produce collection centers and packing houses in the region to market local produce to distant markets.

Learnings, Challenges and Feedbacks

Collective farming on barren land has created short-term employment as well as has helped to increase the availability of food for the family of the poor, women and young migrant workers. There is also the availability of nutritious food in the family. The campaign has been successful in increasing the participation of vulnerable groups of the community such as the poor, women and young people returning from India from work. This has assisted in their economic advancement. Farmers engaged in collective farming have been able to produce millet and pulses for an average of three more months for their families. In order to continue this work in the future and to implement it more effectively, it is necessary to provide technical assistance from the municipality. These assistants include subsidy programs for farmers, marketing, crop insurance and incentive programs for farmers. Marketing agricultural

products produced by farmers on the regional market requires a linkage between the upcoming programs of the municipality and cooperatives. In addition, the role of local bodies and the interest and concern of future governmental and non-governmental organizations as well as local target groups can be taken as important challenges to continue this work.

Limitation

Collective farming has been successfully implemented by the SAKAR project. Collective farming on barren land is a good practice in the age of self-centered people. This work involves the participation of poor and marginalized people especially women and vulnerable groups of the community. Right now, the use and practice of this work are limited to a single village and municipality. Therefore, this practice needs to be promoted by cooperatives and local governments in other communities and areas through the use of additional resources, knowledge, skills and technology.

Success Story

Finger millet and pulses produced by farmers of all seven wards of Charupati Rural Municipality have reached Dhangadhi, a major city in the far-western region. In 2020, with financial support from DCA Nepal, Malika Development Organization (MDO) in association with Chaurpati Rural Municipality through its SAKAR project implemented an initiative to cultivate millet and pulses on barren lands in the village individually and collectively. The returnee migrants who lost their jobs due to COVID 19 were the target beneficiaries of this initiative. 220 immigrant families from all seven wards of Chaurpati Rural Municipality have been cultivating millet and pulses. The MDO had provided support and technical assistance for the preparation of seeds and land on a small scale. The production of millet and pulses has been good despite the unfavorable conditions of rain and weather last year.

The Chaurpati Rural Municipality had initially committed to ensuring a market for the millets and pulses produced by the farmers. For this, the municipality had set up temporary collection depots at three places by mobilizing the staff of the municipality. As a result, the municipality has managed to collect more than 200 quintals of millet and pulses, which were delivered to Dhangadhi. Apart from the immigrant families, the municipality has a plan to collect additional agricultural products produced by other families and send them to the local and foreign markets. Other stakeholders, including the municipality, are showing interest in using locally available millet and soybeans to feed school children as their midday meal, instead of junk foods. In the past, soybeans produced in the village were bartered with salt. Farmers in the area are happy to be able to sell soybeans at Rs 50 per kg or exchange one kg of rice locally. The participating farmers have expressed happiness that MDO and municipality have made good use of their time to help their families in promoting food security when they returned home unemployed due to COVID 19. They have expressed the commitment of other members of their family to continue this work even if they have to go abroad for work again. Chaurpati Rural Municipality and MDO still hope to run more such programs. In its program of 2021, MDO has put forward the concept of developing these temporary collection depots as permanent agricultural produce collection centers and the municipality has also expressed its willingness to further support this initiative. If the local bodies of the Government could adopt such a model to collectively engage the unemployed youth across the country in this type of agricultural work, there is no doubt that the youth will be self-employed to some extent. Currently, the Chaurpati Rural Municipality is also celebrating the 16th of Asar as Finger Millet Day.

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Riverbed (Bagar) farming: Self-reliant farming by low-income communities on wasteland along river banks in the Terai

Good Practices 14



Dharma Singh Rana, NNSWA

Introduction

There are many small and big rivers in Nepal. These rivers flow from the high hills to the lower hills, gorges and valleys and reach the Terai region of Nepal. During the rainy season, floods occur and rivers and streams cut off the land and turn it into bogs, sometimes with sand, soil and stones. Due to deforestation, the capacity to retain rainwater in the soil is decreasing and the incidence of floods is increasing every year. After the end of the rainy season of one year, the bogs around the rivers and streams remain empty until the rains of the next year begin. Riverbed farming is the cultivation of suitable vegetables on the deserted riverbed after the rainy season. Considered a novel technology for conventional farmers, riverbed farming has helped to meet the demand for fresh vegetables in the market.

Additionally, it has helped farmers earn income. In addition, the wasteland on the riverbeds of

the Terai has also been put to exemplary use. By reaching out to freed Kamaiyas, low-income and landless people, riverbed farming will help solve the country's existing unemployment problem by increasing their income through vegetable farming. Introducing this technology every year has the potential to create human resources for vegetable cultivation and to make people self-reliant, which lessens the need to migrate abroad in search of employment.

Benefits

The benefits of riverbed farming are listed below:

- The production and productivity of vegetables are increasing by cultivating vegetables on the river bank.
- Additionally, it creates employment opportunities for poor and vulnerable youth, educated unemployed and landless farmers as well as increasing income levels.

Implementation

There are many ways to farm on riverbeds. Farming methods vary depending on the availability of moisture. If there is enough moisture on the surface of a bank, it uses a different method. A different cultivation technique is used if the moisture level is below 50 cm or 150 cm. The methods of cultivation on the basis of moisture are described as follows:

Preparing narrow and shallow holes:

A ditch of 10 cm diameter and 30-40 cm depth is dug with the help of an iron tool. 5-10 grams of Diammonium Phosphate (DAP) is mixed into one kilogram of dung manure. The ditch has to be moist at a sufficient depth.

Preparing a shallow hole:

In this method, a ditch of 60 cm length, 60 cm width, and 45 cm depth is dug. 15-40 grams of DAP and 10 grams of Murate of Potash are mixed in five kilograms of dung manure and fill the ditch. After that, plant three to four bean seeds in the hole. Make sure the ditch is moist at a depth of 30-40 cm.

Preparing a deep ditch:

Depending on the moisture availability, a ditch of 60-65 cm wide and 100-150 cm deep is dug. Fill the half ditch with a mixture of 10-15 kilograms of dung manure, 15-40 grams of Urea, 25-40 grams of DAP, and 10-25 grams of Potash and soil. Sow 3-4 beans in 2-3 cm of soil depth. A deeper ditch is hard to dig, which is why it is common to dig canals instead.

Single Row Canal:

60-100 cm wide and 100-150 cm deep canals with a difference of 3-5 cm are dug in this method. Dig until enough moisture is found. Half the canal is filled with dung manure, chemical fertilizer, and sand mixture. In the other half, seeds must be sown. Once the seedling has four to six leaves, you can apply the remaining mixture of dung manure, chemical fertilizer, and sand. It is found to be more efficient and productive to farm on a canal than in a ditch.

Double Rows Canal:

A 100 cm wide canal with a difference of 3-5 cm is dug in this method. Approximately one meter wide canal is filled with dung manure, chemical fertilizer, and sand. Leave 25-25 cm space on both sides and sow seeds in both rows of 100 cm. When the seedling has four to six leaves, apply the remaining mixture of dung manure, chemical fertilizer, and sand. It is more effective and productive than other methods if it is cared for properly and irrigated.

Things to consider when doing riverbed farming

The main things to consider when doing riverbed farming are:

Moisture Availability (Height of riverbed)

Riverbeds should be 50-100 cm above water level and well moistened. 30-50 cm deep moistened riverbeds are considered suitable for cultivation. When moisture is found in the depth of 30-50 cm even in November to April, it is considered good.

Fine Sandy Soil

For riverbed farming, suitable soil is essential. The cultivation of vegetables is very suitable for river sand mixed with sandy, loamy, and fertile soil. It is very difficult for plants to grow in rough sand and soil.

Area of Riverbed

In order to involve the community in riverbed farming, the area of the riverbed should be at least more than 30 Kathas.

Proximity to Riverbed

A maximum of two kilometers is a good distance between a farming area and the settlement of the farming group. An area that is close to a riverbed is easy to cultivate and maintain. The closer the distance from the road to the riverbed, the better for marketing.

Transportation Facilities

If the road is nearby or there is a road facility, it is essential to have transport facilities to deliver vegetables to the market. If the farmers themselves or the local level authorities can arrange transportation facilities, the fresh vegetables will reach the market on time. In addition, the farmers will make a higher economic profit.

Ownership

It is important for farmers to take ownership of riverbed farming as they work day and night and also earn profit. No matter what kind of seed or technical assistance is received from any supporting entities, it seems to be possible to achieve the desired result only if it is owned responsibly.

Availability of Production Materials

If the required seeds and agricultural inputs can be properly arranged in time, the production can be taken in the targeted time.

Irrigation System

To maintain the moisture content in the riverbed, an appropriate irrigation system should be arranged as per the need.

Consumer-oriented Products

Doing farming using harmful chemicals and pesticides to make a profit has adverse effects on a consumer's health which also creates a legal and social problem. Organic farming should be adopted keeping the interests of consumers in mind.

Market System

Once the product is produced, the market can be set up right away to get a good price for the product. Consumers will also be able to enjoy fresh vegetables right away. Good market management is essential.

Damage Prevention

Even if riverbed farming is done considering the risk of flooding, sometimes unpredicted disasters can occur. In such a situation, taking into account the risks involved, measures should be taken in advance to reduce the risk by releasing marketable products and some relief can be obtained by insuring the crop in coordination with the local governing bodies.

Growing a wide variety of vegetables and fruits in the riverbed has been proven to be possible from winter to summer. The productivity of agricultural products is also dependent on the type of riverbed. There are two broad categories of riverbeds. In order to maximize farming, farmers should give preference to class A riverbeds as much as possible. Farming can also be done in the class B riverbed by artificially improving the riverbed.

Type Class A	Type Class B
1) Height of riverbed: 0.5 to 1.0 m above water level with moisture	1) Less than 0.5 m or more than 1 m
2) Soil composition: Fine sand, loamy and fertile soil (sand, silt clay to be determined after sample testing)	2) Soil, sand, soil mixed to a lesser extent (after sample testing)
3) Depth of moisture: Digging the riverbed to 30 to 50 cm till the month of November to March.	3) Moisture found at the depths of 50 cm
4) Area of riverbed: 1 hectare (30 Kathas)	4) Limited area of the riverbed at least 10 Kathas
5) Probability of flooding: The probability of flooding during riverbed farming is low	5) Possibility of flooding during farming
6) Distance: 6.1 Settlement from riverbed to settlement: The riverbed should be nearby the community or settlement, up to 2 kilometres or 30 minutes of walking distance 6.2 Riverbed distance by road: Close to the road or access to the transportation. 6.3 Market area or close to the local market (Haat bazaar)	6) Far from the settlement, access to transportation, far from the local markets
7) Ownership for the riverbed: Owned by local government, municipalities, and government entities	7) Owned by a community forestry group, person, club or a school

Riverbed crop calendar: cucumber, squash, watermelon, pumpkin and bitter gourd

S. N.	Place	First Crop	Second Crop	Third Crop
1	Eastern Nepal and Central Nepal	Sowing time: September/October	Sowing time: October/ November	Sowing time: December/January
2		Picking time: December/April	Picking time: January/ April	Picking time: March/ May
3	Western Nepal and Far Western Nepal	Sowing time: November	Sowing time: December	Sowing time: January
4		Picking time: February/May	Picking time: March/ May	Picking time: April/May

Note: After the risk of flooding is over, riverbed farming is started and the produce has to be taken before the rains.

Cost

The estimated costs for cultivation of cucumber, watermelon, squash and persimmon are presented below

Crop	Seed Rate	Fertilizer	Productivity	Production Cost (NPR)	Income
Cucumber	25 to 50 gram	Base fertilizer (300 kg cow dung manure, 0.5 kg urea, 0.5 kg DAP, 0.5 kg potash; Additional fertilizer (300 kg dung manure. 2.5 kg urea, 1.5 kg DAP, 0.5 kg potash)	400 kg	1375	8800
Watermelon	50 to 100 gram	Base manure (300 kg cow dung manure, 0.5 kg urea, 0.5 kg DAP, 0.5 kg potash additional manure (300 kg cow dung manure, 2.5 kg urea, 1.5 kg DAP) , 0.5 kg potash)	600 kg	1692	11400

Squash	50 to 100 gram	Base fertilizer (300 kg cow dung manure, 0.5 kg urea, 0.5 kg DAP, 0.5 kg potash); additional fertilizer (300 kg cow dung manure, 2.5 kg urea, 1.5 kg DAP, 0.5 kg potash)	500 kg	1295	9000
Pumpkin	50 grams	Base fertilizer (300 kg cow dung manure, 0.5 kg urea, 0.5 kg DAP, 0.5 kg potash), additional fertilizer (300 kg cow dung manure, 2.5 kg urea, 1.5 kg DAP, 0.5 kg potash)	400 Kg	1304	6400
Bitter gourd	50 to 100 gram	Base fertilizer (300 kg cow dung manure, 0.5 kg urea, 0.5 kg DAP, 0.5 kg potash); extra manure (300 kg cow dung manure, 2.5 kg urea, 1.5 kg DAP, 0.5 kg potash)	350 kg	1330	14000

Contributions and Impact

In the context of the changing climate in the world, it has also affected Nepal. The riverbed area on the river bank is also increasing day by day. It is likely that the country can benefit from its proper use. It has been more than five years since the beginning of the promotion and expansion of the scientific cultivation of vegetable crops in Nepal. The cultivation techniques of vegetable crops are also different. Depending on the season, commercial cultivation of vegetables is done using seasonal and non-seasonal techniques. Vegetable farming in riverbeds is a non-seasonal vegetable farming technique. Although riverbed farming is already being done in Nepal, it has proved to be a breakthrough technology in Laljhadi Rural Municipality and Belauri Municipality, both commercially and technically. In the past, some

Indians used to come and cultivate in this area. In 2006, the Ilam Plus project implemented by Helvetas in the far west of Nepal successfully tested vegetable farming in riverbeds. After this, this technology was commercialized in Nepal. The flood of the Doda River in Belauri Municipality and Laljhadi Rural Municipality of Kanchanpur District has cut down the land around the river and increased the area of the riverbed. On the one hand, there will be an increase in the source of income from riverbed farming. In addition, there will be protection and growth of the plants brought from the river. In addition, river cutting is also reduced.

Sustainability

In the rainy season, the river is mostly covered with water and in winter, the river gets narrower.

Riverbed made from a mixture of loamy, fertile soil and sand brought by the river is considered suitable for agriculture. There are many rivers flowing through the hilly areas in the Terai districts and thousands of hectares of land are being turned into bogs every year. By involving flood-prone, poor and landless Dalits, Janajatis and women in riverbeds, their income can be increased. At the same time, it contributes greatly to the food security of the area. As a result, the farmers who cultivate riverbeds can save the investment for next year by depositing the required amount into the production fund every year to ensure continuity in the future and to arrange for contingency compensation.

Learnings, Challenges and Feedbacks

This technology has been considered important as it is possible to earn income from the land that has been turned into bogs due to the large and medium rivers of the Terai. Due to the recent climate change, even in the month of March-April,

floods have been causing damage to the riverbed area every year. Crop insurance seems to be the solution and an alternative measure. But due to the lack of proper policies of insurance companies to ensure the crops produced in the riverbank area or in the riverbed, farmers are affected every year. That is why the state should concretely implement programs like crop insurance for the promotion and sustainability of riverbed farming.

Limitation

At present, the supply of vegetables and fruits for Nepal is found to be satisfactory, even if only from riverbed farming. For this, there is a situation where the farmers are using traditional methods to till or dig the farmland without using any other mechanical means. It can be more effective if it is arranged to prepare the soil by any mechanical method. Similarly, in vegetables, the main vegetable crops are cucumber, bitter gourd, watermelon, squash and pumpkin, but in the short term, there is a lot of potentials to produce chilli, tomato and onion.

Success Story

The Hariyali Bagar (Riverbed) Vegetable Farmers' Group has been formed to strengthen the economic condition of the landless, poor, disadvantaged and marginalized people of Belauri Municipality and Bhakunda under the 'Saphal' project run with the financial support of DCA Nepal and initiated by NNSWA, Kanchanpur. All 31 members are from the indigenous community. "Most of the places here have turned into bogs as the floods in the Doda River during the rainy season will erode the land around this place," Mr Ganga Ram Rana, the chairperson of the group said. Therefore, most of the people do riverbed farming by making effective use of the vacant space here. This is because other crops do not flourish in the bog.

In riverbed farming, one person cultivates vegetables in at least five Katha to 1 Bigha area. With the help of the organization, they got training and technical skills related to riverbed farming. They also got seed support for farming. Because of this, they have managed to earn Rs. 30,000 to Rs. 200,000. The group members are very

happy about this. "The income has made it much easier to manage household expenses and send children to school," the chairperson further added.

At present, the group is registered with the District Agriculture Branch Office, Belauri and has been receiving seeds with a 50% subsidy. In the past, they used to do subsistence farming instead of commercial farming. Also, they did not have technical knowledge of riverbed farming. Riverbed farming has its own challenges. As farming is done along the river, there is a possibility of flood damage to the farmland. Therefore, in order to reduce the loss, the organization should run a crop protection insurance campaign in Bagarkheti, said Rana.



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