Ecosystem Management Approach for Agricultural Growth in Mountains: Farmers' Perception of Ecosystem Services and Dis-Services in Kashmir-India

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Abstract:

Besides supplier of provisional services, agricultures' role as source of ecosystem services to the ecology is being increasingly recognized. The two way relationship between agricultural production and ecosystem services made it imperative to examine farmers' perception of importance of and their ability to manage various ecosystem services from and to the agriculture. This study, motivated by limited availability of literature, is an attempt to fill this research gap through focusing on farmers' perceptions of four different attributes towards 17 ecosystem services and 15 dis-services in Kashmir, a mountainous region in India. Results revealed that farmers attributed high rating to the importance of all ecosystem services, professed severity of dis-services to and from agriculture and perceived their inability to fully manage them. The farmers revealed concerns about vulnerability of agriculture to any threat causing deterioration in ecosystem services though their concerns vary across services. The farmers' WTP for enriching services and reducing vulnerability of agriculture to ecosystem service deterioration coupled with their views passed a message to policy makers for implementation of some market-based instruments to overcome any potential loss to services. Study highlighted a need of an environmental policy to encourage socially acceptable and ecosystem-oriented approaches towards land-use management.

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Key words: Ecosystem, Agriculture, Services, Dis-services, Management

1. Context

Since the origin of civilization, the human population have received immense benefits from agriculture. Over the years the technological interventions coupled with advanced practices have enabled agriculture to feed worlds' ever increasing population (Tilman *et al.*, 2002). Agriculture constitutes largest ecosystem, engineered on over a third of global land area (FAOSTAT, 1999). Ecosystem services are the conditions and processes through which natural capital sustains and fulfil human life (Daily 1997). Agriculture provides some and relies upon other important ecosystem services (ES) provided by the natural capital of the system (Swinton *et al.*, 2007; Heal & Small, 2002; Sandhu *et al.*, 2005; Takatsuka *et al.*, 2005). Service of agricultural ecosystem can be classified into four main categories: provisioning, supporting, cultural, and regulating services (MA, 2005). The ecosystem management approach to agriculture without neglecting its linkages with other components of the system would sustain its development on long-term basis or otherwise any of the strategic development efforts may end up in failure.

Agricultural ecosystems are primarily managed to optimize the provisioning ecosystem services viz. food, fibre, and fuel. In the process, they depend upon a wide variety of supporting and regulating services, such as soil fertility and pollination (MA, 2005) that determine the underlying biophysical capacity of agricultural ecosystems (Wood *et al.*, 2000). Increased production of agricultural goods at the expense of other ecosystem services has resulted in the environmental changes that have significant impacts on human health and well-being (Foley *et al.*, 2005). It often leads to an attenuation or even loss of the supply of other ecosystem services, such as the maintenance of soil fertility, water quality, pest control, and pollination (Logsdon et al., 2015; Gonzalez et al., 2015). In turn, there are 'burdens' upon intensive agro-ecosystem that has harmful effects, leading to a decline in biodiversity and threatening the environment (Zhang et al., 2007**;**

Sandhu et al., 2010). Agricultural activities are leading to environmental destruction and loss of ecosystem services (ES) (Heywood, 1995; Krebs *et al.*, 1999; Tilman *et al.*, 2001). Therefore, growing food demand of human population make the challenge to maintain and enhance ecosystem services in agriculture stronger than in other ecosystems (UN, 1992; Pinstrup-Andersen, 1998). The higher market demand of many products year-round resulted in intensification of agriculture (Tilman *et al.*, 2002) coupled with rigorous use of chemical fertilizers and pesticides. This robustness in agriculture has been the cause of loss of valuable ecosystem services (Daily, 1997; Reid *et al.*, 2005) as well as leading to other detrimental effects (Tilman, 1998; Tilman & Lehman, 2001) and high 'external costs' (Pretty, 2005; Pretty *et al.*, 2000; Pretty *et al.*, 2001; Tait *et al.*, 2006; Tegtmeier & Duffy, 2004). These 'external costs' of chemical-dependent, intensive agricultural practices include severe damage to soil fertility, water, biodiversity and human health. This has led to world-wide concerns about the environmental consequences of modern agriculture (Reid *et al.*, 2005). Agriculture also receives an array of ecosystem disservices (EDS) from outside that reduce productivity or increase production costs (e.g., herbivory and competition for water). The flows of these ecosystem services and disservices rely on how and at what level agricultural ecosystems are managed at the site scale and on the diversity, composition, and functioning of the surrounding landscape (Tilman, 1999).

This situation emphasize upon enhancing ability of agriculture to increase productivity without deteriorating ecosystem (Escudero, 1998; Pimentel & Wilson, 2004; Tilman, 1999; UN, 1992). To this effect, many countries have enacted payments for ecosystem services (PES) (Power, 2010; Ekross et al., 2014; Andersson et al., 2015; Baylis et al., 2008; Liu et al., 2008; Demurger and Pelletier, 2015) to utilize these services for the long-term sustainability of agro-ecosystems and their ability to provide increased production while maintaining ecosystem services (Gurr *et al.*, 2004: Pretty & Hine, 2001; Tilman *et al.*, 2006) having substantial economic value (Costanza *et al.*, 1997; Daily *et al.*, 1997; Sandhu *et al.*, 2005). The implementation of any policy that focus on rewarding suppliers of ecosystem services demand incorporating social preferences in ESS assessments (Muhamad et al., 2014) in absence of the techniques to capture the full suite of ecosystem services to assess their value (Qin et al., 2015; Ghermandi & Fichtman, 2015). In agro-ecosystems, flows of ecosystem services are directly affected by farmers' knowledge and management decisions (Foley et al., 2005) and these are to be considered key stakeholders in managing ecosystem services (Purushothaman et al. 2013). Investigating famers' perception of ecosystem services can more easily differentiate and prioritize among provisioning, regulating, cultural and supporting services, which are often supplied in multiple-service bundles (Bryan *et al.*, 2010; Iniesta et al., 2014; Page and Bellotti, 2015). For effective management and investigating of their perceptions of ecosystem services framework is emerging as a complimentary approach (Bryan et al., 2010a; Hatton MacDonald et al., 2013; Plant and Ryan, 2013).

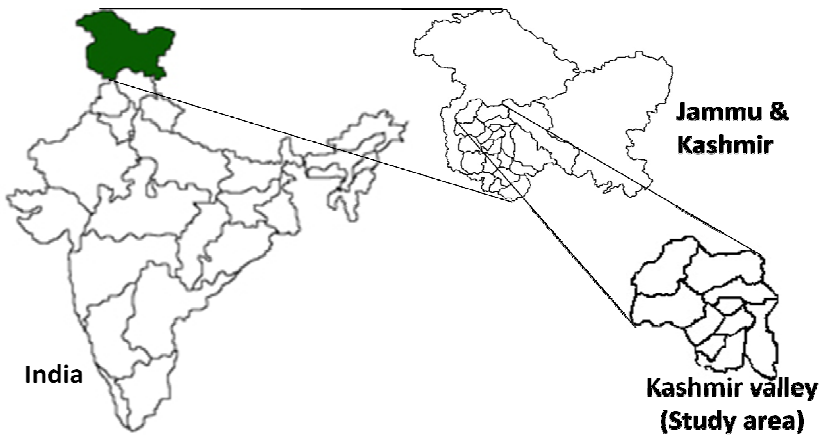
The information on the importance of ecosystem on farmland and the perceptions of farmers who manage ecosystem services is limited for India. Since farmers' perceptions of ecosystem services differ across different regions (Pattanayak et al., 2010) contingent upon available production environment/system that might reflect difference in knowledge among stakeholders, therefore, it is likely that farmers' perception would imitate the constraining and contribution factors agricultural ecosystem is subjected to in mountainous setting in India. Typically, mountains include difficult access, economic and political marginality, outmigration, environmental sensitivity, diversity of livelihoods, and cultural diversity (Baba et al., 2014) at the same time they possesses unique natural resources such as forests, attractive landscapes, rich biodiversity and plays

a crucial role in providing range of goods and services for people (Viviroli et al 2003). Mountain communities, operating marginal lands, have traditionally overcome such limitations by diversifying and using complementarities of various ecosystem services though there is comprehensive of ecosystem services and farmers' perception regarding importance of ecosystem services and their manageability available in literature. To fill this gap, this paper focused on behavior of farmers towards ecosystem services in the context of management of agriculture in mountainous setting of Kashmir valley, India.

2. Data and Methodology

2.1. Study Area

This study is a part of work done under Department of Science & Technology, Ministry of Human Resource Development, New Delhi, India sponsored major research project. This study was conducted in Kashmir Valley, which is located within the Jammu & Kashmir, a northern Himalayan state of India (Map 1). The study area spreads over an area of 15948 sqkm (15.77 % of net state area) and contributes over 48 per cent of state net domestic product (Anonymous, 2010). The study area provides residence to 6.91 million of population (55.04 % of states' population), of which 47.20 per cent were females. The valley has lower literacy level (63 %) than the state and national average. The overall average temperature in different months varies from 1.2°C to 24.5°C with cold thermal index and humid hydric index. It experiences wet and often severe winters with frost, snow or rain and relatively dry and warm summer. The normal precipitation in the valley is 650 mm, experienced mostly during March-April and the Valley is usually not affected by the summer monsoons. About 7.7 lakh agricultural workers operate about 44 per cent of agricultural land of the whole state. Because of the fertile soil, assured irrigation facilities (more than 41% of net area sown is irrigated), the yield rates of major crops in Kashmir Valley are higher than those in the rest of the State. Because of diverse agro-climate, valley has created a niche for variety of crops like temperate fruits, vegetables, etc. With the rapid expansion of area under apple and vegetables, the negative externalities associated with more use of pesticides, fertilizers, and other inorganic and organic matter in agriculture has become increasingly concentrated. Application of pesticides, as for instance, not only prevents crop loss but also its poisoning has serious negative externalities to the ecology (Baba et al., 2016). Likewise the study area has perineal rivers, lakes and numerous canals to irrigate agriculture and at the same time agriculture receives dis-services from the system. Therefore, it is necessary to examine farmers' perception regarding the array of ecosystem services (e.g., soil conservation, pest control, pollination, water filtration) that may flow from the ecosystem to the agriculture.



Map 1. Selection of study area

2.2. Selection of sample respondents

In order to identify a representative sample of respondents we employed multi-stage sampling procedure. The agro-climatic diversity provides suitable environment to different specialized production systems. Based upon production system, the whole Kashmir valley was divided into five specialized farming systems viz rice based, maize based, dry fruit based, fresh fruit based and vegetable based farming systems; considering niche based enterprises and livestock allied to each farming system. One district, out of total ten districts of the valley, representing each farming system were selected based upon maximum area under the crop making up the system. In this way we have selected five districts each representing one farming system viz district Anantnag for rice based, district Kupwara for maize based, district Budgam for vegetable based , district Baramulla for fresh fruit based and district Anantnag for dry fruit based were selected. In consultation with the field level workers and officials of Revenue, Agriculture and Horticulture Department of Government of Jammu & Kashmir, one block from each selected district was selected and finally 50 farmers were identified from a village cluster selected in each block, in this way made a sample of 250 farmers. An in depth interview was carried out with selected farmers to have a comprehensive insight for informative qualitative and quantitative views of ecosystem services and values. More sample size and comprehension in conduct of interviews than other studies (Smith and Sullivan, 2014) helped to achieve better understanding of farmers' view points on ecosystem services and dis-services.

2.3. Classification of ecosystem services and dis-services from and to agriculture

The benefits of natural capital flowing to society and agricultural production were considered as ecosystem services in this study. Any activity whether agriculture or any other which have detrimental impact on natural capital was considered as ecosystem dis-services. A total of 17 ecosystem services were adopted for this study as expressed by few scholars (Binning et al., 2001, Smith and Sullivan, 2014). Of the selected ecosystem services 11 services flowed to agriculture and rest flow from agriculture. In addition, 15 dis-services perused by other scholars (Zhang et al., 2007) were studies. Any modification to the list of services or dis-services adopted in the study was done to have consistency with existing environment and research system of the state.

2.4. Data Collection

A comprehensive survey schedule was employed to interview the selected respondents around their farm. The first part of the interview schedule sought information on the general profile and level of knowledge of farmers on perused ecosystem services. The second section of the schedule encompasses questions on ecosystem attributes viz importance, undesirability and management of focused ecosystem services and dis-services from and to the agriculture and perception were assessed on a Likert scale of 0 to 10 (Iow to high).

2.5 Data Analysis

The variability within the farmers' responses were graphically depicted in box-and-whisker plots displaying the lowest value, second quartile, median, third quartile and highest value and are provided in Figures. 1, 2 and 3. The interview schedule has a provision for the information on their willingness to pay (WTP) for maintaining ecosystem services and this information was expect to provide guideline for for drawing modules for the implementation of 'Incentives for enhancing flow of ecosystem services' and 'payments for ecosystem services'. A regression function of following structural form was employed to quantify the determinant of WTP (a contingent valuation method to estimate value of maintaining services) for maintaining ecosystem services and the function was estimated employing OLS procedure. This approach was widely employed by number of studies for value the services which are typically not

exchanged in the market place (Wani et al., 2013; Ajzen and Driver, 1992; Cummings *et al*., 1986; Mitchell and Carson, 1989; ADB, 2007; Marothia, 2000, 2004).

WTP=*f* (FI, ESC, CESM, FMS, CVES, LND, LIT, AGE,U)

where, WTP= Willingness to Pay (amount in '000 $/annum); FI= Farm income (in '000 US$); ESC= Ecosystem service concerns (0 for no concern and 1 otherwise); CESM= Concerns of ecosystem service maintenance (0 for no concern and 1 otherwise); FMS= Family size (No.); CVES = Concerns of vulnerability of ecosystem dis-services (0 for no concern and 1 otherwise); LND = Average size of holding (ha); LIT = Literacy of farm family head (0 for illiterate, 1 upto middle, 2 upto higher and 3 for above education) and AGE= Age of farm family head (years) and U = Error term. We recognize that there are other unobservable variables which may affect the willingness to pay for enriching the ecosystem services. However, only the specified exogenous variables were kept in its estimated form based upon their role in giving best fit to the function estimates.

3. Result & Discussion

3.1. Profile of respondents

The 250 interviewed farmers belong equally to five specialized farming systems viz rice based, maize based, fresh fruit based, dry fruit based and vegetable based farming system. The age distribution was skewed towards older farmers and their age in years ranged from 60.4 years to 71.3 years with an average of 68 years. There were also almost as many first generation farmers as fourth generation with one-third of farmers in both generations. Of 250 family heads only 45 per cent were found to have acquired at least minimum education up to primary level. Consistent with the dominance (98 %) of small/marginal farmers in the state, all the selected farmers possess 1.11 ha of land holding. Male members outnumbered females; sex ratio being 938 females per 1000 males. This ratio coupled with male migration had made scarcity of agricultural labour for performing various farming activities. The crops grown in the study area were rice, maize, apple, walnut, oilseed main/off-season vegetables and the average intensity of cropping was 149 per cent which vary across farming system consistent with availability of assured irrigation facilities. About 66 per cent members of farm families had agriculture as the main occupation though some might have other subsidiary occupations also. The proportion of agricultural labourers among members of farm families was low, to the tune of only about 6 per cent and this was really a concern for sustainable farming.

Table 1. Descriptive statistics of sample farm respondents

Particulars	Value
Age of family head (years)	67.98
Family heads literate (%)	44.88
Family size (No.)	7.97
Sex ratio (female/000 male)	908
Literate members (%)	70.47
Active family members (%)	65.48
Holding size (ha)	1.11
Net sown area % of land holding	91.00
Net sown area irrigated (%)	60.08
Major crops	Rice, Maize, Apple, Walnut, vegetables, oilseeds
Cropping intensity (%)	149
Approx. farm family income (US$/farm)	8138

3.2. Knowledge level of ecosystem services and dis-services

In the first part of the interview, information was sought on the farmers' level of knowledge of various ecosystem services and dis-services from and to the agriculture and responses presented in Table 2). The farmers' level of knowledge of various services particularly flowing to agriculture was higher. The knowledge about the biological pest control was reported by only 74.8 per cent of farmers while as high as 90 per cent farmers expressed knowledge about natural climate regulation services. All the farmers (100% of surveyed) have expressed that they have knowledge about provisional services including food, fibre, etc while only 57.6 per cent of respondent hae knowledge of 'carbon sequestration' services from the agriculture. The perusal of figures in Table 2, indicated that relatively less number of sample farmers have knowledge of various dis-services from and to agricultural sector. It could be observed that the closeness of association or involvement of farmer with activities reflected their level of knowledge about the ecosystem services. Awareness of primary stakeholders to various ecosystem services and dis-services emancipating in ecology is demanded if they are to be involved in a ecosystem service management process.

3.3. Importance and management of ecosystem services from & to agriculture

Of the 17 ecosystem services considered in this study, first 11 services (from 1 to 11 in figure 1) are being received by the agriculture and rest (from 12 to 17 figure 1) flow from agriculture. The perception of the sample of farmers with regard to their importance has been captured and presented in the Figure 1. Farmers have perceived all the ecosystem services as highly important (median ranges from 5.5 to 8) for the improvement in agricultural productivity and for other components of the system. Relatively small amount of variance was observed across their responses for different services as indicated by standard deviations

Table 2. Extent of knowledge of various services from and to agricultural ecosystem

Services	Response (%)	Dis-services	Response (%)
To agriculture		**To agriculture**	
Water regulation	76.0	Pest damage	51.0
Maintain soil health, and soil formation	86.4	Competition for water	59.0
Retention of nutrient in biomass	83.6	Competition for pollination	46.6
Maintenance of genetic material	75.2	Genetic resistance to pathogen	47.0
Dung burial & decomposition	85.6	Competition for resources	17.8
Pollination services	80.0	Exudates from non-crop plants	14.6
Biological pest control	74.8	Reduced recharge of acquifers	51.0
Maintain healthy waterways & purification	75.6	**From agriculture**	
Natural climate regulation	89.6	Habitat loss	53.4
Provision of native habitat	73.2	Nutrient run off	42.6
Prevention of erosion & nutrient loss	84.4	Pesticide poisoning	29.4
From agriculture		Emissions	7.0
Provisional services (food, fibre, etc.)	100.0	Pests & diseases	7.4
Soil conservation	85.6	Eutrophication & sedimentation	6.6
Provision of shade/shelter & aesthetic scene	67.2	Diversion of waterways	6.2
Natural hazard regulation	56.8	Rangeland erosion	11.8
Carbon sequestration	57.6		
Weed control	61.2		

estimates (s.d. = between 1.09 & 3.25), and as seen in Figure. 1. Few of these responses were found tilted, and were assigned the maximum value of 10, with 42 per cent of the farmers indicating a value greater than

eight for few ecosystem services. Farmers were seen to attribute more importance to the services from which they derive direct benefit or may benefit the activity from where they may get some benefit. It necessitates launching of a campaign of knowledge networking for awareness of masses.

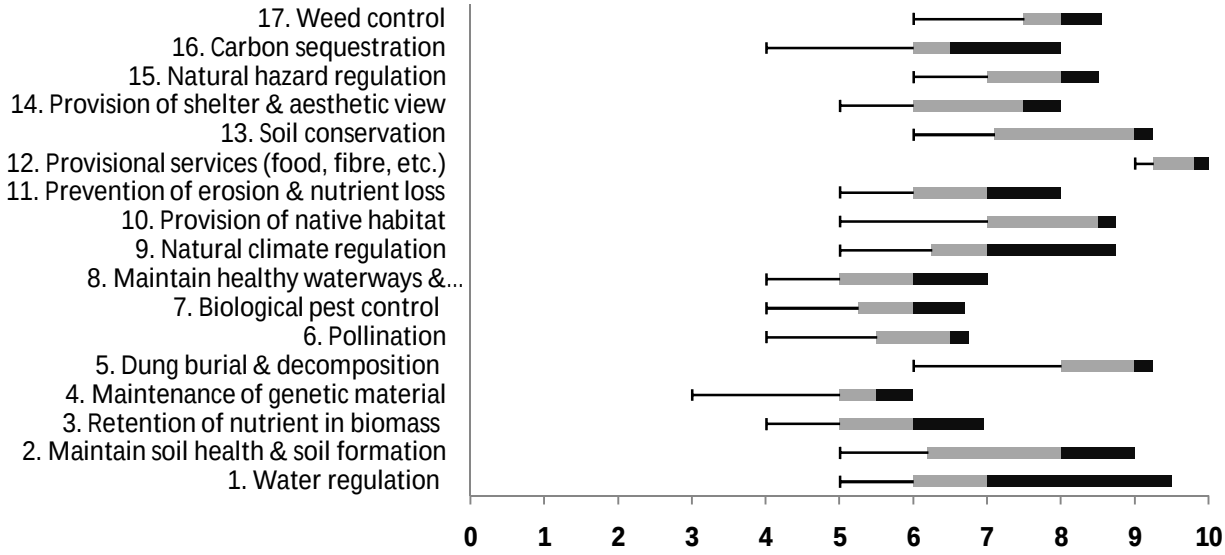


Figure1. Important of ecosystem services from & to agriculture

An ecosystem was considered as manageable, it the respondents perceived their ability to easily and directly improve the supply of it and the extent of manageability was revealed by the score of responds to each service. Dung burial & decomposition and provisional services including production of food, fibre, etc were the only two service perceived highly manageable by the respondents in this study (Figure 2). While the five services viz water regulation, maintenance of genetic material, natural climate regulation, provision of native habitat and natural hazard regulation were ranked as less manageable ecosystem services by the sample farmers. The rest of the ecosystem services were reported as being moderately manageable. The perceptions regarding manageability of ecosystem services is more variable with median ranging between 3.5 and 9.0 with divergence of the perception (sd varies between 1.11 and 3.56). The education with informal approach would build up farmers' competence to manage the various ecosystem services or dis-services.

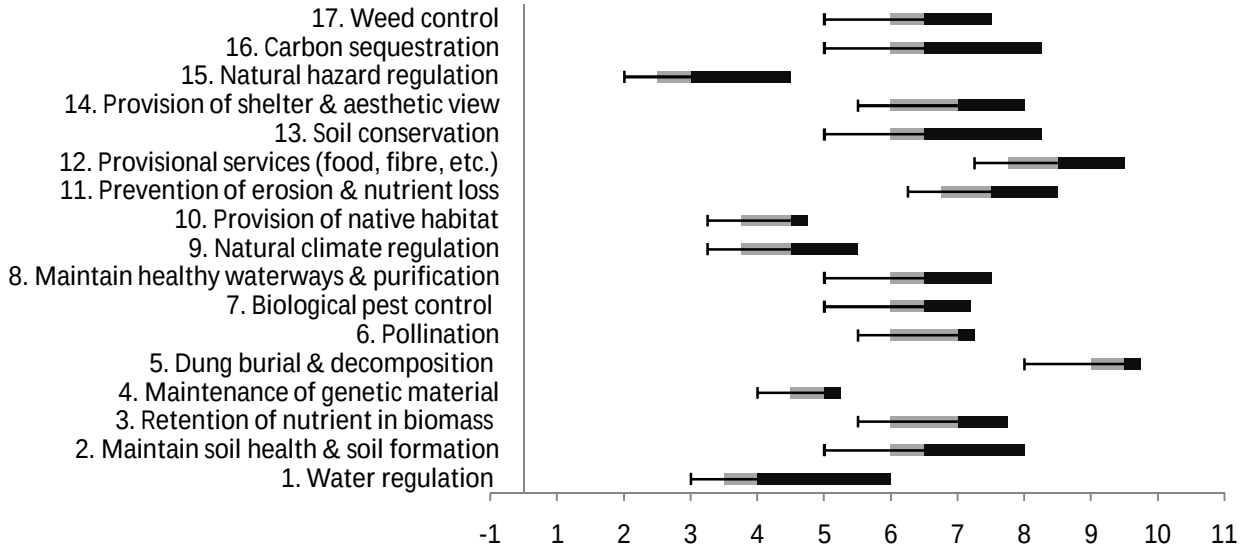


Figure 2. Management of ecosystem services from & to agriculture

3.4. Severity and management of ecosystem dis-services from & to agriculture

As displayed in the Figure 3, 7 (1st to 7th in figure 3) ecosystem dis-services are experienced by agriculture and rest flow out from agriculture. Of course the dis-services to agriculture were perceived more severe by the respondents as expected. However competition for water, pest damage and competitition for resource were perceived as more serve ecosystem dis-services to agriculture by respondents. Except for pesticide poisoning and diversion of waterways, the perception of the sample farmers with regard to their ecosystem dis-services from agriculture were moderate. There are wide variations (sd= between 1.21 and 3.61) in the perception of farmers regarding ecosystem dis-services to and from agriculture.

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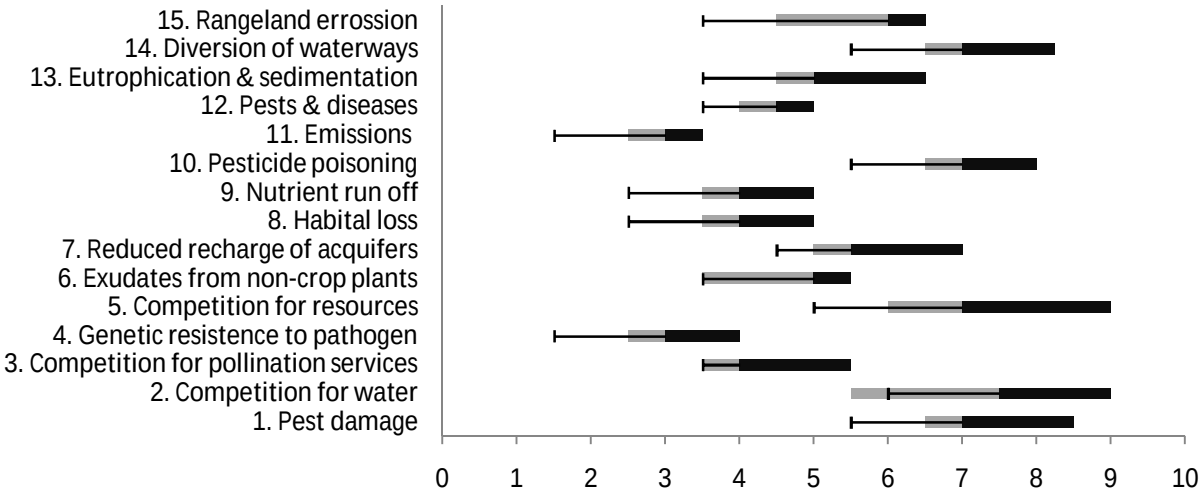

Figure 3. Severity of ecosystem dis-services from & to agriculture

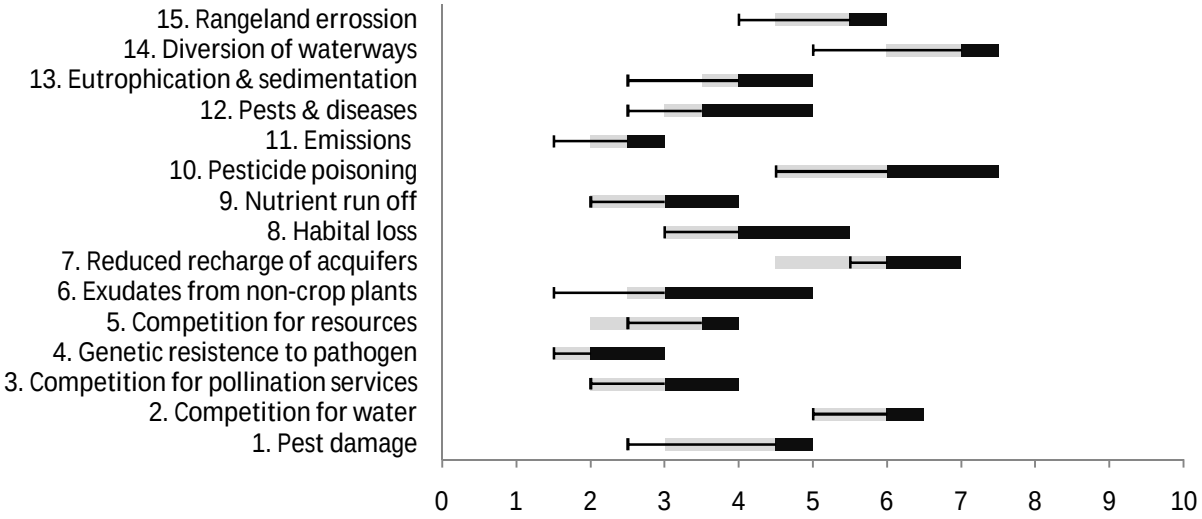

Figure 4. Management of ecosystem dis-services from & to agriculture

3.5. Vulnerability of ecosystem services from & to agriculture

The literature on the vulnerability of ecosystem services to environmental changes appears scanty (Ganaie, 2017; Wani et al., 2013; Beier et aI., 2008; Plieninger et al., 2013; Metzger et al., 2006). Only few studies have investigated the stakeholders' outlook in assessment of vulnerability of ecosystem services (de Chazal et at.. 2008). Studies have indicated that how the quantity and quality of natural capital stocks (Brown et aI., 2011; Cordon et aI., 2008; Kibblewhite et aI., 2008; Power, 2010) are threatened by various agricultural activities and emphasis on provisioning services from agriculture have suppressive impacts on regulatory and supporting services (Cordon et aI., 2010) and agricultural productivity becomes vulnerable to these changes. Farmers were asked in this study to express their concerns about the vulnerability to various ecosystem services to get an idea about the extent of negative impact on their farming if the provision of ecosystem services declined. The perception of farmers indicated that they considered their farming to be more vulnerable to the loss of services (Figure 5). Water regulation, provisional services and carbon sequestration and maintaining soil health were ranked as being highly vulnerable indicating that the farmers' ability to cope with a reduction in these services were considered very low. In line with earlier evidences pollination services were found vulnerable ecosystem service due to its direct economic impact on agricultural production (Gallai et aI., 2009; Gordon and Davis, 2003). It also became clear that the farm related activities may be the major source of threats towards these services. R&D efforts are demanded if the ecosystem components are to be made resilient to various kinds of vulnerabilities.

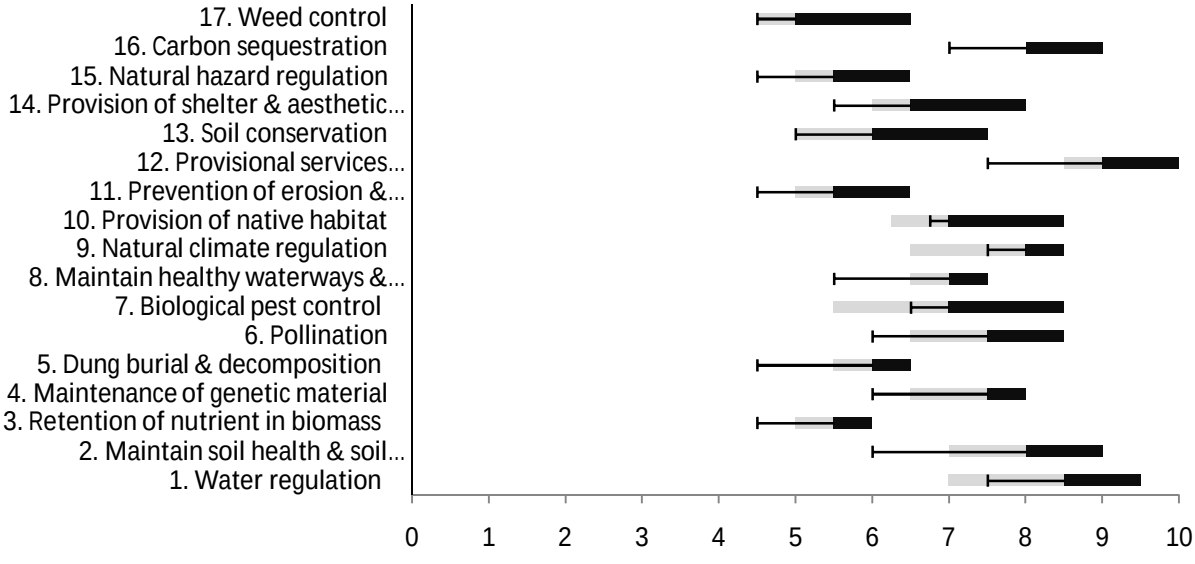

Figure 5. Vulnerability of ecosystem to dis-services from & to agriculture

3.6. Farmers' willingness to pay for ecosystem services to agriculture & its determinants

As reported in economic literature (Renzetti, 2010; Earnhart, 2001) many people show willingness to pay for preserving ecosystem to enrich the services emanating from it, which pushes the non-use value of ecosystem services beyond its use value. The farmers, primary stakeholder, have also shown enthusiasm by revealing their willingness to pay for enhancing ecosystem services from and to the agriculture and avoiding its vulnerability. They have shown their willingness to pay an average amount of 513.12 US$ for maintaining ecosystem system and another 212.63 US$ for reducing vulnerability of ecosystem services which is highly encouraging from management point of view of the ecosystem. These findings are encouraging to enact a market based regulation system

where in people may be charged for use of services or adding to dis-services and awarded incentives for amicably enrich/maintain these services individually or as part of integrated social complex.

An attempt was made by formulating a regression models for their willingness to pay, to capture the influence of different socio-economic variables on it and estimates are presented in Table 4. The regression estimates of the ecosystem concerns, concerns of ecosystem management and concerns regarding reducing vulnerability of ecosystem services were positive and significant determinants of farmers' willingness to pay for maintaining ecosystem services. So any measure which may improve concerns farming community towards ecosystem and its management would help to achieve much bigger goal of management of agricultural ecosystem on sustainable bases. Contrary to this the coefficient of average size of farm family indicated that large families have other priorities of family obligation and may be less concerned about services flowing out to an ecosystem. Further literate heads are sophisticated enough to have shown their willingness to pay for enhancing ecosystem services.

Table 4. Estimated coefficients for model specification

Variable	Coefficient	Standard Error
Constant	2.28	-
FMI	0.07*	0.006
ESC	1.02*	0.10
FMS	-0.06*	0.01
CESM	0.19*	0.09
CVES	0.08*	0.02
LIT	0.72*	0.00
AGE	-0.01	0.02
LND	-0.21	0.22
Adjusted R^2	0.7213	-

* Denote significance at 0.05 or better probability levels

3.7. Threats & possible remedies

Farmers have revealed their concerns about variety of threats to the ecosystem services considered in this study. Generally farmers consider an outcome of human interventions in nature few major threats to ecosystem services, of which agricultural activities form an important segment. Conversion of land for non-agricultural uses, deforestation for agricultural and residential use, indiscriminate use of pesticides and inorganic fertilizers, unplanned switch for one to another crop enterprise, diversion of water for irrigation and eutrophication of water ways were reported by farmers as threat to the ecosystem services created by human beings. Of these agricultural activities related threats were reported to be more prominent than non-agricultural activity related. Among non-agricultural activities urbanisation and infrastructure development, climate change and its manifestations, lack of action by government and local institutions, construction of infrastructure, etc. Farmers suggested the widespread afforestation, cover cropping, and hygiene in farm activities, judicious application of inputs in crop cultivation as few important measure to be taken for diluting the effects of various threats to ecosystem services.

4. Discussion

Ecosystem services hold crucial role in determining the type of economic proposition to be taken up to seek livelihood opportunities. The services flowing to agriculture determine the location and type of farming practices though partially it depends upon profitability of crop enterprises. There is a two way relationship between ecosystem and agricultural production in terms of

ecosystem services to and flowing out of agriculture. The value of agricultural capital stock depend on production costs linked to economic services such as soil health, suitable climate and pest load (Roka and Palmquist, 1997). Many of the services and dis-services to the agricultural sector come out of its landscape and the scales at which services or dis-services are rendered determine the relevant management units for influencing their flows to agriculture (Zhang et al., 2007). If they respond to factors on a small scale then it may be managed within a single farm or otherwise the management actions of individual farmers must be coordinated, hence the management decisions are services specific. For the manipulation of farm scale services, farmer may take responsibility, however, for large scale services or dis-services, an integrated management strategy would enrich services and manage dis-services; (eg) integrated pest management that could increase services from natural enemies and reduce pesticide poisoning (Ehler and Bottrell, 2000; Tilman et al., 2001).

There has been a huge pressure on agro-ecosystems for provisional services, though the natural resources supporting them are deteriorating (Kibblewhite et al., 2008; Tilman et al., 2002). This scenario can be balanced by incorporating farmers' values and perceptions in policy development towards enhancing ecosystem services. In this study farmers have attributed a range of importance to considered ecosystem services; however, the famers' perception indicates their inability to individually manage the ecosystem. Knowledge networking on importance and management of services and encouragement of farmers as individual or as part of social initiative for ecosystem management would have better pay off. Development of competence among this importance stakeholder would enable us to make use of their traditional knowledge in managing the ecosystem and at the same time they can take responsible for farm scale or as an integral portion of complex system for large scale management of ecosystem services. Farmers have perceived all the human interventions in nature to be the direct or indirect threat to the ecosystem services. Farmers have identified unscientific agricultural practices as the main source of threats towards ecosystem services and at the same time they find agriculture more vulnerable to any loss of quality or quantity of ecosystem services. The values put by farmers to various services should have to be kept central to the management of these ecosystem services.

As explored in the section above, that farmers' expression about their willingness to pay for enriching ecosystem services and reducing the various dis-services from and to the agriculture indicated that the degrading process of ecosystem could be restricted by the application of schemes of "payment for services". Although public policies exist that aim to create incentives for farmers to act for a community (Crowe et aI., 2008; Franks and Emery, 2013; Mishra and Khanal, 2013), however, any of these policies has not encouraged coordination of farming practices across a landscape. The perception of farmers regarding importance/severity of ecosystem services/dis-services to agriculture is crucial to get an idea about how they could be involved in management process though it is indicative of a comprehensive policy initiative. Farmers' perception may be used in identifying the regulating services of the agriculture that farmers may agree to improve and they recognize as drivers of ecosystem change. Farmers' response may assist the diffusion of policies attempting to build ecologically sustainable land management systems.

5. Conclusion & policy implications

An attempt was made in this study to get an idea about the farmers' level of knowledge of various ecosystem services and dis-services flowing to and from agriculture and seek the information on the fundamental importance a sample of farmers currently place on perused ecosystem services. Farming in the Kashmir- a northern mountainous region in India, is an economic activity having strong association with farmers' socio-cultural set up contributing to

environmental integrity besides economic development. While farmers have attributed weights to the importance of various ecosystem services, they have perceived their inability to fully manage the ecosystem services or dis-services. In light of the findings of this study we propose following few policy suggestions for manipulation of two way relationship between agriculture and ecosystem so as to enrich and sustain emancipation of services for sustenance of agro-ecosystem:

Farmers' willingness to pay for enrichment of ecosystem services has passed a message to the policy makers to develop a module for 'payment for services (PES)' and 'incentives for preserving services' and enact it in an amicable manner without compromising any further deterioration of ecosystem values. There is a need for an environmental policy to encourage socially acceptable and ecosystem-oriented approaches towards land management activities including agriculture. In view of absence of any existing policies for coordinated habitat conservation and to strengthen our argument on the role of stakeholders view point in the management of ecosystem services further research is required to more explicitly understand and provide insights into fanners' values of the perceived importance, manageability and vulnerability of ecosystem services across various agricultural systems. Evaluation of the monetary value of ecosystem services that lack market have to be done widely to understand approach to assessing trade-offs and this may aid in the evaluation of alternative agro-ecological systems. There is need to create a knowledge house within the community regarding importance of ecosystem services and reducing the costs associated with ecosystem dis-services for enriching the values of ago-ecological complex.

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