Banana plantation in the rehabilitated area (Kuenzang Nima)

Rehabilitation of Fallow Land Through Agroforestry ( )

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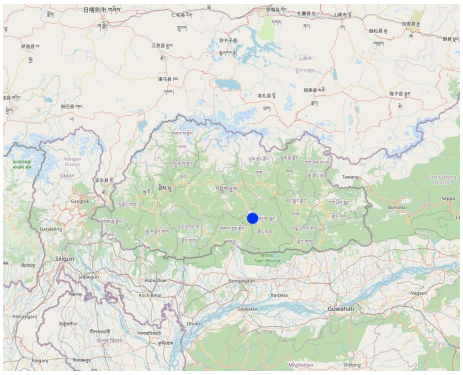
Fallow is arable land deliberately set aside due to challenges faced in cultivation. The rehabilitation of lands left fallow for decades through the adoption of agroforestry has been one success story of the Khengrig Namsum Cooperative in the central region of Bhutan. The integration of perennial trees (fruit and high-value trees) and seasonal crops creates environmental, economic, and social benefits.

Fallow land is the term for arable fields either partially or completely left unused and unproductive, owing to reasons such as labour shortages, lack of irrigation, human-wildlife conflict and/or the plots being far away from the settlements. Land rehabilitation is a promising approach towards mitigating the fallow land issue. Thus, the Khengrig Namsum Cooperative (KNC), a registered firm under the Department of Agriculture Marketing and Cooperatives, Ministry of Agriculture and Livestock (MoAL), Bhutan has ventured into rehabilitating 235 acres (94 ha) of fallow lands since 2016, through the adoption of agroforestry. The KNC was founded by Mr. Thinley Wangdi (the current chairman), with the motive of improving the livelihoods of the people of Zhemgang Dzongkhag through locally grown farm produce.
The KNC with funds from the Global Environment Facility - Small Grant Program (GEF–SGP) through the United Nations Development Program (UNDP), Bhutan, revived the fallow through agroforestry (intercropping of banana and bamboo plants). The KNC intervened in three strategic locations, benefitting 36 households. This particular agroforestry approach was not only aimed towards enhancing livelihoods but also to diversify production: through banana chips production and bamboo product development.
Upon securing the funds, implementation started with the procurement of planting and fencing materials, hands-on training, and then planting and fencing activities. Installation of electric fencing was done to reduce human-wildlife conflict. There was specific training on product development. Moreover, the KNC was able to link up with nearby schools for the school feeding programme, to supply fruits and vegetables. The cooperative demonstrates skills in processing its own products and enabling better access to renewable natural resources in the locality. On the contrary, not having proper cold storage facilities has negative impacts on processing units and has resulted in unreliable market coupling.



: Rebati Chiwog under Ngangla Gewog, Brumbi and Jiwongolia Chiwog under Trong Gewog, Zhemgang Dzongkhag,

: 2-10

- -269.31295, 27.14889

: (0.95 km²)

?:

: 2015

(> 50)

✓ /

✓ , ,

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✓ /

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✓
✓

- : - , / -
, -
, Ginger, turmeric
- ( ): /plantain/abaca
- : ,
citrus, (brazil nuts, pistachio, walnuts, almonds, etc.)

: 2
? /
? /

/

- ( ) / :
.
,

Tree types (/):
: ,

✓

✓ /

- Wt:
, Wg:

- Et:

- Bc:
, Bh:

SLM

-

SLM

- A1: /

- V1:

The technical drawing shows the banana plant and bamboo intercropped.

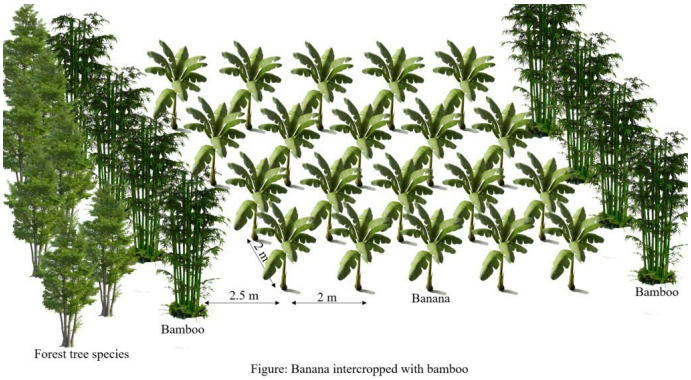


Figure: Banana intercropped with bamboo

Author: Ongpo Lepcha

- (**235 acres**)
- **Ngultrum (Nu.)**
- ( ) 1 USD = 80.0 Ngultrum (Nu.)
- Nu. 450

The most important factors affecting the costs while implementing this technology is land preparation and plantation of seedlings.

1. Explored funds from UNDP through development of project proposal, led by the chairman (/ : 2016)
2. Forest clearing and development using tractor at Brumbi and Rebati (/ : December 2016 - November 2018)
3. Electric fencing (/ : February 2017 - May 2017)

4. Procurement of fruit seedlings (local banana and bamboo) from Bhur nursery, Sarpang Dzongkhag (/ : May 2017 - July 2018)
5. Hands-on-training on fruit tree plantations (KNC members and other farmers) and product development from bamboo (/ : May 2017 - November 2018)
6. Plantation of banana seedlings and bamboo (/ : June 2018)

			(Ngultrum (Nu.))	(Ngultrum (Nu.))	%
Labor	person days	1440,0	451,0	649440,0	100,0
Land preparation	Lumpsum	1,0	725432,0	725432,0	
Cost of seedlings (local banana and bamboo)	Lumpsum	1,0	979170,0	979170,0	
Electric fencing	Lumpsum	1,0	267410,0	267410,0	
Plantation of bamboo and banana	Lumpsum	1,0	231594,0	231594,0	
Project administration and participation	Lumpsum	1,0	182042,0	182042,0	
Project signboard and installation	Lumpsum	1,0	19500,0	19500,0	
Formulation of by-laws and agreements	Lumpsum	1,0	72301,0	72301,0	
Hands-on-training on plantations and product development	Lumpsum	1,0	100781,0	100781,0	
				3'227'670.0	
				40'345.88	

1. Replacement of electric fence poles (/ : Every after three years (winter))
2. Replacement of solar batteries (/ : replaced once (1 battery))
3. Replacement of fruit plants (/ : Every season)

< 250
251-500
501-750
751-1,000
1,001-1,500
1,501-2,000
2,001-3,000
3,001-4,000
> 4,000

The rainfall data of 2017 was used
Station: Bhur, Type: Class A, Station ID: 23310046
The area falls under the warm and humid Subtropical zone among the six Agroecological zones of Bhutan.

(0-2%)
(3-5%)
(6-10%)
(11-15%)
(16-30%)
(31-60%)
(>60%)

0-100
101-500
501-1,000
1,001-1,500
1,501-2,000
2,001-2,500
2,501-3,000
3,001-4,000
> 4,000

(0-20)
(21-50)
(51-80)
(81-120)
(> 120)

(
)
/ ( )
(,)
/ ( )

(> 20
)
/ ( )
(,)
/ ( )

(>3%)
(1-3%)
(<1%)

< 5
5-50
> 50

(
)
/

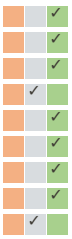
?
/
( )
( )

SLM

10%
10-50%
50%

< 0.5
0.5-1
1-2
2-5
5-15
15-50
50-100
100-500
500-1,000
1,000-10,000
> 10,000

Family land ownership



Crop production increased exponentially in Rebati, where crop production prevailed before the introduction of the agroforestry system. For the reverted fallow land in Brumbi and Jiwongolia, crop production increased by 100%. The abundant availability of bananas from the rehabilitated areas has greatly facilitated the cooperative employees in procuring a sufficient quantity of bananas for banana chip production. Previously, they had to embark on time-consuming journeys to various locations to source bananas, which not only proved laborious but also led to an increase in production costs.

SLM: Local varieties

SLM: Improved varieties

The cultivation of enhanced banana varieties, including G9, Jaji, and Dosari, has resulted in a noticeable enhancement in quality

Following the harvest of banana fruit, the stems and leaves are utilized as fodder for livestock

	✓	The risk of production failure is minimized as the land users engage in agroforestry, diversifying their income sources. Their earnings do not rely solely on one crop; instead, they come from a variety of sources, including bamboo products, bananas, vegetables, and spices. Consequently, if one crop encounters difficulties or fails, the other crops can continue to generate income for the cooperative
	✓	Agroforestry promotes the diverse cultivation of both forest and agricultural plants, resulting in a wide range of products. As an example, the land users are able to produce bamboo products, spices, and banana chips due to the diversity of their cultivation practices
(/)	✓	The technology is implemented in the previously uncultivated land (fallow) leading to the increased production area.
	✓	The conversion of fallow land into cultivated land has enhanced land management and stewardship. This transformation involves the addition of manure and timely interventions, effectively reducing soil erosion and improving the overall care of the land
	✓	There are increased expenses on agricultural inputs. However, the increased expenses are compensated by the income generated from the farm.
	✓	SLM: Nu. 23,00,000/- annual income SLM: Nu. 55,00,000/- annual income The ready availability of bananas as a raw material has significantly boosted the production of banana chips and led to a substantial increase in the annual revenue of the cooperative. Furthermore, land users supplying bananas to the cooperatives have also experienced a rise in their annual income
	✓	The KNC has diverse value-added products and natural products such as watermelon, bamboo products, and homemade pickles diversifying their income sources.
	✓	Reduced workload due to increased availability of raw materials for banana chip processing.

/	✓	The staff of the KNC is food secure due to increased income generated from the cooperative. Likewise, the land users supplying raw materials are also meeting the food security from the income generated by supplying raw materials to the KNC. The land users are self-sufficient in bananas, bamboo and some spices.
	✓	The land users shared that the improved annual income is directly related to improved health and well-being of the family/community.
(.)	✓	Their venture into such activity has added value to the community, where the community has been recognized as one of the successful pilot sites for rehabilitating fallow lands. Moreover, external visitors are attracted to witness the success of the community. Also, the community bond has been strengthened, through an approach like labour sharing practised during the implementation of the technology.
SLM /	✓	Before, the land users' knowledge about SLM technologies was confined to a few technologies. Now they have realized that SLM is a holistic approach involving different technologies. Therefore, the understanding and knowledge

of agroforestry as one of the SLM measures has been enhanced.

( )

Disadvantaged families constrained by poor market access benefited from this technology.

The plantation of banana plants and bamboo has covered a wide range of land, leading to better vegetation cover.

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The increased vegetation cover by different fruit, bamboo, and vegetables leads to increased above-ground biomass.

( )

Agroforestry harbours various plant species attracting diverse beneficial insects that feed on these plants.

The destruction of natural habitats has been decreased due reduced dependency of land users on wild bamboo products.

/

The risk of surface erosion has been mitigated due to improved ground cover.

Cultivation of bamboo species reduces wind velocity reducing surface erosion.

Biological diversity conservation

Decreased Increased

Biological diversity increased due to the cultivation of different plant species which also act as a habitat for different insects and birds.

The agroforestry with banana and bamboo plantations has been advantageous with both short-term and long-term benefits. For instance, banana gives fruiting in less than a year (9 months) after plantation.

( )

/

1-10%
11-50%
> 50%

?

0-10%
11-50%
51-90%
91-100%

/

36 households and one cooperative (KNC)

?

/

?

/

( )

:

- Increased production area. The reversion of fallow land through agroforestry significantly increased the production area for the land users.
- Increased income. The easy access to the raw materials for KNC and easy market access for the land users leads to improved income for the KNC staff and land users supplying bananas to the cooperative.
- The technology is easy to implement as bananas and bamboo are perennial providing continuous income to the land users with little maintenance required. The land users need not be involved in agronomic practices such as land preparation and sowing every year.

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- Restoration of cultivable land lost to forest encroachment.

/ / :

- Loss of cooperative members due to better opportunities, which ultimately would affect sustainability. Provide timely incentives and adequate facilities.

/ / :

- Youths do not prefer to work in agriculture as it is viewed as laborious. Introduce fully mechanized and smart farming systems to attract youth.

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https://qcat.wocat.net/km/wocat/technologies/view/technologies_6839/

SLM

- National Soil Services Centre, Department of Agriculture, Ministry of Agriculture & Livestock (NSSC) -
- Strengthening national-level institutional and professional capacities of country Parties towards enhanced UNCCD monitoring and reporting – GEF 7 EA Umbrella II (GEF 7 UNCCD Enabling Activities_Umbrella II)

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