

# **FRUIT NURSERY ESTABLISHMENT – A CASE STUDY**

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## **Executive Summary**

A fruit tree nursery was established in Rechangloo, Gomdar, Samdrup Jongkhar in 2013 to provide locally produced saplings. Orange, peach, persimmon, walnut, and plum have been sown so far. This initiative has hopes to provide economic and food security in this region.

## INTRODUCTION AND BACKGROUND

Gomdar gewog is located in northeastern Samdrup Jongkhar dzongkhag (Figure 1). Gomdar is reached from Dewathang by car in about three-hours via the Samdrup Jongkhar/Trashigang highway. It is another three-hour trek on foot to reach Rechangloo chiwog (village; Figure 2) under Gomdar gewog. Rechangloo is 1400 meters above sea level and is slightly cooler than Dewathang.



Figure 1. The eleven gewogs of Samdrup Jongkhar



Figure 2. Rechangloo

Rechangloo is Sharchop for “the black water”. Settlement occurred during the early 20<sup>th</sup> century, said Sangay Chopel, the chair person of Rechangloo vegetable group. It is said that three households from Gomdar village migrated to this valley and when they saw the black

stream they called it Rechangloo. The stream is not actually black, but appears dark because it runs through a dense forest.

The population of Rechangloo has gradually increased to 120 people as of 2015 as per Sangay Chopel. According to Tsheten Drukpa, the Agriculture Extension Officer (AEO) of Gomdar, the village has 81 acres of cultivatable land, but only 29% is currently in production, with the remaining in forest.

Villagers have historically been subsistence farmers, growing their own vegetables, such as maize, barley, foxtail millet, and sweet buckwheat. As per Bhutan's development strategy (Tenth Five Year Plan) they started planting Mandarin (*Citrus reticulata*) for export. Saplings were initially grown in Gomdar village and transplanted in Rechangloo. In the year 2008 the AEO of Gomdar formed the Rechangloo Vegetable Group with 31 farmers. These farmers generate cash income from the sale of vegetables, but were interested in further diversifying their production. It was suggested that a tree fruit nursery be established to increase the diversity of locally available tree fruit species, since saplings were only available in the adjacent chiwog, or from other gewogs. The nursery would generate income from the sale of saplings and fruit harvested once orchards were established.

## **APPROACH**

In 2013, the Samdrup Jongkhar Initiative (SJI; [www.sji.bt/](http://www.sji.bt/)) conducted a write-shop to address the needs of 11 gewogs in Samdrup Jongkhar dzongkhag. During this write-shop the idea of agroforestry was brought to the attention of the AEO of Gomdar, by Dr. Julian Gonsalves, International Research and Development Centre (IDRC), of Canada, external reviewer. The AEO with financial support of Nu 56,500 from the IDRC and technical support from the Research Development Center (RDC) in Wengkhari, developed an action plan to implement agroforestry in Gomdar. Unfortunately, the action plan was rejected by villagers in Khoyer and Pangthang chiwogs, Gomdar, because farmers were not interested. The action plan was revised to establish a temperate fruit tree nursery after the SJI staff and the AEO of Gomdar identified an interest from the vegetable group of Rechangloo.

### *Site selection*

The nursery site is a five-minute walk from the village. The proximity to the village allows the group members to visit the nursery to frequently water, weed, and conduct other maintenance in the area.

### *Establishing a fruit tree nursery (Table 1)*



Groundbreaking of the nursery beds and greenhouse occurred on 15 February, 2014 on 60 decimals of land deeded by Mr. Thinley Dorji (Figure 3). All the necessary tools and materials needed were supplied by the AEO of Gomdar. Day wages with lunch and refreshments were also provided to the farmers. The land was cleared of brush and new terraces were constructed. Fifteen nursery beds (1m wide and between 9-10m long) were also constructed. All vegetable group members participated, headed by the Chair, Mr. Sangay Chopel.



Figure 3. Nursery beds and greenhouse.

#### *Nursery soil preparation*

Soil was loosened for nursery beds removing roots and rhizomes from the previous brush onsite. The traditional practice of collecting forest soil as an amendment was used for the new nursery beds (Figure 4). This soil was sieved prior to adding it into the nursery bed. Farmyard manure (FYM) (Figure 5) was also incorporated to increase the fertility and condition the soil in anticipation of sowing.



Figure 4. Forest soil.



Figure 5. Traditional composted manure

The farmers were told by the AEO of Gomdar, “for any crop to be grown, a good nursery is very important. Raising nursery saplings is like the raising of a child. Since it is tender, soft and delicate, one should take care and protect from sun, rain, wind, pests, and disease”. Unlike vegetable nurseries, which can be produced within a few months, the fruit tree takes two to three years before they are ready. So farmers were reminded not to lose patience and to strive for good quality saplings.

Seeds of orange (*Citrus sinensis*), pear (*Pyrus communis*), and persimmon (*Diospyros virginiana*) (Table 2) were bought from the Agriculture Training



Figure 6. Mother plant nursery.

Center at Monger and were sown in the nursery beds and in the greenhouse. The AEO of Gomdar advised the vegetable group that, “persimmon has a poor rooting system and a low survival rate once transplanted, so add enough FYM so that seedlings are vigorous. In the case of citrus and pear, saplings should be transplanted into a polypot”. Inside the greenhouse they only planted persimmon, whereas citrus and pear were planted directly into nursery beds.

The second phase of the nursery was the establishment of a mother plant orchard (Figure 6). A mother plant is grown for the purpose of taking vegetative cuttings or offsets in order to asexually propagate the same plant<sup>i</sup>. Typically a mother plant will have desirable characteristics that have a low heritability if grown from seed. Half of the total 60 decimals of land were used for planting mother plants. For the planting of mother plants, a 1ft deep by 3ft wide hole was dug. Into the hole a layer of topsoil and a layer of decayed leaf mold, collected

from forest was added. Five plum (*Prunus mume*), nine pear, nine persimmon, and three peach (*Prunus persica*) saplings were planted into the prepared holes.

## RESULTS

Even with their best efforts some of the plants did not grow and some were destroyed by wild animals (Table 2) (Figure 7).



Figure 7. Left: Dead sapling. Center & Right: Saplings damaged by a wild animal.

There was little wild animal injury to the saplings in the nursery or inside the polyhouse. However, the seeds of persimmon and pear were of low quality and only a small percentage germinated (Table 3). Luckily the orange seeds had 100% germination.

Table 3. Seeds sown in February, 2014 and number germinated.

	Seeds broadcasted	Seeds germinated
Persimmon	500	120
Pears	5000	60
Orange	3000	3000



The Citrus roots tocks are approximately 20cm tall as of 23<sup>rd</sup> of March, 2015 and have been transplanted into polypots, filled with a 50:50 mixture of top soil: FYM and are expected to be grafted in 2015 (Figure 8).



Figure 8. Citrus rootstocks in polypots

On 8<sup>th</sup> January, 2015, during the farmers' field day, hard shell walnut (*Juglans Regia*) and local peach seeds were sown. Hard shell walnut and peach seeds had undergone stratification for three months prior to aid germination. Two stratification pits were dug (one for walnut and one for peach) and layered with sand, soil, and seeds (Figure 9). Germinating seeds were sown into five new beds 6m long x 1m wide and amended as previously described. As of 23<sup>rd</sup> of March, 2015 some of the peach seedlings have emerged and a few walnuts as well (Figure 10).

To overcome the damage made to mother plants by wild animals, the group made a temporary bamboo fence around the plants in early November 2014, following a traditional method (Figure 6). So far this has been an effective barrier to wildlife.



Figure 9. Stratification pit.

## LESSONS LEARNED

- Wild animals pose a significant risk for exposed saplings in the field.
- Only the highest quality seeds should be purchased and sown.

### Recommendations

- Installation of electric fencing around the nursery and low-tech bamboo barriers around dispersed mother plants would help deter wild animals.
- Locally collected seeds may be of a higher quality than imported; however some species are not locally available so stock plants are needed.

There are many future benefits that are expected from this pilot impact project. However, many of them will take time and will require patience on behalf of the vegetable group.

- Economic benefits to group

- Reduction of soil erosion
- Source of tree litter substantially contributing to soil fertility
- Diversification of the rural farm economy
- Improvement of local food security
- Reduction of labor as compared to annual cropping



Figure 10. Left: Walnut; Right: Peach

## POTENTIAL FOR ECONOMIC DIVERSIFICATION AND UPSCALING

### *Marketing*

Initially, saplings will be sold to local community members and they suspect that they may even eventually help support the establishment of other nurseries and orchards across their gewog and dzongkhag. Orange seedlings grafted cost up to 40 Nu/plant, walnut from 50 Nu/plant, and persimmon up to 125 Nu/plant as of 2011 (Ministry of Agriculture and Forests, RNR). Excess fruit production, not consumed or sold locally, is expected to be exported regionally. This fruit production will help bolster their declining orange orchards.

As mentioned previously, the majority of arable land in this chiwog is still in forest and at risk of being deforested and degraded due to unsustainable annual cropping with species like maize. The availability of fruit trees and establishment of orchards will not only reduce the need to generate income from unsustainable annual cropping systems, but by reducing labour inputs, it is expected that this will help to reduce rural to urban migration.



## RECOMMENDATIONS AND GENERAL CONCLUSIONS

Farmers are generally apprehensive about investing time and resources into perennial crops, which take many seasons before they yield an economic return. The vegetable group of Rechangloo had the foresight to not only take on the planting of perennial fruit trees, but to establish a fruit tree nursery that would supply saplings to the region. The initial stages of this establishment were expected to come with a steep learning curve, since the farmers involved were only experienced in cultivating annual crops. Major obstacles have met them during the first year of their venture, but they remain resolute and dedicated to establishing a fruit tree nursery. These farmers will continue to learn about perennials and are expected to be more open to agroforestry concepts in the near future.

In time, it is expected that the saplings so far produced will develop into young trees, part of new young orchards, and eventually bear fruits for the local farmers of Rechangloo. In the mean time the farmers should continue staggered sowings of seeds so there will not be a shortage of saplings to distribute. The AEO of Gomdar is particularly interested in seeing the success of the new fruit tree nursery and has distributed 10 soft shell walnut saplings and 1000 seeds of pear, and persimmon to the nursery for planting, which were sown in January, 2015. The group plans on adding additional beds since they have utilized all available beds to date.

After consulting with the AEO of Gomdar and Mr. Sangay Chopel our recommendations are as follows:

- During the dry season water is scarce. Decisions have to be made whether to water their vegetables or the nursery. Therefore, there is a need for a reservoir or water tank for specific use in the nursery. This tank could be utilized for drip or mist irrigation, which would reduce the labor of watering, even though, labor is apparently not an issue since there are 31 farmers working the nursery in rotation.
- Electric fencing would reduce human wildlife conflicts, however there is a fear that the electric fence could harm to animals and humans, especially during the monsoon. As an alternative, wire fencing was requested. While this type of fencing may deter animals, a solar electric fence should not pose a significant risk to animals or people. Conversation between the SJI, the AEO, and the group are planned for the future.
- Across all beds and mother plants there is a need for more compost. It was advised that the stock plants should be as healthy and vigorous as possible to insure strong cuttings, which will have a high capacity to root and in turn give vigorous saplings. Compost or a clover cover crop should be applied to all beds to help conserve water and provide fertility to the young seedlings. Compost addition for tree crops can be done by digging a shallow trench around the tree away from the trunk, just below the drip line. Compost

is placed in the trench and covered with soil. Compost should also be applied aboveground under the tree's drip line. A detailed description for the preparation of a nursery bed with a rich soil is given in *Improving Soil Fertility-Naturally*, by Shylaja R. Rao. The compost and green manure methods detailed should be reviewed and considered prior to the installation of additional beds.

- Cuttings and budding were planned, but the technical aspects have not been worked out as of yet. Technical assistance was going to be sought from Wengkhari. Likely, there will be a need for a high humidity environment to ensure a high success rate. This could be done in the greenhouse or with a shade structure fitted with a mist system. Schematic diagrams for both high and low shade structures can be found online<sup>ii</sup>. These structures are low cost and construction materials locally available. The use of seed boxes instead of nursery beds to root cuttings should also be considered.

Agroforestry was the intended project for this pilot impact area. However, the original proposal was met with uncertainty, as the recommended plant species were either foreign to the local inhabitants or were not perceived as providing any economic return.

As farmers become acquainted with orchard management, agroforestry projects may be understood and given a chance. The village of Rechangloo, like many rural villages across southeastern Bhutan, will have to continually negotiate a compromise between wilderness and the demands of a growing human population with economic desires. Agroforestry may be just that compromise and Rechangloo may just be that village that provides a sustainable model for the region.

Some recommendations include:

- Plant *Arachispinto* between fruit trees.
- Planting Napier and Guatemala grasses on unproductive area. These will provide fodder for livestock and serve as a source for compost.
- Planting of multipurpose forestry trees (fodder trees and neem) and bamboo species along the farm boundaries.

**Table 1. Pilot impact area activities, 2014.**

	<b>Activity</b>	<b>Remarks</b>
Feb.	Farmers meeting on establishment of temperate fruit plant nursery	All 31 group members gathered and agreed to establish the temperate fruit plant nursery
Feb.	Clearing of bushes in the site	The area was not cultivated for long time and it was covered with bushes
Feb.	Site development	As the land was not cultivated and moreover since the area was not uniform, the area was developed for nursery raising
Feb.	Nursery Training	Farmers were given basic training on nursery raising
Feb.	Leaf mould collection	Collected around 5 tonnes of leaf mould for nursery raising
Feb.	Installation of green house	The green house was supported by MAGIP <sup>1</sup> .
Feb.	Lay out for mother plant plantation	The technical team from RDC-Wengkhar visited the site, met with farmers, supplied mother plants and root stock seeds.
Feb.	Pit digging and filling	31 pits were dug and filled with manure and leaf mould.
March	Planting and sowing of seeds and seedlings	Planted seedlings of 9 persimmon, 6 peach, 5 plums and 9 pears. Rootstock seeds for citrus, pear and persimmon are sown and the seeds are in germination stage.
	Watering and weeding	Whenever necessary, watering and weeding was done.
End of May	Supply of materials	Supplied 100kgs poly pot, 11 watering cans, 11 flexible pipes and 5 pruning saws
July	Transplanting of citrus root stock in poly pot	Transplanted 1500 rootstock seedlings

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<sup>1</sup> MAGIP stands for Market Access and Growth Intensification Project



**Table 2. Inventory of temperate fruit tree nursery**

<b>Name of seedlings</b>	<b>Quantity</b>	<b>Remarks</b>
<b>Mother Plants</b>		
Pear	6	Out of 8 seedlings supplied for the purpose of mother plant, 2 died.
Persimmon	4	Out of 10 seedlings supplied for the purpose of mother plant, 6 died.
Plum	3	Out of 6 seedlings supplied for the purpose of mother plant, 3 died.
Peach	1	Out of 4 of seedlings supplied for the purpose of mother plant, 3 died
<b>Seed stock</b>		
Peach	10kgs	Sown January 2015
Plum	5kgs	Sown January 2015
Walnut	50kgs	Sown January 2015

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<sup>i</sup> [http://en.wikipedia.org/wiki/Mother\\_plant](http://en.wikipedia.org/wiki/Mother_plant)

<sup>ii</sup> <http://www.nzdl.org/gsdImod?e=d-00000-00---off-0hdl--00-0---0-10-0---0---0direct-10---4-----0-1l--11-en-50---20-about---00-0-1-00-0-0-11-1-0utfZz-8-00&a=d&cl=CL1.15&d=HASH011a9b592cb4b8b846cbd46d.2>