No. J-11017/05/2022-RE-VII
Government of India
Ministry of Rural Development
Department of Rural Development
(Mahatma Gandhi NREGA Division)

Krishi Bhavan, New Delhi,
Dated, 6th June, 2023

OFFICE MEMORANDUM

Subject: Report of the Advisory Group on Bamboo Plantation under Mahatma Gandhi NREGS.

I am directed to forward herewith a copy of approved report of the "**Advisory Group on Bamboo Plantation"** covering different aspects of bamboo plantation under Mahatma Gandhi NREGS.

2. This report will contribute towards better execution of works on bamboo plantation with mixed cropping/inter cropping across the country.

himanshi 6/6/23

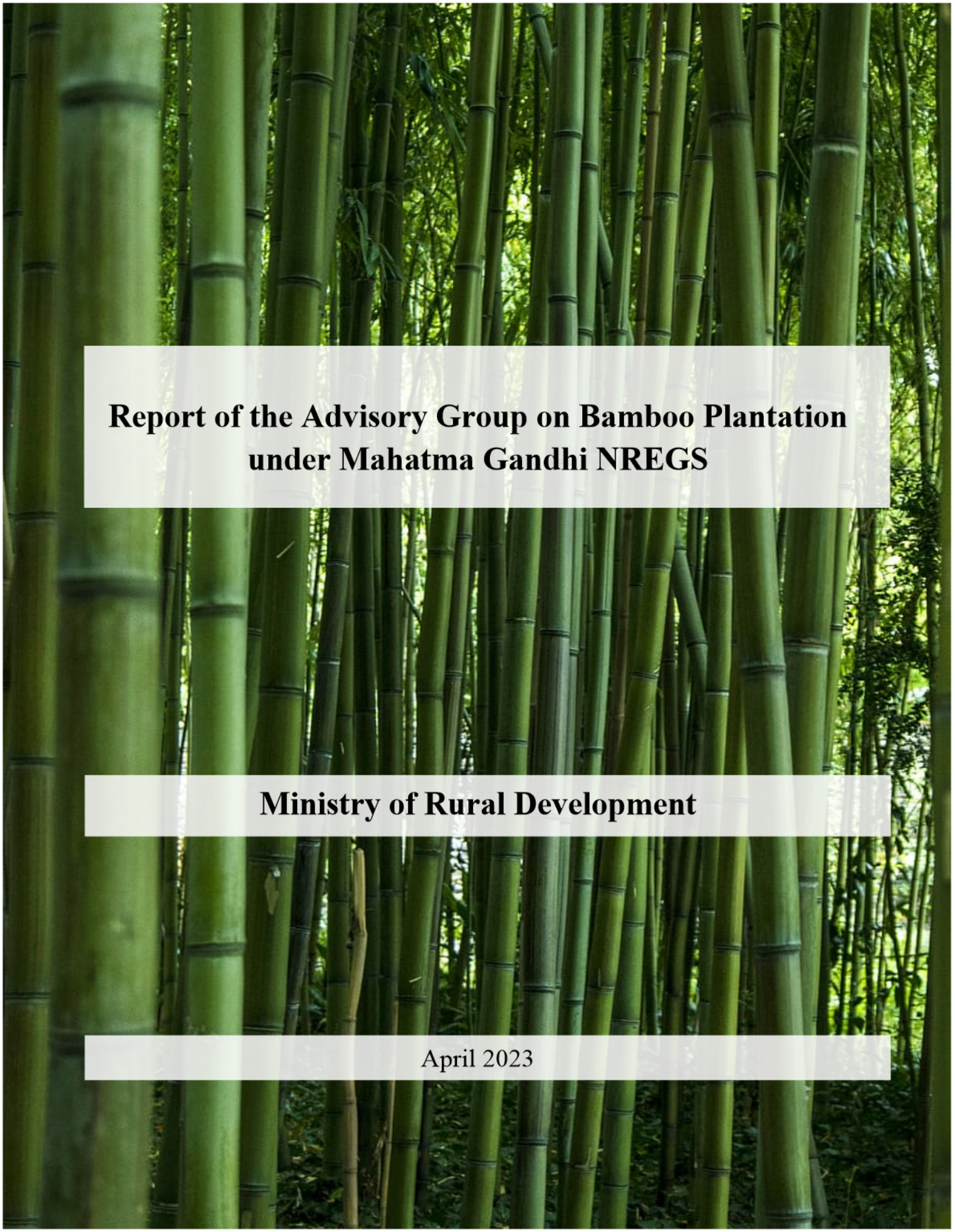
(Himanshi)
Assistant Director (Mahatma Gandhi NREGA)

To

The ACS, Principal Secretary/Secretary/ Commissioner
In-charge of Mahatma Gandhi NREGS,
Rural Development Department,
All States/UTs
(Except Delhi and Chandigarh)

Copy to :

All members of Advisory Group for information



Report of the Advisory Group on Bamboo Plantation under Mahatma Gandhi NREGS

Ministry of Rural Development

April 2023

CONTENTS

Foreword

This report is an outcome of the "Advisory Group on Bamboo Plantation" constituted by Department of Rural Development, Ministry of Rural Development, Government of India. The Advisory Group comprised of members from Ministry of Environment, Forest & Climate Change, Ministry of Agriculture and Farmers Welfare, Research Institutions, NGOs, Scientists and Bamboo Experts.

I would like to place on records the valuable contribution of Advisory Group Members and Shri Dharmvir Jha, Director cum Convener in preparation of this report. The Advisory Group provided valuable inputs/suggestions on mixed plantation/intercropping of bamboo with other species, density of bamboo plantation and other related issues.

This group appreciates support from Shri Kiran P Mali, Programme Officer (Works NRM), Shri Kiran Charan Padhy, Programme Officer (Works) and Shri Hansal Kumar Suthar, Project Officer-Works (SECURE) and other Officers of Mahatma Gandhi NREGS Division in finalization of this report.

The report of the "Advisory Group on Bamboo Plantation" covering different aspects of bamboo planation under Mahatma Gandhi NREGS, I hope this report will contribute towards better execution of works on bamboo plantation with mixed cropping/intercropping across the country.

Joint Secretary (Mahatma Gandhi NREGA) cum Chairperson

Background

Mahatma Gandhi National Rural Employment Guarantee Act, 2005, is an Act to provide for the enhancement of livelihood security of the households in rural areas of the country by providing at least one hundred days of guaranteed wage employment in every financial year to every household whose adult members volunteer to do unskilled manual work." Bamboo is synonymous with 'Green Gold' all over the world and 'Poor Man's timber in India due to its multiple utility. It plays a vital role in the economy and livelihood of the rural and forest dependent community through harvesting, processing and selling variety of bamboo products.

An "advisory group on bamboo plantation" has been constituted vide OM- J-11017/05/2022-RE-VII (381811) dated 03-11-2022, Mahatma Gandhi National Rural Employment Guarantee Act, Division of Department of Rural Development, Ministry of Rural Development, New Delhi. The terms of reference for the group is as under

- To advise the issues of mixed plantation/intercropping of bamboo with other species
- To advise on plantation density of bamboo plantation
- Any other related issues referred to advisory group

Copy of notification on formation of the Advisory Group on Bamboo Plantation under Mahatma Gandhi NREGS is at Annexure-I.

As per the provision under Mahatma Gandhi NREGS bamboo plantation is permissible work and can be promoted for block plantation, boundary plantation, bund plantation, plantation along water bodies and intercropping. Bamboo may be utilized for increased value addition to generate employment and livelihood perspectives for economic growth, primarily in rural areas.

The report structure comprises of three Chapters.

Chapter 1 is about the introduction to the Mahatma Gandhi NREGA, permissible work categories, scope of bamboo plantation under the scheme and various benefit of bamboo plantation.
Chapter 2 summarizes the observations from the members of the advisory group.
Chapter 3 consists of recommendations and conclusion after due compilation of the advises of the advisory group. The various aspects of bamboo plantation covered under this chapter includes cluster based approach, density of bamboo plantation, suitable species of bamboo, year wise plantation and maintenance operations, agricultural/horticultural crops for mixed/intercropping, training and capacity buildings, convergence with line departments, marketing and advise on tissue culture.

Further, the report includes various Annexures of proceedings of the meeting convened with the advisory group, detailed observations/comments of advisory group, comments on draft report of Advisory Group Members on Bamboo Plantation.

Chapter 1: Mahatma Gandhi National Rural Employment Guarantee Scheme and Bamboo Plantation

Introduction

Mahatma Gandhi National Rural Employment Guarantee Act, 2005, is an Act to provide for the enhancement of livelihood security of the households in rural areas of the country by providing at least one hundred days of guaranteed wage employment in
every financial year to every household whose adult members volunteer to do unskilled manual work."

The core objectives of Mahatma Gandhi National Rural Employment Guarantee Scheme (Mahatma Gandhi NREGS) are as followed

a) Providing not less than one hundred days of unskilled manual work as a guarantee employment in a financial year to every household in rural areas as per demand, resulting in creation of productive assets of prescribed quality and durability;
b) Strengthening the livelihood resource base of the poor;
c) Proactively ensuring social inclusion; and
d) Strengthening Panchayat Raj institutions

The focus of the Scheme shall be on the following works as categorized below:

I. Category: A: Public Works Relating To Natural Resources Management

(i) **Water conservation** and water harvesting structures to augment and improve groundwater like underground dykes, earthen dams, stop dams, checks dams and rooftop rainwater harvesting structures in Government or Panchayat building with special focus on recharging ground water including drinking water sources;
(ii) **Watershed management works** such as contour trenches, terracing, contour bunds, boulder checks, gabion structures and spring shed development resulting in a comprehensive treatment of a watershed;
(iii) Micro and minor irrigation works and creation, renovation and maintenance of irrigation canals and drains;
(iv) Renovation of **traditional water bodies** including desilting of irrigation tanks and other water bodies and conservation of old step wells or baolis;

(v) **Afforestation**, tree plantation and horticulture in common and forest lands, road margins, canal bunds, tanks foreshores and coastal belts duly providing right to usufruct to the households covered in Paragraph 5; and

(vi) Land development works in common land.

II. Category B: [Community Assets or Individual Assets] For Vulnerable Sections (Only For Households in Paragraph5)

(i) Improving productivity of lands of households specified in Paragraph 5 through land development and by providing suitable infrastructure for irrigation including dug wells, farm ponds and other water harvesting structures;

(ii) Improving livelihoods through horticulture, sericulture, plantation and farm forestry;

(iii) Development of fallow or waste lands of households defined in Paragraph 5 to bring it under cultivation;

(iv) Unskilled wage component in construction of houses sanctioned under the Pradhan Mantri Awaas Yojana-Gramin or such other State or Central Government Scheme;

(v) Creating infrastructure for promotion of livestock such as, poultry shelter, goat shelter, piggery shelter, cattle shelter and fodder through for cattle; and

(vi) Creating infrastructure for promotion of fisheries such as, fish drying yards, storage facilities, and promotion of fisheries in seasonal water bodies on public land;

(vii) Construction of bio-gas plant for individual; and

(viii) Unskilled wage component towards the construction of bio-gas plant for community.

III. Category C: Common Infrastructure [Including for NRLM] Compliant Self Help Groups

(i) Works for promoting agricultural productivity by creating durable infrastructure required for bio-fertilizers and post-harvest facilities including pucca storage facilities for agricultural produce; and

(ii) Common work-sheds for livelihood activities of self-help groups.

IV. Category D: Rural Infrastructure

(i) Rural Sanitation related works , such as individual household latrines, school toilet units, Anganwadi toilets either independently or in convergence with schemes of other Government Departments and unskilled wage component for construction of Community Sanitary Complexes in convergence with Swachh Bharat Mission (Grameen) to achieve 'open defecation free' status and solid and liquid waste management as per prescribed norms;

(ii) Providing all-weather rural road connectivity to unconnected villages & Border area and to connect identified rural production centres to the existing pucca road network; and construction of pucca internal roads or streets including side drains and culverts within a village;

(iii) Construction of play fields and compound walls for Government run schools in the villages;

(iv) Works for improving disaster preparedness or restoration of roads or restoration of other essential public infrastructure including flood control and protection works, providing drainage in water logged areas, deepening and repairing of flood channel, chaur renovation, construction of storm water drain and coastal protection;

(v) Construction of building for gram Panchayat, women self-help groups federation, cyclone shelters, Anganwadi centers , village haats and crematoria at the village or block level;

(vi) Construction of Food Grain Storage Structures for implementing the provision of The National Food Security Act, 2013 (20 of 2013);

(vii) Production of building material required for construction works under the Act as a part of the estimate of such construction works ;

(viii) Maintenance of rural public asset created under the Act; "including maintenance of tunnel and bridges constructed by the Border Roads Organization ;

Paragraph 5 of Schedule I. Works creating individual assets shall be prioritized on land or homestead owned by households belonging to the:

(a) Scheduled Castes

(b) Scheduled Tribes

(c) Nomadic tribes

(d) denotified tribes

(e) Other families below the poverty line

(f) women-headed households

(g) Physically handicapped headed households

(h) Beneficiaries of land reforms

(i) The beneficiaries under the Pradhan Mantri Awass Yojana-Gramin

(j) beneficiaries under the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 (2 of 2007), and after exhausting the eligible beneficiaries under the above categories, on lands of the small or marginal farmers as defined in the Agriculture Debt Waiver and Debt Relief Scheme, 2008 subject to the condition that such households shall have a job card with at least one member willing to work on the project undertaken on their land or homestead.

Therefore, the scope of undertaking bamboo plantation under Mahatma Gandhi NREGS works will fall under the following category of works as indicated in Table below

Category of works	Components
Category A: Public Works Relating To Natural Resources Management	• Afforestation, tree plantation and horticulture in common and forest lands, road margins, canal bunds, tanks foreshores and coastal belts duly providing right to usufruct to the households covered in Paragraph 5; • Land development works in common land
Category B: [Community Assets or Individual Assets] For Vulnerable Sections (Only For Households in Paragraph 5)	• Improving livelihoods through horticulture, sericulture, • plantation and farm forestry; Development of fallow or waste lands of households defined in Paragraph 5 to bring it under cultivation;

Bamboo plantation under Mahatma Gandhi NREGS

- There are 266 works permissible under the Mahatma Gandhi NREGS. Out of 266 works, 182 works are related to Natural Resource Management of which 85 are water related works and 166 works are related to agriculture and allied activities.
- Bamboo Plantation is a permissible activity under Mahatma Gandhi NREGS.

- Considering ecological benefits, economic and livelihood security of people, plantation of bamboo has already been included as a permissible activity under Mahatma Gandhi NREGS and mentioned at para 7.3 in the Annual Master Circular 2022-23
- Bamboo plantation work is permissible for community as well as individual beneficiary land and hence may be taken up as plantation category.
- Raising of bamboo nursery is permissible work under Mahatma Gandhi NREGS.
- Bamboo plantation are being taken up under Mahatma Gandhi NREGS in many State/UTs such as Karnataka, Kerala, Tamil Nadu, Madhya Pradesh, Maharashtra & Odisha solely under Mahatma Gandhi NREGS or in convergence with National Bamboo Mission and Forest Departments.
- The procurement of planting material will be made by the beneficiary from Government nurseries, private nurseries approved by the Government, at the rates fixed by the Committee headed by the DPC.
- Afforestation, including ANR - Assisted Natural Regeneration (with integrated soil & moisture conservation works), plantation and horticulture activities can be taken up under Mahatma Gandhi NREGS on common, forest and private lands (of households listed in paragraph 5 of Schedule – I) viz.

    i. Degraded Forest lands,
    ii. Waste lands,
    iii. Public and community lands, pasturelands,
    iv. Along riverside, canals and embankments,
    v. Along PMGSY roads and other roads,
    vi. Private lands (block plantation or on bunds of agricultural fields, (backyard/homestead plantation).

- Plantation can be linear or block depending on the site requirements.
- As mentioned in Annual Master Circular, the Technical Resources of Forest Department must be utilized for facilitating PRIs in planning for works within the perspective of the State/ UT plan. It is desirable that the implementation of plantation/ afforestation works is carried out under overall technical supervision of Forest department. As far as possible, the Forest department may be encouraged to be the Project Implementation Agency for such works.
- Convergence can be done with line departments.

Benefits of Bamboo Plantation

It is one of the perennial, evergreen, fast growing and most productive plant and may be grown in the range of soil and weather conditions. India is a home to 125 indigenous and 11 exotic species of bamboos belonging to 22 generas.

The distinctive qualities of bamboo make it a valuable resource with a wide range of environmental benefits and ecosystem services. It is a valuable sink for carbon storage and contributes in carbon sequestration and bio-diversity conservation. Some of the key benefits of bamboo are as follows:

Environmental benefits of bamboo

- Bamboo can be grown on range of soil and variety of weather and climatic conditions;
- Bamboo can be grown with least use of fertilizers and pesticides;
- It is also suitable for reclamation of highly degraded lands;
- Bamboo cultivation increases the ground water table by its fibrous roots that spread up toa depth of 2 feet and to a width of 15 to 20 feet creating porosity in the top soil layer. The roots of bamboo increase the water holding capacity up to the level of 420 mm, the maximum water holding depending on the plantation density and root intensity. The maximum amount water that can be held would be 16 lakh litre of water in an acre of land.
- It reduces surface run-off, downstream flooding and retains water within the watershed areas;
- The rapid growth of bamboo and its selective harvesting sequesters upto 12 tons of CO_2 per hectare. It releases 35% more oxygen than equivalent areas of trees.
- Bamboo also helps mitigate water pollution due to its high nitrogen consumption.
- In the areas with frequently occurring hurricane and typhoons, bamboo protects surrounding environment due to its tall growth and is called windbreak.
- It is a source of bio renewable energy to replace coal and other energy sources and act as biofuel.

Economic benefits of bamboo

- Bamboo can play a very major role in the upliftment of economic condition of the rural people in India. For the past several decades bamboo has been used for food item, handicrafts, housing, construction works, agricultural applications, paper and pulp, agarbatti, biochar, live fencing etc.
- Bamboo is used as industrial raw materials for the manufacturing of mat boards, coagulated roofing material, bamboo lumber, energy pellets to replace coal, charcoal, activated carbon, bioethanol and other liquid biofuels.

- Bamboo products can be the next best possible substitute for hardwood and slow growing timber. Thus, it can be crucial in reducing depletion of forest resource there by meeting the demand for hardwood for different usage.
- Regeneration of bamboo is capable of promoting healthy growth of foliage and yields about 3-5 tonnes of biomass/ha.
- Bamboo biomass has higher calorific value (4000 kcal/kg) and lower ash as compared to other available biomass resources.

Social benefits of bamboo

- Bamboo provides employments to women in bamboo based handicraft, thereby assist in women empowerment.
- Bamboo is used for many socio-cultural rituals.
- Provides job opportunities in bamboo based industries.
- Bamboo increases the level of oxygen, essential for better health.

This shows that bamboo is a versatile plant but not brought under cultivation at large scale, as that of other tree. Therefore, it is urgent to sensitize the importance of bamboo plantation, as similar to any other plantation.

Chapter 2: Observations of Advisory Group

A meeting of the Advisory Group on Bamboo Plantation under Mahatma Gandhi NREGS was held on 29.11.2022 at 03:00 p.m through video conference. A detail deliberation was held as per the Terms of Reference (ToR) for the Group. Some members had shared their respective production units, laboratory and nursery etc to highlight the economic prospects and bamboo plantation and technology available. Members were requested to share their views in writing also. The proceedings of the meeting is appended in Annexure-II. Accordingly comments received from advisory group are summarized as follows and details are placed at Annexure III.

1. Forest Research Institute, MoEF&CC, Dehradun

- **Type of plantation according to availability of land**

The bamboo plantation may be taken up as per the availability as indicated below

Type of Land	Type of plantation
Community land	Block plantations, border plantations of fodder/forage area, shelterbelts, strip planting on the banks of river/nullah/nala/lake/pond
Small farmers (1 to 2 ha)	Preferably bund planting on the farm and may be block plantation
Marginal farmers (less than or equal to 1 ha)	Line or bund plantation.
Bamboo along river banks, nallah, ponds and water bodies	Strip plantations

- **Spacing and selection of bamboo species for plantation**

A very large bamboo *Dendrocalamus giganteus* (size of 30 meters) should be planted at 8 m by 8 m in plantation and 6 m on border plantation whereas for large bamboo like *Bambusa balcooa*, spacing should be 5 m by 5 m in plantation and 3.5 m on border. In case of intensive farming practices with drip irrigation and fertigation, the plantation intensity may be increased by 20 %. The per acre density of bamboo for large bamboo, medium bamboo and small bamboo should be 160-180, 180-200 and 380-425 respectively.

- **Plantation time**

Plantation should preferably in July or early August month in normal area. In flood prone area, it is should be in late August and September month. In drier area it should be done arrival with first monsoon.

- **Direction of plantation**

If plantation is from east to west direction, plant to plant distance should be more and if from south to north then distance should be more in case of row to row. This arrangement gives better sunlight from south during autumn and spring.

- **Plantation and maintenance operation of bamboo**

The plantation involve operations like pit preparation in summer, fertilizer application in pit in the 1st year and cultural operations during 2nd and 3rd year.

- **Period available for intercropping**

With the suggested spacing as per Annexure IV the intercropping can be done for 1st two years in bamboo plantation. The area requirement for growing agricultural/horticultural crops may be achieved by adjusting the spacing of bamboo species.

- **Irrigation**

Bamboo for first three years requires regular irrigation during summers and monthly irrigation during winter. After that, fortnightly irrigation during summers helps to develop early shoots during rainy season.

- **Fertilizer**

The doses given in Flow Chart 1 should be followed, by splitting recommended doses in two during rainy season. Also, must get soil tested before application of fertilizers. In India, potash is high as compare to other crops, there should be caution before application.

- **Border plantation with tree species**

At the border deep rooted tree may be planted keeping sufficient distance of 5 meters from bamboo.

2. Growmore Biotech Limited, Hosur, Tamil Nadu

- **Site selection for bamboo plantation**
  - Surrounding the living place.
  - In barren land adjacent to agricultural land.
  - In community land.
  - Bamboo may be planted along roadside, railway lines, high ways, river banks, dams etc.

- **Issues of bamboo plantation**

Bamboo cultivation is not yet popular due to

- Absence of high-yielding clones,
- Assured good quality planting material,
- Lack of standardized cultivation methods and farming techniques for the field condition.

- **Block plantation of bamboo**

Bamboo, in a block plantation, can be cultivated 1000 plants/ acre, 500 plants/ acre and 200 plants/ acre under high density, medium density and low density respectively denspidng upon end use of bamboo. With ensuring drip irrigation, fertilizer application and well management it yields 30 to 60 wet tons of bamboo /acre /year Or 20 to 40 dry tons/acre/year.

- **Intercropping**

In intercropping of short rotation agricultural and horticultural crops during the first 2 years can be done which includes tomato, lady's fingers, brinjal, chillies, radish, beans, soya bean, cowpea, beetroot, watermelon, sweet potato, maize, wheat, sorghum, bajra, ragi, kutki, red gram, black gram, green gram, mustard, ginger, turmeric, banana, papaya, mushroom and ayurvedic and medicinal plants.

- **Yield**

Bamboo yield may be realised in after 3-5th years onwards and yield may varies from 10 to 40 tons per acre per year according to species and spacing under optimum condition.

- **Cost of cultivation**

The total cost of cultivation of 1 acre of bamboo plantation is between 0.8 to 1.5 lakhs (Annexure VI) which will take 3 to 5 years to get the first harvest with well managed condition.

3. Bamboo & Cane Development Institute (BCDI), Tripura

- **Prerequisites for Bamboo plantation**

It includes the prerequisites like selection of villages, cluster based approach, willingness of farmers, availability of planting material, and convergence with line department like National/State Bamboo Mission, State Forest Department, Pradhan Mantri Krishi SichaiYojana (PMKSY) and man-days required for undertaking the bamboo plantation operations like site cleaning, pit digging, fencing, cost of planting material, mortality replacement and cultural operations.

4. M/s Gajraula Farms Agro Tech, Philibhit, Uttar Pradesh

Based on her experience of almost two decades of growing Bamboo in a non-bamboo growing area, she made the following submissions:

- In a state like UP, where individual landholdings are very small, chances of taking up bamboo plantation in a large scale, say one hectare or more, are remote possibility;
- Another obstacle in UP where lease holders or contract farmers are NOT covered by any scheme which provides Govt assistance in the form of financial or any other support;
- Fairly good species are *B. balcooa, B. tulda, D. strictus, B. pallida, D. hamiltonii,* B. vulgaris and others.
- Bamboo may be raised on bunds in which wheat, paddy, sugarcane, etc. are regularly grown without impacting its productivity and agro-forestry can also be practiced with bamboo plantation ;
- Workshop to impart training about cultivating bamboos at block/district level;

- How to grow bamboos: with free distribution of 10 good quality Bamboo clumps to be planted on plot bunds, to participating farmers (landowner/leasee/contract famer).
- Monitoring by visiting the farmer after a gap of 1-2 years to check health of seedling: and assist with replacement (as necessary).
- Aide in establishing the seedling so farmer can move ahead to using the crop.

- Workshop to impart training on techniques and uses of bamboo at block/district level;
  - Use of bamboo as a structural material (trunk and splinters); sheds, huts, granaries, poultry coops, etc
  - Use of bamboo as a farming tool: Vegetable grower racks, agricultural tools, crop guards, etc
  - Use of bamboo in daily use: domestic use products, storage bins, utensils, furniture, etc.
  - Encourage farmers to devise different uses based on personal/local requirements.

- Provision of a sure market at the block/district level to facilitate:
  - Buying and selling of bamboo and bamboo products.
  - Buying and selling of bamboo biomass.

- In summary, the Plan of Action (POA) should be to implement a scheme to encourage bamboo plantation among small and marginal farmers in Uttar Pradesh;
  - Free distribution of bamboo clumps to individual cultivators (landowner/leaser/contract farmer)
  - Training and monitoring.
  - Introduction to simple tools eg splinters
  - Providing market for surplus production at block/district level.

5 and 6. Transform Rural India Formation (TRIF) and Konkan Bamboo & Cane Development, Maharashtra

- The timely completion of process for undertaking bamboo plantation.

- Women's Self-Help Groups & Farmers Producers Organizations should be involved.

7. Green Bamboo Tech, Jabalpur, Madhya Pradesh

- Bamboo plantation must on species based with the choice of industry.
- Bamboo plantation with maximum number of plants 330 +20/acre for replacement.
- All plantation will be in form of cluster basis i.e., bulk production at one place, like in Veitnam and China.
- Some issues regarding Tissue Culture (TC) plants using in bamboo cultivation when Agriculture ministry is inquiry flowering issues in TC plants by high level committee.
- Before issuing final report please check recommendation by members by field visit which work done by members which they suggest.
- Only cluster base approch save bamboo cultivation with drip irrigation.
- Species suggest not survive in rainfed area accept North East.
- Bamboo can grow waste land with Drip irrigation and compost.

8. Poonji Jaivik Urja Vikas Producer Company Ltd., Pratapgarh, Uttar Pradesh

- The project on bamboo plantation of three years may be taken up through involvement of FPOs/Cooperative Society/NGOs.
- In the estimate, the provision of drip irrigation by the use of solar pump may be made.
- Bamboo plantation may be carried out in minimum 2 ha area. In case of small and marginal farmers the bamboo plantation may be carried out along the boundary of the farms as live fencing, as in case of small and marginal farmers utilize their land for agribusiness purpose.
- Women's Self-Help Groups may be sensitized for development of different handicrafts products of bamboo. Bamboo Compressed Bio Gas (CBG) setup may also be established to empower SHGs / FPOs / Co-operatives.
- Bamboo bio-mass waste to pallets and briquettes production for assuring the 8-10% requirement of NTPC thermal power plants as green fuels.
- Various herbal and aromatic plants like Ashwagandha, Tulsi, Lemongrass, Sarpgandha may also added for intercropping with Bamboo plantation.

9. Ministry of Agriculture and Farmers Welfare, New Delhi

The comments i. r. o. National Bamboo Mission on Draft Report of Advisory Group on Bamboo Plantation:

- The selection of priority species and the spacing of the bamboo plantation have been suggested in the operational Guideline of the Restructured National Bamboo Mission (NBM) after a series of consultations with various stake holders including Indian Council of Forestry Research and Education (ICFRE), Forest Research Institute (FRI) & Kerala Forest Research Institute (KFRI) etc.

- It has been observed from the field that the spacing shall be at least 5.0 m x 5 0 m for getting quality bamboo culms suitable for industrial-uses. As per the field experience and feedback received, the High Density Bamboo Plantation (HDP) has not been observed useful to serve the industrial aspect of the bamboo resources due to its poor quality and growth. It is useful for biomass production only & other aspect of HDP need to be explored by the expert before promoting among the farmers to avoid any ambiguity or dispute in future from the public.

- The convergence of NBM activities with other programmers has been taken up by several State Bamboo Missions (SBM). The experience in this regard by the Kerala and Madhya Pradesh may be explored. There is great potential for the convergence NBM & Mahatma Gandhi NREGS activities. When the plantation of bamboo is done under Mahatma Gandhi NREGS\NRLM, it may be ensured that the priority species suitable for the particular State/ Agro-climatic zone are being used and the saplings have been procured by trusted/accredited nurseries.

- Recently, juvenile flowering issues of bamboo plantation have been noticed in some parts of the country where tissue culture planting materials have been used, especially for the sp. *Bambusa balcooa*. Earlier, the matter was discussed with the expert in the Forest Research Institute (FRI), Rain Forest Research Institute (RFRI) and Kerala Forest Research Institute (KFRI) etc. It was suggested that the vegetative and seed propagation methods also may considered. In case the tissue culture planting materials are used, assurance shall be sought from Tissue Culture (TC) nurseries about the selection of parent material and protocol of the TC procedure of the bamboo species. The Tissue Culture nursery should be held responsible for the replacement of the sapling of the same species with their own cost in case of premature/juvenile flowering within 10 years of plantation. The quality planting materials shall be procured from nurseries accredited by any State Bamboo Missions, State Forest Research Institutes, Central/ State Agriculture

Universities, ICAR/ ICFRE institutes or any other competitive agency in the Govt/-Public Sector.

- The State implementing agencies of Mahatma Gandhi NREGS/NRLM may arrange training for master trainers in coordination with the Bamboo Technology Support Groups of NBM or any other appropriate agencies of expertise.

10. Ministry of Environment, Forest and Climate Change, New Delhi

- It is observed that bamboo is one of the important species for plantation and also for generating the livelihood of the local people. Hence there should be organized market mechanism to promote bamboo plantation which will further encourage the farmers for the bamboo plantation.

- There is the need to develop the sets of standards for the grading and classification of bamboo which will enhance the quality of bamboo plantation

Chapter 3: Recommendations of the Advisory Group

Advisory group members deliberated the ToR in details. The draft report prepared has been shared with all members for their final comments/viewpoints. The comments as received are attached in Annexure VII. The comments have been incorporated in the revised draft report. Accordingly, the recommendations of the advisory group members are categorised as under.

• Cluster based approach for individual beneficiaries

It has been advised to take up the bamboo plantation in individual land selecting the place on a cluster based approach. In case of small landholders, bamboo plantation may be done in concentrated areas i.e., bulk production at one place, like in Veitnam and China. It will facilitate logistic during the plantation and help in its monitoring. It will reduce the cost of fencing, maintenance and protection against grazing animals. It will also help in easy harvest and transport from single point of production.

• Density of bamboo plantation

Plant to plant spacing for bamboo plantation is a major concern for success. Bamboo roots are surface feeder and hence grow horizontally. In close spacing, like less than 3 meters. The plants compete with each other and fail to attain a thickness of commercial size (thickness of 7.5 cm dia and length of 8 m). The spacing of plants advised by the group members according to type of species, number of plants/ha, areas of suitability and its uses are indicated in Annexure IV along with some of commercially important bamboo species at Annexure V. In case of intensive farming practices with drip irrigation and fertigation, the plantation intensity may be increased by 20%. It has been observed from the field that the spacing shall be at least 5m x 5m for yield of quality bamboo culms suitable for industrial uses. As indicated in Annexure IV, the bamboo plants can be planted at spacing of 8mX8m for longer size bamboo (65 plants/acre), 5mX5m for large and medium bamboo (160/acre) and 3mX4m for small bamboo (333/acre). The species of the bamboo according to the size has been mentioned in the table below:

Type of bamboo	Species of bamboo
Largest Size	*Dendrocalamus giganteus*
	D. asper
	D. brandisii
	Dendrocalamus hamiltonii
Large size	*Bambusa balcooa*
	B. vulgaris
	Gigantochloa attrovoilaceae (Black bamboo)
	D. somedevai
Medium Size	*Bambusa tulda*
	Bambusa nutans
	Bambusa polymorpha
	Dendrocalamus membranaceus
Small Size	*D. strictus*
	D. stocksii
	Thyrsostachys oliveri

High Density Bamboo Plantation has not been observed useful to serve the industrial aspect of the bamboo resources due to its poor quality and growth. It is useful for biomass production only. The other aspects of High Density Bamboo Plantation need to be explored by the expert before promoting bamboo plantation to avoid any ambiguity or dispute in future from the community.

It may be ensured that the priority should be given to the species according to Agro-climatic zone and saplings should be procured from trusted/accredited nurseries.

• Plantation and maintenance operation of bamboo

The detail maintenance and operations are indicated in the following flow chart on bamboo plantation:

Start in summer
Pit size: 60 x 60 x 60 cm
Take soil out to solarize in heat

I year
1 bucket (15 litre) compost + (25 gm Urea + 125 gm DAP + 100 gm MoP) or (100 gm 12:32:16 + 100 gm MoP) Or,
Half bucket compost + 100 gm Neem khali + (25 gm Urea + 100 gm DAP + 50 gm MoP) or (50 gm Urea + 100 gm 12:32:16)
Fungicide: 5 gm Bavistein + 5 gm dithane M 45
Insecticide: Cloropyriphos after plantation (20 ml/10 litres water)

Fertilizer in next spring:
Each pit: 10 gm each of (18:18:18 and 17:44:00) + 10 g Boron + 10ml humicil and micronutrients in 10 litres water + 50 gm Khali followed by irrigation
In March, Cloropyriphos (2 ml/l water) - 10 litres followed by irrigation
July and August (Twice): 10 gm each of (18:18:18 and 17:44:00) + 10 g Boron + 10 ml humicil in 10 litres of water + 100 gm Khali followed by irrigation
This will be repeated to next year also
Irrigation: bamboo loves water , proper irrigation result in many shoot emergence. Regular watering through channel: yields at least 7-11 shoots per year after 3 years
Micro-irrigation through drip: this improve 25 % over the regular irrigation; at least 10-14 shoots per year after 3 years

Mixed/Intercropping

The agricultural and horticultural crops have been grown successfully that includes tomato, lady's fingers, brinjal, chillies, radish, beans, soya bean, cowpea, beetroot, watermelon, sweet potato, maize, wheat, paddy, sorghum, bajra, ragi, kutki, red gram, black gram, green gram, mustard, ginger, turmeric, banana, papaya and medicinal plants.

The duration of intercropping depends on the spacing provided in bamboo plantations. As soon as the canopy closes, the shade prevents many crops from coming up well. Trimming of the culms beyond the marketable pole length could be considered as a means of improving the light availability and thereby permitting intercrops to be cultivated for a longer duration and improving the profitability of the farming.

• Training and capacity building

The States/UTs to conduct training on bamboo plantations for master trainers in coordination with the Bamboo Technology Support Groups of National Bamboo Mission (NBM) or any other appropriate agencies of expertise. A set of master trainers will impart training to the stakeholders at District, Block and Gram Panchayat level. The training should cover about the species selected for plantation along with its uses, technical knowhow on cultivation, monitoring growth pattern and mortality replacement procedure and marketing.

Training on cultivation, drip/sprinkler irrigation, knowledge of quality planting material, market demand assessment, sustainable harvesting techniques/practices and seeking the technical know-how should also be covered during the training programme.

• Convergence with line department

The convergence may be made with line departments such National/State Bamboo Mission, Forest Departments, Pradhan Mantri Krishi Sichai Yojana (PMKSY) etc., for taking up bamboo plantation. The convergence of NBM activities with other programms has been taken up by several State Bamboo Missions (SBM). The experience in this regard by the Kerala and Madhya Pradesh may be explored. There is great potential for the convergence NBM & Mahatma Gandhi NREGS activities.

• Marketing

- The support of National/State Bamboo Missions may be taken for backward and forward linkages of bamboo and integrate with an organized marketing structure, primary retail markets nearby of farm gates. The mission aimed at increasing the area under bamboo cultivation, processing, branding and marketing. It will promote bamboo plantation which will further encourage the farmers for bamboo plantation.

- Green Skill Development Programme of Ministry of Environment, Forests & Climate Change (MoEF&CC) offers bamboo-based course on propagation and management of bamboo (factual knowledge of propagation, processing, and management of bamboo) and value addition & marketing of bamboo.

- Women's Self-Help Groups may be sensitized for development of different handicrafts products of bamboo. Bamboo Compressed Bio Gas (CBG) setup may also be established to empower SHGs / FPOs / Co-operatives.

- Bamboo bio-mass waste to pallets and briquettes production for assuring the 8-10% requirement of NTPC thermal power plants as green fuels.

- States/UTs to ensure provision of a assured market at the block/district level to facilitate buying and selling of bamboo and its products.

• Advise on Tissue Culture Planting Material

- Recently, juvenile flowering issues of bamboo plantation have been noticed in some parts of the country where tissue culture planting materials have been used, especially for the species *Bambusa balcooa*. The matter was discussed with the expert in the Forest Research Institute (FRI), Rain Forest Research Institute (RFRI) and Kerala Forest Research Institute (KFRI) and views are not to promote tissue culture at present.

- It was suggested that the vegetative and seed propagation methods also may considered. In case the Tissue Culture (TC) planting materials are used, assurance shall be sought from TC nurseries about the selection of parent material and protocol of the TC procedure of the bamboo species.

- The Tissue Culture nursery should be held responsible for the replacement of the sapling of the same species with their own cost in case of premature/juvenile flowering within 10 years of plantation.

- The quality planting materials shall be procured from nurseries accredited by any National/State Bamboo Missions, State Forest Research Institutes, Central/ State Agriculture Universities, ICAR/ICFRE institutes or any other competitive agency in the Govt/-Public Sector.

• Conclusion

The following aspects need to be followed for undertaking bamboo plantation and intercropping therein under Mahatma Gandhi NREGS

- Cluster based approach may be followed for individual beneficiaries with small land holding.
- The quality planting materials shall be procured from nurseries accredited by any National/State Bamboo Missions, State Forest Research Institutes, Central/ State Agriculture Universities, ICAR/ICFRE institutes or any other competitive agency in the Govt/-Public Sector.
- At present Tissue Culture practice should not be followed however if in case Tissue Culture (TC) planting materials are used, assurance shall be sought from TC nurseries for non-juvenile flowering.
- Bamboo can be planted at spacing of 8mX8m for longer bamboo (65/acre), 5mX5m for large and medium bamboo (160/acre) and 3mX4m for small bamboo (333/acre).
- Plantation and maintenance operation of bamboo should be carried out as per the norms and in-situ requirements.
- The mixed/intercropping of agricultural and horticultural crops along with medicinal plants can be done in the spacing available between bamboo plants.
- The States/UTs to impart training to the master trainers at the state level and the same should be replicated upto the Gram Panchayat level.
- The convergence with line departmental scheme like National Bamboo Mission (NBM), State Bamboo Missions, State Forest Department, Pradhan Mantri Krishi Sichai Yojana (PMKSY) etc., may be made on bamboo plantation.
- The marketing of bamboo and its products may be assured at the village/Panchayat level for facilitating the farmers.
- Women's Self-Help Groups may be sensitized for development of different handicrafts products of bamboo.

- Bamboo Compressed Bio Gas (CBG) setup may also be established to empower SHGs / FPOs / Co-operatives. The bamboo bio-mass waste to pallets and briquettes may be sold to National Thermal Power Corporation thermal power plants as green fuels.

Annexure I - Notification on formation of the advisory Group on Bamboo Plantation under Mahatma Gandhi NREGS

807738/2022/MGNREGA

J-11017/05/2022-RE-VII

J-11017/05/2022-RE-VII (381811)
Government of India
Ministry of Rural Development
Department of Rural Development
(Mahatma Gandhi NREGA Division)

Krishi Bhawan, New Delhi
Dated: 03.11.2022

OFFICE MEMEORANDUM

Subject: **Advisory Group on bamboo plantation - reg.**

With the approval of the Competent authority , a "an advisory Group on bamboo plantation" is constituted with the following composition:

1.	**Shri Amit Kataria, Joint Secretary (Mahatma Gandhi NREGA), D/o Rural Development**	**Chairperson**
2.	Representative from Ministry of Environment, Forests and Climate Change, GoI	Member
3.	Representative from National Bamboo Mission ,Deptt. of Agriculture & Farmer's Welfare, GoI	Member
4.	Shri . Sanjeev S. Kapre, Konkan Bamboo & Cane Development Center , Sindhudurg, Maharashtra	Member
5.	Representative from Bamboo and Cane Development Institute (BCDI) , Tripura	Member
6.	Mr. Pasha Patel, Transform Rural India Formation (TRIF)	Member
7.	Dr. N. Bharti, Growmore Biotech Ltd ,Hosur-635109	Member
8.	Shri. Subhash Bhatia, Green Bamboo Tech ,Jabalpur-482051	Member
9.	Shri.Lalit Sharma, Poongi Jaivik Urja Farmer Producer Company Ltd , Pratapgarh	Member
10.	Representative from FRI	Member
11.	Ms. Kalpana Parmar , M/s Gajraula Farms Agro Tech , Pilibhit ,Uttar Pradesh	Member
12.	Shri. Dharmvir Jha, Director, Dept. of Rural Development	Convener

2. The Terms of Reference of the Committee will be as follows:

I. To advise on issues of mixed plantation /inter-cropping of bamboo with other species.
II. To advise on plantation density of bamboo plantation.
III. Any other related issue referred to the Advisory Group

3. Chairman may co-opt any official/non-official member in the committee with the due approval of the Ministry.

4. The Advisory Group will conclude its task in 1 month's time.

4. Travelling Allowance (TA) and sitting fee for non-official members will be paid at per extent rules.

This issues with the approval of Secretary, Rural Development.

(Dharmvir Jha)
Director (Mahatma Gandhi NREGA)
Telephone- 011-23385991

To
All the Members of the committee

Copy to:

1. Secretary, Ministry of Environment, Forests and Climate Change with the request to nominate an officer not below the rank of Deputy Secretary of the Ministry.
2. Secretary, Ministry of Agriculture
3. Director General, Forest Research Institute (FRI)

Distribution:

1. PS to HMRD/MoS (RD)
2. PSO to SRD
3. Director/DS/JD- of this Division

Annexure II - Minutes of the meeting of the Advisory Group Members on Bamboo Plantation under Mahatma Gandhi NREGS

A virtual meeting of the Advisory Group on Bamboo Plantation under Mahatma Gandhi National Rural Employment Guarantee Scheme (Mahatma Gandhi NREGS) was held under the Chairpersonship of Shri Amit Kataria, Joint Secretary (RE), Ministry of Rural Development on 29.11.2022 at 03:00 p.m. The list of participants is appended.

At outset the Joint Secretary (RE) welcomed the participants and said that bamboo has great potential for livelihood and income generation and is environmentally safe. Bamboo plantation is a permissible activity under Mahatma Gandhi NREGS, and it is also being practiced under the scheme. However, as per the various studies and recommendation it is suggested to plant Bamboo under mixed plantation with other crops. Further, he flagged the following points for discussion:

- To advise the issues of mixed plantation/intercropping of bamboo with other species
- To advice on increasing the productivity (production per unit area), plantation density and area under Bamboo production.
- To prepare technical manual and guidelines on bamboo plantation keeping in views the framework of Mahatma Gandhi NREGS.
- To promote bamboo plantation in large scale in rural areas, the valuable recommendation of the advisory group will be taken into consideration.

The Convener of advisory group Shri Dharmvir Jha, Director (RE), Ministry of Rural Development made detail presentation on ToR and provisions and salient features of Mahatma Gandhi NREGS.

After presentation, Chairperson requested the advisory group members to share their view points and ideas on bamboo plantation.

Representative of Sanjay Kumar Chauhan, Member

Points/ ideas shared by the member are detailed below:

1. The advice on Bamboo plantation will be shared

Representative of Prabhat Kumar, Member

Points/ ideas shared by the member are detailed below:

1. Market demand needs to be kept in mind before undertaking plantation of bamboo species.

Sanjeev S Kapre, Member

Points/ ideas shared by the member is detailed below:

1. Reasons for bottleneck and limited coverage of the schme need to analysed and problems need to be address to simplify the scheme.
2. Finalize on bamboo plantation for spacing, selection of species and inter/mixed cropping.

Abhinav Kant, Member:

Points/ ideas shared by the member are detailed below:

1. Tripura is practicing bamboo plantation since many years, and they have schedule designed for rate, spacing, cultural operations, intercropping etc.
2. Problem in policy issues in Tripura as bamboo plantation is permitted in individual land or community land and not on patta land. This has impacted bamboo planantion in the State since last 3-4 years.
3. The State of Tripura is planting high density plantation. He furher addded that the bamboo species should be selected taking into consideration the purpose for which it is required i.e. bio energy, charcoal, handcrafts and separate SOR to be developed as per the requirement.
4. With refernce to intercropping and common norms for undertaking bamboo platation need to be worked out.

Pasha Patel, member:

Points/ ideas shared by the member are detailed below:

1. Bamboo plantation is time bound process and therefore, the timely approval for such process in prime important.
2. There should be timeline defined for receipts of proposals like 1 April to 30 June.
3. The explicit manpower for bamboo plantations should be deployed with view to properly guiding the farmers and timely taking up operations related to bamboo plantation.
4. Bamboo plantation may be intercropped with teak, Indian gooseberry, sandalwood, custard apple, timber species etc. for this purpose a protocol need to be worked out.
5. Bamboo plantation may be taken up on farm land, farm bunds, river banks, railway line, along road side, highway and fencing of agriculture field to protect against wild animals.
6. Estimates on bamboo plantation and its economic aspects of bamboo cultivation need to be worked out.

7. The rules & regulations and other procedure for growing of bamboo to be simplified for ease of implementation.
8. The Self Help Groups (SHGs) and Farmer Producer Organizations (FPOs) / Farmer Producer Company (FPCs) may be involved for undertaking plantation.

Dr N Barathi, member:

Points/ ideas shared by the member are detailed below:

1. He had made presentation on bamboo plantation and showcased different models to increase and maximize the yield by appropriate spacing of bamboo plantation.
2. Bamboo plantation may be intercropped with banana, beans, maize, rice, mustard, turmeric, ginger, soyabean, pigeon pea, green grams, wheat, paddy etc
3. In his presentation recommended certain species of bamboo like *Bambusa balcoa, B. tulda, B. nutans, Dedrocalamu sstockii, D, aspera* suitable for intercropping,
4. By following the precision farming the production can be increased from 1 ton/ha to 100 tons /ha.
5. The availability of the right planting material needs to be ensured.

Subhash Bhatia, Member:

Points/ ideas shared by the member are detailed below:

1. Along with the cultivation of bamboo and value addition should also be emphasized for livelihood generation.
2. Shared his experience of cultivating bamboo in the adverse condition in a small holding of merely 7.5 acre.
3. Cluster based approach need to be followed up with view to generate employment and successful implementation of bamboo plantation for multiple uses and great demand in market.
4. The convergence with National/State Bamboo Missions may be done for undertaking bamboo plantation.

Lalit Sharma, Member:

Points/ ideas shared by the member are detailed below:

1. Bamboo plantation may aid in addressing the vagaries of climate change and flood control.
2. Intercropping or mixed cropping of lemon grass, khas, citronella with bamboo plantation provide promising returns.
3. Irrigation, especially drip irrigation needs to be ensured for proper growth of bamboo for this purpose convergence with line department may be made and Horticulture

Department/Irrigation Department/Forest Department may be involved for availing the subsidy and other benefits of their scheme.
4. Model Detailed Project Reports (DPRs) on bamboo plantation are available.
5. Various herbal and aromatic plants like Ashwagandha, Tulsi, Lemongrass, Sarpgandha may also added for intercropping with Bamboo plantation.

Dr. Ajay Thakur, Member:

Points/ ideas shared by the member is detailed below:
1. He has made presentation on showcasing the need for bamboo cultivation and different commercial varieties available for cultivation.
2. Standard Operating Procedure (SOP) submitted by ICFRE, Dehra Dun may be referred for development of module on bamboo plantation.
3. He insisted that before taking up plantation, the purpose need to be understood for deciding the spacing.
4. Bamboo may be grown on the river bank, which aids in rejuvenation.

Ms. Kalpana Parmar, Member:

Points/ ideas shared by the member are detailed below:
1. Shared her experience on bamboo farming. She further added that, growing bamboo on patta land is not allowed in the state of Uttar Pradesh.
2. Quality propagation material should be made available for ensuring the confidence of the beneficiary; this will aid in awareness level and motivating the farmer.
3. Market demand to be judged before taking up plantation. The backward and forward linkages may be understood and implemented judiciously.
4. The availability of water for irrigation is primary pre-requisite for bamboo cultivation.
5. The bamboo can be intercropped with poplar, eucalyptus, turmeric. Mango, guava. She shared the availability of good quality seed is prime important.
6. Awareness on bamboo cultivation may be emphasized by encouraging the small and marginal land holders. Bamboo may be grown on fence, as boundary, along the pond i.e. no exclusive land is needed.

After detailed deliberation of the members of Advisory Group, the Chairperson has advised to share the documents and suggestions of the members of the advisory group for further orientation of bamboo plantation under Mahatma Gandhi NREGS.
The meeting ended with vote of thanks to chair.

List of participants
1. Shri Amit Kataria, Joint Secretary (RE), MoRD – Chairperson

2. Shri Sanjeev S. Kapre, Director, Konkan Bamboo & Cane Dev. Maharashtra
3. Shri Abhinav Kant, Incharge, Bamboo & Cane Dev. Institite (BCDI), Tripura
4. Shri Pasha Patel, Senior Farmer Leader, Transform Rural India Formation (TRIF)
5. Dr. N Barathi, Bamboo Scientist, Growmore Biotech Limited , Hosur, Tamil Nadu
6. Shri Subhas Bhatia, Bamboo Expert, Green Bamboo Tech, Jabalpur
7. Shri Lalit Sharma, Poonji Jaivik Urja Farmer Producer Company Ltd., Pratapgarh
8. Dr Ajay Thakur, Scientist F, Forest Research Institute, Dehradun
9. Ms Kalpana Parmar, Farmer, M/s Gajraula Farms Agro Tech, Philibhit, Uttar Pradesh
10. Representative of Shri Sanjay Kumar Chauhan, AIG (Survey and Utilization Division), MoEF& CC
11. Representative of Shri Prabhat Kumar, Horticulture Commissioner, MoA&FW
12. Shri Dharmvir Jha, Director (RE), MoRD-Convener

Annexure III - Comments from Advisory Group Members on Bamboo Plantation

Comments from Advisory Group on Bamboo Plantation are as follows

1. Dr. Ajay Thakur, Member:

1 A presentation showcasing the need for cultivation of bamboo from tested quality planting material developed at Indian Council of Forestry Research Education (ICFRE) was made to committee members.

2 Standard Operating Procedure (SOP) submitted by Forest Research Institute, Dehradun may be referred for development of module on bamboo plantation.

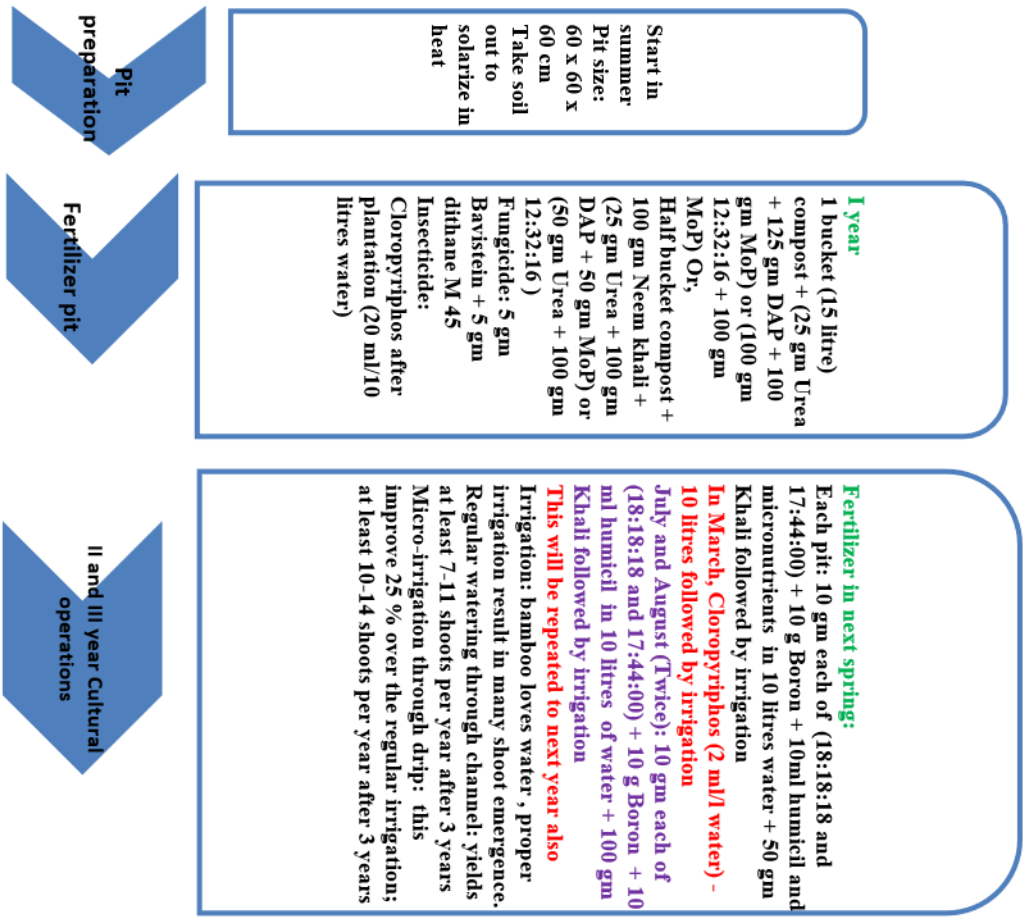
3 Under Mahatma Gandhi National Rural Employment Guarantee Scheme (Mahatma Gandhi NREGS), beneficiaries are expected to be landless and marginal farmers engaged as labour for bamboo plantation on common pool land of village or small and marginal farmers. Hence, it is pertinent to have different types of plantation schemes for different beneficiaries:

- Common pool land: Block plantations, border plantations of fodder/forage area, shelterbelts, strip planting on the banks of river/nullah/Nala/lake/pond
- Small farmers (0.5 to 2 ha): preferably bund planting on the farm and may be block planting
- Marginal farmers (less than 0.5 ha): Line or bund plantation.

4. Species of bamboos: Selection of species should be based on the demand nearby and cluster based approach. It is preferred to have species selected required for an industries nearby or based on end use. Merely potential end-use may end up big loss for the grower.
   If, there is no market nearby then two end-uses with local demand can easily be developed; furniture including hut and polyhouses and bamboo as a prop for agriculture. In that case preferable species may be *Bambusa nutans, B. tulda, B. pallid, B. polymorpha, B. vulgaris, Dendrocalamus sikkimensis, D. stocksii* depending upon geographical area. *Bambusa balcooa* and *Dendrocalamus strictus* are most suitable for structural uses, biomass and pulp, hence for other purpose it should not more than 10 % in combination.
5. Spacing: Spacing is big issue in bamboo plantation. Bamboo roots are surface feeder and hence grows horizontally. In close spacing, like less than 3 meters or 10 feet, it competes most and fails to attain a thickness of commercial size (desirable pole size is thickness of 7.5 cm and length of 8 m, called bullet in commercial terms). It is elaborated further as follows:

- Spacing of bamboo depends on size of bamboo like Very large, large, medium and small, site quality including moisture and soil and end use. In best alluvial soils with sufficient humidity spacing for very large bamboo *Dendrocalamus giganteus* (size of 30 meters) should be 8 m by 8 m in plantation and 6 m on border plantation whereas for large bamboo like *Bambusa balcooa*, spacing should be 5 m by 5 m in plantation and 3.5 m on border. This spacing will yield the desired thickness (more than 7 cm thickness and 8 m height) and good price in 5th years onwards. In case of intensive farming practices with drip irrigation and fertigation, the plantation intensity may be increased by 20 %. Spacing for each species in plantation has been mentioned in Annexure IV. In general for large bamboo like *balcooa, polymorpha* and vulgaris plantation density for block plantation should be 160-180 per acre, medium bamboos like tulda and nutans plantation density for block plantation should be 180-200 per acre and for small bamboos like *Bambusa pallida, Dendrocalamus stocksii* (Managa), *Thyrsostachys oliveri, D. strictus* plantation density for block plantation should be 380-425 per acre.

6. Plantation time: Plantation should preferably in July or early August month in normal area. In flood prone area, it is suggested after receding of water which usually happens in late August and September month. In drier area it should be done arrival with first monsoon.
7. Flow Chart 1: Planting and maintenance operation of bamboo



8. By applying this spacing for plantation, there are two years window of intercropping between the rows, where crops can be grown between lines. In third years, onwards bamboo roots grow more than 2 m, so it creates competition for not only growing crops but also to bamboos.

   Though on outer border deep rooted tree crops may be planted keeping sufficient distance of 5 meters from bamboo. In north India, bamboo can be grown on the border of mango orchards. This act as a good wind break for the orchard, bamboo leaves as a mulching during summer season and co-cultivation helps a regular income in case of bamboo.

9. Direction of plantation: if plantation is from east to west direction, plant to plant distance should be more and if from south to north then distance should be more in case of row to row. This arrangement gives better sunlight from south during autumn and spring.

10. Irrigation: Bamboo for first three years requires regular irrigation during summers and monthly irrigation during winter. Hence farming of other crops in first two years help bamboo. After that, fortnightly irrigation during summers help to develop early shoots during rainy season.

11. Fertilizer: Bamboo grows very fast during rainy and autumn season so a fertilizer application is good during that period. The doses given in above flow chart should be followed, by splitting recommended doses in two during rainy season. Also, must get soil tested before application of fertilizers. In India, potash is high as compare to other crops, there should be caution before application.

12. Bamboo are most suitable on the river bank, nullah, pond and other water bodies, where it aids in rejuvenation and also controls soil erosion. It goes very well with aquaculture as its leaves helps in fish growth. It has been seen that two strip plantation of bamboos on pond are very good.

2. Dr N Barathi, Member

Site selection for bamboo plantation

It is recommended to grow bamboo in units of 50 cents (0.5 acres) by each family in one of the following areas.

1. Surrounding the living place.
2. In barren land adjacent to agricultural land.
3. In common community land.
4. Asan avenue tree along the roadside and high ways

In nature Bamboo is wild and grows on its own with no care and management. Under unmanaged conditions, though the Bamboo grows, the yield is 1 to 2 tons per acre per year.

Bamboo cultivation is not yet popular due to the absence of high-yielding clones, assured good quality planting material, the lack of standardized cultivation methods and farming techniques for the field condition.

Choice of species

The choice of species of bamboo, spacing and uses are attached herewith.

Block plantation of bamboo

Bamboo, in a block plantation, can be cultivated under three plant spacing models. The choice of model is based on the end use of bamboo for which the bamboo plantation is raised. The 3 models of Bamboo plantation density are

1. High Density 2. Medium Density 3. Low Density

Model-1: High-Density Method, No. of required Plants: 1,000 plants/acre
Spacing: Row to Row: 10 feet and Plant to Plant: 4 feet. The First Harvest starts during 3rd year, under irrigated, fertilised and well managed conditions. In 3rd year the culm thickness will 1/3rd and utilised as feedstock for Energy but with full biomass yield. Uses: Biomass such as Power Generation, Bio-CNG, Bio-Ethanol, Bio-Petrol/Diesel, Activated charcoal, Vegetables/Banana staking etc.,

Model-2: Medium Density Method, No. of required Plants: 500 plants/acre
Spacing: Row to Row: 12 feet and Plant to Plant: 9 feet, Uses: Paper pulp, furniture, etc., The First Harvest starts after 4 years, under irrigated, fertilised and well managed conditions. In 4th year grows to Half the culm thickness but with full biomass weight.

Model-3: Low-Density Method, No. of required Plants: 200 plants/acre
Spacing: Row to Row: 15 feet and Plant to Plant: 15 feet, The First Harvest starts after 5 years, under irrigated, fertilised and well-managed conditions. In 5th year grows to full diameter and yield Uses: Construction, furniture, poles, etc.,

Drip irrigation and fertilizer application are important to harvest 30 to 60 wet tons of bamboo /acre /year Or 20 to 40 dry tons/acre/year.

SN	Plant density	Total no of plants/0.5 acre	Intercropping for	Harvestable period
1	High Density	500	6 Months	2.5 yr.
2	Medium Density	250	1 year	4 yr.
3	Low Density	100	2 years	5 yr.

Intercropping:

Since bamboo trees are planted at a distance in plantation, this leaves a gap in the canopy for the first few years, farmers can benefit by using the space for short rotation crops and add to increase the profitability of the plantation. Inter crops also provide cash flow during the first 2 years when bamboo is not ready for harvest. Various agricultural and Horticultural crops have been grown successfully that includes tomato, lady's fingers, brinjal, chillies, radish, beans, soya bean, cowpea, beetroot, watermelon, sweet potato, maize, wheat, sorghum, bajra,


BAMBOO WITH COWPEA

ragi, kutki, red gram, black gram, green gram, mustard, ginger, turmeric, banana, papaya, mushroom and ayurvedic and medicinal plants. The ginger and turmeric are relatively shade tolerant and can be grown even after the canopy partially closes. Some of the Ayurvedic medicinal plants can also be introduced as intercrops in bamboo plantations. In the northeastern states, some of the crops being cultivated include soya beans and maize during the initial years.

The duration of intercropping depends on the spacing provided in bamboo plantations. As soon as the canopy closes, the shade prevents many crops from coming up well. Trimming of the culms beyond the marketable pole length could be considered as a means of improving the light availability and thereby permitting intercrops to be cultivated for a longer duration and improving the profitability of the farming.

Plants recommended for Intercropping with Bamboo

BAMBOO WITH TURMERIC

1. Vegetables. (Tomato, Bhendi, Brinjal, Chillies, Radish, Beetroot, etc)
2. Millets (Maize, Sorghum, Cumbu, Ragi, Samai, Varga, etc)
3. Pulses (Blackgram, Greengram, Cowpea, etc)
4. Cereal (Wheat,etc.)
5. Cash crops (Turmeric, Banana, Mushroom, etc)

Benefits of intercropping

The intercropping offers the following benefits

- The use of nitrogen-fixing leguminous plants is particularly suggested to improve nitrogen availability.
- The use of cover crops will also serve to conserve moisture due to their spreading and leafy nature of these intercrops.
- The presence of such intercrops also helps recycle and retain the nutrients in the soil and prevent the growth of weeds.
- The duration of intercropping depends on the spacing provided in bamboo plantations. As soon as the canopy closes, the shade prevents many crops from coming up well. Trimming of the culms beyond the marketable pole length could be considered as a means of improving the light availability and thereby permitting intercrops to be cultivated for a longer duration and improving the profitability of the farming.

As mentioned in the Para 4 (1) Category: C of Mahatma Gandhi NREG Act, the livelihood activities of Self-Help groups can be increased by creating a common facility center for 500 people or 5 to 10 groups of self-help groups of farmers can combine to start a Value added products following products through Bamboo. Such as

1. Production of Pellets from Bamboo wood chips.
2. Charcoal making from the Bamboo wood
3. Power generation through by utilizing bamboo as raw material 1MW Electricity production through the Bamboo Biomass.
4. Bamboo as a Lumber.
5. Handicrafts made from bamboo such as Bamboo baskets, Bamboo spoons, Bamboo pen stands, Bamboo trays, Bamboo pens, Bamboo hooks, etc.
6. Activated carbon.
7. CNG

Yield

Bamboo yield may be realised in after 3-5th years onwards and yield may varies from 10 to 40 tons per acre per year according to species and spacing under optimum condition.

Cost of cultivation

COST OF CULTIVATION OF 0.5 ACRE BAMBOO UNDER PRECESSION FARMING									
					VALUES IN Rs				
No	Items	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year
1	Ploughing (Ist year - 2 times	500	0	0	0	0	0	0	0
2	Digging of pits	8,000	0	0	0	0	0	0	0
3	Ploughing for Weed Removal	500	500	500	500	500	500	500	500
4	Planting Material	12,500	0	0	0	0	0	0	0
5	Transport cost	1,100	0	0	0	0	0	0	0
6	Mortality Replacement	1,360	0	0	0	0	0	0	0
7	Farm yard Manures	12,000	3,000	0	0	0	0	0	0
8	Fertilizers	3,533	6,007	7,067	7,067	7,067	7,067	7,067	7,067
9	Plant Protection	500	500	500	500	500	500	500	500
10	Electricity for Irrigation	972	1,620	1,620	1,620	1,620	1,620	1,620	1,620
11	Drip system	5,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
12	Inter cultivation cost	7,000	0	0	0	0	0	0	0
13	Labour cost	9,158	3,617	5,173	5,764	6,300	6,300	6,300	6,300
	TOTAL	62,124	16,243	15,860	16,451	16,987	16,987	16,987	16,987
	Bamboo yield in tons			11	13	15	15	15	15
	Cost of Production of one Ton of Bamboo in Rs			1,424	1,250	1,132	1,132	1,132	1,132

The total cost of cultivation of 1 acre of bamboo plantation is between 0.8 to 1.5 lakhs which will take 3 to 5 years to get the first harvest which depends on

1. The final product for which Bamboo is cultivated
2. The spacing between plants and bamboo rows or the number of plants per acre.
3. The type of irrigation and quality of water provided to the plant.
4. Application of manure and fertilizer
5. Adaptation of improved agricultural practices.

The above factors may increase the cost of cultivation from that of conventional methods of bamboo cultivation, However, the increase in yield would justify the additional cost.

The Project:

Fast growing thornless bamboo species would be planted on 0.5 acres under hi-density by each family. The high yielding bamboo species would be selected as per the site condition and based on the final product to be manufactured out of bamboo. 500 numbers of farmers will form a cluster, forming one unit having 250 acres to produce 7500 tons of bamboo annually. The cluster will have

a common bamboo processing facility for manufacturing the bamboo products such as biomass pellets, charcoal, bamboo lumber, gasifier for Power generation, etc.

Cost of cultivation of 250 acre bamboo under precession farming in a single cluster.

Establishment of plantation by Precision Farming method:

Unit area : 0.5 acres

No. of units to be covered in one cluster : 500 no.

1) Capital Investment on Farm Establishment : Rs 392 lakhs
2) Annual cultivation expenses :
   a) 3rd year : Rs.79 lakhs
   b) 4th year : Rs.82 lakhs
   c) 5th year : Rs.85 lakhs
   d) 6th year onwards : Rs.85 lakhs
3) Average cost of cultivation/ton of biomass : Rs.1132
4) Biomass Production per annum in tons : 7500
5) Operation annual net profit. : Rs 215 lakhs
6) Employment generation : 60 persons

1. Production of Pellets from Bamboo wood chips

Biomass Pellets made out of bamboo is replaces coal in thermal plants, since bamboo pellets have an energy value of 4200 kcal and ash of 2 percent. The government of India has formulated

a policy to replace 5 percent in 2022 (7 per cent in 2023, 10 per cent in 2024, 20 per cent in 2025) of coal which amount to 400 lakhs tons of pellets annually. This demands a cultivated bamboo of 6.6 lakhs acres of bamboo to meet 50 percent of the pellet requirement in India. Bamboo pellet production contributes to local economics and the development of quality jobs across the entire value chain, particularly in rural areas. Promoting pellet production is particularly important right now since India is moving towards "Net Zero".

Economics of Bamboo pellet manufacturing

1) Capital Investment on Farm Establishment : Rs 150 lakhs
2) Annual operational expenses : Rs 225 lakhs
3) Average cost of production/ton of pellet : Rs.7000
4) Biomass pellet Production per annum : 7000 Tons
5) Operation annual net profit. : Rs 210 lakhs
6) Employment generation : 30 persons

On the similar line of bamboo pellet production, each cluster can produce 2600 tons of Charcoal from the Bamboo wood every year
Or 1 MW power project, generating 7200 MW hours of Power by utilizing bamboo as raw material
Or 1.5 lakh cu. feet of Bamboo Lumber
Or 900 tons of activated carbon
Or 3000 to 4000 tons of Handicrafts such as Bamboo baskets, Bamboo spoons, Bamboo pen stands, Bamboo trays, Bamboo pens, Bamboo hooks, etc.

3. Mr Abhinav Kant, Member

Standard Operating Procedure for field execution of bamboo plantation

- **Criteria for selection of village, Land and Beneficiary**

    - **High Density Bamboo Plantation with Intercrop**

The villages shall be within 30 km radius of Bamboo industrial/ value addition clusters so that the farmers will get maximum benefit by selling bamboo to the factories/units.

I. The cluster (one village or group of adjacent villages) shall have the potential to plant around 100 ha of bamboo in a commercial format by individual farmers.
II. If one village does not have this much of land for bamboo plantation, than the adjacent villages shall be covered to make one cluster of 100 ha.
III. The farmer shall be interested to take bamboo plantation as they plants rice/wheat/pulses and vegetable on their own interest even without support of Mahatma Gandhi GNREGS
IV. Farmers shall have own land and minimum area for bamboo plantation shall be 0.20 Ha
V. The farmers selected shall have land adjacent to each other so that logistic during the plantation can be provided easily and monitoring can be done properly. It will also reduce the cost of fencing and protection against grazing of animal/ monkey. It will help in easy harvest and transport letter on.
VI. The farmers has to use his own job card for getting the Mahatma Gandhi GNREGS fund and when required shall take the support of another job card holders to utilize all the 360 Unskilled Man Days allocated for one ha of bamboo plantation.
VII. Shall come to the group meeting organized by respective state bamboo mission to discuss and understand the issues and instructions from time to time.
VIII. Intercrop of short term crops within the bamboo plantation may be taken to maximize the benefit.

IX. The nurseries established under respective National/State Bamboo Missions may be given preference considering species availability, proximity to plantation area etc.
X. The convergence with National/State Bamboo Missions, State Forest Department, Pradhan Mantri Krishi SichaiYojana (PMKSY) may be made for training on bamboo plantation/cultivation, drip/sprinkler irrigation, preparation of estimates, supply of adequate quality planting material as per demand in market, sustainable harvesting techniques/practices and seeking the technical know-how, marketing of bamboo etc.

- **Documents required after mobilization & selection of beneficiary**

  - **Bamboo Plantation with Intercrop**

i. Copy of Land document of individual candidates (Parcha, Khatian, Daag no. etc.)
ii. Copy of Aadhaar
iii. Bank Details of individual candidates
iv. Colour Photograph of candidate
v. Resolution of Panchayat/ Village committee approving to take up the activity alongwith list of candidates
vi. Photograph of land in soft copy from various angles

- **Handing over of land/ premises to identified beneficiary group**

The identified suitable land/ building, after mutual verbal consent, has to be formally handed over to the SHG/ SHG Federation/ Panchayat by signing either of the following a legal document as seems suitable:

i. Resolution of PRI body (panchayat, village committee or panchayatsamiti)
ii. Letter from competent authority of in case of Govt. land (department etc.) allowing to use the land and a handover document to handover the land to beneficiary group
iii. Application to competent authority (for industrial estates) in their prescribed form and getting a letter of allotment

- **Procurement of Machineries, Equipment, Fixed Assets & other materials and Handover of Assets**

The identified machineries, equipment, fixed assets & other materials are to be procured through the process of tendering (or limited tendering from shortlisted suppliers).

Procurement Committee: A procurement committee comprising officials of respective state bamboo mission or any other expert agency, as may be desired.

- **Bamboo Plantation with Intercrop**

Planting Material & other material

i. Tender for supply of Planting Material of required species; the nurseries established under respective state bamboo mission may be given preference considering species availability, proximity to plantation area etc.
ii. Receipt of sealed bid documents by respective state bamboo mission
iii. Opening of Bid Documents at respective state bamboo mission office in presence of competent authority
iv. Evaluation of bids and awarding of supply order. Payment may be released to the supplier either by respective state bamboo mission or through District/ Block administration.
v. Final inspection jointly by respective state bamboo mission and panchayat teams and on satisfactory result, release of final payment to the supplier as per supply order

- **Establishment, Operation & Maintenance of Bamboo Agro-Forestry Unit**

- **Plantation with Intercrop**

i. Labour required for establishment & maintenance of Plantation may arranged through Mahatma Gandhi GNREGS, but the beneficiary shall provide his/ her own labour as may be required
ii. Choice of intercrop will depend on easy & adequate availability of species, local market demand and preference of beneficiary
iii. The Plantation has to be established and maintained as per technical specification within specified timeline
iv. Proper care shall be taken by the beneficiary in preventing damage of plantation due to animal grazing, intrusion etc.
v. Any additional cost for maintaining the Plantation shall be borne by the individual beneficiary
vi. The grown bamboo & intercrop shall be harvested in proper technique and in designated time/ season

- **Roles & Responsibility matrix of manpower involved**

Beneficiary SHG/ Individual Beneficiary	- Availing suitable land - Pre-cleaning of land - Proper care & maintenance of nursery/ plantation
Mobilizer	- Day-to-day contact with beneficiary group and provide relevant information - Regular meeting with beneficiaries and resolving issues
Field Supervisor	- Execution as per action plan

	- Report preparation and submission on weekly basis - Providing technical inputs as may be required
Agri Expert	- Overall action plan formulating and monitoring the field team - Providing technical inputs incl. data collection format, reporting format and other technical aspects
Producer Organization/ Farmers' Consortium	- Maintain & ensure proper maintenance of nursery/ plantation - Ensure proper harvesting method by the individual farmers - Undertake organized marketing of bamboo/ intercrop - Undertake primary processing of bamboo & value addition

- **Risk factors**

i. Not following proper techniques may lead to inadequate growth, lower rate of mortality etc.
ii. Improper care & maintenance may lead to damage of nursery/ plantation
iii. Non-placement of fund in due time may lead to conflict among the beneficiaries.

- **Convergence of Expenditure for Bamboo Plantation per Hectare**

S N	Detail of Expenses	Quantity/ Ha	Rate	Amount in Rs. / Ha	Convergence
1	Site cleaning in Man Days	35MDs	As per state		Mahatma Gandhi GNREGS
2	Cost of lining, staging and pitting, refilling and planting ()	3x3 = 1100 4x4 = 625 5x5 = 400	20 MDs (can be converted into MDs)		Mahatma Gandhi GNREGS
3	Fencing around the garden	Lump sum		15,000	National Bamboo Mission (NBM)
4	Cost of Planting material incl. transport	1100 625 400	30 MDs	33,000 18,750 12,000	NBM
5	15% mortality-vacancy filling (with Labour cost)	165 94 60	50 MDs (can be converted into MDs)		Mahatma Gandhi GNREGS& NBM
6	Two weeding and one clearing around the base with earth mounding	105MDs	As per state		Mahatma Gandhi GNREGS

7	Cost of fertilizer	1100 625 400	20 MDs	22,000 12,500 8,000	NBM
8	**Expenditure during 1st year**				
9	Two weeding and one earth mounding around the plant	105MDs	As per state		Mahatma Gandhi GNREGS
10	Cost of fertilizer	1100 625 400	20 MDs	22,000 12,500 8,000	NBM
11	**Expenditure during 2nd year**				
12	**Total expenditure in two years**				

Note:

- Costing will be based on spacing and species to be planted
- Irrigation cost has not been included and treated as beneficiary contribution.

As per the NBM guidelines plantation is only allowed to private land or government land. But in North East most of the land is allocated to tribal people under patta land and in this plantation is not allowed under NBM. Since 2017 no plantation has been done on patta land which also affects the target. It is recommended to include patta land for bamboo plantation under NBM.

4. Ms. Kalpna Parmar, Member

Based on her experience of almost two decades of growing Bamboo in a non-bamboo growing area, she made the following submissions:

- In a state like UP, where individual landholdings are very small, chances of taking up bamboo plantation in a large scale, say one hectare or more, are remote possibility;

- Another obstacle in UP where lease holders or contract farmers are NOT covered by any scheme which provides Govt assistance in the form of financial or any other support;

- It necessitates suitable adjustment / modification in bamboo promotion schemes so as to encourage bamboo plantation by individual farmers in their homestead, marginal lands, bunds, etc;

- There is a need to make farmers aware in pros and cons of bamboo farming;

- In spite of growing bamboo of fairly good species like *B. balcooa, B. tulda, D. strictus, B. pallida, D. hamiltonii, B. vulgaris* and others, I am yet to get an assured market. My bamboos are being used in vegetable fields, flood control measures, besides small domestic uses such as fence etc. ;

- Setting up suitable mechanism to buy back the matured bamboo from the farmer as per locally/regionally established market/facilities;

- Supply of quality planting material of suitable species as per requirement of locally/regionally established market/facilities. Any deviation may result into loss of 3-4 years besides de-motivating the farmer as I have faced flowering in first year and unsuitable bamboo spp next;

- With my experience of over two decades, I can say with certainty that bamboo plantation can be done with other crops. We are raising bamboo on bunds in which wheat, paddy, sugarcane, etc. are regularly grown without impacting its productivity;

- Agro-forestry can also be practiced with bamboo plantation ;

- The above submissions may be summarized as :

    - generating awareness among farmers to remove stigma attached with bamboo cultivation;

    - Development of local/block level market facilities;

    - Supply of quality planting material.

5&6.Shri Pasha Patel and Shri Sanjeev Kapre, Member

1) For effective implementation of bamboo planting scheme on farmer's farmland / farm embankment area at zonal level. It is necessary to take effective measures on the upcoming difficulties.

2) The limit of 100 days of labor should be abolished in respect of bamboo plantation scheme on farmer's farmland / farm embankment area

3) The condition of labor budget should be canceled regarding bamboo planting scheme on farmer's farmland / farm embankment area Provisions should be made for farmers to get approval immediately after applying for bamboo cultivation.

4) Women's Self-Help Groups & Farmers Producers Organizations should be involved.

5) For effective implementation of bamboo planting scheme on farmer's farmland / farm embankment area, economic and physical parameters should be fixed for planting of single bamboo species along with mixed method of bamboo planting.

6) As of now there is no clear directive for bamboo cultivation in mixed method, it cannot be implemented at the regional level.

7) For mixed bamboo cultivation, it is necessary to prepare scientific method and government approved mixed bamboo cultivation samples and sample budgets from the Department of Agriculture.

8) Priority should be given for planting bamboo at river, dams, roads / railway lines.

9) Limit of 2-hectare land for bamboo plantation should be canceled.

10) As the Agriculture Department can provide technical guidance to the farmers for bamboo cultivation and mixed method bamboo cultivation, the implementation of the bamboo cultivation scheme on the farmer's farmland / farm embankment area is to be done only through the Agriculture Department.

11) All the information about bamboo purchasing institutions/individuals/companies should be made available at the district level through the Agriculture Department. For that, a Bamboo cell should be developed at the district level through the agriculture department.

7. Shri Subash Bhatia, Member

1. Bamboo plantation must on species based with the choice of industry.
2. Bamboo plantation with maximum number of plants 330 +20/acre for replacement.
3 . We can give maximum number of employment with value addition of bamboo.
4 All plantation will be in form of cluster basis i.e., Bulk production at one place, like in Veitnam and China
5 All members are invited to our campus to view our model in which 55 person employee for 300 days in only 7.5 acre land.

6. Some issues regarding Tissue Culture (TC) plants using in bamboo cultivation when Agriculture Ministry is inquiry flowering issues in TC plants by high level committee.
7. Before issuing final report please check recommendation by members by field visit which work done by members which they suggest.
8. Only cluster base approach save bamboo cultivation with drip irrigation.
9. Species suggest not survive in rainfed area accept North East.
10. Bamboo can grow on waste land with Drip irrigation and compost.

8. Shri Lalit Sharma, Member

1) Plantation of bamboo may be carried out along the bank of river with view to reduce air/water pollution and enhancement of water table.

2) The project on bamboo plantation of three years may be taken up through involvement of FPOs/Cooperative Society/NGOs.

3) In the estimate, the provision of drip irrigation by the use of solar pump may be made.

4) Bamboo plantation may be carried out in minimum 2 ha area. In case of small and marginal farmers the bamboo plantation may be carried out along the boundary of the farms as live fencing, as in case of small and marginal farmers utilize their land for agribusiness purpose. 5)

5) Various herbal and aromatic plants like Ashwagandha, Tulsi, Lemongrass, Sarpgandha may also added for intercropping with Bamboo plantation.

6) Women's Self-Help Groups may be sensitized for development of different handicrafts products of bamboo. Bamboo Compressed Bio Gas (CBG) setup may also be established to empower SHGs / FPOs / Co-operatives.

7) Bamboo bio-mass waste to pallets and briquettes production for assuring the 8-10% requirement of NTPC thermal power plants as green fuels.

9. Ministry of Agriculture and Farmers Welfare, New Delhi
The comments i. r. o. National Bamboo Mission on Draft Report of Advisory Group on Bamboo Plantation:

- The selection of priority species and the spacing of the bamboo plantation have been suggested in the operational Guideline of the Restructured National Bamboo Mission (NBM) after a series of consultations with various stake holders including Indian Council of Forestry Research and Education (ICFRE), Forest Research Institute (FRI) & Kerala Forest Research Institute (KFRI) etc.

- It has been observed from the field that the spacing shall be a1 least 5.0 m x 5 0 m for getting quality bamboo culms suitable for industrial-uses. As per the field experience and feedback received, the High Density Bamboo Plantation (HDP) has not been observed useful to serve the industrial aspect of the bamboo resources due to its poor quality and growth. It is useful for biomass production only & other aspect of HDP need to be explored by the expert before promoting among the farmers to avoid any ambiguity or dispute in future from the public.

- The convergence of NBM activities with other programmers has been taken up by several State Bamboo Missions (SBM). The experience in this regard by the Kerala and Madhya Pradesh may be explored. There is great potential for the convergence NBM & Mahatma Gandhi NREGS activities. When the plantation of bamboo is done under Mahatma Gandhi NREGS\NRLM, it may be ensured that the priority species suitable for the particular State/ Agro-climatic zone are being used and the saplings have been procured by trusted/accredited nurseries.

- Recently, juvenile flowering issues of bamboo plantation have been noticed in some parts of the country where tissue culture planting materials have been used, especially for the sp. *Bambusa balcooa*. Earlier, the matter was discussed with the expert in the Forest Research Institute (FRI), Rain Forest Research Institute (RFRI) and Kerala Forest Research Institute (KFRI) etc. It was suggested that the vegetative and seed propagation methods also may considered. In case the tissue culture planting materials are used, assurance shall be sought from Tissue Culture nurseries about the selection of parent material and protocol of the TC procedure of the bamboo species. The Tissue Culture nursery should be held responsible for the replacement of the sapling of the same species with their own cost in case of premature/juvenile flowering within 10 years of plantation. The quality planting materials shall be procured from nurseries accredited by any State Bamboo Missions, State Forest Research Institutes, Central/State Agriculture Universities, ICAR/ ICFRE institutes or any other competitive agency in the Govt/-Public Sector.

- The State implementing agencies of Mahatma Gandhi NREGS/ NRLM may arrange training for master trainers in coordination with the Bamboo Technology Support Groups of NBM or any other appropriate agencies of expertise.

10. Ministry of Environment, Forest and Climate Change, New Delhi

- It is observed that bamboo is one of the important species for plantation and also for generating the livelihood of the local people. Hence there should be organized market mechanism to promote bamboo plantation which will further encourage the farmers for the bamboo plantation.

- There is the need to develop the sets of standards for the grading and classification of bamboo which will enhance the quality of bamboo plantation

Annexure IV - Spacing according species of bamboo, number of plants/ha and per acre, areas suitable and uses

Species of bamboo	Spacing	Number / ha	Number / acre	Area suitable to grow	Yield/acre/year in Tonsunder optimum condition	Uses
Largest Size						
Dendrocalamus giganteus	N- 8×8 m I- 6×6 m	160-280	65-110	All regions of India where rice is being cultivated except arid/semi-arid and temperate zone. Water requirement is high. Cultivation restricted to 800 m altitude.	20-25	Furniture, handicrafts, strip boards, edible shoots, charcoal and biomass
D. asper	N- 6×6 m I- 5×5 m	280-400	110-160	Same as above	20-25	Same as above
D. brandisii	N- 6×6 m I- 5×5 m	280-400	110-160	Same as above except in cold regions of north.	20-25	Same as above
Dendrocalamus Hamiltonii	N- 5×5 m I- 5×4 m	400 500	160 200	Suitable for: light (sandy), medium (loamy) and heavy (clay) soils and prefers well-drained soil. Suitable pH: mildly acid, neutral and basic (mildly alkaline) soils. It can grow in semi-shade (light woodland) or no shade. It prefers moist soil.	20-25	Fodder for animal, construction purpose, timber market, strip board, agarbathiinsense sticks, cottage industries, bamboo lumber, edible shoots
Large size						
Bambusa balcooa	N- 5×5 m I- 5×4.5 m	400 – 440	160-180	Versatile, easily grow in rice cultivation regions except arid, saline and temperate zone. Cultivation possible in semi arid area where pH is less than 7,	40	Excellent biomass, strong hence used in construction

				with irrigation and soil maneuvering. Cultivation restricted to 800 m altitude.		New uses like industrial pellets, tiles, timber and Scrimber wood
B. vulgaris	N- 5×5 m I- 5×4.5 m	400 – 440	160-180	Same as above	20	Good biomass, paper and pulp, construction, can be used in handicrafts and furniture as well
Gigantochlo aattrovoilaceae(Black bamboo)	N- 5×5 m I- 5× 4.5 m	400 – 440	160-180	Same as above	20-25	Ornamental, premium grade furniture and handicrafts
D. somedevai	N- 5×5 m I- 5× 4.5 m	400 440	160 180	Restricted to subtropical and temperate zone of north India.	15-20	All use like *B. balcooa*
Medium Size						
Bambusa tulda	N- 5×5 m I- 5×4 m	400 500	160 200	Versatile, easily grow in rice cultivation regions except arid, saline and temperate zone. Cultivation possible in semi arid area where pH is less than 7, with irrigation and soil maneuvering. Cultivation restricted to 800 m altitude.	25	Best bamboo for all utility used in stick, brush and daily usable items, furniture. It gives one of the best finishing among Indian bamboos.
Bambusa nutans	N- 5×5 m I- 5×4 m	400 – 500	160 200	Same as above. Cultivation possible up to 1400 m altitude. Chilling tolerance.	30-35	Similar as *B. tulda*
Bambusa polymorpha	N- 5×5 m I- 5×4 m	400 – 500	160 200	All regions of India where rice is being cultivated, except arid/semi arid and temperate zone. Cultivation restricted to 800 m altitude.	20-25	Erstwhile used for agarbatti sticks, good for furniture,

						handicraft, in construction
Dendrocalamus membranaceus	N- 5×5 m I- 5×4 m	400 500	160 200	Light (sandy), medium (loamy) and heavy (clay) soils, prefers well-drained soil and can grow in nutritionally poor soil. Suitable pH: mildly acid, neutral and basic (mildly alkaline) soils. It can grow in semi-shade (light woodland) or no shade. It prefers dry or moist soil and can tolerate drought.	25	Furniture and Constructions, Pulping, Fiber, Fiber Products, Handicrafts
Small Size						
D. strictus	N- 3×4 m I- 3×3 m	833-1100	333-425	Most versatile bamboo growing in India and grow almost all climatic conditions except dessert and temperate. It grows even in slightly basic and saline semi arid climatic conditions. Productivity with irrigation and soil maneuvering. Cultivation restricted to 1000 m altitude on eastern and southern slopes.	15-20	Strongest bamboo, for construction, biomass, stake, charcoal, paper and pulp
D. stocksii	N- 3 ×4 m I- 3×3 m	833-1100	333-425	Though being grown in Konkan belt now being cultivated in Maharashtra and Karnataka. Suitable to other parts of India where rice is being cultivated except arid, subtropical and temperate zone. Cold sensitivity has been noticed in north so not recommended in hilly regions.	1-12	Uses similar to Laathi bans but poles are straighter. Demand in housing, furniture and artifacts.
Thyrsostachys oliveri	N- 3×4 m I- 2×4 m	833-1250	333-500	Most cultivated bamboo of Tripura. Suitable to grow in all tropical humid and high moisture regions.	15	Cottage industry, construction, light weight special furniture, handicraft, as bamboo pole, edible

						shoots.

N: with normal irrigation

I: Intensive farming with drip and fertigation

Annexure V- Commercially important species of bamboo

SN	Common Name	Botanical Name
1	Balcooa bamboo, Bhaluka bamboo, Barak, Female Bamboo	*Bambusa balcooa*
2	Thorny bamboo, Indian thorny bamboo, spiny bamboo, Kanta bans	*B. bambos*
3	Bom, Betu, Betua	*B. cacharensis*
4	Moklabaans, Nutans, Makla, Kai, Nodding Bamboo, Mai bong	*B. nutans*
5	Bijulibanh, Pallida, Makal	*B. pallida*
6	*Burma Bamboo, Paura*	*B. polymorpha*
7	*Bengal Bamboo or Indian Timber Bamboo, Mritinga, Jaati*	*B. tulda*
8	Bari, Jai, green vulgaris	*B. vulgaris*
9	Asper, Sweet bamboo, Thai bamboo	*Dendocalamus asper*
10	Velvet Leaf Bamboo, Burma bamboo	*D. brandisii*
11	Giant Bamboo or Dragon Bamboo	*D. giganteus*
12	Tama Bamboo, Hamilton's Bamboo, Kako Bamboo, Pecha	*D. hamiltonii*
12	Rupai (Tripura), Khang (Bengali)	*D. longispathus*
14	Waya Bamboo, White Bamboo	*D. mebranacious*
15	Rawami, Sangaur (Mizoram), Wadah (Garo), Pugriang (Lepcha); Bhalu-bans (Nepal), Bhutan bamboo	*D. sikkimensis*
16	Male bamboo/ Male Bamboo/ Chivari, Mes (Maharashtra), Konda (Karnataka), Lathi,	*D. strictus*
17	Managa (Goa), Urshime, MarihalBidur (Karnataka)	*D. stocksii*
18	Maggar	*D. somedevai*
19	Black bamboo, Javanese black	*Gigantochloa attrovoilaceae*
20	Muli Bamboo, Pear Bamboo, Berry bamboo, Terai bamboo	*Melocanna baccifera*
21	Eeral (Tamil Nadu); Etta, Karretta (Kerala), Konda (Karnataka)	*Ochlandra travancorica*
22	Dulloo/Dolo-banh/DaluBanh	*Schizostachyum dullooa*
23	KanakKaich bamboo, Lathimula(Malayalam)	*Thrysostachys oliveri*

Tissue culture cloned, fast growing and desirable few bamboo species like *Bambusa balcooa*, *B. vulgaris* and *Dendrocalamus stocksii* are sterile (no seeds is being produced and clumps survives even after flowering) and reported to thriving for a century or more.

Annexure VI - Cost of cultivation of bamboo

COST OF CULTIVATION OF 0.5 ACRE BAMBOO UNDER PRECESSION FARMING									
					VALUES IN Rs				
No	Items	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year
1	Ploughing (Ist year - 2 times	500	0	0	0	0	0	0	0
2	Digging of pits	8,000	0	0	0	0	0	0	0
3	Ploughing for Weed Removal	500	500	500	500	500	500	500	500
4	Planting Material	12,500	0	0	0	0	0	0	0
5	Transport cost	1,100	0	0	0	0	0	0	0
6	Mortality Replacement	1,360	0	0	0	0	0	0	0
7	Farm yard Manures	12,000	3,000	0	0	0	0	0	0
8	Fertilizers	3,533	6,007	7,067	7,067	7,067	7,067	7,067	7,067
9	Plant Protection	500	500	500	500	500	500	500	500
10	Electricity for Irrigation	972	1,620	1,620	1,620	1,620	1,620	1,620	1,620
11	Drip system	5,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
12	Inter cultivation cost	7,000	0	0	0	0	0	0	0
13	Labour cost	9,158	3,617	5,173	5,764	6,300	6,300	6,300	6,300
	TOTAL	62,124	16,243	15,860	16,451	16,987	16,987	16,987	16,987
	Bamboo yield in tons			11	13	15	15	15	15
	Cost of Production of one Ton of Bamboo in Rs			1,424	1,250	1,132	1,132	1,132	1,132

Annexure VII - Comments on draft report of Advisory Group Members on Bamboo Plantation

Poonji Jaivik Urja Vikas Producer Company Ltd., Pratapgarh, Uttar Pradesh

(i) Common work-sheds for post-harvest handling activities of Farmer Producer Companies/ Farmer Producer Cooperative Societies for sustainable livelihood of agriculture workers/ labours . (under Category C of Act)

(ii) The beneficiaries under the small and marginal farmers (Under Paragraph 5 of Schedule I)

(iii) Land development works (Bamboo plantation to address the soil erosions problems during floods) on farmers land adjoining to river flows (Under Category A works)

(iv) Various herbal and aromatic plants like ashwagandha, tulsi, lemongrass, sarpgandha may also added for intercropping with bamboo plantation.

(v) Bamboo Compressed Bio Gas (CBG) setup may also be established to empower SHGs / FPOs / Co-operatives.

(vi) Bamboo bio-mass waste to pallets and briquettes production for assuring the 8-10% requirement of NTPC thermal power plants as green fuels

Ministry of Agriculture and Farmers Welfare, New Delhi

The comments i. r. o. National Bamboo Mission on Draft Report of Advisory Group on Bamboo Plantation:

I. The selection of priority species and the spacing of the bamboo plantation have been suggested in the operational Guideline of the Restructured National Bamboo Mission (NBM) after a series of consultations with various stake holders including Indian Council of Forestry Research and Education (ICFRE), Forest Research Institute (FRI) & Kerala Forest Research Institute (KFRI) etc.

It has been observed from the field that the spacing shall be a1 least 5.0 m x 5 0 m for getting quality bamboo culms suitable for industrial-uses. As per the field experience and feedback received, the High Density Bamboo Plantation (HDP) has not been observed useful to serve the industrial aspect of the bamboo resources due to its poor quality and growth. It is useful for biomass production only & other aspect of HDP need to be explored by the expert before promoting among the farmers to avoid any ambiguity or dispute in future from the public.

II. The convergence of NBM activities with other programmers has been taken up by several

State Bamboo Missions (SBM). The experience in this regard by the Kerala and Madhya Pradesh may be explored. There is great potential for the convergence NBM & Mahatma Gandhi NREGS activities. When the plantation of bamboo is done under Mahatma Gandhi NREGS\NRLM, it may be ensured that the priority species suitable for the particular State/ Agro-climatic zone are being used and the saplings have been procured by trusted/accredited nurseries.

III. Recently, juvenile flowering issues of bamboo plantation have been noticed in some parts of the country where tissue culture planting materials have been used, especially for the sp. *Bambusa balcooa*. Earlier, the matter was discussed with the expert in the Forest Research Institute (FRI), Rain Forest Research Institute (RFRI) and Kerala Forest Research Institute (KFRI) etc. It was suggested that the vegetative and seed propagation methods also may considered. In case the tissue culture planting materials are used, assurance shall be sought from Tissue Culture nurseries about the selection of parent material and protocol of the TC procedure of the bamboo species. The Tissue Culture nursery should be held responsible for the replacement of the sapling of the same species with their own cost in case of premature/juvenile flowering within 10 years of plantation. The quality planting materials shall be procured from nurseries accredited by any State Bamboo Missions, State Forest Research Institutes, Central/ State Agriculture Universities, ICAR/ ICFRE institutes or any other competitive agency in the Govt/-Public Sector.

IV. The State implementing agencies of Mahatma Gandhi NREGS/ NRLM may arrange training for master trainers in coordination with the Bamboo Technology Support Groups of NBM or any other appropriate agencies of expertise.

Ministry of Environment Forest and Climate Change

Draft report has included all the important aspects i.e., species, spacing, soil condition, temperature etc related to bamboo plantation along with recommendation of the experts. In the response to draft report, the Directorate of Green India Mission has nil comments.

However in general it is observed that bamboo is one of the important species for plantation and also for generating the livelihood of the local people. Hence there should be organized market mechanism to promote bamboo plantation which will further encourage the farmers for the bamboo plantation. There is the need to develop the sets of standards for the grading and classification of bamboo which will enhance the quality of bamboo plantation

M/s Gajraula Farms Agro Tech, Philibhit, Uttar Pradesh

Keeping in mind the drive for Bamboo plantation under Mahatma Gandhi NREGS, there is a need to uplift the condition of the Indian farmers, especially Uttar Pradesh. The conditions of the small,

marginal and landless farmers/cultivators, is testament to the need of schemes to assist and encourage bamboo plantation in Uttar Pradesh.

Such a scheme should address;

1) Workshop to impart training about cultivating bamboos at block/district level;
    1.1) How to grow bamboos: with free distribution of 10 good quality Bamboo clumps to be planted on plot bunds, to participating farmers (landowner/leasee/contractfamer).
    1.2) Monitoring by visiting the farmer after a gap of 1-2 years to check health of seedling: and assist with replacement (as necessary).
    1.3) Aide in establishing the seedling so farmer can move ahead to using the crop.

At such stage;

2) Workshop to impart training on techniques and uses of bamboo at block/district level;
    2.1) Use of bamboo as a structural material (trunk and splinters); sheds, huts, granaries, poultry coops, etc
    2.2) Use of bamboo as a farming tool: Vegetable grower racks, agricultural tools, crop guards, etc
    2.3) Use of bamboo in daily use: domestic use products, storage bins, utensils, furniture, etc.
    2.4) Encourage farmers to devise different uses based on personal/local requirements.

As farmers move towards using the crop, then;

3) Provision of a sure market at the block/district level to facilitate:
    3.1) buying and selling of bamboo and bamboo products.
    3.2) buying and selling of bamboo biomass.

These points envisage a cycle that will benefit the farmers of Uttar Pradesh, majority of whom are small and marginal landowners, leasers and/or contract farmers. The landholdings of cultivators in Uttar Pradesh are much smaller than expected, averaging less than one acre. The financial condition of small and marginal farmers is not very good and they are eager to adopt any assistance to ease their condition and increase their income.

In summary, the Plan of Action (PoA) should be to implement a scheme to encourage bamboo plantation among small and marginal farmers in Uttar Pradesh;
    a) free distribution of bamboo clumps to individual cultivators (landowner/leaser/contract farmer)
    b) training and monitoring.

c) introduction to simple tools eg splinters
d) providing market for surplus production at block/district level.

This is a route one can adopt to achieve the aspired sustainable and green vision for the future of the country, the economy and the individual.

Bamboo as an agricultural commodity has found recent and continued increment in value across the national and international market. This value and value-driven demand is due to a shift towards sustainable and renewable products from biomass, majorly due to the value bamboo has as global imports and uses are rising.

With major exporters coming from Asia, India is, unfortunately, overtaken by a number of nations, due to poor scale of production and use, even though India shares the geoclimatic conditions and biomass resources same as these countries. This is a ripe opportunity for the Indian farmers, especially the small, marginal and landless cultivators/farmers of Uttar Pradesh.

Green Bamboo Tech, Jabalpur, Madhya Pradesh

Please look into some issues can be reconsidered for benefits of bamboo sector.

1. Some issues regarding Tissue Culture (TC) plants using in bamboo cultivation when Agriculture ministry is inquiry flowering issues in TC plants by high level committee.
2. Number of plants in per acre is maximum 300-330 I think or less.
3. I think before issuing final report please check recommendation by members by field visit which work done by members which they suggest.
4. Only cluster base approach save bamboo cultivation with drip irrigation.
5. Species suggest not survive in rainfed area accept North East.
6. Bamboo can grow waste land with Drip irrigation and compost.

Bamboo Scientist, Growmore Biotech Limited, Hosur, Tamil Nadu

Suggested areas for bamboo plantations

i. Home garden
ii. Farm house
iii. In Home, Next to septic tank water, kitchen waste water soak pit
iv. In school campuses
v. Surrounding college buildings
vi. Along the factory compound walls and buildings
vii. Surrounding oxidation pond in your industrial areas

viii. Along sewage streams
ix. In premises of temple, church and mosques
x. Along the water canal networks

Economic benefits of bamboo

- Bamboo biomass has higher calorific value (4000 kcal/kg) and lower ash as compared to other available biomass resources.

Social benefits of bamboo

- Provides job opportunities in bamboo based industries.
- Bamboo increases the level of Oxygen, essential for better health.

Intercropping

Removed sugar cane from intercropping