Template/Pro forma for Submission

NMHS-Himalayan Institutional Fellowship Grant

FINAL TECHNICAL REPORT (FTR)

NMHS Reference No.:	**GBPNI/NMHS-2017-18/HSF-09/603**

Date of Submission:	1	6	0	1	2	0	2	3
	d	**d**	**m**	**m**	**y**	**y**	**y**	**y**

DATABASE ON LIVELIHOOD GENERATION AND CARBON SEQUESTRATION THROUGH WICKER WILLOW IN KASHMIR

Sanctioned Fellowship Duration: *from* (**28.03.2018**) *to* (**28.03.2021**).

Extended Fellowship Duration (if applicable): *from* (01.04.2021) *to* (31.07.2021).

***Submitted to*:**

Er. Kireet Kumar
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***Submitted by*:**
[*Prof. K N Qaisar*]
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[*7006488732*]
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DSL: *Date of Sanction Letter*

2	8	0	3	**2**	**0**	**2**	**1**
d	d	m	m	y	y	y	y

DFC: *Date of Fellowship Completion*

3	1	0	7	**2**	**0**	**2**	**1**
d	d	m	m	y	y	y	y

Part A: CUMULATIVE SUMMARY REPORT

(to be submitted by the Coordinating Institute/Coordinator)

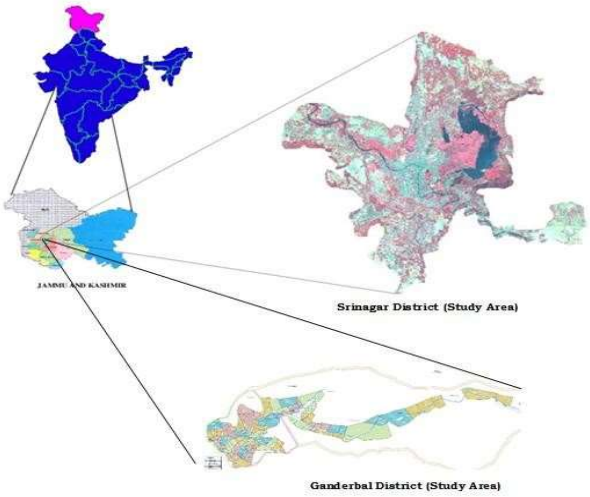
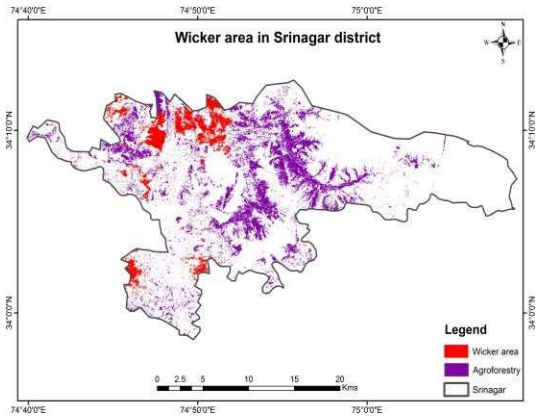
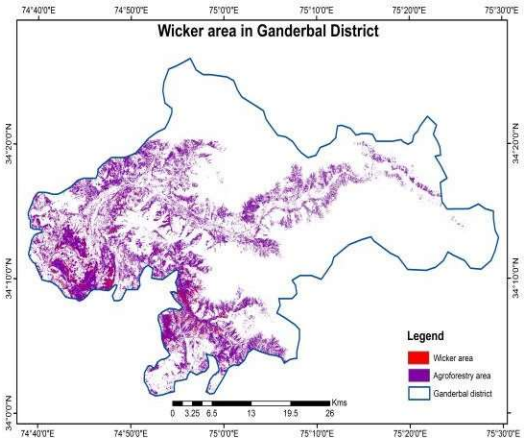
1. Details Associateship/Fellowships

1.1 Contact Details of Institution/University

NMHS Fellowship Grant ID/ Ref. No.:	**GBPNI/NMHS-2017-18/HSF-09**
Name of the Institution/ University:	Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir
Name of the Coordinating PI:	Prof. (Dr.) K. N. Qaisar
Point of Contacts (Contact Details, Ph. No., E-mail):	Controller of Examinations, SKUAST-K C/N: +91-7006488732 Email: navedmoon66@gmail.com

1.2 Research Title and Area Details

i.	Institutional Fellowship Title:	Database on Livelihood Generation and Carbon Sequestration through Wicker Willow in Kashmir					
ii.	IHR State(s) in which Fellowship was implemented:	**Jammu and Kashmir**					
iv.	Scale of Fellowship Operation	Local:	✓	Regional:		Pan-Himalayan:	

iii.	Study Sites covered (*site/location maps to be attached*)	Srinagar & Ganderbal districts of Kashmir Province   
v.	Total Budget Outlay :	INR 1606968.00

1.3 Details Himalayan Research /Project Associates/Fellows inducted

Type of Fellowship	Nos.	Work Duration	
		From	To
Research Associates	-	-	-
Sr. Research Fellow	-	-	-

Jr. Research Fellows	02	30.05.2018	01.09.2019
		29.10.2019	09.06.2021
Project Fellows	-	-	-

2. Research Outcomes

2.1. Abstract (not more than 1000 words) (it should include background of the study, aim, objectives, methodology, approach, results, conclusion and recommendations)

Background:

Wicker willow craft, locally referred to as Keani Keam, is a hand skilled craft from Kashmir involving weaving using willow reeds. Willow weaving is an indigenous business industry of the valley. The peculiarity of this craft lies in the fact that a willow product serves both as a decor and a household utility item to store and carry edible things during special occasions. The study was aimed to assess the plantation area under wicker willow, identify the potential wicker growing areas, and evaluate the profitability associated with wicker cultivation for the upliftment of the rural stakeholders involved in this industry and also to analyze the factors affecting the productivity of wicker. Besides Short Rotation Coppice (SRC) plantations are of interest as producers of biomass for fuel, but also as carbon (C) sinks to mitigate CO2 emissions, indicating a significant potential to sequester C. Keeping in view the importance of wicker willow in Kashmir, the central zone of Kashmir valley was selected on the basis of purposive sampling as bulk of the wicker based industry is concentrated in central zone of Kashmir Valley particularly in the districts of Srinagar and Ganderbal.

Aim:

- To explore the capability of wicker willow in terms of the livelihood generation and economic upliftment of the Shaaksazi community of Kashmir.
- To explore the potential of wicker willow as a short rotation coppice towards carbon Sequestration and CO_2 mitigation.

Methodology:

The primary data was collected from two districts of Kashmir valley namely Srinagar, Ganderbal by using the questionnaire method during the month of July-August, 2019. A pilot survey of the village Harran in district Ganderbal was done for pre-testing the questionnaire. Four towns from district Srinagar and five villages from district Ganderbal were purposively choosen for selecting the sample plantations. A total of 153 households/ farmers were randomly selected for the study and surveyed. Using satellite imagery processing technique, the planting lands were separated with a low cost, high speed and precision. Field visitation recorded 20 ground control points by GPS in the way of features in various areas of district Srinagar and Ganderbal. The methodology for mapping the plantation using GIS is given below:

1. Downloading of Sentinel data from USGS Earth Explorer.
2. Top-of-Atmospheric Correction using QGIS (an open source software).
3. Layer stacking of all bands and clipping of desired area from shape file.
4. Mosaicking of sentinel scenes and removing forest cover using FCC.
5. Finding range of spectral reflectance values for wicker with the help of GPS points.
6. Classification of images by applying Knowledge Classifier using reflectance values (minimum and maximum).
7. Post classification correction for removing of in
correct areas.
8. Area calculation, accuracy assessment and map generation.

To estimate C sequestration in the willow plantations repeated field sampling provided estimates of C in soil, stem, stump, and aboveground litter. The sequestration potential of the 14 age gradations of wicker willow was estimated. Above-ground woody biomass was estimated by taking measurements of willow stems a three randomly placed quadrants of size 1m x 1m within each sampled field. In every plot 10 living stems were collected for further examination, i.e. 30 stems per age gradation. They were sampled so that all sizes were represented. Height, breast height diameter, and fresh weight of each stem were registered in the field. Additionally, tannin estimation in the processed withies of the 3 willow species was done using Folin-Denis Method. This method is based on the non-stoichiometric oxidation of the molecules containing a phenolic hydroxyl group. Tannin-like compounds reduce phosphotungstomolybdic acid in alkaline solution to produce a highly coloured blue solution, the intensity of which is proportional to the amount of tannins. The intensity is measured in a spectrophotometer at 700 nm.

Procedure:

• Extraction of Tannin: Weigh 0.5 g of the powdered material and transfer to a 250 ml conical flask. Add 75 ml water. Heat the flask gently and boil for 30 min. Centrifuge at 2,000 rpm for 20 min and collect the supernatant in 100 ml volumetric flask and make up the volume.

• Transfer 1 ml of the sample extract to a 100-ml volumetric flask containing 75 ml water.

• Add 5 ml of Folin-Denis reagent, 10 ml of sodium carbonate solution and dilute to 100 ml with water. Shake well and read the absorbance at 700 nm after 30 min.

• Prepare a blank with water instead of the sample.

• If absorbance is greater than 0.7, make appropriate dilution.

• Prepare a standard graph by using 0–100 mg tannic acid.

Approach:

The project activities were started by identification of beneficiary farmers and dissemination of fellowship outcomes. The database of such stakeholders was maintained throughout the entire tenure of the fellowship. Identification of the wicker species, area assessment of the wicker plantations in the selected districts, mapping of the wicker growing areas was done. In addition to the

fulfilment of the objectives of the fellowship, the problems faced by the stakeholders involved in the wicker industry were taken note of.

Results:

Objective I: Creation of livelihood database of the farmers and artisans involved in willow based wicker / furniture work in Kashmir.

Deliverables	Overall Achievements
Identification of three commonly grown salix species in Kashmir	Three salix species were reported to be grown on a mass scale in Kashmir region namely: a) *Salix triandra* b) *Salix purpurea* c) *Salix dickymat* (Morphological description alongwith photographs attached)
Identification of major wicker growing areas in the study areas.	Seventeen (17) core villages in Srinagar and Ganderbal districts of Kashmir valley and four (04) villages in Budgam district were earlier identified. Additionally, four (04) more villages have been identified in district budgam where farmers have shifted from paddy to wicker cultivation.
Database creation	Creation of database of the stakeholders involved at different stages in the wicker industry viz. Farmer, Processor, Intermediators, Artisans, Wholesalers and Retailers.

Objective II: To study marketing channels, income generation and employment opportunity provided by the cottage industry.

Identification of Marketing Channels	Based on the field investigations in the study areas and a brief interaction with the growers, processors and the weavers, three of the marketing channels have been identified viz. CHANNEL 1: PRODUCER - WHOLESALER – RETAILER – CONSUMER CHANNEL 2: PRODUCER – RETAILER – CONSUMER

	CHANNEL 3: PRODUCER – PROCESSOR – ARTISAN – WHOLESALER – RETAILER – CONSUMER The value chain analysis and the share of each stake holder involved in the industry is studied.
Value chain analysis, identification and share of each stakeholder in the marketing channel.	Survey done on grower, weaver and trader level and raw data collected for value chain analysis.
Economic Analysis for assessment of the profitability of the wicker industry	Economic analysis of data collected and calculation of profitability indices for the generated data. Benefit Cost ratio (BCR), Internal Rate of Return (IRR) and Net Present Value (NPV) calculated for growers based on the yield data.
Constraints faced by the stakeholders	Identification of constraints faced in marketing of wicker handicraft.

Objective III: Mapping and Assessment of plantation area, production of raw material and carbon stock of wicker willow.

Mapping and Area assessment using GIS	Tracking the GPS coordinates of various wicker growing areas in district Ganderbal and Srinagar (age gradation wise) for generating the satellite maps
Soil Analysis	Collection of soil samples from wicker producing areas for soil analysis of parameters viz. N, P, K, OC, BD and Soil texture
Biomass estimation	Estimation of above and below ground biomass was done for assessing the eCO_2 and the carbon sequestering potential of the wicker willow.

Conclusion:

Wicker cultivation is profitable in the study areas because it gives higher net return. Based on the profitability indices NPV, IRR, BCR, it is ascertained that wicker cultivation has a good potentiality in Kashmir valley. It is also found that among the various input variables only age of the plantation significantly affects the yield. As wicker cultivation is a profitable enterprise with a BC ratio of 2.23,

hence it can be a source of livelihood for various uneducated and educated youth as well. The government in collaboration with the state agriculture university need to take a step forward to expand the wicker plantations in the valley and also formulate appropriate policy for widespread cultivation of wicker. The generated maps will in general help the government and in particular to the policy makers in their future course of action in devising policies for the stakeholders involved in wicker business.

Recommendations:

Awareness among the rural youth is must to make them understand that it's a profitable enterprise over paddy and poplar. Not only being a source of livelihood wicker willow serves as a carbon sink thus mitigating the effects of increasing $C0_2$ concentration in the atmosphere. Maintenance of government record of the plantations and proper policy framing which is lacking in the current state is mandatory for framing policies for the farmers and artisans involved in the business. Cultural operations on a scientific basis must be adopted to increase the yield/ha of the plantations.

2.2. Objective-wise Major Achievements

S. No.	Cumulative Objectives	Major achievements (in bullets points)
01.	Creation of livelihood database of the farmers and artisans involved in willow based wicker / furniture work in Kashmir.	• A database on the economic status and the land holding under wicker was obtained for the study districts. • Profitability of wicker willow as an option of entrepreneurship • Value Addition of major wicker handicraft was studied • Predictive model development to assess the effect of various factors that influence the yield.
02.	To study marketing channels, income generation and employment opportunity provided by the cottage industry.	• 3 marketing channels identified and the most prominent marketing channel identified was: • Farmer-Processor-Artisan-Wholesaler-Retailer-Consumer
03.	Mapping and Assessment of plantation area, production of raw material and carbon stock of wicker willow.	• GIS mapping of the study areas was done for area assessment. However a discrepancy between the area estimate obtained through the survey and GIS mapping was seen

2.3. Outputs in terms of Quantifiable Deliverables*

S. No.	Quantifiable Deliverables*	Monitoring Indicators*	Quantified Output/ Outcome achieved	Deviations made, if any, and Reason thereof:
01.	Area assessment & Evaluation	GIS Maps, Area assessment Table	Area under wicker plantation in various villages of the study districts assessed. GIS maps show the updated plantation areas under wicker willow. This area assessment gives an overview of the interest of rural communities in wicker willow trade and plantation	GIS mapping was done due to lack of proper government records on the plantation under wicker willow
02.	Peeler Prototype	Prototype Cad Design and Image	The different processes involved in the wicker industry were taken note of. However it was seen that manual peeling is a tough job that requires time and cost. So an idea to develop a peeler was proposed and is under construction.	
03.	Marketing Chain Study	Identified channels and chain analysis	The various marketing ch annels and the most prominent amongst them was identified, and share of each stakeholder was ascertained	
04.	Estimation of eCO_2 and Ofset value	Carbon Stock, SOC and Total Carbon Stock	Wicker willow besides giving tangible benefits also plays an important role in	

			mitigating the effects of increasing carbon dioxide and climate change because of its fast growing nature,	

(*) As stated in the Sanction Letter issued by the NMHS-PMU.

2.4. Strategic Steps with respect to Outcomes (in bullets)

S. No.	Particulars	Number/ Brief Details	Remarks/ Enclosures
1.	New Methodology developed:	-	-
2.	New Models/ Process/ Strategy developed:	Peeler developed	Photo attached in detailed report
3.	New Species identified:	-	-
4.	New Database established:	The information on the households relying on wicker business was generated in addition to the database on area under wicker plantation.	Summary given in detailed report
5.	New Patent, if any:		
	I. Filed (Indian/ International)	-	-
	II. Granted (Indian/ International)	-	-
	III. Technology Transfer (if any)	Proposed machine peeler for peeling the bark off the processed withies	Under construction as a part of the M.tech. thesis entitled “Development and Performance Evaluation of Portable Wicker Willow Peeling Machine” of an engineering student of our university
6.	Others, if any:	-	-

3. Technological Intervention

S. No.	Type of Intervention	Brief Narration on the interventions	Unit Details (No. of villagers benefited / Area Developed)
1.	Development and deployment of indigenous technology	Thrusting upon the scientific cultivation and importance of the wicker towards global warming	Awareness programmes and interactions held at various villages of the study areas. Twenty (20) villages from the study districts were surveyed with the aim to benefit the farmers.
2.	Diffusion of High-end Technology in the region	Assurance to farmers regarding the under development machine peelers	The farmers were briefed about the advantage of the machine peeler that is being developed at one of the engineering faculty of our university. Almost 180 farmers (processors) were benefited from the concept of peelers and are ready to adopt it.
3.	Induction of New Technology in the region	Awareness about profitability of wicker enterprise in the region. And the consequent shifting from paddy to wicker	Various villages of the study districts viz. Srinagar, Ganderbal and Budgam were chosen for the induction of the new technology.
4.	Publication of Technological / Process Manuals	-	
	Others (if any)		

4. New Data Generated over the Baseline Data

S. No.	New Data Details	Existing Baseline	Additionality and Utilisation of New data (*attach supplementary documents*)
1.	Identification of new villages where farmers have shifted from Paddy to Wicker Willow cultivation.	-	The government lacks the baseline data of the farmers and the area under wicker plantation. The generated data will be beneficial to the government and policy makers to a large extent.
2.	Map generation		The maps generated using the GIS coordinates will be of advantage to the researchers and scientists in general to plant their research on willow species

5. Linkages with Regional & National Priorities (SDGs, INDC, etc.)/ Collaborations

S. No.	Linkages /collaborations	Details	No. of Publications/ Events Held	Beneficiaries
1.	Sustainable Development Goals (SDGs)	-	-	-
2.	Climate Change/INDC targets	-	-	-
3.	International Commitments	-	-	-
4.	National Policies	-	-	-
5.	Others collaborations	Central Institute of Temperate Horticulture (CITH)	Estimation of tannin and revealing its importance	Farming community of the study villages

6. Financial Summary (Cumulative)*

*Please attach the **consolidated and audited Utilization Certificate (UC) and Consolidated and *Year-wise* Statement of Expenditure (SE)** separately, *ref*. **Annexure I.**

7. Quantification of Overall Research Progress

S. No.	Parameters	Total (Numeric)	Attachments* with remarks
1.	IHR State(s) Covered:	*01*	*Jammu & Kashmir*
2.	Fellowship Site/ LTEM Plots developed:	*01*	
3.	New Methods/ Model Developed:	*01*	*Peeling Machine*
4.	New Database generated:	*02*	*Wicker Area Stakeholder Database*
5.	Types of Database generated:	*01*	
6.	No. of Species Collected:	*03*	
7.	New Species identified:	-	
8.	Scientific Manpower Developed (PhDs awarded/ JRFs/ SRFs/ RAs):	*01*	
9.	No. of SC Himalayan Researchers benefited:	-	
10.	No. of ST Himalayan Researchers benefited:	-	
11.	No. of Women Himalayan Researchers empowered:	-	
12.	No. of Knowledge Products developed:	*01*	
13.	No. of Workshops participated:	*01*	
14.	No. of Trainings participated:	-	
15.	Technical/ Training Manuals prepared:	-	
	Others (if any):		

***** Please attach the soft copies of supporting documents word files and data files in excel.

8. Knowledge Products and Publications*

S. No.	Publication/ Knowledge Products	*Number*		*Total Impact Factor*	*Remarks/* Enclosures**
		National	International		
1.	Journal Research Articles/ Special Issue (Peer-reviewed/ Google Scholar)	01		1.169	Published
2.	Book Chapter(s)/ Books:	-	-		
3.	Technical Reports/ Popular Articles	-	-		
4.	Training Manual (Skill Development/ Capacity Building)	-	-		
5.	Papers presented in Conferences/ Seminars	02	01		Best Paper Presentation Award
6.	Policy Drafts (if any)	-	-		
7.	Others (specify)	-	-		

*Please append the list of KPs/ publications (with impact factor and URL link details) with due Acknowledgement to NMHS.

**Please provide supporting copies of the published documents.

9. Recommendation on Utility of Research Findings, Replicability and Exit Strategy

9.1 Utility of the Fellowship Findings

S. No.	*Research Questions Addressed*	*Succinct Answers (within 150–200 words)*
1.	Livelihood Dependence on wicker willow and its role in rural upliftment	Wicker willow cultivators are receiving income from wicker willow cultivation and handicraft making, agriculture, livestock, wage earnings and other activities. Among these sectors, the average income from wicker willow per year is around Rs. 51,337.
2.	Potential of wicker willow to prevent environmental degradation by mitigating effects of increasing CO_2 by carbon sequestration.	Mainly used today for wicker handicraft, the wicker cropping system is also known for its effective remediation of many environmental issues, from soil decontamination to organic waste disposal. The crafting of items made from wicker helps lock the carbon and because willow biomass i.e. leaves and bark provide a carbon (C) neutral fuel for energy purposes, SRWC is considered a tool to mitigate carbon dioxide (CO_2) emissions.
3.	Area Assessment of wicker plantation	The wicker statistics from the study districts revealed a significant increase in the wicker plantations over the years. Hence indicating a preference by the farming community over paddy and poplar. However, it was reported that the Land records are poorly maintained; they do not reflect the on ground position. A huge difference in the estimates of wicker area for the study districts was seen as obtained from the GIS mapping and from the survey/ government records indicating an immediate intervention by the government agencies to update the plantation area records under wicker plantation for ensuring a holistic development of this sector and other development activities as per the district/state agriculture plan.

4.	Difficulties faced by the industry	Various difficulties faced by the wicker industry are highlighted below: 1. Lack of concept of scientific well managed plantations. Emphasis should be laid on growing large scale scientifically managed plantations to achieve maximum yield even in old age plantations. 2. Lack of recognition of farmers involved in wicker plantation in Kisan Credit Card. 3. Fluctuating Market rates is the most important factor which influences the wicker industry in the valley 4. Need to develop sophisticated machinery to ease in the process of harvesting and peeling of the processed bark.
5.	Addressing the SDG Goals	In context to SDG 1, attention to wicker projects that can promote women entrepreneurship and empowerment through developing and promoting wicker based products must be considered. The current scenario requires a holistic approach and cautions the call for increased cultivation of wicker and the role of women in economic activities, to ensure that rural communities truly benefit. On SDG 7, due consideration must be given to expand the manufacture and distribution of wicker crafted products noting the possibilities for

		small businesses in making wicker proc, and the environmental benefits of substituting eco-friendly wicker for plastic items. Taking into account SDG 11, we focused on construction standards and the properties of wicker-based building products, including their lightness, flexibility, and superior insulating properties, as well as their resistance to fires, and seismic activity. On SDG 13, the high levels of carbon sequestration in wicker are discussed and methodologies for calculating the extent of sequestration described. It must be noted that wicker also has benefits for reducing carbon emissions in terms of emissions that are avoided by substituting wicker willow for conventional timber products. Regarding SDG 15, wicker willow cultivation can restore degraded lands and promote disaster risk reduction (DRR). The fellowship also touched on wicker willow related activities that promote food security (SDG 2), gender equality through women's economic empowerment (SDG 5), and innovation in industry (SDG 9), with emphasis on the market potential of wicker products.
6.	Addressing the AICHI Targets	Addressing the underlying causes of

		biodiversity loss by mainstreaming biodiversity across government and society. Reducing the direct pressures on biodiversity and promoting sustainable use. Improving the status of biodiversity by safeguarding ecosystems, species and genetic diversity. Enhancing the benefits to all from biodiversity and ecosystem services. Enhancing implementation through participatory planning, knowledge management and capacity building.

9.2 Recommendations on Replicability and Exit Strategy:

Particulars	Recommendations
Replicability of Fellowship, if any	Traditionally, small-scale short rotation coppice willow plantations have been used for fuel, fodder, convenience wood, basket making, bee keeping, and for other horticultural purposes. Willows also may be used for erosion control, including wind and water erosion, and to avoid snow drift along roads. Because willow grows so quickly, it is naturally sustainable. This natural sustainability is enhanced by willow's resistance to disease which means that it needs very few chemical treatments. Furthermore, as a natural product, it provides an obvious route to eco-friendly packaging. In fact, this very traditional material and weaving technique is now being adopted by younger customers who love its beautiful appearance, durability, sustainability - and the fact that it can be used in place of plastics and other less eco-friendly materials. The stylish and natural products weaved from wicker willow are enjoying a resurgence in popularity again as customers seek out 'greener' alternatives to plastics and other industrial products which damage the environment. This resurgence may help generate the livelihood opportunities amongst the rural people who are involved in this business and thereby providing a means towards rural upliftment. Besides generating income, the wicker craft made from the processed reeds are an effective way to lock the carbon, thereby mitigating the effects of increasing CO_2 concentration in the atmosphere. Thus it is reported that SRCW plantations may play a critical role in sustainable development, from combating rural unemployment to mitigating the effects of climate change.

Exit Strategy:	Carbon Financing: Wicker plantations accumulate or sequester carbon as plantation grow, reducing carbon dioxide levels in the atmosphere and can be used to earn carbon credits by the farmers. The sale of carbon credits will provide an opportunity for farmers to receive financial benefits through "Carbon Financing". Carbon financing refers to funding mechanisms that puts a monetary amount on carbon emissions, allowing, for example, companies wishing to offset their GHG emissions to buy carbon credits earned from sustainable organizations and their projects. This provides vital funding for innovative projects that make sustainable energy solutions a reality, including for the benefit of those living in developing countries worldwide. It will boost the financial viability of cutting-edge projects, generating an added revenue stream and allowing for the effective transfer of technologies, knowledge, and expertise. The purpose of carbon finance is to reduce global carbon emissions. It serves as a financial mechanism aimed to incentivize and provide opportunities for businesses and individuals to reduce their carbon output. Carbon finance offers an immediate opportunity to reduce the overall effects of climate change by promoting GHG emission reductions.

(NMHS FELLOWSHIP COORDINATOR)

(Signed and Stamped)

(HEAD OF THE INSTITUTION)

(Signed and Stamped)

Place: Shalimar, Srinagar (J&K)
Date: 16/01/2023

Annexure-I

Consolidated and Audited
Utilization Certificate (UC) and Statement of Expenditure (SE)

For the Period: 2018-2022

1.	Title of the fellowship/Scheme:	**Database on Livelihood generation and Carbon Sequestration through wicker willow in Kashmir**
2.	Name of the Principal Investigator & Organization:	Prof. (Dr.) K N Qaisar
3.	NMHS-PMU, G.B. Pant National Institute of Himalayan Environment, Kosi-Katarmal, Almora, Uttarakhand Letter No. and Sanction Date of the Fellowship:	GBPNI/NMHS-2017-18/HSF-09 Dated: 28.03.2018
4.	Amount received from NMHS-PMU, G.B. Pant National Institute of Himalayan Environment, Kosi-Katarmal, Almora, Uttarakhand during the fellowship period (Please give number and dates of Sanction Letter showing the amount paid):	**1. 5,21,400.00/=** **2. 5,13,095.00/=** **3. 5,66,738.00/= (GBPNI/NMHS-2017-18/HSF-09/603/175/98, dated: 10.08.2020)** **4. 1,87,192.00/= (GBPNI/NMHS-2017-18/HSF-09/603/175, dated 28.01.2020) out of which INR 89992/-**
5.	Total amount that was available for expenditure (including commitments) incurred during the fellowship period:	**Rs. 16,30,350 +Rs. 97,200/= (Arrears)**
6.	Actual expenditure (excluding commitments) incurred during the fellowship period:	Rs. 16,83,231.90/=
7.	Unspent Balance amount refunded, if any (Please give details of Cheque no. etc.):	**Rs. 44,318.10/=**
8.	Balance amount available at the end of the fellowships:	**Nil**
9.	Balance Amount:	**Nil**
10.	Accrued bank Interest: (Refunded back to funding agency)	Rs. 10,919/= refunded via NEFT JAKA220121815605

Certified that the expenditure of **Rs.** 16,83,231·90 **(Rupees** Sixteen Lac Eighty Three Thousand two hundred and Thirty one paisa only) mentioned against Sr. No. 6 was actually incurred on the fellowship/scheme for the purpose it was sanctioned.

Date: 16/01/2023

(Signature of Principal Investigator) (Dr. K.N. Qadir)

Principal Investigator
NMHS-Fellowship
Faculty of Forestry, SKUAST-K
Benhama, Ganderbal

(Signature of Registrar/ Finance Officer)

REGISTRAR
Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir, Shalimar, Srinagar

(Signature of Head of the Institution)

DIRECTOR RESEARCH
S.K. University of Agricultural Sciences & Technology of Kashmir
Shalimar, Srinagar-191121

OUR REF. No.

ACCEPTED AND COUNTERSIGNED

Date:

COMPETENT AUTHORITY
NATIONAL MISSION ON HIMALAYAN STUDIES (GBP NIHE)

Statement of Consolidated Expenditure

[Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir]

Statement showing the expenditure of the period from : 2018-2022
Sanction No. and Date :

1. Total outlay of the Fellowship : Rs. 16,06,698

2. Date of Start of the Fellowship : 28.03.2018

3. Duration : 3 year (Extended upto July 2021)

4. Date of Completion : July 2021

a) Amount received during the fellowship period : 5,21,400/- + 5,21,400/- + 5,66,738/- + 97,200 (Arears)

b) Total amount available for Expenditure : 17,27,550/-

S. No.	Budget head	Amount received	Amount received+ Amount carried forward	Expenditure	Amount Balance/ excess expenditure
1.	Fellowship	3,24,000.00	3,24,000.00	2,71,742.00	52,258.00
		4,21,200.00	4,73,458.00	3,45,599.00	1,27,859.00
		3,94,799.00	5,22,658.00	4,78,764.00	**43,894.00**
2.	Contingency	1,50,000.00	1,50,000.00	1,62,502.00	-12,502.00
		1,41,695+8305	1,37,498.00	1,40,011.00	-2,513.00
		1,25,788+9463	1,32,738.00	1,29,745.00+13,917.90	**-10,924.90**
3.	Institutional Charges	47,400.00	47,400.00	47,320.00	80
		47,000.00	47,480.00	47,400.00	80
		46,151.00	46,231.00	46,231.00	**NIL**
4.	Accrued bank Interest	8,305.00	Adjusted in contingency	Adjusted in Contingency	
		9,463.00	Adjusted in contingency	Adjusted in Contingency	
		8,804.00 + 2,545.00 + 268	11,617.00		**11,617.00**
12	**Total**				**44,586.10**

The amount balance **Rs. 44,586.10** has been refunded to the funding agency vide NEFT JAKA220616226404 dated 16.06.2022 amounting **Rs. 44,318.10** and NEFT JAKA220802627984 dated 02.08.2022 amounting to **Rs. 268.00**)

Certified that the expenditure of **Rs.1096105 (Rupees: Ten Lac ninety six thousand one hundred and five rupees)** mentioned against Sr. No.1 was actually incurred on the fellowship/ scheme for the purpose it was sanctioned.

Date: 16/01/2023

(Signature of Principal Investigator)

Principal Investigator
NMHS-Fellowship
Faculty of Forestry, SKUAST-K
Benhama, Ganderbal

(Signature of Registrar/ Finance Officer)

REGISTRAR
Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir, Shalimar, Srinagar

(Signature of Head of the Institution)

DIRECTOR RESEARCH
Sher-e-Kashmir Agri. Sc...
Shalimar, Srinagar-19...

OUR REF. No.

ACCEPTED AND COUNTERSIGNED

Date:

COMPETENT AUTHORITY
NATIONAL MISSION ON HIMALYAN STUDIES (GBP NIHE)

Annexure-II

Consolidated Interest Earned Certificate

Please provide the detailed interest earned certificate on the letterhead of the grantee/ Institution and duly signed.

Budget Head	Amount received	Amount received + Amount Carried Forward	Expenditure	Amount Balance/ excess expenditure
Accrued bank Interest	8,305.00	Adjusted in contingency	Adjusted in Contingency	
	9,463.00	Adjusted in contingency	Adjusted in Contingency	
	8,804.00 + 2,545.00 + 268	11,617.00		**11,617.00**

Principal Investigator
NMHS-Fellowship
Faculty of Forestry, SKUAST-K
Benhama, Ganderbal

Annexure-III

National Mission on Himalayan Studies (NMHS)

DIRECT BENEFIT TRANSFER (DBT) DETAILS

Scheme Name:	**National Mission on Himalayan Studies (NMHS)**
Scheme Type:	**Central Sector (CS) Grant-in-Aid Scheme**
Scheme Code:	**NMHS**
Category:	**Fellowship Grant**
Month-Year:	**1st June-9th June, 2021**

PRO FORMA FOR DBT DETAILS

University/Institution Name: Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir

S#	Position (H-RA, H-JRF/ H-JPF)	Name	DoB*	DoI*	PI	Research title	Objectives	Study Area, IHR State	Contact details (Complete corresponding address), Mobile No., E-mail ID	Bank details (Account number, IFSC Code)	Emoluments /Fellowship	Aadhaar No.
1.	H-JRF	DR. IMMAD ASHAH	07.02.1991	29TH OCT 2019	PROF. (DR.) K N QAISAR	DATABASE ON LIVELIHOOD GENERATION AND CARBON SEQUESTRATION THROUGH WICKER WILLOW IN KASHMIR	Creation of database of farmers and artisans Study marketing channels, income and employement generation Assessment of plantation area and carbon stock	JAMMU AND KASHMIR	Email: immad11w@gmail.com Madina Colony Khanbagh, Malabagh, Srinagar, J & K Phone No.: 8825004745	00570401 00017536 JAKA0A NCHAR	33,480/-	2526-8830-0305

Note: For each month, the DBT Details Pro forma dully filled and signed for each Himalayan Fellowship Grant under NMHS must be submitted at finance.nmhspmu2017@gmail.com; nmhspmu2016@gmail.com. *DoB (Date of Birth); DoJ (Date of Joining).

(Authorized Signatory)

Principal Investigator
NMHS-Fellowship
Faculty of Forestry, SKUAST-K
Benhama, Ganderbal

June **2021 – Latest Updated List of Himalayan Researchers or Fellows** *(working in the current time)*

S#	Name	Fellowship (RA/JRF/JPF)
1.	Dr. Immad A Shah	HJRF
2.		

Annexure-IV

Details and Declaration of Refund of Any Unspent Balance

Please provide the details of refund of any unspent balance as RTGS (Real-Time Gross System) in favor of **NMHS GIA General** and declaration on the official letterhead duly signed by the Head of the Institution.

Kindly note the further Bank A/c Details as follows:

Name of NMHS A/c:	NMHS GIA General
Bank Name & Branch:	Central Bank of India (CBI), Kosi Bazar, Almora, Uttarakhand 263643
IFSC Code:	CBIN0281528
Account No.:	3530505520 (Saving A/c)

In case of any queries/ clarifications, please contact the NMHS-PMU at e-mail: nmhspmu2016@gmail.com

Technology Transfer and/ or Intellectual Property Rights Certificate

With a view to encourage the institutions to file patent applications on their innovations, motivate them to transfer their technologies for commercialization, and facilitate them to reward their inventions, the following instructions are issued.

1. **In these instructions:**

   (a) **"Institution"** means any technical, scientific or academic establishment where research work is carried out through funding by the Central / State Government.

   (b) **"Intellectual Property Rights"** include patents, registered designs, copyrights and layout design of integrated circuits.

   (c) **"Inventor"** means an employee of the institution whose duties involve carrying out of scientific or technical research.

2. **Scope:** These instructions apply to those institutions receiving funds for research projects/ fellowships from NMHS, the Ministry of Environment, Forest and Climate Change (MoEF&CC).

3. **Inventions by institutions:** Institutions shall be encouraged to seek protection of Intellectual Property Rights (IPR) to the results of research through R&D projects/ fellowships. While the patent may be taken in the name(s) of inventor(s), the institutions shall ensure that the patent is assigned to it & DBT, GOI. The institution shall take necessary steps for commercial exploitation of the patent on non-exclusive basis. The institution is permitted to retain the benefits and earnings arising out of the IPR. However, the institution may determine the share of the inventor(s) and other persons from such actual earnings. Such share(s) shall be limited to 1/3rd of the actual earnings.

4. **Inventions by institutions and industrial concerns:** IPR generated through joint research by institution(s) and industrial concern(s) through joint efforts can be owned jointly by them as may be mutually agreed to by them and accepted by the Department through a written agreement. The institution and industrial concern may transfer the technology to a third party for commercialization on exclusive/non-exclusive basis. The third party, exclusively licensed to market the innovation in India, must manufacture the product in India. The joint owners may share the benefits and earnings arising out of commercial exploitation of the IPR. The institution may determine the share of the inventor(s) and other persons from such actual earnings. Such share(s) shall not exceed 1/3rd of the actual earnings.

5. **Patent Facilitating Fund:** The institution shall set apart not less than 25 per cent of such earnings for crediting into a fund called Patent Facilitating Fund. This Fund shall be utilized by the institution for updating the innovation, for filing new patent applications, protecting their rights against infringements, for creating awareness and building competency on IPR and related issues.

6. **Information:** The institutions shall submit information relating to the details of the patents obtained, the benefits and earnings arising out of IPR and the turnover of the products periodically to the Department/Ministry, which has provided funds.

7. **Royalty-free license:** The Government shall have a royalty-free license for the use of the intellectual property for the purposes of the Government of India.

DIRECTOR RESEARCH
S.K. University of Agri. Sci. & Tech
Shalimar, Srinagar-191121.

(HEAD OF THE INSTITUTION)
(Signed and Stamped)

1 INTRODUCTION

1.1. Background/ Summary of the Fellowship Study:

Basket Willow or Wicker Willow locally known as *Veer kani* in Kashmir and *Beed* in Urdu is the best known representative of family Salicaceae. Willows have been growing in Kashmir valley since time immemorial. Various renowned botanists have claimed the existence of willows from few leaf impressions found as fossil deposits in *Karewa* clays and coal deposits in Kashmir during the Pleistocene period in Burzehama and Gufkral areas of district Srinagar. The Mughals of the 17th century, also have mentioned about the existence of willow trees, their habitat and use of willow wood in Kashmir. However, first large scale and commercial plantation of this species was undertaken by Forest Department in the year 1917 around the Wular Lake. Thereafter, other wetlands located at Harran, Shalbugh, Hokarsar, Mirgund, Rakhiarath, Gund and Anchar were brought under the willow plantation and at present approximately 2000 km^2 of land is under its cultivation. These plantations were primarily meant to cater the needs of fuelwood requirements of people of Kashmir. The estimates have revealed that about 5 million trees of willow are existing which comprising about 16 per cent of total broadleaf tree plantation of Kashmir valley (Masoodi *et al.*, 2004). Wicker willow refers to a certain group of medium-sized willow shrubs that are pruned, coppiced or pollarded in such a way that they are stimulated to produce long, straight, flexible shoots. Generally, willow is grown in the cool, fertile, irrigated lands of the Kashmir Division as it requires large quantities of water. Thus these plantations are often accompanied by water troughs in between the plantation beds and the farmers cultivate these species in and around paddy lands where frequent irrigation is available. Among the most common species the plantations of *S. purpurea*, *S. dickymat*, and *S. triandra* are found in many places across the valley especially in Ganderbal, Srinagar and Budgam districts of the valley. These willows are harvested annually and have minimal lateral branching. The pliable branches collected from these plantations are used to make high quality multi-shaped and multi-purpose artifacts of furniture, baskets, *Kangris* (portable fire pot), fascines and containers for storing vegetables, food items and clothes, etc. Till the recent past the leaves of wicker willow boiled in water were used till recent past to relieve fatigue, pain in legs and headache. The bark after boiling is said to relieve the pain of arthritis. The leaves and

bark contain an active ingredient namely bitter glucosides called salicin, which on hydrolysis liberates glucose and salicylic alcohol (saligenin). Salicates in general increase the urinary excretion of uric acid and this property is used in the treatment of gout. As such there is a close association of the people in Kashmir with this shrub. Besides being labour intensive, basket industry involves reasonably large number of local people which is significant for socio-economic upliftment of the rural masses. Production of elaborated willow products has been a productive alternative to supplement the family income of rural and urban people involved in this trade. The cost of willow plantation including land preparation, planting and protection etc. is about Rs. 92000 ha^{-1}. The average yield from these plantations ranges between 7- 12 metric tons (dry) ha^{-1} $year^{-1}$. The weaving of wicker handicrafts generates an income of Rs. 59534.70 $annum^{-1}$ with an employment of 366.61 person days $annum^{-1}$ in the households engaged in this profession.

1.2 Baseline and Scope of the Fellowship:

The goal of this fellowship project was to highlight and quantify the various facets of wicker willow based cottage industry towards livelihood generation in Kashmir and its role in mitigating the effects of increasing CO_2 in the environment by locking the carbon. Native to the temperate and subtropical zones, trees and shrubs of Salicaceae which include poplars (*Populus* spp.) and willows (*Salix* spp.) are fast growing and easy to propagate vegetatively. Many of the species are adapted to a wide range of climatic and soil conditions. They are easy to cultivate and form an important component of forestry and agricultural systems, often for small-scale farmers. They provide a wide range of wood products (including industrial roundwood and poles, pulp and paper, reconstituted boards, plywood, veneer, sawn timber, packing crates, pallets and furniture), non-wood products (fodder, fuelwood) and services (shelter, shade and protection of soil, water, crops, livestock and dwellings). Poplars and willows have an important role in phytoremediation (i.e. taking up heavy metals to purify polluted soils) of degraded sites, rehabilitation of fragile ecosystems (including combating desertification) and forest landscape restoration. They are often integrated with agriculture, horticulture, viticulture and apiculture. They provide employment opportunities, boost exports and contribute to social and economic development and sustainable livelihoods in rural areas. Kashmir being a temperate zone provides a convenient environment for the cultivation of the wicker willow. Grown in the cool, fertile, irrigated lands of the Kashmir Division, wicker

willows require large quantities of water. The farmers usually cultivate these species in and around paddy lands where frequent irrigation is available. The wicker willow plantation is usually found in wet lands as well as those pockets where chances of flood were prevalent. Besides, it is found on the boundaries of fruit orchards and on the bunds of paddy fields as soil binding agents which suggest that such cultivations can be used in agroforestry system. Majority of wicker willow plantations were found in the districts viz. Ganderbal, Srinagar and Budgam of the Kashmir Division. Based on the preliminary surveys, it was found that the bulk of wicker based industry was concentrated in Central zone of Kashmir Valley particularly in the Districts of Srinagar and Ganderbal. Thus in Kashmir valley, the central zone was selected on the basis of purposive sampling and similarly the villages and districts were selected based on the dependence on the wicker industry. 50% of the involved villages were sampled randomly and thereafter 10% of households involved in the selected villages were surveyed and data was collected on value chain analysis based on the interview schedule developed. Studies on the status and distribution of wicker willow in Kashmir by (Rather et al., 2010) have confirmed the presence of wicker willow in all districts of Kashmir region except that of Kupwara. They confirmed that wicker willow contributed about 35.34% to the farmer's average income in Srinagar. During the survey of the study sites it was seen that the farmers are shifting from Poplar/Paddy to wicker plantation. During the study an economic appraisal of wicker willow in contrast to Poplar/Rice revealed that economically wicker willow is equally or even more profitable landuse system than poplar and paddy cultivation making it a prominent small-scale forest based cottage industry playing a vital role in livelihoods, socio-economic, employment, rural development, poverty alleviation of stakeholders involved in this trade. It was reported that *Salix triandra* was found to be grown in all the districts in addition to *Salix purpurea*, *Salix dickymat.* Because of their rapid growth they are effective for carbon sequestration and can be an important part of our renewable energy future. By sequestering carbon in below-ground biomass, it can offset any greenhouse gas (GHG) emissions.

1.3 Overview of the Major Issues to be addressed:

An indepth survey and interaction with the stakeholders of the wicker industry revealed various issues that need immediate attention for strengthening the wicker based cottage industry in the valley. Some the major issues to be addressed are highlighted

below:

- Emphasis should be laid on growing large scale scientifically managed plantations to achieve maximum yield even in old age plantations.
- The quality of the wicker products can be improved tremendously through value addition to fetch good return to the stakeholders.
- Lack of recognition of farmers involved in wicker plantation in Kisan Credit Card. The Kisan Credit Card has emerged as an innovative credit delivery mechanism to meet the production credit requirements of the farmers in a timely and hassle-free manner. The scheme is under implementation in the entire country by the vast institutional credit framework involving Commercial Banks, RRBs and Cooperatives and has received wide acceptability amongst bankers and farmers. However, the stakeholders involved in the wicker industry are yet to avail the benefits of KCC.
- Fluctuating Market rates is the most important factor which influences the wicker industry in the valley. The intermediate contractor mafias decide the rates as per their will, forcing the farmers to sell their harvest as per the rates decided by the contractors. On the other hand the artisans who work hard to craft the produce into beautiful items of international demand are paid meagre amount by the retailers and wholesalers who sell the same items at a good price earning good profit.
- The marketing infrastructure of the wicker products needs to be strengthened for both domestic as well as foreign markets. The co-operative societies and FPOs need to be encouraged to make the wicker handicraft more remunerative.
- The prospective opportunities for income diversification through value addition of wicker handicrafts, fortunate marketing and better commercialization should be explored and accordingly, skill development and capacity building programs on these aspects should be organized among entrepreneurs. Hence, the policy and decision makers should give due recognition during planning and implementation of explicit strategies for improvement and strengthening of wicker handicraft entrepreneurship for rural industrialization and livelihood improvement. During

planning, implementation and execution of strategies for promotion and strengthening of wicker handicraft, the socio-economic characteristics of people having significant impact on wicker handicraft should be given due consideration. The study indicated that the people engaged in wicker handicraft especially artisans are in disadvantageous position with regard to socio-economic status. As a result, the qualities of the life of the people need to be improved by the way of innovative options and by exploiting the existing resources.

- Provisions should be made to give cost reduction incentives to the manufacturers so that they could have an advantageous initial leverage to face the competition of established brands from India and abroad.
- Efforts need to be taken to develop skills and capacity through effective extension and training networks by involving governmental, non-government and community based organizations.
- Government needs to adopt a holistic approach towards the wicker industry. In addition to a comprehensive package of general investment incentives, the promoters of this business should be given special capital investment and subsidy.
- Need to address the problems faced by the base stakeholder (farmer) of the wicker industry for policy framing.
- The socio-economic characteristics of the people having significant impact on wicker handicraft should be given due consideration during planning, implementation and execution of specific strategies for promotion and strengthening of wicker handicraft.

1.4 Brief summary of the activities under taken by the researcher:

1. Survey of the study areas done on grower, weaver and trader level and raw data collected for value chain analysis
2. Preparation and testing of Schedule.
3. Live coverage of various on farm and off farm activities related to wicker.
4. Identification of constraints faced in marketing of wicker handicraft.
5. Economic analysis of the baseline yield data.

6. Identification of the various marketing channels involved in the wicker industry
7. Value chain analysis, identification and share of each stakeholder in the marketing channel.
8. Yield data collected on field for the year 2018-19 for carbon stock assessment and offset value of the 1 to 14 year age gradation of the short rotation wicker willow coppice plantation.
9. Determination of value addition of major wicker handicrafts.
10. Tracking the GPS coordinates of various wicker growing areas in district Ganderbal (age gradation wise).
11. Area assessment and map generation of wicker plantations using GIS technology in the districts of Srinagar, Ganderbal and additionally Budgam as well.
12. Collection of propagules of various species of wicker willow in order to develop a germplasm of wicker willow in the faculty
13. Collection of the samples of the various species of salix grown for their identification and differentiation.
14. Soil analysis and testing of various soil parameters like OC and BD in the study areas.
15. Estimation of Tannin content.

2 METHODOLOGIES, STARTEGY AND APPROACH

2.1 Methodologies used for the study:

a. <u>Description of the study area:</u>

The proposed study was conducted in the purposively selected districts of Srinagar and Ganderbal. Srinagar is the largest city and the summer capital of Jammu and Kashmir. It is situated on the banks of the Jhelum River, a tributary of the Indus, and Dal and Anchar lakes. The city has an average precipitation of 710 millimetres (28 inches), with an average summer and winter temperature of 23.3 °C (73.9 °F) and 3.2 °C (37.8 °F) respectively with an elevation of 1,585 metres above mean sea level. People

living in Srinagar District depend on multiple skills. Total workers are 407,188 out of which men are 333,151 and women are 74,037. A total of 6,602 cultivators are dependent on agriculture and farming, out of which 5,616 are men and 986 are women cultivators respectively. 6,513 people work in the agricultural land as labourers, men are 6,013 and 500 are women as per the 2011 census. The major areas from the district Srinagar which are involved in the wicker industry are Omarhier, Dargah, Batpora and Astanpora. Ganderbal district, has its district headquarters located at 33.73°N 75.15°E in the town of Ganderbal, and is at an average elevation of 1,950 metres (6,400 ft) above mean sea level. The town is at a distance of 21 kilometres (13 mi) from Srinagar city. The mountainous Ganderbal district is spread across the Sind River. It is the only river in Jammu and Kashmir on which three hydroelectric power stations are functional; besides that the river provides water for irrigation, 80% population of the district is engaged with farming. The town has an average summer temperature of 20 °C, and an average winter temperature of 1 °C respectively. People living in Ganderbal District depend on multiple skills, total workers are 100,890 out of which men are 73,305 and women are 27,585. Total 5,227 cultivators are depended on agriculture and farming, out of which 4,210 are men and 1,017 are women cultivators. 5,539 people works in agricultural land as labor, men are 4,761 and 778 are women as per the 2011 census. The major villages from the district Ganderbal involved in the wicker plantation and business are: Harren, Shalbugh, Sehpora, Gadoora, Hakim Gund, Pirpora, Tulmulla, & Gundirehman.

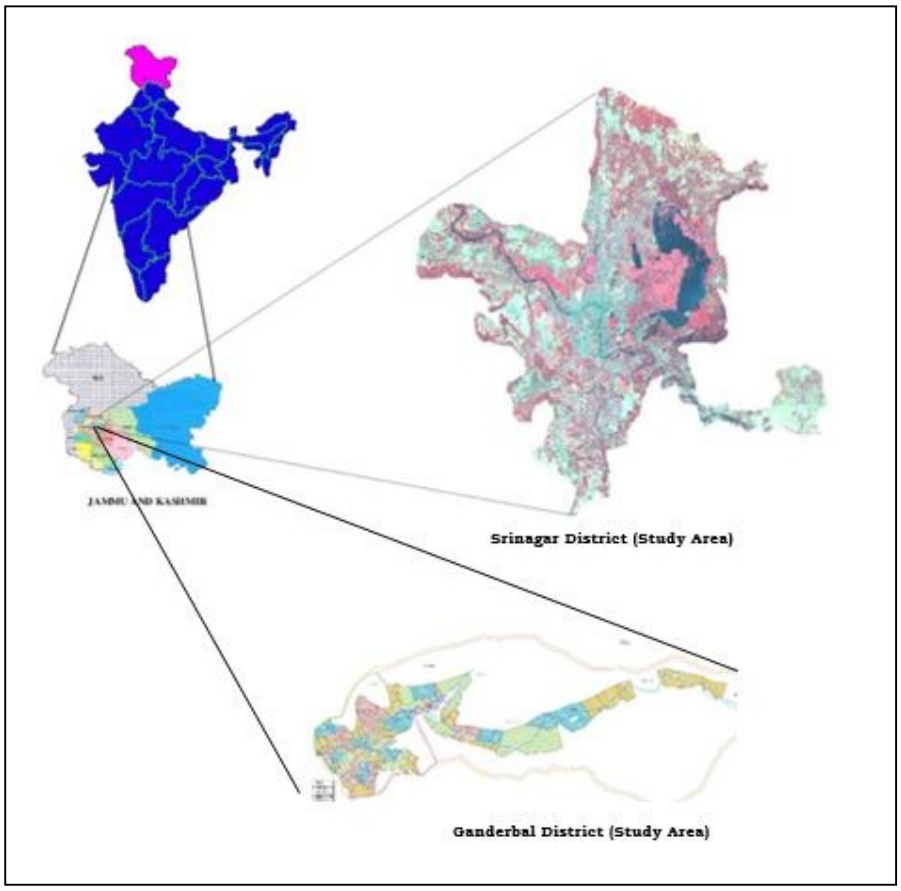


Figure 1: Map of the study area

b. <u>Preparation of schedule:</u>

Data collection through schedule regarding raw material, processing method and time, cost involved, mode of operation with the traders and the raw material suppliers, person involved (Gender wise) in each household, age of artisans involved etc. These are nine steps were involved in the development of a schedule:

- Deciding the information required from the respondents based on the research objectives
- Defining the target respondents who are directly or indirectly involved in the wicker industry.
- Choosing the method(s) of reaching your target respondents.
- Deciding on question content based on the research objectives

- Putting questions into a meaningful order and format as per the respondent convenience.
- Pre-testing the schedule.
- Developing the final survey form.

c. <u>Selection of Sample and Sampling Design:</u>

The central zone of the Kashmir province was selected where the concentration of wicker plantation is higher. The scheme is represented in the flow chart as shown in Figure 2. District Srinagar and Ganderbal were purposively selected because majority of the farmers acted as stakeholders of the wicker industry with an average land holding of 0.43ha/family. Based on the dependence on the wicker industry. 50% of the involved villages were sampled randomly and thereafter 10% of households involved in the selected villages were surveyed. A total of 153 households involved in wicker industry were surveyed for collecting the necessary information concerning the objectives undertaken like socio-economic data of the stakeholders and economic analysis to ascertain the marketing channels and the profitability of this industry.

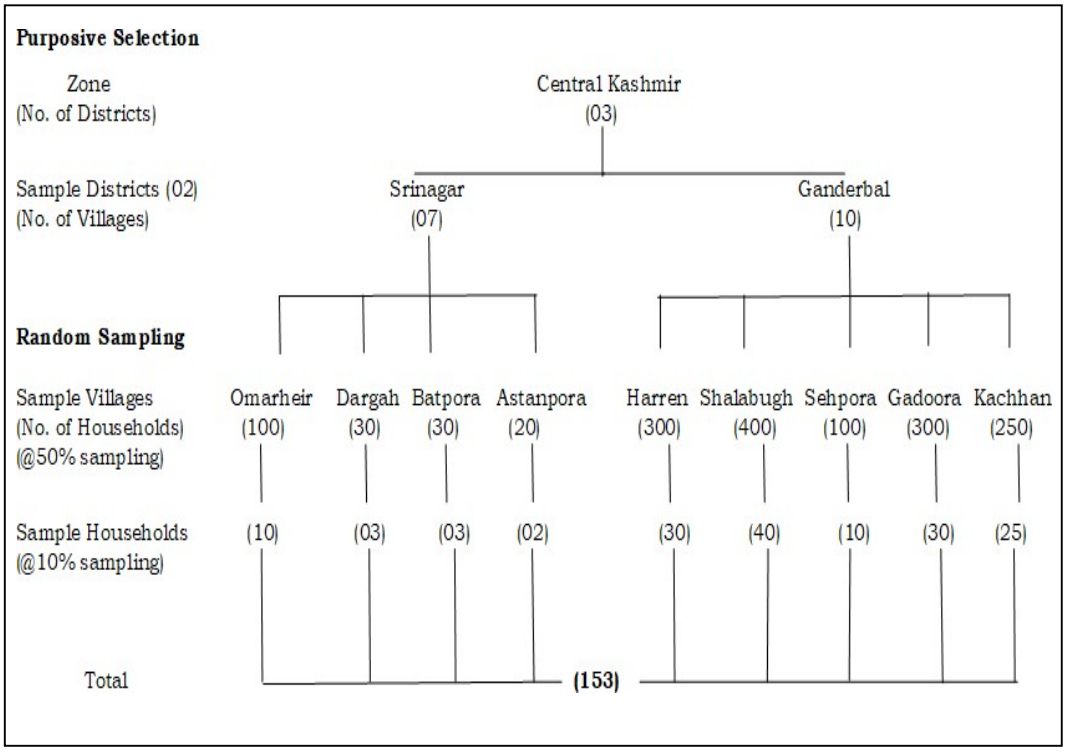


Figure 2: Sampling procedure

d. Selection of wicker willow cultivators, processors and artisans:

During this stage of sampling a list of wicker willow cultivators, processors and wicker willow handicraft makers in the selected blocks was compiled. In this stage of sampling different categories were found:

1) Farmers who are only Wicker willow cultivators

2) Farmers who are only wicker processors.

3) Farmers who are both wicker willow cultivators as well as artisans.

4) Framers who opt for any two of the mentioned activities or who have adopted all of them

On the basis of the information collected through survey in the study areas a total of 2230 households were reported to be directly or indirectly involved with wicker industry in entire Kashmir valley. The percent involvement of the stakeholders involved in different wicker activities is shown in Figure 3. Most of the stakeholders involved were artisans (30%) who were involved in crafting the processed wicker into different craft items, followed by stakeholders (20%) who were involved in both plantation and weaving as well. It was seen that only 1% of the stakeholders were involved in plantation of this short rotation coppice wicker and trading its crafted products as well.

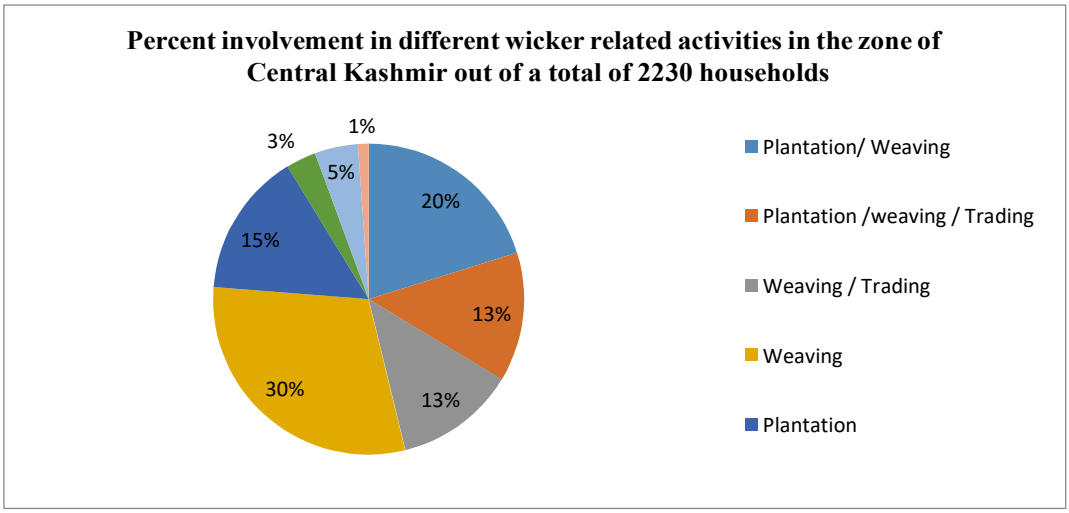
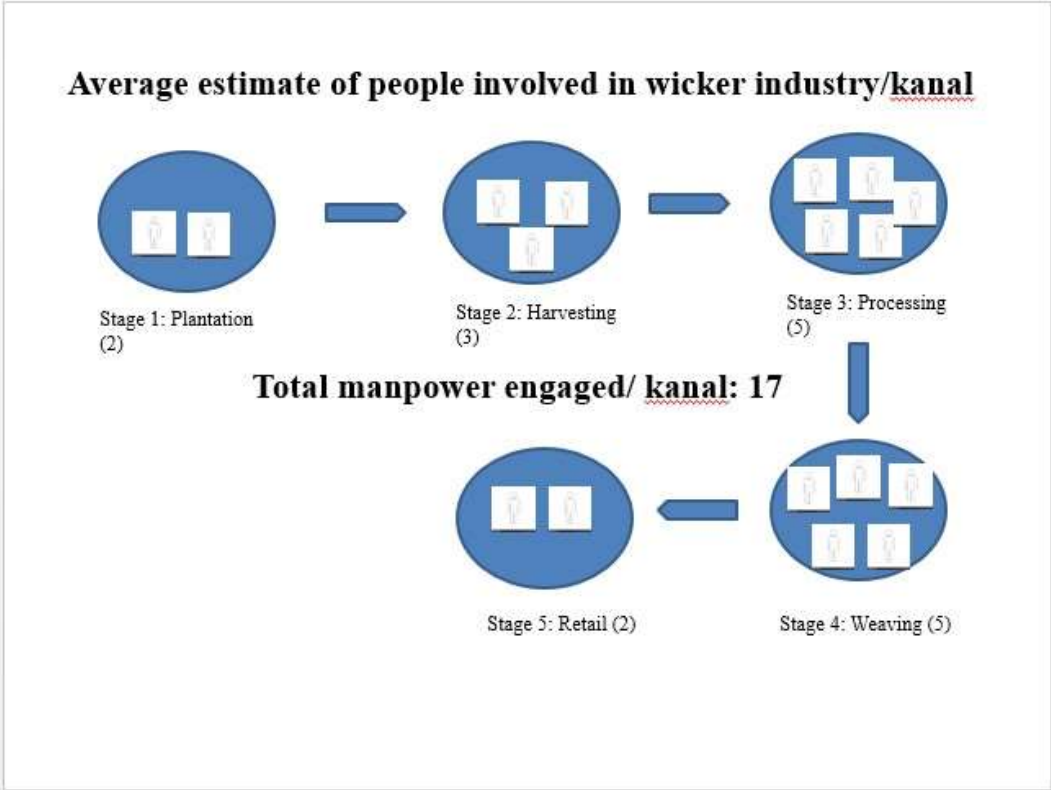


Figure 3: Percent involvement of the stakeholders in different wicker willow related activities

On an average total manpower engaged in wicker industry per kanal is 17. This implies that on an average 17 people are involved from the process of plantation, harvesting etc to the end product retail per kanal of land.



e. Determination of marketing channel and marketing system:

In this step, the main emphasis was on the different marketing channels present in the marketing system. Following were the main marketing channels observed in the selected blocks:

1) Producer — Retailer — Consumer.

2) Producer — Wholeseller — Retailer — Consumer.

3) Producer —Processor— Artisan— Wholeseller — Retailer — Consumer

Data with respect to marketing of wicker handicrafts collected were marketing channel of wicker handicrafts, marketing margin, marketing efficiency and price spread.

f. Survey schedule and data collection:

To meet the objectives of the study the prepared schedule was used to collect data

from the cultivators, wicker artisans, processors and markets relating to different aspects of economics of wicker willow. Primary data on the socio-economic status, total land holding, type of species cultivated, marketing channels, manufacturing of wicker handicrafts and other aspects of wicker production was collected.

2.2 Details of Scientific data collected and Equipment Used (max 500 words):

a. Socio-Economic data:

The data on the socio-economic profile of the sampled households was collected using the schedule. Information on the size of family, no. of family members, size of the land holding, species of wicker willow grown, age of plantation were collected for a total of 153 households, 18 from Srinagar and 135 from Ganderbal respectively. The depiction of the collected data is shown below using the graphical representation. Maximum involvement was seen from district Ganderbal followed by district Srinagar. The information collected from the respondents revealed that out of the total 2230 households in the sampled areas who act as stakeholders in the wicker based cottage industry, majority of the household are artisans that are involved in the weaving of wicker into different crafts (30%) and only 13% of the households are involved in all the three activities viz. Plantation, Weaving and Trading. Such families manage all the processes from plantation to processing, weaving, trading by themselves as a single unit. The distribution of the households involved in the wicker industry for the various villages of the districts Ganderbal and Srinagar are shown in Figure 4 and Figure 5 respectively.

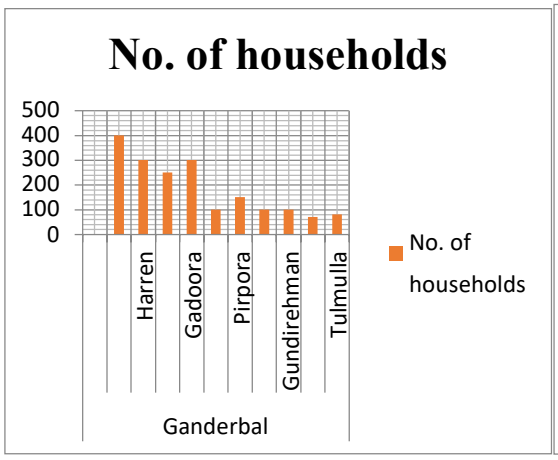


Figure 4: Household involvement for district Ganderbal

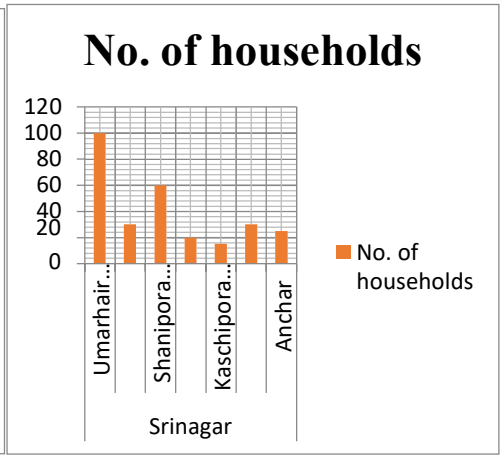


Figure 5: Household involvement for district Srinagar

Age was the first socio economic character that was determined among the surveyed respondents. A perusal of Table 1 reveals that the age among the respondents was ranging from 26 to 80 years.

Table 2: Description of age and total land holding of respondents (N=153)

	Range		
Variable	Minimum	Maximum	Average
1. Age (years)	26	80	50
2. Land Holding	3.5	37	10
3. Irrigated (kanal)	2	14	5
4. Un-Irrigated (kanal)	1	25	5
5. Area under wicker willow (kanal)	1.5	7	2

The average age of the respondents was determined to be 50 years. It was found that the mostly elderly people were involved in the wicker industry, while as the youth of these villages were mostly preferring government jobs or businesses over the wicker trade. The second socio- economic character determined among the respondents was total land holding within these respondents. The respondents were having their land under various agricultural crops, wicker willow cultivation, fruit crops, residential area, wasteland etc. The total land holding among the respondents was ranging from 3.5 to 37 kanal. The average land holding was determined to be about 10 kanals. The educational qualification was observed in the study areas including the respondents only. The score of 0 was given for illiterate and 1 for literate respondent. Among the literate respondents, score of 1 was given for primary education, 2 for middle pass, 3 for matric pass, 4 for 12th pass, 5 for graduation and 6 for post-graduation. It was observed that most of the surveyed respondents belong to the middle pass category (25.50%), followed by matric pass (22%), illiterate (21%), 10+2 category (18.54%), primary pass category (7.5%) and graduate category (5.36%). This Table 3 reveals that most of the surveyed respondents were middle pass followed by matriculate respondents. Family size of the respondents was determined using the scale having the following components: ¬ Small (up to 5 members) ¬ Medium (from 6-10 members) ¬ Large (above 10 members) It was observed that most of the respondents belonged to a small family (59.5%), followed by medium sized family (30.25%) and lastly to large family (10.25%). From the percentage calculation it could be observed that the small sized family was prominent among the surveyed respondents.

Table 2: Educational Status among the surveyed respondents

	Categories	Respondents (N=153)	
		Frequency	Percentage
Educational Qualification	Illiterate	32	21%
	Primary	11	7.5%
	Middle	39	25.50%
	Matric	33	22%
	10+2	28	18.54%
	Graduate	8	5.36%

b. Collection of GPS Points for map generation and area assessment using GIS:

A GPS device Garmin was used to obtain the coordinates of the wicker plantations. It receives signals from satellites that are going around the earth and by receiving these signals from the satellites, it is able to calculate the exact location of the area. Using satellite imagery processing technique, we can separate planting lands with a low cost, high speed and precision (Azadah and Shariar, 2011). Field visitation recorded 20 ground control points by GPS in the way of features in various areas of district Srinagar and Ganderbal. Additionally, the status of district Budgam was also seen and the map for the district was also generated. Results indicate that spectrum reflex of wicker species is different from other vegetation's and is separable. The methodology for wicker mapping is given below:

1. Downloading of Sentinel data from USGS Earth Explorer.
2. Top-of-Atmospheric Correction using QGIS (an open source software).
3. Layer stacking of all bands and clipping of desired area from shape file.
4. Mosaicking of sentinel scenes and removing forest cover using FCC.
5. Finding range of spectral reflectance values for wicker with the help of GPS points.
6. Classification of images by applying Knowledge Classifier using reflectance values (minimum and maximum).
7. Post classification correction for removing of incorrect areas.
8. Area calculation, accuracy assessment and map generation.

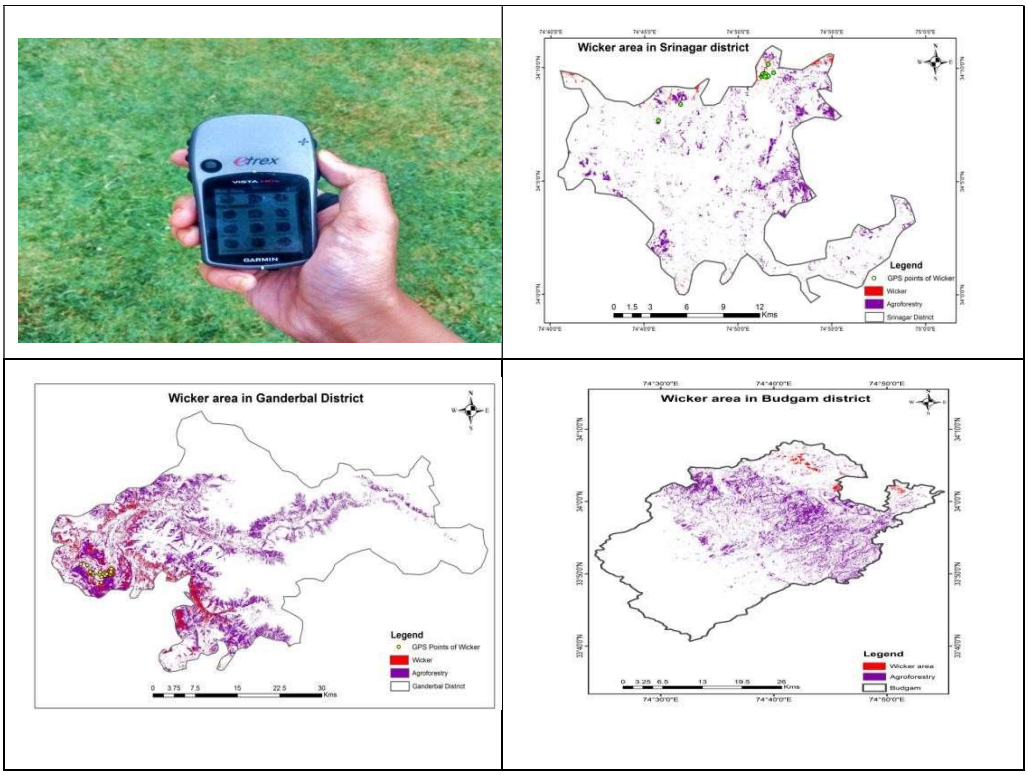


Figure 6: Map showing the areas (in red color) under short rotation coppice wicker willow in the districts Srinagar, Ganderbal and Budgam as well.

Table 3: Statistics obtained from GIS mapping.

SRINAGAR STATISTICS		
Name	**Area in Sqkm**	**Area in ha**
Total Geographical Area	478.46	47846.82
Total Agroforestry Area	86.80	8684
Total Wicker Area	**15.17**	**1517.72**
Agroforestry in % from total geographical area	18.10	
Wicker in % from total geographical area	**3.10**	
GANDERBAL STATISTICS		
Total Geographcal Area	1647.81	164781
Total Agroforestry Area	293.7848	29378.48
Total Wicker Area	**3.804**	**380.4**
Agroforestry in %	17.82	
Wicker in % from total geographical area	0.23	
Wicker in % from total agroforestry area	**1.29**	
BUDGAM STATISTICS		
Total Geographical Area	1222.89	122289.64
Total Agroforestry Area	160.6	16061.7
Total Wicker Area	**6.6**	**660.8**
Agroforestry in % from total geographical area	13.1	
Wicker in % from total geographical area	**0.53**	

The table for area assessment revealed that the area under wicker plantation was maximum in Srinagar district (1517.2 ha) followed by Budgam (660.8 ha) and Ganderbal (380.4 ha) which account for about 3.10% , 1.29% & 0.53% of the total geographical area. The wicker statistics from district Budgam revealed a significant increase in the wicker plantations over the years according to the data obtained from the field surveys and respondents. Hence indicating a preference by the farming community over paddy and poplar. However, it was reported that the land records are poorly maintained; they do not reflect the on ground position. A huge difference in the estimates of wicker area for the study districts was seen as obtained from the GIS mapping and from the survey/ government records indicating an immediate intervention by the government to update the plantation area records under wicker plantation for ensuring a holistic development of this sector and other development activities as per the district/state agriculture plan. This area estimation using GIS in the core districts of Kashmir valley is done for the first time and this has filled the information void left by lack of data collection by the Government Depts.

c. Soil Analysis:

Soil Sampling Augers which include standard soil augers, clay augers (dutch) were used for sampling at the study sites. Each sample was taken at a 15 cm depth at three random locations. All the samples were transferred to polybags. The soil samples were composited stand wise, dried under shade, crushed and passed through 2mm sieve. The sieved samples were analysed for different chemical properties. The samples were analyzed in the soil laboratory of the Division of Soil Science, SKUAST-Kashmir following the standard protocol and procedure. The soil data is given in the tabulated form below. The plots selected for sampling were of *Salix triandra* plantations. Willow is a fast growing species which require fertile soils for short rotation besides climatic conditions, different soil properties effect biomass production. In particular the nutrient status of the soil is very important in short rotation forestry. Willow species grow rapidly and bind a great amount of nutrients in their biomass (Hytonen, 1996). Under most conditions fertilizer will be required to maintain production of short rotation coppice plantation. Information from fertilizer trials together with a knowledge of general soil fertility in an area permit approximation of fertilizer requirements. Also nutrient availability is affected by the soil pH, low soil pH can limit the growth of poplar and

willow in short rotation forestry plantation (Hielman and Norbey, 1997). Suitable pH values of the soil for willow cultivars is 5.5-6.5 (Sennerby and Forsse, 1990). Sites need to be fertile enough to support fast growing broad leaved species as well as poplars and willows grow best on mildly acidic with pH 6.0-7.0 (Cannell, 2004). It is also reported that many favourable changes in feed stock qualities may take place very quickly in coppiced growing stock (Hytonen and Fern, 1984).

Table 4: Soil Analysis of the 14 age gradations of *Salix triandra* plantation

Sample (Plantation)	**SOC (%)**	**Avg. N (Kg/ha)**	**Avg.P (Kg/ha)**	**Avg.K (Kg/ha)**	**B.D. (gm/cc)**	**SOC (tonnes/ha) 0-15 depth**
S1 (1 year old)	1.21	240	12	143	1.10	19.97
S2 (2 year old)	1.24	260	16	151	1.06	19.72
S3 (3 year old)	1.29	275	18	140	1.04	20.12
S4 (4 year old)	1.52	302	18	134	1.04	23.71
S5 (5 year old)	1.74	340	26	140	1.00	26.10
S6 (6 year old)	1.95	375	22	174	1.00	29.25
S7 (7 year old)	1.86	380	22	162	1.00	27.90
S8 (8 year old)	1.95	335	18	174	0.98	28.67
S9 (9 years old)	2.50	480	22	162	0.98	36.75
S10 (10 years old)	1.74	337	20	140	0.97	25.32
S11 (11 years old)	1.78	375	18	157	0.97	25.90
S12 (12 years old)	1.95	400	16	162	0.93	27.20
S13 (13 years old)	2.13	390	18	174	0.93	29.71
S14 (14 years old)	2.86	500	22	241	0.81	34.75

Figure 7: Soil sample collection at the study sites

Every tonne of organic carbon is the equivalent of about 3.67 tonnes of atmospheric carbon dioxide. The SOC near the soil surface is mainly derived from aboveground litter and fine roots distributed near the soil surface layer. The SOC increased more rapidly when stand age increased. The SOC increased from 19.97 tonnes/ha to 34.75 tonnes/ha from a 1st year plantation to 14 year plantation indicating that growing more SRCW could significantly increase SOC. The availability of other nutrients like N,P, and K also increased with the age of the plantation.

d. <u>Carbon Stock Estimation:</u>

Short-rotation willow coppice (SRWC), is a specific land-use management system in which high density fast growing crops are harvested following short rotation cycles. Fast-growing species, such as willow, are of high interest as producers of biomass for crafting, but also as C sinks. Mainly used today for wicker handicraft, this cropping system is also known for its effective remediation of many environmental issues, from soil decontamination to organic waste disposal (Aronsson and Perttu 2001). SRWC is considered a tool to mitigate carbon dioxide (CO_2) emissions. The rate of carbon sequestration depends on the growth characteristics of the tree species, the density of its wood, the location's conditions for growth and the plant stage of the tree. Calculations were based on above- and below-ground biomass production data from field experiments, including soil organic carbon from fine root turnover, litter decomposition rates and production levels from 14 age gradation SRWC. Various other parameters like No. of coppice/mt^2, No. of shoots/coppice, Height of shoot, Collar Diameter and Fresh Weight related to the fourteen age gradation were recorded as shown in Table 3. From each sample plot shoots were taken from an area of 2500 sq. cm to determine the fresh and dry weight of shoots prior to leaf fall and after leaf fall (at the time of harvest). The weight of shoots of an area of 5 x 5 mt sample plot obtained was recorded and expressed as kg/25 sq. mt which was converted to fresh weight (tonnes/ha.). The shoots taken were oven dried at a temperature 105 ± 2 ^oC for 72 hours and weighed (ASAE, 1994). The weight obtained was reported as dry weight kg per 25 sq. mt and then converted to dry weight t/ha. Detritus carbon density was determined by taking sample plot size 1mt x 1mt and collecting all the leaf litter from these plots. The collected leaf litter was oven dried to determine the dry detritus biomass.

Table 5: **Biomass, Carbon Stock and Carbon dioxide mitigation potential of 14 age gradations of short rotation wicker willow coppice.**

Plantation Age	Above ground Fresh Weight (t/ha)	Above Ground Dry Biomass t/ha	Below Ground Dry Biomass (t/ha)	Total Plant Biomass (t/ha)	Vegetation Carbon Density (t/ha)	Soil Carbon Density (t/ha)	Detritus Carbon Density	Ecosystem Carbon Stock (t/ha)	CO_2 Eqv(t/ha)	Offset Value (@2$/tonne)
1 Year	9.4	3.76	0.94	4.7	2.115	19.97	0.200	22.285	81.785	163.570
2 Year	12.4	4.96	1.24	6.2	2.79	19.72	0.197	22.707	83.335	166.671
3 Year	15.8	6.32	1.58	7.9	3.555	20.12	0.201	23.876	87.626	175.251
4 Year	12.4	4.96	1.24	6.2	2.79	23.71	0.237	26.737	98.125	196.250
5 Year	14.6	5.84	1.46	7.3	3.285	26.1	0.261	29.646	108.801	217.602
6 Year	11.8	4.72	1.18	5.9	2.655	29.25	0.293	32.198	118.165	236.330
7 Year	11.2	4.48	1.12	5.6	2.52	27.9	0.279	30.699	112.665	225.331
8 Year	15.6	6.24	1.56	7.8	3.51	28.67	0.287	32.467	119.153	238.306
9 Year	23.6	9.44	2.36	11.8	5.31	36.75	0.368	42.428	155.709	311.418
10 Year	23.2	9.28	2.32	11.6	5.22	25.32	0.253	30.793	113.011	226.022
11 Year	24	9.6	2.4	12	5.4	25.9	0.259	31.559	115.822	231.643
12 Year	22.2	8.88	2.22	11.1	4.995	27.2	0.272	32.467	119.154	238.308
13 Year	27.8	11.12	2.78	13.9	6.255	29.71	0.297	36.262	133.082	266.164
14 Year	28.4	11.36	2.84	14.2	6.39	34.75	0.348	41.488	152.259	304.518

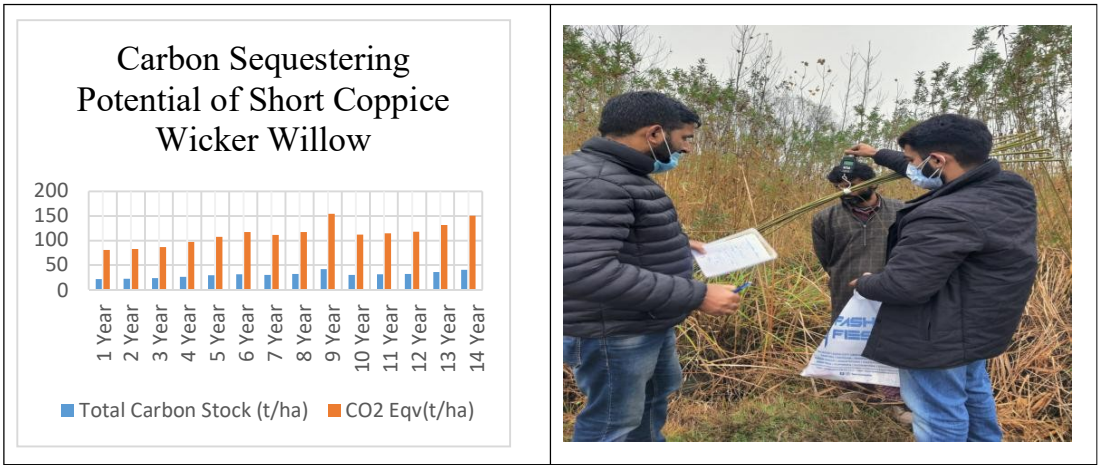


Figure 8: Estimation of carbon sequestering potential and Carbon stock

The calculation of carbon stock was determined by multiplying total biomass by a conversion factor that represents the average carbon content in biomass. The coefficient of 0.45 for the conversion of biomass to carbon was used.

Therefore, the total carbon stock (C) present in the calculated total biomass were equal to C=0.45 × Biomass (total).

(Woomer, 1999)

This carbon stock present in the biomass was added to soil organic carbon stock which was calculated using the formula:

SOC Stock (kg/ha): SOC(%) x BD(gm/cc) x SD (cm) x 1000

The mitigation potential of the system has been worked out by calculating equivalent carbon dioxide (eCO_2) as per formula: Only biomass of the system have been taken.

$$eCO_2 = C \times 3.67$$

(Dury *et al.,* 2002)

Estimation of Tannin:

The tannins in the bark dye the willow a dark tea colour. Tannins and tannin-like substances are widespread in nature and are probably present in all plant materials. Tannin-like compounds reduce phosphor-tungsto-molybdic acid in alkaline solution to produce a highly coloured blue solution, the intensity of which is proportional to the amount of tannins. The intensity is measured in a spectrophotometer at 700nm. Tannin contents of processed withies were measured by Folin-Denis method.

- Preparation of Folin-Denis reagent:

Sodium tungstate (100 g) and phosphomolybdic acid (20 g) were dissolved in 750 ml distilled Water and later 50 ml phosphoric acid was added into the solution. Mixture was refluxed for 2 h and volume was made to one litre with distilled water.

- Preparation of carbonate solution:

Sodium carbonate (350 g) was dissolved in one liter water at 70^{o}C. Solution was allowed to stand overnight and then it was filtered through glass-wool. Preparation of standard tannic acid solution Tannic acid (100 g) was dissolved in 100 ml distilled water.

- Preparation of working solution:

5 ml stock solution was diluted to 100 ml with distilled water. Each ml contained 50µg of tannic acid.

Method:

- Preparation of standard curve

10ml of standard solution was made up to 100ml distilled water. 1 - 10ml aliquots were taken in clear test tubes. 0.5ml of Folin-Denis reagent and one ml of sodium carbonate solution was added to each tube. Each tune was made upto 10 ml with distilled water. All the reagents in each tube were mixed well and kept undisturbed for about 30 minutes and read at 760 nm against reagent blank.

- Extraction of Tannin

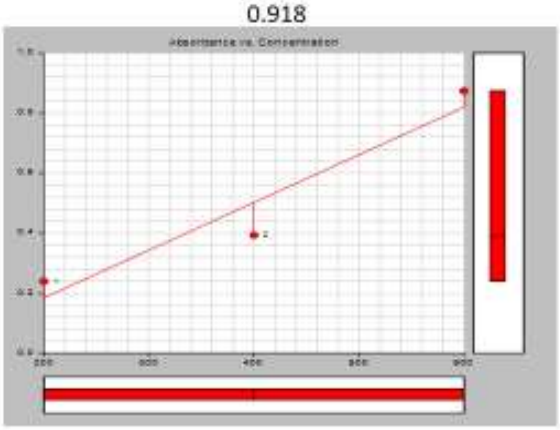
Accurately Weighed 0.5g of the powdered material was transferred to a 250mL conical flask. Add 75mL water. Heat the flask gently and boil for 30 min. Centrifuged at 2,000rpm for 20 min and collect the supernatant in 100mL volumetric flask and make up the volume. Transfer 1mL of the sample extract to a 100mL volumetric flask containing 75mL water. Add 5mL of Folin-Denis reagent, 10mL of sodium carbonate solution and dilute to 100mL with water and Shaken well. Read the absorbance at 700nm after 30 min.

Estimated Model

(-0.1327) + (0.00159) * (Concentration)

R-Squared

0.918



S.No.	Species	ppm	Percentage
01.	*Salix dickymat*	251.9	2.519
02.	*Salix triandra*	239.4	2.394
03.	*Salix purpurea*	219.3	2.193

Figure 9: Concentration curve for the tannin content in various salix species

2.3 Primary Data Collected (max 500 words):

Extensive survey was done throughout the central Kashmir to obtain the primary data pertaining to various aspects related to the wicker industry. The data was collected using the pre-tested schedules which revealed the socio-economic status of the stakeholders involved in the wicker industry. Data on the involvement of the stakeholders in the various stages from plantation to processing was also obtained. The data on how the withies are processed and the different grades available in the market were examined. The prices of various popular craft items made from wicker willow was obtained from the stakeholders to see the market position of the wicker handicraft in the national market and its contribution towards the business economy and trade. Government offices lacked the proper record on the wicker plantation and the number of households dependent on this industry. Data on the economics of the wicker willow in the study districts was generated to evaluate the value chains, marketing channels and also the profitability of the wicker industry. Besides the collection of data through the designed schedule, the data on the various soil parameters like N, P, K, EC, OC were also obtained through the

collection and the analysis of the soil samples. Various other plantation parameters like No. of coppice/mt^2, No. of shoots/coppice, Height of shoot, Collar Diameter and Fresh Weight related to the fourteen age gradation were recorded. These parameters were used to estimate the offset values of the 14 age gradations of the short rotation coppice wicker willow at a global rate of 2$ per tonne. The samples of the three most commonly cultivated species of Salix viz. *Salix triandra, Salix purpurea* and *Salix dickymat* were also obtained and the morphological features of each variety were studied in detail so as to differentiate between the species. Data on the amount of tannins present in the salix species was obtained using the Folin Denis method of Tannin estimation. In order to generate a database on the area under wicker plantation the GPS coordinates were recorded at each location. Using the QGIS software the maps were generated on the obtained coordinates. These maps gave a clear idea and depiction of the total agroforestry area and wicker area out of the total geographical area of the districts under study.

2.4 Details of Field Survey arranged (max 500 words):

Field surveys involved collection and gathering of information at the local level by conducting primary surveys. These are an essential component of geographic enquiry and were carried out through observation, interviews, sketching, measurement, etc. at the target study sites. The districts were selected and the villages were chosen purposively with the objective of field surveys. The surveys were planned according to the objectives to be met. For collecting the information about the wicker plantation areas like Gund, Gund Rahman, Harran, Shallabugh, Tulmulla, Tailbal, Shanapora, Batpora were chosen as the majority of the plantations were found in these areas. For the information related to boilers Umhair, Anchar, Gadoora were chosen for survey as majority of the boilers/processors are found in these areas. For the information related to artisan's areas like Shallabugh and Tulmulla were chosen. Various stakeholders were chosen in different areas as representatives. Such representative persons were chosen to aid in the process of survey and collection of information. Through field surveys the information on the varieties of salix grown were known. The samples pertaining to the different species were collected for morphological characterisation and identification. The samples of wicker rods were collected during the harvesting season from the surveyed areas for the estimation of the above ground biomass and for the estimation of tannin content in the processed withies.

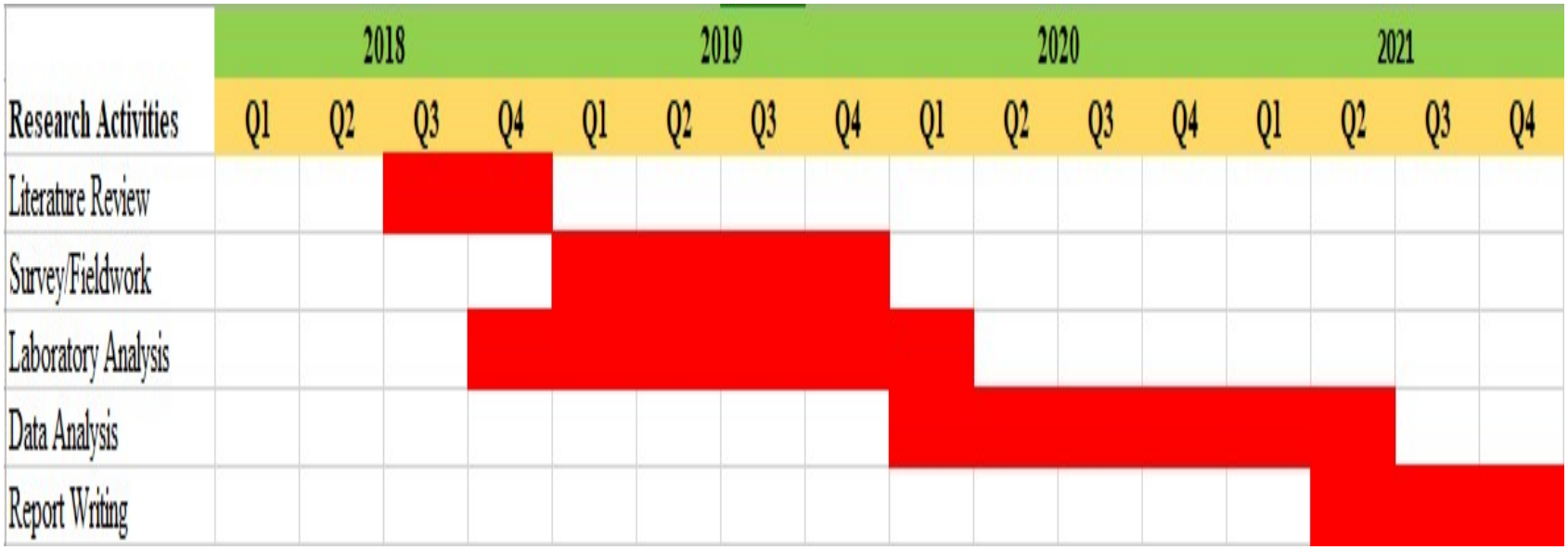
During the entire survey each of the activities involved in the wicker industry from harvesting to boiling and peeling and finally crafting the processed withies into various items was filmed. Various government institutions and offices like DIC, Tehsildar offices were also visited for collecting information pertaining to the area under wicker plantation in the under study districts.

2.5 Strategic Planning for each Activities (max. 1000 words)

S.No.	Activity	Modus Oprandi/Plan of Action
01.	Survey of Plantation areas	• The families involved in the wicker business were identified and information pertaining to their source of livelihood and socio-economic status was obtained. • The areas growing wicker were identified on the generated maps and surveyed for collecting the information on various varieties of Salix grown. • The manpower engaged in planting and harvesting process was ascertained. • Samples of various varieties grown and the soil samples in the respective area were collected for analysis. • Interaction with the farming community involved in the cultivation of wicker willow. • The cost of cultivation/harvesting and other management practices involved were taken note of.
02.	Survey of areas with households involved in processing of willow withies	• The families involved in the process of boiling and peeling of harvested wicker were identified. • Information pertaining to their source of livelihood and socio-economic status was obtained. • The manpower engaged in boiling and peeling process was

		ascertained. • The processes and tools involved in the process were filmed for future reference and studies on wicker willow.
03.	Survey of areas with households involved in crafting of processed willow withies	• The families involved in the process of crafting of processed wicker were identified. • Information pertaining to their source of livelihood and socio-economic status was obtained. • The tools involved in the process were collected and listed. • Different grades of processed wicker used in the process of weaving were identified and taken note of. • Different crafted items were observed.
04.	Mapping of the hotspots of wicker growing areas using GIS	• The coordinates of the various wicker growing areas were taken using a GPS device. • The maps were generated using the coordinates obtained at each of the locations. • Calculation of the Agroforestry area and Wicker area was done.
05.	Estimation of Tannin	• The samples of processed withies was powder grinded using liquid nitrogen. • The estimation was done using the Folis-Denis procedure. • Concentration curves were generated.
06.	Estimation of carbon sequestration potential	• Above ground and below ground biomass was calculated and the carbon stock & offset value of wicker willow was estimated

2.6.1. Activity-wise Timeframe followed using Gantt/ PERT Chart (max. 1000 words)



3 KEY FINDINGS AND RESULTS

3.1 Major Research Findings (max. 1000 words)

a) Schedule based survey:

The database on the 153 households from the selected districts of Kashmir province was obtained. The database gave an overview of the socio-economic status of the households involved in wicker cultivation, processing and sale. Information on various parameters was obtained using a pre-tested schedule. Different tools (surveys, discussions, interviews) were used to obtain different types of information from different groups of informants. Household surveys were used to gather information on age, gender, education, income sources (agriculture, forest and employment), perceptions of change in land use and access to forest resources. In household-level survey, the representative of the household was interviewed, but the village head or traditional leader was interviewed in a key informant interview. Different sources of average household income were observed for the respondents: (a) Wicker willow (b) Wicker willow + Agriculture (c) Wicker willow + Agriculture+ Livestock rearing (d) Wicker willow +Agriculture+ Livestock rearing +Wage earning (e) Wicker willow + Agriculture+ Livestock rearing + Wage earning +Services (f) Wicker willow + Agriculture+ Livestock rearing + Wage earning +Services+ Business (g) Wicker willow + Agriculture+ Livestock rearing + Wage earning +Services+ Business+ other allied services. The maximum average household income was derived from agriculture (29.30%), followed by wicker willow (19.86%) and the least average household income was derived from other allied services (5.83%).

b) Identification and morphological characterisation of the wicker species grown in the selected districts:

Three species of wicker were mostly reported to be cultivated in the designated areas viz. *Salix triandra, Salix dickymat, Salix purpurea*. The classification of the species is shown as under:

Kingdom:	:	Plantae
Division:	:	Magnoliophyta
Class:	:	Magnoliopsida

Order:	:	Malpighiales
Family:	:	Salicaceae
Genus:	:	Salix L.

The species are characterised by many-stemmed shrubs. The willow plant is cultivated from saplings. Once a sapling sprouts, it is severed and sown into the land to harvest its shoots every year. The sapling continues to produce an annual harvest until it is uprooted. Usually the saplings are planted during the month of February and March. A normal willow plant grows up 2-3 meters in its height and the crop is harvested in the month of October. Once the crop is harvested, the withy is grouped into bundles according to length and girth.

Documentation of various activities involved in the wicker industry:

S.No.	ACTIVITY	KEY HIGHLIGHTS
01.	**Plantation**	• Planting of cuttings (9" and pencil thickness) at spacing 30 x 25 cm (6667 cuttings/ kanal) • 3-5 year plantation gives max. yield @1200 kg wicker/ kanal with an average yield of 600 kg/ kanal depending on locality factors.
02.	**Harvesting**	• Harvesting is done in Autumn season
03.	**Boiling**	• Boiling is done in order to make the wicker flexible and easy for weaving and peeling. • Boiling facilitates the absorption of tannin in bark to wood for shine & strength. • Boiling is done in Nov-Dec upto April. • Wickers are boiled for 7 hours and allowed to cool for 12 hour in a boiler.
04.	**Peeling**	• Bark is peeled in order to make it easy to weave and reveal the reddish color imparted to the wood due to boiling. • Peeled wicker is then dried and stacked.
05.	**Sorting**	• Five classes of wicker are later sorted according to girth and sold at different rates to the artisans for weaving. Less the girth more is the cost. As,

		per the latest rates in 2021 diseur was the costliest grade. (1 mann = 40 Kg) as per the Deptt. Of Handicrafts. • Diseur (smallest) @ Rs.8000/mann • Panchseur @ Rs. 6000/mann • Darmiyan @ Rs. 3500/mann • Skeen @Rs. 3000/mann • Sitka (largest) @ Rs. 2000/mann
06.	**Weaving**	• The weaved product is later sold by artisans to the middlemen/traders.
07.	**Trade**	• The traders later sell it to national and international markets at almost double the price it was bought from artisan.

c) <u>Assessment of plantation area and mapping of wicker growing areas:</u>

An assessment of the districts and villages under study was done for the database concerning area under wicker plantation. Additionally, the GPS points of the plantations were collected to generate the GIS maps of the plantation areas for future reference and LULC studies. The survey revealed an area of 32.50 ha & 85.30 ha under wicker plantation in district Srinagar and Ganderbal respectively. However, the estimates obtained from the GIS maps generated differ significantly from the estimates mentioned. (See Table)

d) <u>Economic Analysis of wicker industry and comparison with Poplar and Paddy:</u>

The NPV and BC ratio were Rs. 43837.43 and 2.23 respectively which ensures that the investment in wicker cultivation is economically feasible. The wicker cultivation was also found to be profitable in the sense that the IRR was 32.52%. The functional analysis revealed that the per kanal yield were significantly positively affected by the age of the plantation, number of plants sown/kanal and the amount of fertilizer applied. BCR (Benefit Cost Ratio) in wicker willow, Poplar plantation showed a BCR of 2.34 in the sampled area and the BCR of paddy has already been computed by various workers in the region which comes about 2.12. Furthermore wicker willow has an added advantage

over poplar as it provides returns in the first year itself up to the final harvest whereas poplar has a long gestation period (7 – 12 years).

e) Composition of average annual household income derived from different sectors (Household/year):

Currently, wicker willow cultivators are receiving income from wicker willow cultivation and handicraft making, agriculture, livestock, wage earnings and other activities. Among these sectors, the average income from wicker willow per year is around (Rs 51,337), the income from agriculture (Rs 71,254) will increase the total average income level to Rs 114511, which adds around 48.45% to the total income. Further, average income from livestock is (Rs 33451) and adds around 13.50% to the total income. Wage earnings, which form one of the major incomes, contributed 11.81% (Rs. 29254) to the total income. And income from business is (Rs. 19785) which contributes (7.59%) to total income. Additionally, the income from services and allied activities (Rs. 32480) contributes (12.11%) ad income from other activities (Rs. 15489) contribute (5.83%) to the total income. Thus the approach of sector-wise income distribution indicates the importance of each sector to the total income of rural households (Table 6)

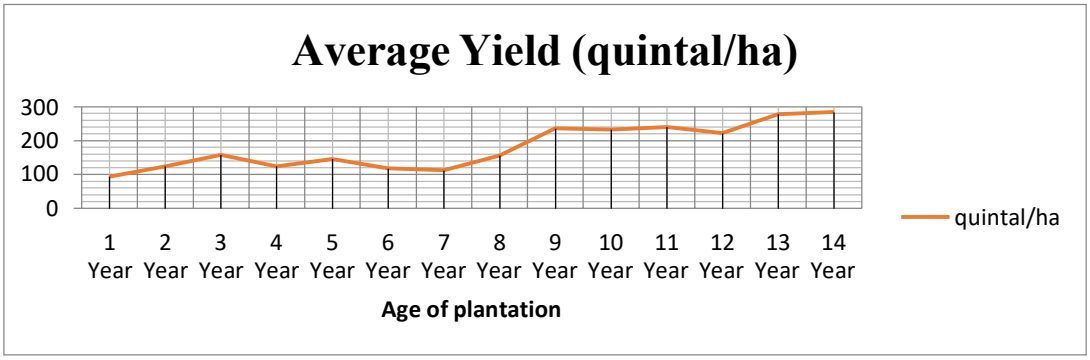
Table 6: Income generated from various activities.

S.No.	Activities	Income Generated (Rs/Household/year)
01.	Wicker Industry	51337 (20.29 %)
02.	Agriculture	71254 (28.16 %)
03.	Livestock Rearing	33451 (13.50 %)
04.	Wage Earning	29254 (11.81 %)
05.	Business	19785 (7.59 %)
06.	Services	32480 (12.11 %)
07.	Others	15489 (5.83 %)

f) Yield Estimation:

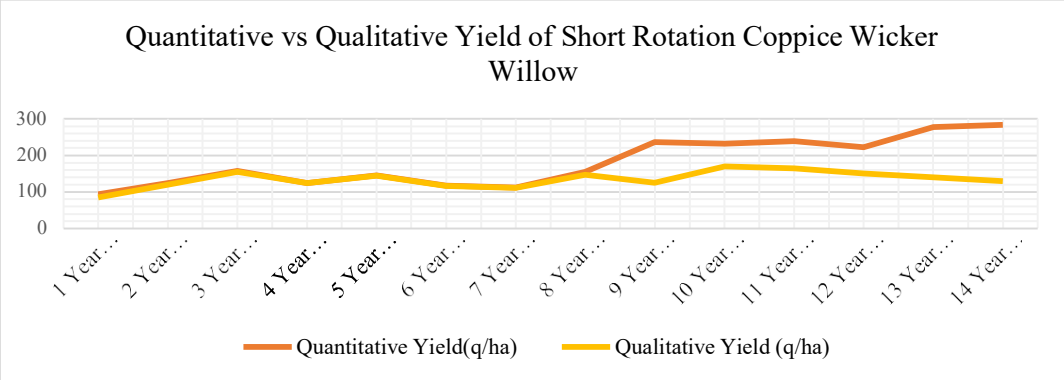
Maximum yield/ha of wicker willow was highest in Srinagar (14.61 t/ha) and minimum in Ganderbal (12.34 t/ha). However average yield for the 14 age gradations of the wicker willow is given in the figure below:

Figure 10: Quantitative Yield of short rotation wicker willow coppice.



Although the quantitative yield increases with the age of the plantation and this increase in the biomass is an important factor towards sequestering more carbon, but increasing girth of the withies may reduce its demand for craft purposes. So there seems to exist a gap between the quantitative and qualitative yield of short rotation coppice wicker as shown in Figure 11 below.

Figure 11: Quantitative vs Qualitative Yield of SRCWW



g) <u>Estimation of Tannin content:</u>

Active constituents in willow (Salix spp.) include salicylates (primarily in the form of glycosides salicortin and salicin) and tannins. The tannin estimation in the three species of salix was done using Folin Denis method. The highest tannin content (251.9 ppm or 2.51%) was found in *Salix dickymat*.

h) <u>SOC Estimation and Carbon Sequestration:</u>

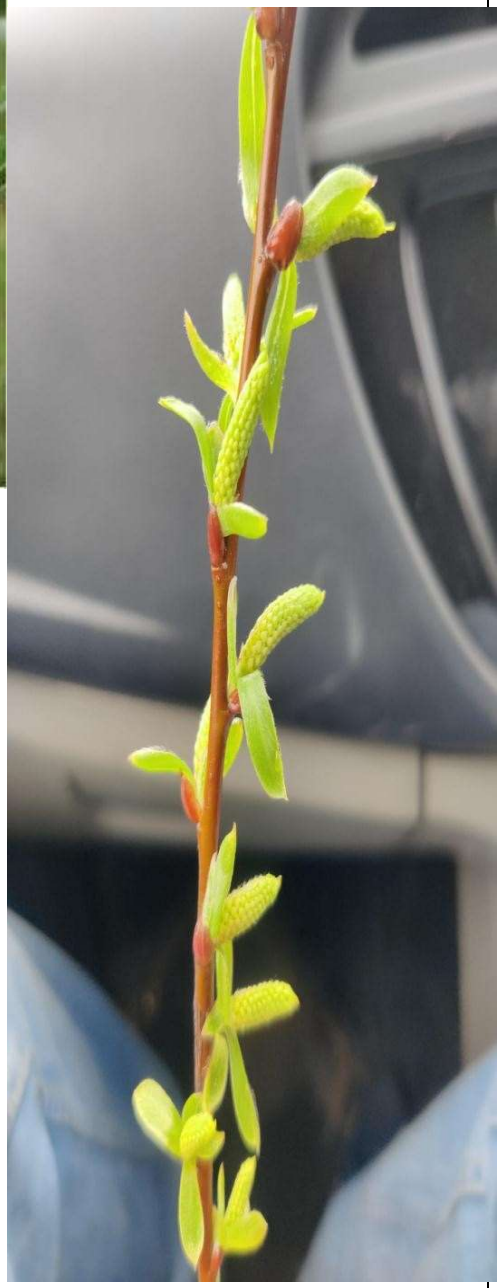
The results show a potential increase in soil C stocks as the plantation grows in age and well as the plant carbon stock. For the 14 year old plantation SOC was recorded at 34.75 tonnes/ha with a total carbon stock of 41.41 tonnes/ha. The maximum offset

value for C is 301.14$ for a 14 year aged plantation and about 161.66$ for the fresh one year old plantation.

3.1 Key Results (max. 1000 words in bullets covering all activities)

(a) Species identification and characterisation:

Salix triandra	*Salix purpurea*
	
• *Salix triandra* is a small, bushy tree or robust, spreading shrub that reaches 10m in height. • The bark of the Almond willow is smooth and dark grey but it flakes off in large irregular patches to expose a reddish-brown under layer. • The twigs are a lustrous olive-brown, glabrous and often angled or ridged. • The leaves of *Salix triandra* are lanceolate, oblong-lanceolate or narrowly elliptic and between 4 and 11 cm long and 1-3 cm wide. • They are regularly serrated and dark green above and green below. • Catkins appear with or a little before the leaves in April and May and sporadically throughout the summer. • Male catkins are yellow, narrowly cylindrical and between 2.5-5cm long and 0.3-1.2 cm wide. • Female catkins are shorter and denser than the male. 10 Almond willow is one of the most attractive and fragrant willow and is being used more	• *Salix purpurea* is a shrub that can sometimes grow in a low and spreading manner no more than 1.5m high and at other time more robust growing as rounded bush or small tree to 5m high. • The bark of the Purple willow is grey and smooth and yellow when the out layer is peeled off. • Twigs are glabrous, slender, tough and flexible usually yellow or grey but sometimes tinged with red or purple. • Leaves of *Salix purpurea* are oblong, oblanceolate or narrowly obovate and variable, 2- 20cm, in length and, 0.5-3cm, in width. • They are a dull dark green above and paler and shinier below. Catkins appear before the leaves in March or April, sometime as late as May in the north.

frequently as a garden shrub. • The twigs have a pleasant flavour of rose-water when chewed.	• They are between 1.5 and 3cm long, densely flowered and black.
Salix dickymat	*CATKIN*
	
• *Salix dickymat* is a tall shrub or small tree which usually grows to between 3 and 6 metres in height. • Its erect or suberect branches usually form a rather narrow, truncate or rounded crown. • The bark is greyish-brown and fissured and twigs are long and straight, very tough and flexible and at first ashy-pubescent becoming smooth and a lustrous yellowish-brown later. • Osier leaves are linear or narrowly linear-lanceolate, between 10-15cm long and 0.5-1.5cm wide and are dull green and thinly puberulous above and silvery below. • Catkins appear before the leaves in late February, March or early April and are generally crowded towards the tips of twigs. • They are yellow, between 1.5-3cm long and 0.5-1cm wide and are densely flowered.	

(b) Variety wise cultivation of wicker willow among surveyed respondents:

The three main species of wicker willow found in the research area were *Salix dickymat*, *Salix triandra* and *Salix purpurea*. These three species are identified on the basis of their bark colour, leaf pattern, durability etc. These three species are grown alone or sometimes in combination with one another with *Salix triandra* + *Salix dickymat* being the best combination among all. In Ganderbal the cultivation of wicker willow was found in villages namely Haran, Shalbugh, Sehpora, Shuhama, Nunnar, Hakimgund, Gundirehman, Gogjigund. It was found that wicker willow (*Salix triandra* L.) also known as (Almond willow) was commonly grown species of wicker willow in all the districts whereas in district Srinagar, two more species *Salix dickymat* and *Salix purpurea* were also found. *Salix dickymat* was located at Haran Sehpora and Shalbugh and *Salix purpurea* at Batipora Tailbal. However, the maximum processing units were found in district Srinagar at Haran, Shalbugh and Sehpora followed by Srinagar at Gadoora and Omar Heir respectively.

(c) Soil Status:

The studies conducted on soil analysis revealed that the soil pH decreased and organic carbon increased with the increase in age of the coppice. The pH recorded (5.5-6.5) was suitable for the growth of wicker willow *Salix triandra* L. The increase in organic carbon and decrease in pH was due to the reason that leaves of the deciduous trees decomposes readily, which increased the organic carbon and during decomposition of leaves the acids were released which consequently decreased the soil pH. Average available N was found to increase with the age of the plantation and was found in the range of (240kg/ha – 500kg/ha). Similarly Average P and K were also found to increase with the age of the plantation and were found in the range of (12kg/ha – 22kg/ha) and (143kg/ha to 241kg/ha) respectively. The results obtained showed that the concentration of N was low and it could be due to the reasons that the short rotation forest species grow rapidly and bind a great amount of nutrients in their biomass and also the losses due to leaching, denitrification and ammonification of N is high. While as P concentration increases due to the addition of litter fall which results into formation of polyhumic substances and coating of Al and Fe ions, thus the higher content of phosphours in soil may be attributed to the higher content of organic matter in the soil which prevents the

fixation of phosphorous ions. Thus, from the above results it is clear that nutrient status of the soil is very important in short rotation forestry which is in confirmation with the observations made by Hytonen (1996) who reported that besides climatic conditions different soil properties effect biomass production. In particular the nutrient status of the soil is very important in short rotation forestry as willow species grow rapidly and bind a great amount of nutrients in their biomass.

(d) Number of shoots/coppice and coppice/m^2

To get the maximum number of shoots per coppice is important from the commercial point of view. The height of the shoot (m) was found to be positively correlated with the collar diameter (mm) with a correlation coefficient of 0.553. The data was taken on 15th November few days before the harvesting. The data revealed an increasing trend in No. of shoots/coppice and coppice/mt^2 as the plantation ages.

(e) Village level involvement and area under wicker cultivation:

From the frequent surveys the following table with the village level involvement and area under wicker cultivation have been compiled. The data was compiled from the various Tehsil offices with rigorous efforts.

Table 7: Village level involvement in wicker willow industry in Kashmir valley

S.No.	District	Villages involved	No. of households	Type of Involvement	Area under wicker (ha)
1.	**Ganderbal**	Shallabugh	400	Plantation + weaving	20.00
		Harren	300	Plantation + weaving + Trading	1.25
		Kachhan	250	Weaving + Trading + plantation	1.00
		Gadoora	300	Weaving + plantation	0.50
		Hakim gund	100	Weaving + plantation	1.00
		Pirpora	150	Weaving + plantation	1.00
		Sehpora	100	Plantation	2.50
		Gundi rehman	100	Weaving + plantation	1.25
		Gogji gund	70	Plantation + boiling + peeling	3.00
		Tulmulla	80	Plantation	1.00
Total		**10**	**1850**		**32.50**
2.	**Srinagar**	Umarhair (Buchpora)	100	Boiling + peeling + plantation + weaving	0.1
		Dargah	30	Trading + weaving	0
		Shanipora (Tailbal)	60	Plantation	0.2
		Astanpora (Tailbal)	20	Plantation	10.00

		Kaschipora (Tailbal)	15	Plantation	7.50
		Batpora (Tailbal)	30	Plantation	5.00
		Anchar	25	Plantation + Traders	62.5
	Total	**07**	**280**		**85.3**
3	**Budgam**	Sundrabad	50	Plantation+ Weaving	2.60
		Narbal	30	Plantation	1.25
		Chak Kawoosa	10	Weaving	0.00
		Yarigund	10	Plantation+ Weaving	1.00
		Wadwan	30	Plantation	0.8
		Daharmuna	14	Plantation	0.25
		Chirpora	20	Plantation	5
		Rakhiarath	50	Plantation	2.5
	Total	**08**	**214**		**13.4**
4.	**Bandipora**	Matipora (Hajin)	10	Weaving	
		Papchhan	8	Weaving	
	Total	**02**	**18**		
5.	**Kulgam**	Chawalgam	100	Weaving	
		Wakaie	50	Weaving + processing	
		Liraw	20	Weaving	
		Hirgama	10	Weaving	
		Bumbrat	25	Weaving	
		Mahipora	20	Weaving	
	Total	**06**	**225**		
6.	**Pulwama**	Padgampora	15	Weaving	
		Tokuen	10	Weaving	
		Gurpora	50	Weaving	
		Wandakpora	50	Weaving	
		Ludgama	05	Processing + trading	
	Total	**05**	**130**		
7.	**Kupwara**	Kaentpora (lolab)	50	Weaving	
		Ramhal	100	Weaving	
	Total	**02**	**150**		
8.	**Shopian**	No involvement found			
9.	**Baramulla**				
10.	**Anantnag**				
Grand Total		**36**	**2857**		

From the data collected it was observed that District Srinagar has the maximum area under wicker plantation (85.3 ha), whereas Ganderbal recorded maximum number of households (1830) involved with wicker willow.

(d) Economic Analysis:

I. **Capital Budgeting of Wicker willow cultivation:** The NPV appeared to be positive and greater than 0. The NPV was Rs. 43837.43 (Table 8). The NPV value indicates that the wicker cultivation is acceptable and profitable investment. This is an indication that the owner was able to increase his income by Rs. 43837.43 per kanal of wicker cultivation at the end of 10 year old plantation.

Table 8: Estimation of NPW for Wicker Cultivation (one kanal):

Year	Costs (in Rs.)	Returns (in Rs.)	Discount Factor at 12%	Net Income (in Rs.)	Net Present Worth (in Rs.)	Year	Costs (in Rs.)	Returns (in Rs.)	Discount Factor at 12%	Net Income (in Rs.)	Net Present Worth (in Rs.)
01.	9520.00	7650.00	0.893	-1870.00	-1669.72	**06.**	5000.00	16500.00	0.507	11500.00	5830.50
02.	5770.00	14025.00	0.797	8255.00	6580.88	**07.**	5000.00	14500.00	0.452	9500.00	4294.00
03.	6270.00	16550.00	0.712	10280.00	7317.30	**08.**	5000.00	13000.00	0.404	8000.00	3232.00
04.	6270.00	19000.00	0.636	12730.00	8089.91	**09.**	5000.00	10550.00	0.361	5550.00	2003.55
05.	6770.00	18000.00	0.567	11230.00	6371.90	**10.**	5000.00	10550.00	0.322	5550.00	1787.10
Total					**26690.28 (a)**						**17147.15 (b)**

- Net Present Worth: (a) + (b) = 26690.28 + 17147.15 = 43837.43

BCR was found to be 2.23 (Table 9) which indicates that the farmers involved in wicker cultivation earned an extra of Rs. 223 by investing Rs. 100 per kanal of land. It shows that investment in wicker cultivation is economically justifiable.

Table 9. Benefit-Cost Ratio for Wicker Plantation (one Kanal):

Year	Costs (in Rs.)	Gross returns (in Rs.)	Discount Factor at 12%	Present worth of costs (in Rs.)	Present worth of gross returns (in Rs.)	Year	Costs (in Rs.)	Gross returns (in Rs.)	Discount Factor at 12%	Present worth of costs (in Rs.)	Present worth of gross returns (in Rs.)
01.	9520.00	7650.00	0.893	8500.41	6830.69	**06.**	5000.00	16500.00	0.507	2535.00	8365.50
02.	5770.00	14025.00	0.797	4599.84	11180.73	**07.**	5000.00	14500.00	0.452	2260.00	6554.00
03.	6270.00	16550.00	0.712	4462.99	11780.29	**08.**	5000.00	13000.00	0.404	2020.00	5252.00
04.	6270.00	19000.00	0.636	3984.59	12074.50	**09.**	5000.00	10550.00	0.361	1805.00	3808.55
05.	6770.00	18000.00	0.567	3841.30	10213.20	**10.**	5000.00	10550.00	0.322	1610.00	3397.10
Total				**25389.12 (a)**	**52079.41 (b)**					**10230.00 (c)**	**27377.15 (d)**

- Total Present worth of costs in Rs. (a+c)= 35619.12 + 10230.00 = 35619.12
- Total Present worth of returns (b+d) in Rs. = 52079.41 + 27377.15 = 79456.56
- Benefit-Cost Ratio = $\frac{Present\ worth\ of\ Gross\ Returns}{Present\ Worth\ of\ Costs} = \frac{79456.56}{35619.12} = 2.23$

The trial and error approach produced an IRR of 32.52% for wicker cultivation which is much greater than the existing bank interest rate (Table 10). So, it assures than investing in Wicker cultivation was secured reasonably which ensured a satisfactory profit for the investors

Table 10: Estimation of IRR for Wicker Cultivation (one kanal):

Year	Costs (in Rs.)	Returns (in Rs.)	Discount Factor at 10%	Net Income (in Rs.)	Net Present Worth (in Rs.)	Year	Costs (in Rs.)	Returns (in Rs.)	Discount Factor at 12%	Net Income (in Rs.)	Net Present Worth (in Rs.)
01.	9520.00	7650.00	0.909	-1870.00	-1700.00	**01.**	9520.00	7650.00	0.893	-1870.00	-1669.64
02.	5770.00	14025.00	0.826	8255.00	6822.31	**02.**	5770.00	14025.00	0.797	8255.00	6580.835
03.	6270.00	16550.00	0.751	10280.00	7723.52	**03.**	6270.00	16550.00	0.712	10280.00	7317.101
04.	6270.00	19000.00	0.683	12730.00	8694.76	**04.**	6270.00	19000.00	0.636	12730.00	8090.145
05.	6770.00	18000.00	0.621	11230.00	6972.95	**05.**	6770.00	18000.00	0.567	11230.00	6372.204
06.	5000.00	16500.00	0.564	11500.00	6491.45	**06.**	5000.00	16500.00	0.507	11500.00	5826.258
07.	5000.00	14500.00	0.513	9500.00	4875.00	**07.**	5000.00	14500.00	0.452	9500.00	4297.318
08.	5000.00	13000.00	0.467	8000.00	3732.06	**08.**	5000.00	13000.00	0.404	8000.00	3231.066
09.	5000.00	10550.00	0.424	5550.00	2353.74	**09.**	5000.00	10550.00	0.361	5550.00	2001.386
10.	5000.00	10550.00	0.386	5550.00	2139.77	**10.**	5000.00	10550.00	0.322	5550.00	1786.951
Total					**48105.56 (a)**	**Total**					**43833.62 (b)**

$$IRR = \text{Lower Discount Rate} + \text{Difference between two discount rates x} \frac{\text{Present Worth of Cash Flow at Lower Discount Rate}}{\text{Absolute difference of the Cash flows at the two discount rates}}$$

$$\text{IRR} = 10 + 2\left(\frac{48105.56}{48105.56 - 43833.62}\right) = 32.52\%$$

II. **Yield determinants – Regression analysis**: The yield of any production system depends on multiple factors which include both controllable and non-controllable factors. Here, the most relevant and yield determining factors were taken into account and regressed with the dependent variable yield to estimate their contribution and resource use in production process so as to arrive at some meaningful conclusion regarding the input use and management in the wicker willow cultivation

Table 11. Regression results explaining determinants on yield.

S.No.	Input	Regression coeffients
01.	Field management (weeding/cleaning)	-0.884
02.	Age	-0.274*
03.	Fertilizer	0.370*
04.	Manure (FYM)	0.590
05.	Planting material	6.460*
Intercept		12.169
R^2		88.96
Adjusted R^2		86.54

***significant at 5% level of significance**

III. **Value Addition:** There are atleast 30-40 wicker handicraft items identified in the study areas out of which eight major wicker handicrafts are produced throughout the year. The major wicker products were: Decorative ducks, Dry fruit bowls, Round tokri (small), Round cups, Buckets with lids, Round tokri (large), Chapatti, Kangri. The various costs involved in making handicrafts Boiling costs, Debarking costs, Drying costs, Sorting costs, Transportation costs and Labour costs.

Table 12: Value addition of major wicker handicrafts (Rs./100 pieces)

S.No.	Products	Quantity for making product (kg)	Boiling cost	Debarking	Drying	Sorting	Transportation	Labour cost
01.	Swan	110	280	300	85	95	65	1500
02.	Dry fruit bowl	135	310	405	115	130	90	1750
03.	Round tokri (small)	225	520	675	190	220	150	3750
04.	Round cups	30	75	75	21	25	20	750
05.	Buckets with lids	150	350	450	130	140	100	2500
06.	Round tokri (large)	320	720	945	265	300	200	4750
07.	Chapatti	110	260	350	90	110	75	1750
08.	Kangri	200	440	570	150	190	125	3150

IV. **Marketing Channels**:

Wicker willow and handicrafts are produced by a large number of farmers and the marketing system of these wicker willow and handicrafts is not so complex and comprises of different marketing channels for distribution of wicker willows and handicrafts in different markets. In each channel number of functionaries are involved, performing numerous business activities called as marketing functions. Following marketing channel was commonly identified in the study area.

CHANNEL: FARMER – PROCESSOR – ARTISAN – WHOLESALER – RETAILER – CONSUMER

Table 13: Trade of wicker handicraft (in Rs. per 100 pieces)

S.No.	Product	PRODUCERS			WHOLESALERS			RETAILER			
		S.P	Expenses	Producers Margin	P.P	Expenses	Wholesalers Margin	P.P	Expenses	C.P.P	Retailers Margin
01.	Swan	10500	9700	800	10500	230	170	10900	225	11395	270
02.	Dry fruit bowl	4370	3900	470	4370	190	150	4710	190	5160	260
03.	Round tokri (small) 16 inch	13000	12300	700	13000	280	200	13480	320	14300	500
04.	Round cups	1500	1350	150	1500	180	110	1790	200	2180	190
05.	Buckets with lids	12000	10500	1500	12000	275	190	12465	290	13155	400
06.	Round tokri (large) 18 inch	22500	21200	1300	22500	320	340	23160	550	24510	800
07.	Heart shaped tokri 12 inch	10500	7500	3000	10500	500	260	11260	320	11980	400

Table 14: Producers share in consumer's rupee.

S.No.	Wicker Handicraft	Price Spread	Producers Share in consumers rupee	Wholesalers share in consumers rupee
01.	Swan	895.00	92.15	95.66
02.	Dry fruit bowl	790.00	84.69	91.28
03.	Round tokri (small) 16 inch	1300.00	90.91	94.27
04.	Round cups	680.00	68.81	82.11
05.	Buckets with lids	1155.00	91.22	94.75
06.	Round tokri (large) 18 inch	2010.00	91.80	94.49
07.	Heart shaped tokri 12 inch	1480.00	87.65	93.99

Offset value and carbon credits:

It was observed that the short rotation wicker willow coppice has a good potential of Carbon sequestration through carbon farming and can be beneficial to the farming community to earn carbon credit. It was estimated that on an average 31.115 tonnes/ha of carbon stock was recorded in the short rotation willow coppice upto 14 age gradations. The maximum carbon stock was recorded at the 14 year coppice with a value of 41.48t/ha with a minimum of 22.28t/ha for the 1st year plantation. The carbon stock measured was reported to show an increasing trend with the age of the coppice/plantation. With the increase in the population more especially urban population due to densification wicker willow plantation will play an important role for carbon demand offsetting to mitigate greenhouse gas emissions to meet carbon neutral, net zero or other established emission reduction goals. Besides this, it may also allow landholders to generate offset credits from activities that reduce emissions or sequester carbon. The huge emitters will be able to utilize credits generated through the carbon farming to meet their emission reduction targets. The global value of one carbon credit (tC) is 2$. Based upon our study a farmer can on an average earn upto $228.38 from the short rotation willow with a minimum and maximum of $163.57 to $304.52 respectively for the 1st and 14th year age gradation.

3.3. Conclusion of the study undertaken (maximum 500 words in bullets)

- This study led to conclude that there were three main species of wicker willow namely (*Salix dickymat, Salix triandra and Salix purpurea*) cultivated in the valley.
- As per data acquired from the sentinel database, the area under wicker plantation was ascertained for the very first time for three districts of the Kashmir valley out of which district Srinagar has the largest area under wicker.
- The initial 1st year plantation requires costs like preparation of land costs, planting material costs, fencing costs, FYM costs and were applicable during the first year only, whereas, costs like fertilizer costs, weeding/cleaning cost were applicable throughout the crop life.
- During this study it was found that the inputs like planting material, fertilizers and weeding/cleaning have a direct impact on the total output of wicker willow.
- The average cost of production stood at Rs. 5960/kanal/year, whereas, the average gross return came to Rs. 14032.5/kanal/year. The average net returns were estimated to be Rs. 8072.5/kanal/year.
- Almost 30% of respondents were involved in making wicker handicrafts (artisans), which indicates that 30% of the respondents were having it as their main source of income.
- During this study, it was calculated that the ratio of benefit and costs was estimated to be 2.23, thereby making this practice as a profitable one.
- With the help of this study, it was concluded that the main wicker willow handicrafts made in the study districts were Tokri's, dry fruit bowls, round cups, decorative ducks, buckets, chapati's, kangri etc.
- Short rotation coppice (SRC) willow plantations of interest as producers of biomass for raw material, but also as carbon (C) sinks to mitigate CO_2 emissions. On an average 114.19 t/ha of eCO_2 can be mitigated through these short rotation coppice plantations and on average a person or organization can earn 228.38$ per tonne to for its measures to mitigate the climate change.

- The study on potential phyto-chemicals revealed that among the three species of wicker willow growing in the state Salix dickymat had the highest tannin content (251.9 ppm) and hence this is a main reason for its characteristic red coloured withies.

4 OVERALL ACHIEVEMENTS

4.1 Achievements on Objectives [Defining contribution of deliverables in overall Mission (max. 1000 words)]

Through the objectives undertaken in this study, the extent of livelihood dependence on wicker willow in the major wicker based villages (Central zone) was determined. It was found that around 21 villages are substantially dependent on this craft. Certain villages solely dependent on one particular aspect of wicker industry e.g Tailbal, Sehpora villages practiced mainly growing of wicker willow, Omarheir village dealt with processing of wicker withies and Dargah area was solely involved with retail outlets of wicker products while the remaining villages had mixed work regime. Furthermore some villages with very high dependence (80-90% households involved) were also identified e.g Harren, Shalabugh, Kacchan and Sehpora in the Ganderbal district. An estimate of manpower engaged at various stages of this industry was evaluated to assess the livelihood potential of this industry. Not only it secured the livelihood of male rural population but also the women folk who are mostly found to be involved in the peeling and weaving process. Based on the field investigations during the project work, the most common marketing channel identified was:

Producer —— Processor —— Artisan —— Wholesaler —— Retailer——Consumer

The whole process involved from harvesting to the final end product was documented and filmed as well. At **grower's level**, the wicker willow particularly *Salix triandra* and *Salix purpurea* are cultivated. The one year old coppice is removed in late autumn (November) or early spring (February) from the stump level and kept in bundles each weighing 40kgs (locally called Mann used as the unit for transactions on weight basis). The selling price for each mann varies each year depending on the rates fixed by the middle men (arbitrarily). The year's harvest is sold to the middleman for processing. At **middle man's** level, the withies are boiled in wrought iron boilers and later bark is peeled manually. The debarked withies are further dried and graded based on length and

thickness into 4-5 grades. Diseur (Grade I), Panseur (Grade II), Skeen (Grade III), Sitka (Grade IV), Tapus (Grade V/ waste during the processing); with Diseur fetching highest price and Tapus with least). The processed withies are later purchased by the weavers for annual stock. At **weaver's level,** the graded withies are crafted into various products like baskets, boxes, vases, trays and even furniture. Each product takes a particular time to complete and fetches a particular amount of profit. At **trader's level,** all the weaved products are collected on weekly basis from the assigned weavers of neighbouring villages on a particular day of the week (usually Thursday). The collected products are kept in godown and later sold to retailers in the state, outside state (Delhi, Mumbai, Bangalore, Kerala etc) and even outside the country (UK, UAE etc). At **retailer's level,** the weaved products are directly sold to the buyers. Most of the retailers in the state were concentrated in Dargah area of Srinagar District. The stakeholders were given inputs about the profitability of this enterprise and were also advised to go for scientific and well managed plantation for better yield and economic return. The farming community was assured of the peeing machine which is taken up as a part of thesis research titled "**Development and Performance evaluation of Portable Wicker Willow Peeling Machine**" by one of the M.Tech engineering student namely Mr. Masroor A Malik of the College of Agricultural Engineering and Technology, SKUAST-Kashmir. The machine will in so many ways benefit the farmers involved in the peeling process by the way of manpower reduction, easy handling and time utilisation. Also, as a part of the database, the maps generated using GIS will in many ways benefit the government in general and researchers in particular in locating the wicker plantations, studies on area estimation and LULC studies in future. The estimation of the carbon sequestration potential of the wicker is of major significance, as sequestration is a major tool for managing carbon emissions. At present, not much information is available on the estimates of carbon sequestration potential in forest and urban areas; therefore more detailed studies are needed for assessing the ultimate changes that are happening in both forest and urban areas. This study and information on the carbon sequestration through wicker willow will play major role in mitigating regional climate change or global warming. The whole process from harvesting to weaving is documented so as to have a good understanding of the activities involved in the industry. The most important aspect of such plantation i.e. the carbon sequestering potential was ascertained. It was seen that such short rotation coppice wicker

willow can play an important role in mitigating the effects of increasing CO_2 concentration in the atmosphere and can be used for getting benefits to the farmers by selling carbon credit.

4.2 Establishing New Database/Appending new data over the Baseline Data (max. 1500 words, in bullet points)

- The data generated comprises of the complete information on the sampled 153 households that were involved in the wicker willow trade. The data was generated using the framed schedule.
- The survey of the households and the plantation areas was accompanied with the collection of GPS coordinates for generating the plantation maps and consequently the area under wicker plantation and agroforestry area using GIS mapping system. The coordinates were collected for each of the districts under study and the maps along with the statistics were generated.
- Information on the various morphological features of the commonly found species of wicker willow was obtained for easier identification and reference.
- The soil samples collected from the plantations were analysed for various parameters viz. N, P, K, OC and BD.
- Tannin estimation was done to study the tannin content present in each of the species of wicker. The tannin content was measured using Folin Denis Method of estimation.
- The information on the economics of wicker willow was generated, value chain analysis was performed and the marketing channels identified. To evaluate the profitability of the wicker based cottage industry various profitability indices were computed.
- The present study appraised the importance of assessing carbon sequestration potential in both forest and urban areas in terms of i) Above ground biomass (Both litter and wood stock), ii) Below ground biomass (roots), iii) Soil carbon (iv)Detritis Carbon (v) Ecoysystem carbon

4.3 Generating Model Predictions for different variables (if any)

The primary data collected through schedules were tabulated to workout averages, ratios, percentages and indices. Tabular technique was employed to determine the economics and resource use efficiency in wicker willow production, resource structure, input costs and disposal besides costs and returns on cultivation and processing.

- Following regression equation was applied to determine the total production of wicker willow;

$$y = b_0 + b_i x_i + u$$

where; y = production of wicker willow (dry weight in kgs), b_0 = intercept, b_i = regression coefficient for different inputs, $x_i = i^{th}$ resources like planting material, FYM, urea, etc. and u is the error term. The regression table depicts the estimates of the key parameters which effects on the yield of wicker willow. The regression results while explaining determinants on yield, six parameters, viz., fertilizers, weeding and cleaning, planting material, FYM, were regressed with total production. The results indicated that fertilizer and planting material had positive and significant effect on the yield. However, weeding and cleaning show negative effect on total production which implies that respondents are either harming or not conducting this practice in a proper way. FYM, preparation of land and fencing also show insignificant effects on total production. The R^2 value turned to 86.54 per cent.

Regression results explaining determinants on yield.

S.No.	Input	Regression coefficients
01.	Field management (weeding/cleaning)	-0.884
02.	Age	-0.274*
03.	Fertilizer	0.370*
04.	Manure (FYM)	0.590
05.	Planting material	6.460*
Intercept		12.169
R^2		86.54%
Adjusted R^2		85.94%

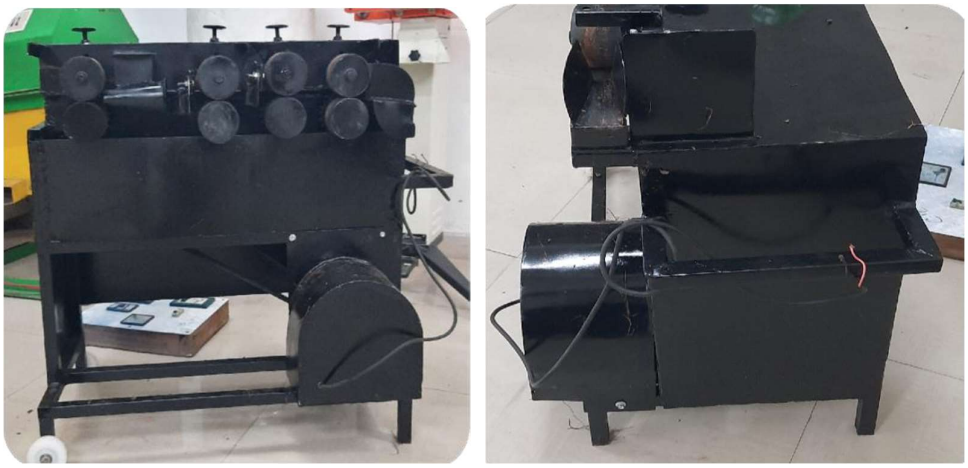
The regression model predicting the yield using the above given factors:

Yield = 12.169 + -0.884(Field management) -0.274(Age) + 0.370(Fertilizer) + 0.590(FYM) + 6.460(Planting material)

4.5 Technological Intervention

Although the activities involved in the wicker industry are simple and environment friendly, there is a need of scientific and technological intervention to enhance the productivity, profitability and reduce the harsh efforts by the farming community involved in wicker trade. The stakeholders were given knowledge about the scientific way of plantation and management of the plantation stands during on field interaction with them. The basic technological necessities were taken note of. On interacting with the farmers, they were found in urgent need of a brush cutter and a peeling machine. The harvesting of wicker willow is a very tough job done manually using a sickle. Since the plants exist as long hard rods, the farmers require an automated brush cutter to ease the operation. This project will be taken up the university. Secondly, the peeling operation is a laborious job requiring the peeling of individual boiled rods using an indegeniously designed wooden V-shaped wedge. This operation results in the blackening of the hands because of the tannins released from the peeled bark. However, the construction of the peeler has been taken up as a requirement for the partial fulfilment towards award of master's degree by one of the M.Tech. student namely Masroor A Malik of College of Agricultural Engineering and Technology of Kashmir (CoAE&T) SKUAST-K under the thesis entitled **"Development and Performance evaluation of portable willow wicker peeling machine"**. The prototype of the same is shown in Figure 11. Once the project is completed, the technology will be disseminated among the concerned stakeholders.

Figure 11: Prototype of the Peeling machine



On-field Demonstration and Value-addition of Products

- The result demonstrations may be used for a single recommended practice or a series of practices that come in sequence with respect to a problem.
- The framework, observability of results, trial ability, complexity of operation and compatibility to the local people are the essential points to be considered for the result demonstration.
- Some of the recommended jobs for which on field demonstration was conducted was introduction to scientific cultivation, awareness regarding the potential of wicker willow for rural employment generation and as well as carbon sequestration etc.
- The workshops and field visits were conducted to demonstrate the potential of wicker based industry towards livelihood generation and empowerment among the rural youth.
- The profitability of wicker over paddy and poplar was evaluated and established amongst the stakeholders.
- In addition to the field demonstration and knowledge dissemination, the artisans were given an insight on how the value addition of wicker craft can fetch higher prices in national and international markets. Most of the value addition costs were involved in round tokri large followed by round tokri small; the least value addition costs were involved in round tokri small. The value addition of wicker willow determines the sum total of processes like boiling, debarking, drying, sorting, transportation and labour, which are involved in making the wicker handicraft. At least 40-45 wicker handicrafts were determined in the study area out of which there were eight major wicker handicrafts, which were produced throughout the year.

4.6 Developing Green Skills in IHR

Sustainable management and use of ecosystem services from IHR presents huge opportunities for creating employment and supporting entrepreneurship. The soft green skills would help to understand these changes and develop an economically and environmentally sound mountain ecosystem, which would improve the living standards

of mountain populations as well as sustain the flow of vital ecosystem services. It was recognized early that wicker willow growth concurs with potentially high evapotranspiration rates and high nitrogen retention rates. Willow species also may exhibit selective uptake of heavy metals, which underlies the potential to use willow as a phytoextractor for e.g. Cd from polluted soils. These special traits of willow have allowed a further development of short-rotation willow coppice systems for environmental purposes. Wicker willow growing systems may be used as vegetation filters for purification of waste water, for cleaning of polluted drainage water from agricultural land and as a recipient of nutrients from municipal sludge. As willow stands are harvested at regular intervals, the pollutants are removed from the soil-plant system, while added nutrients and water enhance the systems' biomass production. These systems then function as multi-purpose systems, simultaneously aiming at biomass production for energy purposes and provision of environmental services, while producing clean water and neutralizing potentially hazardous compounds.

4.7 Addressing Cross-cutting Issues

- Fluctuating rates is the most important factor which influences the wicker industry in the valley. The intermediate contractor mafias decide the rates as per their will, forcing the farmers to sell their harvest as per the rates decided by the contractors. On the other hand the artisans who work hard to craft the produce into beautiful items of international demand are paid meager amount by the retailers and wholesalers who sell the same items at a good price earning good profit. As per the information collected under this project fixing of MSP is highly recommended.
- The Artisan Credit Card has emerged as an innovative credit delivery mechanism to meet the production credit requirements of the artisans in a timely and hassle-free manner.
- The scheme is under implementation in the entire country by the vast institutional credit framework involving Commercial Banks, RRBs and Cooperatives and has received wide acceptability amongst bankers and farmers. However, the stakeholders involved in the wicker industry are yet to avail the benefits of KCC.
- Development of different programs will facilitate the buying and selling of carbon

credits between landholders and Government agencies. Landholders receive carbon credits for storing carbon in the soil which are assembled and sold when planned to reduce emissions. These credits are often bought independently of an exchange and can boost the financial status of the client and help to demonstrate that the practices are helpful in mitigating the effects of the industrial society. Carbon financing project is needed to address the wicker willow farmers of the valley with respect to carbon credits.

5 IMPACTS OF FELLOWSHIP IN IHR

5.1 Socio-Economic Development

Wicker cultivation and manufacturer play a crucial role in economic security of the farmers and handicraft entrepreneurs and contribute considerably to the gross annual income besides acting as safety net in cases of exigency. Further, the wicker handicraft has a strong equalizing effect on local income distribution and reducing the socioeconomic disparity among the farmers. Such prominent role of wicker cultivation should be given due attention in rural development and industrial policies to harmonize socioeconomic improvement, poverty reduction and livelihood security of the growers. The wicker handicraft entrepreneurship has no advertisement or promotional activities to expand the markets of the handicrafts. Hence, branding and certification of wicker handicrafts and marketing through cooperatives and e-commerce must be given due consideration to attract traders and reduce competition with large scale industries.

Further, the prospective opportunities for income diversification through value addition of wicker handicrafts, fortunate marketing and better commercialization should be explored and accordingly, skill development and capacity building programs on these aspects should be organized among growers and entrepreneurs. Likewise, the household socioeconomic factors like education, family composition, housing status, subsequent occupation and gross annual income were the major determinants of wicker handicraft entrepreneurship. Hence, the policy and decision makers should give due recognition during planning and implementation of explicit strategies for improvement and strengthening of wicker handicraft entrepreneurship for rural industrialization and livelihood improvement.

5.2 Scientific Management of Natural Resources in IHR

- Emphasis was given on mechanised processing of boiled wicker withies. The mechanised processing would save considerable time and labour.
- Establishment of nurseries of all the three species of wicker at faculty of forestry to develop a germplasm at the faculty of forestry and acquaint the students with the morphological features of the different wicker species.
- Forest area and human population data of states in the Himalayan region indicate an increasing trend of population growth and decreasing trend of forest area.
- Natural resources are being placed under such strain that the objective of ensuring food production is at least adequate in terms of quantity and quality. It is, therefore, not sufficient merely to review natural conditions and submit strategies for increasing production since they are already in line with the state of the art in production technology.
- Thus what is needed is to appreciate the positive points of traditional resource production and use systems and strengthen them through science and technology inputs for further improvement in their values and efficiency in the context of mountain systems especially in Kashmir valley.
- The most important development objectives in this context are: (i) improving food and energy supplies by increasing in agricultural and forestry products and adjustment of the production structures; (ii) securing the greatest possible employment and income effects for the broad mass of the population; and (iii) long-term protection of natural resources including wicker cultivation, poplar cultivation and salix cultivation for cricket bat production.

5.3 Protection of Environment

- A simple mass balance of the major ecosystem pools and fluxes of carbon in a short rotation wicker willow stand was used to calculate the carbon sequestration.
- It is assumed that carbon in the stand in distributed over the biomass and the soil. The carbon in the biomass part is divided into three different fractions: leaves, shoots and roots.

- The carbon in the soil is divided into two parts: the fresh organic matter (FOM) pool, with a fast decay rate and the humic soil carbon (HUM) pool, with a slow decay rate. The structural/woody root biomass is the most import biomass part for carbon sequestration.
- It is assumed that the carbon allocation pattern did not change during the different cutting cycles, except for the structural/woody root biomass. It is also assumed that the carbon allocation pattern of wicker willow increases with age gradations.
- Short rotation coppice wicker (SRCW) plantations are of interest as producers of biomass for raw material, but also as carbon (C) sinks to mitigate CO_2 emissions.
- Carbon sequestration in biomass and soil was estimated for 14 age gradation SRCW plantations.
- Overall, the SRC wicker willow plantations represented a C sink for fourteen or more years. Estimated increase of total standing C stock was 15-30% on average compared to pre-planting conditions.
- Short rotation wicker plantations on arable lands represented a Carbon sink after fourteen years cultivation which help in environment protection.

5.4 Developing Mountain Infrastructures

Mountain people values need based exchanges more than opportunities for monetary profits through cash driven market. Present marginal status of the Himalaya is thus partly due to lack of economic concerns in the traditional socio-cultural systems of mountain people and partly due to slow pace of industrialization because of physical constraints and pre-existing low level of infrastructural facilities. Realizing the monetary benefits from production processes by the local populace is a recent consciousness in response to growing markets for resources of the region together with emerging technologies of value addition to locally produced raw material at distant places in the lowlands. In context to wicker industry, there is a need to develop sophisticated boilers and steamers that could facilitate quick and effective boiling process. There is also a need to develop community storehouses where the processed withies could be stacked, dried and graded. The government intervention is needed to let the rural communities avail the peelers in order to facilitate the peeling process. The stakeholders need to be informed and trained about

the online platform where they could showcase and exhibit their crafted products to the international buyers. To ensure that communication infrastructure which is the backbone of the communications system upon which various broadcasting and telecommunication services operate need to be developed in the concerned areas.

5.5 Strengthening Networking in IHR

- Worked for Linkage of various departments which have stakes in this industry like revenue, forestry and handicrafts so that they all work in tandem for the upliftment of people involved in this trade.
- Promoting community-based management through developing mechanisms for incentives for protection and enhancement of forested lands.
- Strengthening regional cooperation through established mechanisms for exchanging information with countries sharing the Himalayan ecology.
- The mission, towards achieving the above, will involve various institutions already engaged in investigation, conservation and management of natural resources in IHR. The mission would effectively network such institutions, with common and shared objectives, co-sharing of resources and co-generation of processes leading to ecologically sustainable development Several Institutions, active in the area, can be broadly grouped into following categories:

a) Government institutions dealing with research and development,
b) Non-government Organizations (NGOs) with local, national and international mandate,
c) Community based organizations. While designing and implementing strategies and plans for achieving the goals of the mission, focus will be to follow the following cardinal principles enshrined in NAPCC:

- Protecting of vulnerable sections of society – this includes participatory resource management strategies and development of livelihood options. •
- Developing human resource – there has to be heavy emphasis on skill development, at all levels, across various sectors to enable communities become sufficiently empowered with know-how and mountain specific required skills, necessary for adaptation to climate change.

6 EXIT STRATEGY AND SUSTAINABILITY

6.1. Utilisation of outcomes for sustainable development of IHR

Based on our findings related to impact of wicker plantation on carbon mitigation we are stressing that great emphasis is required for boosting this dwindling industry also there is a great need on tapping the unutilised potential of wicker craft as a sustainable alternative to polythene and plastic.

Baseline data has been generated for the geo mapping for areas under WC now there is a need for further studies under LULC over various decades**.** Traditionally, small-scale short rotation coppice willow plantations have been used for fuel, fodder, convenience wood, basket making, bee keeping, and for other horticultural purposes. Willows also may be used for erosion control, including wind and water erosion, and to avoid snow drift along roads. Because willow grows so quickly, it is naturally sustainable. This natural sustainability is enhanced by willow's resistance to disease which means that it needs very few chemical treatments. Furthermore, as a natural product, it provides an obvious route to eco-friendly packaging. In fact, this very traditional material and weaving technique is now being adopted by younger customers who love its beautiful appearance, durability, sustainability - and the fact that it can be used in place of plastics and other less eco-friendly materials. The stylish and natural products weaved from wicker willow are enjoying a resurgence in popularity again as customers seek out 'greener' alternatives to plastics and other industrial products which damage the environment. This resurgence may help generate the livelihood opportunities amongst the rural people who are involved in this business and thereby providing a means towards rural upliftment. Besides generating income, the wicker craft made from the processed reeds are an effective way to lock the carbon, thereby mitigating the effects of increasing CO_2 concentration in the atmosphere. Thus it is reported that SRCW plantations may play a critical role in sustainable development, from combating rural unemployment to mitigating the effects of climate change.

Carbon finance is the general term applied to financing seeking to purchase greenhouse gas emission reductions to offset emissions in the OECD countries. Commitments of carbon finance for the purchase of carbon have grown rapidly since the first carbon purchases began less than seven years ago. The wicker industry has a great

scope for carbon financing. There are many ways and efforts underway to reduce carbon emissions and promote activities which help to store and remove carbon. This has made carbon a valuable economic commodity. To find a common unit for this commodity all GHGs are converted to CO_2 equivalents (CO_2 -eq)1 . The CO_2 -eqs are traded on carbon markets. The markets work in a similar way to financial markets. The currency used on these markets is carbon credits.

6.2. Efficient ways to replicate the outcomes of the study

Wetlands are very important and productive ecosystems that support a wide range of plants and animals and provide good livelihood opportunities to local communities in rural India. However, they are increasingly being threatened by rapid urbanisation, pollution, developmental interventions, unsustainable management practices and encroachment. Since short rotation coppice wicker is well adapted marshy wetlands. It can serve as a boon to sustain the environment and livelihood opportunities in such areas. Through this fellowship we have evaluated the profitability of the wicker industry. The objectives met in this fellowship can help anyone willing to take up this enterprise as a source of livelihood by getting information on the various varieties of wicker willow, the stages involved from plantation to harvesting, processing and weaving, the amount of carbon sequestered and the benefits in terms of income generation. Through publications, workshops, and online platforms the outcomes of the fellowship can be replicated to the other parts of the IHR.

6.3. Important areas not covered in the study

In this fellowship two study areas viz. Srinagar and Ganderbal were purposively chosen to identify and survey the respondents. However it was noticed that in district Budgam people are shifting from paddy to wicker keeping in view the profitability and other benefits from this industry. It was reported that almost 660.8 ha of land is under wicker plantation. In future district Budgam can be a prominent cluster of wicker cultivation because of a vast area under a wetland namely Rakhiarath which is located in Panchayat Narbal. This area can be taken up to promote wicker cultivation in future studies. Besides the categorization of the salix species on the basis of the structure of the catkins can be an important aspect in species identification and characterisation. Decadal variation in area under wicker plantation needs to be explored based on GIS techniques.

6.4. Major recommendations for sustaining the outcomes of the Fellowship:

- To sustain the outcomes of this fellowship proper efforts in the way of sustainability-oriented courses and experiences that provide rural communities with a firm grounding need to be done.
- There is a need for holistic systems thinking, sustainability knowledge, awareness, integration, and acting for a positive change.
- Collaboration of the government department's viz. Agriculture, Horticulture, Forestry etc. with the research institutes and universities is important in implementing the outcomes of the fellowship.
- The prospective opportunities for income diversification through value addition of wicker handicrafts, fortunate marketing and better commercialization should be explored and accordingly, skill development and capacity building programs on these aspects should be organized among entrepreneurs. Hence, the policy and decision makers should give due recognition during planning and implementation of explicit strategies for improvement and strengthening of wicker handicraft entrepreneurship for rural industrialization and livelihood improvement.

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(Signature of HRA/HJRF/HPF)

(NMHS FELLOWSHIP COORDINATOR)
(Signed and Stamped)

Principal Investigator
NMHS-Fellowship
Faculty of Forestry, SKUAST-K
Benhama, Ganderbal

(HEAD OF THE INSTITUTION)
(Signed and Stamped)

DIRECTOR RESEARCH
SKUAST-K, Shalimar, Srinagar-191121.

Place: 16.01.2023

Date: ...../...../.....

Fig. 1 Splitting of Wicker withies to desirable Size

Fig. 2 Stacking of Wicker withies for sun drying

Fig.3 Alternate shade and sun drying of withies

Fig. 4 Stacking of withies at different stages of drying

Fig. 5: Sun Dried Withies

Fig. 6 Collecting bunches of withies for storage after drying

Fig. 7 Examination of wicker withies to ensure uniform drying

Fig. 8 Peeling of withies

Fig. 9 Stacking of withies

Fig. 10 Stack of withies

Fig. 11 Peeling of withies

Fig. 12 : *Bioler*

Fig. 13: Sun Drying of

Fig. 14: A damaged boiler

Fig. 15: Peeling sticks

Fig. 16: Long queue of dried withies

Fig. 17: Different grades of processed wicker

Fig. 18: Quality grades of wicker

Fig. 19: Disur grade kept for drying

Fig. 20: Examining the quality of withies

Fig. 21 Wicker plantation field

Fig. 22 Salix seedlings during early stages of growth

Fig. 23 Interacting with wicker willow farmers

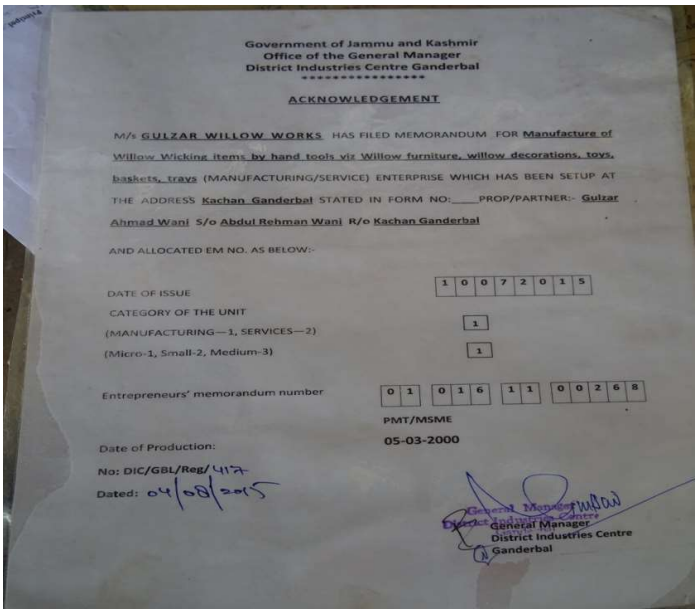
Fig. 24: Surveying the local basket store

Fig. 25 Irrigated plantlets of Salix

Fig. 26 Irrigated plantlets of Salix

Fig. 27 Salix plantation in early Bloom

Fig. 28 Salix plantation in early Bloom



Government of Jammu and Kashmir
Office of the General Manager
District Industries Centre Ganderbal

ACKNOWLEDGEMENT

M/s GULZAR WILLOW WORKS HAS FILED MEMORANDUM FOR Manufacture of Willow Wicking items by hand tools viz Willow furniture, willow decorations, toys, baskets, trays (MANUFACTURING/SERVICE) ENTERPRISE WHICH HAS BEEN SETUP AT THE ADDRESS Kachan Ganderbal STATED IN FORM NO:____PROP/PARTNER:- Gulzar Ahmad Wani S/o Abdul Rehman Wani R/o Kachan Ganderbal

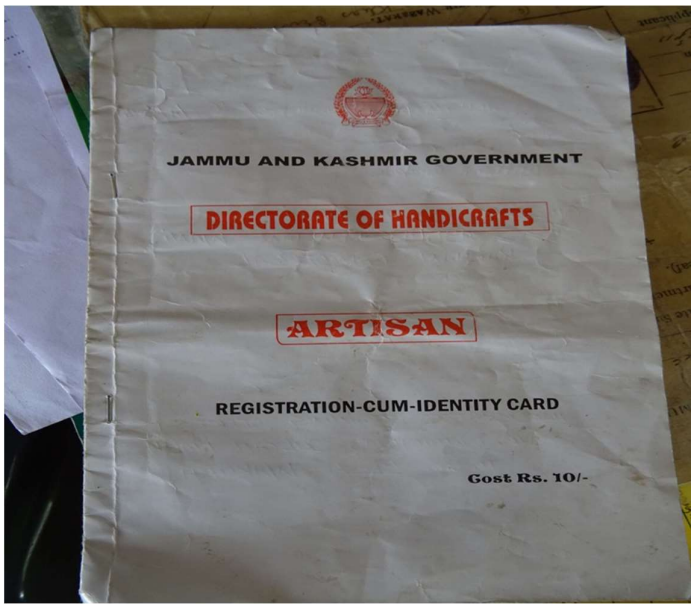
AND ALLOCATED EM NO. AS BELOW:-

DATE OF ISSUE 10072015
CATEGORY OF THE UNIT
(MANUFACTURING—1, SERVICES—2) 1
(Micro-1, Small-2, Medium-3) 1

Entrepreneurs' memorandum number 01 01 16 11 00268
PMT/MSME
Date of Production: 05-03-2000
No: DIC/GBL/Reg/417
Dated: 04/08/2015

General Manager
District Industries Centre
Ganderbal

Fig. 29: Memorandum of an Artisan for crafting Willow Wicker items



JAMMU AND KASHMIR GOVERNMENT

DIRECTORATE OF HANDICRAFTS

ARTISAN

REGISTRATION-CUM-IDENTITY CARD

Cost Rs. 10/-

Fig. 30: Artisan Registration cum Identity Card

(2)

(Valid for life time)

Regd. No: ADHG/Reg/willow.wicker/16-17/A/2015
Date: 10-10-2015
Card No. 2176
Craft Willow wicker
Name of the Artisan GULZAR AHMAD WANI
S/o, D/o, W/o ABDUL REHMAN WANI
R/o KACHAN GANDERBAL

Assistant Director
Handicrafts
Ganderbal

National/State/Awardee Yes/No.

Practical Test and
Verification Conducted by
HANDICRAFTS TRAINING OFFICER
Name DR. PJAHADDIAD SULTAN MALIK
Designation H.T.C. BLOCK WAKURA
Signature

Signature of Issuing Authority
Assistant Director
Handicrafts
Ganderbal

Fig. 31 Entrepreneur's registration card for wicker business

Fig. 32 Tools

Fig.33 Biomass Estimation of salix species

Fig. 34 A tour to artisans of district Ganderbal by IFS, Shri O P Vidhayarthi

Fig 35. Worskhop on rural upliftment and environmental benefits of Wicker Willoe

Fig 36. PI of the project delivering a lecture to the stakeholders involved the wicker industry

Fig 37. Spectrophotometry

Fig 38. Estimation of Tannins

Fig 39. Soil Sampling

Fig 40. A progressive educated farmer involved in wicker business