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Constraints faced by farmers of Haryana in adoption of paddy straw management practices

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Abstract

Haryana is one of the key contributor states in central pool of food grains with predominance of Rice-Wheat cropping system. Paddy straw burning is a very serious threat to sustainability of agriculture in the state, despite sincere efforts by agricultural development stake holders. So, authors felt to analyze the constraints faced by farmers in adoption of recommended practices for paddy straw management. The study was carried out in Fatehabad and Kaithal districts of Haryana and 15 farmers each from eight villages selected randomly. Total 120 farmers were personally interviewed to ascertain the constraints faced by them. The results highlight that partial burning of residue was most adopted ex-situ residue management practice while, zero tillage as *in-situ* practice among farmers. Use of combine for paddy harvesting of non-basmati and early maturing varieties result voluminous paddy straw which hampers tillage operations, narrow Paddy-Wheat sowing window were the very serious constraints faced by farmers. Soil incorporation as well bailing enhanced the cost of cultivation being high power and costly machinery-oriented practice for individual farmers and insufficient CHCs promoted by government besides straw removing and transportation of voluminous biomass were reported serious financial constraints by farmers. Similarly, no provision of assured purchase/procurement of residue by government organizations/ research institutions/ local industries from farmers field were serious marketing constraints. They faced management problems like residue composting a time-consuming practice, labour intensive as well high charges at peak season. Low economic domestic use, non-availability of small holder suitable paddy straw management technologies along with insufficient energy/bioenergy, paper, board industries in vicinity of were the major domestic constraints faced by them. The findings provide insight for addressal of these constraints by stakeholders of agriculture through active participation in organization of cluster front line demonstrations of fast decomposing biological technologies at farmers field to prove economic worth by recycling of nutrients, maintenance of soil fertility by *in-situ* straw management practice, sufficient functional energy, paper, board as well compost or biochar etc. industries for ex-situ residue consumption, economic value enhancement may be established at local level or village level for sustainable farming in the region.

Keywords: Constraints, adoption, paddy straw, *In-situ* and *Ex-situ* management practices

1. Introduction

In South Asia (India, Pakistan, Nepal, Bangladesh, and Bhutan), rice-wheat (RW) crop systems cover an area of 13 Mha (Yadvinder-Singh *et al* 2014) ^[9]. More than 85% of the RW system in South Asia is located in the Indo-Gangetic Plains (IGP). Our country's IGP occupies approximately 20% of the total geographical area (329 Mha) and approximately 27% of India's net cultivated area, generating about 50% of the country's total food consumption (Dhillon BS *et al.* 2010) ^[2]. Continuous rotational cultivation of rice and wheat, intensive tillage for both crops, removal of CR and high use of water and chemicals, has resulted in many adverse effects on productivity and the external environment in India. Disposal of paddy residue has turned out to be a huge problem in north-west Indian states, resulting in farmers preferring to burn the residues *in-situ*. Paddy residue management is of utmost importance as it contains plant nutrients and improves the soil-plant-atmospheric continuum. Burning biomass not only pollutes the environment and results in loss of appreciable amount of plant essential nutrients.

In the National Capital Region crop residue burning has become a serious environmental pollution problem due to high mechanization of Rice-Wheat Cropping System, besides labor scarcity at peak season and less demand for paddy residue as animal fodder, a huge amount of residue is left over in the field. Management of crop residue is quite challenging due to the intensified mono-cropping system prevalence in Indo-Gangetic plains responsible for Food Security of burgeoning population. Huge production of crop produces a good number of residues, which are making obstacles for the cultivators to prepare land in a narrow window of sowing for the wheat crop whose yield is affected by terminal heat effects. In order to clean the field, the farmers switched to residue burning, which is easy, cheap and less time consuming (Bimbraw, 2019) ^[1]. Burning stubble leads to climate change, air pollution, bad soil health. To establish a sustainable agricultural system, it is crucial to recycle the nutrients from residue after harvesting. Every year India generates 500-550 million tons of crop residue, of which paddy and wheat constitute 54 and 34%

crop residue. A good amount of residue of wheat, barley and pearl millet is used in animal feed but a large amount of paddy stubble is inflamed in the field which is very common in Indo- genetic plains such as Uttar Pradesh, Haryana, and Punjab (Van *et al.*, 2013) ^[8]. But in the middle and southern part of India, viz., Maharashtra, Gujrat, Tamil Naidu, and Assam the residue is used as roof thatching, fuel for industries is also used in making bricks and in some other industrial activities (Lohan *et al.*, 2018) ^[6] Burning residue on the field can minimize weed and reduce the risks of pest and plant diseases. But it has many negative impacts on our environment and all living organisms. Air pollution has the highest rank for being responsible for various diseases that lead to premature fatality, especially in developing nations. Burning of stubble increase the suspended particulate matter (SPM) and greenhouse gasses, loading of aerosol, and concentration of black carbon, NO₂, and SO₂ in the environment. Therefore, it is necessary to manage residue effectively and it would not affect the environment as well as soil fertility

Even though the farmers are aware of the adverse effects of paddy straw burning at the farm level but they are constrained by the lack of economically viable and acceptable machineries and alternatives for disposal of paddy residues. Ex-situ alternatives for crop residue incineration alike assortment, gasification as a fuel for the boilers, transforming converting into briquettes and planning suitable harvester should be promoted. *In-situ* alternatives like managing crop residue by happy seeder, zero-till machine, double disc coulters, straw choppers are required for practicing and adoption of conservation agriculture (CA) in the region, which will reduce the residue

burning in rice-wheat rotation (Lohan *et al.* 2018) ^[6]. Study aimed to assess *in-situ* and off-situ paddy straw management practices adopted by farmers and the constraints faced by them in adoption of residue management practices

2. Methodology

A purposive ex-post facto research study was conducted in the year 2020-21, to analyze the constraints faced by farmers in adoption of paddy straw management practices in Haryana state being as key contributor to central pool of food grains of India. Following stratified sampling technique two districts viz. Fatehabad from South -Westron zone and Kaithal from North- Eastern agricultural zones of state were also selected purposively having maximum area under Paddy-wheat cropping system. Similarly, Ratia and Tohana blocks from Fatehabad while Siwan and Guhla blocks from Kaithal district were selected and at village level, two villages viz. Haroli and Hassanga from Ratia, Smain and Kanhri, from Tohana, Siwan and Malikpur from Siwan block and finally Harigarh Kingan and Kallar Majra from Gulha block were selected, randomly. Finally, 15 farmers were selected randomly from each selected village and thus total 120 farmers were interviewed to collect data to fulfill the objectives of present study with the help of a well-structured and pre tested interview schedule. The collected data was analyzed using statistical measures like mean, frequency, percentage and rank orders etc. to draw meaningful inferences.

3. Results and Discussion

Table 1: *In-situ* and off-situ paddy straw management practices adopted by farmers (n=120)

S. No.	Name of activity	Frequency	Percentage
A.	<i>In-situ</i> incorporation by		
	Rotavator	11	9.17
	M B Plough	02	1.67
	Happy seeder	17	14.16
	Zero tillage	72	60.00
	Super seeder	24	20.00
B.	<i>Ex-situ</i> management		
1	Partial burning	63	52.50
2	Sale through open auction in heap or per acre lump sum		
	Farm itself	38	31.67
	Card board industry	20	16.67
	Fuel or bio-fuel industry	12	10.00
	Gaushalas	5	4.16
	Deposited to village Panchayat	7	5.83
3	Mulch material	4	3.33
4	Animal feed	7	5.83
5	Compost making	-	0.00
6	Mushroom production	-	0.00

*Multiple responses

Data presented in Table 1 pertaining to *in-situ* and off-situ paddy straw management practices adopted by farmers depicts that *in-situ* incorporation by zero tillage was adopted by 60.00% of farmers followed by super seeder (20.00%), happy seeder (14.16%), rotavator (9.17%) and M B Plough (1.67%) while none of the respondent farmers used chemical/biological decomposer for decomposition in the

field. The probable reason for maximum use of zero tillage may be proper spacing between tines as well reduction in sowing cost with partial residue, no lodging etc. benefits perceived by farmers. Farmers were concerned for wider spacing between tines in case of happy seeder and super seeder. In case of super seeder major concern of higher moisture requirement needs verified and validated by

researchers.

Partial burning was still most adopted off-situ straw management practice by 52.50% of respondent farmers followed by sale through open auction at farm itself (31.67%), card board industry (16.67%), fuel/bio-fuel industry (10.00%), deposited at village panchayat & animal feed (5.83%), Gaushalas (4.16%) followed by mulch material (3.33%). Findings are supported by past research of Ray *et al.* 2018 who reported 100 percent burn but this has been converted into partial burning by mechanization

promotion by government through different schemes and programmes of NMSA implemented by the state. While, none of the respondent farmers adopted compost making and mushroom production practices of paddy straw management probable reason might be time consuming as well labor-intensive practice. Sale through open auction was most preferred for basmati paddy only or early non-basmati with voluminous biomass by private traders/parties specialized in delivery or supply to Gaushalas, cardboard, energy industries.

Table 2: Technical constraints faced by paddy farmers in adoption of residue management practices (n=120)

S. No.	Constraints	Degree of seriousness			TWS	WMS	Rank order
		Very serious (3)	Serious (2)	Not serious (1)			
1.	Use of combine harvester led to long stubbles/voluminous biomass in the field	120	0	0	360	3.00	I
2.	Crop residues interrupt tillage operations	120	0	0	360	3.00	I
3.	Narrow window of sowing in wheat-paddy cropping system	120	0	0	360	3.00	I
4.	Non availability of locally suitable straw management technologies	72	37	11	301	2.51	IV
5.	Crop residues interfere with seeding operation of next crop	72	14	34	278	2.32	V
6.	Lack of awareness of chemical/biological decomposing technologies/products i.e. Waste decomposer/Pusa decomposer	60	24	36	264	2.20	VI

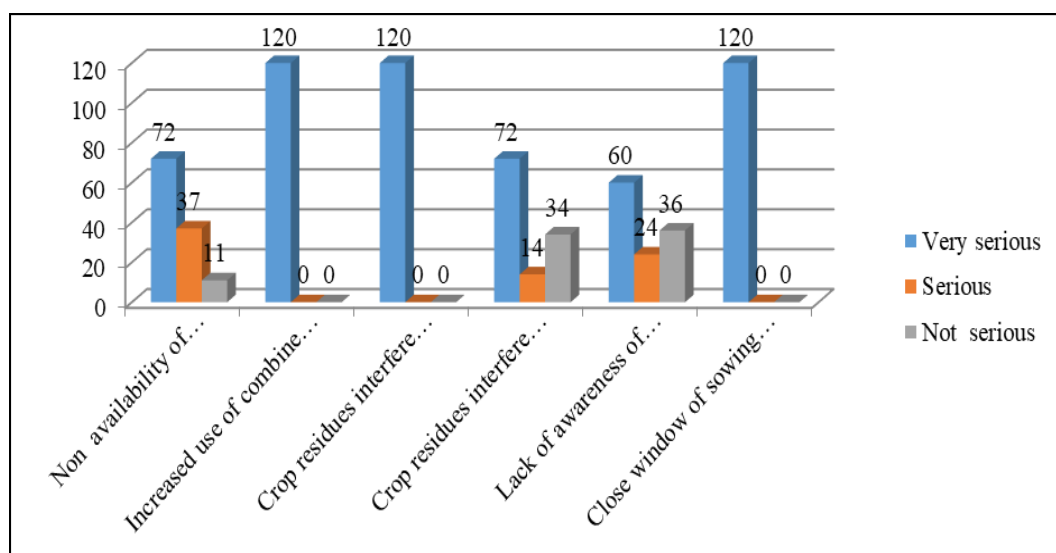


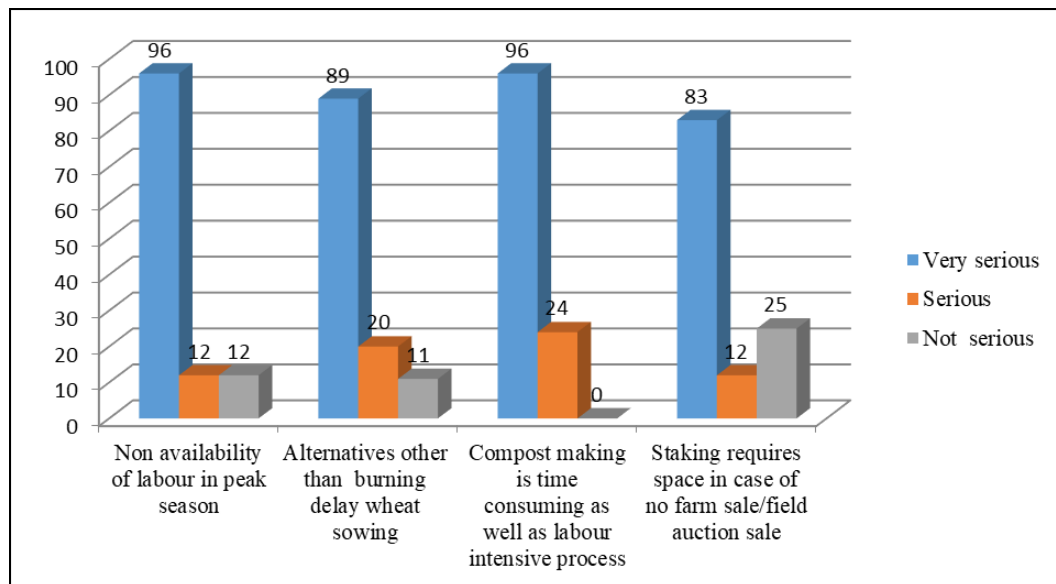
Fig 1: Technical constraints faced by paddy farmers in adoption of residue management practices

Data presented in Table 2 pertaining to technical constraints faced by farmers in adoption of paddy straw management clearly indicate that all farmers reported use of combine harvester for crops lead to long stubbles/voluminous biomass in the field, narrow window of sowing in wheat-paddy cropping system and crop residues interrupts tillage operation as very serious constraints with highest weighted mean of 3.00 followed by non-availability of locally suitable straw management technologies, crop residues interfere with seeding operation for following crop and lack of awareness of chemical/biological decomposing technologies/products

i.e. waste decomposer/pusa decomposer rank of 4th, 5th and 6th with mean scores of 2.51, 2.32 and 2.20, respectively. The findings are in agreement with past findings of Roy and Kaur, 2015 and Roy *et al.* 2018) [4, 5]. This emphasizes organization of more cluster front line demonstrations of fast decomposing chemical/biological technologies by field functionaries and enhancing the accessibility and affordability of machinery in form of low power, single operation small and economic machinery for higher feasibility in small holder farming scenario of the region.

Table 3: Management constraints faced by paddy farmers in adoption of residue management practices (n=120)

S. No.	Constraints	Degree of seriousness			TWS	WMS	Rank order
		Very serious (3)	Serious (2)	Not serious (1)			
1	Compost making is time consuming as well as labour intensive process	96	24	0	336	2.80	I
2	Non availability of labour in peak season	96	12	12	324	2.70	II
3	Alternatives other than burning delay wheat sowing	89	20	11	318	2.65	III
4	Staking requires space in case of no farm sale/field auction sale	83	12	25	298	2.48	IV

**Fig 2:** Management constraints faced by paddy farmers in adoption of residue management practices

Data pertaining to management constraints faced by farmers presented in Table 3 clearly shows that compost making being time consuming as well as labour intensive process was very serious constraint for paddy straw management with top ranking & weighted mean of 2.80 followed by non-availability of labour in peak season (mean score 2.70), alternatives other than burning delay wheat sowing (mean

score 2.65) and staking requires space in case of no sale with mean score of 2.48. The findings are supported by past findings of this highlights dire need for conducting large number of on farm result demonstrations of fast decomposing technologies by field functionaries to motivate farmers to make *in-situ* paddy straw management for recycling the nutrients.

Table 4: Financial constraints faced by paddy farmers in adoption of residue management practices (n=120)

	Constraints	Degree of seriousness			TWS	WMS	Rank order
		Very serious (3)	Serious (2)	Not serious (1)			
1	Incorporation as well bailing enhances the cost of cultivation due to high power and costly machinery	108	12	0	348	2.90	I
2	High cost is involved in straw removing & transportation of voluminous mass from the field.	96	24	0	336	2.80	II
3	High labour wages	86	24	10	316	2.63	III

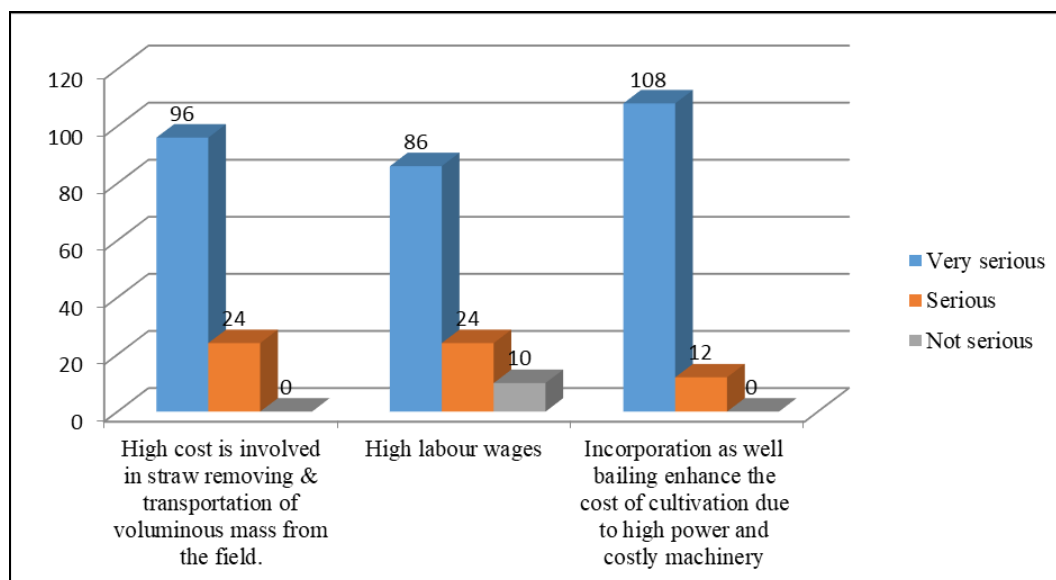


Fig 3: Financial constraints faced by paddy farmers in adoption of residue management practices

Data presented in Table 4 pertaining to financial constraints faced by farmers in adoption of paddy straw management clearly exhibits that incorporation as well bailing enhance the cost of cultivation due to high power and costly machinery was top ranked serious constraint with weighted mean 2.90 followed by high cost is involved in straw removing & transportation of voluminous mass from the field (mean score 2.80) and high labour wages (mean score 2.63). The findings get strength from past research of Roy *et al.* 2018^[5]. The probable reason might be due lack of small single operation machinery available in the field. And findings are in consonance with findings by Roy *et al.* 2018^[5]. Timely availability of conservation agriculture (CA) machinery is of utmost significance to manage the paddy residues *in-situ*. Collection and transportation of voluminous mass of paddy residue is cumbersome, therefore, ex-situ residue management is still not an economically viable option. (Lohan *et al.* 2018)^[6].

al. 2018^[5]. The probable reason might be due lack of small single operation machinery available in the field. And findings are in consonance with findings by Roy *et al.* 2018^[5]. Timely availability of conservation agriculture (CA) machinery is of utmost significance to manage the paddy residues *in-situ*. Collection and transportation of voluminous mass of paddy residue is cumbersome, therefore, ex-situ residue management is still not an economically viable option. (Lohan *et al.* 2018)^[6].

Table 5: Constraints in domestic use faced by paddy farmers for residue management (n=120)

S. No.	Constraints	Degree of seriousness			TWS	WMS	Rank order
		Very serious (3)	Serious (2)	Not serious (1)			
1	Poor fuel at higher temperature	96	24	0	336	2.80	I
2	Paddy residue has no local economic use	91	24	5	326	2.71	II
3	Paddy straw is unpalatable to live stock due to its coarse nature	72	24	24	288	2.40	III
4	Misconception among farmers that paddy straw feeding reduces the milk yield	60	12	48	252	2.10	IV

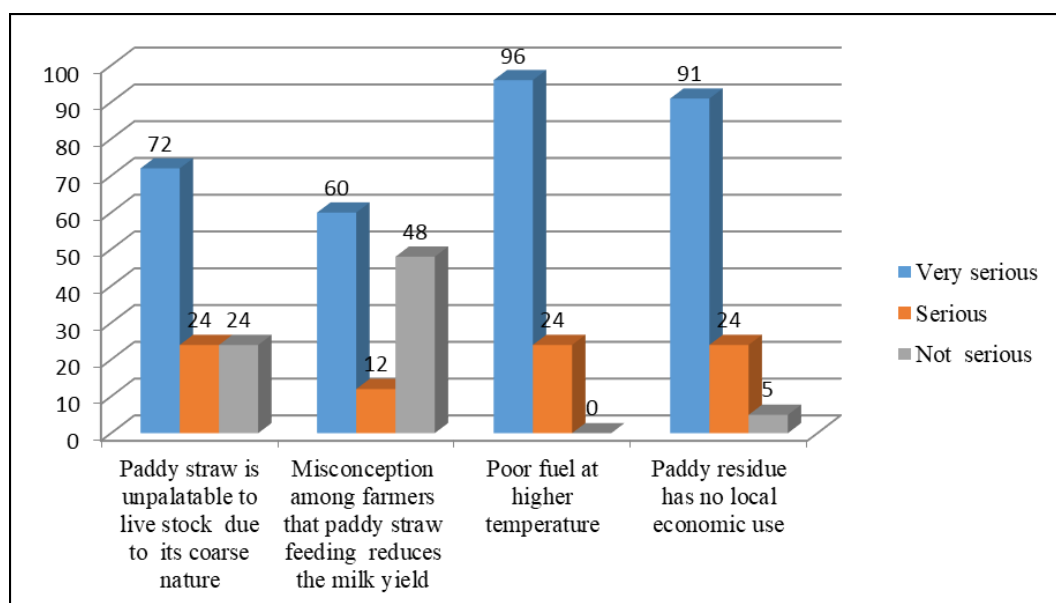


Fig 4: Constraints in domestic use faced by paddy farmers for residue management

It is evident from the data presented in Table 5 that poor fuel at higher temperature was very serious constraint in domestic use of paddy straw with 1st rank & weighted mean 2.80 followed by paddy residue has no local economic use 2nd rank & mean score 2.71, paddy straw is unpalatable to

live stock due to its coarse nature rank 3rd mean score 2.40 and misconception among farmers that paddy straw feeding reduces the milk yield was last ranked with mean score of 2.10.

Table 6: Marketing constraints faced by paddy farmers in adoption of residue management (n=120)

S. No.	Constraints	Degree of seriousness			TWS	WMS	Rank order
		Very serious (3)	Serious (2)	Not serious (1)			
1.	No assured procurement/ purchase by government organizations/institutions/industries	120	0	0	360	3.00	I
2	Basmati paddy straw is highly preferred for purchase by unorganized private parties	108	12	0	348	2.90	II
3	Insufficient energy industry/ power plants, paper and board industries in the region for consumption of paddy straw	88	24	8	320	2.67	III

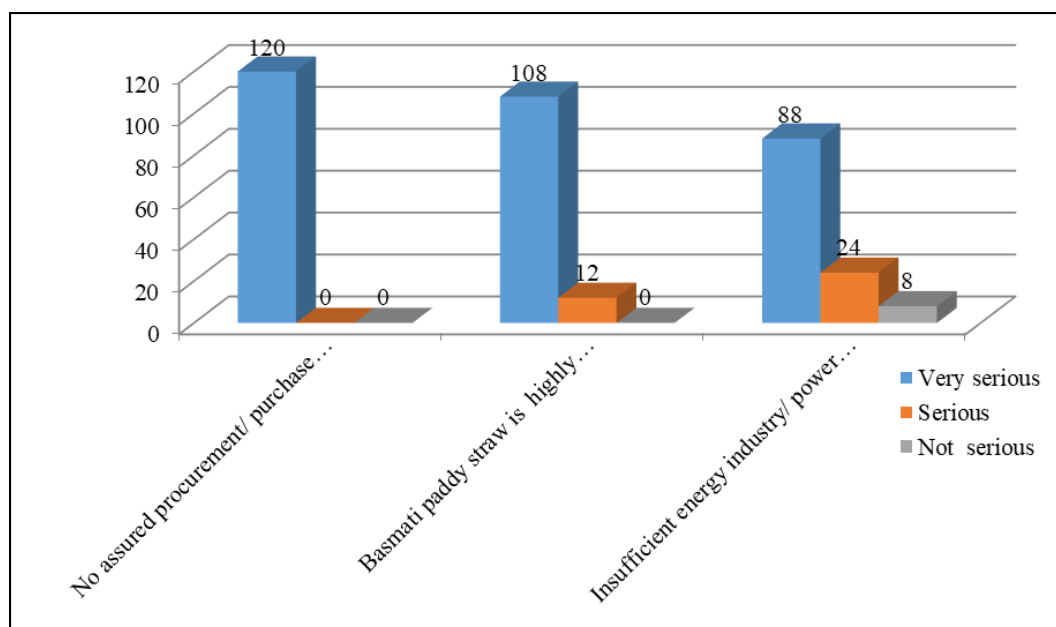


Fig 5: Marketing constraints faced by paddy farmers in adoption of residue management practices

It is obvious from the data presented in Table 6 that no assured procurement / purchase by government organizations / institutions / industries was top ranked very serious marketing constraint by farmers with weighted mean score of 3.00 followed by basmati paddy straw is highly preferred for purchase by unorganized private parties rank second, mean score 2.90 and insufficient energy industry/ power plants, paper and board industries rank 3rd with mean score 2.67 in the region for consumption of paddy straw. So, government should make sincere efforts for development of infrastructure for not only procurement/ purchase but also for sufficient functional energy, board as well compost or biochar industries for its consumption and economic value enhancement for increased income of farmers.

4. Conclusion

Zero tillage was most adopted *in-situ* paddy residue management practice by farmers while, partial burning of straw prevailed *ex-situ* management of residues followed by sale through open auction at farm itself. Use of combine for paddy harvesting led to long stubbles/high biomass load in the field, close window of sowing in wheat-paddy system

and residues interfere with tillage operation were very serious technical constraints faced by farmers and no assured procurement/ purchase by government organizations/institutions/industries, a very serious marketing constraint. Soil incorporation as well bailing enhances the cost of cultivation due to high power and costly machinery and high cost incurred in straw removing & transportation of voluminous biomass from the field were very serious financial constraints encountered. They also faced problems viz. compost making being time consuming as well as labour intensive along with high labour wages as management constraints, besides paddy residue has low local economic domestic use, non-availability of suitable straw management technologies followed by insufficient energy industry/ power plants, paper and board industries in the region for consumption of paddy straw were very serious constraints faced by large number of farmers in effective and efficient management of paddy straw. Single operation Super seeder machine with wider spacing along with moisture concern of farmers may validated through on farm result demonstrations. Availability of low power single operation small and economic machinery for higher

feasibility in small holder farming scenario of the region.

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